**FINAL**

# WORK PLAN

## Remedial Investigation
## Former Camp Hero, Montauk, New York

**Revision: 0**

**Prepared for:**

US Army Corps of Engineers®

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| µg/kg | microgram per kilogram |
| ACWS | Aircraft Control and Warning Squadron |
| AGC | Army Geospatial Center |
| AN | Army-Navy |
| AOC | area of concern |
| APP | Accident Prevention Plan |
| ARAR | Applicable or Relevant and Appropriate Requirements |
| AST | Aboveground Storage Tank |
| BERA | Baseline Ecological Risk Assessment |
| bgs | below ground surface |
| CAIS | Chemical Agent Identification Sets |
| CAMP | Community Air Monitoring Plan |
| CERCLA | Comprehensive Environmental Restoration, Compensation, and Liability Act |
| COPC | compound of potential concern |
| COPEC | compound of potential ecological concern |
| CP | Commissioner Policy |
| CPR | cardiopulmonary resuscitation |
| CSM | conceptual site model |
| CWM | Chemical Warfare Materiel |
| CWS | Community Water Supplies |
| DER | Division of Environmental Remediation |
| DERP | Defense Environmental Restoration Program |
| DERP-FUDS | Defense Environmental Restoration Program-Formerly Used Defense Sites |
| DoD | Department of Defense, United States |
| DQO | data quality objective |
| DU | Decision Unit |
| EE/CA | Engineering Evaluation/ Cost Analysis |
| ELAP | Environmental Laboratory Accreditation Program |
| EPC | exposure point concentrations |
| EPD | exposure pathway diagram |
| ER | Engineer Regulation |
| ft | foot or feet |
| FPS | Fixed-Pulse Radar-Surveillance |
| FUDS | Formerly Used Defense Site |
| GIS | geographic information system |
| HAZWOPER | Hazardous Waste Operations and Emergency Response |
| HHRA | Human Health Risk Assessment |
| MCL | maximum contaminant level |
| MDC | maximum detected concentration |
| MDEH | material documented as an explosive hazard |

| | |
|---|---|
| MEC | Munitions and Explosives of concern |
| mg/kg | milligram per kilogram |
| mm | millimeter |
| NCWS | non-community water supply |
| NDAI | No DoD Action Indicated |
| NPSW | non-potable supply well |
| NY | New York |
| NYCRR | New York Codes, Rules, and Regulations |
| NYSDEC | New York State Department of Environmental Conservation |
| NYSDOH | New York State Department of Health |
| NYSOP | |
| OE | Ordnance and Explosives |
| OESS | Ordnance and Explosive Safety Specialist |
| OPC | Office of Pollution Control (NYSDEC) |
| OSWER | Office of Solid Waste and Emergency Response (USEPA) |
| PAH | Polycyclic aromatic hydrocarbons |
| PCB | polychlorinated biphenyl |
| PWS | Project Work Statement |
| ppm | parts per million |
| PSL | project screening level |
| QA | quality assurance |
| QAPP | Quality Assurance Project Plan |
| QC | quality control |
| RI | Remedial Investigation |
| RME | reasonable maximum exposure |
| SAP | Sampling and Analysis Plan |
| SCG | Standards, Criteria, and Guidance |
| SLERA | Screening-Level Ecological Risk Assessment |
| SSHO | Site Safety and Health Officer |
| SSHP | Site Safety and Health Plan |
| SVOC | semi-volatile organic compound |
| TBC | to be considered |
| TOGS | Technical & Operational Guidance Series (NYSDEC) |
| TSCA | Toxic Substances Control Act (1976) |
| UCL | upper confidence limit |
| UFP | Uniform Federal Policy |
| USACE | United States Army Corps of Engineers |
| USDA | United States Department of Agriculture |
| USEPA | United States Environmental Protection Agency |
| UXO | underground storage tank |
| UST | unexploded ordnance |

| | |
|---|---|
| VOC | volatile organic compound |
| WP | Work Plan |

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## EXECUTIVE SUMMARY

Under contract to the United States Army Corps of Engineers (USACE), AECOM-Tidewater JV will conduct a Comprehensive Environmental Restoration, Compensation, and Liability Act (CERCLA) Remedial Investigation (RI), Feasibility Study, Proposed Plan, and Decision Document, at Camp Hero, a formerly used defense site (FUDS). AECOM-Tidewater JV prepared this RI Work Plan (WP) under Contract Number W912DR-13-D-0016. The lead regulator for this RI is the New York State Department of Environmental Conservation (NYSDEC). The planning and reporting documents prepared as part of this investigation will be provided to NYSDEC for review and comment.

Camp Hero State Park is located on the eastern tip of the south fork of Long Island, New York (NY), approximately 5 miles east of the Village of Montauk. The former Camp Hero was established in early 1942 as a Coastal Defense Installation and the facility changed ownership within the military multiple times over the course of the following decades. Between 1974 and 1984, site lands were transferred to State, Local, and other Federal agencies, and the facility was permanently closed in 1982. The area is now used as Camp Hero State Park and is owned by the New York State Parks Commission.

Former Department of Defense (DoD) activities at Camp Hero may have resulted in contaminated material or an environmental release from these materials at certain Areas of Concern (AOCs). Forty-four AOCs have been identified from 1) the Camp Hero Feasibility Study/Hazardous Materials Survey, prepared by NY State Parks contractor, Cashin Associates, in 1998 (Cashin 1998), and 2) a historical records search conducted by AECOM-Tidewater JV as part of this project. These sites included former waste disposal and coal storage areas, abandoned drum locations, and former storage tanks. The AOCs included in this RI WP are identified in Table ES-1. The AOCs locations are show on site wide Figure 2-1 and individual AOC Figures are presented as Figures 6-1 to 6-42.

The RI technical approach will consist of two phases of field sampling investigation (Phase 1 and Phase 2). The primary objective of the Phase 1 investigation is to determine the presence or absence of contamination at the Camp Hero AOCs. The primary objective of the Phase 2 investigation is to determine the nature and extent of target constituents in soil, groundwater, surface water, and sediment at the Camp Hero AOCs and determine if there are unacceptable risks to human health and ecological health associated with exposure to related constituents.

This RI WP details the activities planned for the Phase 1 RI investigation. The Phase 2 RI sampling activities will be detailed in an Addendum to this WP. The RI WP Addendum will provide the Phase 1 RI sampling results and specific activities and sampling protocols proposed for the Phase 2 RI. The RI WP Addendum will compare sampling results at each AOC against screening criteria and guidance discussed in this WP and provide a recommendation on whether constituents at an AOC are present at levels and to an extent that warrants further delineation of the nature and extent of constituents in the Phase 2 RI sampling or that no further sampling in the Phase 2 RI is warranted.

The WP Addendum will be provided to the project team for review, comments, and concurrence with recommendations.

Additionally, a geospatial survey of the former Camp Hero is currently being performed by the U.S. Army Geospatial Center. The geospatial survey results will be provided in the RI WP Addendum. The geospatial survey is evaluating Camp Hero for the potential presence of waste disposal areas which may have been utilized during DoD activities at Camp Hero. Additional investigation activities at these potential disposal areas, if identified in the survey, will be detailed in the RI WP Addendum.

The information and data collected during this RI will serve as the basis for the baseline human health risk assessment (HHRA) and Screening-Level Ecological Risk Assessment (SLERA). The objectives of the baseline HHRA and the SLERA are to evaluate whether concentrations of constituents from the AOCs pose unacceptable risks to human health and the environment, and to develop site-specific preliminary remediation goals, if necessary.

This RI WP defines the overall project objectives, provides a summary of the AOCs at Camp Hero, presents the preliminary conceptual site model (CSM), describes data quality objectives (DQOs), and presents the investigation tasks that will be conducted to achieve the project objectives.

**Table ES-1**
**Areas of Concern at Camp Hero**

| Area of Concern | Additional Site Names | Reason for Concern | Potential Impact |
|---|---|---|---|
| Battery 113 | Bunker-B1, Battery Dunn | Oil Staining | PCBs |
| | | Tanks, Drums, Pits | Hazardous Materials |
| Former Building 203 | N/A | Possible solvent and residual petroleum | Solvent(s), petroleum |
| Building 2010 | Cashin #39, Water Meter | Lead in Soil | Lead |
| Building F100C | Cashin #40, Well House | Lead in Soil | Lead |
| AST-35 | H-13 | Tank #35, 200,000 gallon tank associated with reported spill | Petroleum |
| Distribution Line for AST-35 | N/A | Distribution line connected to AST-35 | Petroleum |
| Building 20 (Tank-A) | Cashin #14, Fire Department | Suspected former tank location | Petroleum |
| Building 22 (Tank-B) | Cashin #22, Kitchen/Office | Suspected former tank location | Petroleum |
| Building 2 (Tank-C) | Cashin #24, Barracks | Suspected former tank location | Petroleum |
| Building 104R (Tank-D) | Cashin #33, Commissary, | Suspected former tank location | Petroleum |
| Building 3001 (Tank-E) | Cashin #47, AT&T Building, Lilco Building, State Park Police Residence | Suspected former tank location | Petroleum |
| Pump House (Tank F) | Near Battery 216/Bunker 4 | Suspected former tank location, Hazardous Materials | Petroleum |
| Pump House (Tank G) | Near Well 4 | Suspected former tank location | Petroleum |
| Battery 112 | Bunker-3 | Oil Staining | PCBs |
| Building 107 | Cashin #5, Electrical Sub-station | Electrical | PCBs |
| Building 201 | Cashin #1, Main Radar Tower | Electrical | PCBs |
| SS-1 through SS-27 | Abandoned Waste Disposal Systems (Site-wide) | Hazardous Material Disposal | Hazardous Materials |

**Table ES-1**
**Areas of Concern at Camp Hero**

| Area of Concern | Additional Site Names | Reason for Concern | Potential Impact |
|---|---|---|---|
| Motor Pool | | Hydraulic lift, Cesspool, Ordnance Repair | Petroleum, Hazardous Materials, Munitions Constituents |
| Engineering Field Office | Adjacent to Motor Pool | Ordnance Repair | Munitions |
| H-1, H-2, H-3, H-18, H-20, H-22 | Area of Possible DoD Related Disposal | Drums | Hazardous Materials |
| H-4 and H-6 | Area of Possible DoD Related Disposal | Construction Debris | Hazardous Materials |
| H-5 | Area of Possible DoD Related Disposal | Drums, Construction Debris | Hazardous Materials |
| H-7, H-8, H-9 | Area of Possible DoD Related Disposal | Boilers | Petroleum |
| H-11 | Former Power Plant | Suspected Contamination | Petroleum, Metals, PCBs |
| H-12 | Sewage Ejector Station | Suspected Contamination | Hazardous Materials |
| H-14, H-15 | Coal Storage Area | Suspected Contamination | PAH |
| H-16 | Sewage Treatment Area | Suspected Contamination | Hazardous Materials |
| H-17, H-21 | Area of Possible DoD Related Disposal | Open Pits | Hazardous Materials |
| H-19 | Area of Possible DoD Related Disposal | 550 gallon Storage Tank | Hazardous Materials |
| Battery 216 | N/A | Potential unknown storage or vaults | Potential release to the environment |
| Plotting Room 113 | N/A | Potential unknown storage or vaults | Potential release to the environment |
| Camp Hero State Park Bluffs | N/A | Potential Metal Debris | Metal debris hazard |

DoD Department of Defense, United States
N/A Not Applicable

# 1.0 INTRODUCTION

Under contract to the United States Army Corps of Engineers (USACE), AECOM-Tidewater JV will conduct a Comprehensive Environmental Restoration, Compensation, and Liability Act (CERCLA) Remedial Investigation (RI), Feasibility Study, Proposed Plan, and Decision Document, at Camp Hero, a formerly used defense site (FUDS) (see **Figure 1-1** in Appendix A). AECOM-Tidewater JV prepared this RI Work Plan (WP) under Contract Number W912DR-13-D-0016, Order Number DB01. The lead regulator for this RI is the New York State Department of Environmental Conservation (NYSDEC). The planning and reporting documents prepared as part of this investigation will be provided to NYSDEC for review and comment.

The areas of concern (AOCs) at Camp Hero included in this RI WP are based on 1) the Camp Hero Feasibility Study/Hazardous Materials Survey prepared by NY State Parks contractor Cashin Associates in 1998 (hereinafter, "Cashin Report") and 2) a historical records search conducted in 2016 in preparation of this RI. These sites included former waste disposal and coal storage areas, abandoned drum locations, and former storage tanks (see **Figure 1-2** in Appendix A). Some of the AOCs identified in the Cashin Report have been removed or addressed during previous decommissioning related to park development activities.

The RI phase of the project is limited to the investigation of these sites (i.e., no remediation); however, the exception will include proposed disposal of empty containers at the Camp Hero State Park bluffs and at former drum sites.

## 1.1 Scope and Objectives

This RI WP defines the overall project objectives, provides a summary of the AOCs at Camp Hero, presents the preliminary conceptual site model (CSM), describes data quality objectives (DQOs), and presents the investigation tasks that will be conducted to achieve the project objectives.

The RI technical approach will consist of two phases of field sampling investigation (Phase 1 and Phase 2):

- **Phase 1 RI:** The primary objective of the Phase 1 RI is to determine the presence or absence of contamination at the Camp Hero AOCs. This RI WP primarily addresses activities to be accomplished during Phase 1 of the RI.

  Subsequent to the Phase 1 RI, a RI WP Addendum will be prepared that provides the Phase 1 RI sampling results and specific activities and sampling protocols proposed for the Phase 2 RI. The RI WP Addendum will compare sampling results at each AOC against screening criteria and guidance identified in this WP and provide a recommendation on whether constituents at an AOC are present at levels and to an extent that warrants further

delineation of constituents in the Phase 2 RI sampling or that no further sampling in the Phase 2 RI is warranted. The RI WP Addendum will be provided to the project team for review, comments, and concurrence with these recommendations.

- **Phase 2 RI:** For AOCs requiring further investigation, the primary objective of the Phase 2 RI is to determine the nature and extent of target constituents in soil and groundwater at the Camp Hero AOCs and to determine if there are unacceptable risks to human health and ecological receptors associated with exposure to AOC-related constituents.

  The Phase 1 RI sampling results will be used as a basis for determining the locations of Phase II samples and analyses to be conducted to determine the nature and extent of contamination at the Camp Hero AOCs and to estimate the average concentration of a contaminant that may be contacted by a receptor at a site, which will be estimated as an upper confidence limit (UCL) (95% or greater) of the arithmetic mean.

  The information and data collected during this RI (Phase 1 and 2) will serve as the basis for the baseline human health risk assessment (HHRA) and Screening-Level Ecological Risk Assessment (SLERA) that will be conducted as part of the RI. Samples collected for the Phase 1 RI may be used to determine the locations of Decision Units (DUs) that will be additionally characterized during the Phase 2 RI, but in general, biased sample results will not be pooled with representative samples collected during the Phase 2 RI. The objectives of the baseline HHRA and the SLERA are to evaluate whether concentrations of constituents from the AOCs pose unacceptable risks to human health and the environment, and to develop site-specific preliminary remediation goals, if necessary.

This RI WP identifies the equipment, methods, and staffing necessary to perform the tasks necessary to meet the project objectives.

Work under this task order will be completed in accordance with applicable USACE policies, regulations and guidance, and Federal, State, and local laws. Additionally, applicable and appropriate DoD FUDS guidance and policy will be followed. Key references and policy documents for this investigation include, but are not limited to, the following:

- United States Environmental Protection Agency (USEPA) Guidance For Conducting Remedial Investigations and Feasibility Studies under CERCLA, Office of Solid Waste and Emergency Response (OSWER) Directive 9335.3-01; Interim Final, October 1998.
- USEPA Guidance for Performing Site Inspections under CERCLA; Interim Final, September 1992.

- USEPA Federal Facilities Remedial Site Inspection Summary Guide. July 2005.
- USACE Engineer Regulation (ER) No. 200-3-1, FUDS Program Policy. 10 May 2004.
- USACE ER No. 200-1-7, Chemical Data Quality Management for Environmental Restoration Activities. November 2014.
- Chapter 6, NY Codes, Rules, and Regulations (NYCRR): Part 375-1, General Remedial Program Requirements; Part 6 NYCRR 613.9 (b), Closure of Tanks Permanently Out of Service; and Part 375-6 Soil Cleanup Objectives.
- NYSDEC Division of Environmental Remediation (DER)-10, Technical Guidance for Site Investigation and Remediation. May 2010.
- NYSDEC Spills, Technology, and Remediation Services (STARS) Commissioner Policy (CP)-51, Soil Cleanup Guidance.
- NYSDEC Technical & Operational Guidance Series (TOGS), 1.1.1 Ambient Water Quality Standards and Guidance Values.

Applicable regulations are further discussed in Section 5.1 Regulatory Framework.

## 1.2 Work Plan Organization

This RI WP is organized into the following sections:

- Section 1.0: Introduction – provides an introduction to the project including the scope and objectives.
- Section 2.0: Background – provides site background information including the site location, historical information, and records review.
- Section 3.0: Physical and Environmental Conditions – provides information on climate, geology, soils, hydrology, physiography and topography, flora and fauna, and protected species at Camp Hero.
- Section 4.0: Preliminary Conceptual Site Model – outlines the preliminary CSM for Camp Hero.
- Section 5.0: Technical Approach – provides the regulatory framework and description of the phased RI approach.

- Section 6.0: Areas of Concern Descriptions – presents historical information, reason for concern, and general RI approach for each AOC at Camp Hero.

- Section 7.0: References – lists the references utilized in this WP.

The following appendices are included in this WP:

- Appendix A of this RI WP contains the figures referred to in the WP.

- Appendix B of this RI WP is the NY State Department of Health (NYSDOH) Generic Community Air Monitoring Plan (CAMP), Attachment 1A of the NYSDEC Division of Environmental Remediation (DER)-10 Technical Guidance for Site Investigation and Remediation. The CAMP details air monitoring activities that will be implemented to protect the community from any potential airborne releases that could result from field activities associated with the remedial investigation or remedial action efforts as necessary (NYSDEC 2010b).

- Appendix C of this RI WP is the Sampling and Analysis Plan (SAP), prepared in accordance with The DoD Environmental Field Sampling Workbook (DoD 2013). The SAP includes a Quality Assurance Project Plan (QAPP), prepared in accordance with the Uniform Federal Policy (UFP) for QAPPs. The SAP and QAPP identify the detailed procedures/methods for the RI sampling and analysis, and address quality assurance (QA) and quality control (QC) methods used to control activities on the project. The UFP QAPP contains the Environmental Laboratory Accreditation Program Certification (ELAP).

- Appendix D of this RI WP includes a Photograph Log of the Camp Hero AOCs.

- Appendix E of this RI WP is the Accident Prevention Plan (APP) with a Site Safety and Health Plan (SSHP) attachment. The APP/SSHP details the Health and safety requirements for RI field activities, identifies potential site hazards, and provides methodologies to mitigate these hazards.

- Appendix F of this RI WP, Risk Assessment Guidance for Superfund - Table 4s for Current/Future Human Receptors, provides supplemental information for the Human Health Risk Assessment (HHRA). Specifically, preliminary exposure factors for receptors and potentially complete exposure pathways are identified for the Camp Hero AOCs.

## 1.3 Project Organization and Responsibilities

The AECOM-Tidewater JV's project organization is provided in **Figure 1-3** (Appendix A). This figure also shows the communication pathways and lines of authority for the overall project. Details on personnel and subcontractor roles/responsibilities are presented in the Uniform Federal Policy

SAP (Appendix C). For this RI, Gregory Goepfert is the USACE (NY District) Project Manager and Megan Cullen is the USACE (New England District) Technical Lead.

Mark MacEwan is the AECOM-Tidewater JV Project Manager, and Megan Donahue is the AECOM-Tidewater JV Deputy Project Manager. For the RI field operations, Amanda Martin will function as the AECOM-Tidewater JV Site Supervisor. She will lead field operations, coordinate field activities, and act as the liaison between site and laboratory personnel. RI work will be conducted under the oversight of the AECOM-Tidewater JV Site Safety and Health Officers, Kelly Lurie and Greta White (alternate SSHO).

The AECOM-Tidewater JV field team will be supported by office-based personnel including the Project Chemist (Devon Chicoine), Project Geologist (Brendan McGuinness), Quality Assurance Officer (John Maier), Geographic Information System (GIS)/Data Manager (Dan Shultz), and Health and Safety Manager (Bob Miller).

**Table 1-1**
**Camp Hero Project Key Personnel**

| Key Personnel | Title | Organization | Phone | Email |
|---|---|---|---|---|
| Gregory Goepfert | USACE PM | USACE-NY | 917-790-8235 | Gregory.J.Goepfert@usace.army.mil |
| Megan Cullen | Technical Lead | USACE-NE | 978-318-8423 | Megan.E.Cullen@usace.army.mil |
| Cynthia Colquitt | Risk Assessor | USACE-NE | 978-318-8042 | Cynthia.A.Colquitt@usace.army.mil |
| Mark Keonig | Chemist | USACE-NE | 978-318-8312 | Mark.R.Koenig@usace.army.mil |
| Patrick Mion | Geologist | USACE-NE | 978-318-8437 | Patrick.J.Mion@usace.army.mil |
| Marc Paiva | Cultural Resources | USACE-NE | 978-318-8796 | Marcos.A.Paiva@ usace.army.mil |
| Mike Penko | Ecologist | USACE-NE | 978-318-8139 | Michael.Penko@ usace.army.mil |
| Tom Dess | State Park Superintendent | NY State Parks | 631-668-2765 | Thomas.Dess@parks.ny.gov |
| Mark MacEwan | Project Manager | AECOM | 703-682-9092 | Mark.MacEwan@aecom.com |
| Megan Donahue | Deputy Project Manager | AECOM | 703-682-9142 | Megan.Donahue@aecom.com |
| Brendan McGuinness | Technical Lead/Geologist | AECOM | 703-682-1564 | Brendan.McGuinness@aecom.com |
| John Maier | QA Officer | AECOM | 703-682-3110 | John.maier@aecom.com |
| Devon Chicoine | Chemist | AECOM | 703-682-9069 | Devon.chicoine@aecom.com |
| Kelly Lurie | Site Safety and Health Officer | AECOM | 518-542-2944 | Kelly.Lurie@aecom.com |
| Greta White | Site Safety and Health Officer | AECOM | 518-698-3012 | Greta.White@aecom.com |
| Amanda Martin | Site Supervisor | AECOM | 703-339-3953 | Amanda.martin@aecom.com |
| Naoum Tavantzis | Data Validator | AECOM | 443-737-1299 | Naoum.Tavantzis@aecom.com |

## 1.4 Project Schedule Summary

Table 1-1 presents a summary of the planned schedule for the completion of RI investigation operations.

**Table 1-2**
**Camp Hero Project Schedule Summary**

| Activities | Anticipated Start Date | Anticipated Completion Date |
|---|---|---|
| Prepare RI WP, SAP (with QAPP), and APP (with SSHP) | December 2015 | May 2016 |
| RI Field Operations – Phase 1 | May 2016 | June 2016 |
| Laboratory Analysis | June 2016 | July 2016 |
| RI Field Operations – Phase 2 | September 2016 | September 2016 |
| Laboratory Analysis | October 2016 | November 2016 |
| Prepare RI Report | September 2016 | August 2017 |

## 1.5 Health and Safety Requirements and Response

Health and safety requirements for RI field activities are provided in the Camp Hero APP and the SSHP attachment (Appendix E) (AECOM 2016). Detailed job hazard analyses identifying the physical, chemical, and biological hazards that may be encountered at the site and the associated mitigation methods are presented in the APP/SSHP.

### 1.5.1 Hazardous Waste Activities

Level D PPE will be worn during majority of general work activities. However, respiratory protection associated with Modified Level D PPE may be required at some AOCs, as determined in the field by the Site Safety and Health Officer (SSHO). A half mask or full-face respirator equipped with a P100/organic vapor cartridges will be used when collecting samples of suspect PCBs. A half mask or full-face respirator equipped with a P100 cartridge will be used if working in old or abandoned buildings with potential mold, avian or rodent droppings, or other biological hazards.

On-site personnel who may be exposed to hazardous conditions will be required to meet training requirements identified in Federal Regulation 29 CFR 1910.120 (Hazardous Waste Operations and Emergency Response [HAZWOPER]). At least two personnel trained in first aid and cardiopulmonary resuscitation (CPR) will be onsite during field activities. Training certificates for personnel (HAZWOPER 40-hour training; current HAZWOPER 8-hour refresher training; and first aid/CPR) will be maintained onsite by the SSHO. Additional details on the safety program that will be implemented during RI field operations are presented in the APP/SSHP.

### 1.5.2 Unexploded Ordnance

Based on the UXO Probability Assessment for Intrusive Investigation at Former Camp Hero completed by USACE Baltimore District, it has been determined that the Camp Hero site activities have a low probability of encountering munitions and explosives of concern (MEC) except for areas H and K, which will not be entered at any point during RI field activities. Anomaly avoidance will be conducted in accordance with EM 385-1-97 during subsurface investigations. "Anomaly avoidance" is defined as the avoidance of surface MEC and any subsurface anomalies where the specific activity can be moved to another location. A UXO Technician II will conduct anomaly avoidance during intrusive RI field activities. The UXO Technician II will have the appropriate level of training and experience as stated in Department of Defense Explosives Safety Board Technical Paper 18.

Additionally, all field personnel, including AECOM-Tidewater JV employees and subcontractors, will complete Ordnance Recognition Training prior to the start of field activities. **Stop work authority will be used immediately if ordnance is suspected and the team leader will call 911 to notify authorities.**

### 1.5.3 Chemical Warfare Materiel

Based on the CWM Probability Assessment for Intrusive Investigation at Former Camp Hero completed by USACE Huntsville, it has been determined that the Camp Hero site activities have a low probability of encountering CWM. The field team will be trained in the recognition of CWM, especially the chemical agent identification sets (CAIS) which contain dilute nerve agents and which had been identified in the Archives Search Report for Former Camp Hero (USACE, 2000). The team will also be trained in exposure recognition training.

The team will withdraw immediately to an upwind site and **Stop work authority will be used immediately if CWM OR CAIS is suspected. The team leader will call 911 and Greg Goepfert at USACE.** See Table 2-1 of the APP for Phone numbers and communication guidelines.

## 1.6 Community Air Monitoring

Community air monitoring will be performed in accordance with the NYSDOH Generic CAMP, Attachment 1A of the NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation (Appendix B). Air monitoring activities will be implemented to protect the community from any potential airborne releases that could result from field activities associated with the remedial investigation or remedial action efforts as necessary (NYSDEC 2010b).

A CAMP is typically required by the NYSDEC whenever intrusive work is conducted as part of an environmental investigation or remediation. The need for a CAMP will be further discussed with NYSDEC, upon their review of this RI WP, to determine if this requirement can waived or modified.

The CAMP may be modified to be more appropriate for site activities, such as monitoring with a photoionization detector (PID) for volatile organic compounds (VOCs) at the individual AOCs.

## 1.7 Quality Assurance/Quality Control

The SAP (Appendix C) identifies the DQOs and details the QA/QC procedures for investigation activities that will be implemented to ensure DQOs are achieved. The DQOs are qualitative and quantitative statements developed to clarify the study objectives, define the most appropriate data to collect under what conditions, and specify tolerable limits on decision errors that are used as the basis for establishing the quantity and quality of data needed to support decision-making. The quality of data will be assessed through the collection and analysis of field and laboratory QC samples. These QC samples will be used to check the sampling methodology and analytical precision, accuracy, and representativeness.

## 1.8 Data Management

The field and analytical data collected during this project is critical to site characterization efforts and the further refinement of the CSM. Investigation data will be recorded and maintained for future use and reporting. Logbooks and field data sheets will be used to record data collection activities. Project documentation will be collected and managed onsite during the field activities. Data will be uploaded into a GIS database, as appropriate, and digital data will be backed up. Samples collected for off-site analysis will be analyzed by RTI Laboratories for VOCs, semi-volatile organic compounds (SVOCs) including Polycyclic Aromatic Hydrocarbons (PAHs), metals, energetics (please see QAPP Worksheets #15.6a and 15.6b for a list of compounds), and/or polychlorinated biphenyls (PCBs)using methods identified in the SAP. Aspects of sample collection, data analysis, and data reporting are addressed in the SAP (Appendix C). GIS data will be compliant with the most current USACE and DoD spatial data requirements, using Spatial Data Standards for Facilities, Infrastructure, and Environment version 3.1 as the model.

## 1.9 Remedial Investigation Report

A Draft, Draft Final, and Final RI Report for Camp Hero will be submitted to the USACE (NY District) Project Manager and USACE (New England District) Technical Lead. The RI Report will be comprehensive, describing the site history and source of compounds of potential concern (COPCs), site setting, current and future land use, scope of project investigation activities, Phase 1 and Phase 2 investigation results and updated CSM, the rationale and data used to arrive at conclusions/recommendations concerning COPCs, a baseline HHRA and SLERA, and the QA/QC procedures utilized to check assumptions and verify findings. Detailed maps of the site including AOCs, site boundaries, structures and other site-specific details will be provided. The RI Report will compile and analyze site data in a clear and concise manner as well as provide defensible justifications for recommendations.

# 2.0 BACKGROUND

## 2.1 Site Location

Camp Hero State Park, consisting of 469 acres, is located on the eastern tip of the south fork of Long Island, NY, approximately 5 miles east of the Village of Montauk (**Figure 1-1** in Appendix A). Camp Hero State Park is split into two large subareas: the former Military Area (the Site) and the "Sanctuary Area." The Camp is located in Suffolk County, NY. The Camp is bounded by Montauk Highway (Route 27) to the north, the Atlantic Ocean to the south, Montauk Point State Park to the east, and Camp Hero State Park's undeveloped sanctuary area to the west.

## 2.2 Description of Site

The former Camp Hero operates as the Camp Hero State Park. The landscape includes wooded areas, freshwater wetlands, and sea-side bluffs. The park contains hiking trails and roadways leading to former military buildings, picnic areas, and recreational areas.

## 2.3 Current and Future Land Use

The Camp Hero State Park is owned by the NY State Office of Parks, Recreation, and Historic Preservation and is operating as the public recreational area. The future land use is anticipated to remain the same as the current state park use (USACE 2003).

Approximately 17.4 acres of Camp Hero were transferred to the Town of East Hampton for low income housing in 1982. This area had been previously used for residential purposes when the installation was operational under the Department of Defense and there is no evidence of industrial activity within the area; therefore, the low income housing area has not been defined as an AOC. All USTs in the area what were used for the residents have been removed.

## 2.4 Historical Information

The former Camp Hero was established in early 1942 as a Coastal Defense Installation to defend the approaches to New York and was named in honor of Major General Andrew Hero. Three self-sufficient batteries (Battery 112, 113, and 216) and supporting facilities were constructed which included barracks, mess halls, hospital facilities, a motor repair shop, a recreation facility, sentry boxes, and water supply and sewage facilities. A total of 600 enlisted men and 37 officers were stationed at Camp Hero.

Camp Hero was a sub-installation of the 11th Coast Artillery Regiment (Harbor Defense) located at Fort H.G. Wright, Fischers Island, Block Island Sound, New York. Fort H.G. Wright was under the control of the Eastern Defense Command. Elements from the 11th Coast Artillery Regiment, along with elements from the 242$^{nd}$ Connecticut National Guard Coast Artillery Regiment (Harbor Defense), which augmented the 11th Coast Artillery Regiment at Fort H .G . Wright.

Battery 216 (identified as Bunker 216 on Figure 1-2) contained two 6-inch shielded guns, a mechanical power room, and powder room for storage of ammunition and powder charges. Battery 113 (identified as Bunker 113 on maps) consisted of two 16-inch casemated guns and battle allowances of ammunition and powder charges were stored within the battery. Battle allowances of ammunition and powder charges for the Camp Hero battery guns were stored within the individual batteries of the camp. A requirement for war reserve allowances of ammunition for the batteries also existed. However this ammunition was stored outside of Camp Hero installation boundaries at an unknown central depot location under the control of the Chief of Ordnance. Batteries 112 and 113 had a battle allowance of 200 16-inch 2,240-lb projectiles and a war reserve allowance of 300 16-inch 2,240-lb projectiles. Battery 216 had a battle allowance of 200 6-inch 90-lb HE (high explosive) rounds and 300 6-inch 105-lb AP (armor piercing) rounds and a war reserve allowance of 300 6-inch 90-lb HE rounds and 400 6-inch 105-lb AP rounds (USACE 2000).

Additionally, 37-millimeter (mm) weapons and .50-caliber antiaircraft weapon platoons were assigned to protect the Camp from air attack. The Camp's weaponry was periodically fired to practice over water but was never fired as a result of an act of hostility. It is presumed that the antiaircraft weapon ammunition for Camp Hero and nearby facilities was also stored within the battery ammunition storage facilities of Camp Hero, as no other historical or physical evidence is present to display a separate storage facility for these items. This was conceivably possible due to the storage capacity of 400 rounds of ammunition in Batteries 112 and 113, and a battle allowance requirement of only 200 rounds of ammunition (USACE 2000).

The Camp was placed on inactive status on July 31, 1947 and ultimately declared surplus by the Department of the Army on December 31, 1949. In 1949, approximately 97 acres of Former Camp Hero was transferred to the Department of the Air Force for an aircraft control and warning station. On January 24, 1951, the former Camp Hero was withdrawn from surplus and designated for use as a firing range and field exercise area for antiaircraft artillery from Fort Totten, NY. Arrangements were made for an Army cadre at the Camp and 90 mm and quad .50-caliber antiaircraft artillery began firing exercises from firing positions established in the southern bluff overlooking the Atlantic Ocean near Bunker 216. Tow target planes and radio controlled aircraft were utilized to gauge firing accuracy (later towed barges were also used). Due to limited facilities for the training units, the units bivouacked at the Camp. Ammunition for training exercises, when required, was stored in the internal bunkers of the now unused Battery 216 (USACE 2000).

In 1952, the Air Force property was renamed the Montauk Air Force Station and was occupied by the Aircraft Control and Warning Squadron (ACWS). The Former Montauk Air Force Station portion of Former Camp Hero has been shown on Figure 1-1. Army unit training continued using 90 mm and 120 mm guns, 3.5-inch rockets, and .50 caliber guns until 1957. The facility was active until

October 1958 when the ACWS was re-designated as the Radar Squadron with a new mission to provide surveillance data of air traffic in the area. In order to accomplish this mission, an advanced Specific Frequency Diversity Search Radar was built in late 1960 (Army-Navy [AN]/Fixed-Pulse Radar-Surveillance [FPS]-35 Radar Tower and Antenna).

Between 1974 and 1984, site lands were transferred to State, Local, and other Federal agencies and the ACWS facility was permanently closed in 1982. The current Camp Hero State Park consists of 415.35 acres and is owned by the NY State Parks Commission.

In 2002, the AN/FPS-35 Radar Tower and Antenna was listed under the National Register of Historic Places (NRHP). Camp Hero State Park as a whole is potentially eligible for listing on the NRHP according to the NY State Historic Preservation Office.

## 2.5 Records Review Summary

The following sections summarize the results of the records reviewed including the agencies visited, personnel interview, and the documents reviewed.

**The Division of Environmental Remediation, NY State Department of Environmental Conservation:** A site visit to the NYSDEC DER office in Stony Brook, New York was conducted on 17 November 2015 to inspect and obtain copies of storage tank closure documentation, spill reports and assessments, and spill report closure documentation. The Spill Reports and associated documentation listed in

Table 2-1 were obtained and reviewed.

The spill cases listed in Table 2-1 at Camp Hero have been closed by the NYSDEC DER. It was noted by Mr. Nick Acampora, Environmental Program Specialist with the DER, in a meeting in November 2015 that the tank construction methods at Camp Hero may have reduced the potential of a release from the underground storage tank (UST) to the environment. The UST construction methods at Camp Hero included in-ground concrete vaults with tank support saddles beneath and concrete lids above some of the USTs. This helped to minimize weathering of the tanks and potential releases to the environment at the UST locations that had this construction. In some cases, localized impacted soil was removed from the UST excavation and then closed as witnessed by DER personnel.

Mr. Acampora indicated that spill report number 93-09575 at the Camp Hero Power Plant (Building 203) was a significant incident which included two 25,000 gallon fuel tanks. A 1,000-gallon spill resulting from trespassers opening a valve on a former 200,000 gallon

#2 Diesel Range Oil tank was also noted in this area. The release traveled via surface water to a sensitive environment at off-site Oyster Bay which resulted in a remedial action at Camp Hero.

**Table 2-1**
**NYSDEC DER Spill Report Cases for Camp Hero**

| Spill Report Case Number | Date | Description of Location |
|---|---|---|
| 94-06313 | 08/09/1994 | Drum Storage/Staging Area |
| 94-06038 | 08/03/1994 | Battery 112, UST #36, 37 |
| 94-03067 | 06/01/1994 | Former Building 203 |
| 94-03066 | 06/01/1994 | Drum Storage/Staging Area |
| 93-11848 | 01/06/1994 | Camp Hero |
| 93-12037 | 11/18/1993 | Battery 113, UST #9 |
| 93-12038 | 11/18/1993 | Building 201, UST #20 |
| 93-09575 | 11/08/1993 | Former Building 203 |
| 93-11689 | 11/08/1993 | Building 3001, UST #26 |
| 93-11688 | 11/03/1993 | Building 20, UST #21 |
| 93-11690 | 11/03/1993 | Camp Ground, UST #39 |
| 93-09098 | 10/25/1993 | Former Building 36, UST #24A, 24B, 25 |
| 93-11687 | 10/25/1993 | Battery 113, UST #8 |
| 90-10990 | 01/13/1991 | Montauk Point Camp Hero State Park |

The USTs and aboveground storage tanks (ASTs) identified in the records search of NYSDEC DER and descriptions of the storage tank locations are provided on **Table 2-2**. A figure showing the location of USTs and ASTs is provided as **Figure 1-2**.

**Suffolk County Bureau of Hazardous Materials Storage, Office of Pollution Control:** The Suffolk County Office of Pollution Control (OPC) has conducted storage tank inspections at Camp Hero since the early 1980s. Walter Petrule, Program Manager, Suffolk County OPC, was interviewed regarding available storage tank files available for review. Mr. Petrule was knowledgeable of the history of storage tanks at Camp Hero and had spent some effort correlating former tank numbers with locations at Camp Hero. A site visit to the OPC office in Farmingville, NY was conducted on December 1, 2015 to review Camp Hero storage tank records. The USTs and ASTs identified in the records search at the Suffolk County OPC and descriptions of the locations are provided on **Table 2-2**. A figure showing the location of identified USTs and ASTs is provided as **Figure 1-2**.

As shown on Table 2 2, there were 48 USTs and ASTs (plus one transformer storage area) removed at Camp Hero and four (plus one drum storage area) that are still currently listed as in use by the Suffolk County OPC. There are seven suspected USTs at Camp Hero without documentation or information (Tanks A through G), identified through a review of archive drawings of Camp Hero and previous environmental assessment.

**Table 2-2**
**Summary of Hazardous Material Storage Tanks**

| Tank # | Tank Type | Location | Tank Contents | Tank Status | Closure Status | Removal Documentation |
|---|---|---|---|---|---|---|
| 1 | UST | Battery 113, Battery Dunn | #2 Fuel Oil | Removed | N/A | NYSDEC-Region 1 Tank Removal Report |
| 2 | UST | Battery 113, Battery Dunn | #2 Fuel Oil | Removed | N/A | NYSDEC-Region 1 Tank Removal Report |
| 3 | AST | Battery 113, Battery Dunn | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 4 | AST | Battery 113, Battery Dunn | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 5 | AST | Battery 113, Battery Dunn | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 6 | AST | Battery 113, Battery Dunn | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 7 | AST | Battery 113, Battery Dunn | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 8* | UST | Battery 113, Battery Dunn | #2 Fuel Oil | Removed | Closed | NYSDEC-Region 1 Tank Removal Report |
| 9* | UST | Battery 113, Battery Dunn | #2 Fuel Oil | Removed | Closed | NYSDEC-Region 1 Tank Removal Report |
| 10 | UST | Building #104T - Transmitter | #2 Fuel Oil | Removed | N/A | NYSDEC-Region 1 Tank Removal Report |
| 11 | AST | Building #104T - Transmitter | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 12 | AST | Former Building #203 | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 13 | AST | Former Building #203 | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 14 | AST | Former Building #203 | Lube Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 15 | AST | Former Building #203 | Lube Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 16* | UST | Former Building #203 | Motor Oil | Removed | Closed | NYSDEC-Region 1 Tank Removal Report |

**Table 2-2**
**Summary of Hazardous Material Storage Tanks**

| Tank # | Tank Type | Location | Tank Contents | Tank Status | Closure Status | Removal Documentation |
|---|---|---|---|---|---|---|
| 17* | UST | Former Building #203 | #2 Fuel Oil | Removed | Closed | NYSDEC-Region 1 Tank Removal Report |
| 18* | UST | Former Building #203 | #2 Fuel Oil | Removed | Closed | NYSDEC-Region 1 Tank Removal Report |
| 19 | UST | Former Building #203 | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 20* | UST | Building # 201 and Former Building #203 | #2 Fuel Oil | Removed | Closed | NYSDEC-Region 1 Tank Removal Report |
| 21* | UST | Building #20 | Gasoline | Removed | Closed | NYSDEC-Region 1 Tank Removal Report |
| 22 | AST | Building #20 | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 23 | AST | Former Building #203 | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 24A* | UST | Former Building #36 (Former Fueling Station) | Gasoline | Removed | Closed | NYSDEC-Region 1 Tank Removal Report |
| 24B* | UST | Former Building #36 (Former Fueling Station) | Gasoline | Removed | Closed | NYSDEC-Region 1 Tank Removal Report |
| 25* | UST | Former Building #36 (Former Fueling Station) | Diesel | Removed | Closed | NYSDEC-Region 1 Tank Removal Report |
| 26* | UST | Building 3001 - AT&T | Diesel | Removed | Closed | NYSDEC-Region 1 Tank Removal Report |
| 27 | AST | Building #9 | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 28 | AST | Building 105 | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 29 | AST | Building 105 | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 30 | UST | Building 2010 | Gasoline | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 31 | AST | Building #33 - Motor Pool | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 32 | UST | HILL 72 | #2 Fuel Oil | Removed | N/A | NYSDEC-Region 1 Tank Removal Report |
| 33 | UST | HILL 72 | #2 Fuel Oil | Removed | N/A | NYSDEC-Region 1 Tank Removal Report |
| 34 | UST | Building F100C | Gasoline | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |

**Table 2-2**
**Summary of Hazardous Material Storage Tanks**

| Tank # | Tank Type | Location | Tank Contents | Tank Status | Closure Status | Removal Documentation |
|---|---|---|---|---|---|---|
| 35 | AST | N/A | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 36* | UST | Battery 112 | #2 Fuel Oil | Removed | Closed | NYSDEC-Region 1 Tank Removal Report |
| 37* | UST | Battery 112 | #2 Fuel Oil | Removed | Closed | NYSDEC-Region 1 Tank Removal Report |
| 38 | UST | Plotting-Switchboard Room for Battery 113 & 112 | #2 Fuel Oil | Removed | N/A | NYSDEC-Region 1 Tank Removal Report |
| 39* | UST | Trailer Park | #2 Fuel Oil | Removed | Closed | NYSDEC-Region 1 Tank Removal Report |
| 40 | UST | HILL 83 | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 41 | UST | HILL 83 | Gasoline | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 42 | UST | HILL 83 | Gasoline | Removed | N/A | NYSDEC-Region 1 Tank Removal Report |
| 43 | UST | HILL 83 | Gasoline | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 44 | UST | Plotting Room for Battery 113 | #2 Fuel Oil | Removed | N/A | NYSDEC-Region 1 Tank Removal Report |
| 45 | UST | Battery 216 | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 46 | UST | Battery 216 | #2 Fuel Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 47 | Storage | Near Former Building #203 | Transformers - PCB | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 48 | UST | Location has not been confirmed through the record review. | Diesel | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 49 | UST | Building #3001 - AT&T Building | #2 Fuel Oil | In use | N/A | NYS State Park Use |
| 50 | UST | Building #33 - Motor Pool | #2 Fuel Oil | In use | N/A | NYS State Park Use |
| 51 | AST | Location has not been confirmed through the record review. | Waste Oil | Removed | N/A | OCP Tank Compliance Inspection Data Sheet |
| 52 | drum storage | Building #33 - Motor Pool | Miscellaneous | In use | N/A | NYS State Park Use |
| 53 | AST | Building #33 - Motor Pool | Waste Oil | In use | N/A | NYS State Park Use |

**Table 2-2**
**Summary of Hazardous Material Storage Tanks**

| Tank # | Tank Type | Location | Tank Contents | Tank Status | Closure Status | Removal Documentation |
|---|---|---|---|---|---|---|
| 54 | AST | Building #33 - Motor Pool | Antifreeze | In use | N/A | NYS State Park Use |
| A** | Unknown | Building #20 (Cashin #14) | Suspected #2 Fuel Oil | Unknown | Unknown | These tanks were noted in the Cashin Report; however, the existence of the tanks or locations has not been confirmed through the Records Review. See Section 4.4 for additional information. |
| B** | Unknown | Building #22 (Cashin #22) | Suspected #2 Fuel Oil | Unknown | Unknown | |
| C** | Unknown | Building # 2 (Cashin #24) | Suspected #2 Fuel Oil | Unknown | Unknown | |
| D** | Unknown | Building #104R (Cashin #33) | Suspected #2 Fuel Oil | Unknown | Unknown | |
| E** | Unknown | Building 3001 – AT&T | Suspected #2 Fuel Oil | Unknown | Unknown | |
| F** | Unknown | Pump House, near Battery 216 | Suspected Gasoline | Unknown | Unknown | |
| G** | Unknown | Pump House, near Well 4 | Suspected Gasoline | Unknown | Unknown | |

* Tanks associated with reported spills and case closed under the NYSDEC regulatory program
** Additional suspected former tank locations (Closure Status Unknown)
N/A Not Applicable. No release was observed at these tanks requiring a NYSDEC spill case number.

**Camp Hero Archive Drawings, NY State Office of Parks, Recreation and Historic Preservation, Long Island Region, West Babylon, NY:** Mr. August Muff, R.A., Associate Architect, provided an electronic version of approximately 700 historic drawings of various electrical, mechanical, structural, architectural, utilities layout, and site plans for Camp Hero. These drawings were reviewed for evidence of undocumented petroleum or hazardous materials and storage tanks that may have existed at Camp Hero. The USTs and ASTs identified through the review of these historical drawings are included on **Table 2-2**.

**Suffolk County Department of Health Services, Office of Water Resources:** The Office of Water Resources is empowered by the Federal Safe Drinking Water Act and the NY State and Suffolk County Sanitary Codes to enforce regulations controlling 39 Community Water Supplies (CWS) and 254 Non-Community Water Supplies (NCWS) in Suffolk County. The Office of Water Resources obtains a water sample from these supplies yearly that is analyzed for a comprehensive suite of analysis. The laboratory analysis of the groundwater at the CWS wells consists of pesticides, radiological (gross alpha/beta), herbicide metabolites, metals, standard inorganics (chloride, sulfate, nitrate, nitrite), semi-volatile organics, volatile organics, and bacteriological analysis (total coliform and *E. coli*).

This drinking water analysis was requested for former CWS wells that existed at the Madison Hill Drive Well Field adjacent to Camp Hero and from the NCWS at the Montauk Light house. Copies of laboratory analyses available from the early 1980's (when military activities formerly ceased) and a recent analysis conducted in 2010 were requested for review. The Office of Water Resources does not have comprehensive analytical results for these wells prior to the 1980s.

A telephone interview was conducted with Ms. Susan Riley, Water Resources Specialist, of the Office of Water Resources regarding her knowledge of the water quality at these CWS wells. Ms. Riley indicated that from her review of the database records, that the Madison Hill Drive Well Field CWS wells had exceeded the drinking water maximum contaminant levels (MCLs) for arsenic before being abandoned and the supply wells were relatively high in content for secondary drinking water MCLs manganese and iron. According to sampling documentation for these three supply wells obtained from Suffolk County, two supply wells at the Madison Hill Drive Well Field were placed permanently out of use in 2004 due to drinking water exceedances for manganese, iron, and arsenic. A third supply well was placed in service in 2004 and was inactive by 2010 due to exceedances for manganese, iron, and arsenic. The total depth of these wells ranged from 125 to 141 feet below ground surface (bgs). The community supplied water by the Madison Hill Drive Well Field was connected to the Suffolk County Water Authority municipal water.

**Camp Hero Previous Environmental Documents Review:** Previous environmental and hazardous material assessments and removal actions at Camp Hero conducted by the Defense Environmental Restoration Program for Formerly Used Defense Sites (DERP-FUDS) were reviewed in preparation of this RI WP. These documents included but not limited to: Ordnance and Explosives Archives Search Report for Former Camp Hero (USACE, 2000); several remedial design, remedial action, and removal documents for containerized hazardous and toxic waste at Camp Hero; UST closure reports; and a Data Collection Report for DERP-FUDS at Camp Hero (Weston, 2000).

Additionally, as part of this investigation, the Hydrologic and Environmental Analysis Branch of the Warfighter Support Directorate of the USACE ACG was tasked to search, collect, and review historical aerial photography from 1940 to 1982 searching for features associated with dumps within the former Camp Hero boundary. Their report concluded that there was no photographic evidence of debris accumulation suggestive of a dump in the years collected within the timeframe of this project. However, four areas where dumping could have taken place were identified, described as access points to cleared areas near or along the bluff (USACE 2016). The four areas, designated "AGC Sites 1, 2, 3 and 4," are addressed in Section 6 of this RI WP.

A Camp Hero Feasibility Study, Hazardous Materials Survey, and Preliminary Report (Cashin, 1998) conducted by NYS Parks was also reviewed in preparation of this RI WP. This Feasibility Study, Hazardous Materials Survey, and Preliminary Report identified sites at Camp Hero which included former waste disposal and coal storage areas, abandoned drum and boiler tank locations, and suspected former UST locations. All of the sites identified in the Camp Hero Feasibility Study, Hazardous Materials Survey, and Preliminary Report are included this RI WP and listed and discussed in Section 6.0.

## 2.6 Previous Investigations

This section summarizes the previous investigations at Camp Hero.

### 2.6.1 Storage Tanks- Underground and Above Ground

With the exception of four USTs and ASTs (and one drum area) that are currently listed as in use at Camp Hero by Suffolk County OPS, all the USTs and ASTs have been removed at Camp Hero. All USTs and ASTs with reported petroleum releases and respective NYSDEC spill case numbers have a case closed status with NYSDEC. Analytical data from the closure reports at USTs 30 and 34 indicated that lead is present at concentrations that exceed screening criteria and further characterization is required.

### 2.6.2 Areas of Concern

Based on the records review discussed above, 44 AOCs have been identified at Camp Hero. There have been no environmental investigations at the sites identified in this RI WP.

### 2.6.3 Areas A through K

Based on the results of the archives search report in 2000 (USACE 2000), an Engineering Evaluation and Cost Analysis (EE/CA) was conducted at Camp Hero on Areas A through K (Figure 2-1). As summarized below, no munitions and MEC were identified in Areas A through I, Area J, and part of Area K. The EE/CA did recommend a removal action at Area H and part of Area K where MEC may have existed. The removal actions at Area H and part of Area K were conducted in 2003 by the USACE and are summarized below. MEC response alternatives were also evaluated for each of the areas of interest within Camp Hero and following recommendations were made for each area shown on Figure 2-1:

- Area A - Fire Control/37mm Training, was designated for "No DoD Action Indicated" (NDAI).
- Area B, C, D, E, F, G, 1, J, and were not geophysically investigated due to ASR recommendation of No Further Action or FUDs ineligibility.
- Area L was not investigated based on low potential exposure and lack of available technology.

- The majority of Area K - Near-Shore Ordnance Area was also designated "NDAI". The EE/CA investigation results indicated the distribution of MEC in Area K was confined to the land immediately adjacent to the bluffs and below Area H- Ordnance Destruction Range. Portion of Area K recommended for an MEC removal action was reduced from the original 44.88 acres to the 9 acres directly below Area H (referred to as Revised Area K).

- Areas H and the remainder of Area K- Although no ordnance was encountered during the EE/CA investigation, scrap metals indicative of demolition activity, 3.5-inch practice rockets, and 105mm high explosive projectiles were present to a maximum depth of 18 inches bgs in areas identified as Area H and Revised Area K (Parsons 2002).

EODT removed 1,324 pounds of ordnance explosive and non-ordnance scrap and concluded the following:

- No material documented as an explosive hazard (MDEH) requiring detonation was found during the EODT RA. Accordingly, potential risk to the public is considered low. Any future MEC exposure to the public would be associated with items eroding from the bluffs along the beach or washing up on the beach after major storm events. The three acres of woodland that was not cleared should not pose a threat. This conclusion is based on the findings of the areas that were cleared. No MEC was found in any of the cleared areas and it is unlikely that any MEC is present in the woodland area not cleared (EODT 2004).

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# 3.0 PHYSICAL AND ENVIRONMENTAL CHARACTERISTICS

## 3.1 Climate

The Montauk Point area has a temperate marine climate, which is influenced greatly by the Atlantic Ocean and Block Island Sound (USGS 1960). In Montauk, the annual average precipitation is 43.65 inches. In January, Montauk has an average high temperature of 38 degrees Fahrenheit and an average low of 26 degrees Fahrenheit. Montauk has an average high of 79 degrees Fahrenheit and an average low of 65 degrees Fahrenheit in July (US Climate Data 2016).

## 3.2 Geology

The Montauk Point area is underlain by crystalline bedrock of Precambrian age upon which rest, in succession, un-consolidated deposits of Cretaceous, Pleistocene, and Recent age. No bedrock wells have been completed at Montauk Point, however, the bedrock likely consists of gneiss and schist. The bedrock surface is about 1,000 to 1,300 feet (ft) below sea level and slopes southeastward at a rate of approximately 80 ft per mile.

The Pleistocene deposits of Long Island are end products of the advance and melting of several ice sheets during the Pleistocene Epoch. Because of the complex geologic history of these deposits, which are important sources of groundwater, a summary of the general character of glacial deposits is described below.

As the glacier moved over Suffolk County, it carried large quantities of rock, much of which was ground into gravel, sand and silt-size particles. Part of this material was deposited directly by the glacier in a compact, heterogeneous mass called glacial till.

In addition to the materials within the glacier, the glacier moved large quantities of materials ahead of the glacier. The material that was ahead of the glacier was left in place as a ridge called a terminal moraine. After stopping, the glacial till melted and enormous quantities of swiftly flowing water ran from the glacier, carrying and sorting the glacially transported materials. In addition to carrying large quantities of material, the water reworked the mixed materials in the moraine and left much of it in a stratified condition. Most of the material carried from the glacier was sand and well-rounded gravel, which was redeposited on a broad plain in front of the terminal moraine. These stratified sand and gravel glacial till deposits make up the substratum of most of the soils in Suffolk County including Camp Hero. Upon further retreat of the ice, most of the till and parts of the outwash and morainic deposits were covered by water or wind-deposited silt, clay, and fine or very fine sand to varying depths. These deposits comprise the upper soils found at Camp Hero.

## 3.3 Soils

According to the Soil Survey of Suffolk County (USDA 1975), the former Camp Hero property contains the following soil types. The locations of these soils at Camp Hero are shown on Figure 3-3.

Beach type soil deposits are present along the Atlantic Ocean in the northeastern portion of Camp Hero. Beach deposits are made up of sandy, gravelly, or cobbly areas between the water at mean sea level (msl) and dunes or escarpments. The slope is nearly level in most areas but it is as much as 15 percent in some places on the Atlantic shore.

Escarpments are present and referred to as bluffs located along the Atlantic coastline on the southern boundary of Camp Hero. The soil horizons have not formed in this actively eroding material. Except for a few scattered areas, this unit is devoid of vegetation. The height of the escarpments on Camp Hero ranges from twenty feet to more than 100 feet above msl. The material in the escarpments is sandy loam or loamy sand at Camp Hero. Many of the escarpments have large boulders embedded in the soil, which roll to the beach as the escarpment erodes (USDA 1975).

**Montauk Loam.** This soil unit is characterized as gently sloping to undulating soil located on moraines. On Montauk Point this soil has a thicker, darker surface layer, which indicates higher organic-matter content. The Montauk loam series consists of deep, well drained to moderately well drained, moderately coarse textured to medium-textured soils that formed in fine sandy loam or in a mantle of silt loam and loam. These soils have a fragipan over a compact firm glacial till. They are on terminal moraines and have the topography characteristic of this landform. Slope ranges from O to 15 percent, but it generally is 3 to 15 percent. In many places slopes are complex and characterized by closed depressions. In a representative profile, in wooded areas, the surface layer is brown to dark-brown fine sandy loam about 2 inches thick. The subsoil is yellowish-brown, friable to very friable fine sandy loam to a depth of about 27 inches. The lower part is a dark-brown to reddish-brown sandy loam fragipan to a depth of about 40 inches. It is firm and brittle, and the content of gravel is 5 to 10 percent. The substratum, to a depth of about 60inches, is reddish-brown to dark brown loamy sand that is firm and brittle. Montauk soils have moderate to high available moisture capacity. Permeability is moderate to moderately rapid in the surface layer and in the upper part of the subsoil and moderately slow in the fragipan and underlying till (USDA 1975).

**Montauk loamy sand.** The sandy variants of the Montauk series are made up of deep, excessively drained, coarse-textured soils that contain a fragipan over firm glacial till. Slopes range from O to 35 percent, and they generally are complex on all areas except the nearly level areas. In

a representative profile the surface layer in wooded areas is very dark grayish-brown loamy sand about 3 inches thick. The subsoil is friable or very friable, yellowish-brown to dark yellowish-brown loamy sand to a depth of about 34 inches. The till substratum, to a depth of about 60 inches, is a dark yellowish-brown firm loamy sand. The Montauk loamy sands have very low to low available moisture capacity above the fragipan.

Permeability is rapid in the upper 18 to 36 inches, moderately slow in the fragipan, and moderate in the till. Moderately slow permeability in the fragipan slows the rapid downward movement of water (USDA 1975).

**Urban Land-Montauk complex.** As shown on Figure 3-3, the Urban Land-Montauk complex at Camp Hero are located in man-made fill areas and disturbed soils of the Montauk series surrounding bunkers and other areas of construction at Camp Hero.

The Bridgehampton silt loam, till substratum. As shown on Figure 3-3, this soil type is located in the southwest area of Camp Hero. The soil type has a deep, well drained, medium textured soil that formed in thick silty deposits over coarse sand and gravel. These soils generally are nearly level to gently sloping and are mainly on flat outwash plains, but a small area of these soils is near Montauk on uneven moraines, and slope is as much as 12 percent (USDA 1975).

**Swansea muck.** Muck is made up of very poorly drained organic soils that formed in partly decomposed or almost completely decomposed woody or herbaceous plants. The areas are generally level and occur in the bottom of closed depressions or kettle holes. Muck typically occurs in depressions that are irregular in shape. Muck is made up of spongy, black or dark-reddish organic materials over loose sand and gravel. The amount of partly decayed plants in the organic layer varies. The water table is at or near the surface most of the year and several inches of water are typically on the surface late in winter and early in spring (USDA 1975).

**Wallington silt loam.** The Wallington soil series consists of deep, somewhat poorly drained, medium-textured soils that have a fragipan at a depth of 18 to 24 inches. The soils formed in a mantle of silty material over thick deposits of moderately coarse textured or coarse textured material. These soils are found in the Montauk Point area of Suffolk County in low-lying areas along drainage and near perennial ponds. Slopes are 0 to 5 percent. In a representative profile, a thin layer of leaves and organic matter is on the surface in wooded areas. Below this layer is a surface layer of very dark gray silt loam about 2 inches thick over a subsurface layer of grayish-brown to light brownish- gray silt loam that has a few distinct mottles. The sub- surface layer extends to a depth of about 10 inches. The upper part of the subsoil, to a depth of about 18 inches, is mottled, grayish-brown, friable silt loam. The lower part of the subsoil, to a depth of 38 inches, is mottled light olive-brown silt loam that makes up a firm and brittle fragipan. The substratum to a depth of

47 inches is mottled gray to light-gray, friable silt loam. Below, to a depth of about 60 inches, the substratum consists of firm, strong-brown fine sandy loam glacial till.

**Wareham loamy sand.** This soil unit is located along the margins of tidal marshes and creeks or in low-lying positions around marshes and ponds. Slopes are 3 percent or less and are typically located between areas of poorly drained marshy soils and well-drained upland soils (USDA 1975).

## 3.4 Hydrology

The Montauk area has several surface-water features including lakes, ponds, streams, and small marsh areas. The major lakes in the Montauk area include Fresh Pond, Fort Pond, Big Reed Pond, Little Reed Pond, and Lake Montauk (tidal bay). Oyster Pond is the closest lake located approximately 1,200 feet northwest of Camp Hero (USGS 1986).

More than 50 kettle holes of various sizes and depth are occupied by swamps and ponds in the Montauk area. Most of these are readily discernible in the field and on aerial photographs. The kettle holes were occupied by detached masses of ice, which were partly or entirely covered by glacial deposits. Melting of the ice blocks and collapse of surrounding material left depressions, or kettle holes, in the land surface.

At Camp Hero most of the surface runoff is through four small un-named streams. Three of the streams flow northwestward to Oyster Pond; the fourth flows southward to the Atlantic Ocean. Much of the area precipitation runs off in temporary channels and in gullies to the Atlantic Ocean, to Block Island Sound, and into kettle holes.

## 3.5 Hydrogeology

Groundwater is the only source of water supply for irrigation and drinking water at at Camp Hero. The groundwater is contained in the upper 200 ft of deposits of late Pleistocene age, which are broadly divided into an upper unit of undifferentiated till and stratified drift and a lower unit of stratified drift. Figure 3-1 presents a cross-section of the hydrogeology at Camp Hero.

Groundwater at Camp Hero is obtained primarily from the principal aquifer, which is in the lower unit of stratified drift. The principal aquifer is a lens shaped body, which lies above saline water containing as much as 11,300 parts per million (ppm) of chloride. The fresh water in the principal aquifer is under artesian pressure and has a head ranging from about sea level to 3.5 ft above sea level. Scattered perched water bodies are found above the principal water table, owing to lenses and beds of silt and clay, which retard downward movement of water. The perched water bodies are generally small isolated bodies of water temporarily stored above the principal aquifer in scattered lenses of permeable material underlain by clay and silt. During the drilling of previous monitoring and observation wells at Camp Hero, perched groundwater was reported at depths

ranging from about 5 to 25 ft below ground surface (bgs) or about 35 to 100 ft above sea level. These elevations, which are as much as 40 to 95 ft above the water level in the principal aquifer, are a strong indication of the existence of perched water bodies (USGS 1960).

## 3.6 Physiography and Topography

Montauk Point is at the eastern extremity of the Ronkonkoma moraine. The moraine forms a ridge of coalescing hills traversing Long Island from west to east and marks the maximum advance of an ice sheet during late Pleistocene time.

The land surface, characterized by knob-and-kettle topography, ranges in elevation from sea level to about 100 ft above sea level. Steep wave-cut bluffs rise abruptly from 30 to 80 ft above narrow rock-strewn beaches along the south shore. The topography of Camp Hero is shown on **Figure 3-2**.

## 3.7 Vegetation and Plant Communities

The Montauk Peninsula has been identified as a Significant Habitat and Habitat Complex of the New York Bight Watershed by U.S. Fish and Wildlife Service (USFWS) Southern New England (USFWS 1997). The complex as a whole contains a diversity of upland, wetland, and shoreline habitats and communities of a maritime nature. A Significant Natural Communities Site Map is provided in Figure 3-4.

The maritime oak-holly forest community found here is composed of American holly (*Ilex opaca*), black oak (*Quercus velutina*), or American beech (*Fagus grandifolia*) as dominant trees, often with sassafras (*Sassafras albidum*), and with an abundance of vines and ericaceous (heath) shrubs in the understory. A mosaic of open canopy maritime plant communities occurring on much of the peninsula, particularly grassland, heathland, and shrubland communities, comprises what is collectively referred to as moorlands. These maritime communities occur on sandy, glacially derived soils of the Atlantic Coastal Plain and are under the influence of a maritime climate, which is characterized by moderate temperatures, long frost-free season, ocean winds, and salt spray. The grasslands are generally dominated by bunch-forming grasses such as little bluestem (*Schizachyrium scoparium*), common hairgrass (*Deschampsia flexuosa*), and poverty-grass (*Danthonia spicata*), often with low heath shrubs and reindeer moss (*Cladonia rangiferina*). The grasslands occur as small pockets in the Montauk Moorlands, especially on hilltops. Maritime heathlands on the Montauk Peninsula are dominated by bearberry (*Arctostaphylos uva-ursi*), beach heather (*Hudsonia tomentosa*), blueberry (*Vaccinium angustifolium*), black huckleberry (*Gaylussacia baccata*), bayberry (*Myrica pensylvanica*), and beach plum (*Prunus maritima*); maritime shrublands include black cherry (*Prunus serotina*) and pin cherry (*Prunus pensylvanica*), sumacs (*Rhus glabra* and *R. copallinum*), bayberry, arrow-wood (*Viburnum dentatum* var. *lucidum*), hawthorns (*Crataegus* spp.), beach plum, wild roses (*Rosa* spp.), catbrier (*Smilax rotundifolia*), and

blackberries (*Rubus* spp.). Wet depressions have ponds and red maple hardwood swamps dominated by red maple (*Acer rubrum*) and black gum (*Nyssa sylvatica*) trees.

The shoreline along Camp Hero is dominated in stretches by steep bluffs or large dunes and broad expanses of sparsely vegetated or unvegetated sandy to cobbly beach. There are several types of dune and interdunal plant communities in this area, for example, beachgrass (*Ammophila breviligulata*)-dominated ocean dunes, mixed associations of beach heather (*Hudsonia tomentosa*), bearberry, and bayberry in interdunal areas, and extensive stands of pitch pine (*Pinus rigida*) and oak (*Quercus* spp.) woodlands (USFWS 1997). The revetment surrounding Montauk Point is generally unvegetated (USACE 2005).

## 3.8 Wildlife

The diverse maritime habitats of Camp Hero support a diverse variety of wildlife. The nearshore open waters surrounding Montauk Point provide regionally significant and critical wintering waterfowl habitat and concentration areas; they also contain extensive beds of blue mussel (*Mytilis edulis*) and kelp (*Laminaria agardhii*). Found here in significant numbers, particularly in winter, are several species of special emphasis in the region, such as common loon (*Gavia immer*), common eider (*Somateria mollissima*), white-winged scoter (*Melanitta fusca*), surf scoter (*Melanitta perspicillata*), black scoter (*Melanitta nigra*), bufflehead, common goldeneye, great cormorant (*Phalacrocorax carbo*), and red-breasted merganser. Harlequin duck and king eider (*Somateria spectabilis*) occur here regularly during the winter, and this is the southernmost regular wintering population of harlequin ducks on the East Coast. The sea duck concentrations around Montauk Point are the largest nearshore winter concentrations in New York, and notable concentrations of pelagic seabirds occur in the spring, summer, and fall (USFWS 1997).

The nearshore waters off Montauk Point are one of the most important nearshore areas for sea turtles and marine mammals in the New York Bight region. Recent studies indicate that the nearshore waters within Peconic and Gardiners Bays, Block Island and Long Island Sounds, and off Montauk Point are critical developmental habitat for juvenile Atlantic ridley sea turtles, one of the rarest of the marine turtles, and a major feeding area for the loggerhead sea turtle. A regular feeding area for leatherback sea turtles also occurs just to the east of Montauk Point. Gray and harbor seals (*Halichoerus grypus* and *Phoca vitulina*) often use the rocks around Montauk Point and other shoreline areas, including Culloden Point, as haulout areas during the winter. Northern right whales (usually individuals) are regularly sighted migrating through the area, mostly from March through June. Small aggregations of finback whales feed close to shore from Shinnecock Inlet to Montauk Point from January to March. Minke whales (*Balaenoptera acutorostrata*) occur along the south shore throughout the year but are more abundant in the summer. Humpback whales feed all around Montauk Point, primarily between June and September. An inshore

population of bottlenosed dolphin (*Tursiops truncatus*) feed along Long Island's south shore from June through September. Regular sightings of harbor porpoise (*Phocoena phocoena*) in nearshore waters off Montauk Point and Block Island Sound occur from December to June (USFWS 1997).

Several Reptile and Amphibian species occur within the project area. Species of frog and toad such as the green frog (*Rana clamitans melanota*), northern spring peeper (*Pseudacris crucifer*) and Fowler's toad (*Bufo fowleri*) are common to the area and can be found inhabiting brackish water wetlands and ponds (NYSDEC 2001b). Diamondback terrapins (*Malaclemys terrapin*) are also common to Long Island waters, although their preference for more estuarine waters associated with bays and marshes make their presence in the Project area unlikely. Common snakes such as the eastern ribbon snake (*Thamnophis sauritus*), eastern garter snake (*Thamnophis sirtalis*), and northern black racer (*Coluber constrictor*) can be found inhabiting vegetated upland and wetland areas in the Project area. Several species of sea turtle seasonally migrate through the deeper waters off Montauk Point. However, their presence in the shallow nearshore waters associated with the Project area is not likely (USACE 2005).

Terrestrial mammal species most likely to occur in the Project area are habitat generalists tolerant of development, including the white-tailed deer (*Odocoileus virginianus*), eastern gray squirrel (*Sciurus carolinensis*), eastern cottontail (*Sylvilagus jloridanus*), eastern chipmunk (*Tamias striatus*), raccoon (*Procyon lotor*), muskrat (*Ondatra zibethica*), little brown bat (*Myotis lucifugus*), house mouse (*Mus musculus*), and white-footed mouse (*Peromyscus leucopus*) (USACE 2005).

## 3.9 Rare and Protected Species

The New York State Natural Heritage Program, in conjunction with The Nature Conservancy, recognizes several Priority Sites for Biodiversity within the Montauk Peninsula habitat complex, including Montauk Point. The Nature Conservancy has designated Montauk Point as a core area within its Peconics Bioreserve, one of its "Last Great Places" (USFWS 1997). The complex of undeveloped maritime communities on the Montauk Peninsula supports a diversity of rare plants and animals, and the nearshore waters support important concentrations of marine species.

The Camp Hero RI Project Team will work with members of the New York Natural Heritage Program during the field effort to identify species that need to be protected as well as the protection measures. The tables included below are species that are anticipated to be in the area; however, this list will be modified throughout the process and actual flora and fauna species encountered will be summarized in the final report.

**Federal:** According to the United States Fish and Wildlife Service, there are four endangered species and five threatened species found in Suffolk County, NY, as listed on Table 3-1 (USFWS 2016).

**Table 3-1**
**Federally Protected Species in Suffolk County, NY**

| Common Name | Scientific Name | Group | Status |
|---|---|---|---|
| Piping plover | *Charadrius melodus* | Bird | Threatened |
| Roseate tern | *Sterna dougallii dougallii* | Bird | Endangered |
| Red knot | *Calidris canutus rufa* | Bird | Threatened |
| Sandplain gerardia | *Agalinis acuta* | Flowering Plant | Endangered |
| Seabeach amaranth | *Amaranthus Pumilus* | Flowering Plant | Threatened |
| Northern long-eared bat | *Myotis septentrionalis* | Mammal | Threatened |
| Hawksbill sea turtle | *Eretmochelys imbricata* | Reptile | Endangered |
| Leatherback sea turtle | *Dermochelys coriacea* | Reptile | Endangered |
| Green sea turtle | *Chelonia mydas* | Reptile | Threatened |

**State:** Table 3-2 lists the State of New York endangered, threatened and special concerns species which may exist at the investigation area (NYSDEC 2007). This list will be revised based on site evaluation (addition or deletion of species) or changes to the conceptual site model (addition of pathways and receptors).

For this discussion, the following definitions are used for the status:

- Endangered: Any native species in imminent danger of extirpation or extinction in New York State. Those endangered species which meet one or both of the criteria specified in section 182.2(g) of 6NYCRR Part 182 and which are found, have been found, or may be expected to be found at the project site.

- Threatened: Any native species likely to become an endangered species within the foreseeable future in New York State. Those threatened species which meet one or both of the criteria specified in section 182.2(h) of 6NYCRR Part 182 and which are found, have been found, or may be expected to be found at the project site.

- Special Concern: Any native species for which a welfare concern or risk of endangerment has been documented in New York State. The following are designated as species of special concern as defined in Section 182.2(i) of 6NYCRR Part 182. Species of special concern warrant attention and consideration but current information, collected by the department, does not justify listing these species as either endangered or threatened.

**Table 3-2**
**State Protected Species in Suffolk County, NY**

| Common Name | Scientific Name | Group | Status |
|---|---|---|---|
| Tiger Salamander | *Ambystoma tigrinum* | Amphibians | Endangered |
| Mud Turtle | *Kinosternon subrubrum* | Reptiles | Endangered |
| Atlantic Hawksbill Sea Turtle | *Eretmochelys imbricata* | Reptiles | Endangered |
| Atlantic Ridley Sea Turtle | *Lepidochelys kempii* | Reptiles | Endangered |
| Leatherback Sea Turtle | *Dermochelys coriacea* | Reptiles | Endangered |
| Peregrine Falcon | *Falco peregrinus* | Birds | Endangered |
| Least Bittern | *Ixobrychus exilis* | Birds | Threatened |
| Bald Eagle | *Haliaeetus leucocephalus* | Birds | Threatened |
| Northern Harrier | *Circus cyaneus* | Birds | Threatened |
| Common Tern | *Sterna hirundo* | Birds | Threatened |
| Least Tern | *Sterna antillarum* | Birds | Threatened |
| Blue-spotted Salamander | *Terrapene carolina carolina* | Reptile | Special Concern |
| Eastern Box Turtle | *Ambystoma laterale* | Amphibians | Special Concern |
| Southern Leopard Frog | *Rana sphenocephala utricularius* | Amphibians | Special Concern |
| Common Loon | *Gavia immer* | Birds | Special Concern |
| Red-shouldered Hawk | *Buteo lineatus* | Birds | Special Concern |
| Grasshopper Sparrow | *Ammodramus savannarum* | Birds | Special Concern |
| Harbor Porpoise | *Phocoena phocoena* | Mammals | Special Concern |

Table 3-3 lists the State protected plants listed for Suffolk County as listed in the New York Plant Status report (NYNHP 2010) and included in the New York Flora Atlas (NYFA 2015).

For this report, the status of the plants are defined below (NYNHP 2010):

- Endangered Species: listed species are those with

  1) 5 or fewer extant sites, or

  2) fewer than 1,000 individuals, or

  3) restricted to fewer than 4 U.S.G.S. 7 1/2 minute topographical maps, or

  4) species listed as endangered by the U. S. Department of Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11.

- Threatened: listed species are those with

  1) 6 to fewer than 20 extant sites, or

2) 1,000 to fewer than 3,000 individuals, or

3) restricted to not less than 4 or more than 7 U.S.G.S. 7 1/2 minute topographical maps, or

4) listed as threatened by the U. S. Department of the Interior, as enumerated in the Code of Federal Regulations 50 CFR 17.11.

- Rare: listed species have

1) 20 to 35 extant sites, or

2) 3,000 to 5,000 individuals statewide.

**Table 3-3**
**State Protected Plants in Suffolk County, NY**

| Common Name | Scientific Name | Plant | Status |
|---|---|---|---|
| three-seeded mercury | *Acalypha virginica* | Plant | Endangered-State |
| sandplain gerardia | *Agalinis acuta* | Plant | Endangered-State |
| fascicled false-foxglove | *Agalinis fasciculata* | Plant | Rare-State |
| salt-marsh false-foxglove | *Agalinis maritima var. maritima* | Plant | Threatened-State |
| yellow giant hyssop | *Agastache nepetoides* | Plant | Threatened-State |
| small-leaved white snakeroot, lesser snakeroot | *Ageratina aromatica var. aromatica* | Plant | Endangered-State |
| swamp agrimony | *Agrimonia parviflora* | Plant | Rare-State |
| woodland agrimony | *Agrimonia rostellata* | Plant | Threatened-State |
| white-tubed colicroot, unicorn root, white stargrass | *Aletris farinosa* | Plant | Threatened-State |
| seabeach amaranth, coast amaranth | *Amaranthus pumilus* | Plant | Threatened-State |
| Nantucket shadbush | *Amelanchier nantucketensis* | Plant | Endangered-State |
| annual peanut grass, Pursh's blue maidencane | *Amphicarpum amphicarpon* | Plant | Endangered-State |
| angelica | *Angelica lucida* | Plant | Threatened-State |
| hairy angelica | *Angelica venenosa* | Plant | Rare-State |
| swamp-pink | *Arethusa bulbosa* | Plant | Threatened-State |
| Pacific silverweed | *Argentina egedii ssp. groenlandica* | Plant | Threatened-State |
| purple milkweed | *Asclepias purpurascens* | Plant | Threatened-State |
| white milkweed | *Asclepias variegata* | Plant | Endangered-State |
| whorled milkweed | *Asclepias verticillata* | Plant | Rare-State |
| green milkweed | *Asclepias viridiflora* | Plant | Threatened-State |
| thick-leaved orach | *Atriplex dioica* | Plant | Endangered-State |
| northeastern saltbush, glabrous orach | *Atriplex glabriuscula* | Plant | Endangered-State |

**Table 3-3**
**State Protected Plants in Suffolk County, NY**

| Common Name | Scientific Name | Plant | Status |
|---|---|---|---|
| twining screwstem | *Bartonia paniculata ssp. paniculata* | Plant | Endangered-State |
| river birch, red birch | *Betula nigra* | Plant | Rare-State |
| smooth beggar-ticks, bur-marigold | *Bidens laevis* | Plant | Threatened-State |
| Missouri rock-cress | *Boechera missouriensis* | Plant | Threatened-State |
| rock-cress | *Boechera stricta* | Plant | Threatened-State |
| seaside bulrush, prairie bulrush, saltmarsh bulrush | *Bolboschoenus maritimus ssp. paludosus* | Plant | Threatened-State |
| New England bulrush, saltmarsh bulrush | *Bolboschoenus novae-angliae* | Plant | Endangered-State |
| blunt-lobe grape-fern | *Botrychium oneidense* | Plant | Threatened-State |
| side-oats grama | *Bouteloua curtipendula var. curtipendula* | Plant | Endangered-State |
| autumnal water-starwort | *Callitriche hermaphroditica* | Plant | Endangered-State |
| terrestrial water-starwort | *Callitriche terrestris* | Plant | Threatened-State |
| Long's bitter-cress | *Cardamine longii* | Plant | Threatened-State |
| thicket sedge | *Carex abscondita* | Plant | Endangered-State |
| glomerate sedge | *Carex aggregata* | Plant | Endangered-State |
| Emmons sedge | *Carex albicans var. emmonsii* | Plant | Rare-State |
| narrow-leaved sedge | *Carex amphibola* | Plant | Endangered-State |
| Barratt's sedge | *Carex barrattii* | Plant | Endangered-State |
| button sedge | *Carex bullata* | Plant | Endangered-State |
| Bush's sedge | *Carex bushii* | Plant | Rare-State |
| Buxbaum's sedge | *Carex buxbaumii* | Plant | Threatened-State |
| Collins' sedge | *Carex collinsii* | Plant | Endangered-State |
| white-edged sedge, weak sedge | *Carex debilis var. debilis* | Plant | Threatened-State |
| marsh straw sedge | *Carex hormathodes* | Plant | Threatened-State |
| false hop sedge | *Carex lupuliformis* | Plant | Threatened-State |
| Fernald's sedge | *Carex merritt-fernaldii* | Plant | Threatened-State |
| midland sedge | *Carex mesochorea* | Plant | Threatened-State |
| Mitchell's sedge | *Carex mitchelliana* | Plant | Endangered-State |
| Muhlenberg's sedge | *Carex muehlenbergii var. enervis* | Plant | Rare-State |
| black-margined sedge | *Carex nigromarginata* | Plant | Threatened-State |
| short's sedge | *Carex shortiana* | Plant | Endangered-State |
| straw sedge | *Carex straminea* | Plant | Endangered-State |
| Walter's sedge | *Carex striata var. brevis* | Plant | Rare-State |
| bent sedge | *Carex styloflexa* | Plant | Endangered-State |
| cat-tail sedge | *Carex typhina* | Plant | Endangered-State |
| dark-green sedge | *Carex venusta* | Plant | Endangered-State |

**Table 3-3**
**State Protected Plants in Suffolk County, NY**

| Common Name | Scientific Name | Plant | Status |
|---|---|---|---|
| Willdenow's sedge | *Carex willdenowii* | Plant | Rare-State |
| American bittersweet, climbing bittersweet | *Celastrus scandens* | Plant | Rare-State |
| dune sandbur | *Cenchrus tribuloides* | Plant | Threatened-State |
| prickly coontail, prickly hornwort | *Ceratophyllum echinatum* | Plant | Rare-State |
| Atlantic white cedar, southern white cedar | *Chamaecyparis thyoides* | Plant | Threatened-State |
| slender spikegrass | *Chasmanthium laxum* | Plant | Endangered-State |
| pit-seeded goosefoot | *Chenopodium berlandieri var. macrocalycium* | Plant | Endangered-State |
| coast-blite goosefoot | *Chenopodium rubrum var. rubrum* | Plant | Threatened-State |
| red-topped panicgrass | *Coleataenia longifolia ssp. elongatum* | Plant | Endangered-State |
| broom crowberry | *Corema conradii* | Plant | Endangered-State |
| rose coreopsis | *Coreopsis rosea* | Plant | Rare-State |
| yellow corydalis | *Corydalis flavula* | Plant | Rare-State |
| water pigmy-weed | *Crassula aquatica* | Plant | Endangered-State |
| barberry hawthorn | *Crataegus berberifolia* | Plant | Endangered-State |
| Arnold hawthorn | *Crataegus mollis* | Plant | Endangered-State |
| one-flowered hawthorn, dwarf hawthorn | *Crataegus uniflora* | Plant | Endangered-State |
| bushy rockrose | *Crocanthemum dumosum* | Plant | Threatened-State |
| low frostweed | *Crocanthemum propinquum* | Plant | Threatened-State |
| arrowhead rattlebox | *Crotalaria sagittalis* | Plant | Endangered-State |
| field dodder | *Cuscuta campestris* | Plant | Endangered-State |
| sessile dodder | *Cuscuta compacta* | Plant | Rare-State |
| five-angled dodder | *Cuscuta pentagona* | Plant | Rare-State |
| smartweed dodder | *Cuscuta polygonorum* | Plant | Endangered-State |
| redroot flatsedge | *Cyperus erythrorhizos* | Plant | Rare-State |
| yellow flatsedge | *Cyperus flavescens* | Plant | Endangered-State |
| Houghton's umbrella-sedge | *Cyperus houghtonii* | Plant | Rare-State |
| Great Plains flatsedge | *Cyperus lupulinus ssp. lupulinus* | Plant | Threatened-State |
| fragrant flatsedge, rusty flatsedge | *Cyperus odoratus* | Plant | Rare-State |
| many-spiked flatsedge | *Cyperus polystachyos* | Plant | Endangered-State |
| retrorse flatsedge | *Cyperus retrorsus* | Plant | Endangered-State |
| lowland brittle fern | *Cystopteris protrusa* | Plant | Endangered-State |
| hairy small-leaved tick-trefoil | *Desmodium ciliare* | Plant | Threatened-State |
| smooth tick-trefoil | *Desmodium laevigatum* | Plant | Endangered-State |
| stiff tick-trefoil | *Desmodium obtusum* | Plant | Endangered-State |

**Table 3-3**
**State Protected Plants in Suffolk County, NY**

| Common Name | Scientific Name | Plant | Status |
|---|---|---|---|
| Heller's rosette grass | *Dichanthelium oligosanthes ssp. oligosanthes* | Plant | Endangered-State |
| panic grass | *Dichanthelium scabriusculum* | Plant | Endangered-State |
| broom panic grass | *Dichanthelium scoparium* | Plant | Endangered-State |
| Wright's witchgrass | *Dichanthelium wrightianum* | Plant | Endangered-State |
| slender crabgrass | *Digitaria filiformis var. filiformis* | Plant | Endangered-State |
| persimmon | *Diospyros virginiana* | Plant | Threatened-State |
| Carolina whitlow-grass | *Draba reptans* | Plant | Threatened-State |
| thread-leaved sundew | *Drosera filiformis* | Plant | Rare-State |
| American water-wort | *Elatine americana* | Plant | Endangered-State |
| Engelmann spike-rush | *Eleocharis engelmannii* | Plant | Endangered-State |
| horse-tail spike-rush | *Eleocharis equisetoides* | Plant | Threatened-State |
| creeping spike-rush | *Eleocharis fallax* | Plant | Endangered-State |
| black-fruited spike-rush | *Eleocharis melanocarpa* | Plant | Rare-State |
| ovate spike-rush | *Eleocharis ovata* | Plant | Endangered-State |
| square-stemmed spike-rush | *Eleocharis quadrangulata* | Plant | Endangered-State |
| Robbin's spike-rush | *Eleocharis robbinsii* | Plant | Rare-State |
| slender spike-rush | *Eleocharis tenuis var. pseudoptera* | Plant | Endangered-State |
| three-angled spike-rush | *Eleocharis tricostata* | Plant | Endangered-State |
| long-tubercled spike-rush | *Eleocharis tuberculosa* | Plant | Threatened-State |
| salt-marsh spike-rush | *Eleocharis uniglumis var. halophila* | Plant | Threatened-State |
| black crowberry | *Empetrum nigrum* | Plant | Rare-State |
| meadow horsetail | *Equisetum pratense* | Plant | Threatened-State |
| fireweed | *Erechtites hieraciifolius var. megalocarpus* | Plant | Endangered-State |
| white thoroughwort | *Eupatorium album var. subvenosum* | Plant | Threatened-State |
| white-bracted thoroughwort, justiceweed | *Eupatorium leucolepis* | Plant | Endangered-State |
| hairy boneset | *Eupatorium pubescens* | Plant | Endangered-State |
| round-leaved boneset | *Eupatorium rotundifolium* | Plant | Endangered-State |
| Torreyâ€™s thoroughwort | *Eupatorium torreyanum* | Plant | Threatened-State |
| wild ipecac | *Euphorbia ipecacuanhae* | Plant | Endangered-State |
| rough-leaved aster, low rough aster | *Eurybia radula* | Plant | Endangered-State |
| eastern showy aster | *Eurybia spectabilis* | Plant | Threatened-State |
| Rocky Mountain fescue | *Festuca saximontana var. saximontana* | Plant | Endangered-State |
| marsh fimbry | *Fimbristylis castanea* | Plant | Threatened-State |
| dwarf umbrella-sedge | *Fuirena pumila* | Plant | Rare-State |

**Table 3-3**
**State Protected Plants in Suffolk County, NY**

| Common Name | Scientific Name | Plant | Status |
|---|---|---|---|
| dwarf huckleberry | *Gaylussacia bigeloviana* | Plant | Endangered-State |
| soapwort gentian, soap gentian, harvestbells | *Gentiana saponaria* | Plant | Endangered-State |
| cream avens | *Geum virginianum* | Plant | Threatened-State |
| rough false pennyroyal | *Hedeoma hispida* | Plant | Threatened-State |
| swamp sunflower, narrow-leaved sunflower | *Helianthus angustifolius* | Plant | Threatened-State |
| kidney-leaved mud-plantain | *Heteranthera reniformis* | Plant | Rare-State |
| featherfoil | *Hottonia inflata* | Plant | Threatened-State |
| purple bluet | *Houstonia purpurea var. purpurea* | Plant | Endangered-State |
| wild hydrangea | *Hydrangea arborescens* | Plant | Threatened-State |
| many-flowered pennywort | *Hydrocotyle umbellata* | Plant | Rare-State |
| whorled pennywort | *Hydrocotyle verticillata var. verticillata* | Plant | Endangered-State |
| Allegheny stonecrop | *Hylotelephium telephioides* | Plant | Endangered-State |
| creeping St. John's-wort | *Hypericum adpressum* | Plant | Threatened-State |
| bushy St. John's-wort | *Hypericum densiflorum* | Plant | Endangered-State |
| coppery St. John's-wort | *Hypericum denticulatum* | Plant | Endangered-State |
| St. Andrew's cross | *Hypericum hypericoides ssp. multicaule* | Plant | Endangered-State |
| shrubby St. John's-wort | *Hypericum prolificum* | Plant | Threatened-State |
| slender blue flag | *Iris prismatica* | Plant | Threatened-State |
| southern blueflag | *Iris virginica var. shrevei* | Plant | Endangered-State |
| small whorled pogonia | *Isotria medeoloides* | Plant | Endangered-State |
| grass-leaved rush | *Juncus biflorus* | Plant | Endangered-State |
| short-fruited rush | *Juncus brachycarpus* | Plant | Endangered-State |
| weak rush | *Juncus debilis* | Plant | Endangered-State |
| needlepod rush | *Juncus scirpoides* | Plant | Endangered-State |
| woods-rush | *Juncus subcaudatus* | Plant | Endangered-State |
| Carolina redroot | *Lachnanthes caroliniana* | Plant | Endangered-State |
| hairy lettuce | *Lactuca hirsuta* | Plant | Endangered-State |
| bead pinweed | *Lechea pulchella var. moniliformis* | Plant | Endangered-State |
| Illinois pinweed | *Lechea racemulosa* | Plant | Rare-State |
| slender pinweed | *Lechea tenuifolia* | Plant | Threatened-State |
| minute duckweed | *Lemna perpusilla* | Plant | Endangered-State |
| pale duckweed | *Lemna valdiviana* | Plant | Endangered-State |
| bearded sprangletop, salt-meadow grass | *Leptochloa fusca ssp. fascicularis* | Plant | Endangered-State |
| narrow-leaved bush-clover | *Lespedeza angustifolia* | Plant | Threatened-State |

**Table 3-3**
**State Protected Plants in Suffolk County, NY**

| Common Name | Scientific Name | Plant | Status |
|---|---|---|---|
| violet bush-clover | *Lespedeza frutescens* | Plant | Rare-State |
| creeping bush-clover | *Lespedeza repens* | Plant | Rare-State |
| tall bush-clover | *Lespedeza stuevei* | Plant | Threatened-State |
| New England blazing star | *Liatris scariosa var. novae-angliae* | Plant | Threatened-State |
| Scottish licorice-root | *Ligusticum scothicum ssp. scothicum* | Plant | Endangered-State |
| eastern lilaeopsis | *Lilaeopsis chinensis* | Plant | Threatened-State |
| mudwort | *Limosella australis* | Plant | Rare-State |
| sandplain flax | *Linum intercursum* | Plant | Threatened-State |
| stiff yellow flax | *Linum medium var. texanum* | Plant | Threatened-State |
| ridged yellow flax | *Linum striatum* | Plant | Rare-State |
| lily-leaved twayblade, large twayblade, mauve sleekwort, brown widelip orchid | *Liparis liliifolia* | Plant | Endangered-State |
| dwarf bulrush | *Lipocarpha micrantha* | Plant | Endangered-State |
| southern twayblade | *Listera australis* | Plant | Endangered-State |
| Virginia false-gromwell | *Lithospermum virginianum* | Plant | Endangered-State |
| Nuttall's lobelia | *Lobelia nuttallii* | Plant | Rare-State |
| globe-fruited false-loosestrife | *Ludwigia sphaerocarpa* | Plant | Threatened-State |
| sundial lupine | *Lupinus perennis ssp. perennis* | Plant | Rare-State |
| southern woodrush | *Luzula bulbosa* | Plant | Rare-State |
| woodrush | *Luzula echinata* | Plant | Rare-State |
| sessile-leaved bugleweed | *Lycopus amplectens* | Plant | Threatened-State |
| stalked bugleweed | *Lycopus rubellus* | Plant | Endangered-State |
| climbing fern, American climbing fern | *Lygodium palmatum* | Plant | Endangered-State |
| lance-leaved loosestrife | *Lysimachia hybrida* | Plant | Endangered-State |
| narrow loosestrife | *Lythrum lineare* | Plant | Endangered-State |
| sweet-bay, northern sweet-bay, swamp-bay, magnolia-bay, laurel-magnolia, beaver-tree | *Magnolia virginiana var. virginiana* | Plant | Endangered-State |
| Bayard's adder's-mouth orchid, Bayardâ€™s malaxis | *Malaxis bayardii* | Plant | Endangered-State |
| pine-barren sandwort | *Minuartia caroliniana* | Plant | Rare-State |
| Farwell's water-milfoil | *Myriophyllum farwellii* | Plant | Threatened-State |
| cut-leaved water-milfoil | *Myriophyllum pinnatum* | Plant | Endangered-State |
| bog aster | *Oclemena nemoralis* | Plant | Rare-State |
| cut-leaved evening-primrose | *Oenothera laciniata* | Plant | Endangered-State |
| Oakes' evening-primrose | *Oenothera oakesiana* | Plant | Threatened-State |
| clustered bluets, clustered mille graines | *Oldenlandia uniflora* | Plant | Endangered-State |

**Table 3-3**
**State Protected Plants in Suffolk County, NY**

| Common Name | Scientific Name | Plant | Status |
|---|---|---|---|
| golden club | *Orontium aquaticum* | Plant | Threatened-State |
| violet wood-sorrel | *Oxalis violacea* | Plant | Threatened-State |
| smaller seabeach grass | *Panicum amarum ssp. amarum* | Plant | Rare-State |
| field paspalum | *Paspalum laeve* | Plant | Endangered-State |
| Carey's smartweed | *Persicaria careyi* | Plant | Endangered-State |
| swamp smartweed, bog smartweed | *Persicaria setacea* | Plant | Endangered-State |
| Virginia ground-cherry | *Physalis virginiana var. virginiana* | Plant | Endangered-State |
| jack pine | *Pinus banksiana* | Plant | Rare-State |
| short-leaved pine | *Pinus echinata* | Plant | Endangered-State |
| seaside plantain | *Plantago maritima var. juncoides* | Plant | Threatened-State |
| yellow fringed orchid | *Platanthera ciliaris* | Plant | Endangered-State |
| yellow crested orchis | *Platanthera cristata* | Plant | Endangered-State |
| horn-leaved riverweed, riverweed, river-moss, threadfoot | *Podostemum ceratophyllum* | Plant | Threatened-State |
| cross-leaved milkwort | *Polygala cruciata var. aquilonia* | Plant | Rare-State |
| yellow milkwort | *Polygala lutea* | Plant | Endangered-State |
| Nuttall's milkwort | *Polygala nuttallii* | Plant | Threatened-State |
| Small's knotweed, American knotweed | *Polygonum aviculare ssp. buxiforme* | Plant | Endangered-State |
| seabeach knotweed | *Polygonum glaucum* | Plant | Rare-State |
| slender knotweed, pleat-leaved knotweed | *Polygonum tenue* | Plant | Rare-State |
| swamp cottonwood | *Populus heterophylla* | Plant | Threatened-State |
| northern pondweed | *Potamogeton alpinus* | Plant | Threatened-State |
| algae-like pondweed, alga pondweed, Tuckermana pondweed | *Potamogeton confervoides* | Plant | Rare-State |
| water-thread pondweed | *Potamogeton diversifolius* | Plant | Endangered-State |
| spotted pondweed | *Potamogeton pulcher* | Plant | Threatened-State |
| comb-leaved mermaid-weed | *Proserpinaca pectinata* | Plant | Threatened-State |
| low sand cherry | *Prunus pumila var. depressa* | Plant | Threatened-State |
| small rabbit tobacco | *Pseudognaphalium micradenium* | Plant | Endangered-State |
| Carolina clubmoss | *Pseudolycopodiella caroliniana* | Plant | Endangered-State |
| wafer-ash, common hoptree | *Ptelea trifoliata ssp. trifoliata* | Plant | Endangered-State |
| bracken fern | *Pteridium aquilinum var. pseudocaudatum* | Plant | Endangered-State |
| mock bishop-weed | *Ptilimnium capillaceum* | Plant | Rare-State |
| blunt mountain mint | *Pycnanthemum muticum* | Plant | Threatened-State |
| whorled mountain-mint | *Pycnanthemum verticillatum var.* | Plant | Endangered-State |

**Table 3-3**
**State Protected Plants in Suffolk County, NY**

| Common Name | Scientific Name | Plant | Status |
|---|---|---|---|
| | *verticillatum* | | |
| pink wintergreen | *Pyrola asarifolia ssp. asarifolia* | Plant | Threatened-State |
| flowering moss, pyxies | *Pyxidanthera barbulata* | Plant | Endangered-State |
| blackjack oak | *Quercus marilandica var. marilandica* | Plant | Rare-State |
| willow oak | *Quercus phellos* | Plant | Endangered-State |
| seaside crowfoot | *Ranunculus cymbalaria* | Plant | Endangered-State |
| small-flowered crowfoot, rock crowfoot | *Ranunculus micranthus* | Plant | Rare-State |
| brown beak-rush | *Rhynchospora fusca* | Plant | Rare-State |
| drowned horned-rush | *Rhynchospora inundata* | Plant | Threatened-State |
| tall beaked-rush | *Rhynchospora macrostachya* | Plant | Rare-State |
| bald-rush, short-beaked beaksedge | *Rhynchospora nitens* | Plant | Threatened-State |
| pale beak-rush | *Rhynchospora pallida* | Plant | Endangered-State |
| long-beaked bald-rush | *Rhynchospora scirpoides* | Plant | Rare-State |
| toothcup | *Rotala ramosior* | Plant | Threatened-State |
| sand blackberry | *Rubus cuneifolius* | Plant | Endangered-State |
| sea-side dock, American golden dock, Tierra del Fuego dock | *Rumex fueginus* | Plant | Endangered-State |
| heart-winged sorrel | *Rumex hastatulus* | Plant | Endangered-State |
| sea-side dock | *Rumex persicarioides* | Plant | Endangered-State |
| slender marsh pink | *Sabatia campanulata* | Plant | Endangered-State |
| sea pink | *Sabatia stellaris* | Plant | Threatened-State |
| small-flowered pearlwort | *Sagina decumbens ssp. decumbens* | Plant | Endangered-State |
| strap-leaved arrowhead | *Sagittaria subulata* | Plant | Rare-State |
| slender arrowhead, quill-leaved sagittaria | *Sagittaria teres* | Plant | Endangered-State |
| dwarf glasswort | *Salicornia bigelovii* | Plant | Threatened-State |
| curly-grass fern | *Schizaea pusilla* | Plant | Endangered-State |
| slender bulrush | *Schoenoplectus heterochaetus* | Plant | Endangered-State |
| Georgia bulrush | *Scirpus georgianus* | Plant | Endangered-State |
| slender nutrush | *Scleria minor* | Plant | Endangered-State |
| Muhlenberg's nutrush | *Scleria muehlenbergii* | Plant | Endangered-State |
| few-flowered nutrush | *Scleria pauciflora var. caroliniana* | Plant | Endangered-State |
| netted nutrush | *Scleria reticularis* | Plant | Rare-State |
| whip nutrush | *Scleria triglomerata* | Plant | Endangered-State |
| hyssop skullcap | *Scutellaria integrifolia* | Plant | Endangered-State |
| narrow-leaved aster | *Sericocarpus linifolius* | Plant | Threatened-State |

**Table 3-3**
**State Protected Plants in Suffolk County, NY**

| Common Name | Scientific Name | Plant | Status |
|---|---|---|---|
| slender sea-purslane, Puerto Rico sea-purslane | *Sesuvium maritimum* | Plant | Endangered-State |
| Pennsylvania catchfly | *Silene caroliniana ssp. pensylvanica* | Plant | Threatened-State |
| Elliott's goldenrod | *Solidago latissimifolia* | Plant | Endangered-State |
| seaside goldenrod | *Solidago sempervirens ssp. mexicana* | Plant | Endangered-State |
| wedgegrass | *Sphenopholis obtusata* | Plant | Endangered-State |
| swamp wedgescale | *Sphenopholis pensylvanica* | Plant | Endangered-State |
| twisted ladies'-tresses | *Spiranthes vernalis* | Plant | Endangered-State |
| rough dropseed | *Sporobolus clandestinus* | Plant | Endangered-State |
| hyssop-leaved hedge-nettle | *Stachys hyssopifolia* | Plant | Threatened-State |
| pink wild-bean | *Strophostyles umbellata* | Plant | Endangered-State |
| sea-blite, annual seepweed | *Suaeda linearis* | Plant | Endangered-State |
| Roland's sea-blite | *Suaeda rolandii* | Plant | Endangered-State |
| eastern silvery aster | *Symphyotrichum concolor var. concolor* | Plant | Endangered-State |
| skyblue aster | *Symphyotrichum oolentangiense* | Plant | Endangered-State |
| eastern annual saltmarsh aster | *Symphyotrichum subulatum var. subulatum* | Plant | Threatened-State |
| perennial salt-marsh aster | *Symphyotrichum tenuifolium var. tenuifolium* | Plant | Rare-State |
| white basswood | *Tilia americana var. heterophylla* | Plant | Endangered-State |
| cranefly orchid | *Tipularia discolor* | Plant | Endangered-State |
| narrow-leaved blue-curls | *Trichostema setaceum* | Plant | Endangered-State |
| northern gama grass, eastern gama grass | *Tripsacum dactyloides var. dactyloides* | Plant | Threatened-State |
| rock elm | *Ulmus thomasii* | Plant | Threatened-State |
| hiddenfruit bladderwort | *Utricularia geminiscapa* | Plant | Rare-State |
| southern bladderwort | *Utricularia juncea* | Plant | Endangered-State |
| lesser bladderwort | *Utricularia minor* | Plant | Rare-State |
| small floating bladderwort, little floating bladderwort | *Utricularia radiata* | Plant | Threatened-State |
| striped bladderwort | *Utricularia striata* | Plant | Threatened-State |
| zigzag bladderwort | *Utricularia subulata* | Plant | Rare-State |
| pine barren bellwort | *Uvularia puberula* | Plant | Endangered-State |
| southern arrowwood | *Viburnum dentatum var. venosum* | Plant | Threatened-State |
| possumhaw | *Viburnum nudum var. nudum* | Plant | Endangered-State |
| northern coastal violet | *Viola brittoniana* | Plant | Endangered-State |
| southern wood violet | *Viola hirsutula* | Plant | Endangered-State |
| bird's-foot violet | *Viola pedata* | Plant | Rare-State |

**Table 3-3**
**State Protected Plants in Suffolk County, NY**

| Common Name | Scientific Name | Plant | Status |
|---|---|---|---|
| primrose-leaved violet | *Viola primulifolia* | Plant | Threatened-State |
| winter grape | *Vitis vulpina* | Plant | Endangered-State |
| Small's yellow-eyed-grass | *Xyris smalliana* | Plant | Threatened-State |

## 3.10 Cultural Resources

In 2002, the Radar Tower and Antenna was added to the NRHP as Site AN/FPS-35 and identified as the only surviving long-range radar station of the 12 built by Sperry Corporation in the 1960s. Camp Hero State Park as a whole is potentially eligible for listing on the NRHP, according to the NY State Historic Preservation Office. Additionally, there are areas of archaeological sensitivity within the State Park, in addition to significant individual historic properties. Both Phase 1 and 2 activities under this RI WP will be coordinated with the State Historic Preservation Officer and other interested parties and stakeholders, in accordance with Section 106 of the National Historic Preservation Act of 1996, as amended and 36 CFR 800. The integrity of the original buildings will not be impacted while attempting to gain access for the sampling effort.

## 3.11 Socioeconomic Setting

As mentioned in Section 2-3, with the exception of the area located to the northeast that was transferred to the Town of East Hampton, the remaining part of the former Camp Hero is currently operating as a park. The low income housing was formerly used by the DoD as residential housing and there is no evidence of any “industrial” activity with that area. The housing area is currently on municipal water and sewer systems.

Camp Hero State Park does not have a Master Plan. Hunting is not allowed in the park within the former Camp Hero boundary. Hunting is allowed during certain seasons within the adjacent wildlife sanctuary; however, no work will be conducted there so there are no associated safety concerns. An extensive system of trails is available for hiking, biking, horseback riding, and areas for picnicking. There are no wells for potable water. Nearby facilities are available at the Montauck Point Lighthouse. The park is heavily visited by the public, especially in the summer season. The park boasts some of the best surf fishing locations in the world, open 24 hours a day to fishermen with permits.

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# 4.0 PRELIMINARY CONCEPTUAL SITE MODEL

A CSM is an essential engineering management tool, which helps the project team successfully manage a site through the investigation and remediation process. The CSM is dynamic and should be updated as more information is collected about a site. A comprehensive CSM should include background information, geologic and hydrogeologic data, contaminant source, distribution and fate and transport data, and risk assessment information (USACE 2012). There are several formats which can be used to display elements of a CSM, and a comprehensive CSM should include a variety of data visualization methods, such as text, schematics, tables, photos, a receptor flow chart, cross sections, time-series plots, etc.

The information that formulates the basis of the CSM (e.g., background information, land use, geologic and hydrogeologic data, etc.) for Camp Hero is documented in Sections 2.0 and 3.0 of this WP. **Figure 4-1** (Appendix A) summarizes the preliminary CSM and potential exposure pathways for the Camp Hero AOCs. Data collected as part of this RI will be used to update and refine the current CSM. An updated CSM will be incorporated into the RI Report based on the RI findings.

## 4.1 Location and Site Description

The location and site description of Camp Hero are described in Sections 2.1 and 2.2 of this RI WP.

## 4.2 Historical Use

The historical use of Camp Hero is presented in Section 2.4 of this RI WP.

## 4.3 Contamination Associated with the Site

Suspected contamination for each AOC is described below in Section 5.0 of this RI WP.

## 4.4 Contaminant Migration Routes

Subsurface contaminant movement depends on the site environmental, physical, chemical, and biological characteristics and the contaminant chemical properties. Migration pathway, mobility, and persistence are chemical dependent and are also affected by site environment factors, including pH, concentration of other chemicals, oxidation-reduction potential, groundwater geochemistry, organic matter content, and the presence of microorganisms. Mobility is the potential for a contaminant to migrate from a source, and persistence is a measure of how long a contaminant will remain in the environment.

Contamination at the Camp Hero AOCs may potentially migrate within the soil, groundwater, and surface water via leaching, runoff, erosion, or plant uptake. Contamination in soil could potentially migrate into groundwater through infiltration. Additionally, contaminants may migrate downstream via drainage ditches through stormwater transport and/or potentially leach from the sediments into

site soils and groundwater. Wetlands and streams are located throughout the Camp Hero property. Surface water runoff could potentially erode the soil and transport contamination off site to the wetland.

## 4.5 Current and Future Land Use

The current and future land use of Camp Hero is described in Section 2.3 of this RI WP.

## 4.6 Receptors

The following summarizes a preliminary CSM for exposure has been developed which identifies potential human and ecological receptors and potentially complete exposure pathways for the Camp Hero AOCs.

### 4.6.1 Human Receptors and Exposure Pathways.

A CSM for exposure describes the relationships among contaminant concentrations and sources, transport pathways, and receptors at a site. The model reflects pertinent information including prior site operations, current and potential future land uses, potentially exposed populations, and potentially complete exposure pathways. Prior to developing a CSM, pertinent site history and environmental setting information is reviewed including climate, topography, geology, hydrogeology, and surface water hydrogeology. The exposure setting is described in terms of the natural environment and local land use and demographics to provide information pertinent to the identification of exposure pathways and the estimation of exposure factors for current and hypothetical future human receptors.

**Groundwater Use.** There is one existing residence located within the park boundaries. The residence is currently being provided potable water by municipal water supply. The current and future use of the park is recreational. Shallow groundwater underlying the park is not expected be used for potable purposes in the future; however, it will be assumed (conservatively) for the risk assessment that a future resident may be exposed to contaminants in shallow groundwater via potable use.

A preliminary CSM is provided in RAGS Part D Table 1 format as Table 4-1. Additionally, an exposure pathway diagram (EPD) has been developed to illustrate potential exposure pathways at the AOCs. In each EPD, the potentially complete pathways to be evaluated in the baseline HHRA are indicated by an "X" in a box. A box without an "X" indicates an incomplete pathway (which occurs when at least one of the pathway elements is missing) or a potentially complete but insignificant exposure pathway. The EPD is provided as Figure 4-1. Based on the results of the RI sampling and additional information on the environmental/exposure setting obtained during the RI, the preliminary CSM will be revised accordingly prior to execution of the HHRA.

In summary, potential human receptors associated with current and potential future land use, and potentially complete exposure pathways include:

- **Current/Future Maintenance Workers, Future Full-time Outdoor Workers, Current/Future Recreational User, and Current/Future Trespasser**
  - Incidental ingestion of surface soil
  - Dermal contact with surface soil
  - Inhalation of particulates from surface soil
  - Inhalation of volatiles from surface soil
  - Incidental ingestion of sediment and surface water
  - Dermal contact with sediment and surface water
- **Future Construction Workers**
  - Incidental ingestion of surface/subsurface soil
  - Dermal contact with surface/subsurface soil
  - Inhalation of particulates from surface/subsurface soil
  - Inhalation of volatiles from surface/subsurface soil
  - Incidental ingestion of groundwater in excavation trench
  - Dermal contact with groundwater in excavation trench
  - Inhalation of volatiles in air migrating from groundwater in excavation trench
  - Incidental ingestion of sediment and surface water
  - Dermal contact with sediment and surface water
- **Future Residents.** The expected future land use of the park is recreational. Residential reuse of the park is not expected to occur in the future. As such, residential land use and potable water well exposure scenarios are not considered applicable for this property. Their inclusion is strictly to determine whether there are unacceptable risks under conservative unrestricted use (UU)/unrestricted exposure (UE) land use, thereby providing information to risk managers that may be used as the basis for establishing land use controls. The evaluation of the UU/UE land use will not be used to identify chemicals of concern requiring remediation based on unacceptable risks for these conservative scenarios. The other current and future exposure scenarios evaluated in the HHRA are intended as the basis for these determinations.

- If necessary, the Army may need to take a firm stand on this approach with the state agency that may be pushing to apply these more conservative exposure scenarios to drive risk determinations that may not be consistent with planned and likely future land used."

- The quantitative evaluation of a potential future residential exposure scenario will serve to inform risk management and may support No Further Action (NFA) for AOCs where cumulative receptor risk does not exceed actionable target risk levels (i.e., excess lifetime cancer risk of $10^{-4}$ and non-carcinogenic hazard index of 1).

  – Incidental ingestion of surface soil
  – Dermal contact with surface soil
  – Inhalation of particulates from surface soil
  – Inhalation of volatiles from surface soil
  – Ingestion of groundwater (potable use)
  – Dermal contact with groundwater (potable use)
  – Inhalation of vapors in shower air while using groundwater for showering
  – Inhalation of volatiles in indoor air migrating from groundwater
  – Incidental ingestion of sediment and surface water
  – Dermal contact with sediment and surface water

- **<u>Mixed Surface/Subsurface Soil Re-Deposited As Surface Soil Via Future Excavation</u> – Current/Future Maintenance Workers, Future Full-time Outdoor Workers, Current/Future Recreational User, Current/Future Trespasser, and Future Residents**

  – Incidental ingestion of surface soil
  – Dermal contact with surface soil
  – Inhalation of particulates from surface soil
  – Inhalation of volatiles from surface soil

- **Current/Future Trespassers.** Potential exposures/risks to a trespasser will be qualitatively evaluated by using the recreational user whose potential exposures/risks are likely more conservative. The current/future recreational user will be assumed to be a 26-year resident (adult/child) who will use the park for recreational activities while a trespasser would be an adult/adolescent. Because a recreational user would have the similar exposure areas, the

same or greater exposure frequency, greater exposure duration and ingestion rates, and lower body weight (child), potential exposures/risks to a recreational user would likely be greater than those to trespasser.

- **Current/Future Off-Site Residents.** Off-site residents may be potentially exposed via potable use of groundwater and subsurface vapor intrusion to indoor air in a residence if groundwater contamination is detected at the Camp Hero AOCs and it determined that it is impacting off-site locations.
  - Ingestion of groundwater (potable use)
  - Dermal contact with groundwater (potable use)
  - Inhalation of vapors in shower air while using groundwater for showering
  - Inhalation of volatiles in indoor air migrating from groundwater

### 4.6.2 Ecological Receptors and Exposure Pathways.

Terrestrial and aquatic wildlife are considered potential ecological receptors. Terrestrial ecological receptors include plants, soil invertebrates, mammals, birds, and reptiles. Aquatic ecological receptors include fish, benthic invertebrates, reptiles, and amphibians. Ecological receptors may come into direct contact with contaminants in sediment, soil, surface water, and/or groundwater. Contaminants may also be incorporated into the food chain (bioaccumulated in plants and animals) through uptake or ingestion.

## 4.7 Conceptual Site Model Summary

Contaminants may have been released into the environment as a result of former military activities at Camp Hero. However, the presence of contamination is not confirmed and no previous sampling has been conducted at most AOCs. Sample collection is necessary as part of the RI to determine the presence, extent, and location of contamination at the Camp Hero AOCs. As such, the Exposure Pathway Analysis indicates that potentially complete exposure pathways exist for both human and ecological receptors under both current and hypothetical future land uses. Data collected as part of this RI will be used to update and refine the current CSM. An updated CSM will be incorporated into the RI Report based on the RI findings.

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**Table 4-1 (RAGS Part D Table 1)**
**Selection of Exposure Pathways**
**Human Health Risk Assessment**

| Scenario Timeframe | Medium | Exposure Medium | Exposure Point | Receptor Population | Receptor Age | Exposure Route | Type of Analysis | Rationale for Selection or Exclusion of Exposure Pathway |
|---|---|---|---|---|---|---|---|---|
| Current/Future | Surface Soil | Surface Soil | Surface Soil | Outdoor Maintenance Worker | Adult | Ingestion<br>Dermal | Quant | A current/future maintenance worker may be exposed to contaminants in surface soil while conducting work activities such as grass maintenance. A current/future recreational user may be exposed to contaminants in surface soil during recreational activities such as hiking. Exposure pathways include incidental ingestion, dermal contact, and inhalation of non-volatile particulates. These receptor may also be exposed via inhalation of VOCs migrating from soil (vadose zone) to ambient air.<br><br>Trespasser: Potential exposures to soil for a trespasser will be qualitatively evaluated by using the on-site recreational user whose exposures are likely more conservative.<br><br>Off-site Resident: Receptor is offsite and is not likely to come into direct contact with surface soil. On-site vegetation and paved areas are likely to inhibit wind-blown dust from the park from migrating off-site to this receptor. On-site vegetation and paved areas are likely to inhibit vapors from reaching the surface and migrating off-site to this receptor. |
| | | | | Recreational User | Adult/Child | Ingestion<br>Dermal | Quant | |
| | | | | Trespasser | Adult/Adolescent | Ingestion<br>Dermal | Qual (2) | |
| | | | | Off-Site Resident (1) | Adult/Child | Ingestion<br>Dermal | None | |
| | | Air | Particulates | Outdoor Maintenance Worker | Adult | Inhalation | Quant | |
| | | | | Recreational User | Adult/Child | Inhalation | Quant | |
| | | | | Trespasser | Adult/Adolescent | Inhalation | Qual (2) | |
| | | | | Off-Site Resident (1) | Adult/Child | Inhalation | None | |
| | Soil (Vadose Zone) | Air | Vapors in Ambient Air | Outdoor Maintenance Worker | Adult | Inhalation | Quant | |
| | | | | Recreational User | Adult/Child | Inhalation | Quant | |
| | | | | Trespasser | Adult/Adolescent | Inhalation | Qual (2) | |
| | | | | Off-Site Resident (1) | Adult/Child | Inhalation | None | |
| | Sediment | Sediment | Sediment | Outdoor Maintenance Worker | Adult | Ingestion<br>Dermal | Quant | A current/future maintenance worker may be exposed to contaminants in sediment while inspecting or maintaining the park drainage areas. A current/future recreational user may be exposed to contaminants in sediment during recreational activities. Exposure pathways include incidental ingestion and dermal contact.<br><br>Trespasser: Potential exposures to sediment for a trespasser will be qualitatively evaluated by using the on-site recreational user whose exposures are likely more conservative.<br><br>Off-site Resident: A park recreational user will be used to address this exposure pathway. |
| | | | | Recreational User | Adult/Child | Ingestion<br>Dermal | Quant | |
| | | | | Trespasser | Adult/Adolescent | Ingestion<br>Dermal | Qual (2) | |
| | | | | Off-Site Resident (1) | Adult/Child | Ingestion<br>Dermal | None | |
| | Surface Water | Surface Water | Surface Water | Outdoor Maintenance Worker | Adult | Ingestion<br>Dermal | Quant | A current/future maintenance worker may be exposed to contaminants in surface water while inspecting or maintaining the park drainage areas. A current/future recreational user may be exposed to contaminants in surface water during recreational activities. Exposure pathways include incidental ingestion and dermal contact.<br><br>Trespasser: Potential exposures to surface water for a trespasser will be qualitatively evaluated by using the on-site recreational user whose exposures are likely more conservative.<br><br>Off-site Resident: A park recreational user will be used to address this exposure pathway. |
| | | | | Recreational User | Adult/Child | Ingestion<br>Dermal | Quant | |
| | | | | Trespasser | Adult/Adolescent | Ingestion<br>Dermal | Qual (2) | |
| | | | | Off-Site Resident (1) | Adult/Child | Ingestion<br>Dermal | None | |
| | | Fish | Consumption of Fish | Outdoor Maintenance Worker | Adult | Ingestion | None | Recreational or subsistence fishing is not known to occur at the park. |
| | | | | Recreational User | Adult/Child | Ingestion | None | |
| | | | | Trespasser | Adult/Adolescent | Ingestion | None | |
| | | | | Off-Site Resident (1) | Adult/Child | Ingestion | None | |

**Table 4-1 (RAGS Part D Table 1)**
**Selection of Exposure Pathways**
**Human Health Risk Assessment**

| Scenario Timeframe | Medium | Exposure Medium | Exposure Point | Receptor Population | Receptor Age | Exposure Route | Type of Analysis | Rationale for Selection or Exclusion of Exposure Pathway |
|---|---|---|---|---|---|---|---|---|
| Current/Future | Soil/Subsurface Soil Re-Deposited as Surface Soil Via Future Excavation | Soil/Subsurface Soil Re-Deposited as Surface Soil Via Future Excavation | Surface Soil, Particulates and Vapors in Air | Outdoor Maintenance Worker | Adult | Ingestion<br>Dermal<br>Inhalation | Quant | A current/future maintenance worker may be exposed to contaminants in mixed surface/subsurface soil (re-deposited as surface soil via a future excavation) while conducting work activities. A current/future recreational user may be exposed to contaminants in mixed surface/subsurface soil (re-deposited as surface soil via a future excavation) during recreational activities. Exposure pathways include incidental ingestion, dermal contact (chemical only), and inhalation of non-volatile particulates. This receptor may also be exposed via inhalation of VOCs migrating from soil (vadose zone) to ambient air.<br><br>Trespasser: Potential exposures to mixed surface/subsurface soil (re-deposited as surface soil via a future excavation) for a trespasser will be qualitatively evaluated by using the on-site recreational user whose exposures are likely more conservative.<br><br>Off-site Resident: An offsite resident is not likely to come into direct contact with surface soil. On-site vegetation and paved areas are likely to inhibit wind-blown dust from the park from migrating off-site to this receptor. On-site vegetation and paved areas are likely to inhibit vapors from reaching the surface and migrating off-site to this receptor. |
| | | | | Recreational User | Adult/Child | Ingestion<br>Dermal<br>Inhalation | Quant | |
| | | | | Trespasser | Adult/Adolescent | Ingestion<br>Dermal<br>Inhalation | Qual (2) | |
| | | | | Off-Site Resident (1) | Adult/Child | Ingestion<br>Dermal<br>Inhalation | None | |
| | Shallow Groundwater | Shallow Groundwater | Tap Water | Outdoor Maintenance Worker | Adult | Ingestion<br>Dermal | None | Shallow groundwater underlying the park is not currently used for potable purposes such as restrooms, showers, and park water foundations. The local municipal water supply is available and it is assumed will be used to supply potable water for the park in the future.<br><br>Off-site residents may be potentially exposed via potable use of shallow groundwater if shallow groundwater contamination is detected at the Camp Hero AOCs and it is determined to be impacting off-site residences. |
| | | | | Recreational User | Adult/Child | Ingestion<br>Dermal | None | |
| | | | | Trespasser | Adult/Adolescent | Ingestion<br>Dermal | None | |
| | | | | Off-Site Resident (1) | Adult/Child | Ingestion<br>Dermal | Quant | |
| | | | Vapors at Showerhead | Outdoor Maintenance Worker | Adult | Inhalation | None | |
| | | | | Recreational User | Adult/Child | Inhalation | None | |
| | | | | Trespasser | Adult/Adolescent | Inhalation | None | |
| | | | | Off-Site Resident (1) | Adult/Child | Inhalation | Quant | |
| | | | Vapors in Indoor Air | Outdoor Maintenance Worker | Adult | Inhalation | None | An outdoor maintenance worker is not expected to work indoors. |
| | | | | Recreational User | Adult/Child | Inhalation | None | A recreational user is expected to spend an insignificant amount of time indoors (such as restrooms) |
| | | | | Trespasser | Adult/Adolescent | Inhalation | None | A trepasser is not expected to spend time indoors. |
| | | | | Off-Site Resident (1) | Adult/Child | Inhalation | Quant | Off-site residents may be potentially exposed via subsurface vapor intrusion to indoor air in a residence if shallow groundwater contamination is detected at the Camp Hero AOCs and it is determined to be impacting off-site residences. |
| | | | Groundwater in a Trench | Outdoor Maintenance Worker | Adult | Ingestion<br>Dermal and Inhalation | None | These receptors are not expected to come into direct contact with groundwater in an excavation trench during future construction/excavation. Groundwater exposure during construction/excavation activities are addressed under the future construction worker scenario. |
| | | | | Recreational User | Adult/Child | Ingestion<br>Dermal and Inhalation | None | |
| | | | | Trespasser | Adult/Adolescent | Ingestion<br>Dermal and Inhalation | None | |
| | | | | Off-Site Resident (1) | Adult/Child | Inhalation | None | |

**Table 4-1 (RAGS Part D Table 1)**
**Selection of Exposure Pathways**
**Human Health Risk Assessment**

| Scenario Timeframe | Medium | Exposure Medium | Exposure Point | Receptor Population | Receptor Age | Exposure Route | Type of Analysis | Rationale for Selection or Exclusion of Exposure Pathway |
|---|---|---|---|---|---|---|---|---|
| Future | Surface Soil and Post-Excavation Soil | Surface Soil and Post-Excavation Soil | Surface Soil and Post-Excavation Soil | On-Site Resident | Adult/Child | Ingestion Dermal | Quant | The current and future use of the park is recreational. It is anticipated that a future residence will be prohibited within the park. For the HHRA, it will be assumed (conservatively) that a future residence may be constructed and a future resident may be exposed to contaminants in surface soil (and post-excavation soil) via incidental ingestion and dermal contact. |
| | | | | Outdoor Worker | Adult | Ingestion Dermal | Quant | A future outdoor worker may be exposed to contaminants in surface soil (and post-excavation soil) via incidental ingestion and dermal contact during outdoor work activities. |
| | Surface Soil and Post-Excavation Soil | Air | Particulates | On-Site Resident | Adult/Child | Inhalation | Quant | As stated above, it is anticipated that a future residence will be prohibited within the park. For the HHRA, it will be assumed (conservatively) that a future resident may be exposed to contaminants in surface soil (and post-excavation soil) via inhalation of non-volatile particulates. |
| | | | | Outdoor Worker | Adult | Inhalation | Quant | A future outdoor worker may incidentally inhale contaminants adhered to wind-blown particulates from surface soil (and post-excavation soil) during work activities. |
| | Vadose Zone Soil and Post-Excavation Vadose Zone Soil | Air | Vapors in Ambient Air | On-Site Resident | Adult/Child | Inhalation | Quant | As stated above, it is anticipated that a future residence will be prohibited within the park. For the HHRA, it will be assumed (conservatively) that a future resident may incidentally inhale vapors emanating from soil to ambient air. |
| | | | | Outdoor Worker | Adult | Inhalation | Quant | A future outdoor worker may incidentally inhale vapors emanating from soil to ambient air during work activities. |
| | Soil/Subsurface Soil (Excavation Scenario) | Soil/Subsurface Soil | Soil During Excavation Activities | Construction Worker | Adult | Ingestion Dermal | Quant | A future construction worker may be exposed to contaminants in surface/subsurface soil during excavation activities via incidental ingestion, dermal contact, and inhalation of non-volatile particulates. This receptor may also be exposed via inhalation of VOCs migrating from soil (vadose zone) to ambient air. |
| | | Air | Particulates During Excavation Activities | Construction Worker | Adult | Inhalation | Quant | |
| | | Air | Vapors During Excavation Activities | Construction Worker | Adult | Inhalation | Quant | |
| | Sediment | Sediment | Sediment | On-Site Resident | Adult/Child | Ingestion Dermal | Quant | An on-site resident may be exposed to contaminants in sediment via incidental ingestion and dermal contact. |
| | | | | Outdoor Worker | Adult | Ingestion Dermal | Quant | A future outdoor worker may be exposed to contaminants in sediment via incidental ingestion and dermal contact while inspecting or maintaining the park drainage areas.. |
| | | | | Construction Worker | Adult | Ingestion Dermal | Quant | A future construction worker may be exposed to contaminants in sediment via incidental ingestion and dermal contact if present at construction areas. |
| | Surface Water | Surface Water | Surface Water | On-Site Resident | Adult/Child | Ingestion Dermal | Quant | An on-site resident may be exposed to contaminants in surface water via incidental ingestion and dermal contact. |
| | | | | Outdoor Worker | Adult | Ingestion Dermal | Quant | A future outdoor worker may be exposed to contaminants in surface water via incidental ingestion and dermal contact while inspecting or maintaining the park drainage areas.. |
| | | | | Construction Worker | Adult | Ingestion Dermal | Quant | A future construction worker may be exposed to contaminants in surface water via incidental ingestion and dermal contact if present at construction areas. |
| | Surface Water | Fish | Consumption of Fish | On-Site Resident | Adult/Child | Ingestion | None | Recreational or subsistence fishing is not known to occur at the park. |
| | | | | Outdoor Worker | Adult | Inhalation | None | |
| | | | | Construction Worker | Adult | Ingestion | None | |

**Table 4-1 (RAGS Part D Table 1)**
**Selection of Exposure Pathways**
**Human Health Risk Assessment**

| Scenario Timeframe | Medium | Exposure Medium | Exposure Point | Receptor Population | Receptor Age | Exposure Route | Type of Analysis | Rationale for Selection or Exclusion of Exposure Pathway |
|---|---|---|---|---|---|---|---|---|
| Future | Shallow Groundwater | Shallow Groundwater | Tap Water | On-Site Resident | Adult/Child | Ingestion<br>Dermal | Quant | There is one existing residence located within the park boundaries. The residence is currently being provided potable water by municipal water supply. Shallow groundwater underlying the park is not expected be used for potable purposes in the future. For the HHRA, it will be assumed (conservatively) that a future resident may be exposed to contaminants in shallow groundwater (potable use) via incidental ingestion and dermal contact. |
| | | | | Outdoor Worker | Adult | Ingestion<br>Dermal | None | Potable water is currently provided to the park by municipal water supply and will be continued to be so in the future. Shallow groundwater underlying the park is not expected be used for potable purposes such as restrooms and park water foundations. |
| | | | | Construction Worker | Adult | Ingestion<br>Dermal | None | Potable water is currently provided to the park by municipal water supply and will be continued to be so in the future. Incidental ingestion and dermal contact with shalow groundwater is addressed under the groundwater in a trench scenario (see below). |
| | | | Vapors at Showerhead | On-Site Resident | Adult/Child | Inhalation | Quant | There is one existing residence located within the park boundaries. The residence is currently being provided potable water by municipal water supply. Shallow groundwater underlying the park is not expected be used for potable purposes in the future. For the HHRA, it will be assumed (conservatively) that a future resident may be exposed to contaminants in shower air while using shallow groundwater for shower water. |
| | | | | Outdoor Worker | Adult | Inhalation | None | As stated above, shallow groundwater underlying the park will not be used for potable purposes (i.e. for trail water fountains, restrooms, etc.). |
| | | | | Construction Worker | Adult | Inhalation | None | Future construction worker spends time at a work site and is unlikely to shower at the park. |
| | | | Vapors in Indoor Air | On-Site Resident | Adult/Child | Inhalation | Quant | The current and future use of the park is recreational. It is anticipated that a future residence will be prohibited within the park. For the HHRA, it will be assumed (conservatively) that a future residence may be constructed and residents may be exposed to VOCs in indoor air due to subsurface vapor intrusion from shallow groundwater, |
| | | | | Outdoor Worker | Adult | Inhalation | None | A future outdoor worker spends the majority of his/her work day outdoors. |
| | | | | Construction Worker | Adult | Inhalation | None | Future construction worker spends time outdoors at the work site; pathway is incomplete. |
| | | | Groundwater in a Trench | On-Site Resident | Adult/Child | Ingestion<br>Dermal<br>Inhalation | None | These receptors are not expected to come into direct contact with groundwater in an excavation trench during future construction/excavation. Groundwater exposure during construction/excavation activities are addressed under the future construction worker scenario. |
| | | | | Outdoor Worker | Adult | | | |
| | | | | Construction Worker | Adult | Ingestion<br>Dermal<br>Inhalation | Quant | A future construction workers may be exposed to contamination in groundwater via incidental ingestion, dermal contact, and inhalation of VOCs migrating from shallow groundwater to air in an excavation trench. |

**Notes:**

(1) Off-site residents are not expected to come into direct contact (incidental ingestion and dermal contact) with surface soil within the park. Particulates and vapors may migrate from soil at Camp Hero to off-site areas; however, the potential exposure to off-site receptors is considered potentially complete but insignificant due to park's vegetative cover which would reduce particulates emitted to air and dilution of vapors with ambient air.

(2) = Potential exposures/risks to a trespasser will be qualitatively evaluated by using the recreational user whose potential exposures/risks are likely more conservative. The current/future recreational user will be assumed to be a 26-year resident (adult/child) who will use the park for recreational activities while a trespasser would be an adult/adolescent. Because a recreational user would have the similar exposure areas, the same or greater exposure frequency, greater exposure duration and ingestion rates, and lower body weight (child), potential exposures/risks to a recreational user would likely be greater than those to trespasser.

Key:
Quant = Exposures to be quantitatively evaluated in the HHRA.
Qual = Exposures to be qualitatively evaluated in the HHRA.

# 5.0 TECHNICAL APPROACH

## 5.1 Regulatory Framework

RI work will be conducted in accordance with CERCLA and the FUDS ER-200-3-1. NYSEDEC is the lead regulator for this RI and will provide review and concurrence pursuant to CERCLA. Additionally, potential Applicable or Relevant and Appropriate Requirements (ARARs) discussed in the RI Report.

The criteria established for constituents of concern in NYCRR Subpart 375-6, "Remedial Program Soil Cleanup Objectives" will be utilized for screening criteria, subsequent to completion of the CERCLA risk assessment. For those areas of this project strictly addressing releases of fuels from formerly removed or used storage tanks, the following NY State Regulation and guidance will be applied: 6 NYCRR 613.9 (b), Closure of Tanks Permanently Out of Service and NYSDEC DER-10, Technical Guidance for Site Investigation and Remediation. Seven suspected USTs, which were identified in the Cashin Report and during the records review, have been included as AOCs in this RI. These suspected USTs have not been previously investigated; therefore, if a petroleum release is confirmed through this investigation, the NYSDEC DER Oil Spill Response Program will be notified and a spill number assigned. The regulatory status of these sites will be summarized in the RI documents and if additional technical documents are required, such as a Corrective Action Plan, they will be conducted under a different regulatory program.

Soil samples at petroleum storage tank AOCs are proposed for analysis of petroleum compounds by the NYSDEC Spills, Technology, and Remediation Services (STARS) list for either fuel oil or gasoline, which include VOCs, SVOCs, and/or lead analyses, in accordance with NYSDEC policy CP-51. Groundwater samples at petroleum tank AOCs are proposed for analysis of VOCs, SVOCs, and lead, depending on whether the fuel oil or gasoline list is more appropriate. Soil and groundwater analysis at non-petroleum AOCs are proposed for analysis of the more comprehensive SW-846 analytical lists and are detailed for each AOC in the SAP (Appendix C).

**Human Health Screening Criteria:** The project screening levels (PSLs) for soil will be based on the following criteria: 6 NYCRR Part 375-1 Soil Cleanup Objectives (NYCRR 2015), NYSDEC CP-51/Soil Cleanup Guidance (NYSDEC 2010a), and/or USEPA Regional Screening Levels for Residential Soil (USEPA 2015). The PSLs for soil will be based on the lowest of each of the criteria listed.

The PSLs for groundwater will be based on the more stringent of the following criteria: USEPA MCLs (USEPA 2015a), NYSDEC TOGS 1.1.1 Ambient Water Quality Standards and Guidance Values (NYSDEC 2004), New York State Department of Health Maximum Contaminant Level criteria (NYCRR 2011) or USEPA Regional Screening Level for Tap Water (USEPA 2015b).

PSLs are provided in the QAPP (Appendix C). The PSLs for soil will be based on the lowest of each of the criteria listed.

In order to meet PSLs, SVOCs in soil and groundwater will be analyzed by Method 8270D in the SIM mode.

**Ecological Screening Levels:** For the surface soil data sets, the maximum detected concentration of each chemical will be compared to media-specific screening ecological values (SEVs) to assess the potential for risks to the plant and soil invertebrate communities. Chemicals detected above these SEVs will be identified as COPECs for further evaluation in the Tier 2 BERA. Soil SEVs will be selected, when available, from the following hierarchy of sources:

- USEPA Ecological Soil Screening Levels (Eco-SSLs) for plants and soil invertebrates derived according to USEPA guidance (USEPA 2005a).
- Canadian Council of Ministers of the Environment (CCME) Soil Quality Guidelines for environmental health (CCME 2002; 2015).
- Plant and invertebrate based soil screening values developed by the Oak Ridge National Laboratory (ORNL) (Efroymson et al. 1997a; 1997b).
- Dutch Target Values (Buchman 2008) were also considered for organic chemicals.

Soil SEVs from alternate sources (e.g., USEPA 2003a; 2015c) will be considered when values are not available from the sources listed above.

## 5.2 Phased Approach

The RI technical approach will consist primarily of two phases of investigation, Phase 1 and Phase 2.. The Phase 1 investigation is intended to confirm either the presence or the absence of suspected CERCLA DoD waste at an AOC. Based on Phase 1 findings confirming CERCLA DoD waste at an AOC, a Phase 2 investigation will be conducted to define the nature and extent of CERCLA DoD waste at an AOC. The Phase 1 investigation is detailed in Section 6. Details of the Phase 2 investigation will be provided in the RI WP Addendum.

This RI WP details the activities planned for the Phase 1 RI investigation. The Phase 2 RI sampling activities will be detailed in an addendum to this RI WP. The RI WP Addendum will provide the Phase 1 RI sampling results and specific activities and sampling protocols proposed for the Phase 2 RI. The RI WP Addendum will compare sampling results at each AOC against screening criteria and guidance identified in this Work Plan and provide a recommendation on whether constituents at an AOC are present at levels and to an extent that warrants further delineation of constituents in the

Phase 2 RI sampling or that no further sampling in the Phase 2 RI is warranted. The RI WP Addendum will be provided to the project team for review, comments, and concurrence with these recommendations.

Additionally, geospatial survey results of the Camp Hero which is concurrently being performed with this Work Plan by the U.S Army Geospatial Center will be provided in the RI WP Addendum. The geospatial survey is evaluating Camp Hero for the potential presence of waste disposal areas which may have been utilized during DoD activities at Camp Hero. Additional investigation activities at these potential disposal areas, if identified in the survey, will be detailed in the RI WP Addendum.

### 5.2.1 Phase 1

The Phase 1 investigation is intended to confirm either the presence or the absence of contamination at an AOC indicating that a release has occurred. The details of the Phase 1 investigation for each AOC included in this RI are included in Section 6.0, Areas of Concern Summaries. The sample collection methodologies for the Phase 1 investigation for surface soil (defined as soil between 0-1 ft bgs), subsurface soil (greater than 1 ft bgs), concrete chip, and groundwater sampling are discussed in the SAP. The Phase 1 RI soil sampling will focus on the perched groundwater-soil interface. If no groundwater is encountered within the anticipated depth of the perched water table (encountered in previous assessments at 5 to 25 ft bgs), borings will be advanced to a maximum of 25 ft bgs (USGS 1986). Unfiltered groundwater samples will be collected from the perched aquifer to assess potential human health risk during Phase 1. Filtered and unfiltered groundwater samples will be collected from permanent monitoring wells in Phase 2, based on the results of Phase 1 sampling.

Temporary wells may be required in order to collect a sufficient groundwater sample. If within 24 hours, groundwater recharge is insufficient for sample collection, then no groundwater sample will be collected during Phase 1. The necessity for installation of monitoring wells into the principle aquifer will be evaluated based on the Phase 1 results.

Piezometers will be installed at some AOCs to obtain information to determine the direction of groundwater flow. The piezometers will be constructed as standard PVC wells with filter-pack and a bentonite seal, as necessary, but will not be grouted in place. Water level data will be collected manually with a water level meter during Phase 1.

A draft and final field report will be prepared following the completion of the Phase 1 investigation. The field report will summarize the field activities, compare the analytical data obtained to PSLs, and identify whether each AOC can be considered for no further action or require further sampling during the Phase 2 investigation. A technical review meeting will be conducted with the project stakeholders to obtain consensus with the Phase 2 investigation activities.

### 5.2.2 Phase 2

The objective of Phase 2 is to define the extent of contamination at AOCs that have confirmed presence of contamination either from historical sampling and analysis or the Phase 1 investigation. As described above, a field report will be prepared and submitted following the Phase 1 investigation followed by a technical review meeting to obtain consensus on the scope of the Phase 2 investigation. The details of the Phase 2 investigation approach will be provided in the RI WP Addendum, with draft and final versions. The Phase 2 data requirements may include concrete chip samples, liquid samples from containers, surface soil (0 to 1 ft bgs), subsurface soil (greater than 1 ft bgs), surface water, sediment, and/or groundwater samples from permanent monitoring wells in the perched aquifer or potentially in the deeper drinking water aquifer.

## 5.3 Background Sampling

Background soil samples will be collected in Phase 1 to establish park-wide background levels for naturally occurring constituents and anthropogenic impacts. A total of 62 background soil samples (30 surface and 32 subsurface) will be collected. The samples will be collected from four different locations (BG-01 through BG-04) representing two different soil types, Whitman Sandy loam (outwash deposits of stratified sand and gravel) and Montauk loam (glaciofluvial deposits of stratified sand and gravel in forms of kames). These two soil types represent the soil types where most of the Camp Hero RI AOCs are located, excluding urban soil complexes, which are not representative of background conditions. Background samples will be analyzed for metals and PAHs (by method 8270D in SIM mode). PAHs are included in the background analysis because they may be ubiquitous to the environment and may be derived from anthropogenic influences.

A total of 16 soil borings will be advanced for background sampling. Eight borings will be located in the Whitman Sandy Loam (4 borings at 2 locations), while 8 will be located in the Montauk Loam (4 borings at 2 locations). Sample locations will be spaced a minimum of 25 ft apart. Borings will be advanced to 10 ft bgs or the depth of the perched aquifer, whichever is encountered first. Two subsurface soil samples will be collected per boring: 4 to 5 ft bgs and 9 to 10 ft bgs or 1 to 2 ft above the depth to ground water, whichever is encountered first. One surface soil sample will be collected from 0 to 1 ft from each boring. Fourteen additional surface soil samples will be collected, between the four background locations. All four background soil sampling locations are shown on the site map (**Figure 1-2**) and individual background location maps are provided as **Figures 5-1, 5-2, 5-3,** and **5-4**, respectively (Appendix A).

Per this methodology, the sample sizes for the background soil samples are as follows:

- n = 15 for surface soil in Montauk Loam (at locations BG-02, BG-04)
- n = 15 for surface soil in Whitman Sandy Loam (at locations BG-01, BG-03)

- n = 16 for subsurface soil in Montauk Loam (at locations BG-02, BG-04)
- n = 16 for subsurface soil in Whitman Sandy Loam (at locations BG-01, BG-03)

Because of the heterogeneous nature of perched groundwater flow direction and surface water flow at each of the AOCs, background locations and sampling will be conducted based on the Phase I RI results. The location and need for groundwater, sediment and surface water background data, and the methods that will be used to determine whether site concentrations are within background levels for these media, will be defined in the RI WP Addendum prior to Phase 2 sampling. Filtered and unfiltered background groundwater will be collected during Phase 2 and analyzed for COPCs identified during the Phase 1 sampling.

One or more of the following methods will be used to determine whether chemical constituents detected at the AOCs are within background levels, or exceed background and may potentially be site-related. For the background comparisons, surface and subsurface soil will be evaluated separately. Analytical results for chemical constituents (inorganics and PAHs) detected in surface soil at each AOC will be compared to their concentrations detected in background surface soil. Analytical results for chemical constituents (inorganics) detected in subsurface soil at each AOC will be compared to their concentrations detected in background subsurface soil.

- Two-sample (one-sided) Hypotheses Tests (Student's t test, Wilcoxon-Mann Whitney (WMW) test, and Gehan Test) – These statistical tests compare concentrations of two populations to determine if the concentrations of one population (site concentrations) are within the concentrations of the other population (background concentrations). The tests require at least 10 samples results. In general, the Student's t test is used in cases where data are normally distributed in both site and background, while the WMW and Gehan tests are non-parametric tests that may be used for a wide variety of data distributions.
- Graphical Displays – multiple side-by-side box plots and other graphical displays will be used as needed to supplement the evaluation.

## 5.4 Risk Assessment Methodology

The RI results will be used to conduct a baseline HHRA and SLERA for the Camp Hero AOCs. The following sections summarize these assessments.

### 5.4.1 Baseline Human Health Risk Assessment

A baseline HHRA will be conducted for the Camp Hero AOCs. The objectives of the baseline HHRA will be to (1) provide an analysis of baseline risks posed to human health as a result of potential exposures to chemical contaminants in environmental media at each AOC; (2) provide a basis for

determining levels of chemicals that can remain at each AOC and still be adequately protective of human health; and (3) provide a basis for comparing potential impacts of various remedial alternatives (USEPA 1989).

For each AOC, chemicals detected in environmental media will be compared to screening criteria to identify COPCs that may pose adverse effects to human health. The HHRA will assess baseline risks to human receptors based on potentially complete exposures to COPCs identify in environmental media under current conditions and hypothetical future land-use scenarios. If potential risks to a human receptor(s) are unacceptable (i.e., exceed target risk levels), chemical-specific remediation levels will be derived to support possible corrective action(s). The HHRA will be conducted according to USEPA's human health risk assessment guidance for Superfund (USEPA, 1989, 2001, 2004, 2009), OSWER directives (USEPA, 1991, 2003, 2014), USACE guidance for risk assessment, and applicable NYSDEC requirements. The HHRA results will be presented in USEPA RAGS Volume 1, Part D standard table formats (USEPA, 2001).

The following provides an overview of the main components of the HHRA:

**Data Evaluation.** Analytical results from environmental samples collected during the RI will be evaluated for their applicability in the HHRA. Data selection/reduction steps for the HHRA will include (1) reviewing analytical data and grouping data into medium-specific exposure units based on potential exposures of receptors, (2) analytes not detected in any samples for a particular medium-specific exposure unit will be eliminated for that medium-specific exposure unit, (3) evaluating the analytical data with respect to the quality of the analytical data to determine their usability in the HHRA, (4) evaluating duplicate samples, and (5) determining summary statistics for each medium specific exposure unit. Summary statistics for each Exposure Unit (EU) include the following: mean, median, standard deviation, interquartile range, minimum detected concentration, maximum detected concentration, sample size, number of non-detects, and range of reporting limits for the non-detects. Only validated data will be used in evaluating the analytical data quality.

**Identification of Chemicals of Potential Concern.** A comparison to screening criteria will be conducted to identify COPCs in environmental media at each AOC. The purpose of the comparison is to identify COPCs that may pose adverse effects to human health, thereby focusing efforts on chemicals most likely to be associated with excess human health risks. If a chemical is selected as a COPC, it does not imply that the chemical poses a health risk or that it will contribute to a significant risk in an environmental medium. COPCs are merely those chemicals that require further evaluation for their potential human health effects.

A chemical will be selected as a COPC if its maximum detected concentration exceeds its respective screening level. The chemical-specific screening levels for each medium will be based on the lowest of the following criteria:

### *Soil and Sediment*

- USEPA RSLs for Residential Soil, based on (1) a carcinogenic risk level of $10^{-6}$ or (2) a non-carcinogenic hazard quotient (HQ) of 0.1 (USEPA, 2015b). The RSLs for non-carcinogens are based on a HQ of 1; however, they will be lowered by a factor of 10 to account for potential cumulative effects from multiple non-carcinogens.
- NYCRR Chapter 6 Part 375-1: Remedial Soil Cleanup Objectives (NYCRR 2015)
- NYSDEC CP-51: Soil Cleanup Guidance (NYSDEC 2010)

### *Groundwater and Surface Water*

- USEPA RSLs for Tap Water, based on (1) a carcinogenic risk level of $10^{-6}$ or (2) a non-carcinogenic HQ of 0.1 (USEPA, 2015b). The RSLs for non-carcinogens are based on a HQ of 1; however, they will be lowered by a factor of 10 to account for potential cumulative effects from multiple non-carcinogens.; or
- USEPA Drinking Water Standards MCLs (USEPA, 2015b).
- A RSL has not been developed for lead in tap water. The USEPA action level for lead in drinking water of 15 μg /L will be used.
- NYSDEC TOGS, 1.1.1 Ambient Water Quality Standards and Guidance Values (NYSDEC 2004)

**Conceptual Site Model for Exposure**. Refer to Section 4.6.

**Exposure Assessment.** The exposure assessment for the HHRA will consist of (1) the development of a CSM for exposure (discussed above), and (2) the determination of the extent of human exposure to environmental contaminants which will be represented by an estimation of daily intake or dose, which is composed of environmental and human-oriented variables such as exposure point concentrations (EPCs) and intake rates, respectively. Daily intake estimates will be calculated for the potentially complete receptor exposure scenarios identified in the CSM.

- **EPCs** – An EPC is the concentration of a COPC at the point of contact made between the COPC and a human receptor. In long-term exposures (e.g., years), a receptor can be expected to contact the exposure medium at all locations within an exposure unit (i.e., the site). As a result, the contaminant concentrations contacted by a receptor approaches the

average concentration (i.e., arithmetic mean) within the site. Typically, an upper confidence limit (UCL) (95% or greater) of the arithmetic mean is used as a best estimate of the true arithmetic mean concentration at the site (USEPA 1992b).

EPCs will be estimated for COPCs using ProUCL Version 5.0.00. ProUCL calculates UCLs of the mean with a specific confidence level (95% or greater) using 15 computational methods and recommends the most appropriate UCL based on the data. ProUCL is designed to test the normality of a dataset and compute a conservative and stable UCL of the true population mean while considering sample size, the distribution of the data, and the skewness of the data. Based on information presented in the ProUCL guidance regarding minimum sample size and frequency of detection, UCLs will be calculated where at least 8-10 samples and at least 6 detects were available. Where too few samples or detects are available, the maximum detected concentration (MDC) will be used as the EPC. In cases where the UCL exceeds the MDC, the MDC will be used as the EPC, in accordance with USEPA guidance.

- **Intake Parameters** – A reasonable maximum exposure (RME) estimate of intake will be developed for each receptor exposure pathway identified for quantitative evaluation in the CSM. The RME estimate is the highest exposure that is reasonably expected to occur in a small but definable "high-end" segment of a potentially exposed population. It is derived using upper-bound values for a few of the most sensitive exposure parameters (e.g., contact rate, exposure frequency, and duration) and average values for the remaining parameters.

  The development of chemical intakes will be based on USEPA methodology presented in RAGS Part A, Part E, and Part F (USEPA, 1989, 2004, and 2009) and Office of Solid Waste and Emergency Response Directive 9285.6-03 (USEPA 1991). The values used for many exposure parameters in the HHRA will be standard values based on available risk assessment guidance documents, such as the Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors, OSWER Directive 9200.1-120 (USEPA 2014), RAGS Part A, Part E, and Part F (USEPA 1989, 2004, and 2009). The values used for some exposure parameters will be derived from site-specific information and professional judgment regarding the specific exposure scenario.

Refer to Appendix F, Tables F-1 through F-11, which provide preliminary exposure factors for receptors and potentially completer exposure pathways (Section 4.6.1) identified for the Camp Hero AOCs.

**Toxicity Assessment**. The toxicity assessment is a combination of two steps in the risk assessment process: hazard identification and dose-response assessment. Hazard identification determines whether or not an environmental contaminant is causally associated with particular

adverse health effects. Dose-response assessment determines the relationship between exposure and the probability of occurrence of the health effects defined during the hazard identification.

The toxicity assessment portion of a risk assessment is, for the most part, completed by private toxicology industries or by government agencies, such as the USEPA and the Agency for Toxic Substances and Disease Registry. Toxicological data are made available to risk assessors through databases, such as the on-line USEPA Integrated Risk Information System. Carcinogenic and non-carcinogenic toxicity values used for the HHRA will be based on the three tiered hierarchy of toxicity values established per OSWER Directive 9285.7-53 (USEPA 2003b). COPCs that lack toxicity data, and where appropriate surrogate toxicity data cannot be identified, will be included in the HHRA for consideration during risk management decisions.

**Risk Characterization**. Risk characterization is a description of the nature and magnitude of human risk, including attendant uncertainties. The toxicity and exposure assessments will be combined to provide quantitative assessments of the cancer risk and noncancer hazards. Cancer risks and/or noncancer hazards will be estimated for each COPC for which toxicity values are available, the significance of the calculated risks and hazards will be characterized, and the uncertainties associated with these estimates will be described. As discussed in Section 4.6.1, current/future trespassers are the only receptor whose potential risks will be evaluated qualitatively using the potential risks/HI estimated for a current/future recreational user.

**Uncertainty Analysis**. Uncertainty is defined as a lack of precise knowledge as to what the truth is, whether qualitative or quantitative. There are numerous sources of uncertainty that can affect the reliability of a risk assessment. In general, sources of uncertainty can be identified for each of the three main components of an HHRA: exposure assessment, toxicity assessment, and risk characterization. As stated in the USEPA risk assessment guidance, conducting a detailed quantitative uncertainty analysis is often not practical or necessary for a site-specific human health risk assessment. Instead, a qualitative uncertainty analysis is typically sufficient. For the HHRA, a qualitative analysis will be provided to identify the primary assessment-specific and site-specific uncertainties such that risk managers can appropriately interpret the risk assessment results.

### 5.4.2 Ecological Screening Level Risk Assessment

A SLERA will be completed as required by CERCLA which provides information necessary for the completion of the RI. Maps, site descriptions, and resource descriptions will be provided to identify possible pathways of COPEC migration affecting wildlife. The SLERA will be conducted in two phases. Surface soil samples will be collected for sites where surface impacts from the contaminants of potential ecological concern (COPEC) is anticipated; no surface soil samples will be

collected from AOCs where potential contamination occurred at depths greater than one foot bgs (i.e. USTs, waste disposal system) since ecological receptors will not encounter subsurface soil.

Data from the surface soil samples, as well as information from the Phase 1 site characterization to assess surface water flow directions, wetlands, and ecological receptors, will be used to identify data gaps to be addressed in Phase 2. The approach to the ecological risk assessment is summarized below and details on the receptors, COPEC, and the areas of concern where surface soil contamination was detected above the ecological screening criteria will be identified in the WP Addendum.

The underlying guidance for the ecological risk assessment will be USEPA Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments, Interim Final, 1997a (EcoRAGS). The USEPA methodology is an 8-step approach as outlined in Figure 2-1. The organization of the ERA will be a tiered approach as recommended in:

- Tri-Service Environmental Risk Assessment Working Group, 2008. A guide to Screening Level Ecological Risk Assessment, TSERAWG TG-090801.September;
- US Army Biological Technical Assistance Group, 2005. Technical Document for Ecological Risk Assessment, *A Guide to Screening Level Ecological Risk Assessment*, US Army Environmental Center. Aberdeen Proving Ground, MD, April; and
- USEPA Region I and New York guidance for ERAs.

The ERA will consist of two primary components: Tier I -SLERA-) consisting of USEPA's Steps 1 and 2 and Tier II Baseline ecological risk assessment (BERA) consisting of the preliminary problem formulation for Step 3 (i.e., Step 3a).

The Tier I SLERA will identify chemicals of potential ecological concern that may pose adverse effects to ecological receptors, thereby focusing efforts on those chemicals most likely to be associated with excess risk of adverse effects to plants, soil invertebrates, wildlife, aquatic life, and benthic organisms. Maximum Detected Concentrations of chemicals detected in soil, groundwater impacted by the sites will be compared to protective screening criteria to identify COPECs for further evaluation in the Tier II BERA. Chemicals with MDCs that exceeded screening levels for a specific medium and those non-detected chemicals with reporting limits that exceed their screening value will be retained as COPECs for that medium in the Tier II BERA where a more site-specific evaluation will be conducted.

## 6.0 AREAS OF CONCERN DESCRIPTIONS

The AOCs included in the RI are a combination of sites previously identified in the 1998 Camp Hero FS (Cashin 1998) and others identified during the 2016 records review conducted in preparation of this RI. The locations of the AOCs are shown on the Site Map in **Figure 1-2**. Photographs of the AOCs are included in the Photograph Log (Appendix D). A summary of these AOCs and the RI approach can be found in **Table 6-1.** The scope for the Phase 1 investigation is provided by AOC in each subsection below. Specific details for the sampling and analysis are provided in the SAP. The scope of the Phase 2 investigation will be provided in the RI WP Addendum.

### 6.1 Battery 113

Battery 113 has historically been referred to as Bunker-1 and Battery Dunn. Battery 113 (identified as Bunker 113 on maps) consisted of two 16-inch casemated guns and battle allowances of ammunition and powder charges were stored within the battery. Battle allowances of ammunition and powder charges for the Camp Hero battery guns were stored within the individual batteries of the camp. Battery 113 had a battle allowance of 200 16-inch 2,240-lb projectiles.

The Camp Hero FS (Cashin 1998) noted a cluster of tanks of various sizes and shapes inside Battery 113, the prior purpose of which is unknown. These included two cylindrical red-painted tanks suspended from the wall; three vertical tanks standing on the floor, which have heavily rusted exteriors; and what was suspected to be one or more tanks in a wooden enclosure on the floor. These tanks were thought to be part of a single system, or multiple systems, possibly including fire suppression, hydraulic fluids, emergency water supply, or emergency fuel supply. Waste drums were also noted.

During the records review of archived NY State Park Service drawings of Battery 113, the two cylindrical red-painted tanks suspended from the wall are identified as 150 gallon diesel fuel tanks.

Additionally, the Cashin Report notes Battery 113 to have had oil staining under electrical equipment in the old electrical room. This location was sampled for PCBs, and results showed a PCB level of 24,200 ppb (Cashin 1998).

**Phase 1:** Access to Battery 113 will be assessed in Phase 1. If safe access is available, a site survey will be conducted to identify the use of the remaining tanks and waste drums. If liquid is present, up to four characterization samples will be collected within the tanks and drums. Standing water in the pits will also be sampled for disposal purposes.

The site survey will also confirm visual evidence of PCB-contaminated stained concrete. Up to three concrete chip samples will be collected for analysis of PCB content. Phase 1 sampling locations at Battery 113 are shown on **Figure 6-1**.

If safe access is not available in Phase 1 of the RI field activities, the approach for Battery 113 will be re-evaluated in the RI WP Addendum for Phase 2 activities. The integrity of the original buildings will not be impacted while attempting to gain access for the sampling effort.

**Table 6-1**
**Areas of Concern Summary Table**

| Area of Concern | Additional Site Names | Figure | Reason for Concern | Potential Impact | Phase 1 |
|---|---|---|---|---|---|
| Battery 113 | Bunker-B1, Battery Dunn | Figure 6-1 | Oil Staining | PCBs | Assessment for access, 3 concrete chip samples to be analyzed for PCBs. |
| | | | Tanks, Drums, Pits | Hazardous Materials | Assessment for access, site survey to identify use of tanks and waste drums, 4 liquid samples for hazardous material characterization (if applicable) from tanks and drums, water samples taken from pits (if applicable). |
| Former Building 203 | N/A | Figure 6-2 | Possible solvent and residual petroleum | Solvent(s), petroleum | 5 Geoprobe® borings, 5 groundwater samples, 10 soil samples (5 shallow and 5 deep). Up to 5 piezometers to determine groundwater flow. |
| Building 2010 | Cashin #39, Water Meter | Figure 6-3 | Lead in Soil | Lead | 2 Geoprobe® borings, up to 4 soil samples per boring (1 sample 0 – 4 fts bgs, 1 sample every foot from 4 – 7 ft bgs or depth) and 1 groundwater sample per boring |
| Building F100C | Cashin #40, Well House | Figure 6-4 | Lead in Soil | Lead | 2 Geoprobe® borings, up to 4 soil samples per boring (1 sample 0 – 4 fts bgs, 1 sample every foot from 4 – 7 ft bgs or depth) and 1 groundwater sample per boring |
| AST-35 | H-13 | Figure 6-5 | Tank #35, 200,000 gallon tank associated with reported spill | Petroleum | 4 Geoprobe® borings to perched water table, 8 soil samples (4 deep and 4 shallow), 4 groundwater samples. |
| Distribution Line for AST-35 | N/A | Figure 6-6 | Distribution line connected to AST-35 | Petroleum | 6 Geoprobe® borings to perched water table, 12 soil samples (6 deep and 6 shallow), 6 groundwater samples. |
| Building 20 (Tank-A) | Cashin #14, Fire Department | Figure 6-7 | Suspected former tank location | Petroleum | Verify Tank-A removal via magnetometer, up to 5 Geoprobe® borings, 5 groundwater samples, 10 soil samples (5 shallow and 5 deep). |
| Building 22 (Tank-B) | Cashin #22, Kitchen/Office | Figure 6-8 | Suspected former tank location | Petroleum | Verify tank removal via magnetometer, up to 5 Geoprobe® borings, 5 groundwater samples, 10 soil samples (5 shallow and 5 deep). |
| Building 2 (Tank-C) | Cashin #24, Barracks | Figure 6-9 | Suspected former tank location | Petroleum | Verify tank removal via magnetometer, up to 5 Geoprobe® borings, 5 groundwater samples, 10 soil samples (5 shallow and 5 deep). |

**Table 6-1**
**Areas of Concern Summary Table**

| Area of Concern | Additional Site Names | Figure | Reason for Concern | Potential Impact | Phase 1 |
|---|---|---|---|---|---|
| Building 104R (Tank-D) | Cashin #33, Commissary, | Figure 6-10 | Suspected former tank location | Petroleum | Verify tank removal via magnetometer, up to 5 Geoprobe® borings, 5 groundwater samples, 10 soil samples (5 shallow and 5 deep). |
| Building 3001 (Tank-E) | Cashin #47, AT&T Building, Lilco Building, State Park Police Residence | Figure 6-11 | Suspected former tank location | Petroleum | Magnetometer survey to verify UST. If UST location is confirmed: 5 Geoprobe® borings, 5 groundwater samples, 10 soil samples (5 shallow and 5 deep). One additional groundwater sample from existing well. |
| Pump House (Tank F) | Near Battery 216/Bunker 4 | Figure 6-12 | Suspected former tank location, Hazardous Materials | Petroleum | Magnetometer survey to verify UST. If UST location is confirmed: 5 Geoprobe® borings, 5 groundwater samples, 10 soil samples (5 shallow and 5 deep). |
| Pump House (Tank G) | Near Well 4 | Figure 6-13 | Suspected former tank location | Petroleum | Magnetometer survey to verify UST. If UST location is confirmed: 5 Geoprobe® borings, 5 groundwater samples, 10 soil samples (5 shallow and 5 deep). |
| Battery 112 | Bunker-3 | Figure 6-14 | Oil Staining | PCBs | Assessment for access to Battery, site survey to identify any tanks or staining, 3 concrete chip samples. |
| Building 107 | Cashin #5, Electrical Sub-station | Figure 6-15 | Electrical | PCBs | Assessment for access to basement, verify liquids in transformers, sample transformer fluids (if applicable) and sample for PCBs. |
| Building 201 | Cashin #1, Main Radar Tower | Figure 6-16 | Electrical | PCBs | Assessment for access, Site Survey to identify staining, 3 PCB wipe samples. 1 Geoprobe® boring at cesspool. |
| Abandoned Waste Disposal Systems (Site-wide) | N/A | Figure 6-17 | Hazardous Material Disposal | Hazardous Materials | 27 Geoprobe® borings, 1 soil sample (specific depths), and 1 groundwater sampleat each location (27 total soil and groundwater samples). |
| Motor Pool | N/A | Figure 6-18 | Hydraulic lift, Cesspool, Ordnance Repair | Petroleum, Hazardous Materials, Munitions Constituents | 3 Geoprobe® borings, 3 groundwater samples and 6 soil samples (3 shallow and 3 deep), one additional GW sample from existing non-potable supply well (NPSW). |

**Table 6-1**
**Areas of Concern Summary Table**

| Area of Concern | Additional Site Names | Figure | Reason for Concern | Potential Impact | Phase 1 |
|---|---|---|---|---|---|
| Engineering Field Office | Adjacent to Motor Pool | Figure 6-19 | Ordnance Repair | Munitions Constituents | 1 Geoprobe® boring, 1 groundwater sample, 2 soil samples (1 shallow and 1 deep). |
| H-1, H-2, H-3, H-18, H-20, H-22 | Area of Possible DoD Related Disposal | Figures 6-20, 6-21, 6-22, 6-35, 6-37, 6-39 | Drums | Hazardous Materials | Site survey to identify drums, 12 surface and 12 near-surface soil samples (2 surface and near-surface at each H-location). If applicable, sample liquid in drums. |
| H-4 and H-6 | Area of Possible DoD Related Disposal | Figures 6-23, 6-25 | Construction Debris | Hazardous Materials | Site survey to identify debris, 6 Geoprobe® borings, 6 groundwater samples, 12 soil samples. |
| H-5 | Area of Possible DoD Related Disposal | Figure 6-24 | Construction Debris | Hazardous Materials | 8 surface and 8 near-surface soil samples under debris locations; if applicable: sample liquid in drums. |
| H-7, H-8, H-9 | Area of Possible DoD Related Disposal | Figures 6-26, 6-27, 6-28 | Boilers | Petroleum | Site Survey to identify boilers, 3 surface soil samples (1 under each). Based on site survey, 3 Geoprobe borings (1 at each) may be necessary (2 subsurface soil samples, 1 groundwater sample per boring . |
| H-11 | Former Power Plant | Figure 6-29 | Suspected Contamination | Petroleum, Metals, PCBs | 2 Geoprobe® borings, 2 groundwater samples, 4 soil samples (2 shallow and 2 deep). |
| H-12 | Sewage Ejector Station | Figure 6-30 | Suspected Contamination | Hazardous Materials | 1 Geoprobe® boring, 1 groundwater sample, and 2 soil samples (1 shallow and 1 deep). |
| H-14, H-15 | Coal Storage Area | Figures 6-31, 6-32 | Suspected Contamination | PAH | 6 Geoprobe® borings (3 borings at each location), 6 groundwater samples and 12 soil samples (6 shallow and 6 deep). |
| H-16 | Sewage Treatment Area | Figure 6-33 | Suspected Contamination | Hazardous Materials | Site Survey, 3 Geoprobe® borings, 3 groundwater samples and 6 soil samples (3 shallow and 3 deep). |
| H-17, H-21 | Area of Possible DoD Related Disposal | Figures 6-34, 6-38 | Open Pits | Hazardous Materials | Site Survey to identify pits, 6 Geoprobe® borings (3 at each location), 6 groundwater samples and 12 soil samples (6 shallow and 6 deep). |

**Table 6-2**
**Areas of Concern Summary Table**

| Area of Concern | Additional Site Names | Figure | Reason for Concern | Potential Impact | Phase 1 |
|---|---|---|---|---|---|
| H-19 | Area of Possible DoD Related Disposal | Figure 6-36 | 550 gallon Storage Tank | Hazardous Materials | Site Survey to identify tank, 2 surface soil samples, liquid characterization if applicable. Based on site survey, 2 Geoprobe borings may be necessary (2 subsurface soil samples, 1 groundwater sample per boring). |
| Battery 216 | N/A | Figure 6-40 | Potential unknown storage or vaults | Potential release to environment. | Geophysics around building. |
| Plotting Room 113 | N/A | Figure 6-41 | Potential unknown storage or vaults | Potential release to environment | Geophysics around building. |
| Camp Hero State Park Bluffs (AGC Site 3) | N/A | Figure 6-42 | Metal Debris | Metal debris hazards | Visual and screening level magnetometer survey. |
| AGC Sites 1, 2, and 4 | N/A | Figure 6-43 | Waste Dumping or Metal Debris | Potential release to environment Metal debris hazards | Based on a visual and screening level magnetometer survey, up to 3 borings for soil and groundwater samples (2 subsurface soil samples, 1 groundwater sample per boring). |
| Background Samples | N/A | Figure 1-2 | N/A | N/A | 16 Geoprobe® borings (4 borings at 4 locations), 32 subsurface soil samples, 30 surface soil samples (one from each Geoprobe® boring and 14 additional, between the four locations) |

N/A not applicable
PAH polynuclear aromatic hydrocarbon
DoD Department of Defense, United States
PCB Polychlorinated biphenyls

## 6.2 Building 203

Former Building 203 is shown on Figure 6-2. The building housed four large generators which supplied electrical power to Camp Hero. USTs outside of Building 203 were utilized to supply fuel and lubricants to the generators. Ethylene glycol Several hundred feet of piping containing 150 gallons of ethylene glycol were noted in the former power generator building, presumably used for cooling the generators. In 1994, UST 16 (25,000 gallon #2 fuel oil), UST 18 (25,000 gallon #2 fuel oil), and UST 17 (1000 gallon lube oil) were removed from the perimeter of former Building 203. USTs 16 and 18 were located on the south side of the building and UST 17 was located on the southeast side of the building. Upon removal of USTs 16 and 18, a green liquid that appeared to be ethylene glycol was observed on the sidewalls of the excavation and on water standing in the bottom of the excavation at 17 ft bgs. A solvent odor was present and it was suspected that solvents had been dumped around the building based on visual evidence of surface soil staining and elevated volatile and semi-volatile laboratory results of soil. The area behind building 203 and adjacent to the USTs was described as a dumping ground for waste oil and spent solvents. A French drain was also observed during excavation activities to surround the Building 203 foundation. The French drain was suspected of acting as a conduit to allow hazardous liquids to migrate around the foundation of the building and into the subsurface soil (NYSDEC Spill Report 93-09575, 1993).

There were several drums of glycol at the site during the UST removal action and several hundred feet of piping containing 150 gallons of glycol in the former generator building, presumably used for cooling the generators (NYSDEC Spill Report 93-09575, 1993). However, ethylene glycol is a clear, colorless, and viscous liquid that is miscible in water and rapidly biodegrades in soils. It is very likely that ethylene glycol in soils would not be detected at this time decades after it was released. In addition, the soils and foundation around former Building 203, which likely contained ethylene glycol, were excavated during decommission of the building.

The single excavation pit for USTs 16 and 18 was over-excavated. The NYSDEC spill report indicates 2,500 yards of soil were removed. A Site Assessment Report was submitted for the site to NYSDEC in June 1995. Nine Geoprobe® borings were conducted surrounding the USTs excavation and two Geoprobe® locations were conducted near the center of the excavation. The Geoprobe® location near the center of the excavation was advanced to 53 ft bgs in an attempt to reach groundwater; however, no groundwater was intercepted to this depth. Dense clay was found at depth and surrounding the UST excavation. A soil sample was taken at 53 ft bgs with analysis results below screening criteria. A temporary well was installed to 21 ft below grade, which slowly recharged with groundwater overnight. The results of the soil samples and the groundwater sample taken from the Geoprobe® boreholes were below screening criteria. However, the laboratory method detection limits utilized in the assessment at that time are roughly 10 orders of magnitude

higher than what is currently required to evaluate human health risk. The Spill Report Case was closed by the NYSDEC in July 1995.

In 2000, during additional site-wide environmental assessment at Camp Hero by the USACE, a surface water sample was obtained from a drainage area below Building 203 near where a small ditch leading from Building 203 was observed to outfall (Weston 2000). The sample was analyzed for PCBs, SVOCs, and metals. No PCBs or SVOCs were detected in the surface water sample. Two metals, zinc and arsenic, were detected in the sample but were below screening criteria.

**Phase 1:** The USTs at former Building 203 (USTs 16, 17, and 18) have been previously closed in accordance with 6 NYCRR 613.99(b); however, use of solvents and ethylene glycol in the area of the tanks and Building is suspected based on NYSDEC closure reports. To investigate the presence of solvents, five DPT borings will be advanced in the area of the former Building 203 and UST excavation. Building 203 and USTs have been excavated and replaced with clean fill. The boring will be located just beyond the excavation and fill zones to the extent possible.

The Phase 1 RI soil sampling will focus on the perched groundwater-soil interface at 17 to19 ft and above as a potential contaminant transport zone from former Building 203 and the USTs. Two soil samples will be obtained from each boring – one from the upper portion (where there are PID readings are above background or visual indicators of staining) and one at the perched groundwater-soil interface. Contamination was not detected in samples collected from the previous UST site assessment, which targeted the depth of the former UST excavation (at 17 to 19 ft bgs). If no groundwater is encountered within the anticipated depth of the perched water table (5 to 25 ft bgs), borings will be advanced to a maximum of 25 ft bgs.

One grab groundwater sample will also be obtained from each of the soil borings. Based on the slow recharge rate to temporary monitoring wells noted during the 2000 site-wide environmental assessment, temporary wells may be necessary at each borehole in order to collect sufficient groundwater sample volumes from each location (Weston 2000). If within 24 hours, groundwater recharge is insufficient for sample collection, then no groundwater sample will be collected during Phase 1. The necessity for installation of monitoring wells into the principle aquifer will be evaluated based on the Phase 1 results.

Because of the potential presence of residual solvents and waste oil in soils at Building 201 above human health risk based criteria , soil and groundwater samples from the area behind Building 201 and adjacent to former petroleum storage tank sites are proposed for the full SW-846 suite of analysis for VOCs, SVOCs, PCBs, and metals.

Additionally, three piezometers will be installed upgradient and downgradient of the Building 203 UST 16 and 18 excavations (PZ-1 through PZ-3). Piezometers will be used for radial groundwater flow and direction information in the vicinity; no analytical samples will be collected from piezometers. Phase 1 sampling locations and piezometer locations at Building 203 are shown on **Figure 6-2**.

## 6.3 Building 2010 (UST 30)

Building 2010 was formerly operated as a groundwater well house. The well house contained a power generator for groundwater pump operation which was connected to UST 30. Building 2010 is also referred to as "Building 39" in the Cashin Report archives drawings. A 100-gallon gasoline UST was removed from the southeast corner of Building 2010 in October 1993. The excavation was 4.5 ft by 7 ft by 4.5 ft deep. The NYSDEC Tank Removal Form indicated that no release had occurred from the UST. Low levels of petroleum were detected in soil samples from the excavation; however, lead was reported to be as high as 600 ppm (NYSDEC Tank Removal Form, December 1994). Additional sampling will be conducted during Phase 1 RI activities to determine the presence or absence of lead in soil and groundwater.

**Phase 1:** Two Geoprobe® borings will be advanced immediately adjacent to the former 100-gallon UST excavation at the southeast corner of Building 2010 to a depth of 7 ft bgs or the depth of the perched water table, whichever is encountered first. One soil sample will be collected from the 0 – 4 ft bgs interval and additional soil samples will be collected every foot from 4 ft bgs to the depth of the boring (at depths of 4 – 5 ft bgs, 5 – 6 ft bgs, and 6 – 7 ft bgs), for a total of up to 4 samples per boring. A groundwater grab sample will be obtained from each of the soil borings, if perched water is present. The soil and groundwater samples will be analyzed for lead. Phase 1 sampling locations at Building 2010 are shown on **Figure 6-3**.

## 6.4 Building F100C (UST 34)

Building F100C has previously been referred to in the Cashin Report as Building 40 and formerly operated as a groundwater well house. UST 34 was a 275 gallon gasoline tank removed from the south side of Building F100C in October 1993. Ten yards of petroleum-impacted soil was removed from around the UST. Low levels of petroleum were detected in soil samples from the excavation; however, lead was reported to be as high as 549 ppm (NYSDEC Tank Removal Report, December, 1994). Additional sampling will be conducted during Phase 1 RI activities to determine the presence or absence of lead in soil and groundwater.

**Phase 1:** Two Geoprobe® borings will be advanced immediately adjacent to the former 100-gallon UST excavation at the south of Building F100C to a depth of 7 ft bgs or the depth of the perched water table, whichever is encountered first. One soil sample will be collected from the 0 – 4 ft bgs

interval and additional soil samples will be collected every foot from 4 ft bgs to the depth of the boring (at depths of 4 – 5 ft bgs, 5 – 6 ft bgs, and 6 – 7 ft bgs), for a total of up to 4 samples per boring. A groundwater grab sample will be obtained from each of the soil borings, if perched water is present. The soil and groundwater samples will be analyzed for lead. Phase 1 sampling locations at Building F100C are shown on **Figure 6-4**.

## 6.5 Former and Suspected Tanks

One AST at Camp Hero (AST-35, also identified as H-13 in the Cashin Report) does not have complete closure documentation. As such, additional investigation is proposed at this AOC. Additionally, seven suspected tanks are located at Camp Hero; there is no closure documentation for these tanks, but archive drawings indicate possible tank storage locations.

The locations of the seven suspected USTs will begin with a geophysical survey to confirm the absence or presence of the UST and help locate subsurface utilities. The geophysical survey will include a magnetometer and/or ground-penetrating radar geophysical methods. DPT will then be utilized for soil logging and sampling. Four borings will be conducted in each direction around the UST. If the UST is not found during the geophysical survey, an additional boring will be conducted from the center, where the UST was suspected. One soil sample will be collected from each soil boring from the most impacted interval as identified by visual or olfactory evidence of contaminants, or elevated photoionization detector readings. A second soil sample will be collected from the interval immediately above the groundwater and soil interface. One groundwater sample will be collected from each boring from the perched water table.

A summary of tank numbers, locations, and removals were compiled during the records review. This information is presented in Section 2.0 of this RI WP.

### 6.5.1 AST-35/H-13

The H-13 location has been previously identified in the Cashin Report as a sewage holding tank. However, it also appears from the Cashin Report (Cashin 1998) and archive drawings that a 200,000-gallon diesel fuel AST was located at this site. The archive research indicated that there was a 1,000-gallon release from this tank; however, the available documentation is incomplete. Therefore, additional investigation is recommended. If any additional information or documentation is located, it will be used to further refine the investigation and will be included in the RI report.

**Phase 1:** Four Geoprobe® soil borings to the perched water table will be advanced around the former storage tank. Boring locations will be completed in compliance with 6 NYCRR 613.9(b). One of the Geoprobe® borings is located on the pad of the AST and coring will be necessary prior to boring. Two soil samples will be obtained from each boring: one from the upper portion (where there are PID readings are above background or visual indicators of staining) and one at the

perched groundwater-soil interface. Soil samples will be analyzed for petroleum compounds by the NYSDEC STARS list for fuel oil VOCs and SVOCs. One groundwater sample will be collected from each boring for analysis of VOCs and SVOCs.

Additionally, two piezometers will be installed upgradient and downgradient in adjacent former diesel storage tank/sewage disposal area (H-13) in the direction of groundwater flow. One of the two piezometers will also be used for evaluating the groundwater flow direction for the Building 203 AOC (PZ-1). Piezometers will be used for groundwater flow and direction; no analytical samples will be collected from piezometers. Phase 1 sampling locations at AST-35/H-13 are shown on **Figure 6-5.**

### 6.5.2 Fuel Pump House and Distribution Line for AST-35

Archive drawings indicate that a fuel pump house is located on the northwest side of the former AST pad and a fuel line may have extended from the former AST-35 location to the former generators at Building 203 or to the fuel storage tank at AOC H-13. No additional information about the fuel line is available. During the January 2016 site walk, fuel odor was noticed inside the Fuel Pump House.

**Phase 1:** Three Geoprobe® borings to the perched water table will be advanced at the Fuel Pump House (two downgradient and one inside the building). At the one location inside the building, concrete coring will be completed prior to drilling. For the distribution lines, a geophysical survey will be conducted in the vicinity of the suspected distribution line to determine the exact location of the line. Up to six Geoprobe® soil borings to the perched water table will be advanced along the fuel line to Building 203 at locations based on the results of the geophysical survey... Borings will be completed in compliance with 6 NY Codes, Rules, and Regulations (NYCRR) 613.9(b). Two soil samples will be obtained from each boring: one from the upper portion (where there are PID readings are above background or visual indicators of staining) and one at the perched groundwater-soil interface. Soil samples will be analyzed for petroleum compounds by the NYSDEC STARS list for fuel oil VOCs and SVOCs. One groundwater sample will also be collected from each boring for analysis of VOCs and SVOCs. Phase 1 sampling locations at Fuel Pump House and Distribution Line for AST-35/H-13 are shown on **Figure 6-6**.

### 6.5.3 Suspected Tanks A, B, C, D

The Cashin report recommended verification of removal for nine USTs at Camp Hero by geophysical survey. However, the 2016 records search identified Office of Pollution Control (OCP) Tank Compliance Inspection Data Sheets from August 1, 2012, which indicated that five of the nine tanks identified (USTs 40, 41, 43, 45, and 46) had been removed. These five USTs have no reported spills associated with them and are therefore not included in this RI.

The remaining four USTs noted in the Cashin Report will be investigated as part of the RI activities as Tanks A, B, C, and D. The Cashin Report noted four buildings containing features indicating possible tanks: Buildings 2, 20, 22, and 104R (referred to in the Cashin Report as Buildings 14, 22, 24, and 33 under a different building numbering scheme). Archive drawings also indicated that USTs were installed at one time at these four buildings.

**Phase 1:** A geophysical survey will be conducted at Buildings 20, 22, 2, and 104R to verify if the suspected petroleum USTs exists. If a UST is located at these buildings, up to five Geoprobe® borings are proposed at each AOC. The determination for the number and placement of the borings will be in compliance with 6 NYCRR 613.9(b). Two soil samples will be collected from each boring: one from the upper portion (where there are PID readings are above background or visual indicators of staining) and one immediately below the bottom of the suspected UST. A groundwater sample will be collected from each of the soil borings from the perched water table at each AOC. Soil samples will be analyzed for petroleum compounds by the NYSDEC STARS list for fuel oil VOCs and SVOCs. Groundwater samples will be analyzed for VOCs and SVOCs.. Phase 1 sampling locations at Suspected Tanks A through D are shown on **Figure 6-7** through **Figure 6-10** of the RI WP, respectively.

Based on results of the geophysical survey, test pits may be required to determine the presence or absence of underground tanks or other anomalies. The need for test pitting will be assessed after the Phase 1 field work, and if test pits are deemed necessary, they will be included in RI WP Addendum and executed during Phase 2 activities.

### 6.5.4 Suspected Tank E

Suspected Tank E is located near Building 3001, which has also historically been referred to as Building 47 (Cashin Report), State Park Police Lilco Building, and AT&T Building. UST 26 has been removed from the AOC, although UST 49 remains in use. Archive drawings suggest a third UST in the vicinity of the former UST 26 location. One existing well is located on the Southwest side of Building 3001.

**Phase 1:** A geophysical survey will be conducted at Building 3001 to verify if the suspected petroleum UST exists. If a UST is located, up to five Geoprobe® soil borings are proposed to obtain soil and groundwater samples. Determination of boring placement will be in compliance with 6 NYCRR 613.9(b). Two soil samples will be collected from each boring: one from the upper portion (where there are PID readings are above background or visual indicators of staining) and one immediately below the bottom of the suspected UST. A groundwater sample will be collected from each boring from the perched water table. Additionally, one groundwater sample will be collected from the existing well on the southwest side of Building 3001 from an available untreated tap. Soil

samples will be analyzed for petroleum compounds by the NYSDEC STARS list for fuel oil VOCs and SVOCs. Groundwater samples will be analyzed for VOCs and SVOCs. Phase 1 sampling locations at Suspected Tank E are shown on **Figure 6-11**.

Based on results of the geophysical survey, test pits may be required to determine the presence or absence of underground tanks or other anomalies. The need for test pitting will be assessed after the Phase 1 field work, and if test pits are deemed necessary, they will be included in RI WP Addendum and executed during Phase 2 activities.

### 6.5.5 Suspected Tanks F and G

Archive figures indicate that suspected Tank F could be located at the pump house near Battery 216 (also known as Bunker-4). This groundwater pump house is suspected to have a UST in proximity to the building. An additional pump house was noted at Well 4 during the January 2016 site walk, and an additional tank (Tank G) is suspected at that location. A similar pump house on Camp Hero had a 100 gallon gasoline UST removed.

**Phase 1:** A geophysical survey will be conducted to locate the potential UST at each pump house. If a UST is located, up to five Geoprobe® borings will be advanced immediately adjacent to each tank, in compliance with 6 NYCRR 613.9(b). Two soil samples will be collected from each boring: one from the upper portion (where there are PID readings are above background or visual indicators of staining) and one immediately below the bottom of the suspected UST. A groundwater sample will be collected from each boring from the perched water table. Soil samples will be analyzed for petroleum compounds by the NYSDEC STARS list for gasoline VOCs and lead. Groundwater samples will be analyzed for VOCs and metals. Phase 1 sampling locations at Suspected Tanks G and F are shown on **Figures 6-12** and **6-13**.

Based on results of the geophysical survey, test pits may be required to determine the presence or absence of underground tanks or other anomalies. The need for test pitting will be assessed after the Phase 1 field work, and if test pits are deemed necessary, they will be included in RI WP Addendum and executed during Phase 2 activities.

## 6.6 Polychlorinated Biphenyls

### 6.6.1 Battery 112

Battery 112, also known as Bunker-3, is also associated with UST 36 and UST 37, which were located outside the battery. Battery 112 consisted of two 16-inch casemated guns and battle allowances of ammunition and powder charges were stored within the battery. Battle allowances of ammunition and powder charges for the Camp Hero battery guns were stored within the individual batteries of the camp. Battery 112 had a battle allowance of 200 16-inch 2,240-lb projectiles.

Access to Battery 112 will be assessed during the Phase 1. It was noted in the Project Kick-Off Meeting in October 2015 that Battery 112 is sealed and access inside the building may not be feasible. The Cashin Report noted that the "as-built" plans for Battery 112 show that the floor plan for Battery 113 and Battery 112 (Bunker 3) are identical; however, no tanks or waste drums were observed in Battery 112, as noted in the Cashin Report.

**Phase 1:** Access to Battery 112 will be assessed during Phase 1. If safe access is available, a site survey will be conducted to confirm no ASTs are present and to locate potential visual evidence of PCB contaminated stained concrete. Up to three concrete chip samples will be collected for analysis of PCB content. Phase 1 sampling locations at Battery 112 are shown on **Figure 6-14**.

If safe access is not available in Phase 1 of the RI field activities, the approach for Battery 112 will be re-evaluated in the RI WP Addendum for Phase 2 activities. The integrity of the original buildings will not be impacted while attempting to gain access for the sampling effort.

### 6.6.2 Building 107

Building 107 has also been known as Building 5 (Cashin Report) or the Electrical Substation. The Cashin Report noted that transformers were in the basement of the building and may have contained or contain PCBs. Archive pictures of Building 107 show multiple electrical conduits in a concrete trench with metal covering that extended to the power generating building 203.

In an August 2000 environmental assessment, a stained area was noted in the northeast comer of the basement of Building 5, which was three feet by five feet in area. At that time, there was an opening to the outside approximately three to four feet above the floor. No floor drains were observed in the basement where the four transformers are still mounted on the wall. A concrete chip sample was collected from the stained area (Weston 2000).

Analytical results indicate that PCBs are present within the observed oil stain at a level above the Toxic Substances Control Act (TSCA) unrestricted use limit of 1 milligram per kilogram (mg/kg) in Building 107. Based on the depth of the PCBs in the concrete, it appeared that the oil had not migrated outside the building at that time. The findings indicated that no significant ecological or human health threats existed via migration.

**Phase 1:** Access to the basement of Building 5 will be assessed in Phase 1. If safe access to the wall mounted transformers exists, the field team will attempt to verify if fluids are present in the transformers. One fluids sample will be collected, if possible, for analysis of PCB content. The Phase 1 sampling location at Building 107 is shown on **Figure 6-15**.

If safe access is not available in Phase 1 of the RI field activities, the approach for Building 107 will be re-evaluated in the RI WP Addendum for Phase 2 activities. The integrity of the original buildings will not be impacted while attempting to gain access for the sampling effort.

### 6.6.3 Building 201

Building 201 is also known as Building 1 (Cashin Report), Building #P-201, the Radar Tower, and AN/FPS-35. Building 201 is a 5 story high radar tower with 2-foot thick concrete walls and was sealed off by USACE and NYS Parks to prohibit entrance. The building has a large steel radar dish on top which was a prime component of the DoD early detection radar systems. Building 201 is associated with UST 20, which was removed and included in NYSDEC Spill Report #93-12038.

The Cashin Report recommended further investigation be conducted to investigate associated oil leaks and any spills containing PCBs to prevent a possible release to the environment. In an August 2000 Data Collection Report (Weston 2000), the first floor of the Radar Tower contained a stained area, which was approximately four feet by six feet in area. The stained area was present below several pipes extending from the ceiling labeled "refrigerated water return." The stained area was reported as not darkly stained and adjacent to a six-inch diameter floor drain. The concrete was not stained below 0.5 inches. A concrete chip sample (sample C-2) was collected from the stained area (Weston 2000). A structure which appeared to be a cesspool was noted in the Data Collection Report to be adjacent to the Radar Tower. This cesspool was also identified on sanitary drawings obtained during the records research for this RI WP.

One chip sample, four surficial soil, and one subsurface soil sample was obtained at the Radar Tower for PCB analysis. PCBs were detected in the surface soil only at sample location SS-14 near the radar tower. Aroclor 1254 was detected at 1.4 mg/kg, which is just above the regulatory criteria of 1 mg/kg. Based on the data provided in the 2000 report, the area of contamination appears to be minimal, as no PCBs were detected above the regulatory criteria in adjacent samples collected within 50 ft of that location.

Analytical results indicate that PCBs are present within the observed oil stain at a level above the TSCA unrestricted use limit of 1 mg/kg in the Radar tower. Based on the depth of the PCBs in the concrete, it appears that the oil has not migrated outside the building. The findings indicated that no significant ecological or human health threats existed via migration. The stains could be addressed by concrete removal, painting over the stains, or, if necessary, controlling building access (Weston 2000).

In 2002, this Radar Tower was listed on the National Register of Historic Places through the Department of the Interior. The NY State Office of Parks, Recreation, and Historic Preservation and the Department of Interior will be contacted prior to beginning the Phase 1 investigation at this

AOC. Proposed PCB sampling at this location will include a minimally invasive Phase 1 to ensure the preservation and conservation of the Radar Tower and Antenna.

**Phase 1:** If safe access is available, a site survey of the bottom floor of the Radar Tower, where transformers and staining was observed during previous assessment in 2000 (Weston 2000), will be conducted to verify that there is no other stained areas. If additional staining is observed, one wipe sample will be collected within the stained area for analysis of PCB content.

Additionally, one Geoprobe® boring will be advanced at the former Radar Tower cesspool to the depth of the perched water table. Two soil samples will be obtained from each boring: one from the upper portion (where there are PID readings are above background or visual indicators of staining) and one at the perched groundwater-soil interface. One groundwater sample will also be collected from each boring. Soil and groundwater samples will be analyzed for the SW-846 list of analytes for VOCs, SVOCs, and metals, which may have been released to the cesspool. The soil and groundwater samples will also be analyzed for PCBs to determine if a release has occurred at the Radar Tower and/or nearby structures. Phase 1 sampling locations at Building 201 are shown on **Figure 6-16**.

If safe access is not available in Phase 1 of the RI field activities, the approach will be re-evaluated in the RI WP Addendum for Phase 2 activities. The integrity of the original buildings will not be impacted while attempting to gain access for the sampling effort.

### 6.7 Abandoned Waste Disposal System (Site-Wide)

The Abandoned Waste Disposal Systems (site-wide) are suspected former areas of hazardous waste dumping. This system has been abandoned and has not been used by the NY State Parks. The abandoned site-wide sanitary sewer was identified during the 2016 historical records search from archive drawings of Camp Hero provided by the NY State Parks. It appears from these drawings that septic fields and cesspools were also utilized at Camp Hero prior to construction of the site-wide sanitary sewer system that is now abandoned. The site-wide sanitary sewer system was connected to a chlorine chamber (chlorine house) for treatment prior to discharging into the Atlantic Ocean at a headwall outfall. The location of the site-wide sanitary sewer line and former septic fields and cesspools are shown on the Site Map (**Figure 1-2**).

**Phase 1:** Soil and groundwater sampling of the abandoned site-wide waste disposal system will be focused at former leach fields and cesspools downgradient from buildings which may have utilized hazardous materials. The sample locations are biased to potential weak sites or collection areas along the sewer line, such as locations of 90-degree turns, where the sanitary line is joined by a secondary sanitary line from former operations buildings, collection tanks, and at the chlorination building. The locations of former sanitary leach fields, septic tanks, and cesspools

utilized prior to construction of the site-wide sanitary sewer system are also included in the soil and groundwater sampling.

Twenty-seven Geoprobe® borings will be advanced throughout the waste disposal system to the depth of the abandoned site-wide sanitary sewer line or bottom of the leach field, septic tank, or cesspool structure. The sewer line profiles have been supplied in archive drawings by NY State Parks and were utilized to determine depths of samples. Depths of each boring are specified in the SAP. One soil sample and a grab groundwater sample will be collected from each boring at depth. Soil and groundwater samples will be analyzed for the SW-846 list of analytes for VOCs, SVOCs, PCBs, and metals. Phase 1 sample locations for the site-wide abandoned waste disposal system are shown on **Figures 6-17a** through **6-17e**.

### 6.8 Motor Pool

The Motor Pool building contained a hydraulic lift for vehicle maintenance. According to the State Park Superintendent (Mr. Tom Dess) in a phone interview, the concrete floor over the hydraulic lift was capped at the time the State Park began utilizing the Facility. Since that time, the Motor Pool building has been beneficially reused by the NYS State Park. A 1940 Camp Hero archive site map identifies the Motor Pool building was once utilized as an Ordnance Repair Shop. A floor drain was likely present in the building during DoD use of the building.

Additionally, a cesspool on the east side of the motor pool, downgradient from the building, has also been identified through the historical records search. There is potential that petroleum, munitions constituents, and/or hazardous materials may have drained through the floor drain, which may have led to the cesspool. There was no evidence of a discharge pipe from the Motor Pool Building to the ground surface outside of the Motor Pool Building observed during a site walk over in this area conducted on 3 November 2015 during the project kick-off meeting.

One existing groundwater supply well currently utilized for non-potable purposes at the Motor Pool (untreated tap) is located on the west side of the building.

**Phase 1:** At the location of the former hydraulic lift, one soil boring will be advanced through the concrete slab adjacent at the former hydraulic lift to the depth of the bottom of the former lift, which is assumed to be 8 to 10 ft bgs (at the interface of the fill and native soil). Concrete coring will be conducted prior to boring. Two soil samples will be obtained from the boring: one from the upper portion (where there are PID readings are above background or visual indicators of staining) and one at the perched groundwater-soil interface. Soil samples will be analyzed for petroleum compounds by the NYSDEC STARS list for fuel oil VOCs and SVOCs. One groundwater sample will also be collected from the boring for analysis of VOCs and SVOCs.

Adjacent to the location of the former floor drain to the cesspool just outside the building, one Geoprobe boring will be advanced to the depth of the perched water table outside the building (approximately 2 ft from the outfall). Two soil samples will be obtained from the boring: one surface soil sample from 0 to 1 ft bgs interval and one subsurface soil sample at the perched groundwater-soil interface. If PID readings above background or visual indicators of staining are noted, a third soil sample will be collected at the corresponding location. Soil samples will be analyzed for petroleum compounds by the NYSDEC STARS list for fuel oil VOCs and SVOCs and for energetics. One groundwater sample will also be collected for analysis of VOCs, SVOCs, and energetics.

Along the sewer line from the building to the cesspool, one soil boring will be advanced to the depth of the perched water table. Two soil samples will be obtained from the boring: one surface soil sample from 0 to 1 ft bgs interval and one subsurface soil sample at the perched groundwater-soil interface. If PID readings above background or visual indicators of staining are noted, a third soil sample will be collected at the corresponding location. One groundwater sample will also be collected. Soil and groundwater samples will be analyzed for the NYSDEC STARS list for fuel oil VOCs and SVOCs, PCBs, and energetics. Additionally, one groundwater sample will be collected from the existing well located on the west side of the Motor Pool from an available untreated tap for analysis of the SW-846 list of analytes for VOCs, SVOCs, PCBs, energetics, and metals. The Phase 1 sampling locations at the Motor Pool are shown on **Figure 6-18**.

Note that an additional soil boring (WDS-SB11) will be conducted immediately adjacent to the cesspool as part of the site-wide abandoned waste disposal system AOC (see **Figure 6-17d**). WDS-SB11 will be advanced adjacent to the former cesspool to the depth of the cesspool.

## 6.9 Engineering Field Office

A former engineering field office building was identified on a 1940 site map located adjacent to the Motor Pool building. The 1940 site map identifies the motor pool building as once utilized as an Ordnance Repair Shop. Archive pictures of the engineering field office indicate it was a two-story high wooden building with double doors. Work related to ordnance repair may have also occurred in the engineering field office located adjacent to the Motor Pool building.

**Phase 1:** One soil boring will be advanced downgradient of the former engineering field office, on the south side of the building within the drainage area adjacent to the building foundation, to the depth of the perched water table. Two soil samples will be obtained from the boring: one surface soil sample from 0 to 1 ft bgs interval and one subsurface soil sample at the perched groundwater-soil interface. Soil samples will be analyzed energetics. One groundwater sample will also be

collected for analysis of and energetics. The Phase 1 sampling location for the Engineering Field Office is shown on **Figure 6-19**.

## 6.10 Areas of Possible DoD Related Disposal

The Cashin Report identified several AOCs related to potential DoD disposal activities. These areas include drums, pits, boilers, building debris, and buildings. These AOC locations are provided on the Site Map in **Figure 1-2**.

### 6.10.1 Drum Locations (H-1, H-2, H-3, H-18, H-20, and H-22)

During the Camp Hero FS (Cashin 1998) these six locations were observed with one or two 55-gallon drums or drum remnants.

**Phase 1:** A site survey will be conducted to verify the number of drums present at each location, record any labeling or identification on the drums, and sample liquid if present in the drums. The liquid in the drums, if present, will be analyzed for liquid characterization (VOCs, SVOCs, PCBs, and metals) prior to removal or disposal, which will be addressed during Phase 2.

Two surface soil samples (approximately 1 ft bgs) and two near-surface soil samples (approximately 2 ft bgs) will be collected from underneath each drum location for analysis of the SW-846 list of analytes for VOCs, SVOCs, PCBs, and metals. Phase 1 sampling locations for H-1 are shown on **Figure 6-20**; H-2, **Figure 6-21**; H-3, **Figure 6-22**; H-18, **Figure 6-35**; H-20, **Figure 6-37**; and H-22, **Figure 6-39**.

### 6.10.2 Construction Debris Areas (H-4 and H-6)

The Cashin Report noted AOCs H-4 and H-6 contained construction debris. It appears from aerial photography that amount of construction debris may have been significant at AOC H-4 based on the cleared area and a concrete pad at the site.

**Phase 1:** A walk-over survey will be conducted to identify the amount and location of construction debris at both H-4 and H-6. Three Geoprobe® borings will be advanced to the depth of the perched aquifer under the debris (at each AOC) or on the downgradient edge of the debris. Two soil samples will be obtained from each boring: one surface soil sample from 0 to 1 ft bgs interval and one subsurface soil sample at the perched groundwater-soil interface. One groundwater sample will be collected from each boring. Soil and groundwater samples will be analyzed for lead from lead-based paint and PCBs. Groundwater samples will be collected from the perched aquifer at each boring. Phase 1 sampling locations for H-4 and H-6 are shown on **Figures 6-23** and **6-25**, respectively.

### 6.10.3 Drum Location with Construction Debris (H-5)

There are five drums with construction debris at AOC H-5 which were pictured in the Cashin Report located in a topographic swale southeast of the Motor Pool Building. Three of the drums were identified as contents unknown. However, there was no evidence of these drums present during a Site Walk Over in this area conducted on November 3, 2015 during the RI/FS Project kick-off meeting. Mr. Dess (NYS Camp Hero Superintendent) indicated the parks had removed a motorcycle frame and some debris from this area previous.

**Phase 1:** A walk-over survey will be conducted to verify the number of drums and record any labeling or identification on the drums. Eight surface soil samples (approximately 1 ft bgs) and eight near-surface soil samples (approximately 2 ft bgs), co-located, will be collected from underneath the drum locations and construction debris. Soil samples at the construction debris area will be sampled for lead from lead-based paint and PCBs. Soil samples from underneath the drums will be sampled for VOCs, SVOCs, PCBs, and metals.

If liquid is present in the drums, a sample will be collected from each drum for liquid characterization (VOCs, SVOCs, PCBs, and metals). Phase 1 sampling locations for H-5 are shown on **Figure 6-24**.

### 6.10.4 Possible Boilers (H-7, H-8 and H-9)

The Cashin Report noted that these locations at Camp Hero contained what appeared to be old boilers (1998).

**Phase 1:** A visual survey will be conducted to determine whether boilers still exist at these AOCs. If the boilers are present, one surface soil sample (0–1 ft bgs) will be collected under each boiler for analysis of the SW-846 methods analyte list for SVOCs (PAHs only) and metals. If stained soils are noted or if field screening of the surface soil samples with the PID (in the plastic, re-sealable bag bag) indicates the presence of petroleum during the inspection, one Geoprobe® boring will be advanced to the depth of the perched water table. Two soil samples (one from the upper portion where there are PID readings are above background or visual indicators of staining and one at the perched groundwater-soil interface) and one grab-groundwater sample will be collected, for the same analyte list. Phase 1 sampling locations for H-7, H-8, and H-9 are shown on **Figures 6-26**, **6-27**, and **6-28**, respectively.

### 6.10.5 Former Power Plant (H-11)

As noted in the Cashin Report, further investigation was recommended to investigate potential petroleum, metals, and PCBs in soil and groundwater associated with the former power plant. In an August 2000 environmental assessment, five groundwater, two surficial soil, two subsurface soil,

and two sediment samples were collected and analyzed for PCBs, SVOCs, and metals (Weston 2000).

At that time, the former Power Plant location contained three to five feet of fill material, consisting mostly of charcoal. No PCBs were detected in soils or groundwater from the area. Beryllium was detected above the regulatory criteria in one subsurface soil (SS-1) and chromium and lead were detected at concentrations that slightly exceeded screening criteria in one of five groundwater sample locations (GW-2). The levels of chromium and lead were somewhat elevated in relation to the reference well located up-gradient of the former Power Plant location.

Results from surface water and sediment samples indicated no evidence of contaminant transport pathways from the buildings to adjacent sensitive environmental areas, such as forested wetlands and streams (Weston 2000).

**Phase 1:** Two Geoprobe® borings will be advanced to the depth of the perched aquifer within the footprint of the former Power Plant Building to confirm previous data results reported in 2000 (Weston 2000). Two soil samples will be obtained from each boring: one surface soil sample from 0 to 1 ft bgs interval and one subsurface soil sample at the perched groundwater-soil interface. If PID readings above background or visual indicators of staining are noted, a third soil sample will be collected at the corresponding location. One groundwater sample will also be collected from each boring. Soil and groundwater samples will be analyzed for the SW-846 methods analyte list for SVOCs (PAHs only), PCBs, and metals. Unfiltered groundwater samples will be collected to assess potential human health risk from total metals during Phase 1. Filtered and unfiltered groundwater samples will be collected from permanent monitoring wells installed during Phase 2, based on the results of Phase 1 sampling. Phase 1 sampling locations for the Former Power Plant are shown on **Figure 6-29**.

Note that two Geoprobe® borings are being conducted in the tile drain field associated with the former Power Plant Building as part of the site-wide abandoned sanitary sewer investigation and will be addressed as part of that AOC.

### 6.10.6 Sewage Ejector Station (H-12)

The sewage ejector station, located near the former heating plant, was noted in the Cashin Report as a potential AOC due to waste handling.

**Phase 1:** One Geoprobe® soil boring will be advanced to the perched water table or to the depth of the former sewage ejector station, approximately 12 ft bgs. Two soil samples (one from the upper portion where there are PID readings are above background or visual indicators of staining and one at the approximate depth corresponding to the bottom of the former sewage ejector

station) and one groundwater sample will be collected for analysis of VOCs, SVOCs, PCBs, and metals using SW-846. The results from this location will also be included in the overall assessment of the site-wide abandoned sanitary sewer system. Phase 1 sampling locations for the Sewage Ejector Station are shown on **Figure 6-30**.

### 6.10.7 Former Coal Storage (H-14 and H-15)

Two former coal storage areas were identified in the Cashin Report and on archive drawings obtained during the 2016 historical records search.

**Phase 1:** Three Geoprobe® borings to the perched water table will be advanced within the suspected area of each coal storage area (six total soil borings). Two soil samples will be obtained from each boring: one surface soil sample from 0 to 1 ft bgs interval and one subsurface soil sample at the perched groundwater-soil interface. If PID readings above background or visual indicators of staining are noted, a third soil sample will be collected at the corresponding location. One groundwater sample will also be collected from each boring. Soil and groundwater samples will be analyzed for the SW-846 methods analyte list for SVOCs (PAHs only) and metals. Phase 1 sampling locations for H-14 and H-15 are shown on **Figures 6-31** and **6-32**, respectively.

### 6.10.8 Former Sewage Treatment Area (H-16)

The Cashin Report reported a sewage treatment area just east of the current Camp Hero motor pool. Historic site drawings indicate a proposed sewage treatment plant in this area; however, the available documentation is incomplete. Therefore, additional investigation is recommended. If any additional information or documentation is located, it will be used to further refine the investigation and will be included in the RI Report.

**Phase 1:** A walk-over survey will be conducted to identify the status and size of former sewage treatment area at this location. Two Geoprobe® borings will be advanced to the perched groundwater table in and around the former sewage treatment area. Two soil samples will be obtained from each boring: one surface soil sample from 0 to 1 ft bgs interval and one subsurface soil sample at the perched groundwater-soil interface. If PID readings above background or visual indicators of staining are noted, a third soil sample will be collected at the corresponding location. One groundwater sample will also be collected from each boring. Soil and groundwater samples will be analyzed for VOCs, SVOCs, PCBs, and metals. Phase 1 sampling locations for H-16 are shown on **Figure 6-33**.

Additionally, one boring location associated with the abandoned site-wide waste disposal system (WDS-SB11) is located within the H-16 area. WDS-SB11 will be advanced adjacent to the former cesspool to the depth of the cesspool.

### 6.10.9 Open Pits (H-17 and H-21)

The Cashin Report noted two open pit locations which may have been dumping areas. Geospatial analysis of these areas by the USACE AGC were inconclusive (USACE 2016). Based on visual inspection of the areas, there have been ground disturbances. Phase 1 investigation is planned to confirm or deny suspected waste related to DoD utilization of this area.

**Phase 1:** A walk-over survey will be conducted to identify the status, size, and topography of both open pits. One Geoprobe® boring will be advanced topographically upgradient and two Geoprobe® borings will be advanced topographically downgradient of each pit (for a total of three borings at each pit) to the depth of the perched aquifer.

Two soil samples will be obtained from each boring: one surface soil sample from 0 to 1 ft bgs interval and one subsurface soil sample at the perched groundwater-soil interface. If PID readings above background or visual indicators of staining are noted, a third soil sample will be collected at the corresponding location. One groundwater sample will also be collected at each boring. Soil and groundwater samples will be analyzed for the SW-846 methods analyte list for VOCs, SVOCs, PCBs, and metals. Phase 1 sampling locations for H-17 and H-21 are shown on **Figures 6-34** and **6-38**, respectively.

### 6.10.10 AST 550-Gallon (H-19)

The Cashin Report noted one discarded 550-gallon above ground storage tank was located in the area of Camp Hero between Hill 72 and 83, in the northern section of the site. The location is shown in the Site Map in **Figure 1-2**.

**Phase 1:** A walk-over survey will be conducted to identify if the 550-gallon AST still exists at Camp Hero. Two surface soil samples will be collected under or adjacent to the tank for analysis of SW-846 methods analyte list for VOCs, SVOCs (PAHs only), and metals. If stained soils are noted or vapor monitoring using the PID indicates the presence of petroleum during the walk-over, two Geoprobe® borings will be advanced to the depth of the perched water table. Two soil samples (one from the upper portion where there are PID readings are above background or visual indicators of staining and one at the perched groundwater-soil interface) and one grab-groundwater sample will be collected from each boring, for the same analyte list. If liquid is present in the AST, one sample will be collected from the tank and analyzed for hazardous waste characteristics. Phase 1 sampling locations at H-19 are shown on **Figure 6-36**.

## 6.11 Geophysical Survey Areas – Battery 216 and Plotting Room 113

There is concern for the potential of buried metal debris or unknown USTs around two AOCs, which are identified as Battery 216 and Plotting Room 113.

**Phase 1 –** A geophysical survey will be conducted around both buildings. The survey area at each AOC is shown on **Figures 6-40** and **6-41**, respectively. If a geophysical anomaly is identified which is suspected to be a potential waste disposal or UST, up to five Geoprobe® borings will be advanced immediately adjacent to each tank, in compliance with 6 NYCRR 613.9(b). Two soil samples will be collected from each boring, one from the upper portion (where there are PID readings are above background or visual indicators of staining) and one immediately below the estimated bottom of the suspected UST. A groundwater sample will be collected from each boring from the perched water table. Soil samples will be analyzed for petroleum compounds by the NYSDEC STARS lists for gasoline and fuel oil VOCs, SVOCs, and lead. Groundwater samples will be analyzed for VOCs, SVOCs, and lead.

Based on results of the geophysical survey, test pits may be required to determine the presence or absence of underground tanks or other anomalies. The need for test pitting will be assessed after the Phase 1 field work, and if test pits are deemed necessary, they will be included in RI WP Addendum and executed during Phase 2 activities.

### 6.12 Camp Hero State Park Bluffs/AGC Site 3

A boiler or small tank and metal debris was observed at the bottom of the steep slope along the southern bluffs of Camp Hero during the Site Walk conducted in October 2015. Additionally, this area corresponds to Site 3, identified by the USACE Army Geospatial Center (ACG), as an area where dumping could have taken place (see details in Section 6.13 below).

**Phase 1:** To investigate potential buried debris, the AECOM-Tidewater JV will conduct a visual inspection and screening level geophysical survey using a metal detector at AGC Site 3 during Phase 1 of the RI field activities.. Based on a previous walk-over survey, it was concluded that the miscellaneous metal debris was inert and did not previously contain liquid contents. Therefore, it has been determined that soil and/or groundwater samples are not necessary for this AOC. The survey area at the Camp Hero State Park Bluffs is shown on **Figure 6-42**.

### 6.13 AGC Sites 1, 2, and 4

As part of this investigation, the Hydrologic and Environmental Analysis Branch of the Warfighter Support Directorate of the USACE ACG was tasked to search, collect, and review historical aerial photography from 1940 to 1982 searching for features associated with dumps within the former Camp Hero boundary. Their report concluded that there was no photographic evidence of debris accumulation suggestive of a dump in the years collected within the timeframe of this project. However, four areas were identified where dumping could have taken place, described as access points to cleared areas near or along the bluff (USACE 2016). The four areas, designated "AGC Sites 1, 2, and 4" for this RI WP, are shown on **Figure 6-43**.

AGC Site 3 corresponds to the "Camp Hero State Park Bluffs" AOC, which was already established as a part of this investigation.

**Phase 1:** To investigate potential buried debris, the AECOM-Tidewater JV will conduct a visual inspection and screening level geophysical survey using a metal detector at AGC Sites 1, 2, and 4during Phase 1 of the RI field activities. If the visual and magnetometer results indicate subsurface anomalies, up to 3 borings at each of the AGC Sites (except AGC Site 3, as established in Section 6.12 above) will be installed to confirm or deny waste dumping. Borings will be advanced to the depth of the perched water table. Two soil samples (one from the upper portion where there are PID readings are above background or visual indicators of staining and one at the perched groundwater-soil interface) and one grab-groundwater sample will be collected for analysis of SVOCs (PAHs only) and metals.

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## 7.0 REFERENCES

***Note:*** *Numerous files from the NYS DEC DER were used to document UST removal actions and closures. These files have been referenced by their Spill Number in the RI WP and are not listed below.*

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# Appendix A

# Figures

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# General Location Map
# Former Camp Hero Military Base

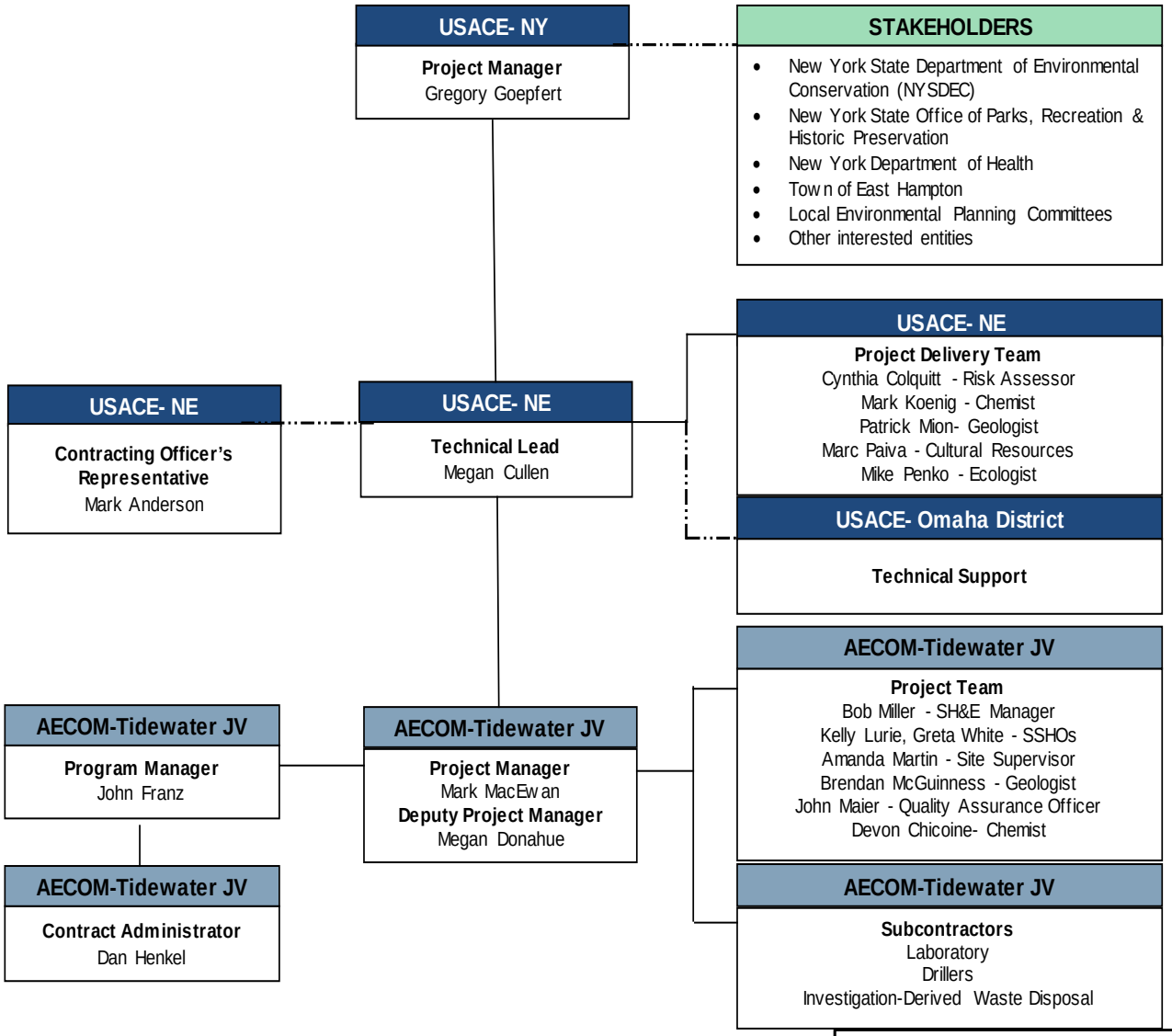
Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 1-1** |

5/2/2016 1:24,000 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 1-1 General Location.mxd

**Figure 1-2 Site Map with AOC Locations**

*Please see attached map.*




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# Camp Hero Project Organization Chart

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE | FIGURE 1-3 |
|---|---|---|---|
| 60443903 | DDS | May 2016 | |







MAP LOCATION

N
W
E
S

0 465 930 Feet

1 inch = 900 feet

AECOM

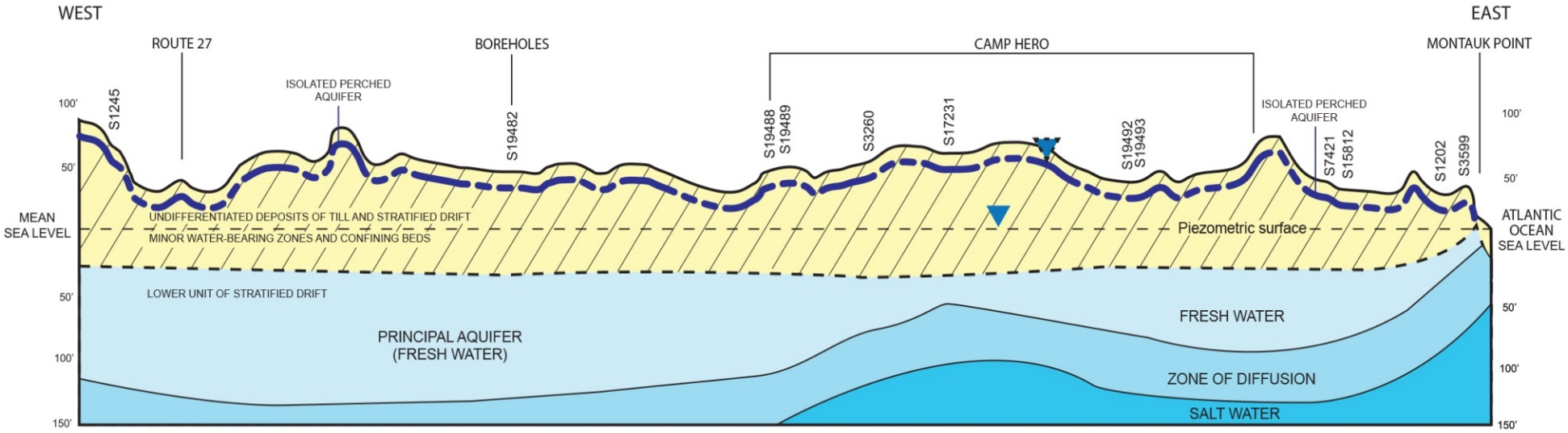
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# Areas of Interest Identified in the EE/CA

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 2-1** |

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LEGEND

- UPPER UNIT OF UNDIFFERENTIATED DEPOSITS OF TILL AND STRATIFIED DRIFT WITH ISOLATED PERCHED AQUIFER
- ISOLATED PERCHED AQUIFER
- LOWER UNIT OF STRATIFIED DRIFT WITH PRINCIPAL AQUIFER (FRESH WATER)
- ZONE OF DIFFUSION SALT WATER / FRESH WATER
- SALT WATER
- PIEZOMETRIC SURFACE OF PRINCIPLE AQUIFER
- PIEZOMETRIC SURFACE OF PERCHED WATER TABLE (WHERE PRESENT)

SOURCE:
Modified from *Availability of Fresh Water, Montauk Point Area, Suffolk County, Long Island*. Geologic Survey Paper 1613-3

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# General Hydrology at Camp Hero

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE | FIGURE 3-1 |
|---|---|---|---|
| 60443903 | DDS | May 2016 | |

**Figure 3-2 Topographic Site Map**

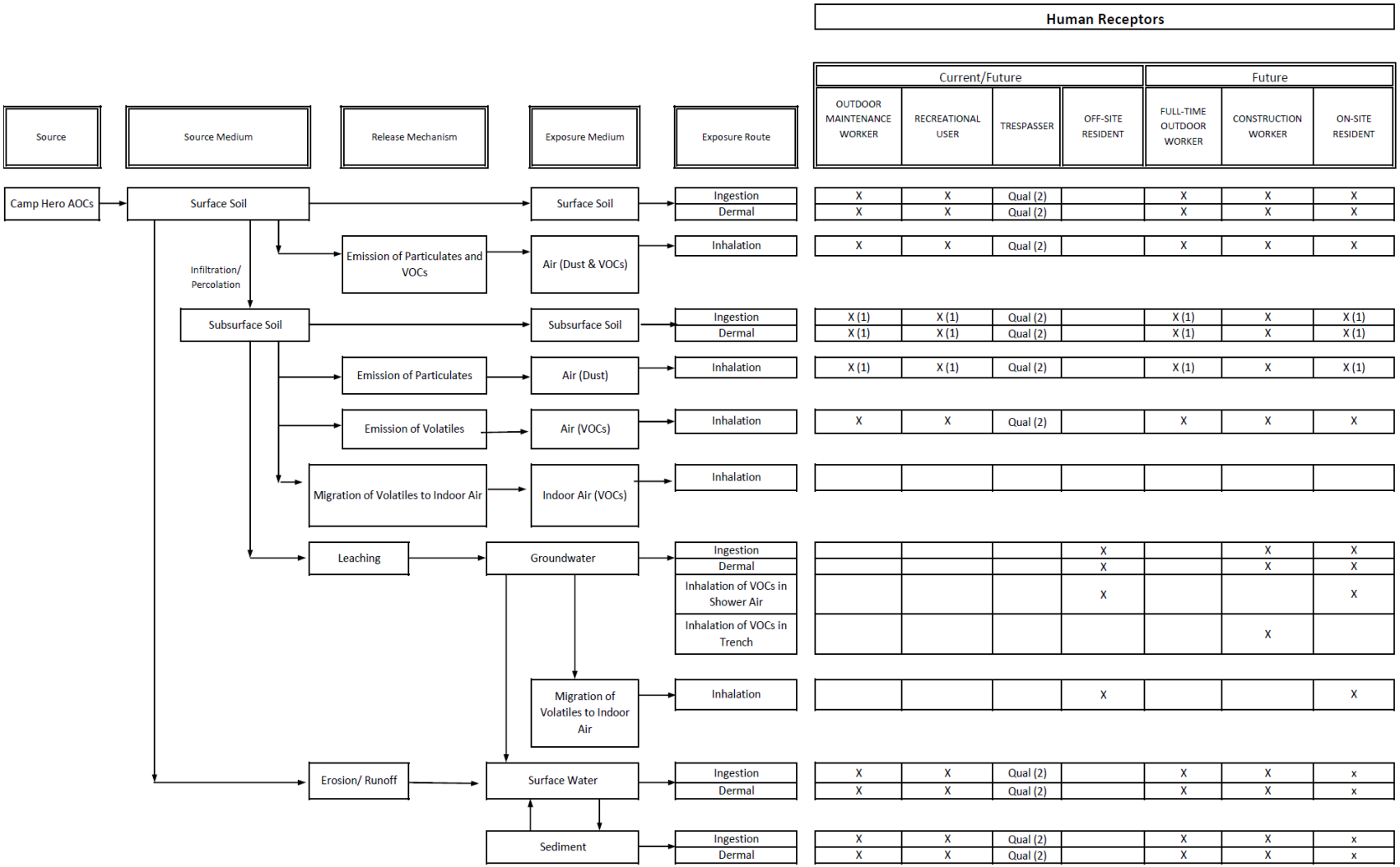
*Please see attached map.*

**Figure 3-3 Soils Site Map**

*Please see attached map.*

**Figure 3-4 Significant Communities Site Map**

*Please see attached map.*




LEGEND

X = Potentially complete exposure pathway to be evaluated
Empty block = Incomplete exposure pathway

(1) Assumes subsurface soil may be re-deposited as surface soil via future excavation.

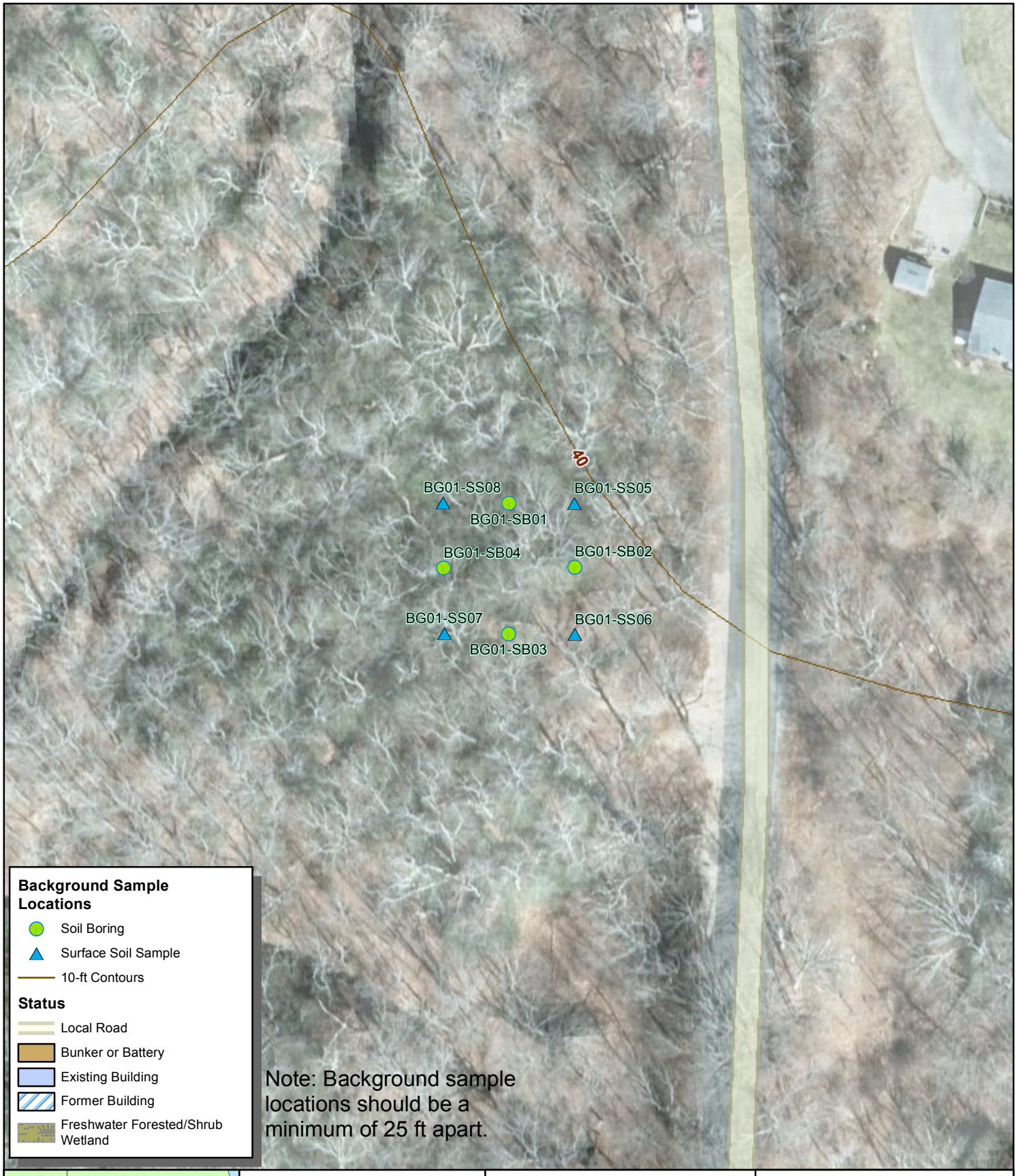
Qual (2) = Potential exposures/risks to a trespasser will be qualitatively evaluated by using the recreational user whose potential exposures/risks are likely more conservative. The current/future recreational user will be assumed to be a 26-year resident (adult/child) who will use the park for recreational activities while a trespasser would be an adult/adolescent. Because a recreational user would have the similar exposure areas, the same or greater exposure frequency, greater exposure duration and ingestion rates, and lower body weight (child), potential exposures/risks to a recreational user would likely be greater than those to trespasser.


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# Exposure Pathway Diagram for AOCs at Camp Hero

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **FIGURE 4-1** |







MAP LOCATION

N
W
E
S

0 25 50

Feet

1 inch = 50 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

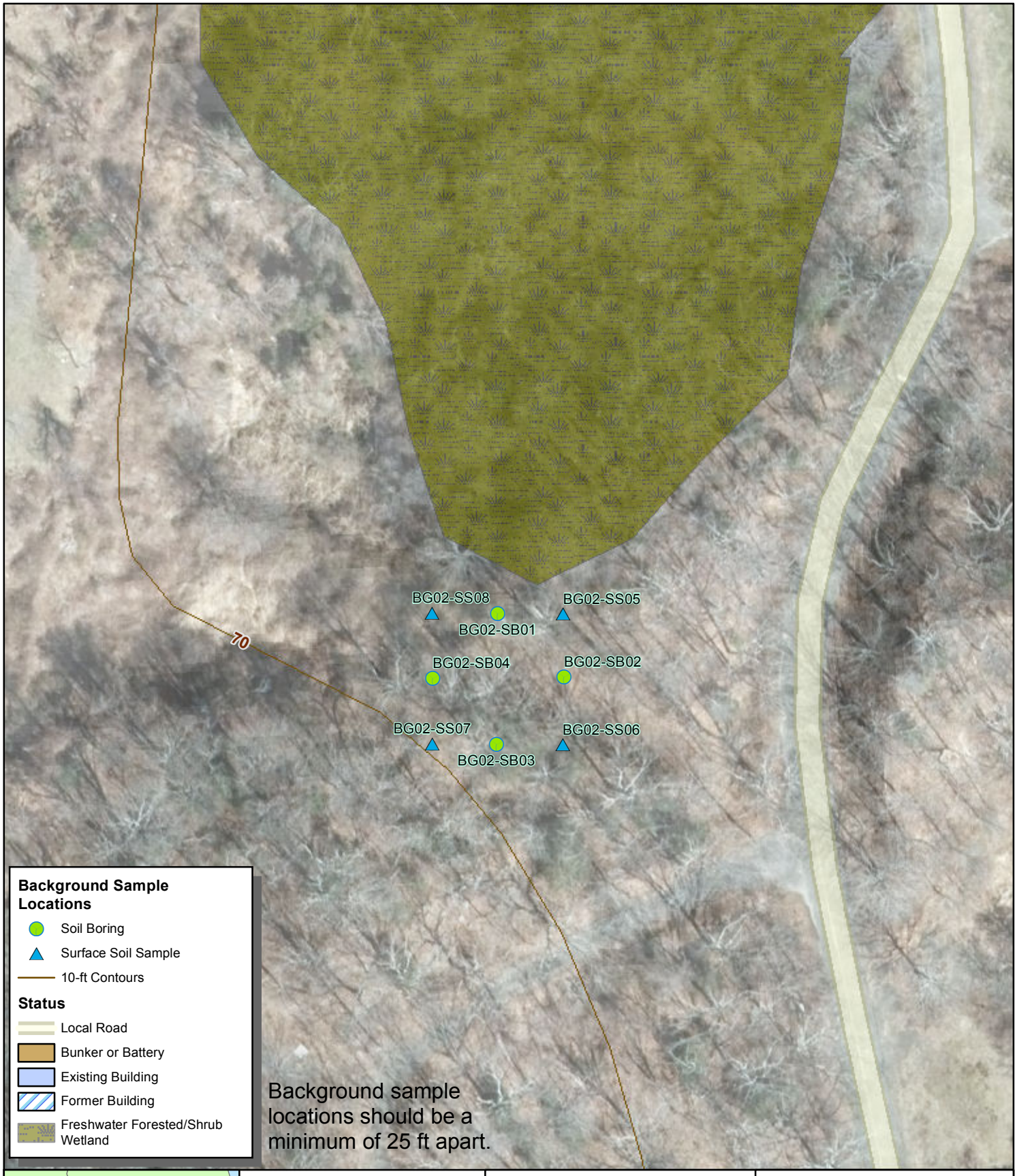
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# Background Sample Location 01

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | BP | May 2016 | **Figure 5-1** |

5/26/2016 1:600 \\USCHL1FP002\Data\Library\Gisprojects\Projects\Camp_Hero\Maps\Workplan\Fig 5-1 BG01.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W
E
S

0 25 50

Feet

1 inch = 50 feet

NAD 1983 StatePlane Long Island FIPS 3104

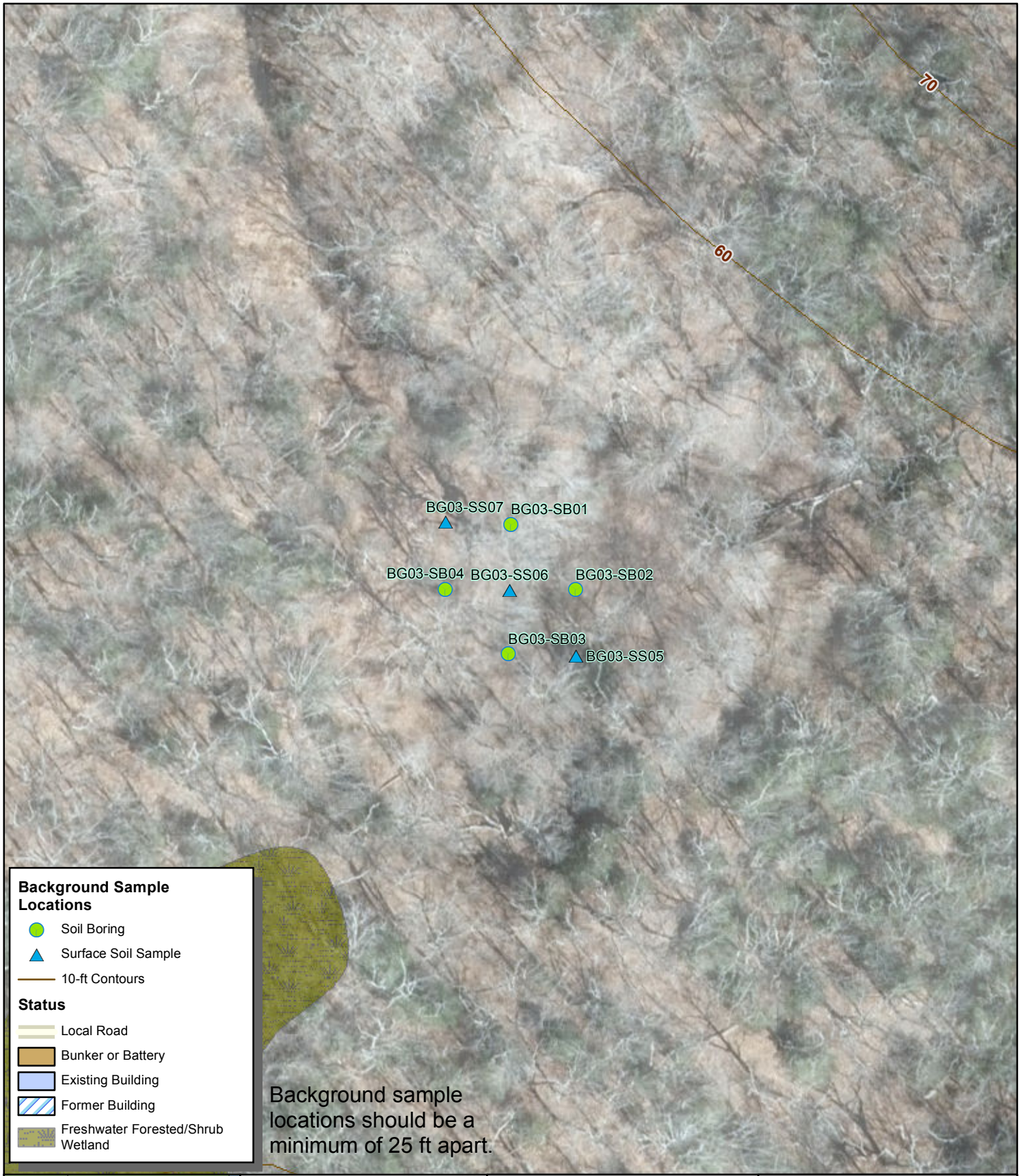
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# Background Sample Location 02

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | BP | May 2016 | **Figure 5-2** |

5/27/2016 1:600 \\USCHL1FP002\Data\Library\Gisprojects\Projects\Camp_Hero\Maps\Workplan\Fig 5-2 BG02.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W
E
S

0 25 50

Feet

1 inch = 50 feet

NAD 1983 StatePlane Long Island FIPS 3104

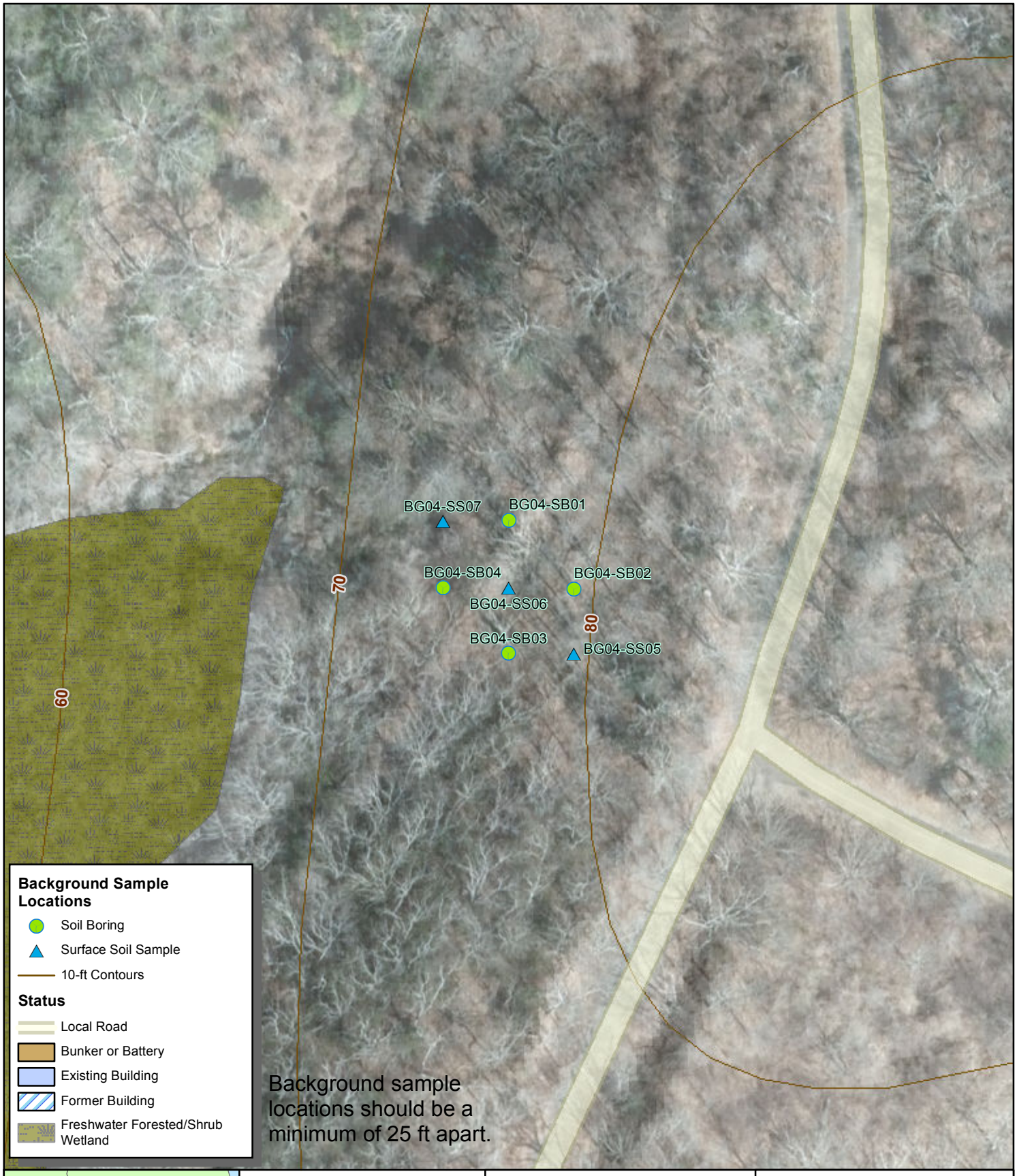
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# Background Sample Location 03

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | BP | May 2016 | **Figure 5-3** |

5/27/2016 1:600 \\USCHL1FP002\Data\Library\Gisprojects\Projects\Camp_Hero\Maps\Workplan\Fig 5-3 BG03.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W
E
S

0 25 50

Feet

1 inch = 50 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

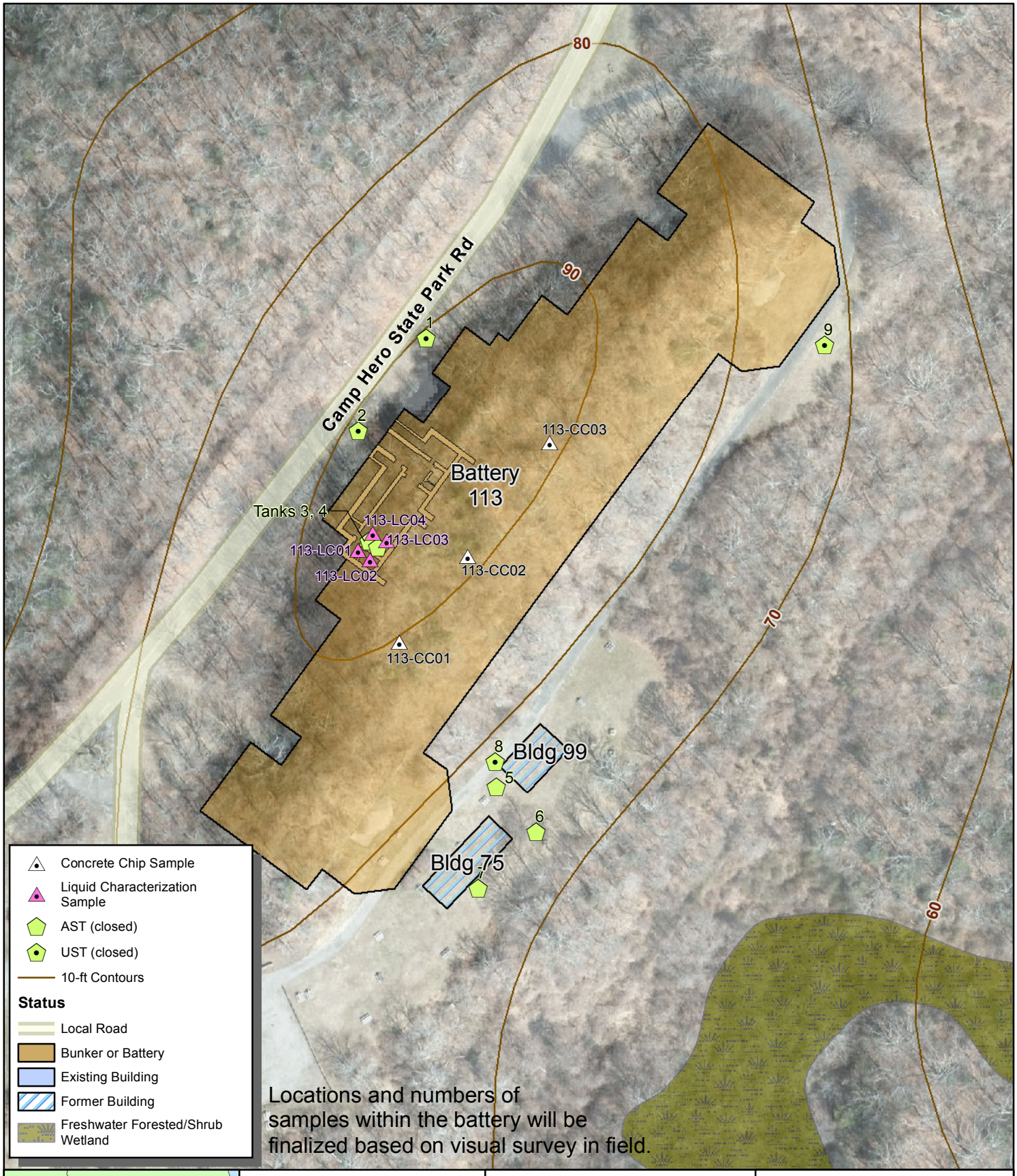
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# Background Sample Location 04

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | BP | May 2016 | **Figure 5-4** |

5/27/2016 1:600 \\USCHL1FP002\Data\Library\Gisprojects\Projects\Camp_Hero\Maps\Workplan\Fig 5-4 BG04.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W
E
S

0 50 100 Feet

1 inch = 100 feet

NAD 1983 StatePlane Long Island FIPS 3104

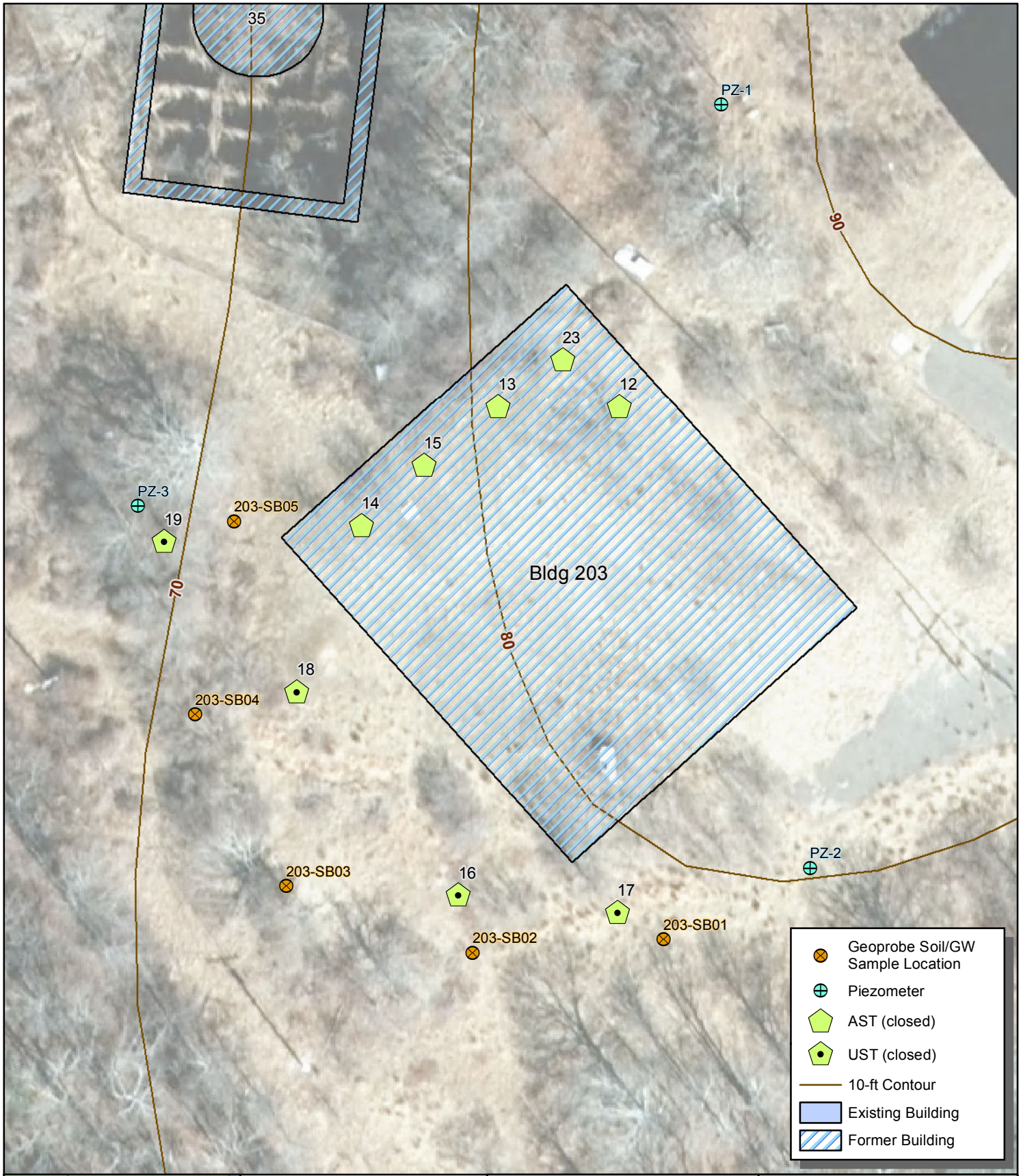
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# Battery 113 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-1** |

5/2/2016 1:1,200 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-1 Battery 113.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 15 30
Feet

1 inch = 35 feet

NAD 1983 StatePlane Long Island FIPS 3104

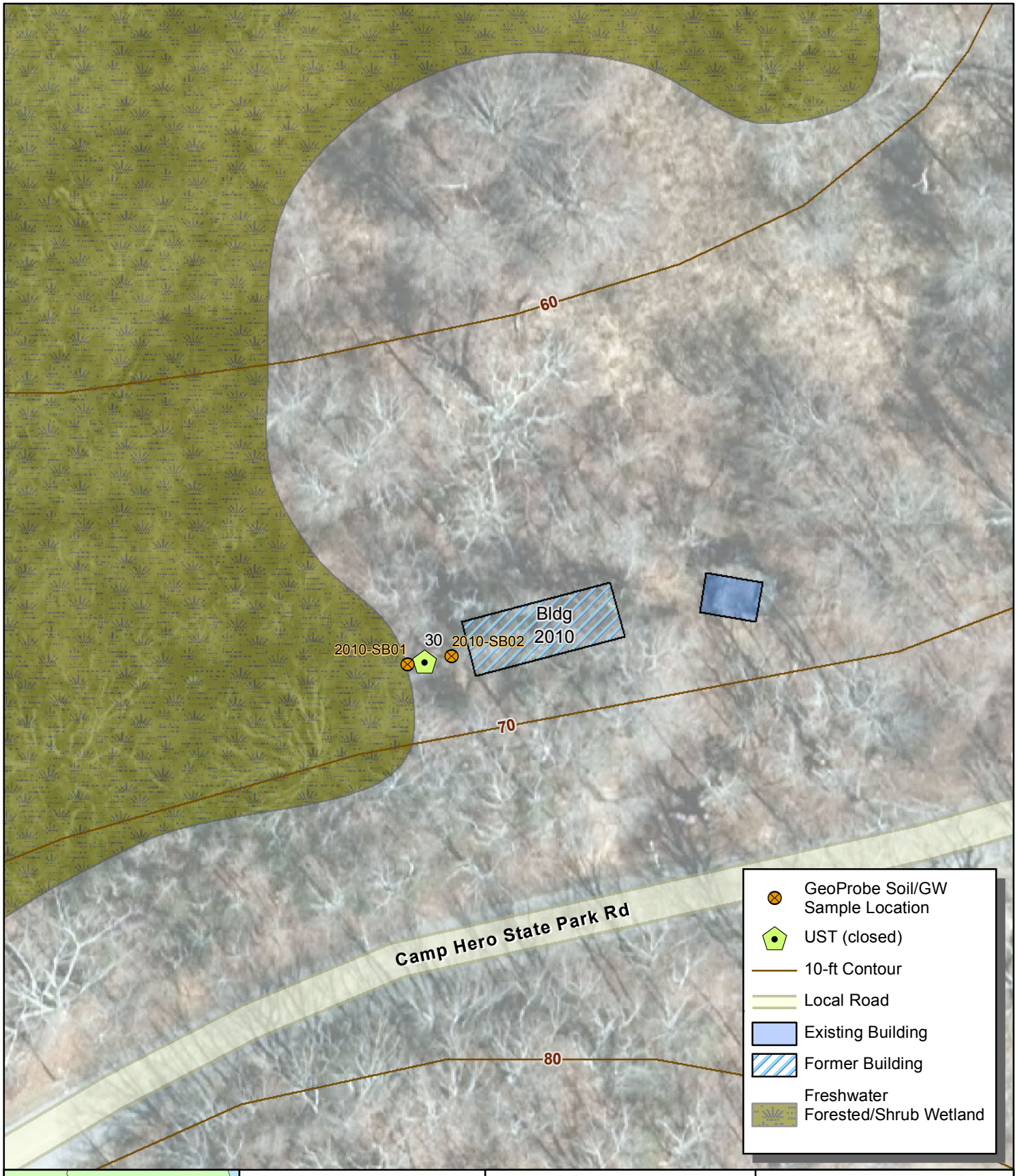
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# Building 203 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-2** |

5/2/2016 1:420 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-2 Bldg 203.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W
E
S

0 20 40 Feet

1 inch = 40 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

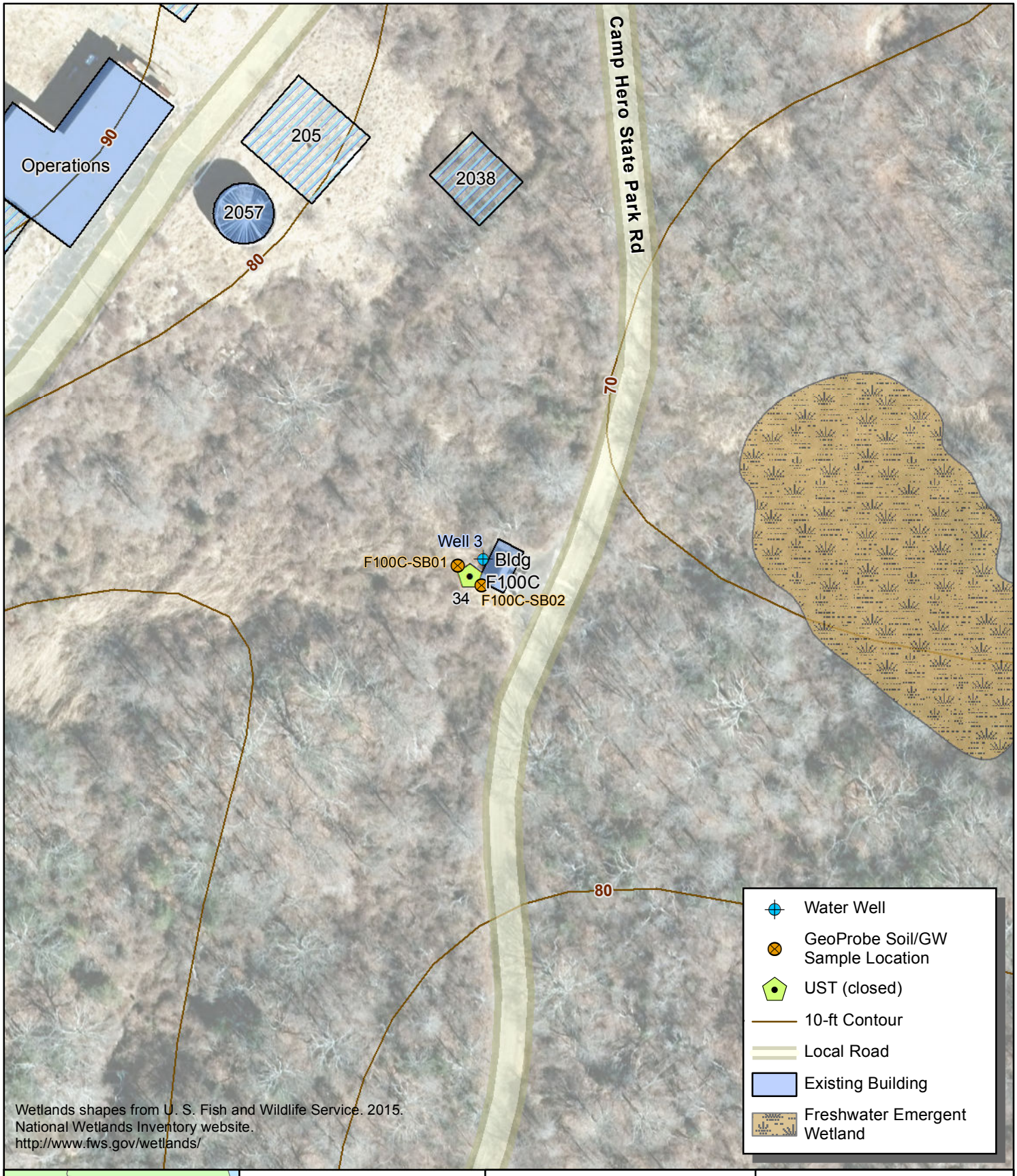
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# Building 2010 Phase 2 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-3** |

5/2/2016 1:480 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-3 Bldg 2010.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 37.5 75

Feet

1 inch = 75 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

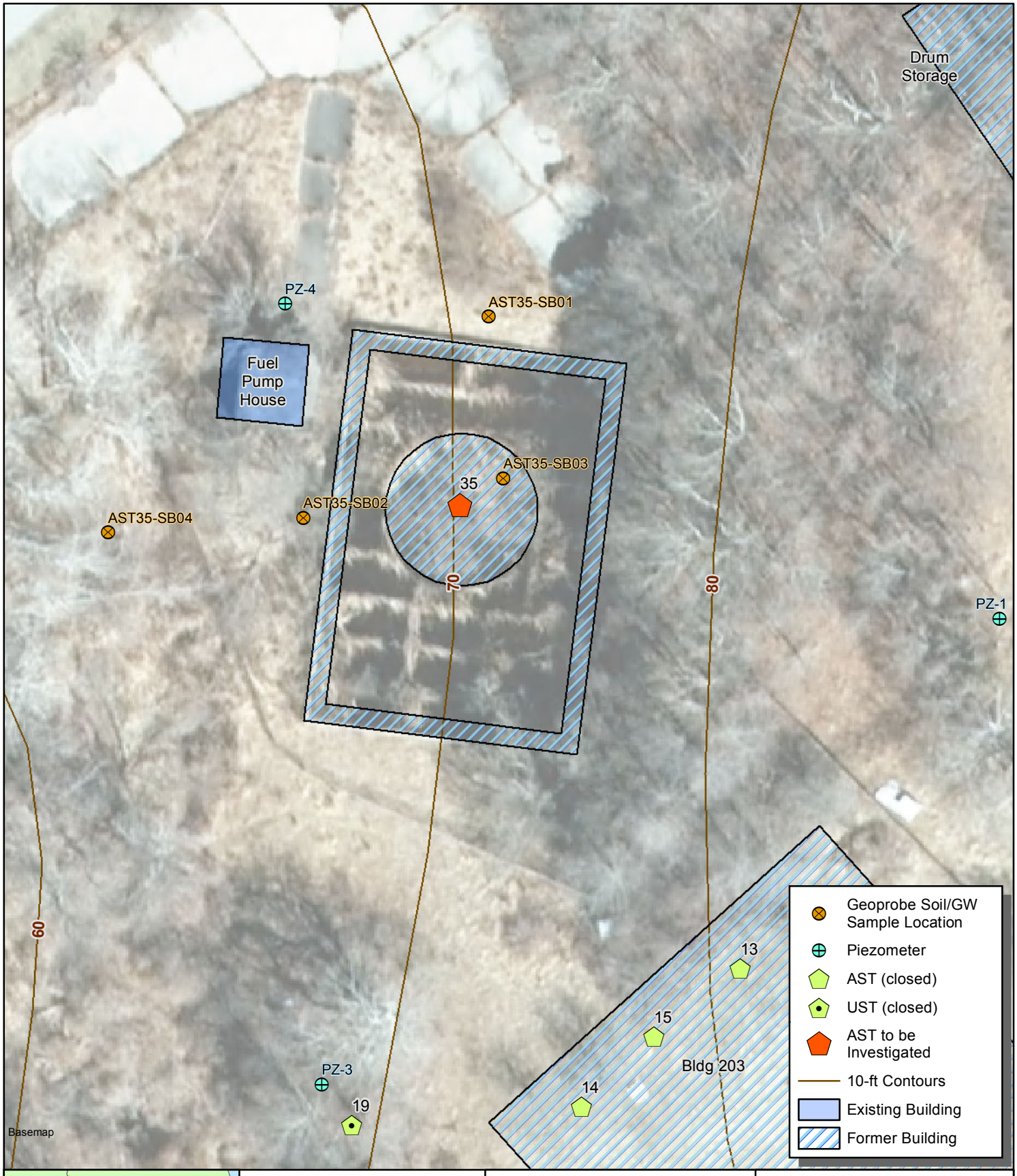
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# Building F100C Phase 2 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-4** |

3/13/2016 1:900 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-4 Bldg F100C.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W
E
S

0 15 30

Feet

1 inch = 30 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

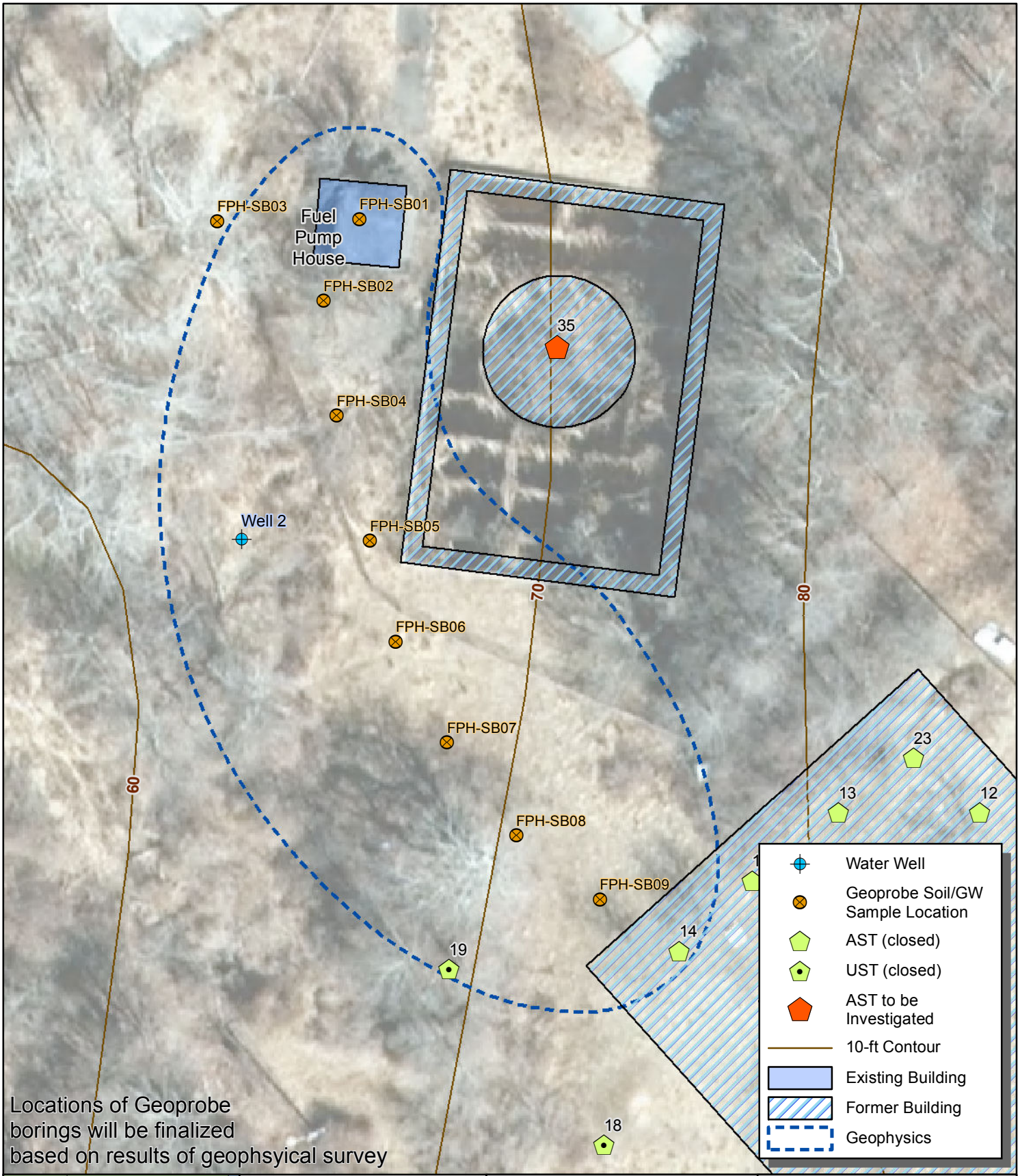
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# AST-35 (H-13) Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-5** |

5/2/2016 1:360 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-5 AST 35.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W
E
S

0 15 30 Feet

1 inch = 30 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

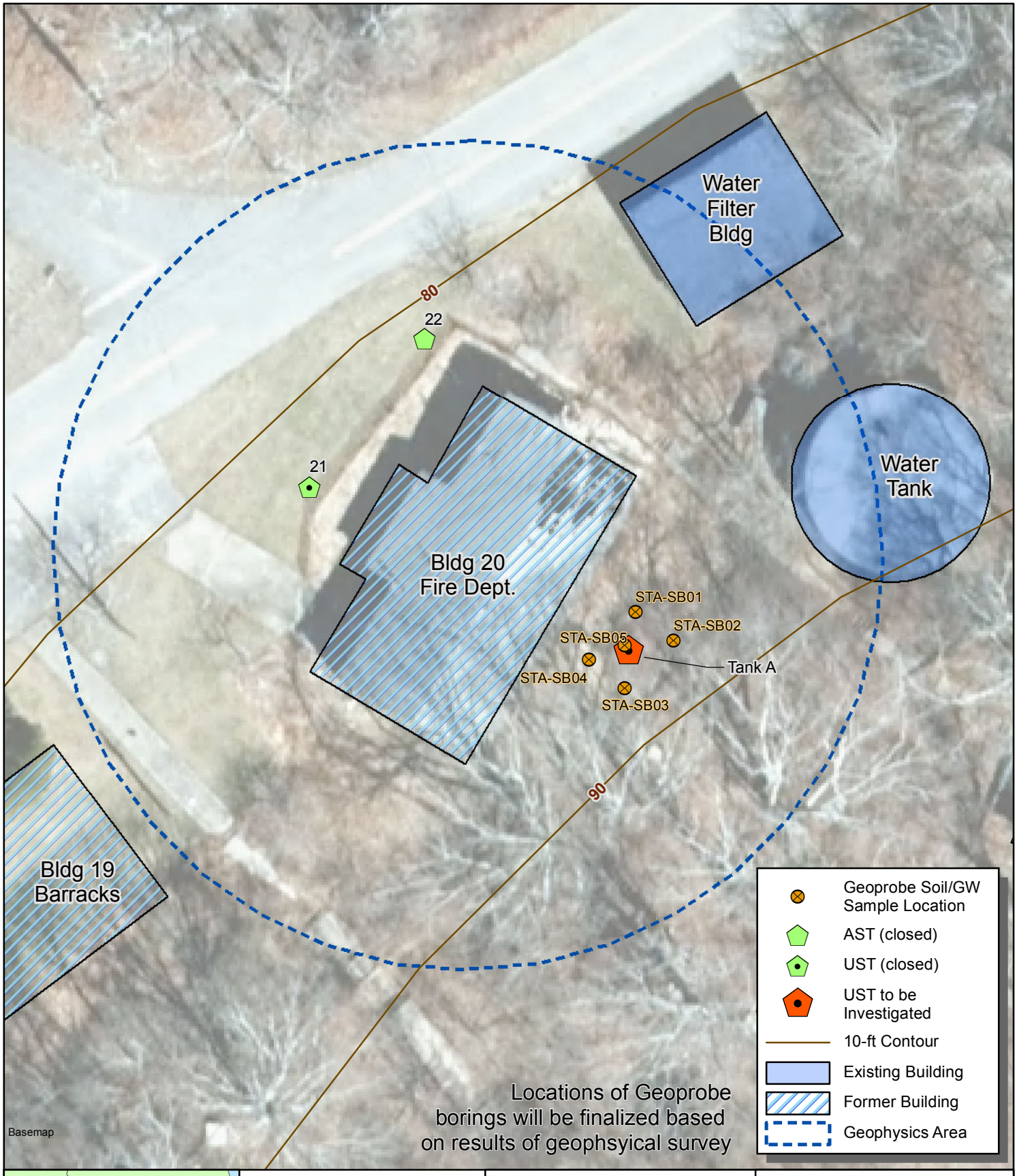
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# Fuel Pump House and Distribution Line for AST-35 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-6** |

5/2/2016 1:360 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-6 Fuel Pump House.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W
E
S

0 12.5 25
Feet

1 inch = 25 feet

NAD 1983 StatePlane Long Island FIPS 3104

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# Building 20 (Tank-A)
# Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-7** |

5/2/2016 1:300 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-7 Bldg 20 - Tank A.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W
E
S

0 15 30

Feet

1 inch = 30 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

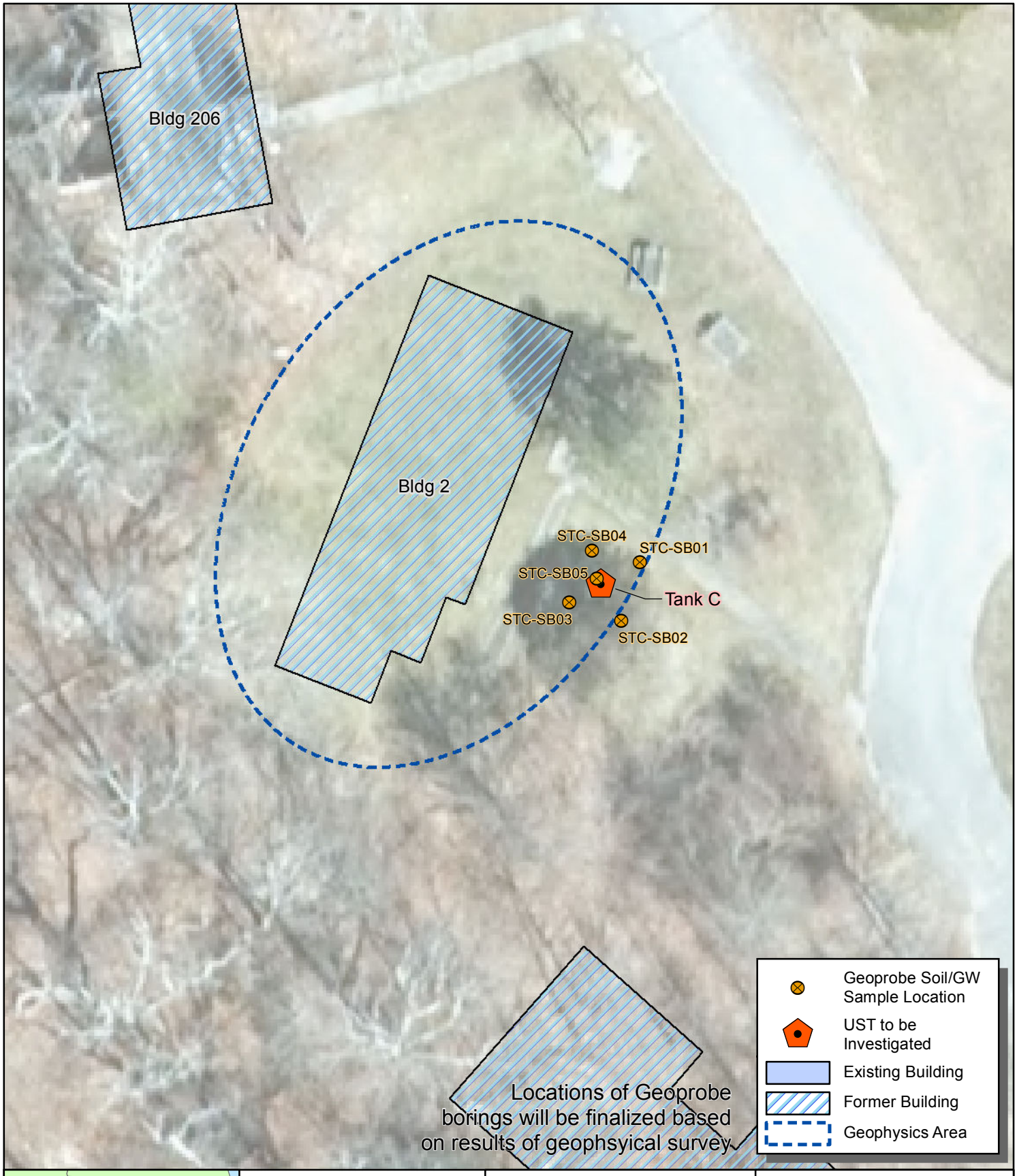
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# Building 22 (Tank B)
# Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-8** |

5/2/2016 1:360 \\USCHL1FP002\Data\Library\Gisprojects\Projects\Camp_Hero\Maps\Workplan\Fig 6-8 Bldg 22 - Tank B.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 10 20
Feet

1 inch = 20 feet

NAD 1983 StatePlane Long Island FIPS 3104

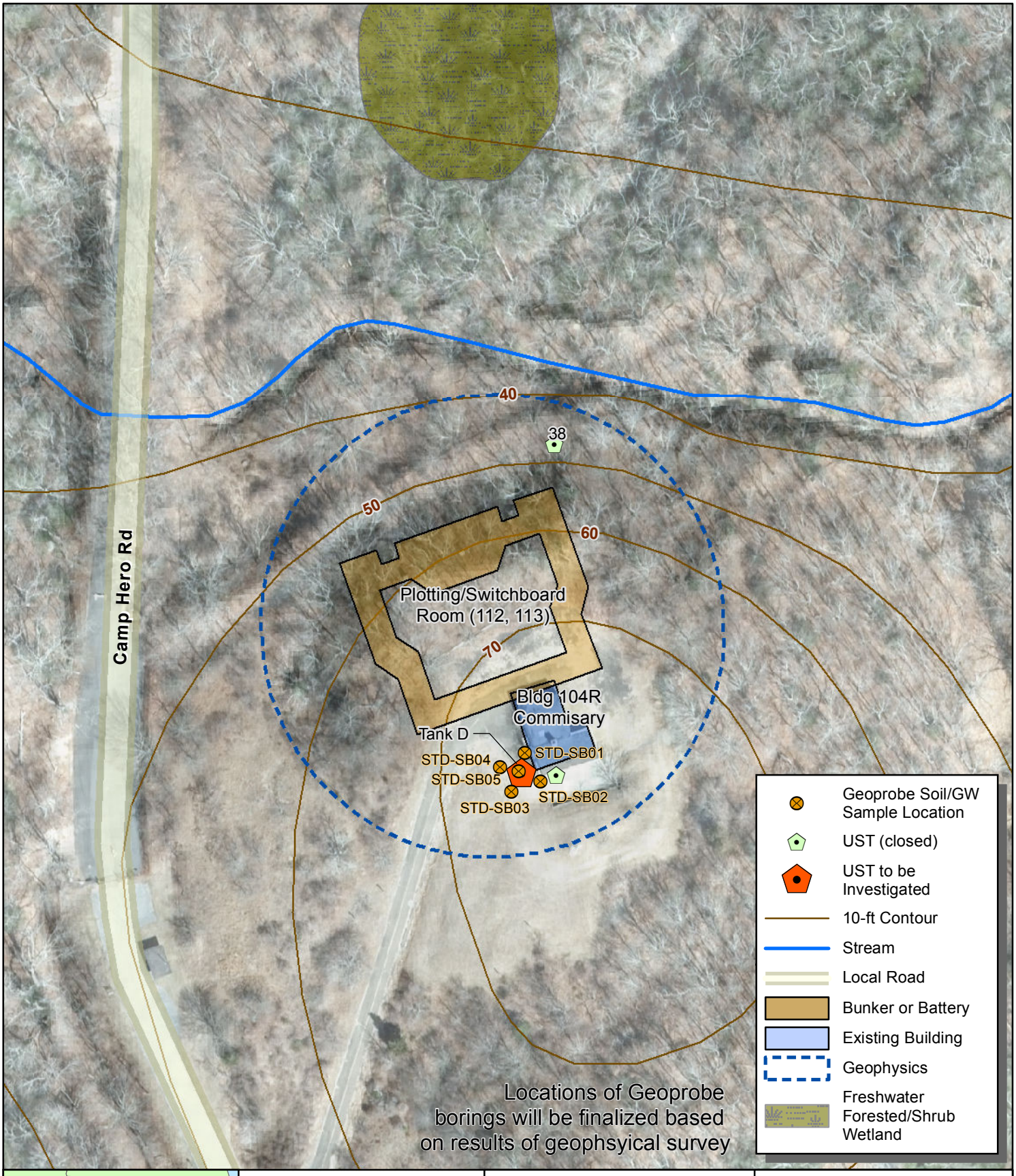
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# Building 2 (Tank C)
# Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-9** |

5/2/2016 1:240 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-9 Bldg 2 - Tank C.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 40 80

Feet

1 inch = 80 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

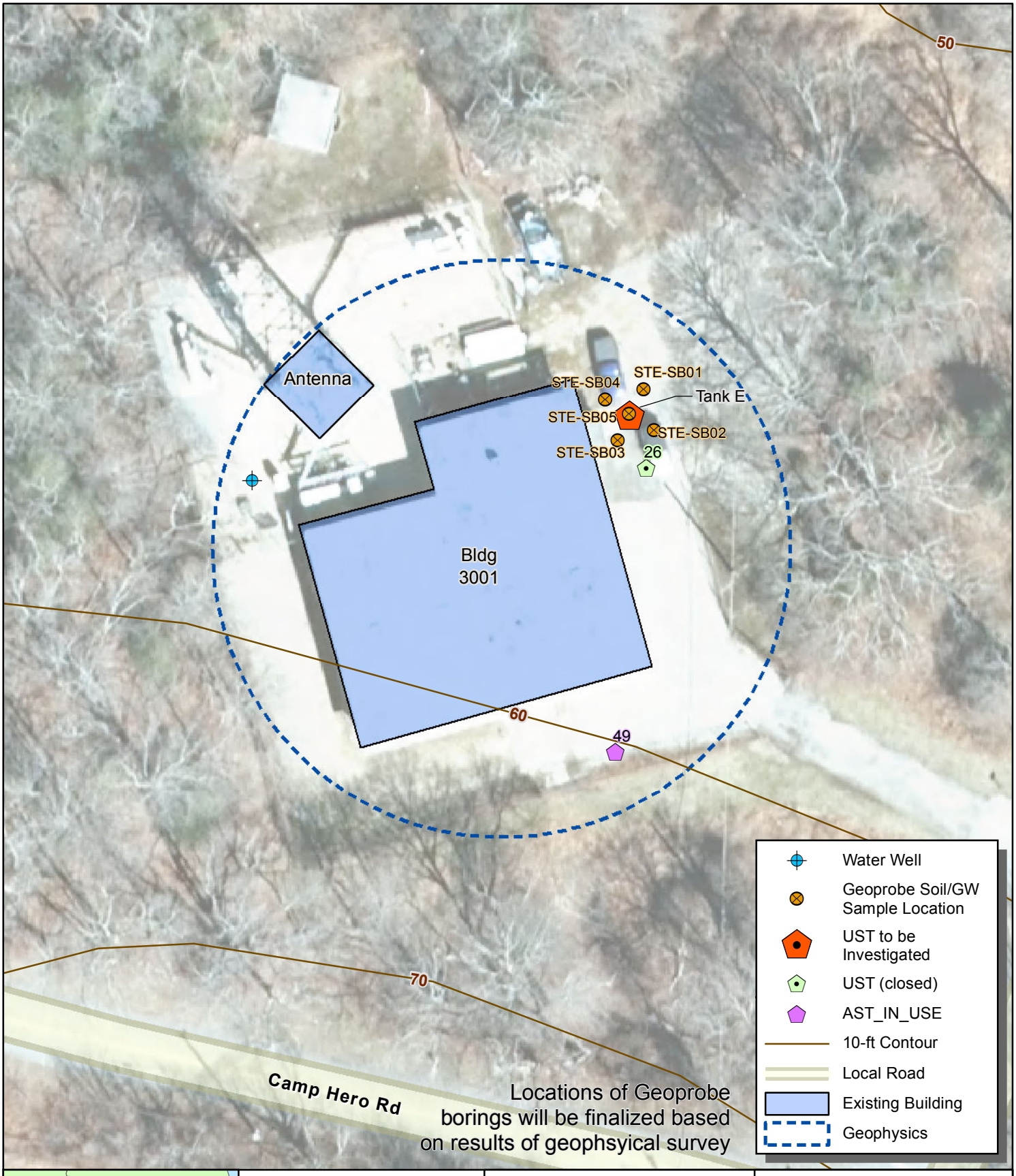
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# Building 104R (Tank D)
# Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-10** |

5/2/2016 1:960 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-10 Bldg 104R - Tank D.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 15 30
Feet

1 inch = 35 feet

NAD 1983 StatePlane Long Island FIPS 3104

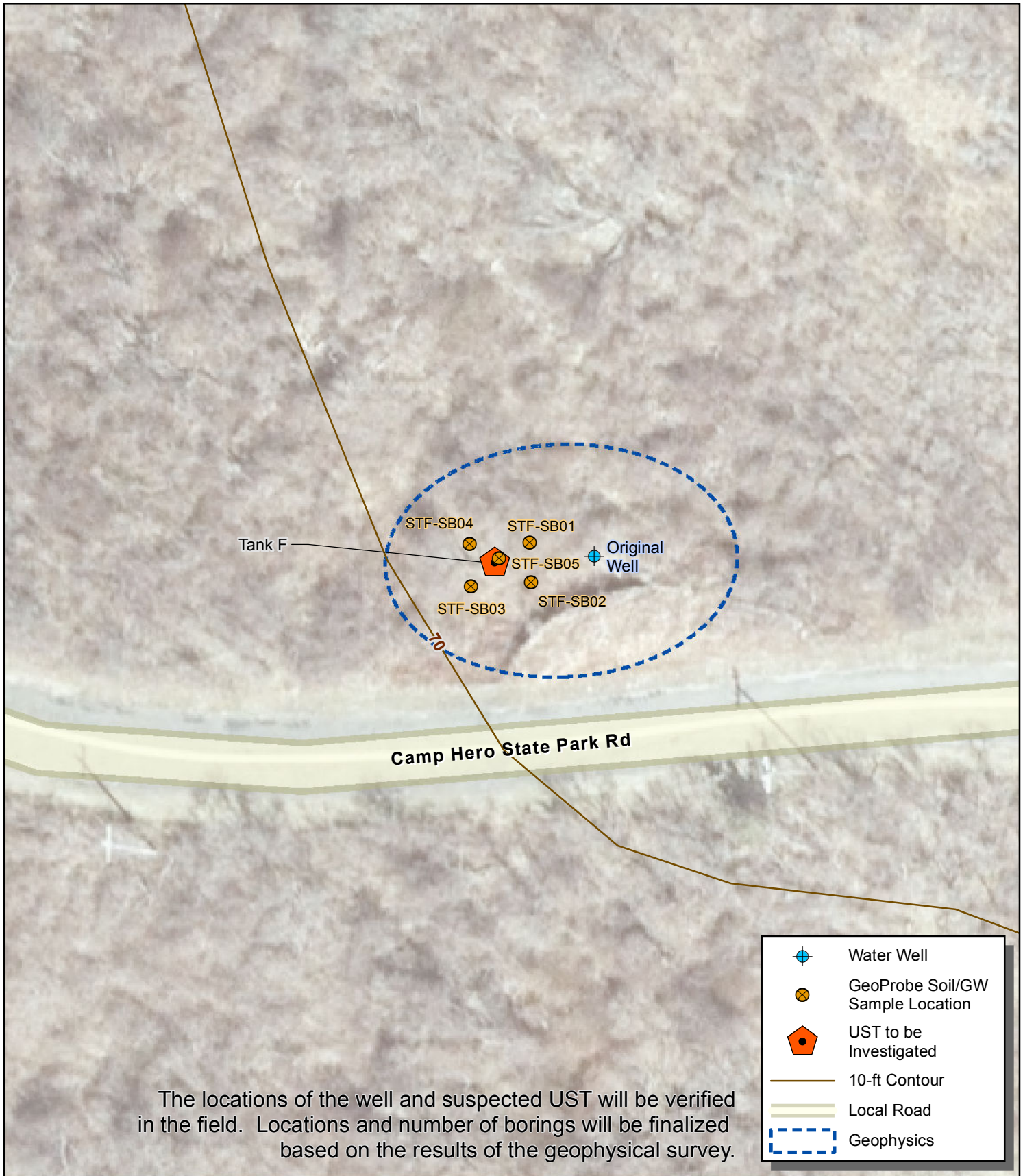
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# Building 3001 (Tank E)
# Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-11** |

5/2/2016 1:420 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-11 Bldg 3001 - Tank E.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W
E
S

0 15 30 Feet

1 inch = 30 feet

NAD 1983 StatePlane Long Island FIPS 3104

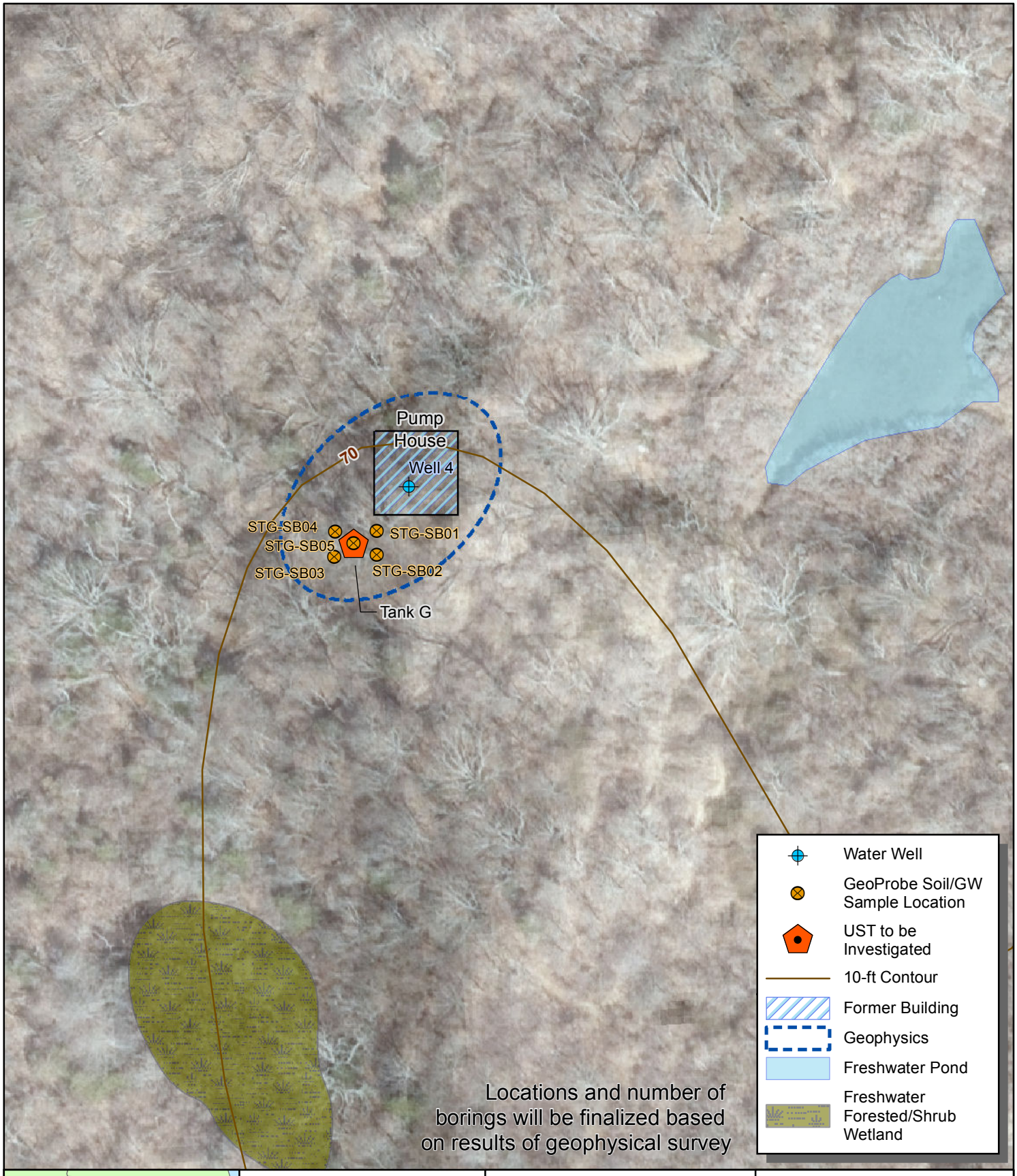
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# Pump House (Tank F)
# Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-12** |

5/2/2016 1:360 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-12 PumpHouse - Tank F.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W
E
S

0 25 50 Feet

1 inch = 55 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

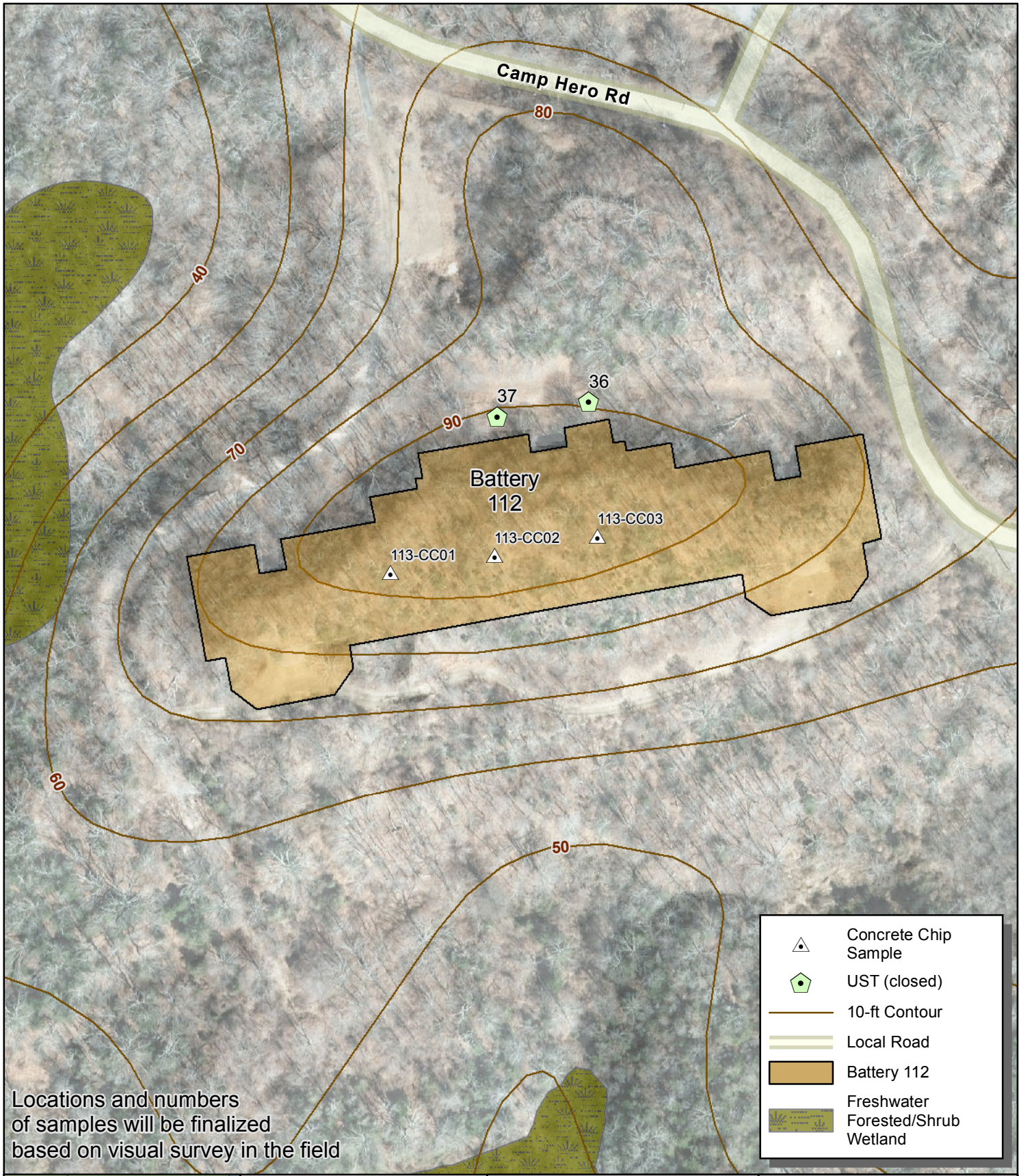
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# Pump House (Tank G)
# Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-13** |

5/2/2016 1:660 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-13 PumpHouse - Tank G.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 62.5 125 Feet

1 inch = 125 feet

NAD 1983 StatePlane Long Island FIPS 3104

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# Battery 112
## Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-14** |

5/2/2016 1:1,500 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-14 Battery 112.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 15 30
Feet

1 inch = 30 feet

NAD 1983 StatePlane Long Island FIPS 3104

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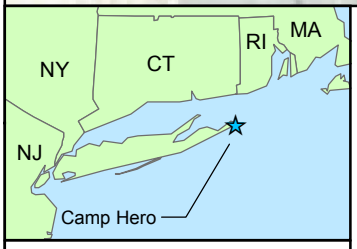
# Building 107
# Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-15** |

5/2/2016 1:360 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-15 Building 107.mxd (USCHL1FP002\Data\Library\Gisprojects\)




MAP LOCATION

N
W E
S

0 15 30
Feet

1 inch = 30 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

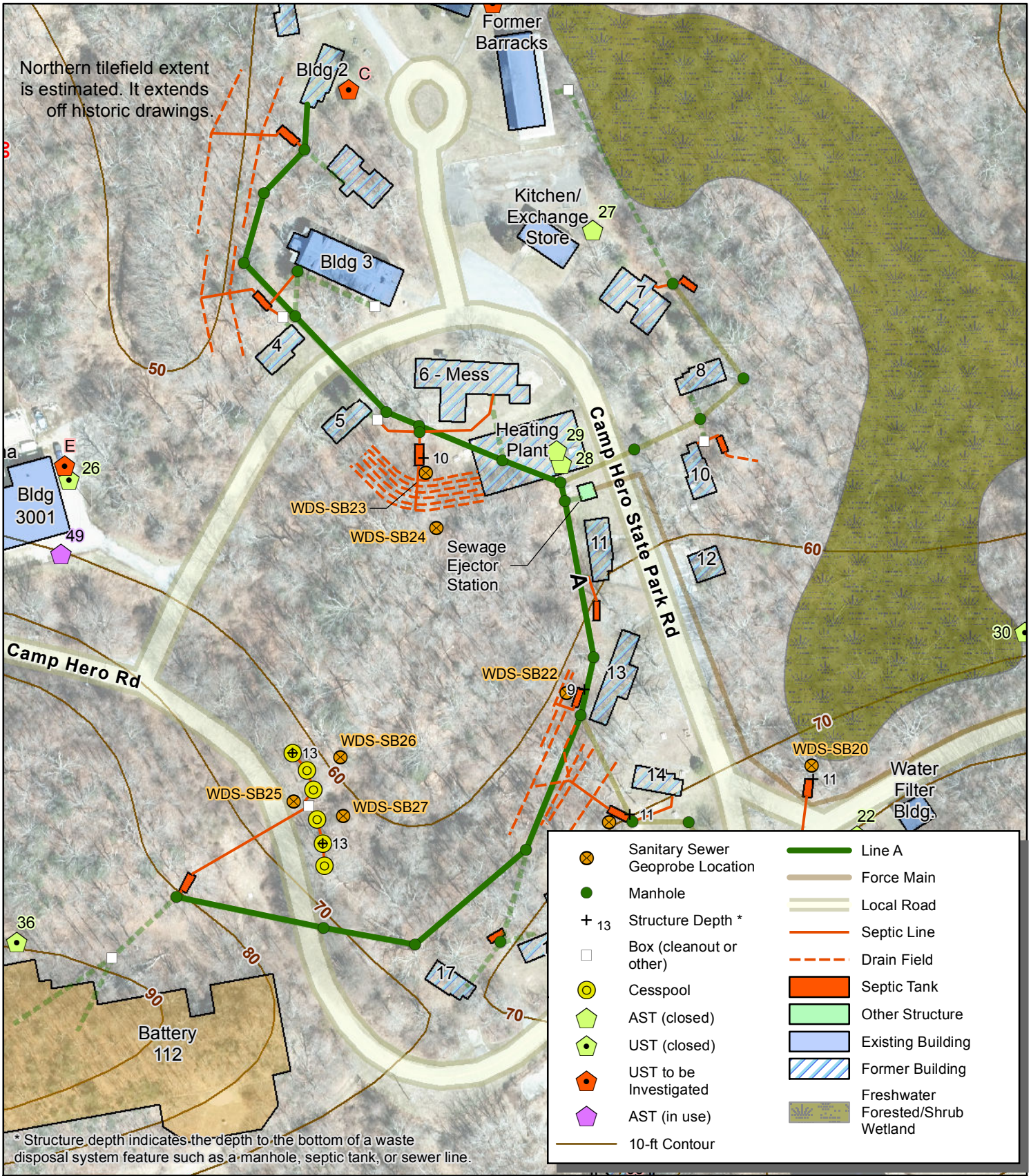
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# Building 201
# Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-16** |

5/2/2016 1:360 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-16 Building 201.mxd (USCHL1FP002\Data\Library\Gisprojects\)




AECOM

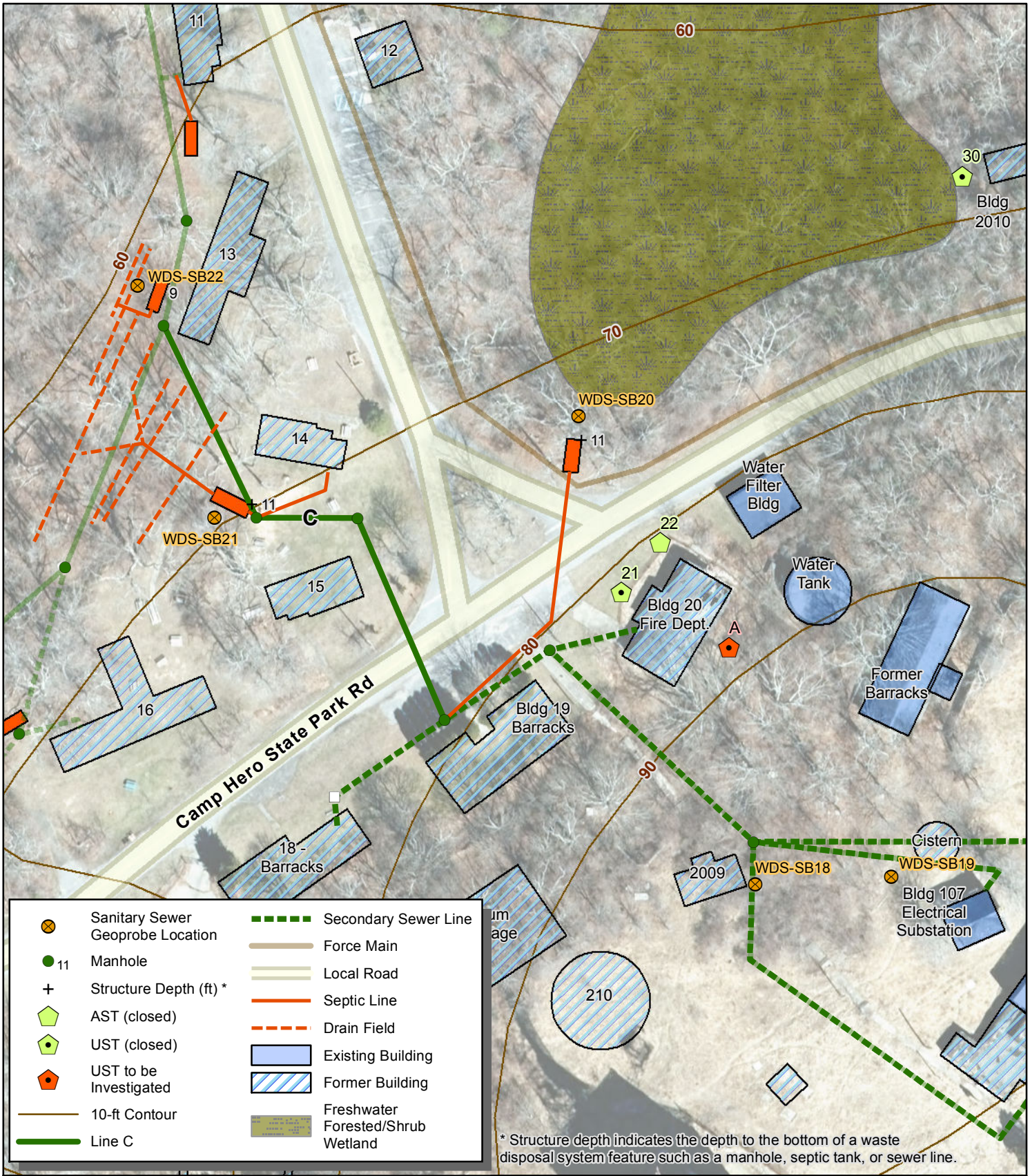
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# Line A
# Abandoned Waste Disposal Systems (Site-wide)
# Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-17a** |

5/2/2016 1:1,620 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-17A SS Line A.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 37.5 75 Feet

1 inch = 75 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

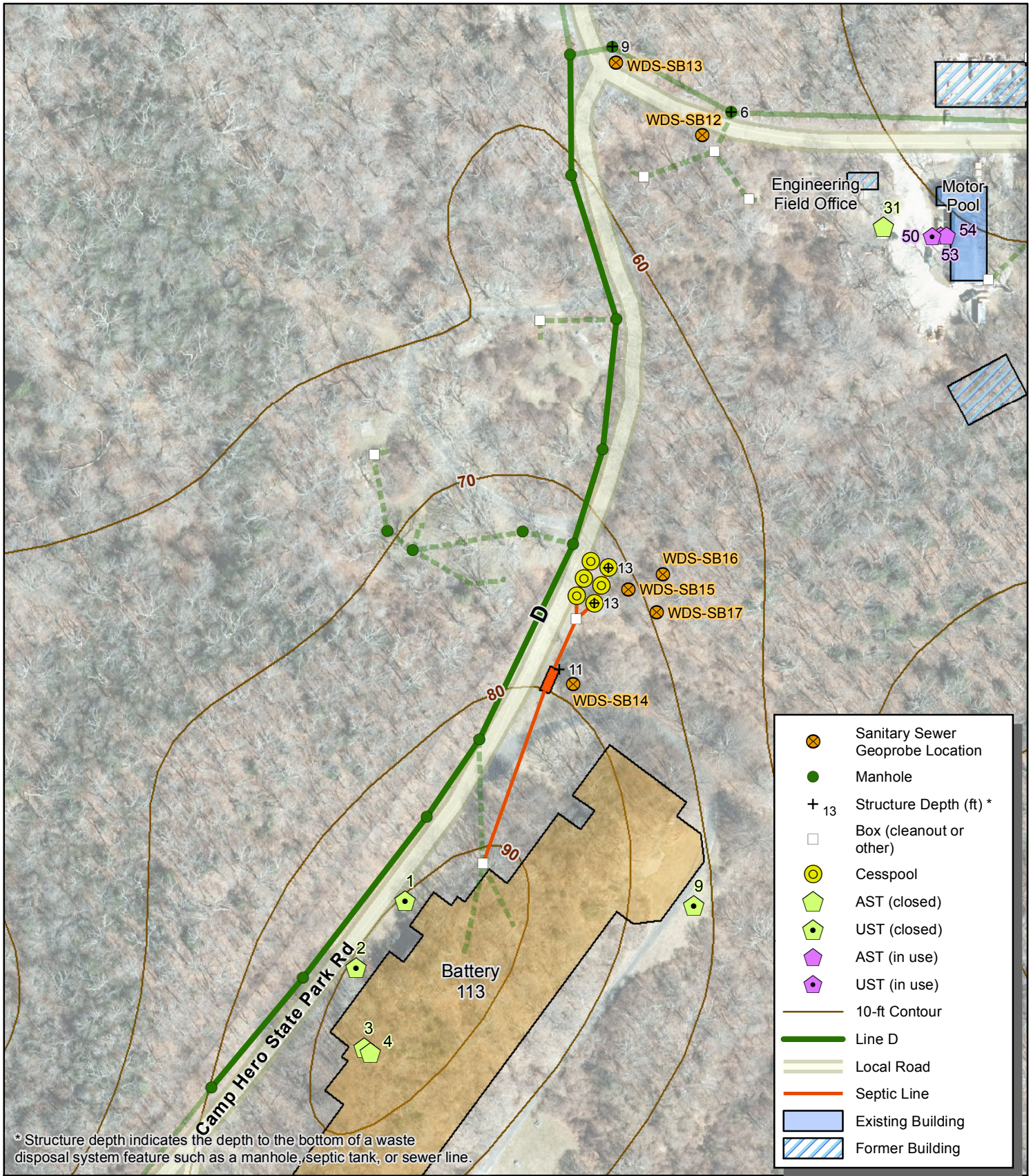
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# Line C
# Abandoned Waste Disposal Systems (Site-wide)
# Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-17b** |

5/2/2016 1:900 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-17b SS Line C.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W
E
S

0 70 140

Feet

1 inch = 140 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

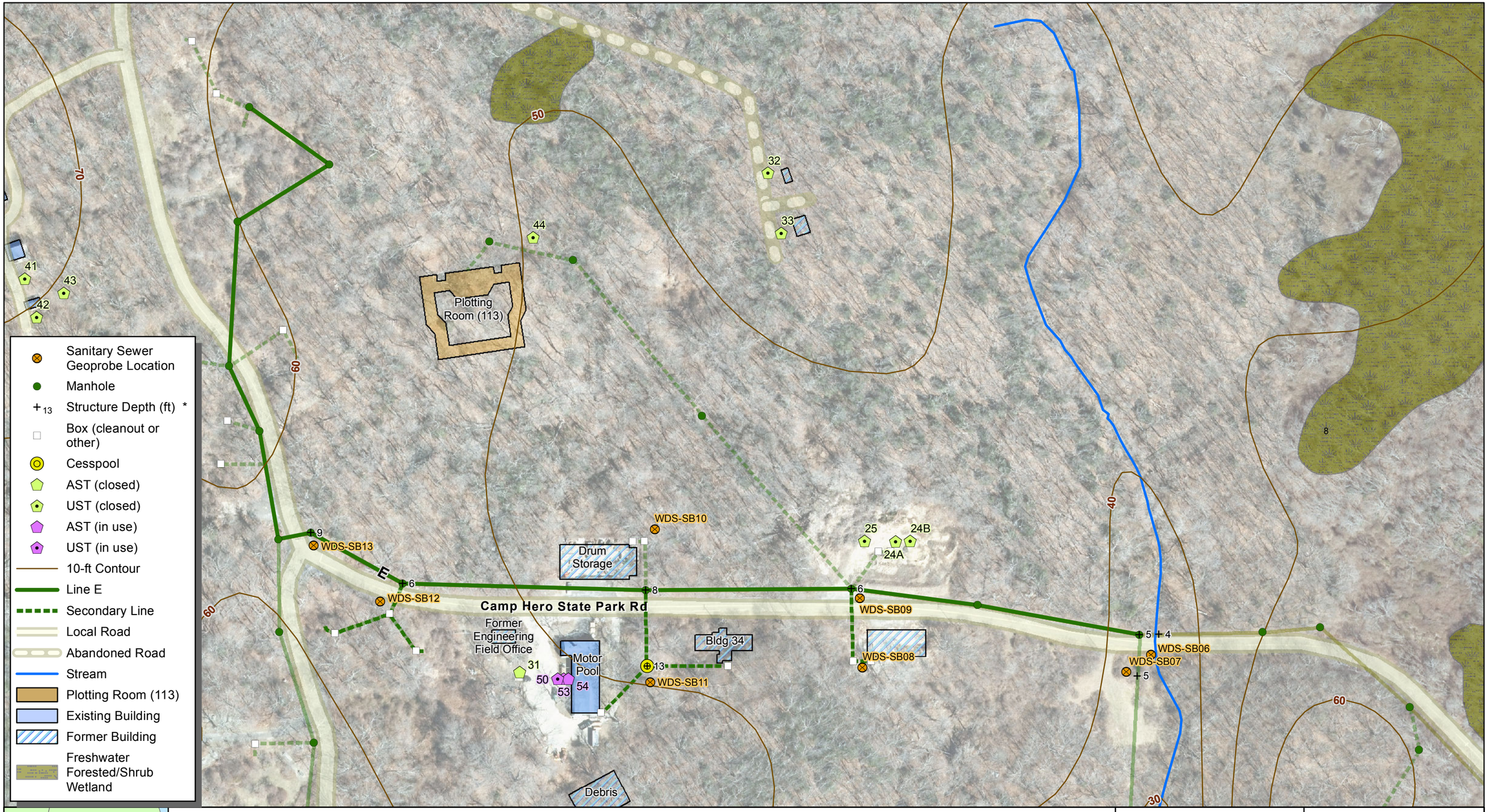
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# Line D
# Abandoned Waste Disposal Systems (Site-wide)
# Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-17c** |

3/13/2016 1:1,680 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-17c SS Line D.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

* Structure depth indicates the depth to the bottom of a waste disposal system feature such as a manhole, septic tank, or sewer line.

Surface water features obtained from National Hydrography Dataset (NHD) Dates of publication vary.

Wetlands shapes from U. S. Fish and Wildlife Service. 2015. National Wetlands Inventory website. http://www.fws.gov/wetlands/

NAD 1983 StatePlane Long Island FIPS 3104

N W E S

0 62.5 125 250 Feet

1 inch = 125 feet

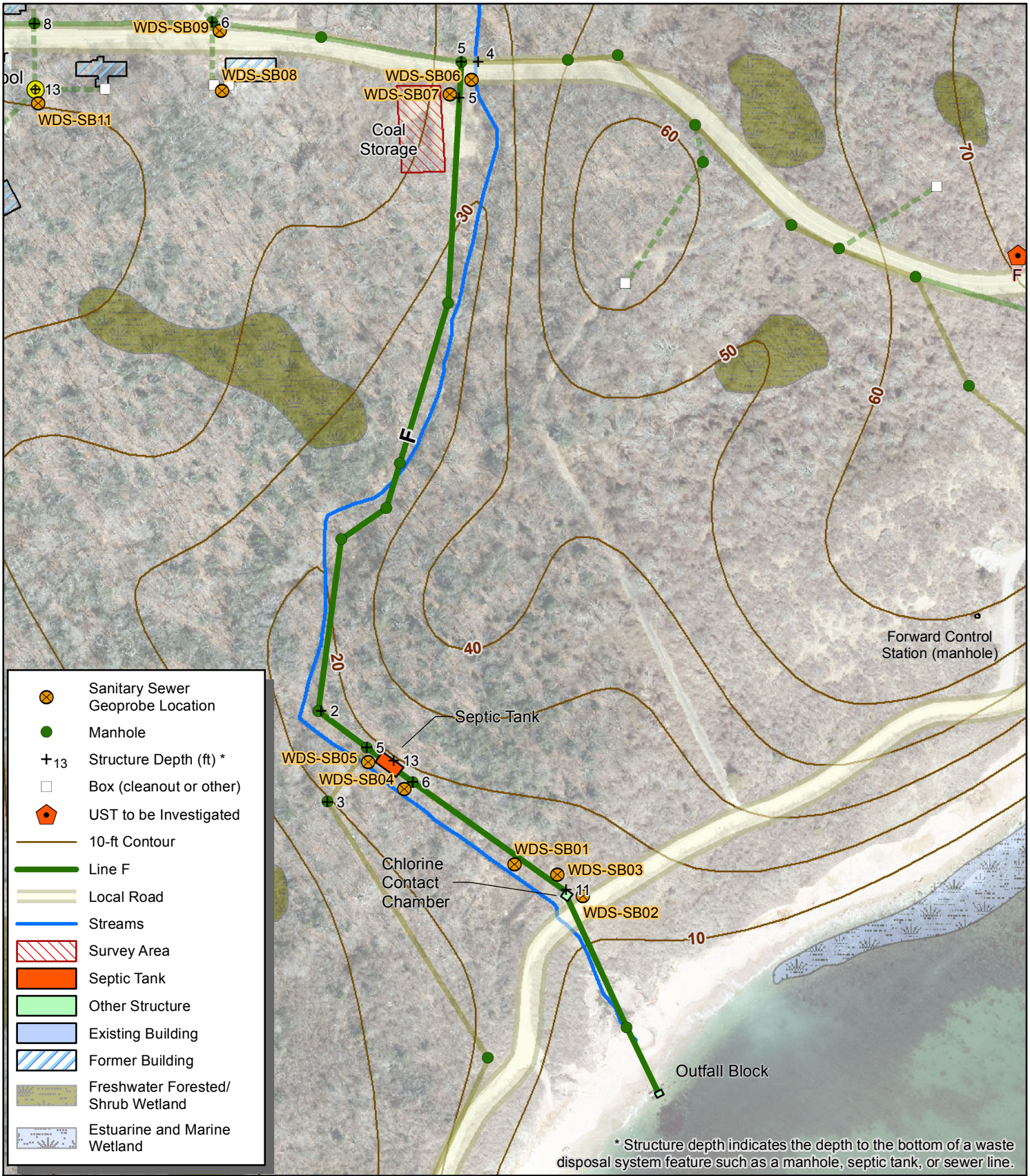
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# Line E
## Abandoned Waste Disposal Systems (Site-wide)
## Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-17d** |

5/2/2016 1:1,500 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-17d SS Line E.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 105 210 Feet

1 inch = 210 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

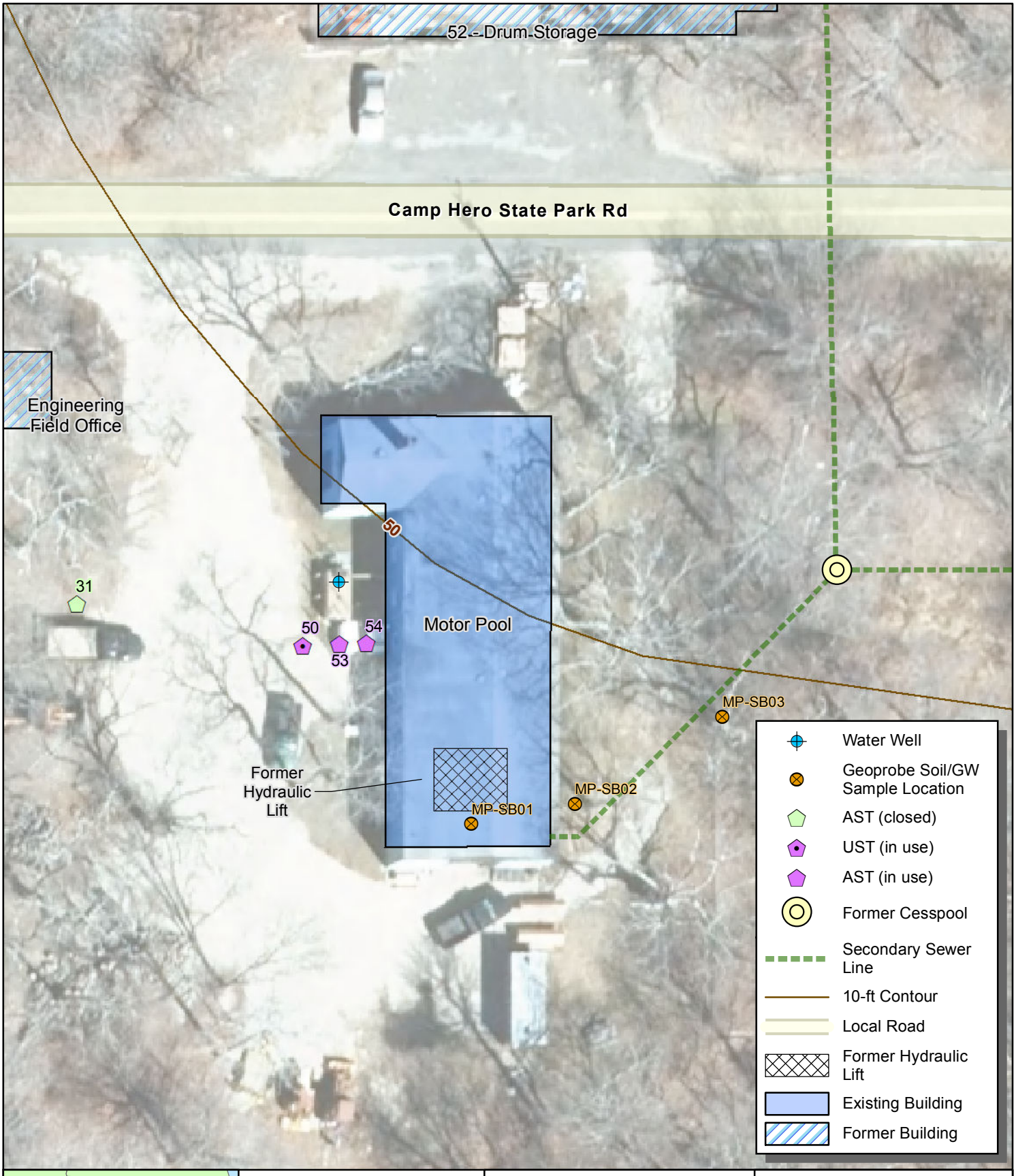
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# Line F
# Abandoned Waste Disposal Systems (Site-wide)
# Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-17e** |

5/2/2016 1:2,520 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-17e SS Line F.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 15 30

Feet

1 inch = 30 feet

NAD 1983 StatePlane Long Island FIPS 3104

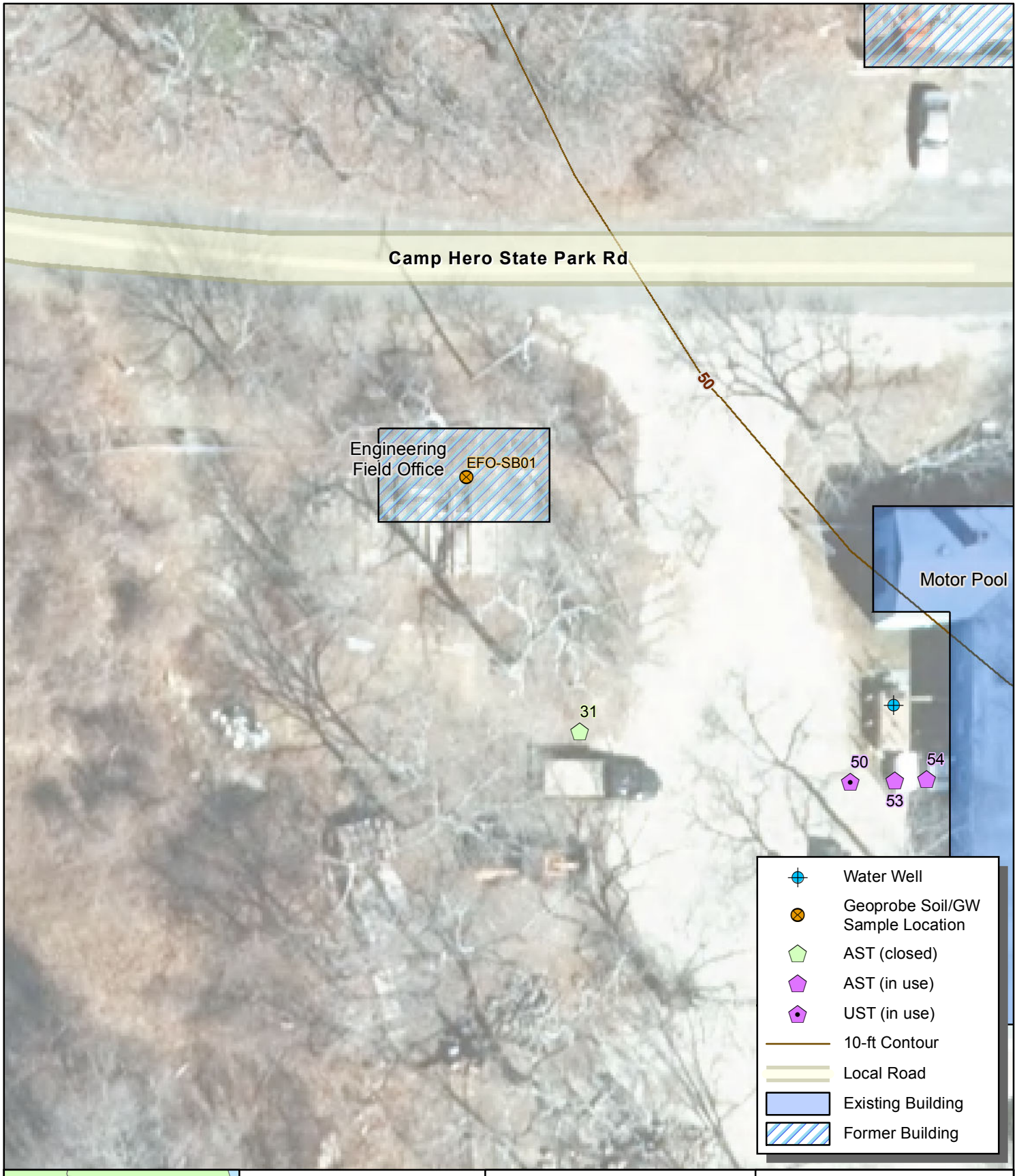
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# Motor Pool
# Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

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|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-18** |







MAP LOCATION

N
W E
S

0 12.5 25

Feet

1 inch = 25 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

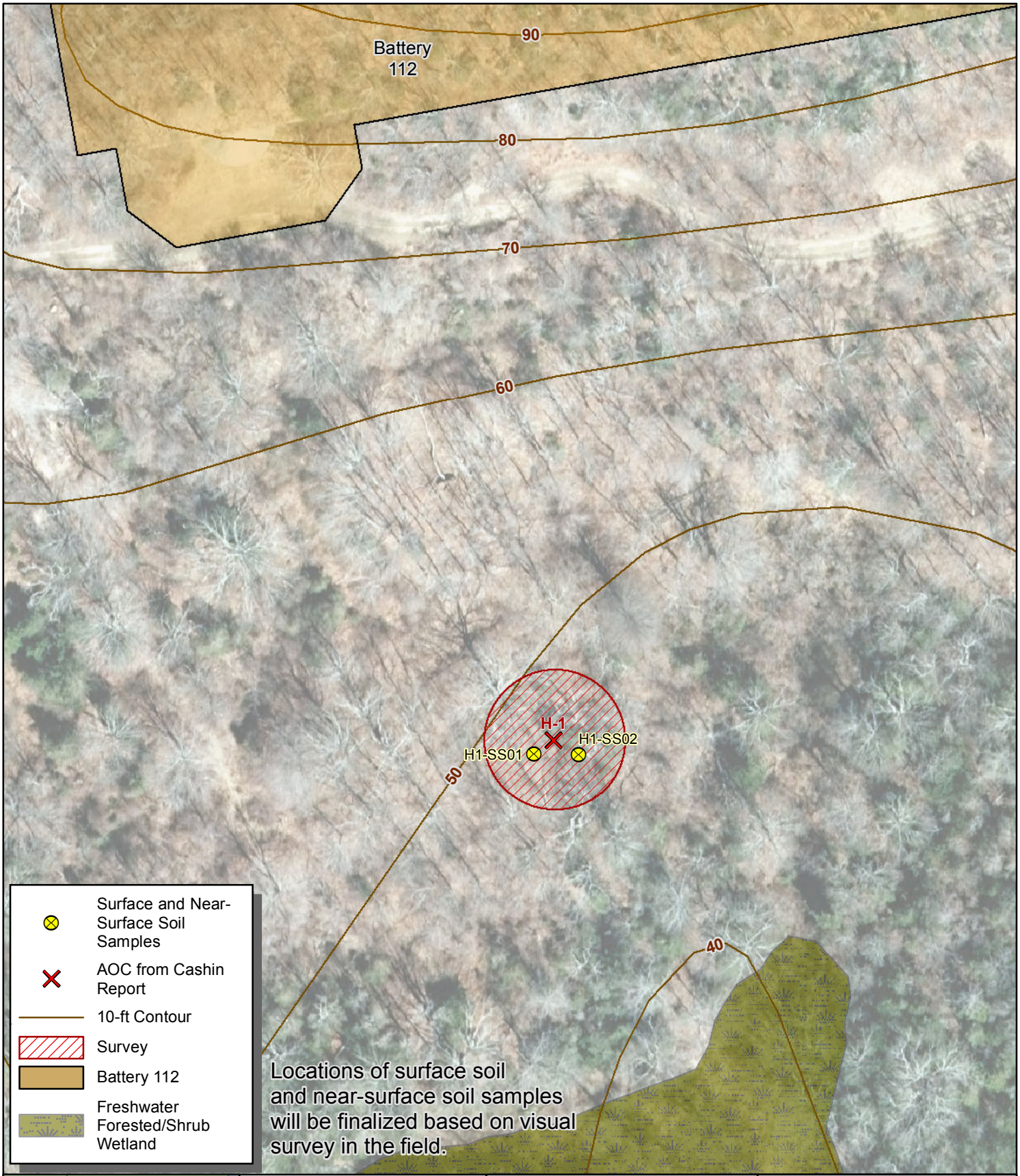
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# Engineering Field Office
# Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

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|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-19** |

5/2/2016 1:300 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-19 Engineering Field Office.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W
E
S

0 30 60

Feet

1 inch = 65 feet

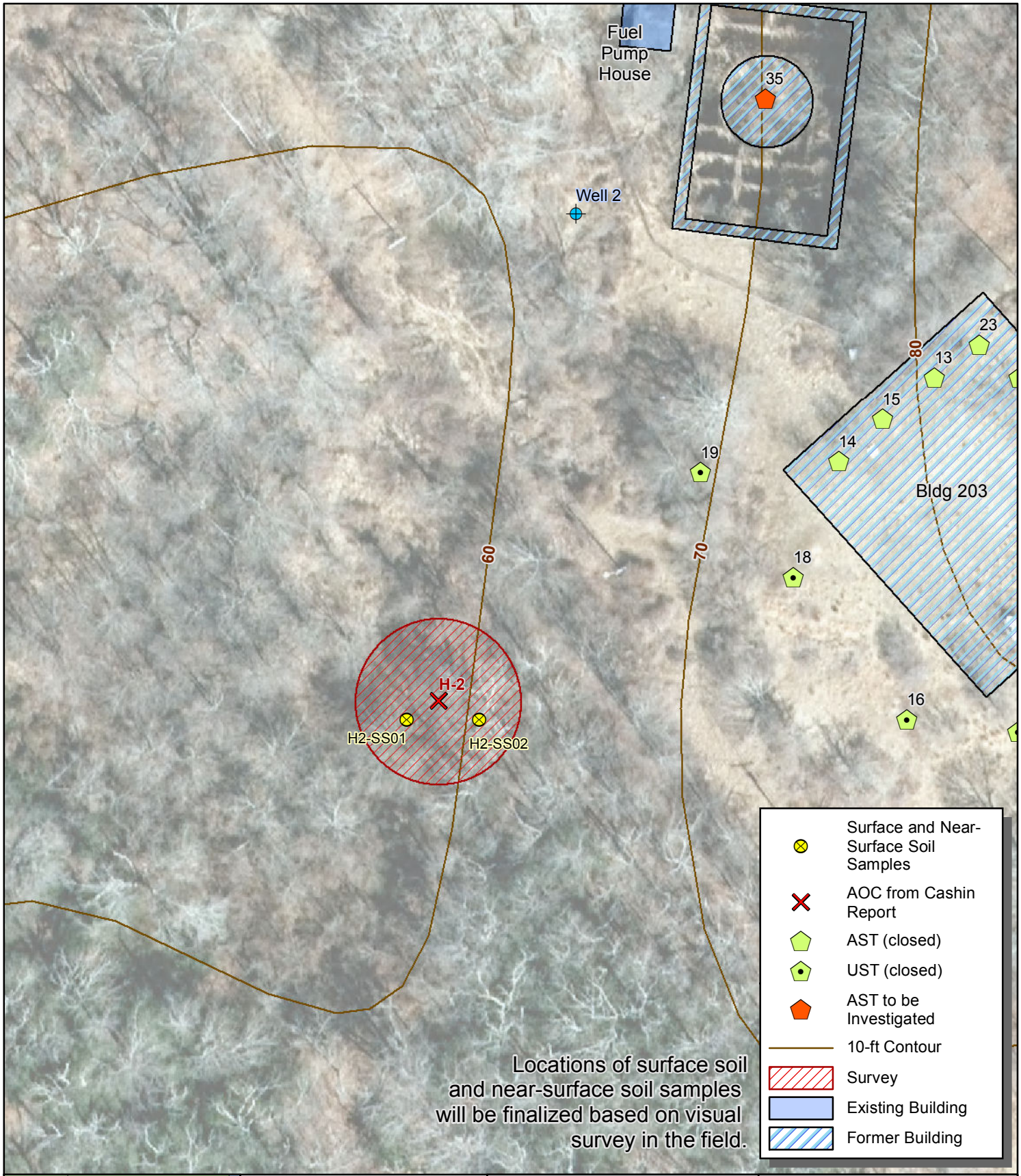
NAD 1983 StatePlane Long Island FIPS 3104

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# H-1 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

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|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-20** |







MAP LOCATION

N
W
E
S

0 25 50

Feet

1 inch = 50 feet

NAD 1983 StatePlane Long Island FIPS 3104

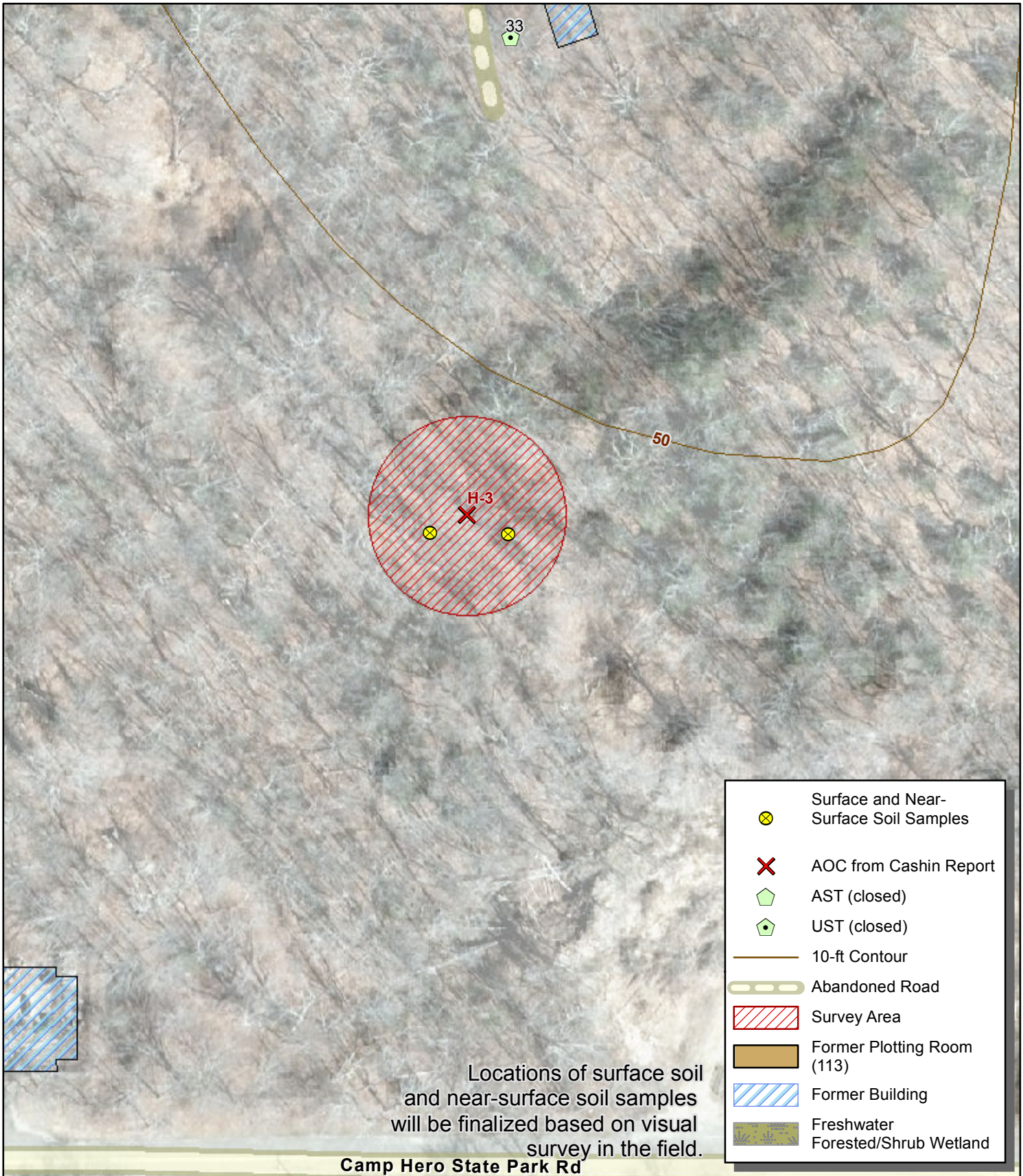
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# H-2 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-21** |

5/2/2016 1:600 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-21 H-2.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 30 60
Feet

1 inch = 60 feet

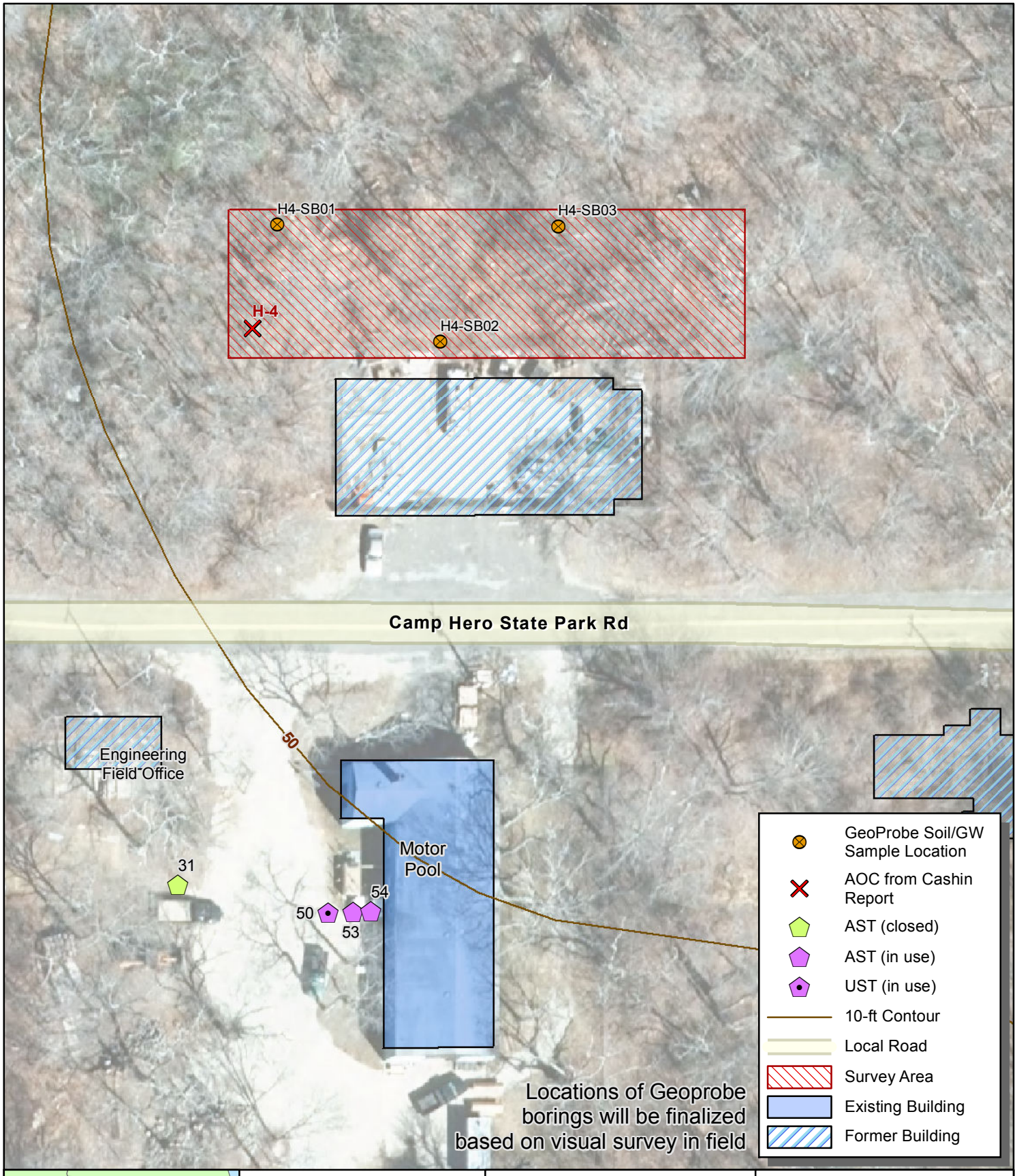
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# H-3 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-22** |







MAP LOCATION

N
W E
S

0 20 40
Feet

1 inch = 45 feet

NAD 1983 StatePlane Long Island FIPS 3104

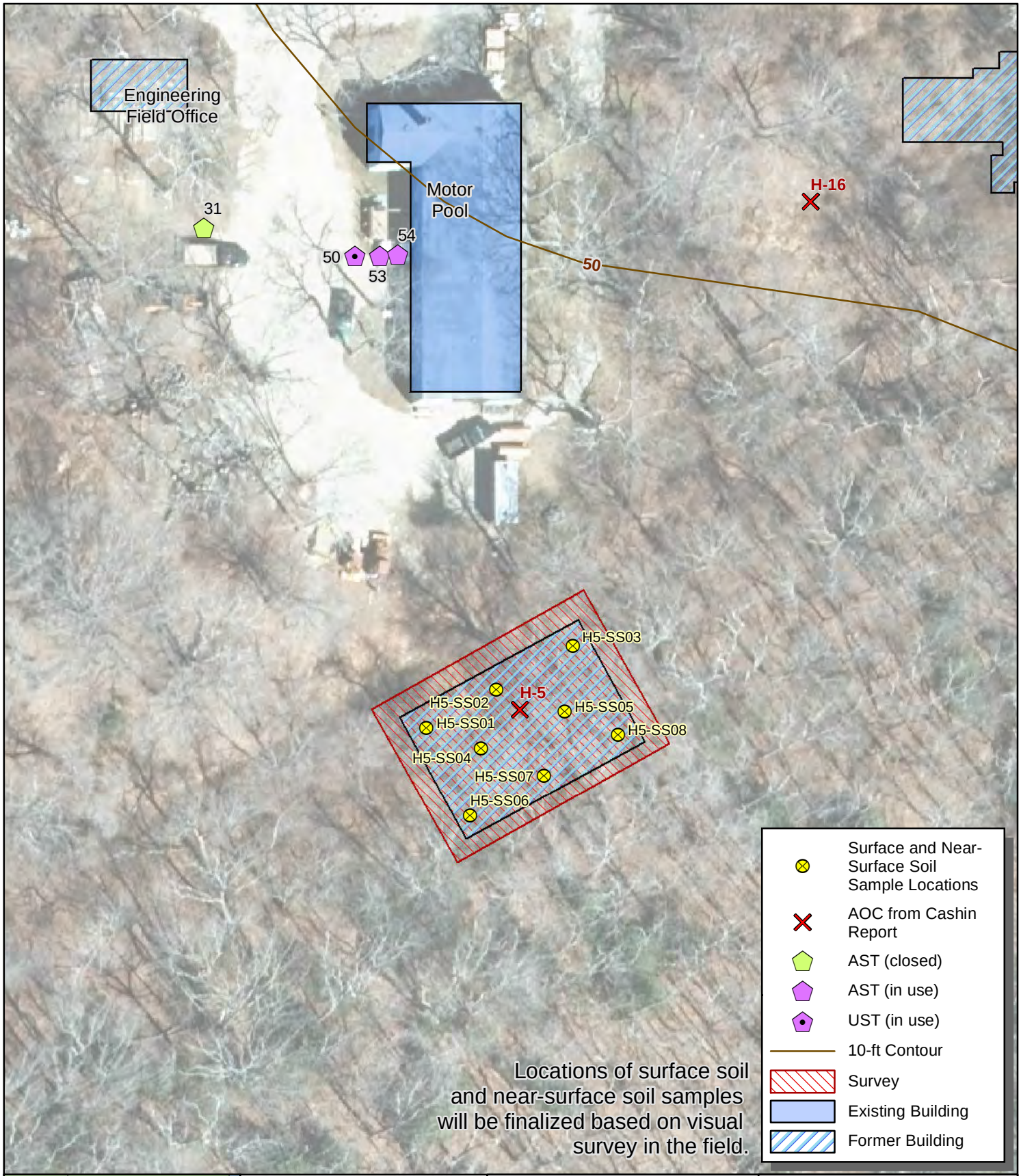
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# H-4 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-23** |

5/2/2016 1:540 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-23 H-4.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 20 40 Feet

1 inch = 45 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

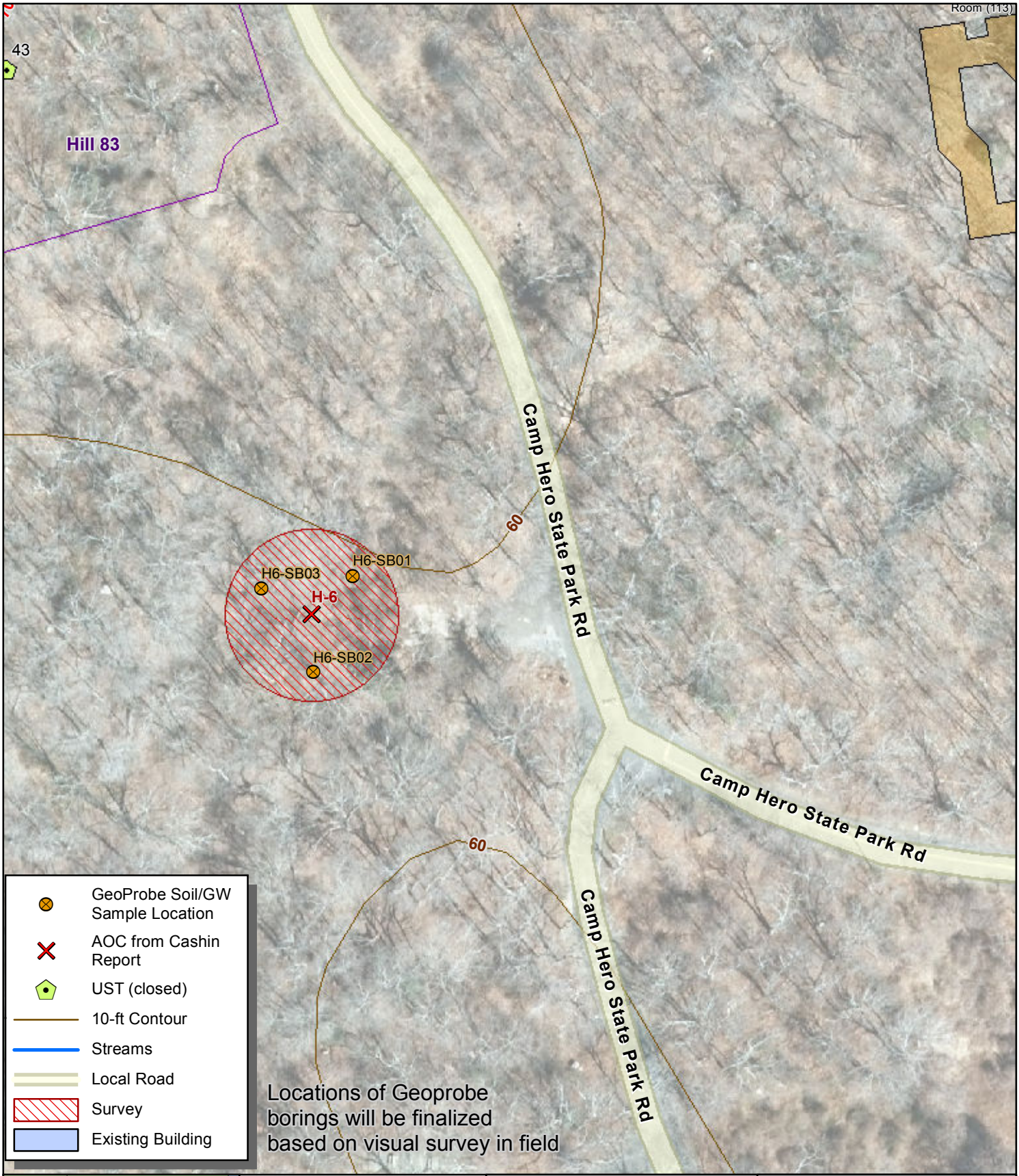
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# H-5 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-24** |

5/2/2016 1:540 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-24 H-5.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 35 70

Feet

1 inch = 70 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

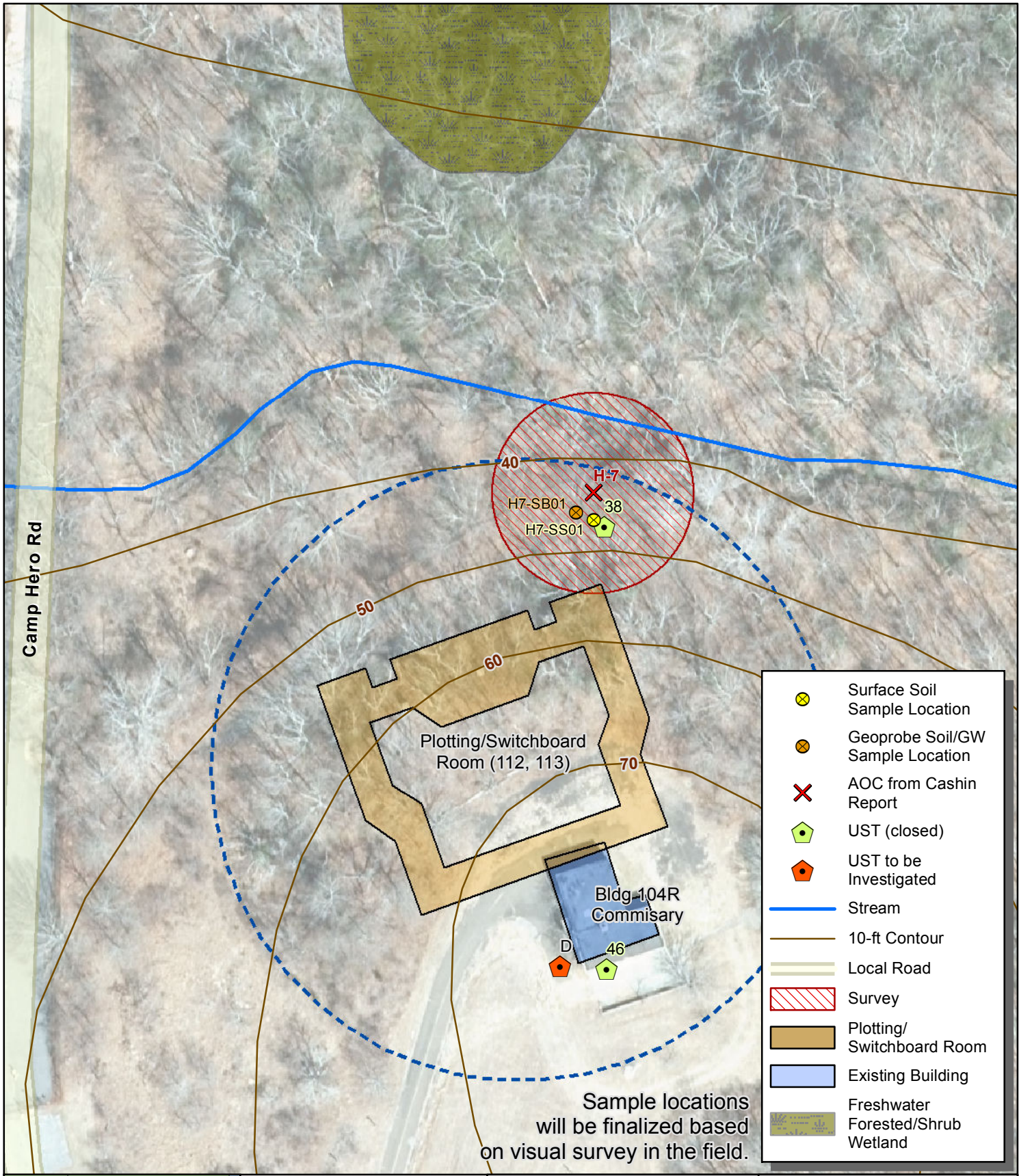
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# H-6 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-25** |

5/26/2016 1:840 \\USCHL1FP002\Data\Library\Gisprojects\Projects\Camp_Hero\Maps\Workplan\Fig 6-25 H-6.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W
E
S
0 30 60
Feet
1 inch = 60 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

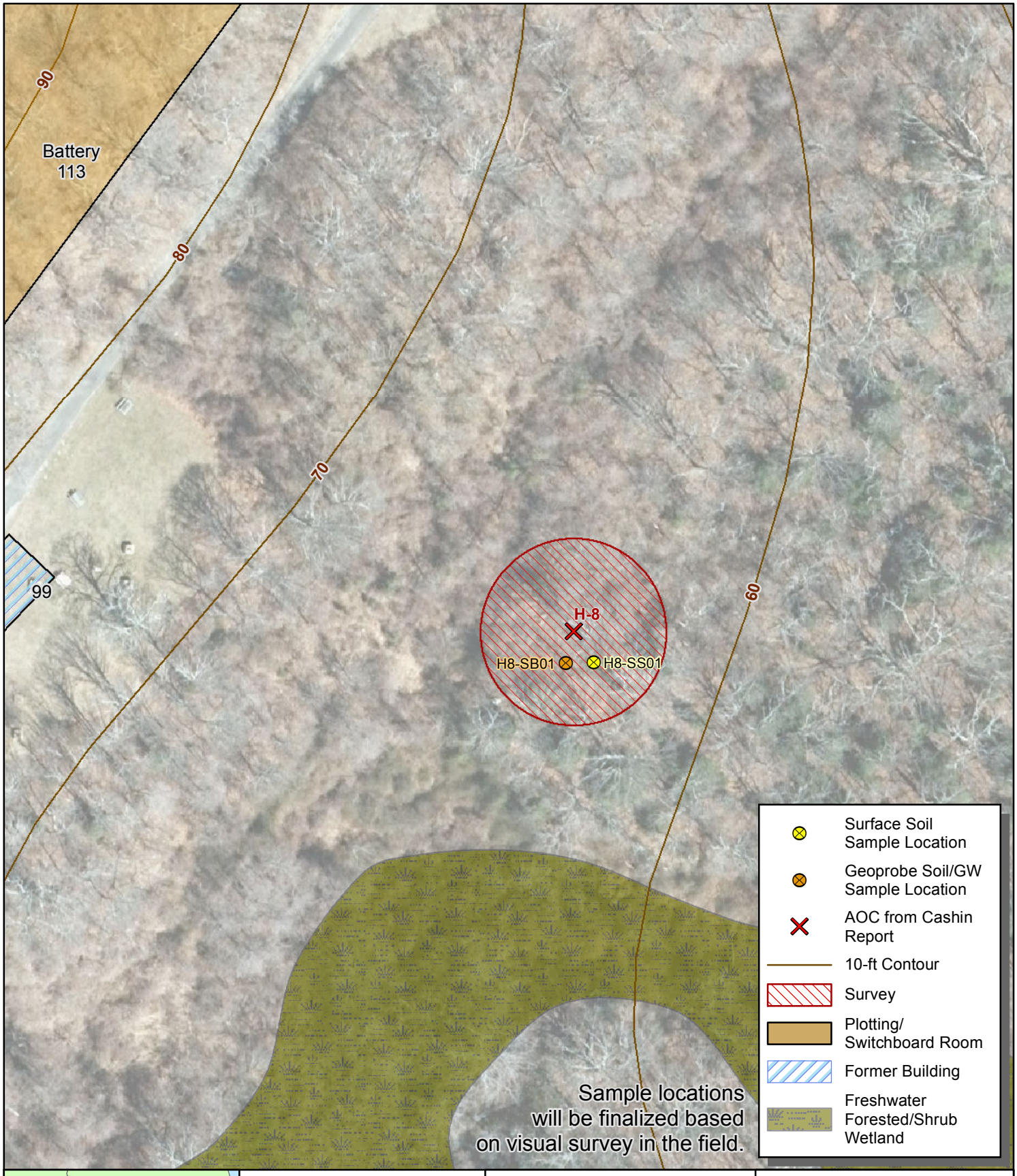
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# H-7 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-26** |

5/2/2016 1:720 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-26 H-7.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 30 60

Feet

1 inch = 60 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

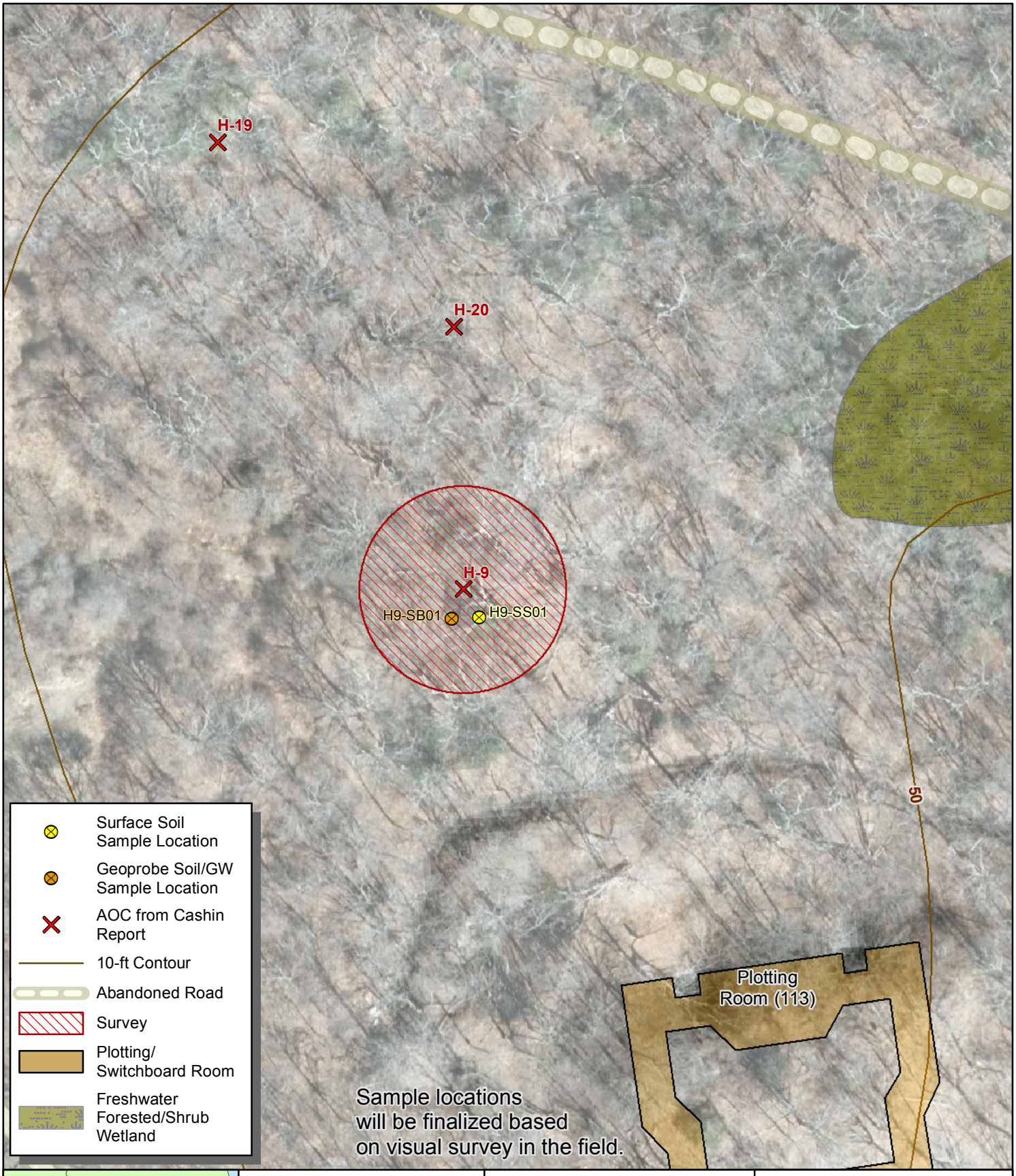
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# H-8 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-27** |

5/2/2016 1:720 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-27 H-8.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION




0 30 60

Feet

1 inch = 60 feet

NAD 1983 StatePlane Long Island FIPS 3104

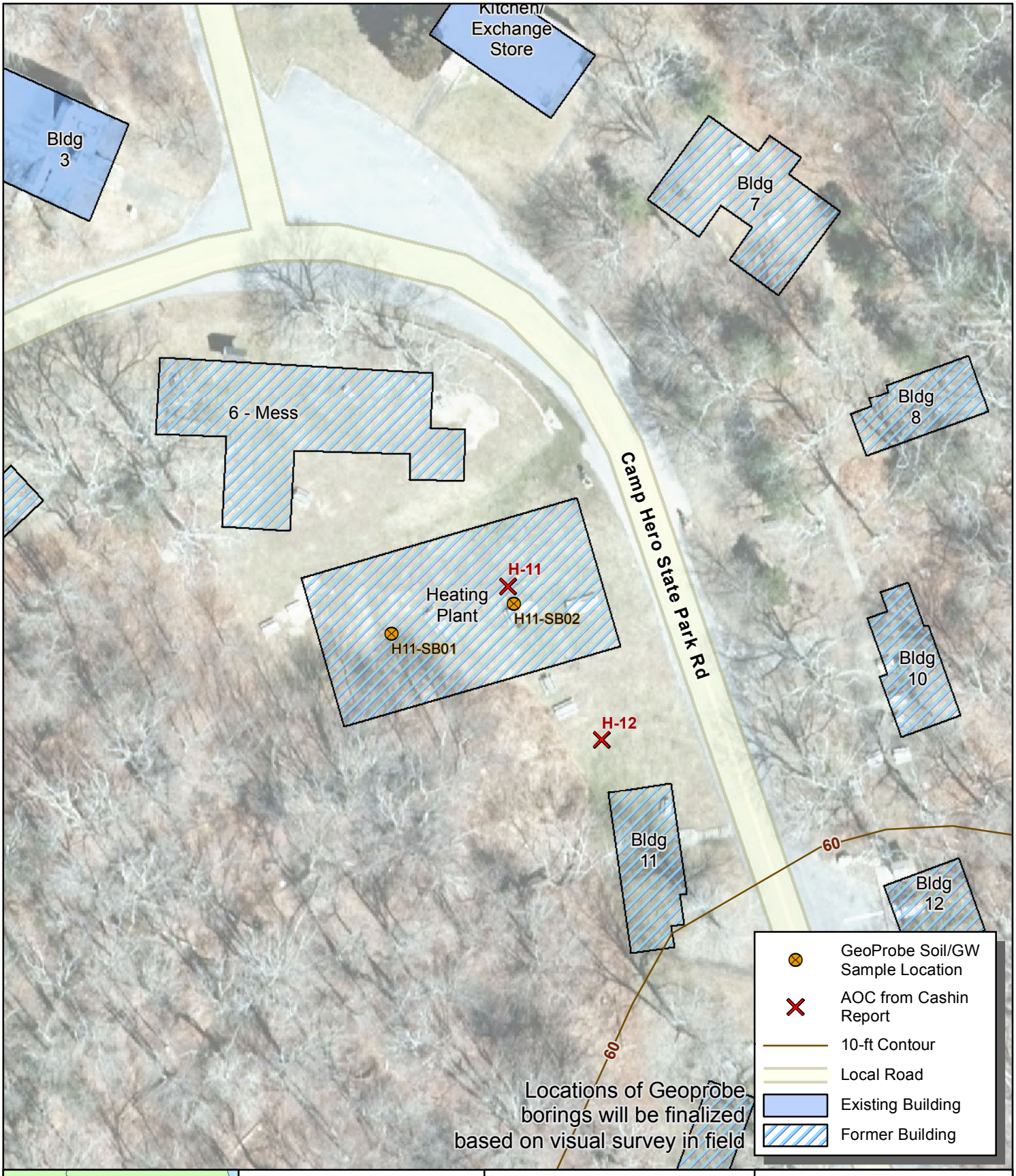
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# H-9 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-28** |







MAP LOCATION

N
W
E
S

0 25 50

Feet

1 inch = 50 feet

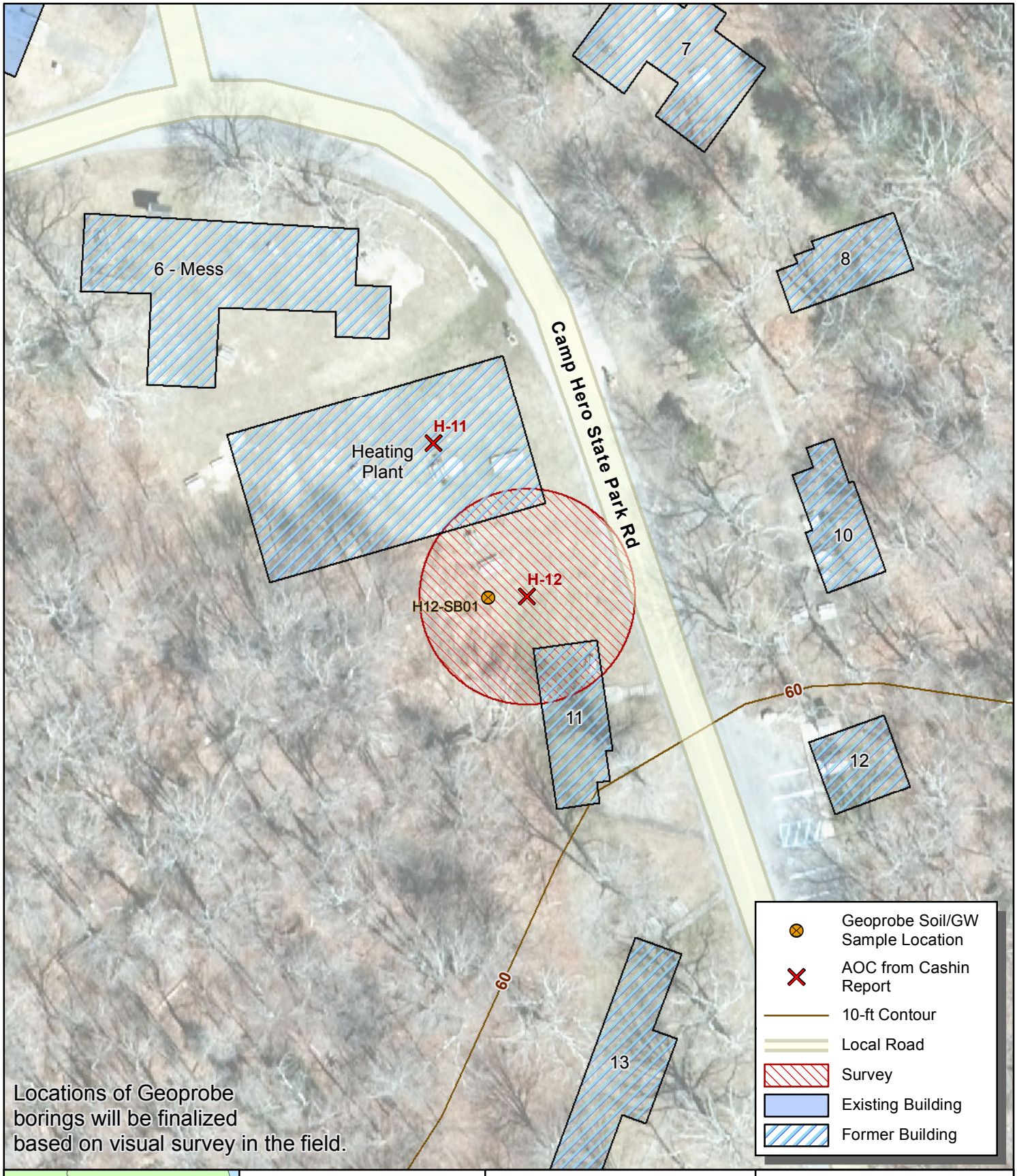
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# H-11 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

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|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-29** |







MAP LOCATION

N
W E
S

0 25 50 Feet

1 inch = 50 feet

NAD 1983 StatePlane Long Island FIPS 3104

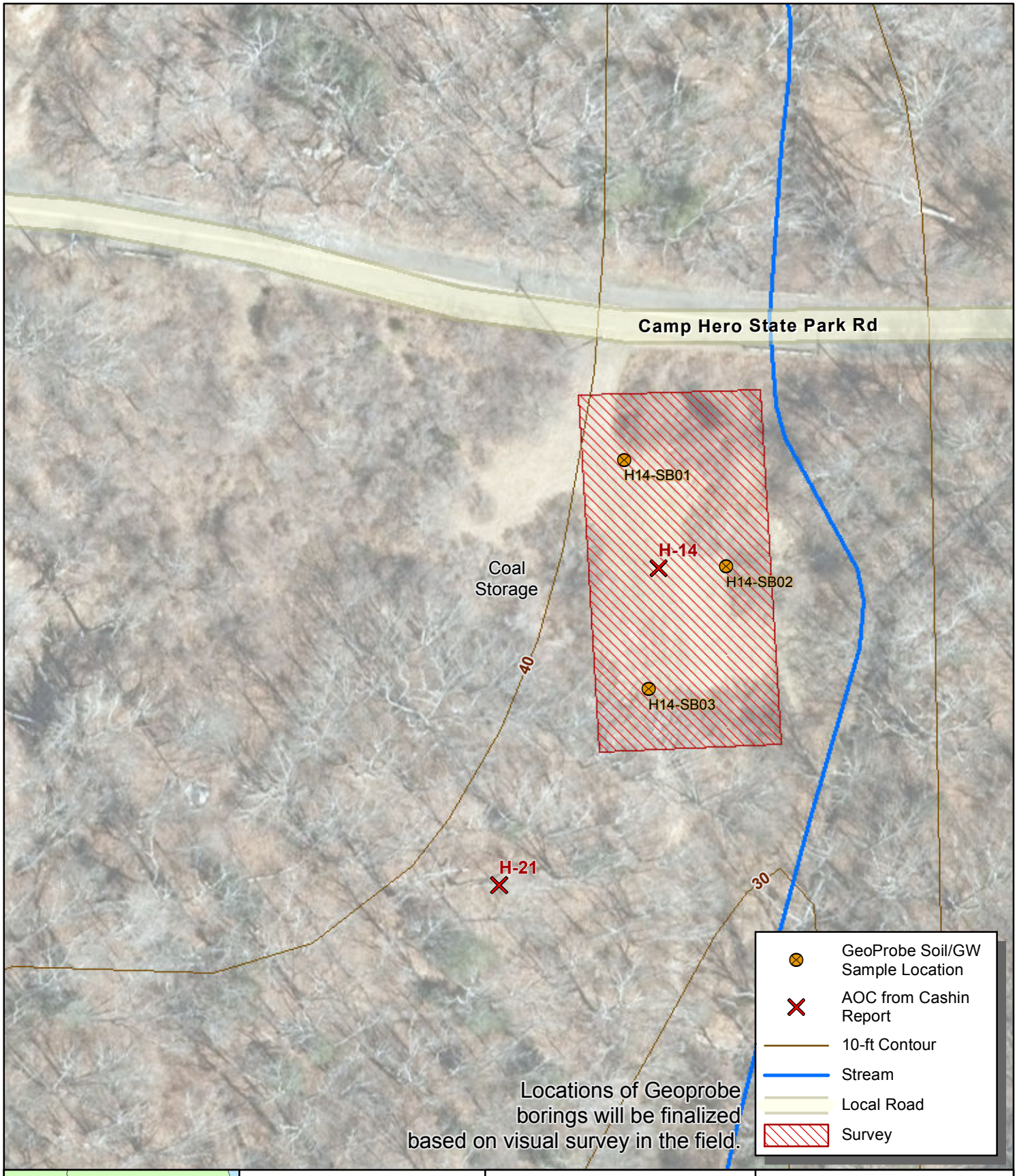
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# H-12 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-30** |

5/2/2016 1:600 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-30 H-12.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 25 50

Feet

1 inch = 50 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

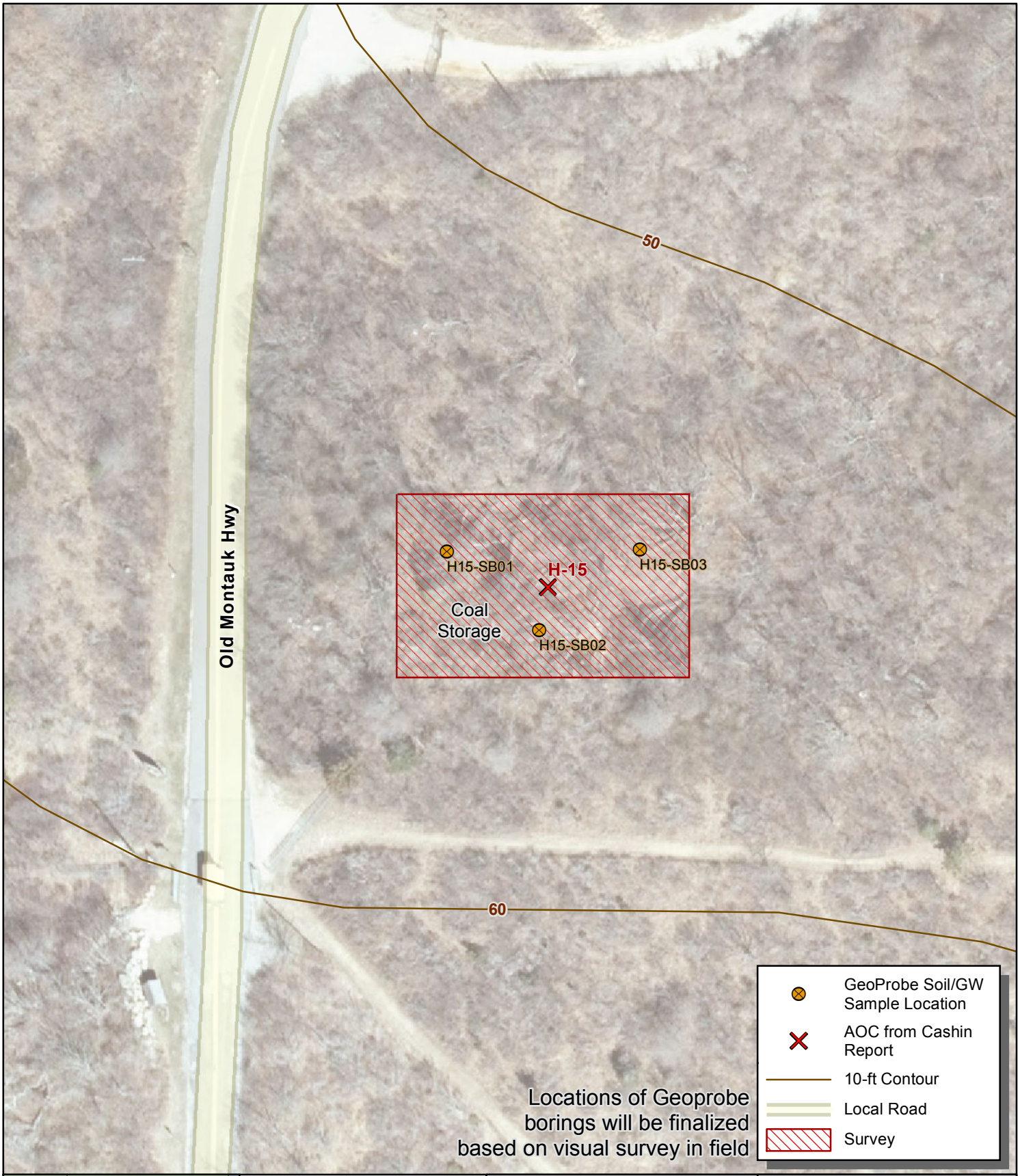
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# H-14 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-31** |

5/2/2016 1:600 \\USCHL1FP002\Data\Library\Gisprojects\Projects\Camp_Hero\Maps\Workplan\Fig 6-31 H-14.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 25 50

Feet

1 inch = 50 feet

NAD 1983 StatePlane Long Island FIPS 3104

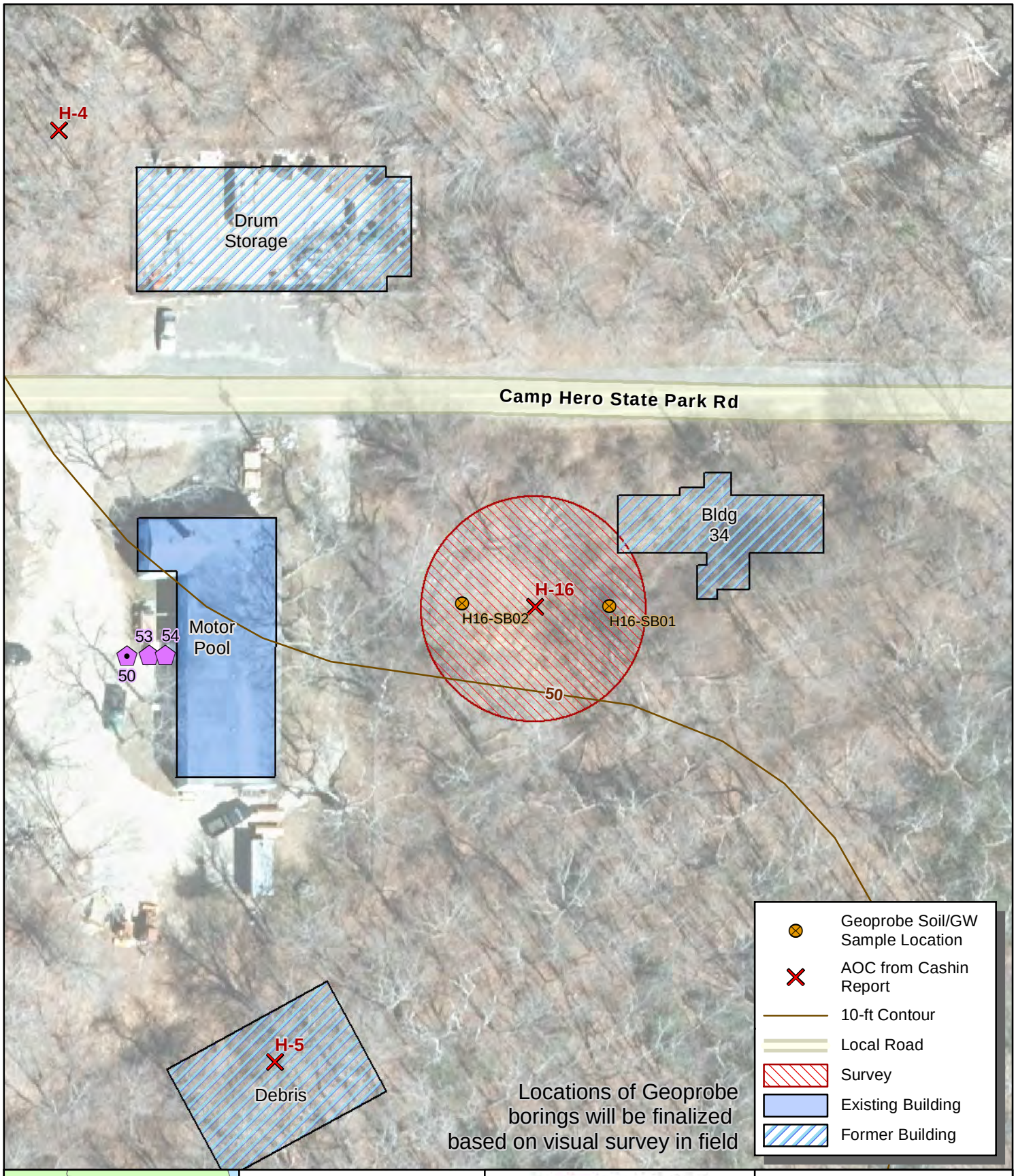
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# H-15 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-32** |

5/2/2016 1:600 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-32 H-15.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W
E
S

0 25 50

Feet

1 inch = 50 feet

NAD 1983 StatePlane Long Island FIPS 3104

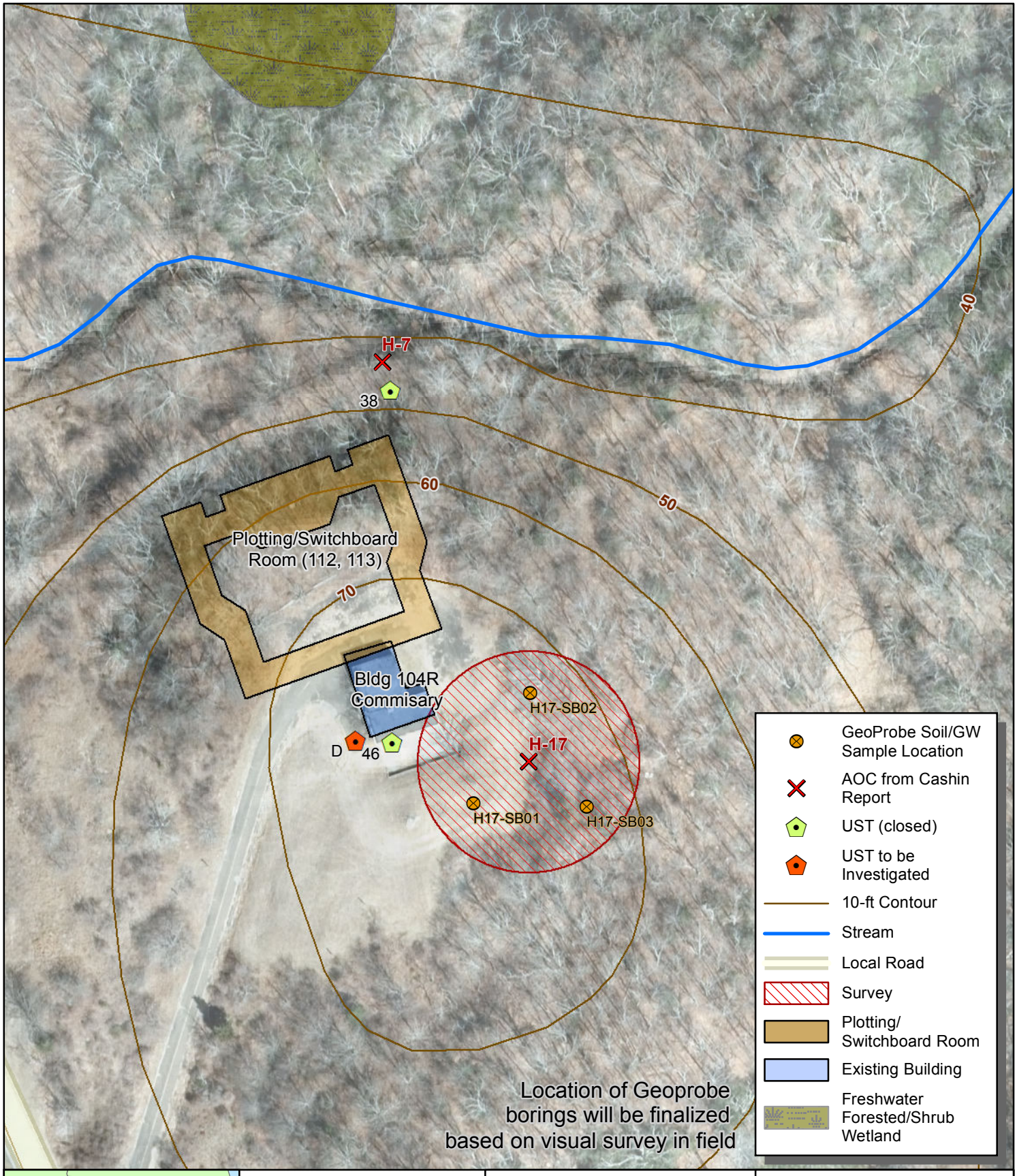
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# H-16 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-33** |

5/2/2016 1:600 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-33 H-16.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 37.5 75

Feet

1 inch = 75 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

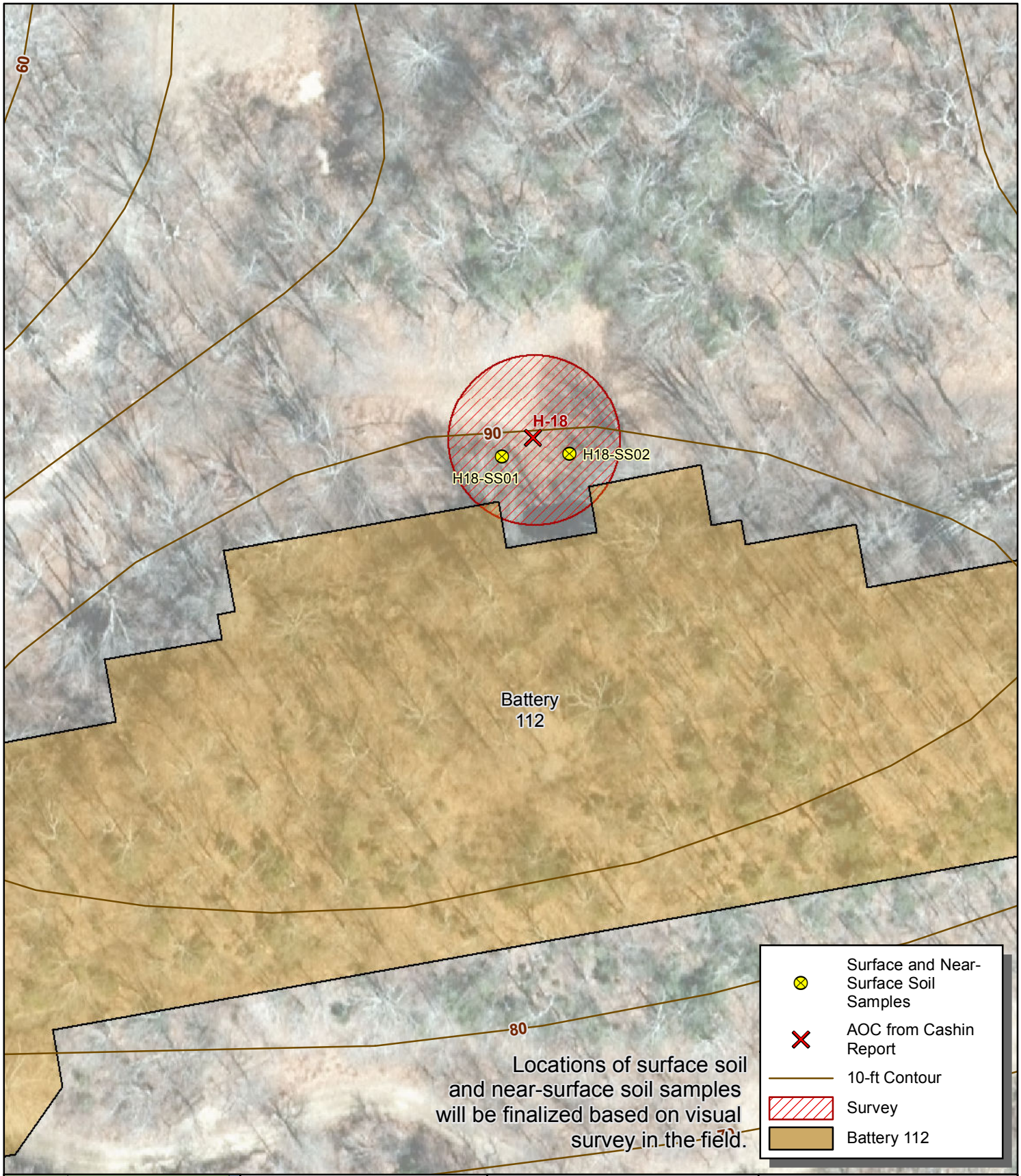
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# H-17 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

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|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-34** |

5/2/2016 1:900 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-34 H-17.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION




0 25 50

Feet

1 inch = 50 feet

NAD 1983 StatePlane Long Island FIPS 3104

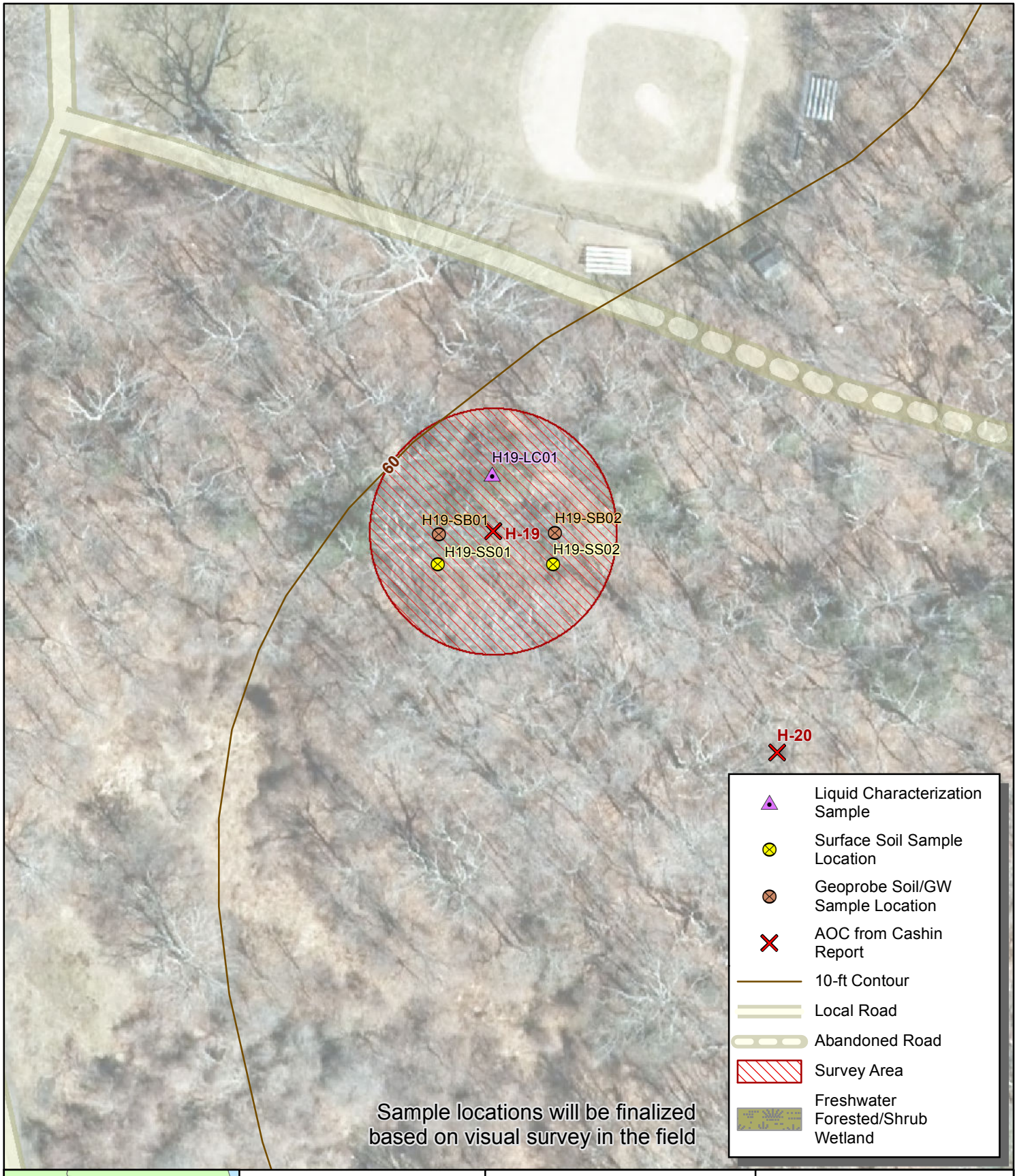
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# H-18 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

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|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-35** |







MAP LOCATION

N
W
E
S

0 25 50

Feet

1 inch = 50 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

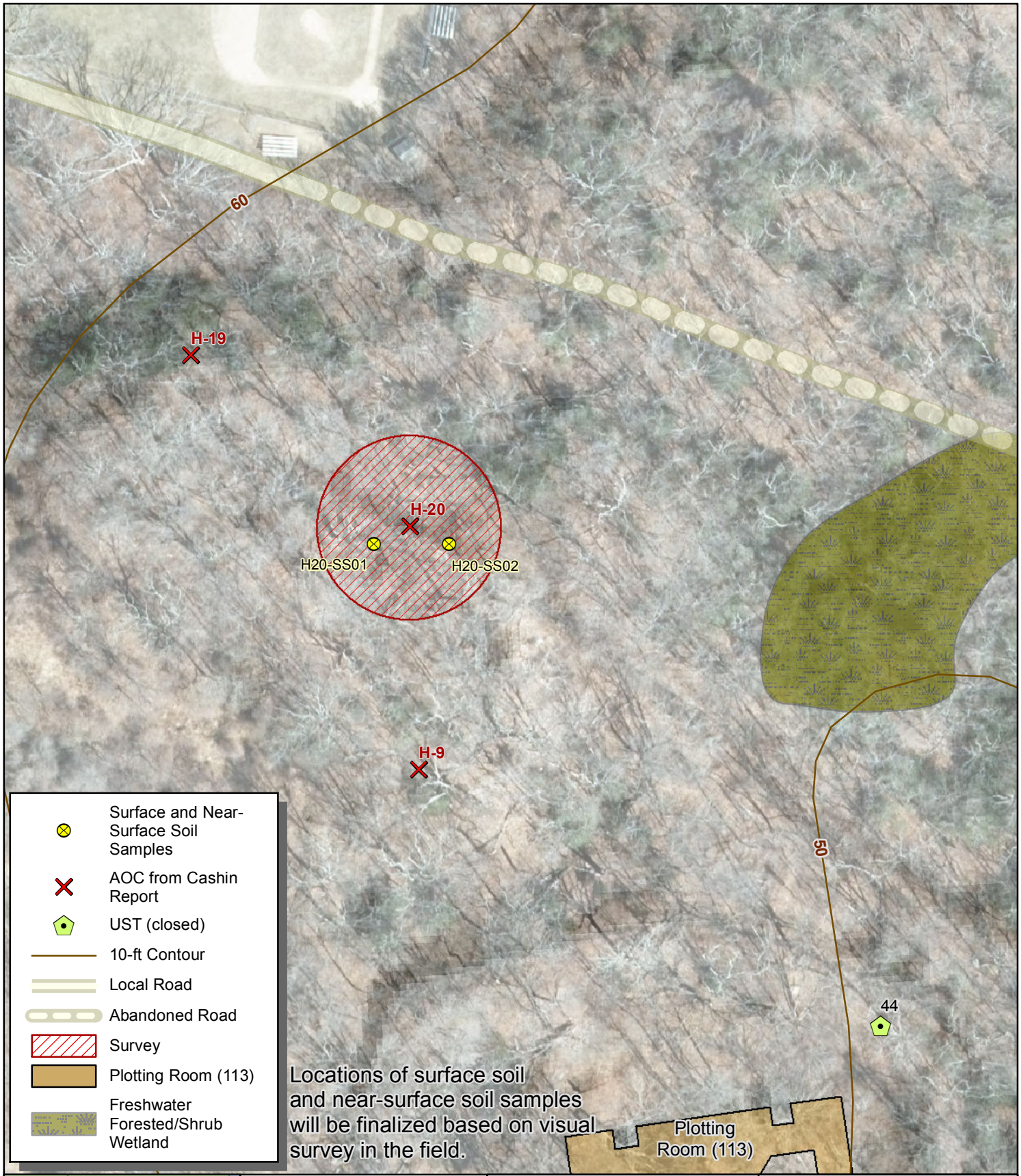
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# H-19 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-36** |

5/2/2016 1:600 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-36 H-19.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 30 60
Feet

1 inch = 65 feet

NAD 1983 StatePlane Long Island FIPS 3104

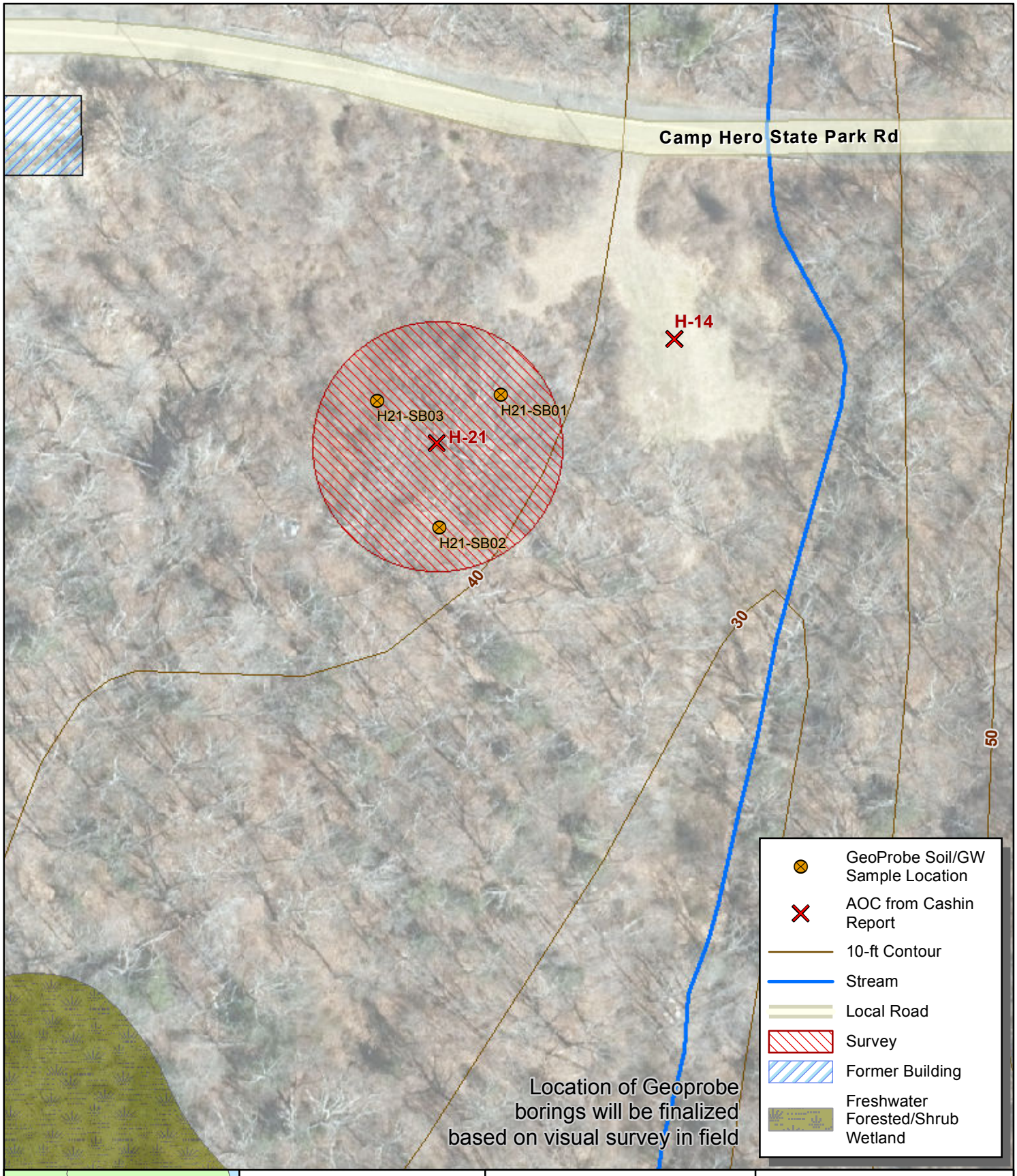
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# H-20 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

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|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-37** |

5/2/2016 1:780 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-37 H-20.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W
E
S

0 30 60

Feet

1 inch = 60 feet

NAD 1983 StatePlane Long Island FIPS 3104

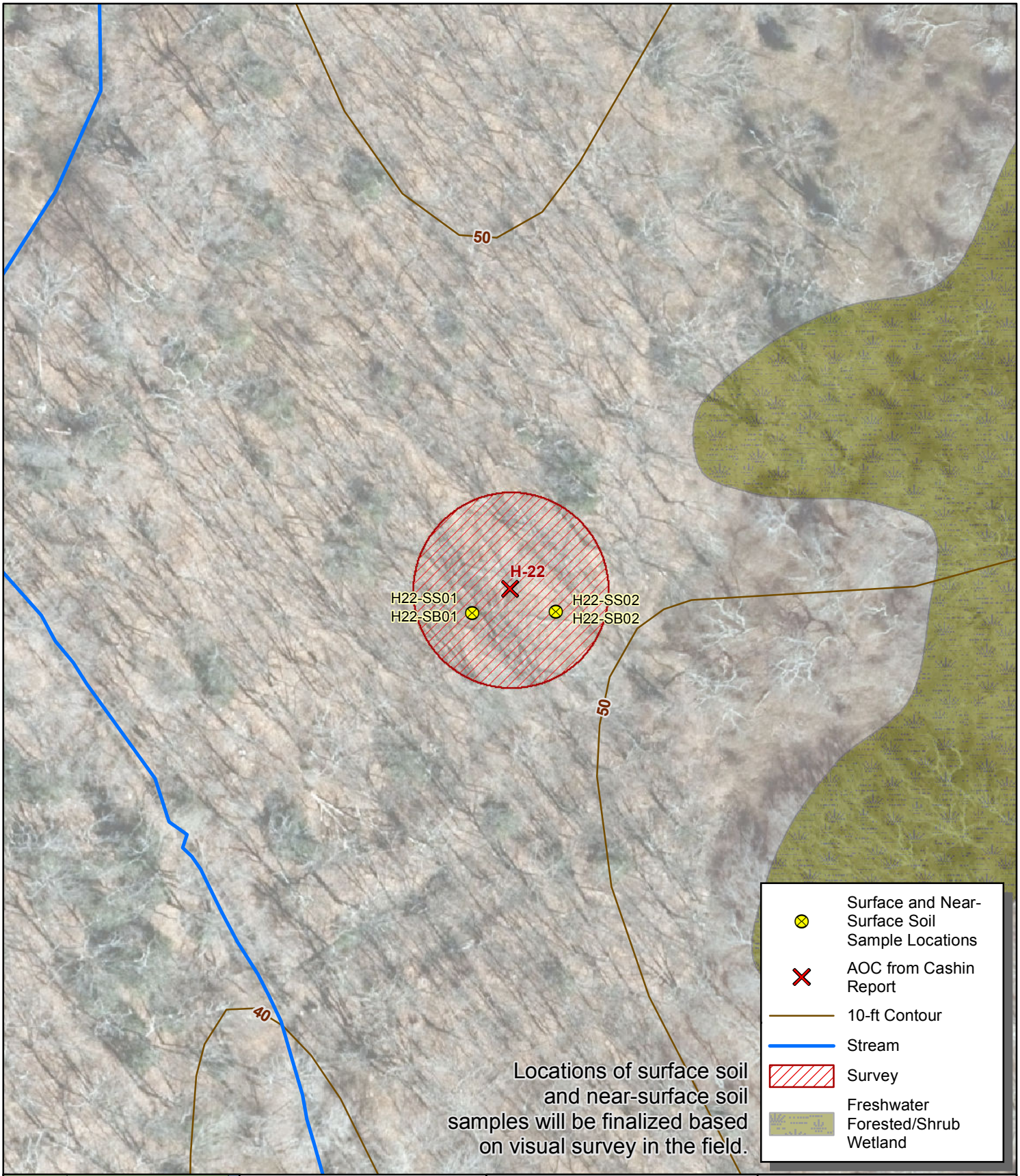
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# H-21 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

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|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-38** |







MAP LOCATION

N
W
E
S

0 30 60 Feet

1 inch = 60 feet

NAD 1983 StatePlane Long Island FIPS 3104

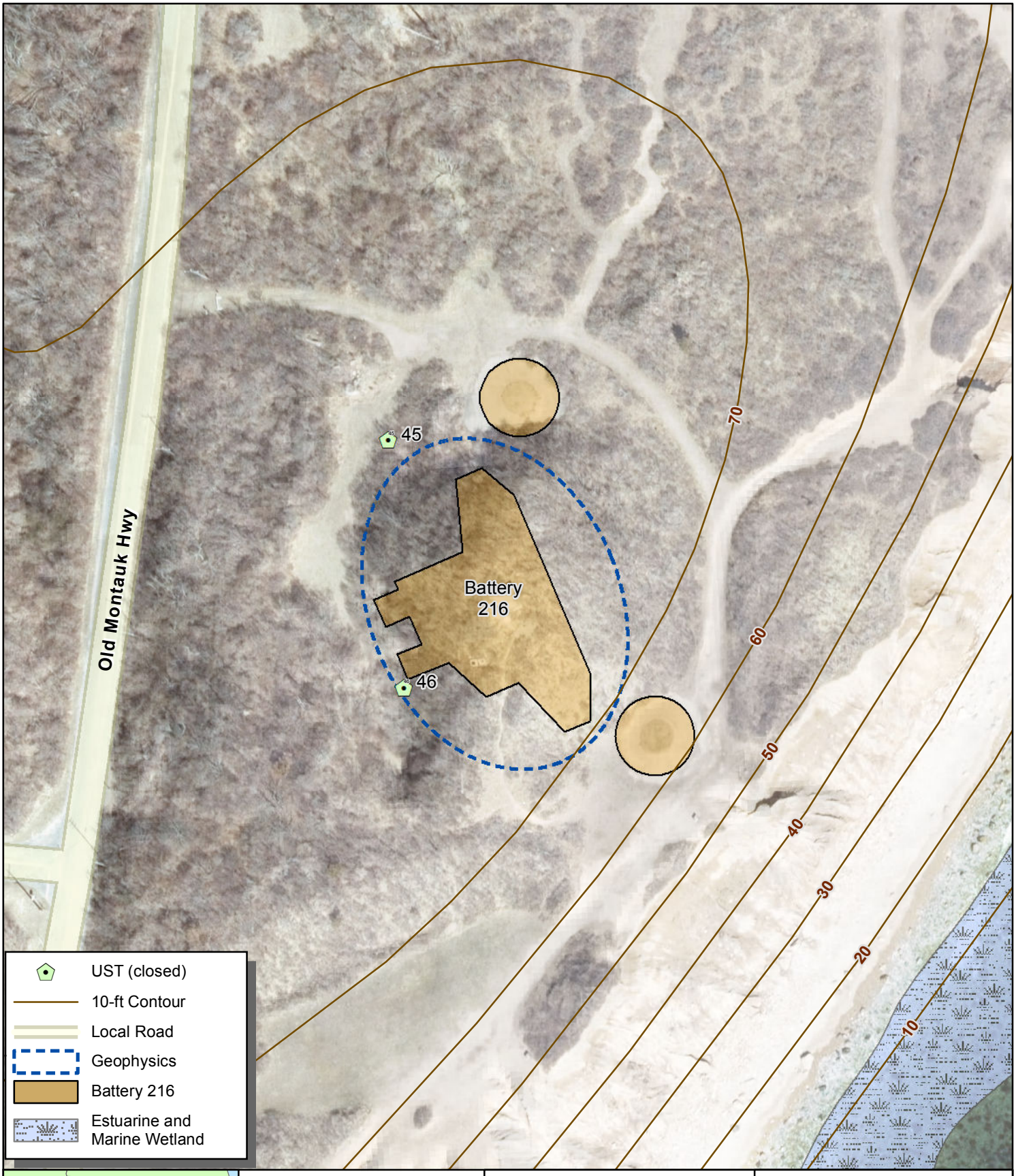
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Arlington, VA 22201
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# H-22 Phase 1 RI Sampling Locations

Camp Hero Remedial Investigation Work Plan

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|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-39** |

5/2/2016 1:720 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-39 H-22.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W
E
S

0 37.5 75

Feet

1 inch = 75 feet

NAD 1983 StatePlane Long Island FIPS 3104

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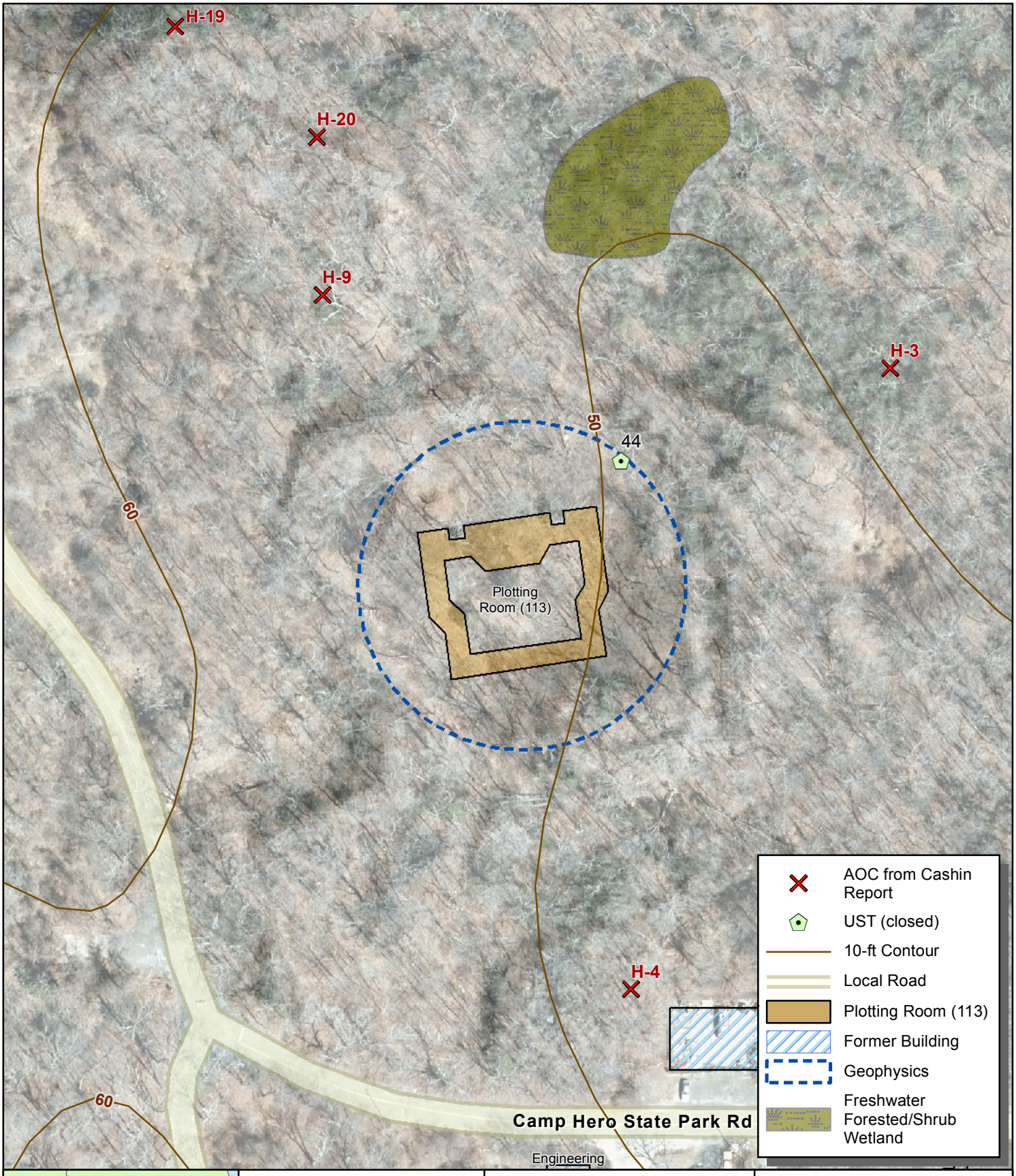
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# Battery 216
# Phase 1 RI Geophysical Survey Area

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-40** |

5/2/2016 1:900 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-40 Battery 216.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 50 100 Feet

1 inch = 100 feet

NAD 1983 StatePlane Long Island FIPS 3104

AECOM

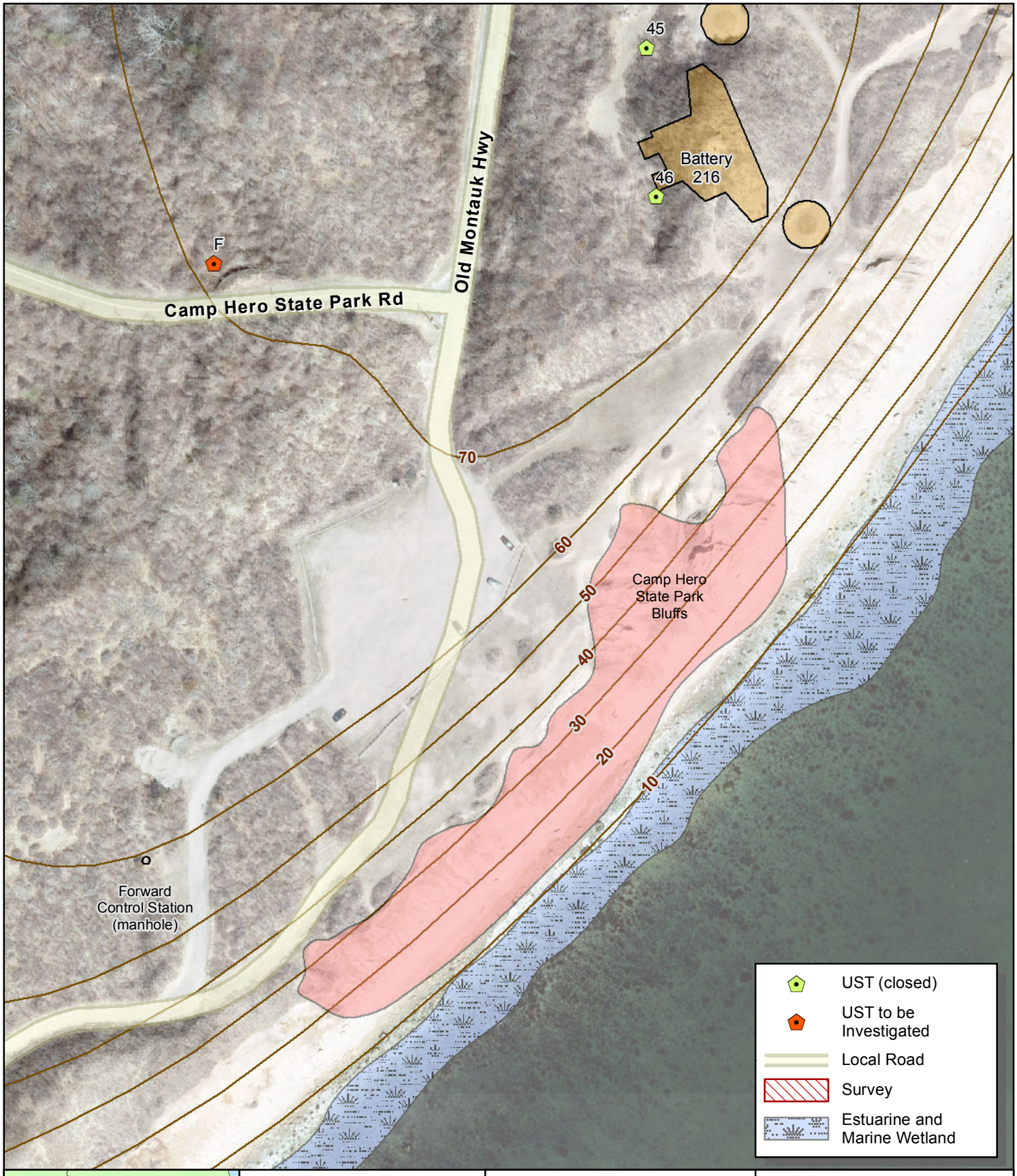
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# Plotting Room 113
# Phase 1 RI Geophysical Survey Area

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-41** |

5/2/2016 1:1,200 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-41 Plotting Room 113.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 62.5 125
Feet

1 inch = 125 feet

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# Camp Hero State Park Bluffs Survey Area

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 6-42** |

5/2/2016 1:1,500 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-42 SP Bluffs.mxd (USCHL1FP002\Data\Library\Gisprojects\)







MAP LOCATION

N
W E
S

0 255 510 Feet

1 inch = 500 feet

NAD 1983 StatePlane Long Island FIPS 3104

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# Army Geospatial Center Sites 1 - 4

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | March 2016 | **Figure 6-43** |

3/21/2016 1:6,000 Y:\Projects\Camp_Hero\Maps\Workplan\Fig 6-43 Army Geospatial Center Sites.mxd (USCHL1FP002\Data\Library\Gisprojects\)

# Appendix B

# Community Air Monitoring Plan

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**New York State Department of Health**
**Generic Community Air Monitoring Plan**
**(Appendix 1A of the NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation)**

Overview

A Community Air Monitoring Plan (CAMP) requires real-time monitoring for volatile organic compounds (VOCs) and particulates (i.e., dust) at the downwind perimeter of each designated work area when certain activities are in progress at contaminated sites. The CAMP is not intended for use in establishing action levels for worker respiratory protection. Rather, its intent is to provide a measure of protection for the downwind community (i.e., off-site receptors including residences and businesses and on-site workers not directly involved with the subject work activities) from potential airborne contaminant releases as a direct result of investigative and remedial work activities. The action levels specified herein require increased monitoring, corrective actions to abate emissions, and/or work shutdown. Additionally, the CAMP helps to confirm that work activities did not spread contamination off-site through the air.

The generic CAMP presented below will be sufficient to cover many, if not most, sites. Specific requirements should be reviewed for each situation in consultation with NYSDOH to ensure proper applicability. In some cases, a separate site-specific CAMP or supplement may be required. Depending upon the nature of contamination, chemical- specific monitoring with appropriately-sensitive methods may be required. Depending upon the proximity of potentially exposed individuals, more stringent monitoring or response levels than those presented below may be required. Special requirements will be necessary for work within 20 feet of potentially exposed individuals or structures and for indoor work with co-located residences or facilities. These requirements should be determined in consultation with NYSDOH.

Reliance on the CAMP should not preclude simple, common-sense measures to keep VOCs, dust, and odors at a minimum around the work areas.

Community Air Monitoring Plan

Depending upon the nature of known or potential contaminants at each site, real-time air monitoring for VOCs and/or particulate levels at the perimeter of the exclusion zone or work area will be necessary. Most sites will involve VOC and particulate monitoring; sites known to be contaminated with heavy metals alone may only require particulate monitoring. If radiological contamination is a concern, additional monitoring requirements may be necessary per consultation with appropriate DEC/NYSDOH staff.

**Continuous monitoring** will be required for all ground intrusive activities and during the demolition of contaminated or potentially contaminated structures. Ground intrusive activities include, but are not limited to, soil/waste excavation and handling, test pitting or trenching, and the installation of soil borings or monitoring wells.

**Periodic monitoring** for VOCs will be required during non-intrusive activities such as the collection of soil and sediment samples or the collection of groundwater samples from existing monitoring wells. “Periodic” monitoring during sample collection might reasonably consist of taking a reading upon arrival at a sample location, monitoring while opening a well cap or

overturning soil, monitoring during well baling/purging, and taking a reading prior to leaving a sample location. In some instances, depending upon the proximity of potentially exposed individuals, continuous monitoring may be required during sampling activities. Examples of such situations include groundwater sampling at wells on the curb of a busy urban street, in the midst of a public park, or adjacent to a school or residence.

VOC Monitoring, Response Levels, and Actions

Volatile organic compounds (VOCs) must be monitored at the downwind perimeter of the immediate work area (i.e., the exclusion zone) on a continuous basis or as otherwise specified. Upwind concentrations should be measured at the start of each workday and periodically thereafter to establish background conditions, particularly if wind direction changes. The monitoring work should be performed using equipment appropriate to measure the types of contaminants known or suspected to be present. The equipment should be calibrated at least daily for the contaminant(s) of concern or for an appropriate surrogate. The equipment should be capable of calculating 15-minute running average concentrations, which will be compared to the levels specified below.

1. If the ambient air concentration of total organic vapors at the downwind perimeter of the work area or exclusion zone exceeds 5 parts per million (ppm) above background for the 15-minute average, work activities must be temporarily halted and monitoring continued. If the total organic vapor level readily decreases (per instantaneous readings) below 5 ppm over background, work activities can resume with continued monitoring.

2. If total organic vapor levels at the downwind perimeter of the work area or exclusion zone persist at levels in excess of 5 ppm over background but less than 25 ppm, work activities must be halted, the source of vapors identified, corrective actions taken to abate emissions, and monitoring continued. After these steps, work activities can resume provided that the total organic vapor level 200 feet downwind of the exclusion zone or half the distance to the nearest potential receptor or residential/commercial structure, whichever is less - but in no case less than 20 feet, is below 5 ppm over background for the 15-minute average.

3. If the organic vapor level is above 25 ppm at the perimeter of the work area, activities must be shutdown.

4. All 15-minute readings must be recorded and be available for State (DEC and NYSDOH) personnel to review. Instantaneous readings, if any, used for decision purposes should also be recorded.

Particulate Monitoring, Response Levels, and Actions

Particulate concentrations should be monitored continuously at the upwind and downwind perimeters of the exclusion zone at temporary particulate monitoring stations. The particulate monitoring should be performed using real-time monitoring equipment capable of measuring particulate matter less than 10 micrometers in size (PM-10) and capable of integrating over a period of 15 minutes (or less) for comparison to the airborne particulate action level. The equipment must be equipped with an audible alarm to indicate exceedance of the action level. In addition, fugitive dust migration should be visually assessed during all work activities.

1. If the downwind PM-10 particulate level is 100 micrograms per cubic meter (mcg/$m^3$) greater than background (upwind perimeter) for the 15-minute period or if airborne dust is observed leaving the work area, then dust suppression techniques must be employed. Work may continue with dust suppression techniques provided that downwind PM-10 particulate levels do not exceed 150 mcg/$m^3$ above the upwind level and provided that no visible dust is migrating from the work area.

2. If, after implementation of dust suppression techniques, downwind PM-10 particulate levels are greater than 150 mcg/$m^3$ above the upwind level, work must be stopped and a re-evaluation of activities initiated. Work can resume provided that dust suppression measures and other controls are successful in reducing the downwind PM-10 particulate concentration to within 150 mcg/$m^3$ of the upwind level and in preventing visible dust migration.

3. All readings must be recorded and be available for State (DEC and NYSDOH) and County Health personnel to review.

December 2009

Memorandum for Appendix B: Community Air Monitoring Plan
Final Work Plan
Remedial Investigation
Former Camp Hero, Montauk, New York

To protect the community from any potential airborne releases that could result from field activities associated with the remedial investigation, community air monitoring will be performed in general accordance with the NYSDOH Generic CAMP, Attachment 1A of the NYSDEC DER-10 Technical Guidance for Site Investigation and Remediation, included as Appendix B (NYSDEC 2010b). A CAMP is typically required by the NYSDEC whenever intrusive work is conducted as part of an environmental investigation or remediation.

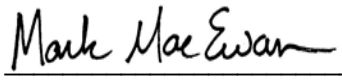
Per DER-10, continuous air monitoring will be performed in the vicinity of each drill rig when intrusive activities are underway. Air monitoring will consist of VOC monitoring with a photoionization detector (PID) and a dust monitor placed on a tripod adjacent to the work areas, in a downwind location. Background (upwind) levels will be measured each day prior to start-up of site activities and periodically throughout the day. Per the NYSDOH Generic CAMP (Appendix B), the following actions will be taken if acceptable levels of air impacts are exceeded:

- If VOCs exceed 5 ppm above background for a 15-minute average, work activities will be temporarily stopped and monitoring will continue. Work activities can resume with continued monitoring if VOCs readily decrease to below 5 ppm above background.

- If VOCs exceed between 5 and 25 ppm above background for a 15-minute average, work will be stopped, the source of the emissions will be identified, and corrective measures will be implemented. See Appendix B for requirements to resume work.

- If particulate levels (PM10) are greater than 100 µg/$m^3$ above background for a 15 minute period, or if airborne dust is observed leaving the work area, dust suppression techniques will be employed. Work will continue with these suppression techniques provided that PM10 levels do not exceed 150 µg/$m^3$ above background and no visible dust is migrating from the work area. If PM10 exceeds 150 µg/$m^3$ over background, work will be stopped, and a re-evaluation of activities will be initiated.

Signed:



Mark MacEwan
Project Manager
AECOM-Tidewater JV

# Appendix C

# Sampling and Analysis Plan

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FINAL

# APPENDIX C
# SAMPLING AND ANALYSIS PLAN

## Remedial Investigation
## Former Camp Hero, Montauk, New York

**Revision: 0**

**Prepared for:**




**U.S. Army Corps of Engineers, New York District**
**26 Federal Plaza**
**New York, New York, 10278**

**and**

**U.S. Army Corps of Engineers, New England District**
**696 Virginia Road**
**Concord, Massachusetts 01742**

**Prepared By:**

**A Joint Venture of AECOM – Tidewater**
**3101 Wilson Boulevard**
**Suite 900**
**Arlington, VA 22201**

**June 2016**

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**FINAL**

# APPENDIX C
# SAMPLING AND ANALYSIS PLAN

**June 2016**

**Remedial Investigation,**
**Former Camp Hero, Montauk, New York**

**Prepared for:**

**U.S. Army Corps of Engineers, New York District**
**26 Federal Plaza**
**New York, New York, 10278**

**and**

**U.S. Army Corps of Engineers, New England District**
**696 Virginia Road**
**Concord, Massachusetts 01742**

**Prepared by:**

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**3101 Wilson Boulevard**
**Suite 900**
**Arlington, VA 22201**

**Prepared under:**

**Contract Number W912DR-13-D-0016**

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Table 2-1 Summary of Camp Hero RI Field Activities (First Field Effort)
Table 2-2 Depths of Phase 1 Geoprobe® Borings for Abandoned Waste Disposal System

## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| % | percent |
| AECOM | AECOM |
| AGC | Army Geospatial Center |
| AOC | area of concern |
| APP | Accident Prevention Plan |
| AST | aboveground storage tank |
| ASTM | ASTM International (2002) |
| bgs | below ground surface |
| CERCLA | Comprehensive Environmental Restoration, Compensation, and Liability Act |
| CFR | Code of Federal Regulations |
| cm | centimeter |
| CWM | Chemical Warfare Materiel |
| DDESB | Department of Defense Explosives Safety Board |
| DER | Department of Environmental Remediation |
| DPT | direct-push technology |
| ELAP | Environmental Laboratory Accreditation Program Certification |
| EM | engineering manual |
| ER | engineer regulation |
| ft | foot or feet |
| FUDS | formerly used defense site |
| ID | identification |
| IDW | investigation-derived waste |
| MEC | Munitions and Explosives of Concern |
| MS | matrix spike |
| MSD | matrix spike duplicate |
| NTU | nephelometric turbidity unit |
| NY | New York |
| NYCRR | New York Codes, Rules, and Regulations |
| NYSDEC | New York State Department of Environmental Conservation |
| ORP | oxidation-reduction potential |
| OSHA | Occupational Safety and Health Administration |
| PCB | polychlorinated biphenyl |
| PID | photoionization detector |
| PM | project manager |
| PPE | personal protective equipment |

| | |
|---|---|
| QA | quality assurance |
| QAPP | quality assurance project plan |
| QC | quality control |
| RI | Remedial Investigation |
| SAP | Sampling and Analysis Plan |
| SC | specific conductivity |
| SOP | Standard Operating Procedure |
| SS | site supervisor |
| SSHO | site safety and health officer |
| SSHP | Site Safety and Health Plan |
| STARS | Spills Technology and Remediation Series |
| SVOC | semivolatile organic compound |
| T&D | transportation and disposal |
| UFP | uniform federal policy |
| USACE | United States Army Corp of Engineers |
| USEPA | United States Environmental Protection Agency |
| UST | underground storage tank |
| VOC | volatile organic compound |
| WDS | waste disposal system |
| WP | work plan |
| UXO | Unexploded Ordnance |

## 1.0 INTRODUCTION

This document was prepared under contract to the United States Army Corps of Engineers (USACE), to conduct a Comprehensive Environmental Restoration, Compensation, and Liability Act (CERCLA) Remedial Investigation (RI), Feasibility Study, Proposed Plan, and Decision Document, at Camp Hero, a Formerly Used Defense Site (FUDS). AECOM-Tidewater JV prepared this RI Sampling and Analysis Plan (SAP) appendix to the RI Work Plan (WP) under Contract Number W912DR-13-D-0016 in accordance with the USACE Engineer Regulation (ER) Number 200-3-1, FUDS Program Policy. The lead regulator for this RI is the New York State Department of Environmental Conservation (NYSDEC). The NYSDEC will be provided with the planning and reporting documents prepared as part of this investigation for review and comment. Background information on the areas of concern (AOCs) included in this SAP is included in the RI WP.

As outlined in the WP, this RI will be conducted in two phases. All AOCs will be investigated as part of Phase 1 to determine of contaminants of concern are present at concentrations that will impact human health and the environment (See Section 2.0). Data will be evaluated following the Phase 1 investigation and an addendum to this RI WP will be prepared to further evaluate sites where contamination was detected at concentrations that exceeded screening criteria. Phase 2 will determine lateral and vertical extent of contamination. This SAP summarizes the activities proposed for Phase 1; the specific approach to Phase 2 will be detailed in the RI WP Addendum.

This RI SAP is organized into the following sections:

- Section 1.0: Introduction – provides an introduction to the project and document.
- Section 2.0: Summary of RI Activities – presents the general RI approach for each AOC at Camp Hero.
- Section 3.0: Field Operations and Methodology – details the planned RI field operations that will be conducted to obtain required data including appropriate measures to ensure data quality and achievement of project objectives.
- Section 4.0: References – lists the references utilized in this SAP.

The following appendices are included in this SAP:

- Appendix A of this includes Standard Operating Procedures (SOPs) for field activities.
- Appendix B of this SAP is the Quality Assurance Project Plan (QAPP), prepared in accordance with Uniform Federal Policy (UFP) for QAPPs (DTIC ADA 427785). The QAPP describes data quality objectives to be applied, the analytical methods and measurements, quality assurance

(QA)/quality control (QC) protocols for the work efforts, and the data assessment procedures for the evaluation and identification of any data limitations. The UFP QAPP contains the Environmental Laboratory Accreditation Program Certification (ELAP).

## 2.0 SUMMARY OF PHASE 1 RI ACTVITIES

This section includes a summary of the field activities to be conducted during the first field effort of the Camp Hero RI. The summaries below include a description of the Phase 1 activities at each AOC. The Phase 2 investigation activities will be determined based on the results of the Phase 1 investigation. A description of the remaining Phase 2 RI activities will be detailed in the RI WP Addendum.

Locations of the AOCs are shown on the Site Map in **Figure 1-2** of the RI WP. A summary of RI Field Activities during the first field effort are presented in Table 2-1.

### 2.1 Battery 113

**Phase 1:** Access to Battery 113 will be assessed in Phase 1. If safe access is available, a site survey will be conducted to identify the use of the remaining tanks and waste drums. If liquid is present, up to four characterization samples will be collected within the tanks and drums. Standing water in the pits will also be sampled for disposal purposes.

The site survey will also confirm visual evidence of polychlorinated biphenyl (PCB)-contaminated stained concrete. Up to 3 concrete chip samples will be collected for analysis of PCB content. Phase 1 sampling locations at Battery 113 are shown on **Figure 6-1** of the RI WP.

If safe access is not available in Phase 1 of the RI field activities, the approach for Battery 113 will be re-evaluated in the RI WP Addendum for Phase 2 activities. The integrity of the original buildings will not be impacted while attempting to gain access for the sampling effort.

### 2.2 Building 203

**Phase 1:** Five direct-push technology (DPT) borings will be advanced in the area of the former Building 203 and underground storage tank (UST) excavation to perched groundwater soil interface (approximately 17-19 feet [ft] below ground surface [bgs]). If no groundwater is encountered within the anticipated depth of the perched water table (5 to 25 ft bgs), borings will be advanced to a maximum of 25 ft bgs. Two soil samples will be obtained from each boring: one from the upper portion [where there are photoionization detector (PID) readings are above background or visual indictors of staining] and one at the perched groundwater-soil interface. One direct-push (grab) groundwater sample will also be obtained from each of the soil borings. Soil and groundwater samples at petroleum storage tank sites are proposed for the full SW-846 suite of analysis for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), PCBs, and metals. .

One grab groundwater sample will also be obtained from each of the soil borings. Based on the slow recharge rate to temporary monitoring wells noted during the 2000 site-wide environmental assessment, temporary wells may be necessary at each borehole in order to collect sufficient

groundwater sample volumes from each location (Weston 2000). If within 24 hours, groundwater recharge is insufficient for sample collection, then no groundwater sample will be collected during Phase 1. The necessity for installation of monitoring wells into the principle aquifer will be evaluated based on the Phase 1 results.

Additionally, three piezometers will be installed upgradient and downgradient of the Building 203 UST 16 and 18 excavations (PZ-1 through PZ-3). Piezometers will be used to evaluate for radial groundwater flow and direction in the vicinity; no analytical samples will be collected from the piezometers. Phase 1 sampling locations and piezometer locations at Building 203 are shown on **Figure 6-2** of the RI WP.

### 2.3 Building 2010 (UST 30)

**Phase 1:** Two Geoprobe® borings will be advanced immediately adjacent to the former 100-gallon UST excavation at the southeast corner of Building 2010 to a depth of 7 ft bgs or the depth of the perched water table, whichever is encountered first. One soil sample will be collected from the 0 – 4 ft bgs interval and additional soil samples will be collected every foot from 4 ft bgs to the depth of the boring (at depths of 4 – 5 ft bgs, 5 – 6 ft bgs, and 6 – 7 ft bgs), for a total of up to 4 samples per boring. A groundwater grab sample will be obtained from each of the soil borings, if perched water is present. The soil and groundwater samples will be analyzed for lead. Phase 1 sampling locations at Building 2010 are shown on **Figure 6-3** of the RI WP.

### 2.4 Building F100C (UST 34)

**Phase 1:** Two Geoprobe® borings will be advanced immediately adjacent to the former 100-gallon UST excavation at the south of Building F100C to a depth of 7 ft bgs or the depth of the perched water table, whichever is encountered first. One soil sample will be collected from the 0 – 4 ft bgs interval and additional soil samples will be collected every foot from 4 ft bgs to the depth of the boring (at depths of 4 – 5 ft bgs, 5 – 6 ft bgs, and 6 – 7 ft bgs), for a total of up to 4 samples per boring. A groundwater grab sample will be obtained from each of the soil borings, if perched water is present. Phase 1 sampling locations at Building F100C are shown on **Figure 6-4** of the RI WP.

**Table 2-1. Summary of Camp Hero Phase 1 RI Field Activities**

| AOC ID | AOC Name | Reason for Concern | Geoprobe Borings | Boring/ Sample Depth | Sample Quantities SB | SS | GW | CC | WP | LC | Analyses | Other |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| B113 | Battery 113 | Oil Staining | | | | | | 3 | | | CC: PCBs | |
| | | Tanks, Drums, Pits | | | | | | | | 4 | LC: VOC, SVOC, PCBs, metals | |
| 203 | Former Building 203 | Possible solvent and residual petroleum | 5 | *A | 10 | | 5 | | | | Soil and GW: VOC, SVOC, PCBs, Metals | 2 piezometers |
| 2010 | Building 2010 (UST 30) | Pb in Background | 2 | *B | 8 | | 2 | | | | Soil and GW: Lead | Vegetation Removal |
| F100C | Building F100C (UST 34) | Pb in Background | 2 | *B | 8 | | 2 | | | | Soil and GW: Lead | |
| AST35 | AST 35/H-13 | Tank #35, 200,000 gallon tank associated with reported spill | 4 | *A | 8 | | 4 | | | | Soil: STARS for fuel oil VOCs and SVOCs \| GW: VOCs, SVOCs | Vegetation Removal<br>2 piezometers, Coring Needed |
| FPH | Fuel Pump House and Distribution Line for AST-35 | Fuel Line | 9 | *A | 18 | | 9 | | | | Soil: STARS for fuel oil VOCs and SVOCs \| GW: VOCs, SVOCs | Vegetation Removal<br>Geophysics, Coring Needed |
| STA | Building 20 (Tank A) | Suspected former tank location | 5 (If needed) | *C | 10 (If needed) | | 5 (If Needed) | | | | Soil: STARS for fuel oil VOCs and SVOCs \| GW: VOCs, SVOCs | Geophysics |
| STB | Building 22 (Tank B) | Suspected former tank location | 5 (If needed) | *C | 10 (If needed) | | 5 (If Needed) | | | | Soil: STARS for fuel oil VOCs and SVOCs \| GW: VOCs, SVOCs | Geophysics |
| STC | Building 2 (Tank C) | Suspected former tank location | 5 (If needed) | *C | 10 (If needed) | | 5 (If Needed) | | | | Soil: STARS for fuel oil VOCs and SVOCs \| GW: VOCs, SVOCs | Geophysics |
| STD | Building 104R (Tank D) | Suspected former tank location | 5 (If needed) | *C | 10 (If needed) | | 5 (If Needed) | | | | Soil: STARS for fuel oil VOCs and SVOCs \| GW: VOCs, SVOCs | Vegetation Removal, Geophysics |
| STE | Building 3001 (Tank E) | Suspected former tank location | 5 (If needed) | *C | 10 (If needed) | | 5 (If Needed) | | | | Soil: STARS for fuel oil VOCs and SVOCs \| GW: VOCs, SVOCs | Geophysics |
| | | Existing well (untreated tap) | | | | | 1 | | | | GW: VOCs, SVOCs | |
| STF | Pump House (Tank F) | Suspected former tank,Hazardous Materials | 5 (If needed) | *C | 10 (If needed) | | 5 (If Needed) | | | | Soil: STARS for gasoline VOCs and Leads \| GW: VOCs and Lead | Vegetation Removal, Geophysics |
| STG | Pump House (Tank G) | Suspected former tank location | 5 (If needed) | *C | 10 (If needed) | | 5 (If Needed) | | | | Soil: STARS for gasoline VOCs and Leads \| GW: VOCs and Lead | Vegetation Removal, Geophysics |
| 112 | Battery 112 (UST 36, 37) | Oil Staining | | | | | | 3 | | | CC: PCBs | |
| 107 | Building 107 | Electrical | | | | | | | | If Present | LC: PCBs | |
| 201 | Building 201 | Cesspool | 1 | *A | 2 | | 1 | | | | Soil and GW: VOC, SVOC, PCBs, metals | |
| | | Electrial | | | | | | | 1 | | WP: PCBs | |
| WDS | Abandoned Waste Disposal Systems (Site-wide) | Hazardous Material Disposal | 27 | *D | 27 | | 27 | | | | Soil and GW: VOC, SVOC, PCBs, metals | Vegetation Removal |
| MP | Motor Pool | Hydraulic Lift | 1 | *E | 2 | | 1 | | | | Soil: STARS for fuel oil VOCs and SVOCs \| GW: VOCs, SVOCs | Coring Needed |
| | | Ordinance Repair | 1 | *I | 1 | 1 | 1 | | | | Soil: STARS for fuel oil VOCs and SVOCs, Energetics \| GW: VOCs, SVOCs, Energetics | |
| | | Cess Pool | 1 | *I | 1 | 1 | 1 | | | | Soil: STARS for fuel oil VOCs and SVOCs, PCBs, Energetics \| GW: VOCs, SVOCs, PCBs, Energetics | |
| | | Existing well (untreated tap) | | | | | 1 | | | | GW: VOCs, SVOCs, PCBs, Energetics, Metals | |
| EFO | Engineering Field Office | Ordinance Repair | 1 | *I | 1 | 1 | 1 | | | | Soil: Energetics \| GW: Energetics | |
| H1 | H-1 | Drums | | *F | | 4 | | | | If Present | Soil and LC: VOC, SVOC, PCBs, metals | |
| H2 | H-2 | Drums | | *F | | 4 | | | | If Present | Soil and LC: VOC, SVOC, PCBs, metals | |
| H3 | H-3 | Drums | | *F | | 4 | | | | If Present | Soil and LC: VOC, SVOC, PCBs, metals | |
| H4 | H-4 | Construction Debris | 3 | *I | 3 | 3 | 3 | | | | Soil and GW: lead, PCBs | Vegetation Removal |
| H5 | H-5 | Drums | | *F | | 10 | | | | If Present | Soil and LC: VOC, SVOC, PCBs, metals | |
| | | Construction Debris | | *F | | 6 | | | | | Soils: Lead and PCBs | |
| H6 | H-6 | Construction Debris | 3 | *I | 3 | 3 | 3 | | | | Soil and GW: lead, PCBs | Vegetation Removal |
| H7 | H-7 | Boilers | 1 (If Needed) | *G | 2 (If Needed) | 1 | 1 (If Needed) | | | | Soil and GW: PAHs and Metals | |
| H8 | H-8 | Boilers | 1 (If Needed) | *G | 2 (If Needed) | 1 | 1 (If Needed) | | | | Soil and GW: PAHs and Metals | |
| H9 | H-9 | Boilers | 1 (If Needed) | *G | 2 (If Needed) | 1 | 1 (If Needed) | | | | Soil and GW: PAHs and Metals | |
| H11 | H-11 | Former Power Plant | 2 | *I | 2 | 2 | 2 | | | | Soil and GW: PAHs, Metals, PCBs | |
| H12 | H-12 | Sewage Ejector Station | 1 | *H | 2 | | 1 | | | | Soil and GW: VOC, SVOC, PCBs, metals | |
| H14 | H-14 | Coal Storage Area | 3 | *I | 3 | 3 | 3 | | | | Soil and GW: PAHs and Metals | |
| H15 | H-15 | Coal Storage Area | 3 | *I | 3 | 3 | 3 | | | | Soil and GW: PAHs and Metals | Vegetation Removal |
| H16 | H-16 | Sewage Treatment Area | 2 | *I | 4 | 2 | 2 | | | | Soil and GW: VOC, SVOC, PCBs, metals | |
| H17 | H-17 | Open Pits | 3 | *I | 3 | 3 | 3 | | | | Soil and GW: VOC, SVOC, PCBs, metals | Vegetation Removal |
| H18 | H-18 | Drums | | *F | | 4 | | | | If Present | Soil and LC: VOC, SVOC, PCBs, metals | |
| H19 | H-19 | 550 gal Storage Tank | 2 (If Needed) | *G | 4 (If Needed) | 2 | 2 (If Needed) | | | If Present | Soil, GW, and LC: VOC, PAHs, Metals | |
| H20 | H-20 | Drums | | *F | | 4 | | | | If Present | Soil and LC: VOC, SVOC, PCBs, metals | Vegetation Removal |
| H21 | H-21 | Open Pits | 3 | *I | 3 | 3 | 3 | | | | Soil and GW: VOC, SVOC, PCBs, metals | |
| H22 | H-22 | Drums | | *F | | 4 | | | | If Present | Soil, GW, and LC: VOC, SVOC, PCBs, metals | |
| 216 | Battery 216 | Possible Debris | 5 (If needed) | *C | 10 (If needed) | | 5 (If Needed) | | | | Soil: STARS for fuel oil and gasoline VOC, SVOC, Lead \| GW: VOC, SVOC, Lead | Vegetation Removal, Geophysics |
| P113 | Plotting Room 113 | Possible Debris | 5 (If needed) | *C | 10 (If needed) | | 5 (If Needed) | | | | Soil: STARS for fuel oil and gasoline VOC, SVOC, Lead \| GW: VOC, SVOC, Lead | Vegetation Removal, Geophysics |
| AGC3 | Camp Hero State Park Bluffs (AGC Site 3) | Possible Debris | | | | | | | | | | Geophysics via Metal Detector |
| AGC1 | AGC Site 1 | Possible Debris | 3 (If Needed) | *A | 6 (If Needed) | | 3 (If Needed) | | | | Soil and GW: PAHs and Metals | Geophysics via Metal Detector |
| AGC2 | AGC Site 2 | Possible Debris | 3 (If Needed) | *A | 6 (If Needed) | | 3 (If Needed) | | | | Soil and GW: PAHs and Metals | Geophysics via Metal Detector |
| AGC4 | AGC Site 4 | Possible Debris | 3 (If Needed) | *A | 6 (If Needed) | | 3 (If Needed) | | | | Soil and GW: PAHs and Metals | Geophysics via Metal Detector |
| BG | Background Samples | | 16 | *J | 32 | 30 | | | | | Soil: PAHs and Metals | Vegetation Removal |

**Notes**

| | |
|---|---|
| AOC | Area of Concern |
| AST | Aboveground Storage Tank |
| ID | Identification |
| N/A | Not Applicable |
| PCB | Polychlorinated Biphenyls |
| STARS | [NYSDEC] Spills, Technology, and Remediation Services |
| SVOC | Semi-Volatile Organic Compound |
| UST | Underground Storage Tank |
| VOC | Volatile Organic Compound |

**Media Type Codes**

| | |
|---|---|
| GW | Groundwater Sample |
| SB | Soil Boring/Subsurface Soil Sample |
| SS | Surface Soil |
| WP | Wipe Sample |
| CC | Concrete Chip Sample |
| LC | Liquid Characterization Sample |

**Boring/Sample Depth Classifications**

| | |
|---|---|
| A | Boring to perched aquifer (or max 25 ft bgs). Two SB per boring – one from upper portion at staining/elevated PID, one at depth |
| B | Boring to depth of former UST (7 ft bgs) or the perched water table. Up to 4 SB per boring: first 0 - 4 ft bgs (homogenize), then additional sample every 1 ft interval from 4 ft bgs to depth (4 - 5, 5 - 6, 6 - 7 ft bgs) |
| C | Boring to perched aquifer. Two SB per boring – one from the upper portion and one at the depth of the suspected UST |
| D | Boring to specific depth - see Table 2-2 of the SAP. One SB per boring at depth |
| E | Boring to depth of former lift, approx. 8 - 10 ft bgs (at the interface of the fill and native soil). Two SB per boring – one from upper portion, one at depth |
| F | One SS sample (0 - 1 ft bgs) and one near-surface soil sample (1 - 2 ft bgs) at 2 locations |
| G | One SS sample (0 - 1 ft bgs). Based on site survey, one geoprobe may be needed to depth of perched water table. One additional SB at depth |
| H | Boring to perched aquifer but at least as deep as the ejector station, approx. 12 ft bgs. Two SB from each boring – one from upper portion, one at depth |
| I | Boring to perched aquifer. Two samples per boring – one SS from 0 - 1 ft bgs, one SB at depth. Third sample if staining/elevated PID readings are noted |
| J | Borings to 10 ft bgs or perched aquifer (whichever encountered first). Two SB per boring: 4-5 ft bgs, 9-10 ft bgs or1-2 ft above GW, if GW is above 10 ft bgs One SS from 0 - 1 ft from each boring. |

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## 2.5 Aboveground Storage Tank (AST)-35/H-13

**Phase 1:** Four Geoprobe® soil borings will be advanced to the depth of the perched water table (anticipated to be within 25 ft bgs) around the former storage tank. One of the Geoprobe® borings is located on the asphalt pad of the AST and coring will be necessary prior to boring. Two soil samples will be obtained from each boring: one from the upper portion (where there are PID readings are above background or visual indictors of staining) and one at the perched groundwater-soil interface. Soil samples will be analyzed for the NYSDEC Spills Technology and Remediation Series (STARS) list for fuel oil VOCs and SVOCs. One groundwater sample will be collected from each boring for analysis of VOCs, SVOCs, and metals.

Additionally, two piezometers will be installed upgradient and downgradient in adjacent former diesel storage tank/sewage disposal area (H-13) in the direction of groundwater flow. One of the two piezometers will also be used for evaluating the groundwater flow direction for the Building 203 AOC (PZ-1). Piezometers will be used for groundwater flow and direction; no analytical samples will be collected from piezometers. Phase 1 sampling locations at aboveground storage tank (AST)-35/H-13 are shown on **Figure 6-5** of the RI WP.

## 2.6 Fuel Pump House and Distribution Line for AST-35

**Phase 1:** Three Geoprobe® borings to the perched water table will be advanced at the Fuel Pump House (two downgradient and one inside the building). At the one location inside the building, concrete coring will be completed prior to drilling. For the distribution lines, a geophysical survey will be conducted in the vicinity of the suspected distribution line to determine the exact location of the line. Up to six Geoprobe® soil borings to the perched water table will be advanced along the fuel line to Building 203 at locations based on the results of the geophysical survey. Borings will be completed in compliance with 6 NY Codes, Rules, and Regulations (NYCRR) 613.9(b). Two soil samples will be obtained from each boring: one from the upper portion (where there are PID readings are above background or visual indictors of staining) and one at the perched groundwater-soil interface. Because these petroleum vessels are underground and have not been utilized in decades, no surface soils will be collected for laboratory analysis. Soil samples will be analyzed for petroleum compounds by the NYSDEC STARS list for fuel oil VOCs and SVOCs. One groundwater sample will also be collected from each boring for analysis of VOCs, SVOCs, and metals. Phase 1 sampling locations at Fuel Pump House and Distribution Line for AST-35/H-13 are shown on **Figure 6-6** of the RI WP.

## 2.7 Suspected Tanks A, B, C, D

**Phase 1:** A geophysical survey will be conducted at Buildings 20, 22, 2, and 104R to verify if the suspected petroleum USTs exists. If a UST is located at these buildings, up to five Geoprobe® borings are proposed at each AOC. The determination for the number and placement of the borings will be in compliance with 6 NYCRR 613.9(b). Two soil samples will be collected from each boring: one from

the upper portion (where there are PID readings are above background or visual indictors of staining) and one immediately below the bottom of the suspected UST. A groundwater sample will be collected from each of the soil borings from the perched water table at each AOC. Soil samples will be analyzed for petroleum compounds by the NYSDEC STARS list for fuel oil VOCs and SVOCs. Groundwater samples will be analyzed for VOCs, SVOCs, and metals. Phase 1 sampling locations at Suspected Tanks A through D are shown on **Figure 6-7** through **Figure 6-10** of the RI WP, respectively.

Based on results of the geophysical survey, test pits may be required to determine the presence or absence of underground tanks or other anomalies. The need for test pitting will be assessed after the Phase 1 field work, and if test pits are deemed necessary, they will be included in RI WP Addendum and executed during Phase 2 activities.

### 2.8 Suspected Tank E

**Phase 1:** A geophysical survey will be conducted at Building 3001 to verify if the suspected petroleum UST exists. If a UST is located at these buildings, up to five Geoprobe® soil borings are proposed at the AOC to obtain soil and groundwater samples. Determination of boring placement will be in compliance with 6 NYCRR 613.9(b). Two soil samples will be collected from each boring: one from the upper portion of each boring and one immediately below the bottom of the suspected UST. A groundwater sample will be collected from each boring from the perched water table. Additionally, one groundwater sample will be collected from the existing well on the southwest side of Building 3001 from an available untreated tap. Soil samples would be analyzed for petroleum compounds by the NYSDEC STARS list for fuel oil VOCs and SVOCs. Groundwater samples would be analyzed for VOCs, SVOCs, and metals. Phase 1 sampling locations at Suspected Tank E are shown on **Figure 6-11** of the RI WP.

Based on results of the geophysical survey, test pits may be required to determine the presence or absence of underground tanks or other anomalies. The need for test pitting will be assessed after the Phase 1 field work, and if test pits are deemed necessary, they will be included in RI WP Addendum and executed during Phase 2 activities.

### 2.9 Suspected Tanks F and G

**Phase 1:** A geophysical survey will be conducted to locate the potential UST at each Pump House (near Battery 2016 and Well 4). If a UST is located, up to five Geoprobe® borings will be advanced adjacent to each tank, in compliance with 6 NYCRR 613.9(b). Two soil samples will be collected from each boring: one from the upper portion (where there are PID readings are above background or visual indictors of staining) and one immediately below the bottom of the suspected UST. A groundwater sample will be collected from each boring from the perched water table. Soil samples will be analyzed for petroleum compounds by the NYSDEC STARS list for gasoline VOCs and lead.

Groundwater samples will be analyzed for VOCs and metals. Phase 1 sampling locations at Suspected Tanks G and F are shown on **Figures 6-12** and **6-13** of the RI WP.

Based on results of the geophysical survey, test pits may be required to determine the presence or absence of underground tanks or other anomalies. The need for test pitting will be assessed after the Phase 1 field work, and if test pits are deemed necessary, they will be included in RI WP Addendum and executed during Phase 2 activities.

### 2.10 Battery 112

**Phase 1:** Access to Battery 112 will be assessed during Phase 1. If safe access is available, a site survey will be conducted to confirm no ASTs are present and to located potential visual evidence of PCB-contaminated stained concrete. Up to 3 concrete chip samples will be collected for analysis of PCB content. Phase 1 sampling locations at Battery 112 are shown on **Figure 6-14** of the RI WP.

If safe access is not available in Phase 1 of the RI field activities, the approach for Battery 112 will be re-evaluated in the RI WP Addendum for Phase 2 activities. The integrity of the original buildings will not be impacted while attempting to gain access for the sampling effort.

### 2.11 Building 107

**Phase 1:** Access to the basement of Building 107 will be assessed in Phase 1. If safe access to the wall mounted transformers exists, the field team will attempt to verify if fluids are present in the transformers. One fluids sample will be collected, if possible, for analysis of PCB content. The Phase 1 sampling location at Building 107 is shown on **Figure 6-15** of the RI WP.

If safe access is not available in Phase 1 of the RI field activities, the approach for Building 107 will be re-evaluated in the RI WP Addendum for Phase 2 activities. The integrity of the original buildings will not be impacted while attempting to gain access for the sampling effort.

### 2.12 Building 201

**Phase 1:** If safe access is available, a site survey of the bottom floor of the Radar Tower, where transformers and staining was observed during previous assessment in 2000 (Weston 2000), will be conducted to verify that there is no other stained areas. If additional staining is observed, one wipe sample will be collected within the stained area for analysis of PCB content.

Additionally, one Geoprobe® boring will be advanced at the former Radar Tower cesspool to the depth of the perched water table. Two soil samples will be obtained from each boring: one from the upper portion (where there are PID readings are above background or visual indictors of staining) and one at the perched groundwater-soil interface. One groundwater sample will also be collected from each boring. Soil and groundwater samples will be analyzed for the SW-846 list of analytes for

VOCs, SVOCs, and metals, which may have been released to the cesspool. The soil and groundwater samples will also be analyzed for PCBs to determine if a release has occurred at the Radar Tower and/or nearby structures. Phase 1 sampling locations at Building 201 are shown on **Figure 6-16** of the RI WP.

If safe access is not available in Phase 1 of the RI field activities, the approach will be re-evaluated in the RI WP Addendum for Phase 2 activities. The integrity of the original buildings will not be impacted while attempting to gain access for the sampling effort.

### 2.13 Abandoned Waste Disposal System (Site-Wide)

The location of the site-wide abandoned sanitary sewer line and former septic fields and cesspools [known collectively as the waste disposal system (WDS)] are shown on the Site Map (**Figure 1-2** of the RI WP).

**Phase 1:** Twenty-seven Geoprobe® borings will be advanced throughout the abandoned WDS to the depth of the site-wide abandoned sanitary sewer line or bottom of the leach field, septic tank, or cesspool structure. Sample locations are shown on **Figures 6-17a** through **6-17e** of the RI WP. The depth of each boring is indicated on Table 2-2 below and on the corresponding figure. One soil sample will be collected from each boring at depth. The sewer line profiles have been supplied in archive drawings by NY State Parks and were utilized to determine depths of samples. Depths of the each sample are indicated on the sanitary sewer figures. Grab groundwater samples will also be obtained from each boring. Soil and groundwater samples will be analyzed for the SW-846 list of analytes for VOCs, SVOCs, PCBs, and metals.

**Table 2-2**
**Depths of Phase 1 Geoprobe® Borings for Abandoned Waste Disposal System**

| Boring Number | WDS Line | Figure | Adjacent Feature | Depth of Boring (ft bgs) |
|---|---|---|---|---|
| WDS-SB01 | F | Figure 6-17e | Chlorine Contact Chamber | 11 |
| WDS-SB02 | F | Figure 6-17e | Chlorine Contact Chamber | 11 |
| WDS-SB03 | F | Figure 6-17e | Chlorine Contact Chamber | 11 |
| WDS-SB04 | F | Figure 6-17e | Septic Tank | 13 |
| WDS-SB05 | F | Figure 6-17e | Sewer Line | 6 |
| WDS-SB06 | F | Figure 6-17e | Manhole | 5 |
| WDS-SB07 | F | Figure 6-17e | Sewer Line | 5 |
| WDS-SB08 | E | Figure 6-17d | Box | 8 |
| WDS-SB09 | E | Figure 6-17d | Manhole | 6 |
| WDS-SB10 | E | Figure 6-17d | Box | 10 |
| WDS-SB11 | E | Figure 6-17d | Cesspool | 13 |
| WDS-SB12 | E | Figure 6-17d | Manhole | 6 |
| WDS-SB13 | E | Figure 6-17d | Manhole | 9 |
| WDS-SB14 | D | Figure 6-17c | Septic Tank | 11 |
| WDS-SB15 | D | Figure 6-17c | Cesspool | 13 |
| WDS-SB16 | D | Figure 6-17c | Cesspool | 13 |
| WDS-SB17 | D | Figure 6-17c | Cesspool | 13 |
| WDS-SB18 | C | Figure 6-17b | Sewer Line | 12 |
| WDS-SB19 | C | Figure 6-17b | Sewer Line | 12 |
| WDS-SB20 | C | Figure 6-17b | Septic Tank | 11 |
| WDS-SB21 | C | Figure 6-17b | Septic Tank | 11 |
| WDS-SB22 | A | Figure 6-17a | Drain Field | 9 |
| WDS-SB23 | A | Figure 6-17a | Septic Tank | 10 |
| WDS-SB24 | A | Figure 6-17a | Drain Field | 10 |
| WDS-SB25 | A | Figure 6-17a | Cesspool | 13 |
| WDS-SB26 | A | Figure 6-17a | Cesspool | 13 |
| WDS-SB27 | A | Figure 6-17a | Cesspool | 13 |

## 2.14 Motor Pool

**Phase 1:** At the location of the former hydraulic lift, one soil boring will be advanced through the concrete slab adjacent at the former hydraulic lift to the depth of the bottom of the former lift, which is assumed to be 8 to 10 ft bgs (at the interface of the fill and native soil). Concrete coring will be conducted prior to boring. Two soil samples will be obtained from each boring: one from the upper portion (where there are PID readings are above background or visual indictors of staining) and one at the perched groundwater-soil interface. Soil samples will be analyzed for petroleum compounds by the NYSDEC STARS list for fuel oil VOCs and SVOCs. One groundwater sample will also be collected from each boring for analysis of VOCs, SVOCs, and metals.

Adjacent to the location of the former floor drain to the cesspool just outside the building, one Geoprobe boring will be advanced to the depth of the perched water table outside the building (approximately 2 ft from the outfall).

Two soil samples will be obtained from each boring: one surface soil sample from 0 to 1 ft bgs interval and one subsurface soil sample at the perched groundwater-soil interface. If PID readings above background or visual indictors of staining are noted, a third soil sample will be collected at the corresponding location. Soil samples will be analyzed for petroleum compounds by the NYSDEC STARS list for fuel oil VOCs and SVOCs and for energetics. One groundwater sample will also be collected for analysis of VOCs, SVOCs, metals, and energetics.

Along the sewer line from the building to the cesspool, one soil boring will be advanced to the depth of the perched water table. Two soil samples will be obtained from each boring: one surface soil sample from 0 to 1 ft bgs interval and one subsurface soil sample at the perched groundwater-soil interface. If PID readings above background or visual indictors of staining are noted, a third soil sample will be collected at the corresponding location. One groundwater sample will also be collected. Soil and groundwater samples will be analyzed for the SW 846 list of analytes for VOCs, SVOCs, PCBs, and metals. Additionally, one groundwater sample will be collected from the existing well located on the west side of the Motor Pool from an available untreated tap for analysis of the SW-846 list of analytes for VOCs, SVOCs, PCBs, energetics, and metals. The Phase 1 sampling locations at the Motor Pool are shown on **Figure 6-18** of the RI WP.

### 2.15 Engineering Field Office

**Phase 1:** One soil boring will be advanced downgradient of the former engineering field office, on the south side of the building within the drainage area adjacent to the building foundation, to the depth of the perched water table. Two soil samples will be obtained from each boring: one surface soil sample from 0 to 1 ft bgs interval and one subsurface soil sample at the perched groundwater-soil interface. Soil samples will be analyzed for energetics. One groundwater sample will also be collected for analysis of energetics. The Phase 1 sampling location for the Engineering Field Office is shown on **Figure 6-19**.

### 2.16 Drum Locations (H-1, H-2, H-3, H-18, H-20, and H-22)

During the Camp Hero Feasibility Study (Cashin 1998), these six locations were observed with one or two 55-gallon drums or drum remnants.

**Phase 1:** A site survey will be conducted to verify the number of drums present at each location, record any labeling or identification on the drums, and sample liquid if present in the drums. The liquid in the drums, if present, will be analyzed for liquid characterization (VOCs, SVOCs, PCBs, and

metals) prior to removal or disposal, which will be addressed during Phase 2.

Two surface soil samples (approximately 1 ft bgs) and two near-surface soil samples (approximately 2 ft bgs) will be collected from underneath each drum location for analysis of the SW-846 list of analytes for VOCs, SVOCs, PCBs, and metals. Phase 1 sampling locations for H-1 are shown on **Figure 6-20**; H-2, **Figure 6-21**; H-3, **Figure 6-22**; H-18, **Figure 6-35**; H-20, **Figure 6-37**; and H-22, **Figure 6-39** of the RI WP.

### 2.17 Construction Debris Areas (H-4 and H-6)

The Cashin Report noted AOCs H-4 and H-6 contained construction debris.

**Phase 1:** A site survey is will be conducted to identify the amount and location of construction debris at both H-4 and H-6. Three Geoprobe® borings (at each AOC) will be advanced to the depth of the perched aquifer under the debris or on the downgradient edge of the debris. Two soil samples will be obtained from each boring: one surface soil sample from 0 to 1 ft bgs interval and one subsurface soil sample at the perched groundwater-soil interface. If PID readings above background or visual indictors of staining are noted, a third soil sample will be collected at the corresponding location. One groundwater sample will be collected from each boring. Soil and groundwater samples will be analyzed lead from lead-based paint and PCBs. Phase 1 sampling locations for H-4 and H-6 are shown on **Figures 6-23** and **6-25** of the RI WP, respectively.

### 2.18 Drum Location with Construction Debris (H-5)

There are 5 drums pictured in the 1998 Cashin Report picture of H-5. Three of the drums are identified as contents unknown.

**Phase 1:** A site survey will be conducted to verify the number of drums and record any labeling or identification on the drums. Eight surface soil samples (approximately 1 ft bgs) and eight near-surface soil samples (approximately 2 ft bgs), co-located, will be collected from underneath the drum locations and construction debris. Soil samples at the construction debris area will be sampled for lead from lead-based paint and PCBs. Soil samples from underneath the drums will be sampled for VOCs, SVOCs, PCBs, and metals.

If liquid is present in the drums, up to 3 samples for liquid characterization (VOCs, SVOCs, PCBs, and metals) . Phase 1 sampling locations for H-5 are shown on **Figure 6-24** of the RI WP.

### 2.19 Possible Boilers (H-7, H-8 and H-9)

The Report noted that these locations at Camp Hero contained what appeared to be old boilers (Cashin 1998).

**Phase 1:** A visual survey will be conducted to determine whether boilers still exist at these AOCs. If the boilers are present, one surface soil sample (0–1 ft bgs) will be collected under each boiler for analysis of the SW-846 methods analyte list for SVOCs (PAHs only) and metals. If stained soils are noted or if field screening of the surface soil samples with the PID (in the plastic, re-sealable bag bag) indicates the presence of petroleum during the inspection, one Geoprobe® boring will be advanced to the depth of the perched water table. Two soil samples (one from the upper portion where there are PID readings are above background or visual indictors of staining and one at the perched groundwater-soil interface) and one grab-groundwater sample will be collected, for the same analyte list. Phase 1 sampling locations for H-7, H-8, and H-9 are shown on **Figures 6-26**, **6-27**, and **6-28**, respectively.

### 2.20 Former Power Plant (H-11)

**Phase 1:** Two Geoprobe® borings will be advanced to the depth of the perched aquifer within the footprint of the former Power Plant Building to confirm previous data results reported in 2000 (Weston 2000). Two soil samples will be obtained from each boring: one surface soil sample from 0 to 1 ft bgs interval and one subsurface soil sample at the perched groundwater-soil interface. If PID readings above background or visual indictors of staining are noted, a third soil sample will be collected at the corresponding location. One groundwater sample will also be collected from each boring. Soil and groundwater samples will be analyzed for the SW-846 methods analyte list for SVOCs (PAHs only), PCBs, and metals. Phase 1 sampling locations for the Former Power Plant are shown on **Figure 6-29** of the RI WP.

### 2.21 Sewage Ejector Station (H-12)

**Phase 1:** One Geoprobe® soil boring will be advanced to the perched water table or to the depth of the former sewage ejector station, approximately 12 ft bgs. Two soil samples (one from the upper portion where there are PID readings are above background or visual indictors of staining and one at the approximate depth corresponding to the bottom of the former sewage ejector station) and one groundwater sample will be collected for analysis of VOCs, SVOCs, PCBs, and metals using SW-846. The results from this location will also be included in the overall assessment of the site-wide abandoned sanitary sewer system. Phase 1 sampling locations for the Sewage Ejector Station are shown on **Figure 6-30**.

### 2.22 Former Coal Storage (H-14 and H-15)

**Phase 1:** Three Geoprobe® borings to the perched water table will be advanced within the suspected area of each coal storage area (six total soil borings). Two soil samples will be obtained from each boring: one surface soil sample from 0 to 1 ft bgs interval and one subsurface soil sample at the perched groundwater-soil interface. If PID readings above background or visual indictors of staining are noted, a third soil sample will be collected at the corresponding location. One

groundwater sample will also be collected from each boring. Soil and groundwater samples will be analyzed for the SW-846 methods analyte list for SVOCs (PAHs only) and metals. Phase 1 sampling locations for H-14 and H-15 are shown on **Figures 6-31** and **6-32** of the RI WP, respectively.

### 2.23 Former Sewage Treatment Area (H-16)

**Phase 1:** A site survey is will be conducted to identify the status and size of former sewage treatment area at this location. Two Geoprobe® borings will be advanced to the perched groundwater table in and around the former sewage treatment area. Two soil samples will be obtained from each boring: one surface soil sample from 0 to 1 ft bgs interval and one subsurface soil sample at the perched groundwater-soil interface. If PID readings above background or visual indictors of staining are noted, a third soil sample will be collected at the corresponding location. One groundwater sample will also be collected from each boring. Soil and groundwater samples will be analyzed for VOCs, SVOCs, PCBs, and metals. Phase 1 sampling locations for H-16 are shown on **Figure 6-33** of the RI WP.

### 2.24 Open Pits (H-17 and H-21)

**Phase 1:** A site survey will be conducted to identify the status, size, and topography of both open pits. One Geoprobe® boring will be advanced topographically upgradient and two Geoprobe® borings will be advanced topographically downgradient of each pit (for a total of 3 borings at each pit) to the depth of the perched aquifer.

Two soil samples will be obtained from each boring: one surface soil sample from 0 to 1 ft bgs interval and one subsurface soil sample at the perched groundwater-soil interface. If PID readings above background or visual indictors of staining are noted, a third soil sample will be collected at the corresponding location. One groundwater sample will also be collected at each boring. Soil and groundwater samples will be analyzed for the SW-846 methods analyte list for VOCs, SVOCs, PCBs, and metals. Phase 1 sampling locations for H-17 and H-21 are shown on **Figures 6-34** and **6-38**, respectively.

### 2.25 AST 550-Gallon (H-19)

**Phase 1: Phase 1:** A visual survey will be conducted to identify if the 550-gallon AST still exists at Camp Hero. Two surface soil samples will be collected under or adjacent to the tank for analysis of SW-846 methods analyte list for VOCs, SVOCs (PAHs only), and metals. If stained soils are noted or vapor monitoring using the PID indicates the presence of petroleum during the survey, two Geoprobe® borings will be advanced to the depth of the perched water table. Two soil samples (one from the upper portion where there are PID readings are above background or visual indictors of staining and one at the perched groundwater-soil interface) and one grab-groundwater sample will be collected from each boring, for the same analyte list. If liquid is present in the AST, one sample will

be collected from the tank and analyzed for hazardous waste characteristics. Phase 1 sampling locations at H-19 are shown on **Figure 6-36**.

### 2.26 Geophysical Survey Areas – Battery 216 and Plotting Room 113

**Phase 1:** A geophysical survey will be conducted around both buildings. The survey area at each AOC is shown on **Figures 6-40** and **6-41** of the RI WP, respectively. If a geophysical anomaly is identified which is suspected to be a potential waste disposal or UST, up to five Geoprobe® borings will be advanced immediately adjacent to each tank, in compliance with 6 NYCRR 613.9(b). Two soil samples will be collected from each boring, one from the upper portion of each boring (where there are PID readings are above background or visual indictors of staining) and one immediately below the estimated bottom of the suspected UST. A groundwater sample will be collected from each boring from the perched water table. Soil samples will be analyzed for petroleum compounds by the NYSDEC STARS list for fuel oil and gasoline VOCs, SVOCs, and lead. Groundwater samples will be analyzed for VOCs, SVOCs, and metals.

Based on results of the geophysical survey, test pits may be required to determine the presence or absence of underground tanks or other anomalies. The need for test pitting will be assessed after the Phase 1 field work, and if test pits are deemed necessary, they will be included in RI WP Addendum and executed during Phase 2 activities.

### 2.27 Camp Hero State Park Bluffs/AGC Site 3

**Phase 1:** To investigate potential buried debris, the AECOM-Tidewater JV will conduct a visual inspection and screening level geophysical survey using a metal detector at AGC Site 3 during Phase 1 of the RI field activities. The survey area at the Camp Hero State Park Bluffs is shown on **Figure 6-42** of the RI WP. Based on a previous walk-over survey, it was concluded that the miscellaneous metal debris was inert and did not previously contain liquid contents. Therefore, it has been determined that soil and/or groundwater samples are not necessary for this AOC.

### 2.28 AGC Sites 1, 2, and 4

**Phase 1:** To investigate potential buried debris, the AECOM-Tidewater JV will conduct a visual inspection and geophysical survey using a metal detector at AGC Sites 1 through 4 during Phase 1 of the RI field activities. If the visual and magnetometer results indicate subsurface anomalies, up to 3 borings at each of the AGC Sites (except AGC Site 3, as established in Section 6.12 above) will be installed to confirm or deny waste dumping. Borings will be advanced to the depth of the perched water table. Two soil samples (one from the upper portion where there are PID readings are above background or visual indicators of staining and one at the perched groundwater-soil interface) and one grab-groundwater sample will be collected Soil and groundwater samples (2 subsurface soil

samples and 1 groundwater sample per boring) will be collected for analysis of SVOCs (PAHs only) and metals.

Note that AGC Site 3 corresponds to the "Camp Hero State Park Bluffs" AOC, which was already established as a part of this investigation. AGC Sites 1, 2, 3 and 4 are shown on **Figure 6-43** of the RI WP.

### 2.29 Background Samples

**Phase 1:** A total of 62 background soil samples (30 surface and 32 subsurface) will be collected during the Phase 1 investigation. The surface and subsurface soil samples will be collected from four different locations (BG-01 through BG-04), as follows:

- BG-01: 4 borings plus 4 independent surface soil locations
- BG-02: 4 borings plus 4 independent surface soil locations
- BG-03: 4 borings plus 3 independent surface soil locations
- BG-04: 4 borings plus 3 independent surface soil locations

Borings will be advanced to 10 ft bgs or the depth of the perched aquifer, whichever is encountered first. Two subsurface soil samples will be collected per boring: 4 to 5 ft bgs and 9 to 10 ft bgs or 1 to 2 ft above the depth to ground water, whichever is encountered first. One surface soil sample will be collected from 0 to 1 ft from each boring. Fourteen additional surface soil samples will be collected, between the four background locations. All four background soil sampling locations are shown on the site map (**Figure 1-2** of the RI WP) and individual background location maps are provided as **Figures 5-1, 5-2, 5-3,** and **5-4** of the RI WP, respectively.

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# 3.0 FIELD OPERATIONS AND METHODOLOGY

This section summarizes the RI field investigation operations at Camp Hero. RI field investigation operations include site preparation activities including the mobilization/demobilization of field team personnel and equipment, utility clearance, geophysical surveying, test pitting, soil and groundwater sampling and analysis, sample handling and storage, decontamination, and investigation-derived waste (IDW) management. The respective field activities are described in this section, and other sections and appendices provide further detail where appropriate. Field sampling SOPs are provided in Appendix A.

The AECOM-Tidewater JV will establish site controls to ensure that any site investigation activities do not further impact (temporarily or permanently) or contaminate the project site or surrounding area. The AECOM-Tidewater JV will be responsible for decontaminating equipment and/or tools, implementing soil erosion control measures, removing any temporary facilities, and restoring areas impacted by site activities. Field activities will be executed in accordance with the UFP-QAPP (Appendix B) and the Site Safety and Health Plan (SSHP)/Accident Prevention Plan (APP).

## 3.1 Personnel Qualifications

Personnel mobilized to the site will meet applicable Occupational Safety and Health Administration (OSHA) training including hazardous waste operations and emergency response training, medical surveillance requirements, and First Aid/automated external defibrillator/cardiopulmonary resuscitation certification, as specified in the APP/SSHP.

The Site Safety and Health Officer (SSHO) will have completed the 30-hour OSHA General Industry or Construction Industry Safety Class, as specified in EM-385 (USACE, 2014). The SSHO will be responsible for managing, implementing, and enforcing the AECOM-Tidewater JV's health and safety program in accordance with the accepted APP. The SSHO will be a competent person that can identify existing and predictable hazards in the working environment or working conditions that are dangerous to personnel, and who has authorization to take prompt corrective measures to eliminate them.

The Site Supervisor (SS) will have completed the 8-hour OSHA SS training, as specific in EM-385. The SS will lead field operations, coordinate field activities, and act as the liaison between site and laboratory personnel, among other responsibilities.

The Unexploded Ordnance (UXO) Technician II will have the appropriate level of training and experience as stated in Department of Defense Explosives Safety Board (DDESB) Technical Paper 18.

## 3.2 Site-Specific Training

As part of the mobilization process, site-specific training for on-site personnel will be conducted by the SSHO prior to performance of work. Site-specific training will include, but is not limited to:

- A review of applicable project documents (e.g., SAP including UFP-QAPP and SOPs, etc.), by all AECOM-Tidewater JV employees and the AECOM-Tidewater JV subcontract employees.
- Ordnance Recognition Training to identify potential explosive hazards and react appropriately, by all AECOM-Tidewater JV employees and the AECOM-Tidewater JV subcontract employees. **Stop work authority will be used immediately if ordnance or Chemical Warfare Materiel (CWM) is suspected.**

Training will be provided by the SSHO and the AECOM-Tidewater JV corporate staff, as required. The purpose of this training is to ensure that personnel fully understand the operational procedures and methods to be used at Camp Hero, individual duties and responsibilities, and safety and environmental concerns associated with the planned investigation activities.

Digital and paper copies of required project documents will be maintained on site for reference. Site workers, whether arriving at the start of the project or rotating on site as a substitution for another employee, will not be allowed to conduct their daily field operations without receiving site-specific training, reviewing the required documents, and signing off that they have reviewed, understood, and will follow the project SAP.

## 3.3 Mobilization/Demobilization

The AECOM-Tidewater JV will schedule the arrival of its workforce, and subcontracted workforce, in a manner that is most effective and designed to allow immediate productivity. Personnel mobilized to the site will meet the OSHA training and medical surveillance requirements specified in the APP. As part of the mobilization process, site-specific training for on-site personnel will be performed.

## 3.4 Site Coordination

In accordance with project kick-off meetings with the project team, including the Camp Hero Park Superintendent Tom Dess, anticipated work hours will be 0700 to 1900. Both Phase 1 and 2 activities under this RI WP will be coordinated with the Mr. Dess to ensure activities do not impact park visitors and seasonal work restrictions. Additionally, activities under this RI WP will be coordinated with the State Historic Preservation Officer and other interested parties and stakeholders, in accordance with Section 106 of the National Historic Preservation Act of 1996, as amended and 36 CFR 800.

## 3.5 Site Preparation

The AECOM-Tidewater JV will perform the necessary site preparation activities to initiate the planned sampling methodology. Personnel and equipment deployments will be implemented as planned and anomaly avoidance techniques will be strictly employed during field activities. The site preparation activities for the field investigation operations include mobilization of field team personnel and equipment.

Additionally, vegetation removal will be necessary prior to beginning sampling activities. Several AOCs are severely overgrown with vegetation. To facilitate access, hand tools and mechanized equipment will be used to trim the overgrowth of vegetation along the site access roads and clear paths to the sampling locations. Only small shrubs and brush will be cleared; no hardwood trees. Cut brush will be left on site in the general vicinity of its generation. The removal of snags will be avoided, and no large a hardwood trees will be cleared, defined as a tree with greater than or equal to a 3 in diameter, to ensure protected habitat for the endangered Northern long-eared bat. Clearing will be minimized to the maximum extent practicable. A map of significant natural communities has been included as Figure 3-4, and vegetation removal will be avoided in these areas.

The AECOM-Tidewater JV and the USACE is also working with Julie Lundgren (NY Natural Heritage Program of SUNY ESF in partnership with NYS Office of Parks, Recreation and Historic Preservation), the NYSDEC, and the USFWS, whom are providing guidance on the known occurrence of rare, threatened, or sensitive species in the vicinity of the RI field and appropriate protection measures. The field team will sweep the path ahead of the drill rig or other equipment at all sampling locations to check for box turtles or other significant species.

## 3.6 Field Equipment Check-Out

Equipment, regardless of source, will be checked to ensure its completeness and operational readiness. Any equipment found damaged or defective will be returned to the point of origin, and a replacement will be secured. Instruments and equipment that require routine maintenance and/or calibration will be checked initially upon arrival and then prior to use each day, if needed to support that day's operations. This system of checks ensures that the equipment is functioning properly. If an equipment check indicates that any piece of equipment is not operating correctly and field repair cannot be made, the equipment will be tagged and removed from service, and a request for replacement equipment will be placed immediately. Replacement equipment will meet the same specifications for accuracy and precision as the equipment removed from service.

## 3.7 UXO Technician Support

Based on a UXO probability analysis completed by USACE Baltimore District, it has been determined that the Camp Hero site activities have a low probability of encountering munitions and explosives of

concern (MEC), except for areas H and K, which will not be entered at any point during RI field activities. Anomaly avoidance will be conducted in accordance with EM 385-1-97 during subsurface investigations. "Anomaly avoidance" is defined as the avoidance of surface MEC and any subsurface anomalies where the specific activity can be moved to another location. A UXO Technician II will conduct anomaly avoidance during RI field activities. The UXO Technician II will have the appropriate level of training and experience as stated in DDESB Technical Paper 18.

Additionally, all field personnel, including AECOM-Tidewater JV employees and subcontractors, will complete Ordnance Recognition Training prior to the start of field activities. **Stop work authority will be used immediately if ordnance or Chemical Warfare Materiel (CWM) is suspected and the team leader will call 911 to notify authorities.**

It should be noted that anomaly avoidance is only applicable to MEC hazards. The CWM Design Center in Huntsville will provide guidance for the potential of encountering CWM.

### 3.8 Utility Clearance

AECOM-Tidewater JV will coordinate required utility clearances with a qualified contractor and/or other responsible entities before commencement of any ground-intrusive activities at the site. The locations of the proposed borings/monitoring wells and test pit excavations will be staked before mobilizing equipment to the site, and subsurface utilities in their vicinity will be clearly marked to avoid them during field activities. See *SOP 3-01: Utility Clearance* (Appendix A) for more details.

### 3.9 Geophysical Surveying

Geophysical surveys using magnetometer will be conducted at 10 AOCs during the Camp Hero RI field work to determine the presence of suspected USTs and identify metal anomalies. Geophysical work will be conducted in accordance with *SOP 3-09: Geophysics* (Appendix A).

Geophysical data will be stored in a data recorder or laptop during acquisition, if practical. At the earliest practical time, and at least at the conclusion of each field day, data will be downloaded to a separate computer and backed up via external drive or email attachments. Field notes and drawings of the survey will be recorded in the field logbook, which is a primary document of record for the project.

### 3.10 Test Pitting

Test pitting may be conducted at Camp Hero AOCs where suspected tanks are located. Based on results of the geophysical survey, test pits may be required to determine the presence or absence of underground tanks or other anomalies. The need for test pitting will be assessed after the Phase 1 field work, and if test pits are deemed necessary, they will be included in RI WP Addendum and executed during Phase 2 activities.

Prior to test pitting, utility locations will also be marked before any excavation or ground intrusive/disturbance activities occur to avoid contacting subsurface utilities during test pit excavations.

Test pits will be shallow, narrow exploratory trenches to determine the presence or absence of tanks. Trenches are anticipated to be up to 6 feet in depth and 2 feet in width. Surface/subsurface soil overlying the geophysical anomalies will be excavated using a backhoe or a trackhoe. The excavated soil will be stockpiled on plastic sheeting adjacent to the excavation. The stockpiled soil will be covered with plastic sheeting in the event of rainfall to prevent erosion. No employee will be entering the trenched area at any time.

The excavated soil as well as the sides and bottom of the test pits will be observed and assessed visually during the excavation for any signs of contamination such as stains, odors, or any other unusual conditions. The excavated soil stockpiled on the temporary staging pad will be screened with a PID to determine the presence of contamination followed by confirmatory soil sampling.

Any scrap metallic debris removed during the test pit excavations will be staged in a separate holding area pending recycling or disposal. The excavated metallic debris will be segregated and transported to an off-site recycling/disposal facility as dictated by applicable Federal and State regulations and guidelines. Metallic debris will be recycled wherever possible instead of disposal. Any necessary permits and administrative requirements for off-site recycling/disposal of scrap metallic debris will be obtained and met, respectively. At the completion of test pitting activities, the surface will be restored at each location to match the surrounding area. The soil will be placed back into the excavation in accordance with the original soil profile with the root zone in proper orientation.

### 3.11 Land Surveying

The horizontal and vertical position of soil sample locations (surficial and subsurface borings) and monitoring wells will be surveyed by a state-registered surveyor to a horizontal accuracy of 0.1 ft and a vertical accuracy of 0.01 ft. These positions will be tied to a permanent benchmark located near the site. Land survey of subsurface sample locations will be conducted in accordance with applicable specifications. See *SOP 3-07: Land Surveying* (Appendix A) for more details.

### 3.12 Air Monitoring

Community air monitoring will be performed in accordance with the NY State Department of Health Generic Community Air Monitoring Plan, Attachment 1A of the NYSDEC Division of Environmental Remediation-10 Technical Guidance for Site Investigation and Remediation (Appendix B of the RI WP). Air monitoring activities will be implemented to protect the community from any potential airborne releases that could result from field activities associated with the RI or remedial action efforts as necessary (NYSDEC 2010b).

The field personnel will monitor their breathing zones during project activities using a PID when working at AOCs potentially contaminated with petroleum hydrocarbons and organic solvents. An action level for respiratory protection has been established at 5 ppm as averaged over a 15-minute time period. If this limit is exceeded, work will stop and the SSHO and PM will determine how to proceed. See *SOP 3-20: Operation and Calibration of a PID* (Appendix A) for more details.

### 3.13 Sample Collection Methodology

The AECOM-Tidewater JV will collect surface and near-surface soil samples, subsurface soil samples, groundwater samples, concrete chip samples, wipe samples, and liquid characterization samples as part of the Camp Hero Phase 1 RI sampling program. Sample depths in the removal action area will range from surface soil (0 to 1 ft bgs) to depths of the perched water table (approximately 17 to 19 ft bgs). Specific sample quantities and depths are outlined by AOC in Table 2-1. The sample collection effort will be led by the SS and overseen by the SSHO.

**Surface and Near-Surface Soil:** A clean (decontaminated) coring device will be utilized to collect surface and near-surface soil samples, unless soils are not cohesive, in which case certified clean, disposable sample scoops will be used. Surface soil samples are considered to be 0 – 1 ft bgs, while near-surface samples are considered to be 1 – 2 ft bgs. VOC samples will be collected directly from the recently-exposed soil using a sampling corer (Encore sampler, Terra Core, or equivalent) and in accordance with *SOP 3-21*. For other analyses, soil will be removed and transferred to a disposable, re-sealable plastic bag. The sample will then be homogenized, which will consist of mixing the soil until the sample is a uniform color, texture, and particle size. Any non-homogenous particles, organic matter, and projectile debris will be removed from the samples. After homogenization, the soil sample will be field-screened with the PID while in the plastic bag. After field screening, the sample will be transferred to the appropriate sample container for laboratory analysis and placed in a cooler on ice. The required sample containers, preservatives, and holding times are specified in the UFP SAP (Appendix B). Sample locations will be marked with a pin flag with sample identification number, photo-documented, and recorded with a hand-held global positioning system. See *SOP 3-21: Surface and Subsurface Soil Sampling* (Appendix A) for more details. Non-disposable sampling equipment (i.e., hand auger) will be decontaminated between sample locations according to the procedures in Section 3.16 and *SOP 3-06: Decontamination Procedures* (Appendix A). An equipment blank will be collected from the hand auger for analysis of VOCs only.

**Subsurface Soil:** Subsurface soil samples will be collected using DPT. A Geoprobe® dual-tube sampling system (or equivalent) will be used to collect continuous soil cores to the target depth. The target depth is specified for each AOC in Section 2.0. In most cases, borings will be advanced to the depth of the perched water table. If no groundwater is encountered within the anticipated depth of the perched water table (5 to 25 ft bgs), borings will be advanced to a maximum of 25 ft bgs. If

within 24 hours, groundwater recharge is insufficient for sample collection, then no groundwater sample will be collected during Phase 1. The necessity for installation of monitoring wells into the principle aquifer will be evaluated based on the Phase 1 results.

Concrete coring will be necessary prior to boring at locations with asphalt or cement (see below). The continuous soil sampling will be accomplished by advancing a 5-ft (60-inch) coring barrel fitted with the dedicated, disposable polyvinyl chloride (PVC) liners. The soil core will be screened for VOCs immediately upon opening the sleeve with a PID utilizing an 11.7 electron-Volt bulb. Details regarding the air monitoring procedures and specific action levels are provided in the APP (AECOM 2016). The soils from the core will be screened with the PID immediately following removal from the sample liner. The soil core will be logged for lithologic descriptions by a field geologist. Observations and measurements will be recorded on a soil boring log. Photographs will also be taken of the boring cores. At a minimum, depth interval, recovery thickness, PID concentrations, moisture, relative density, color (using a Munsell soil color chart), and texture using the Unified Soil Classification System will be recorded. Additional observations to be recorded may include detectable odors, groundwater or perched water depth, organic material, cultural debris, or color changes indicating staining.

Two subsurface soil samples will generally be collected from each DPT location unless otherwise specified in the RI SAP. Samples will be collected from depth intervals where field screening or observations (i.e., highest VOC concentration measured with the photo-ionization detector, odor, staining) indicate the potential presence of contaminants, the depth of the structure being evaluated, or at the depth of groundwater. VOC samples will be collected using a sampling corer (Encore sampler, Terra Core, or equivalent) and in accordance with SOP 3-21. See *SOP 3-16: Soil and Rock Classification, SOP 3-17: Direct Push Sampling Techniques*, and *SOP 3-21: Surface and Subsurface Soil Sampling* (Appendix A) for more details.

**Concrete Coring:** Coring will be conducted prior to drilling at sampling locations situated in concrete covered areas. A 4-inch diameter core barrel will be advanced through the concrete using a stand mounted core drill to access soils for direct push sampling. The core drill will be anchored to the concrete surface either by vacuum or lag bolts during drilling. All cores will be wet drilled and water and slurry will be vacuumed as they are generated. Once drilling and sampling activities are completed the core and lag holes (if any) will be patched with concrete.

**Groundwater Sample Collection from DPT Points or Temporary Wells (Grab Sample):** Groundwater samples will be collected using DPT methodology through a Geoprobe® discrete interval, screen point sampler (or equivalent) or installation of a temporary well. The Geoprobe® discrete interval, screen point sampler consists of a 1.625-inch outer diameter, 51.5-inch long steel sheath

equipped with an expendable steel drive point, which contains a retractable 41-inch long stainless-steel screen. The DPT sampler and tool string are driven to the desired depth interval and retracted approximately 44-inches to release the expendable drive point, and the screen is deployed into the groundwater using an internal push rod. Grab groundwater samples will be collected via low-flow sampling methods using bladder pumps or peristaltic pumps with disposable tubing as specified in the QAPP. See *SOP 3-17: Direct Push Sampling Techniques* for more details.

If groundwater is not observed during boring activities, a temporary well will be installed. Boreholes for temporary wells will be created using a Geoprobe® DT325 dual-tube sampling system (or equivalent). Once the borehole has been advanced to the specified depth, the temporary well will be constructed of a 5-ft section of 1-inch Schedule 40 PVC screen with sufficient casing to reach ground surface. The target depth is specified for each AOC in Section 2.0. In most cases, borings will be advanced to the depth of the perched water table. If no groundwater is encountered within the anticipated depth of the perched water table (5 to 25 ft bgs), borings will be advanced to a maximum of 25 ft bgs. The well will be allowed to recharge and limited purging will be conducted as allowed by the recharge to the well to reduce turbidity in the groundwater prior to sampling.

Piezometers will be installed at some AOCs to obtain information to determine the direction of groundwater flow. The piezometers will be constructed as standard PVC wells with filter-pack and a bentonite seal, as necessary, but will not be grouted in place. Water level data will be collected with a water level meter.

Groundwater samplers will be decontaminated between boring locations. Water quality parameters (e.g., temperature, specific conductance, pH, dissolved oxygen, oxidation–reduction potential) will be measured and recorded on the field sampling form after the grab sample has been collected. See *SOP 3-14: Monitoring Well Sampling* and *SOP 3-24: Water Quality Parameter Testing* for more details.

**Borehole Abandonment:** DPT borings will be abandoned at completion of sampling activities. Borings in grass or sand will be abandoned by backfilling with bentonite chips. Borings in asphalt or concrete shall be abandoned by backfilling with bentonite chips to approximately 6 inches bgs, and the remainder of the borehole will be patched with asphalt cold patch or hydraulic concrete. The surface at each location will be restored to match the surrounding area. See *SOP 3-15: Monitoring Well and Borehole Abandonment* for more details.

**Permanent Monitoring Well Construction:** Monitoring wells may be installed at Camp Hero based on the analytical results of the Phase 1 investigation. Monitoring wells will be installed by a driller licensed by the State of New York. The monitoring wells will be installed using Geoprobe® dual-tube sampling system (or equivalent) DPT rig. The monitoring wells will be constructed using a 2-inch

diameter, Schedule 40 PVC screen and riser. The screen will be machine slotted with 0.010-inch slots. Screen and casing will be flush threaded; no PVC solvent or cement will be used in well construction. A filter pack consisting of Size 1 silica quartz sand will be placed in the annulus surrounding the screened interval and extend two feet above the top of screen. A three-foot-thick sodium bentonite seal will be placed in the annulus above the filter pack and hydrated according to the manufacturer's specifications. The remainder of the annulus will be grouted. Grout will be comprised of a mixture of Type I Portland cement, sodium bentonite powder, and potable water, and emplaced with a Tremie pipe. Wells will be completed with a locking cap and a 12-inch diameter manhole set in a two foot by two foot by six inch thick concrete pad.

The SSHO will provide oversight of the subcontractor performing DPT drilling, continuous soil core collection, and monitoring well installation. Field personnel will perform the lithologic logging in accordance with USCS and develop the monitoring wells. See *SOP 3-12: Monitoring Well Installation* for more details.

**Monitoring Well Development:** The wells will be developed by a combination of surging and over-pumping with a submersible monsoon pump and associated HDPE tubing in accordance with *SOP 3-13 (Monitoring Well Development)*. Water clarity will be visually monitored and water quality parameters, including dissolved oxygen, specific conductivity (SC), oxidation-reduction potential (ORP), pH, temperature, and turbidity will be measured using a flow-through cell per the *SOP 3-24 (Water Quality Parameter Testing for Groundwater Sampling)* every 5 minutes during purging to determine progress of development. The multi-parameter water quality meter will be calibrated initially and continually throughout its usage each day, as needed. A calibration check will be performed at the end of each day. Each well will be developed until the well produces clear (silt-free) water with a minimum of 3 stable water quality readings as outlined below:

- pH – within ± 0.2 units.
- SC – within ± 3 percent (%).
- ORP – within ± 10 millivolts.
- Temperature – within ±1 degree Celsius.
- Turbidity – at or below 10 nephelometric turbidity unit (NTU) or within ± 10% if above 10 NTU.

If the well has slow groundwater recharge and is purged dry, the well will be considered developed when bailed or pumped dry three times in succession and the turbidity has decreased. If any water is added to the well's borehole during development or drilling, three times the volume of water added will also be removed during well development.

Reusable sampling equipment will be properly decontaminated after each use in accordance with SOP 3-06. Excess soil or groundwater generated will be containerized, managed and disposed of as IDW. See *SOP 3-13: Monitoring Well Development* for more details.

**Groundwater Sample Collection from Permanent Monitoring Wells:** Groundwater samples will be collected from permanent monitoring wells using low-flow sampling methodology. Groundwater levels will be measured in each well prior to sampling using a water level meter (Solonist or equivalent). The monitoring wells will be purged using low-flow sampling techniques using a bladder or peristaltic pump and disposable tubing in accordance with *SOP-3-14*. Water clarity will be visually monitored and water quality parameters, including dissolved oxygen, SC, ORP, pH, temperature, and turbidity will be measured using a flow-through cell per the *SOP 3-24 (Water Quality Parameter Testing for Groundwater Sampling).* Readings will be collected every 5 minutes until the well produces clear (silt-free) water with a minimum of 3 stable water quality readings, as outlined above in the Well Development procedures. The multi-parameter water quality meter will be calibrated initially and continually throughout its usage each day, as needed. A calibration check will be performed at the end of each day. Once the water quality parameters reach stabilization, samples will be collected in laboratory-supplied bottleware. Non-disposable sampling equipment will be decontaminated between each well. See *SOP 3-14: Monitoring Well Sampling* and *SOP 3-24: Water Quality Parameter Testing* for more details.

**Aquifer Testing at Permanent Monitoring Wells:** Transducers will be placed in designated monitoring wells during the Phase 2 RI Activities. The RI WP Addendum will include specifications for the use of transducers. The groundwater aquifer hydraulic conductivity analysis will also be conducted at AOCs which are included in the Phase 2 RI Activities. The methodologies for the aquifer analysis will be specified in the RI WP Addendum.

**Liquid Characterization and Transformer Fluid Sampling:** Liquid characterization sampling will conducted at AOCs containing unknown liquids. Unknown liquids may be present as standing water in bunkers, transformer liquid, and potentially unknown drum and tank liquids. Samples will be collected into laboratory-supplied bottleware using disposal dippers. Equipment blanks will not be prepared or analyzed unless a deviation from this plan requires sample handling using non-dedicated equipment (a peristaltic pump and disposal polystyrene tubing). If non-dedicated sampling equipment is used, an equipment blank will be collected and will be analyzed for VOCs. See SOP 3-10: Surface Water and Liquid Sampling for more details.

**Concrete Chip Samples:** Prior to sampling, the sample collection location with marked off with chalk and the area will be measured. The surface of the location to be sampled will be broken up using the decontaminated chisel and hammer. An effort will be made to avoid scattering pieces out of the marked sampling area boundary. Any pieces that fall outside the sampling area should not be used. The area should be chipped to less than ¼" and preferably ⅛". Depth of the chips will be

recorded in the field logbook or field data sheet. The chipped pieces will be collected using dedicated gloves or equipment/brush and transferred directly into the laboratory-provided sample container. See POP 001: Chip Sampling for more details.

**Wipe Sampling for PCBs**: Wipe sampling is proposed at Building 201. The wipe sample will be collected in accordance with 40 CFR §761.123. Prior to sampling, a gauze pad will be inserted into the sample jar and hexane will be added to saturate the gauze pad. A 10 centimeter (cm) × 10 cm sample area will be prepared at the proposed sample location. The sample area will be thoroughly wiped from left to right and again from top to bottom. Once the area has been wiped, the gauze pad is air dried and placed back into the sample jar.

### 3.14 Quality Assurance/Quality Control Sample Collection

QA/QC sampling will take place according to the specifications described in the UFP-QAPP (Appendix B). Field duplicate samples will be collected at a rate of 10% and analyzed for the same parameters as the accompanying samples. Matrix spike (MS) and matrix spike duplicate (MSD) samples will be collected at the rate of 5% and analyzed for the same parameters as the accompanying samples. Trip blanks will accompany each cooler containing samples for VOC analysis and will be analyzed for select VOCs. Equipment blanks will not be prepared or analyzed unless a deviation from this plan requires sample handling using non-dedicated equipment. If non-dedicated sampling equipment is used, an equipment blank will be collected and analyzed for VOCs. A temperature blank shall be placed in each cooler to ensure that samples are preserved at or below four degrees Celsius during shipment.

### 3.15 Sample Identification

The sample identification number will consist of an alphanumeric designation related to the AOC, event, media type, and consecutive number, according to the following conventions:

AOC Identification (ID): **203** = Building **203** *(see Table 2-1 for AOC IDs)*
Media Type: **SB** = **S**urface **B**oring *(see Table 2-1 for Media Type Codes)*
Consecutive Number: 01, 02, 03, etc.
Depth of sample (in ft): 01, 02, 03 etc. *(if applicable – for soil samples only)*

For example, the sample identification number for the first soil boring sample collected at Building 203 from 1 to 3 ft bgs will be: 203-SB01-03. The sample identification number for the groundwater sample collected from the same boring will be 203-GW01. Duplicate sample identification numbers will be followed with a “D”. MS sample identification numbers will be followed with a “MS” and MSD sample identification numbers will be followed with a “MSD.”

## 3.16 Sampling Handling, Storage, and Shipping

Each sample will be collected into laboratory-supplied glassware and submitted to the laboratory for analysis of selected parameters. The laboratory method detection limits for these analytes are presented in the UFP-QAPP, Attachment B to this SAP. Samples will be packaged on ice and transported daily via overnight commercial carrier under standard chain-of-custody procedures to the laboratory. See *SOP 3-04: Sample Handling, Storage, and Shipping* (Appendix A) for additional information.

## 3.17 Field Documentation

The field logbook and field data sheets will serve as the primary record of field sampling activities. Entries will be made chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct each day's events. All exterior AOCs should be evaluated for distressed vegetation and surface staining of soils. Photographs of sampling locations and any staining and distressed vegetation should be provided in the field report. Logbooks and data sheets will be scanned and available digitally after the field effort. See *SOP 3-02: Logbooks* for additional information.

## 3.18 Decontamination Procedures

Decontamination activities will be performed in accordance with *SOP 3-06* (Appendix A). Equipment that may directly or indirectly contact samples will be decontaminated. Only individually-packaged equipment designated as “single use” or “disposable” are exempt from the decontamination policy. In addition, care will be taken to prevent the sample from coming into contact with potentially contaminating substances such as tape, oil, engine exhaust, corroded surfaces, or soil.

The following procedure will be used to decontaminate hand held sampling equipment:

- Place dirty equipment on a plastic ground sheet at the head of the decontamination line.
- Rinse equipment with potable water to remove surface dirt and mud if necessary.
- Scrub equipment with a bristle brush using a non-phosphate detergent (e.g., Liquinox) and potable water. To clean the inside of a bailer, use a bottlebrush pulled through the bailer with a polypropylene cord.
- Rinse off soap with potable water.
- Using a squirt bottle, rinse with 10% ultrapure nitric acid (use 1% nitric acid for metallic sampling materials) if equipment will be used for the collection of metals samples. Collect nitric acid rinsate in a tub or bucket.

- Rinse with ASTM Type II reagent-grade water.
- For equipment used to collect samples analyzed for organics, rinse with medical grade isopropanol or equivalent. Collect solvent rinsate in a tub or bucket separate from the nitric acid rinsate.
- Rinse with ASTM Type II reagent-grade water.
- Allow equipment to air dry.
- Wrap equipment with aluminum foil (shiny side facing out).
- Sampling equipment used to collect samples for organic analyses will not be allowed to contact any type of plastic after decontamination.
- Equipment that cannot be washed and rinsed (e.g., PID) should be covered with a plastic bag while sampling, with only the probe tip exposed.

Sampling personnel will store materials in such a manner to assure the decontamination materials remain free of contaminants. If any question of purity exists, new materials will be used.

At the end of the decontamination procedures, the proper disposal of the decontamination liquids will be placed in a designated 55-gallon drum or other designated container for future characterization and disposal.

Additional details on the decontamination procedures are presented *SOP 3-06* (Appendix A). Waste generated in the decontamination process will be containerized and handled as IDW as referenced in *SOP 3-05* (Appendix A).

### 3.19 IDW Management

AECOM-Tidewater JV will manage IDW generated during site field activities pursuant to applicable Federal, State, and local regulations and guidance including the United States Environmental Protection Agency (USEPA) Management of Investigation-Derived Wastes during Site Inspections (USEPA 1992), USACE guidance (2013), and NYSDEC Technical Guidance for Site Investigation and Remediation (2010b). IDW includes materials generated during the performance of the work that cannot be effectively reused, recycled, or decontaminated in the field. IDW consists of materials that could potentially pose a risk to human health and the environment (e.g., boring/well installation cuttings, sampling, and decontamination wastes) as well as materials that have minimal potential to pose a risk to human health and the environment (e.g., sanitary solid wastes).

In accordance with NYSDEC Technical Guidance for Site Investigation and Remediation (2010b), drill cuttings from on-site soil boring locations will be stored on protective sheeting and covered with protective sheeting if cuttings remain on ground at the end of the day. Soil cuttings will be disposed at the site within the borehole that generated them to within 24 inches of the ground surface and the remainder of the borehole completed with bentonite, unless:

- Soil volatile organic field screening instruments detect measurements from soil above background, visual discoloration of soil or olfactory evidence of contamination in soil cuttings is noted, free product, NAPL or grossly contaminated soil, are present in the soil cuttings;
- The borehole will be used for the installation of a permanent monitoring well;
- The borehole has penetrated an aquitard other confining layer; or extended into bedrock;
- Backfilling the borehole with cuttings will create a significant path for vertical movement of contaminants. If this is the case, soil additives (bentonite) may be added to the cuttings to reduce permeability;
- Previous soil sample results are available which document constituents in the soil are above appropriate residential risk screening level criteria. At Camp Hero, this includes AOC Site Building F100C and AOC Site Building 2010. These AOCs have previous soil results which indicate lead concentrations are above residential risk based screening criteria;
- The soil cannot fit into the borehole.

Groundwater generated during development and/or purging from temporary monitoring wells before sampling will be collected, handled and discharged/disposed pursuant to NYSDEC Technical Guidance for Site Investigation and Remediation (2010b) and all other applicable guidance and regulations. Groundwater generated during the RI investigation will be containerized upon production and properly treated or disposed of, when any of the following are observed:

- Visual evidence of contamination, consisting of discoloration, sheens, free product or NAPL are observed in groundwater;
- olfactory evidence of contamination; or
- concentrations of contaminants above groundwater standards at levels of concern are known to be present in the monitoring wells, based on previous sampling of the groundwater; or

If none of the conditions described above are observed or apply, the containerized water may be recharged to unpaved ground into the same groundwater unit, within or directly adjacent to a source area in a manner which does not result in surface water runoff.

Waste streams generated at the site which require containerization will be sampled to support waste characterization and waste disposal facility waste acceptance requirements. Based upon this characterization, disposal options will be identified and ultimate disposition of IDW will be determined. Disposal manifests and associated paperwork will be included in the appendices to the RI report.

Containers that meet Department of Transportation requirements will be used for the different types of IDW generated during the project: solids (e.g., drill cuttings from boring/monitoring well installation drums); liquid (monitoring well development water, purge water, decontamination water drums); and personal protection equipment (PPE), disposable sampling equipment, and trash (e.g., gloves, Tyvek®). When applicable, IDW will be containerized at the time of generation and temporarily staged at a designated secure location at the site. Hazardous waste is not anticipated to be generated during RI activities; however, any containers of IDW determined to contain hazardous waste will be removed from the temporary staging area for disposal at an off-site permitted facility with the proper manifests and disposal documents. Approval for waste disposal will be obtained prior to IDW pickup and disposal to an offsite permitted treatment, storage, or disposal facility.

Solid IDW associated with the soil borings, monitoring well installations, and test pit excavations generated during the RI will be field-screened using a PID. Solid IDW above background readings with the PID will be segregated and staged in a designated secure IDW storage location in containers (drums) until waste profiling on soil composite samples is performed by an off-site laboratory. Characterization data will be used to prepare waste profiles for offsite disposal if necessary.

Generated liquid IDW will include temporary monitoring well development water, purge water from sampling, and decontamination water. Liquid IDW generated during project activities which requires containerization will be placed in appropriately labeled containers (drum/tank) and temporarily staged until waste profiling is performed by an off-site laboratory. It is anticipated that IDW will be stored in the secure, fenced area north of the Motor Pool, as per discussions with Camp Hero State Park Superintendent, Tom Dess.

Other non-hazardous waste anticipated to be generated at the site and its disposal method include:

- Concrete debris generated to access the silos will be disposed of as construction debris at an appropriate/regulated landfill. NYSDEC has a list of active permitted construction and demolition debris processing facilities (NYSDEC, 2016)]

- PPE (e.g., Tyvek®, nitrile gloves, ear plugs), disposable sampling equipment (e.g., disposable bladders from bladder pumps, used sample tubing), and miscellaneous refuse will be double-bagged and disposed of in a designated waste dumpster or other receptacle located on site for eventual disposal as municipal solid waste

Containers of IDW will be labeled indicating the generator, contact information, contents, and date of generation. Initial identification will include the following information:

- "Hazardous Waste – Pending Analysis"
- Project name (e.g., Camp Hero)
- USEPA Site ID Number
- Container name that includes Point of Generation (well number(s)/boring number(s) and depth, if applicable)
- Contents (soil, development water, purge water, etc.)
- Date of generation
- Contact phone number and name

Hazardous waste determination will be made using available analytical data (including Toxicity Characteristic Leaching Procedure). If the waste is determined to be non-hazardous solid waste, the "Hazardous Waste – Pending Analysis" label will be removed. AECOM-Tidewater JV will label the container with a nonhazardous waste label within 5 working days of this determination. If the waste is determined to be hazardous, AECOM-Tidewater JV will label and mark the containers in accordance with 49 CFR Part 172 within 5 working days of the hazardous waste determination.

Containers of IDW will be cataloged in the field logbook or on an IDW tracking form. The unique ID number for each container will consist of the site, location (well/boring ID), and container number. Containers will be numbered consecutively and will include the media type (i.e., LIQ001 or SOIL002). Information for materials requiring off-site disposal based on laboratory analysis will include pertinent information regarding the container, including:

- General label information
- Whether the material is hazardous or non-hazardous
- Storage location
- Proposed disposition of the waste
- Date manifested from the site
- Manifest number
- Final disposition of the container

Off-site disposal of IDW will be arranged in a manner appropriate to its classification (e.g., characteristic hazardous waste or non-hazardous, solid/liquid waste). AECOM-Tidewater JV will coordinate waste handling activities with licensed disposal subcontractor to identify properly licensed and permitted transportation and disposal (T&D) firms for the project. In general, disposal includes the following activities:

- Procurement of T&D subcontractor(s)
- Completion of waste profile forms, as appropriate for each disposal facility
- Completion of T&D manifests
- Pickup, transportation, and disposal of the wastes

Approval to accept the IDW will be required from each facility selected to receive IDW and will be obtained prior to shipment of wastes from the site. Depending on the waste volume, alternate disposal and/or contamination reduction methods will be evaluated with USACE and NYSDEC.

AECOM-Tidewater JV will provide the following to USACE for waste sent offsite for disposal:

- Facility name
- Location
- Point-of-contact
- USEPA Identification Number
- Verification the transporter is licensed

Preparation of a draft profile package will be performed by AECOM-Tidewater JV with assistance from field support subcontractors. The draft profile package will be sent to the USACE for review and approval. Upon approval of the profile package, AECOM-Tidewater JV will submit the package for approval. Once the profiles are approved, AECOM-Tidewater JV will prepare draft manifests and other required shipping paperwork, which will then be provided to the USACE NY District Construction for review. Once the manifest package has been approved, AECOM-Tidewater JV will coordinate with the USACE for scheduling shipment of the wastes. A USACE representative will be present on site to sign manifests on the day of shipment, or make accommodations for signature prior to the day of shipment. AECOM-Tidewater JV will forward the final signed paperwork to the USACE within 30 days of the date of shipment. USACE will be listed as the generator of the IDW on the manifests. Copies of the manifests and shipping forms will be maintained in both the AECOM-Tidewater JV and USACE Project Files. Manifest copies will contain the information in Section 5 of USEPA Form 8700-22 including generator name, mailing address, and phone number.

Additional details on waste containerized and handled as IDW is referenced in *SOP 3-05: IDW Management* (Appendix A).

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## 4.0 REFERENCES

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# Appendix A

# Field Standard Operating Procedures

SOP 3-01: Utility Clearance
SOP 3-02: Logbooks
SOP 3-03: Record Keeping, Sample Labeling, and Chain-of-Custody Procedures
SOP 3-04: Sample Handling, Storage, and Shipping
SOP 3-05: IDW Management
SOP 3-06: Equipment Decontamination
SOP 3-07: Land Surveying
SOP 3-09: Geophysics
SOP 3-10: Surface Water and Liquid Sampling
SOP 3-12: Monitoring Well Installation
SOP 3-13: Monitoring Well Development
SOP 3-14: Monitoring Well Sampling
SOP 3-15: Monitoring Well and Borehole Abandonment
SOP 3-16: Soil and Rock Classification
SOP 3-17: Direct Push Sampling Techniques
SOP 3-20: Operation and Calibration of a PID
SOP 3-21: Surface and Subsurface Soil Sampling
SOP 3-24: Water Quality Parameter Testing
POP 001: Chip Sampling

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# Utility Clearance

# Procedure 3-01

## 1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the process for determining the presence of subsurface utilities and other cultural features at locations where planned site activities involve the physical disturbance of subsurface materials.

1.2 This procedure is the Program-approved professional guidance for work performed by AECOM under contract to the Unites States Army Corp of Engineers (USACE).

1.3 The procedure applies to the following activities: soil gas surveying, excavating, trenching, drilling of borings and installation of monitoring and extraction wells, use of soil recovery or slide-hammer hand augers, and all other intrusive sampling activities.

1.4 The primary purpose of the procedure is to minimize the potential for damage to underground utilities and other subsurface features, which could result in physical injury, disruption of utility service, or disturbance of other subsurface cultural features.

1.5 If there are procedures, whether it be from AECOM, state, and/or federal, that are not addressed in this SOP and are applicable to utility clearance, those procedures should be added as an appendix to the project specific SAP.

1.6 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

## 2.0 Safety

2.1 Field and subcontractor personnel shall adhere to a site-specific Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP).

## 3.0 Terms and Definitions

3.1 **Utility**

For the proposes of this SOP, a utility is defined as a manmade underground line or conduit, cable, pipe, vault or tank that is, or was, used for the transmission of material or energy (e.g., gas, electrical, telephone, steam, water or sewage, product transfer lines, or underground storage tanks).

3.2 **As-Built Plans**

As-built plans are plans or blueprints depicting the locations of structures and associated utilities on a property.

3.3 **One-Call**

The Utility Notification Center is the one-call agency for nationwide call before you dig. The Utility Notification Center is open 24 hours a day, and accepts calls from anyone planning to dig. The phone number 811 is the designated call before you dig phone number that directly connects you to your local one-call center. Additional information can be found at www.call811.com.


**PRINTED COPIES ARE UNCONTROLLED. CONTROLLED COPY IS AVAILABLE ON COMPANY INTRANET.**

Calling before you dig ensures that any publicly owned underground lines will be marked so that you can dig around them safely. Having the utility lines marked not only prevents accidental damage to the lines, but prevents property damage and personal injuries that could result in breaking a line.

The following information will need to be provided when a call is placed to One-Call:

- Your name, phone number, company name (if applicable), and mailing address.
- What type or work is being done.
- Who the work is being done for.
- The county and city the work is taking place in.
- The address or the street where the work is taking place.
- Marking instructions, (specific instructions as to where the work is taking place).

Under normal circumstances it takes between 2 to 5 days from the time you call (not counting weekends or holidays) to have the underground lines marked. Because these laws vary from state to state, exactly how long it will take depends on where your worksite is located. You will be given an exact start time and date when your locate request is completed, which will comply with the laws in your area.

In the event of an emergency (any situation causing damage to life or property, or a service outage), lines can be marked sooner than the original given time if requested.

3.4 **Toning**

Toning is the process of surveying an area utilizing one or more surface geophysical methods to determine the presence or absence of underground utilities. Typically, toning is conducted after identifying the general location of utilities and carefully examining all available site utility plans. Each location is marked according to the type of utility being identified. In addition, areas cleared by toning are flagged or staked to indicate that all identified utilities in a given area have been toned.

## 4.0 Training and Qualifications

4.1 The **Project Manager** is responsible for verifying that these utility locating procedures are performed prior to the initiation of active subsurface exploration.

4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

4.3 The **Site Supervisor** is responsible for ensuring that all utility locating activities are performed in accordance with this procedure.

4.4 All **Field Personnel** are responsible for the implementation of this procedure.

## 5.0 Equipment and Supplies

5.1 Equipment and supplies necessary for locating subsurface utilities will be provided by the subcontractor; however, the project **Site Supervisor/Field Personnel** will provide any additional equipment and supplies as needed as well as maintain information regarding the utility clearance activities in the field logbook.

## 6.0 Procedure

Proceed wtih the following steps where subsurface exploration will include excavations, drilling, or any other subsurface investigative method that could damage utilities at a site. In addition to the steps outlined below, always exercise caution while conducting subsurface exploratory work.

6.1 **Prepare Preliminary Site Plan**

- Prepare a preliminary, scaled site plan depicting the proposed exploratory locations as part of the project specific Sampling and Analysis Plan (SAP) or Work Plan. Include as many of the cultural and natural features as practical in this plan.

6.2 **Review Background Information**

- Search existing plan files to review the as-built plans to identify the known location of utilities at the site. Plot the locations of utilities identified onto a preliminary, scaled site plan. Inform the CTO Manager if utilities lie within close proximity to a proposed exploration or excavation location. The Project Manager will determine if it is necessary to relocate proposed sampling or excavation locations.
- Include the utility location information gathered during previous investigations (e.g., remedial investigation or remedial site evaluation) in the project design documents for removal or remedial actions. In this manner, information regarding utility locations collected during implementation of a project can be shared with the subcontractor during implementation of a particular task order. In many instances, this will help to reduce the amount of additional geophysical surveying work the subcontractor may have to perform.
- Conduct interviews with onsite and facility personnel familiar with the site to obtain additional information regarding the known and suspected locations of underground utilities. In addition, if appropriate, contact shall be made with local utility companies to request their help in locating underground lines. Pencil in the dimensions, orientation, and depth of utilities, other than those identified on the as-built plans, at their approximate locations on the preliminary plans. Enter the type of utility, the personnel who provided the information, and the date the information was provided into the field log.
- During the pre-field work interviewing process, the interviewer will determine which site personnel should be notified in the event of an incident involving damage to existing utilities. Record this information in the field logbook with the corresponding telephone numbers and addresses.

6.3 **Site Visit/Locate Utilities/Toning**

- Prior to the initiation of field activities, the Site Supervisor similarly qualified field personnel shall visit the site and note existing structures and evidence of associated utilities, such as fire hydrants, irrigation systems, manhole and vault box covers, standpipes, telephone switch boxes, free-standing light poles, gas or electric meters, pavement cuts, and linear depression. Compare notes of the actual site configuration to the preliminary site plan. Note deviations in the field logbook and on the preliminary site plan. Accurately locate or survey and clearly mark with stakes, pins, flags, paint, or other suitable devices all areas where subsurface exploration is proposed. These areas shall correspond with the locations drawn on the preliminary site plan.
- Following the initial site visit by the Site Supervisor, a trained utility locating subcontractor will locate, identify, and tone all utilities depicted on the preliminary site plan. The Field Task Manager or similarly qualified field personnel shall visit the site and identify the areas of subsurface disturbance with white spray paint, chalk, white pin flags or some other easily identifiable marking. The utility locator should utilize appropriate sensing equipment to attempt to locate utilities that might not have appeared on the as-built plans. At a minimum, the utility subcontractor should utilize a metal detector and/or magnetometer; however, it is important to consider the possibility that non-metallic utilities or tanks might be present at the site. Use other appropriate surface geophysical methods such as Ground Penetrating Radar, Radiodetection, etc. as appropriate. Clear proposed exploration areas of all utilities in the immediate area where subsurface exploration is proposed. Clearly tone all anomalous areas. Clearly identify all toned areas on the preliminary site plan. All utilities near the area of subsurface disturbance should also be marked out by the utility subcontractor using the universal colors for subsurface utilities (i.e., red – electric; blue – water; green – sewer; yellow – gas; etc.). After toning the site and plotting all known or suspected buried utilities on the preliminary site plan, the utility locator shall provide the Field Task Manager with a copy of the completed preliminary

site plan. Alternatively, the Site Supervisoror designee shall document the results of the survey on the preliminary site plan.

- Report to the Site Supervisor anomalous areas detected and toned that are in close proximity to the exploration or excavation areas. The Field Task Manager shall determine the safe distance to maintain from the known or suspected utility. It may be necessary to relocate the proposed exploration or excavation areas. If this is required, the Site Supervisor or designee shall relocate them and clearly mark them using the methods described above. Completely remove the markings at the prior location. Plot the new locations on the site plan and delete the prior locations from the plan. In some instances, such as in areas extremely congested with subsurface utilities, it may be necessary to dig by hand or use techniques such as air knife to determine the location of the utilities.

6.4 **Prepare Site Plan**

- Prior to the initiation of field activities, draft a final site plan that indicates the location of subsurface exploration areas and all known or suspected utilities present at the site. Provide copies of this site plan to the USACE and the subcontractor who is to conduct the subsurface exploration/excavation work. Review the site plan with the NTR to verify its accuracy prior to initiating subsurface sampling activities.

## 7.0 Quality Control and Assurance

7.1 Utility locating must incorporate quality control measures to ensure conformance to these and the project requirements.

## 8.0 Records, Data Analysis, Calculations

8.1 A bound field logbook will be kept detailing all activities conducted during the utility locating procedure.

8.2 The logbook will describe any changes and modifications made to the original exploration plan. The trained utility locator shall prepare a report and keep it in the project file. Also, a copy of the final site plan will be kept in the project file.

## 9.0 Attachments or References

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| Author | Reviewer | Revisions (Technical or Editorial) |
|---|---|---|
| Caryn DeJesus<br>Senior Scientist | Bob Shoemaker<br>Senior Scientist | Rev 0 – Initial Issue (June 2012) |

# Logbooks

# Procedure 3-02

## 1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the activities and responsibilities pertaining to the identification, use, and control of logbooks and associated field data records.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

## 2.0 Safety

2.1 In order to keep the logbook clean, store it in a clean location and use it only when outer gloves used for PPE have been removed.

## 3.0 Terms and Definitions

3.1 **Logbook**

A logbook is a bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the relevant activity, the person assigned responsibility for maintenance of the logbook, and the beginning and ending dates of the entries.

3.2 **Data Form**

A data form is a predetermined format utilized for recording field data that may become, by reference, a part of the logbook (e.g., soil boring logs, trenching logs, surface soil sampling logs, groundwater sample logs, and well construction logs are data forms).

## 4.0 Training and Qualifications

4.1 The **Project Manager** or **designee** is responsible for determining which team members shall record information in field logbooks and for obtaining and maintaining control of the required logbooks. The **Project Manager** shall review the field logbook on at least a monthly basis. The **Project Manager** or **designee** is responsible for reviewing logbook entries to determine compliance with this procedure and to ensure that the entries meet the project requirements.

4.2 A knowledgeable individual such as the **Site Supervisor, Project Manager**, or **Program Quality Manager** shall perform a technical review of each logbook at a frequency commensurate with the level of activity (weekly is suggested, or, at a minimum, monthly). Document these reviews by the dated signature of the reviewer on the last page or page immediately following the material reviewed.

4.3 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

4.4 The **Site Supervisor** is responsible for ensuring that all **field personnel** follow these procedures and that the logbook is completed properly and daily. The **Site Supervisor** is also responsible for submitting copies to the **Project Manager**, who is responsible for filing them and submitting a copy (if required by the Statement of Work).

4.5 The **logbook user** is responsible for recording pertinent data into the logbook to satisfy project requirements and for attesting to the accuracy of the entries by dated signature. The **logbook user** is also responsible for safeguarding the logbook while having custody of it.


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4.6 All **field personnel** are responsible for the implementation of this procedure.

## 5.0 Equipment and Supplies

5.1 Field logbooks shall be bound field notebooks with water-repellent pages.

5.2 Pens shall have indelible black ink.

## 6.0 Procedure

6.1 The field logbook serves as the primary record of field activities. Make entries chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct the applicable events. Store the logbook in a clean location and use it only when outer gloves used for personal protective equipment (PPE) have been removed.

6.2 Individual data forms may be generated to provide systematic data collection documentation. Entries on these forms shall meet the same requirements as entries in the logbook and shall be referenced in the applicable logbook entry. Individual data forms shall reference the applicable logbook and page number. At a minimum, include names of all samples collected in the logbook even if they are recorded elsewhere.

6.3 Enter field descriptions and observations into the logbook, as described in Attachment 1, using indelible black ink.

6.4 Typical information to be entered includes the following:

- Dates (month/day/year) and times (military) of all on-site activities and entries made in logbooks/forms;
- Site name and description;
- Site location by longitude and latitude, if known;
- Weather conditions, including temperature and relative humidity;
- Fieldwork documentation, including site entry and exit times;
- Descriptions of, and rationale for, approved deviations from the work plan (WP) or field sampling plan;
- Field instrumentation readings;
- Names, job functions, and organizational affiliations of on-site personnel;
- Photograph references;
- Site sketches and diagrams made on site;
- Identification and description of sample morphology, collection locations, and sample numbers;
- Sample collection information, including dates (month/day/year) and times (military) of sample collections, sample collection methods and devices, station location numbers, sample collection depths/heights, sample preservation information, sample pH (if applicable), analysis requested (analytical groups), etc., as well as chain-of-custody (COC) information such as sample identification numbers cross-referenced to COC sample numbers;
- Sample naming convention;
- Field quality control (QC) sample information;
- Site observations, field descriptions, equipment used, and field activities accomplished to reconstruct field operations;


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- Meeting information;
- Important times and dates of telephone conversations, correspondence, or deliverables;
- Field calculations;
- PPE level;
- Calibration records;
- Contractor and subcontractor information (address, names of personnel, job functions, organizational affiliations, contract number, contract name, and work assignment number);
- Equipment decontamination procedures and effectiveness;
- Laboratories receiving samples and shipping information, such as carrier, shipment time, number of sample containers shipped, and analyses requested; and
- User signatures.

6.5 The logbook shall reference data maintained in other logs, forms, etc. Correct entry errors by drawing a single line through the incorrect entry, then initialing and dating this change. Enter an explanation for the correction if the correction is more than for a mistake.

6.6 At least at the end of each day, the person making the entry shall sign or initial each entry or group of entries.

6.7 Enter logbook page numbers on each page to facilitate identification of photocopies.

6.8 If a person's initials are used for identification, or if uncommon acronyms are used, identify these on a page at the beginning of the logbook.

6.9 At least weekly and preferably daily, the **preparer** shall photocopy and retain the pages completed during that session for backup. This will prevent loss of a large amount of information if the logbook is lost.

## 7.0 Quality Control and Assurance

7.1 Review per Section 4.2 shall be recorded.

## 8.0 Records, Data Analysis, Calculations

8.1 Retain the field logbook as a permanent project record. If a particular CTO requires submittal of photocopies of logbooks, perform this as required.

8.2 Deviations from this procedure shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

## 9.0 Attachments or References

9.1 Attachment 1 – Description of Logbook Entries

9.2 Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.


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| Author | Reviewer | Revisions (Technical or Editorial) |
|---|---|---|
| Mark Kromis<br>Program Chemist | Chris Barr<br>Program Quality Manager | Rev 0 – Initial Issue |


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# Attachment 1
# Description of Logbook Entries

Logbook entries shall be consistent with Section A.1.4 *Field Documentation SOPs* of the UFP-QAPP Manual (DoD 2005) and contain the following information, as applicable, for each activity recorded. Some of these details may be entered on data forms, as described previously.

| Name of Activity | For example, Asbestos Bulk Sampling, Charcoal Canister Sampling, Aquifer Testing. |
|---|---|
| Task Team Members and Equipment | Name all members on the field team involved in the specified activity. List equipment used by serial number or other unique identification, including calibration information. |
| Activity Location | Indicate location of sampling area as indicated in the field sampling plan. |
| Weather | Indicate general weather and precipitation conditions. |
| Level of PPE | Record the level of PPE (e.g., Level D). |
| Methods | Indicate method or procedure number employed for the activity. |
| Sample Numbers | Indicate the unique numbers associated with the physical samples. Identify QC samples. |
| Sample Type and Volume | Indicate the medium, container type, preservative, and the volume for each sample. |
| Time and Date | Record the time and date when the activity was performed (e.g., 0830/08/OCT/89). Use the 24-hour clock for recording the time and two digits for recording the day of the month and the year. |
| Analyses | Indicate the appropriate code for analyses to be performed on each sample, as specified in the WP. |
| Field Measurements | Indicate measurements and field instrument readings taken during the activity. |
| Chain of Custody and Distribution | Indicate chain-of-custody for each sample collected and indicate to whom the samples are transferred and the destination. |
| References | If appropriate, indicate references to other logs or forms, drawings, or photographs employed in the activity. |
| Narrative (including time and location) | Create a factual, chronological record of the team's activities throughout the day including the time and location of each activity. Include descriptions of general problems encountered and their resolution. Provide the names and affiliations of non-field team personnel who visit the site, request changes in activity, impact the work schedule, request information, or observe team activities. Record any visual or other observations relevant to the activity, the contamination source, or the sample itself.<br>It should be emphasized that logbook entries are for recording data and chronologies of events. The logbook author must include observations and descriptive notations, taking care to be objective and recording no opinions or subjective comments unless appropriate. |
| Recorded by | Include the signature of the individual responsible for the entries contained in the logbook and referenced forms. |
| Checked by | Include the signature of the individual who performs the review of the completed entries. |

# Recordkeeping, Sample Labeling, and Chain-of-Custody

# Procedure 3-03

## 1.0 Purpose and Scope

1.1 The purpose of this standard operating procedure is to establish standard protocols for all field personnel for use in maintaining field and sampling activity records, writing sample logs, labeling samples, ensuring that proper sample custody procedures are utilized, and completing chain-of-custody/analytical request forms.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

## 2.0 Safety

Not applicable.

## 3.0 Terms and Definitions

3.1 **Logbook**

A logbook is a bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the relevant activity, the person responsible for maintenance of the logbook, and the beginning and ending dates of the entries.

3.2 **Chain-of-Custody**

Chain-of-custody (COC) is documentation of the process of custody control. Custody control includes possession of a sample from the time of its collection in the field to its receipt by the analytical laboratory, and through analysis and storage prior to disposal.

## 4.0 Training and Qualifications

4.1 The **Project Manager** is responsible for determining which team members shall record information in the field logbook and for checking sample logbooks and COC forms to ensure compliance with these procedures. The **Project Manager** shall review COC forms on a monthly basis at a minimum.

4.2 The **Project Manager** and **Program Quality Manager** are responsible for evaluating project compliance with the Project Procedures Manual.

4.3 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

4.4 The **Laboratory Project Manager** or **Sample Control Department Manager** is responsible for reporting any sample documentation or COC problems to the **Project Manager** or **Laboratory Coordinator** within 24 hours of sample receipt.

4.5 The **Site Supervisor** is responsible for ensuring that all **field personnel** follow these procedures. The **Laboratory Coordinator** is responsible for verifying that the COC/analytical request forms have been completed properly and match the sampling and analysis plan. The **Project Manager** or **Laboratory Coordinator** is responsible for notifying the **laboratory**, **data managers**, and **data validators** in writing if analytical request changes are required as a corrective action. These small changes are different from change orders, which involve changes to the scope of the subcontract with


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the laboratory and must be made in accordance with a respective contract (e.g., remedial action contract).

4.6 All **field personnel** are responsible for following these procedures while conducting sampling activities. **Field personnel** are responsible for recording pertinent data into the logbook to satisfy project requirements and for attesting to the accuracy of the entries by dated signature.

# 5.0 Procedure

This procedure provides standards for documenting field activities, labeling the samples, documenting sample custody, and completing COC/analytical request forms. The standards presented in this section shall be followed to ensure that samples collected are maintained for their intended purpose and that the conditions encountered during field activities are documented.

## 5.1 Recordkeeping

The field logbook serves as the primary record of field activities. Make entries chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct each day's events. Field logs such as soil boring logs and ground-water sampling logs will also be used. These procedures are described in Procedure 3-02, *Logbooks*.

## 5.2 Sample Labeling

Affix a sample label with adhesive backing to each individual sample container. Place clear tape over each label (preferably prior to sampling) to prevent the labels from tearing off, falling off, being smeared, and to prevent loss of information on the label. Record the following information with a waterproof marker on each label:

- Project name or number (optional);
- COC sample number;
- Date and time of collection;
- Sampler's initials;
- Matrix (optional);
- Sample preservatives (if applicable); and
- Analysis to be performed on sample (this shall be identified by the method number or name identified in the subcontract with the laboratory).

These labels may be obtained from the analytical laboratory or printed from a computer file onto adhesive labels.

## 5.3 Custody Procedures

For samples intended for chemical analysis, sample custody procedures shall be followed through collection, transfer, analysis, and disposal to ensure that the integrity of the samples is maintained. Maintain custody of samples in accordance with the U.S. Environmental Protection Agency (EPA) COC guidelines prescribed in EPA *NEIC Policies and Procedures*, National Enforcement Investigations Center, Denver, Colorado, revised May 1986; EPA *RCRA Ground Water Monitoring Technical Enforcement Guidance Document* (TEGD); *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA OSWER Directive 9355 3-01); Appendix 2 of the *Technical Guidance Manual for Solid Waste Water Quality Assessment Test (SWAT) Proposals and Reports*; and *Test Methods for Evaluating Solid Waste* (EPA SW-846)

A description of sample custody procedures is provided below.

### 5.3.1 Sample Collection Custody Procedures

According to the U.S. EPA guidelines, a sample is considered to be in custody if one of the following conditions is met:

- It is in one's actual physical possession or view;
- It is in one's physical possession and has not been tampered with (i.e., it is under lock or official seal);
- It is retained in a secured area with restricted access; and
- It is placed in a container and secured with an official seal such that the sample cannot be reached without breaking the seal.

Place custody seals on sample containers immediately after sample collection and on shipping coolers if the cooler is to be removed from the sampler's custody. Place custody seals in such a manner that they must be broken to open the containers or coolers. Label the custody seals with the following information:

- Sampler's name or initials; and
- Date and time that the sample/cooler was sealed.

These seals are designed to enable detection of sample tampering. An example of a custody seal is shown in Attachment 1.

**Field personnel** shall also log individual samples onto COC forms (carbon copy or computer generated) when a sample is collected. These forms may also serve as the request for analyses. Procedures for completing these forms are discussed in Section 7.4, indicating sample identification number, matrix, date and time of collection, number of containers, analytical methods to be performed on the sample, and preservatives added (if any). The **samplers** will also sign the COC form signifying that they were the personnel who collected the samples. The COC form shall accompany the samples from the field to the laboratory. When a cooler is ready for shipment to the analytical laboratory, the **person delivering the samples for transport** will sign and indicate the date and time on the accompanying COC form. One copy of the COC form will be retained by the **sampler** and the remaining copies of the COC form shall be placed inside a self-sealing bag and taped to the inside of the cooler. Each cooler must be associated with a unique COC form. Whenever a transfer of custody takes place, **both parties** shall sign and date the accompanying carbon copy COC forms, and the **individual relinquishing the samples** shall retain a copy of each form. One exception is when the samples are shipped; the **delivery service personnel** will not sign or receive a copy because they do not open the coolers. The **laboratory** shall attach copies of the completed COC forms to the reports containing the results of the analytical tests. An example COC form is provided in Attachment 2.

### 5.3.2 Laboratory Custody Procedures

The following custody procedures are to be followed by an **independent laboratory** receiving samples for chemical analysis; the procedures in their Naval Facilities Engineering Service Center-evaluated Laboratory Quality Assurance Plan must follow these same procedures. A **designated sample custodian** shall take custody of all samples upon their arrival at the analytical laboratory. The **custodian** shall inspect all sample labels and COC forms to ensure that the information is consistent, and that each is properly completed. The **custodian** will also measure the temperature of the temperature blank in the coolers upon arrival using either a National Institute for Standards and Technology calibrated thermometer or an infra-red temperature gun. The **custodian** shall note the condition of the samples including:

- If the samples show signs of damage or tampering;
- If the containers are broken or leaking;
- If headspace is present in sample vials;
- If proper preservation of samples has occurred (made by pH measurement, except volatile organic compounds [VOCs] and purgeable total petroleum hydrocarbons [TPH] and temperature). The pH of VOC and purgeable TPH samples will be checked by the **laboratory analyst** after the sample aliquot has been removed from the vial for analysis; and
- If any sample holding times have been exceeded.

All of the above information shall be documented on a sample receipt sheet by the **custodian**.

Discrepancies or improper preservation shall be noted by the **laboratory** as an out-of-control event and shall be documented on an out-of-control form with corrective action taken. The out-of-control form shall be signed and dated by the **sample control custodian** and **any other persons** responsible for corrective action. An example of an out-of-control form is included as Attachment 4.

The **custodian** shall then assign a unique laboratory number to each sample and distribute the samples to secured storage areas maintained at 4 degrees Celsius (soil samples for VOC analysis are to be stored in a frozen state until analysis). The unique laboratory number for each sample, COC sample number, client name, date and time received, analysis due date, and storage shall also be manually logged onto a sample receipt record and later entered into the laboratory's computerized data management system. The **custodian** shall sign the shipping bill and maintain a copy.

**Laboratory personnel** shall be responsible for the care and custody of samples from the time of their receipt at the laboratory through their exhaustion or disposal. Samples should be logged in and out on internal laboratory COC forms each time they are removed from storage for extraction or analysis.

### 5.4 Completing COC/Analytical Request Forms

COC form/analytical request form completion procedures are crucial in properly transferring the custody and responsibility of samples from field personnel to the laboratory. This form is important for accurately and concisely requesting analyses for each sample; it is essentially a release order from the analysis subcontract.

Attachment 2 is an example of a generic COC/analytical request form that may be used by **field personnel**. Multiple copies may be tailored to each project so that much of the information described below need not be handwritten each time. Attachment 3 is an example of a completed site-specific COC/analytical request form, with box numbers identified and discussed in text below.

COC forms tailored to each CTO can be drafted and printed onto multi-ply forms. This eliminates the need to rewrite the analytical methods column headers each time. It also eliminates the need to write the project manager, name, and number; QC Level; TAT; and the same general comments each time.

Complete one COC form per cooler. Whenever possible, place all VOC analyte vials into one cooler in order to reduce the number of trip blanks. Complete all sections and be sure to sign and date the COC form. One copy of the COC form must remain with the field personnel.


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Box 2 **Bill To:** List the name and address of the person/company to bill only if it is not in the subcontract with the laboratory.

Box 3 **Sample Disposal Instructions:** These instructions will be stated in the Master Service Agreement or each CTO statement of work with each laboratory.

**Shipment Method:** State the method of shipment (e.g., hand carry or air courier via FedEx or DHL).

**Comments:** This area shall be used by the field team to communicate observations, potential hazards, or limitations that may have occurred in the field or additional information regarding analysis (e.g., a specific metals list, samples expected to contain high analyte concentrations).

Box 4 **Cooler No.:** This will be written on the inside or outside of the cooler and shall be included on the COC. Some laboratories attach this number to the trip blank identification, which helps track samples for VOC analysis. If a number is not on the cooler, field personnel shall assign a number, write it on the cooler, and write it on the COC.

**QC Level:** Enter the reporting quality control (QC) requirements (e.g., Full Data Package, Summary Data Package).

**Turnaround time (TAT):** TAT will be determined by a sample delivery group (SDG), which may be formed over a 14-day period, not to exceed 20 samples. Once the SDG has been completed, standard TAT is 21 calendar days from receipt of the last sample in the SDG. Entering NORMAL or STANDARD in this field will be acceptable. If quicker TAT is required, it shall be in the subcontract with the laboratory and reiterated on each COC to remind the laboratory.

Box 5 **Type of Containers:** Write the type of container used (e.g., 1-liter glass amber, for a given parameter in that column).

**Preservatives:** Field personnel must indicate on the COC the correct preservative used for the analysis requested. Indicate the pH of the sample (if tested) in case there are buffering conditions found in the sample matrix.

Box 6 **Sample Identification (ID) Number:** This is typically a five-character alphanumeric identifier used by the contractor to identify samples. The use of this identifier is important since the laboratories are restricted to the number of characters they are able to use. Sample numbering shall be in accordance with the project-specific sampling and analysis plan.

**Description (Sample ID):** This name will be determined by the location and description of the sample, as described in the project-specific sampling and analysis plan. This sample identification should not be submitted to the laboratory, but should be left blank. If a computer COC version is used, the sample identification can be input, but printed with this block black. A cross-referenced list of the COC Sample Number and sample identification must be maintained separately.

**Date Collected:** Record the collection date in order to track the holding time of the sample. Note: For trip blanks, record the date it was placed in company with samples.

**Time Collected:** When collecting samples, record the time the sample is first collected. Use of the 24-hour military clock will avoid a.m. or p.m. designations (e.g., 1815 instead of 6:15 p.m.). Record local time; the laboratory is responsible for calculating holding times to local time.

**Lab ID:** This is for laboratory use only.


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Box 7 **Matrix/QC:** Identify the matrix (e.g., water, soil, air, tissue, fresh water sediment, marine sediment, or product). If a sample is expected to contain high analyte concentrations (e.g., a tank bottom sludge or distinct product layer), notify the laboratory in the comment section. Mark an "X" for the sample(s) that have extra volume for laboratory QC matrix spike/matrix spike duplicate (MS/MSD) purposes. The sample provided for MS/MSD purposes is usually a field duplicate.

Box 8 **Analytical Parameters:** Enter the parameter by descriptor and the method number desired (e.g., BTEX 8260B, PAHs 8270C, etc.). Whenever practicable, list the parameters as they appear in the laboratory subcontract to maintain consistency and avoid confusion.

If the COC does not have a specific box for number of sample containers, use the boxes below the analytical parameter, to indicate the number of containers collected for each parameter.

Box 9 **Sampler's Signature:** The person who collected samples must sign here.

**Relinquished By:** The person who turned over the custody of the samples to a second party other than an express mail carrier, such as FedEx or DHL, must sign and date here.

**Received By:** Typically, a representative of the receiving laboratory signs and dates here. Or, a field crew member who delivered the samples in person from the field to the laboratory might sign here. A courier, such as FedEx or DHL, does not sign here because they do not open the coolers. It must also be used by the prime contracting laboratory when samples are to be sent to a subcontractor.

**Relinquished By:** In the case of subcontracting, the primary laboratory will sign and date the Relinquished By space and fill out an additional COC to accompany the samples being subcontracted.

**Received By (Laboratory):** This space is for the final destination (e.g., at a subcontracted laboratory). A representative of the final destination (e.g., subcontracted laboratory) must sign and date here.

Box 10 **Lab No. and Questions:** This box is to be filled in by the laboratory only.

Box 11 **Control Number:** This number is the "COC" followed by the first contractor identification number in that cooler, or contained on that COC. This control number must be unique (i.e., never used twice). Record the date the COC is completed. It should be the same date the samples are collected.

Box 12 **Total # of Containers:** Sum the number of containers in that row.

Box 13 **Totals:** Sum the number of containers in each column. Because COC forms contain different formats depending on who produced the form, not all of the information listed in items 1 to 13 may be recorded; however, as much of this information as possible shall be included.

## 6.0 Quality Control and Assurance

6.1 Recordkeeping, sample labeling, and chain-of-custody activities must incorporate quality control measures to ensure accuracy and completeness.

6.2 Deviations from this procedure or the project-specific CTO work plan shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

## 7.0 Records, Data Analysis, Calculations

7.1 The COC/analytical request form shall be faxed approximately daily to the **Laboratory Coordinator** for verification of accuracy. Following the completion of sampling activities, the sample

logbook and COC forms will be transmitted to the **Project Manager** for storage in project files. The **data validators** shall receive a copy also. The original COC/analytical request form shall be submitted by the **laboratory** along with the data delivered. Any changes to the analytical requests that are required shall be made in writing to the laboratory. A copy of this written change shall be sent to the data validators and placed in the project files. The reason for the change shall be included in the project files so that recurring problems can be easily identified.

7.2 Deviations from this procedure or the project-specific sampling and analysis plan shall be documented in the records. Significant changes shall be approved by the **Program Quality Manager**.

## 8.0 Attachments or References

8.1 Attachment 1 – Chain-of-Custody Seal

8.2 Attachment 2 – Generic Chain-of-Custody/Analytical Request Form

8.3 Attachment 3 – Sample Completed Chain-of-Custody

8.4 Attachment 4 – Sample Out-of-Control Form

8.5 Environmental Protection Agency, United States (EPA). 1988. *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA.* Interim Final. EPA/540/G-89/004. Office of Emergency and Remedial Response. October.

8.6 EPA. 1992. *RCRA Groundwater Monitoring Draft Technical Guidance*. EPA/530/R-93/001. Office of Solid Waste. November.

8.7 EPA. 1997. Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846. 3rd ed., Final Update IIIA. Office of Solid Waste.

8.8 Water Resources Control Board, State of California. 1988. *Technical Guidance Manual for Solid Waste Water Quality Assessment Test (SWAT) Proposals and Reports*. August.

8.9 Procedure 3-02, *Logbooks.*

| Author | Reviewer | Revisions (Technical or Editorial) |
|---|---|---|
| Mark Kromis<br>Program Chemist | Chris Barr<br>Program Quality Manager | Rev 0 – Initial Issue |



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# Attachment 1
# Chain-of-Custody Seal

**CHAIN-OF-CUSTODY SEAL**

| | | | |
|---|---|---|---|
| *[LABORATORY]* | SAMPLE NO. | DATE | SEAL BROKEN BY |
| | SIGNATURE | | DATE |
| | PRINT NAME AND TITLE *(Inspector, Analyst or Technician* | | |


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# Attachment 2
# Generic Chain-of-Custody / Analytical Request Form

M901376

**CHAIN OF CUSTODY RECORD** Page ____ of ____

| | |
|---|---|
| Client/Project Name: | Project Location: |
| Project Number: | Field Logbook No.: |
| Sampler: (Print Name) /Affiliation: | Chain of Custody Tape No.: |
| Signature: | Send Results/Report to: |

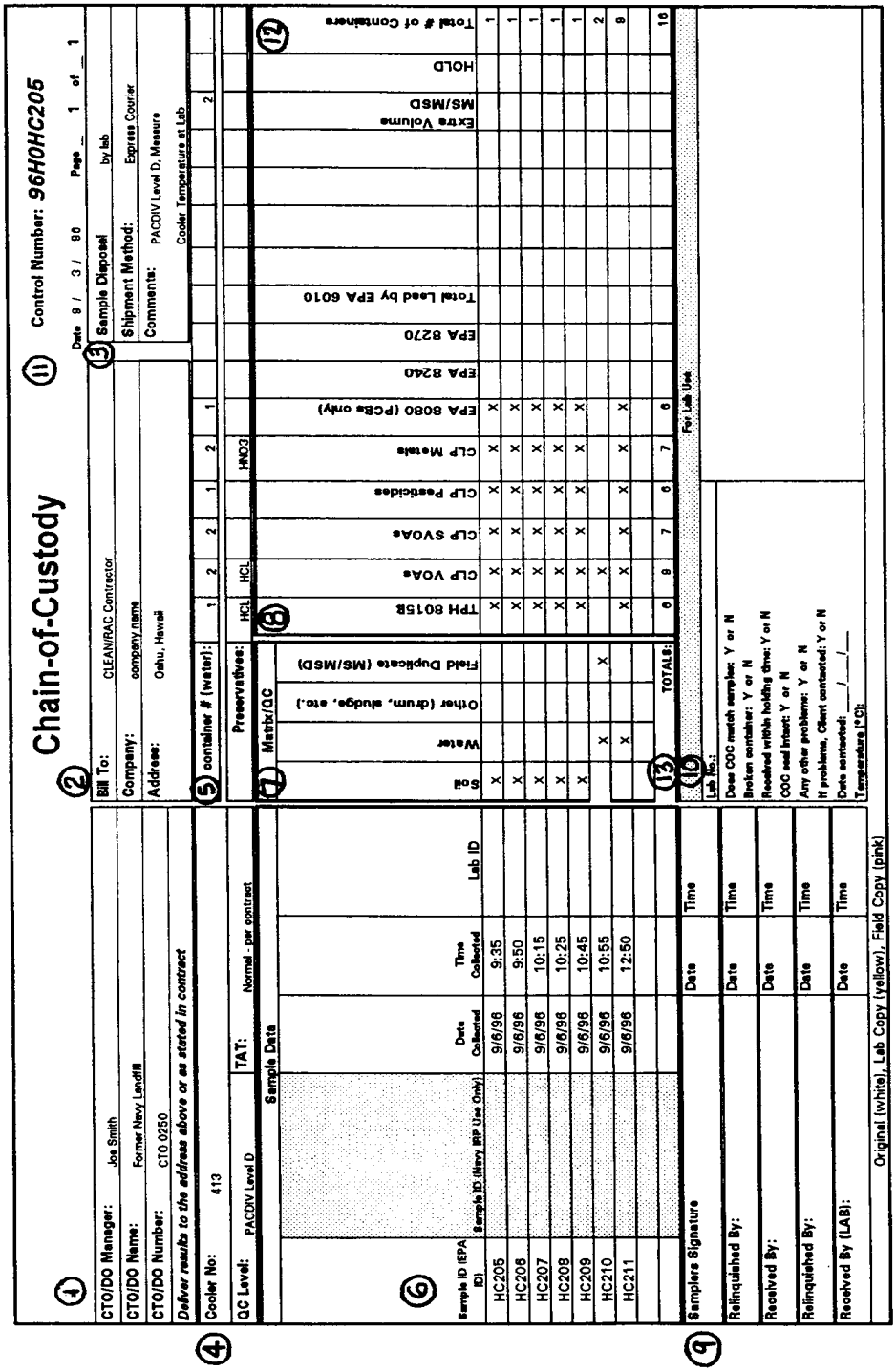
Analysis Requested

| Field Sample No./ Identification | Date | Time | Grab | Comp | Sample Container (Size/Mat'l) | Sample Type (Liquid, Sludge, Etc.) | Preservative | Field Filtered | | | | | | | Lab I.D. | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
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| | | | | |
|---|---|---|---|---|
| Relinquished by: (Print Name) | Date: | Received by: (Print Name) | Date: | Analytical Laboratory (Destination): |
| Signature: | Time: | Signature: | Time: | |
| Relinquished by: (Print Name) | Date: | Received by: (Print Name) | Date: | |
| Signature: | Time: | Signature: | Time: | |
| Relinquished by: (Print Name) | Date: | Received by: (Print Name) | Date: | |
| Signature: | Time: | Signature: | Time: | Serial No. |


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# Attachment 3
# Sample Completed Chain-of-Custody






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# Attachment 4
# Sample Out-of-Control Form

| OUT OF CONTROL FORM | Status | Date | Initial |
|---|---|---|---|
| | Noted OOC | | |
| | Submit for CA* | | |
| | Resubmit for CA* | | |
| | Completed | | |

| | |
|---|---|
| Date Recognized: | By: |
| Dated Occurred: | Matrix |
| Parameter (Test Code): | Method: |
| Analyst: | Supervisor: |

| Samples Affected (List by Accession AND Sample No.) |
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| |

| 1. Type of Event (Check all that apply) | | 2. Corrective Action (CA)* (Check all that apply) | |
|---|---|---|---|
| | Calibration Corr. Coefficient <0.995 | | Repeat calibration |
| | %RSD>20% | | Made new standards |
| | Blank >MDL | | Reran analysis |
| | Does not meet criteria: | | Sample(s) redigested and rerun |
| | Spike | | Sample(s) reextracted and rerun |
| | Duplicate | | Recalculated |
| | LCS | | Cleaned system |
| | Calibration Verification | | Ran standard additions |
| | Standard Additions | | Notified |
| | MS/MSD | | Other (please explain) |
| | BS/BSD | | |
| | Surrogate Recovery | | |
| | Calculations Error | | |
| | Holding Times Missed | | |
| | Other (Please explain | Comments: | |

| 3. Results of Corrective Action | |
|---|---|
| | Return to Control (indicated with) |
| | Corrective Actions Not Successful - DATA IS TO BE FLAGGED with _____. |

| | |
|---|---|
| Analyst: | Date: |
| Supervisor: | Date: |
| QA Department: | Date: |


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# Sample Handling, Storage, and Shipping

# Procedure 3-04

## 1.0 Purpose and Scope

1.1 This standard operating procedure describes the actions to be used by personnel engaged in handling, storing, and transporting samples. The objective is to obtain samples of actual conditions with as little alteration as possible.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

## 2.0 Safety

2.1 Avoid lifting heavy coolers with back muscles; instead, use leg muscles or dollies.

2.2 Wear proper gloves, such as blue nitrile and latex, as defined in the project-specific health and safety plan, when handling sample containers to avoid contacting any materials that may have spilled out of the sample containers.

## 3.0 Terms and Definitions

None.

## 4.0 Training and Qualifications

4.1 The **Project Manager** and the **Laboratory Project Manager** are responsible for identifying instances of non-compliance with this procedure and ensuring that future sample transport activities comply with this procedure.

4.2 The **Site Supervisor** is responsible for ensuring that all samples are shipped according to this procedure.

4.3 **Field personnel** are responsible for the implementation of this procedure.

4.4 The **Program Quality Manager** is responsible for ensuring that sample handling, storage, and transport activities conducted during all CTOs comply with this procedure.

4.5 All **field personnel** are responsible for the implementation of this procedure.

## 5.0 Procedure

5.1 **Handling and Storage**

Immediately following collection, label all samples according to Procedure 3-03, *Recordkeeping, Sample Labeling, and Chain-of-Custody*. The lids of the containers shall not be sealed with duct tape, but may be covered with custody seals or placed directly into self-sealing bags. Place the sample containers in an insulated cooler with frozen gel packs (e.g., “blue ice”) or ice in double, sealed self-sealing bags. Samples should occupy the lower portion of the cooler, while the ice should occupy the upper portion. Place an absorbent material (e.g., proper absorbent cloth material) on the bottom of the cooler to contain liquids in case of spillage. Fill all empty space between sample containers with Styrofoam® “peanuts” or other appropriate material. Prior to shipping, wrap glass sample containers on the sides, tops, and bottoms with bubble wrap or other appropriate padding and/or surround them in Styrofoam to


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prevent breakage during transport. Pack all glass containers for water samples in an upright position, never stacked or on their sides. Prior to shipment, replace the ice or cold packs in the coolers so that samples will be maintained as close to 4 degrees Celsius (°C) as possible from the time of collection through transport to the analytical laboratory. Ship samples within 24 hours or on a schedule allowing the laboratory to meet holding times for analyses. The procedures for maintaining sample temperatures at 4°C pertain to all field samples.

## 5.2 Shipping

Follow all appropriate U.S. Department of Transportation regulations (e.g., 49 Code of Federal Regulations [CFR], Parts 171-179) for shipment of air, soil, water, and other samples. Elements of these procedures are summarized below.

### 5.2.1 Hazardous Materials Shipment

**Field personnel** must state whether any sample is suspected to be a hazardous material. A sample should be assumed hazardous unless enough evidence exists to indicate it is non-hazardous. If not suspected to be hazardous, shipments may be made as described in the Section 5.2.2 for non-hazardous materials. If hazardous, follow the procedures summarized below.

Any substance or material that is capable of posing an unreasonable risk to life, health, or property when transported is classified as hazardous. Perform hazardous materials identification by checking the list of dangerous goods for that particular mode of transportation. If not on that list, materials can be classified by checking the Hazardous Materials Table (49 CFR 172.102 including Appendix A) or by determining if the material meets the definition of any hazard class or division (49 CFR Part 173), as listed in Attachment 2.

All **persons shipping hazardous materials** must be properly trained in the appropriate regulations, as required by HM-126F, Training for Safe Transportation of Hazardous Materials (49 CFR HM-126F Subpart H). The training covers loading, unloading, handling, storing, and transporting of hazardous materials, as well as emergency preparedness in the case of accidents. **Carriers**, such as commercial couriers, must also be trained. Modes of shipment include air, highway, rail, and water.

When shipping hazardous materials, including bulk chemicals or samples suspected of being hazardous, the proper shipping papers (49 CFR 172 Subpart C), package marking (49 CFR 172 Subpart D), labeling (49 CFR 172 Subpart E), placarding (49 CFR 172 Subpart F, generally for carriers), and packaging must be used. Attachment 1 shows an example of proper package markings. Refer to a copy of 49 CFR each time hazardous materials/potentially hazardous samples are shipped.

According to Section 2.7 of the International Air Transport Association Dangerous Goods Regulations publication, very small quantities of certain dangerous goods may be transported without certain marking and documentation requirements as described in 49 CFR Part 172; however, other labeling and packing requirements must still be followed. Attachment 2 shows the volume or weight for different classes of substances. A “Dangerous Goods in Excepted Quantities” label must be completed and attached to the associated shipping cooler (Attachment 3). Certain dangerous goods are not allowed on certain airlines in any quantity.

As stated in item 4 of Attachment 4, the Hazardous Materials Regulations do not apply to hydrochloric acid (HCl), nitric acid ($HNO_3$), sulfuric acid ($H_2SO_4$), and sodium hydroxide (NaOH) added to water samples if their pH or percentage by weight criteria is met. These samples may be shipped as non-hazardous materials as discussed below.

### 5.2.2 Non-Hazardous Materials Shipment

If the samples are suspected to be non-hazardous based on previous site sample results, field screening results, or visual observations, if applicable, then samples may be shipped as non-hazardous.

When a cooler is ready for shipment to the laboratory, place two copies of the chain-of-custody form inside a self-sealing bag and tape it to the inside of the insulated cooler. Then, seal the cooler with waterproof tape and label it with "Fragile," "This-End-Up" (or directional arrows pointing up), or other appropriate notices. Place chain-of-custody seals on the coolers as discussed in Procedure 3-03, *Recordkeeping, Sample Labeling, and Chain-of-Custody*.

### 5.2.3 Shipments from Outside the Continental United States

Shipment of sample coolers to the United States from locations outside the continental United States is controlled by the U.S. Department of Agriculture (USDA) and is subject to their inspection and regulation. A "USDA Soil Import Permit" is required to prove that the receiving analytical laboratory is certified by the USDA to receive and properly dispose of soil. In addition, all sample coolers must be inspected by a **USDA representative**, affixed with a label indicating that the coolers contain environmental samples, and accompanied by shipping forms stamped by the **USDA inspector** prior to shipment.

In addition, the U.S. Customs Service must clear samples shipped from U.S. territorial possessions or foreign countries upon entry into the United States. As long as the commercial invoice is properly completed (see below), shipments typically pass through U.S. Customs Service without the need to open coolers for inspection.

Completion and use of proper paperwork will, in most cases, minimize or eliminate the need for the USDA and U.S. Customs Service to inspect the contents. Attachment 5 shows an example of how paperwork may be placed on the outside of coolers for non-hazardous materials. For hazardous materials, refer to Section 5.2.1.

In summary, tape the paperwork listed below to the outside of the coolers to accompany sample shipments. If a shipment is made up of multiple pieces (e.g., more than one cooler), the paperwork need only be attached to one cooler, provided that the **courier** agrees. All other coolers in the shipment need only to be taped and have the address and chain-of-custody seals affixed.

1. **Courier Shipping Form & Commercial Invoice:** See Attachment 6 and Attachment 7 for examples of the information to be included on the commercial invoices for soil and water, respectively. Place the courier shipping form and commercial invoice inside a clear, plastic, adhesive-backed pouch that adheres to the package (typically supplied by the courier) and place it on the cooler lid as shown in Attachment 5.
2. **Soil Import Permit (soil only):** See Attachment 8 and Attachment 9 for examples of the soil import permit and soil samples restricted entry labels, respectively. The **laboratory** shall supply these documents prior to mobilization. The USDA often stops shipments of soil without these documents. Staple together the 2-inch × 2-inch USDA label (described below) and soil import permit, and place them inside a clear plastic pouch. The **courier** typically supplies the clear, plastic, adhesive-backed pouches that adhere to the package.

   Placing one restricted entry label as shown in Attachment 5 (covered with clear packing tape) and one stapled to the actual permit is suggested.

   The USDA does not control water samples, so the requirements for soil listed above do not apply.
3. **Chain-of-Custody Seals:** The **laboratory** should supply the seals. **CTO personnel** must sign and date these. At least two seals should be placed in such a manner that they stick to both the cooler lid and body. Placing the seals over the tape (as shown in Attachment 5), then covering it with clear packing tape is suggested. This prevents the seal from coming loose and enables detection of tampering.
4. **Address Label:** Affix a label stating the destination (laboratory address) to each cooler.
5. **Special Requirements for Hazardous Materials:** See Section 5.2.1.

Upon receipt of sample coolers at the laboratory, the **sample custodian** shall inspect the sample containers as discussed in Procedure 3-03, *Recordkeeping, Sample Labeling, and Chain-of-Custody*. The samples shall then be immediately extracted and/or analyzed, or stored in a refrigerated storage area until they are removed for extraction and/or analysis. Whenever the samples are not being extracted or analyzed, they shall be returned to refrigerated storage.

## 6.0 Quality Control and Assurance

6.1 Sample handling, storage, and shipping must incorporate quality control measures to ensure conformance to these and the project requirements.

## 7.0 Records, Data Analysis, Calculations

7.1 Maintain records as required by implementing these procedures.

7.2 Deviations from this procedure or the project-specific sampling and analysis plan shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

## 8.0 Attachments or Reference

8.1 Attachment 1 – Example Hazardous Material Package Marking

8.2 Attachment 2 – Packing Groups

8.3 Attachment 3 – Label for Dangerous Goods in Excepted Quantities

8.4 Attachment 4 – SW-846 Preservative Exception

8.5 Attachment 5 – Non-Hazardous Material Cooler Marking Figure for Shipment from Outside the Continental United States

8.6 Attachment 6 – Commercial Invoice – Soil

8.7 Attachment 7 – Commercial Invoice – Water

8.8 Attachment 8 – Soil Import Permit

8.9 Attachment 9 – Soil Samples Restricted Entry Labels

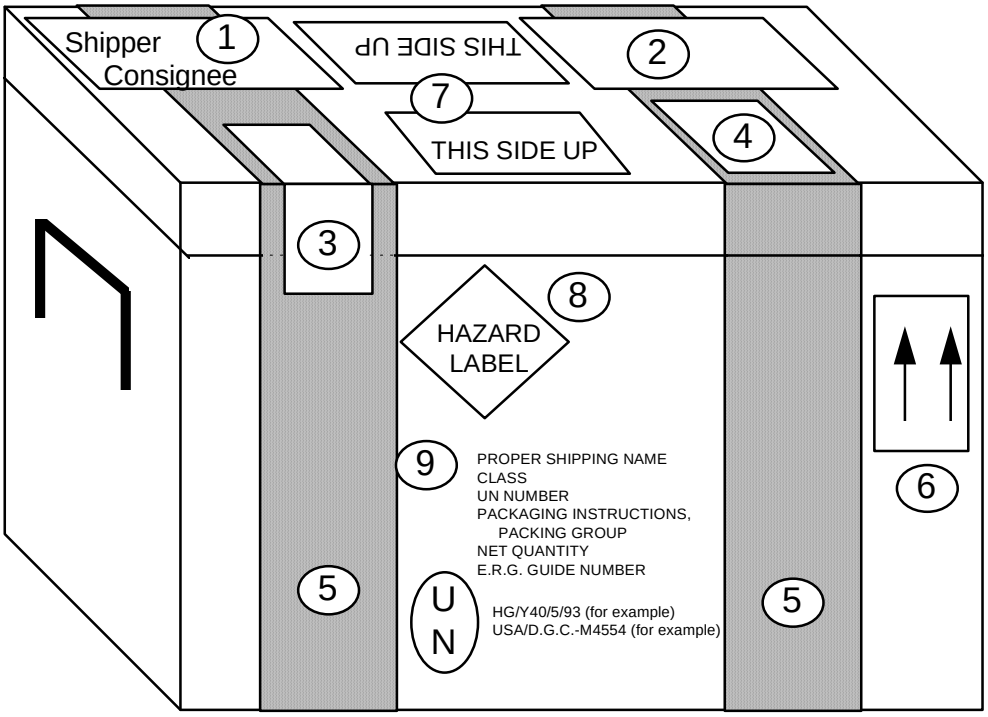
8.10 Procedure 3-03, *Recordkeeping, Sample Labeling, and Chain-of-Custody*.

| Author | Reviewer | Revisions (Technical or Editorial) |
|---|---|---|
| Mark Kromis<br>Program Chemist | Chris Barr<br>Program Quality Manager | Rev 0 – Initial Issue |



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# Attachment 1
# Example Hazardous Material Package Marking




1. **AIR BILL/COMMERCIAL INVOICE**
2. **USDA PERMIT (Letter to Laboratory from USDA)**
3. **CUSTODY SEAL**
4. **USDA 2" X 2" SOIL IMPORT PERMIT**
5. **WATERPROOF STRAPPING TAPE**
6. **DIRECTION ARROWS STICKER - TWO REQUIRED**
7. **THIS SIDE UP STICKERS**
8. **HAZARD LABEL**
9. **HAZARDOUS MATERIAL INFORMATION**
10. **PACKAGE SPECIFICATIONS**


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# Attachment 2
# Packing Groups

| PACKING GROUP OF THE SUBSTANCE | PACKING GROUP 1 | | PACKING GROUP II | | PACKING GROUP III | |
|---|---|---|---|---|---|---|
| CLASS or DIVISION of PRIMARY or SUBSIDIARY RISK | Packagings | | Packagings | | Packagings | |
| | Inner | Outer | Inner | Outer | Inner | Outer |
| 1: Explosives | ---------- Forbidden (Note A) ---------- | | | | | |
| 2.1: Flammable Gas | ---------- Forbidden (Note B) ---------- | | | | | |
| 2.2: Non-Flammable, non-toxic gas | ---------- See Notes A and B ---------- | | | | | |
| 2.3: Toxic gas | ---------- Forbidden (Note A) ---------- | | | | | |
| 3. Flammable liquid | 30 mL | 300 mL | 30 mL | 500 mL | 30 mL | 1 L |
| 4.1 Self-reactive substances | Forbidden | | Forbidden | | Forbidden | |
| 4.1: Other flammable solids | Forbidden | | 30 g | 500 g | 30 g | 1 kg |
| 4.2: Pyrophoric substances | Forbidden | | Not Applicable | | Not Applicable | |
| 4.2 Spontaneously combustible substances | Not Applicable | | 30 g | 500 g | 30 g | 1 kg |
| 4.3: Water reactive substances | Forbidden | | 30 g or 30 mL | 500 g or 500 mL | 30 g or 30 mL | 1 kg or 1 L |
| 5.1: Oxidizers | Forbidden | | 30 g or 30 mL | 500 g or 500 mL | 30 g or 30 mL | 1 kg or 1 L |
| 5.2: Organic peroxides (Note C) | See Note A | | 30 g or 30 mL | 500 g or 250 mL | Not Applicable | |
| 6.1: Poisons - Inhalation toxicity | Forbidden | | 1 g or 1 mL | 500 g or 500 mL | 30 g or 30 mL | 1 kg or 1 L |
| 6.1: Poisons - oral toxicity | 1 g or 1 mL | 300 g or 300 mL | 1 g or 1 mL | 500 g or 500 mL | 30 g or 30 mL | 1 kg or 1 L |
| 6.1: Poisons - dermal toxicity | 1 g or 1 mL | 300 g or 300 mL | 1 g or 1 mL | 500 g or 500 mL | 30 g or 30 mL | 1 kg or 1 L |
| 6.2: Infectious substances | ---------- Forbidden (Note A) ---------- | | | | | |
| 7: Radioactive material (Note D) | ---------- Forbidden (Note A) ---------- | | | | | |
| 8: Corrosive materials | Forbidden | | 30 g or 30 mL | 500 g or 500 mL | 30 g or 30 mL | 1 kg or 1 L |
| 9: Magnetized materials | ---------- Forbidden (Note A) ---------- | | | | | |
| 9: Other miscellaneous materials (Note E) | Forbidden | | 30 g or 30 mL | 500 g or 500 mL | 30 g or 30 mL | 1 kg or 1 L |

***Note A:*** *Packing groups are not used for this class or division.*
***Note B:*** *For inner packagings, the quantity contained in receptacle with a water capacity of 30 mL. For outer packagings, the sum of the water capacities of all the inner packagings contained must not exceed 1 L.*
***Note C:*** *Applies only to Organic Peroxides when contained in a chemical kit, first aid kit or polyester resin kit.*
***Note D:*** *See 6.1.4.1, 6.1.4.2, and 6.2.1.1 through 6.2.1.7, radioactive material in excepted packages.*
***Note E:*** *For substances in Class 9 for which no packing group is indicated in the List of Dangerous Goods, Packing Group II quantities must be used.*


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# Attachment 3
# Dangerous Goods in Excepted Quantities

**DANGEROUS GOODS IN EXCEPTED QUANTITIES**

This package contains dangerous goods in excepted small quantities and is in all respects in compliance with the applicable international and national government regulations and the IATA Dangerous Goods Regulations.

_____

Signature of Shipper

_____ _____

Title Date

_____

_____

Name and address of Shipper

This package contains substance(s) in Class(es)
(check applicable box(es))

| Class: | 2 | 3 | 4 | 5 | 6 | 8 | 9 |
|---|---|---|---|---|---|---|---|
| | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ |

and the applicable UN Numbers are:


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# Attachment 4
# SW-846 Preservative Exception

| Measurement | Vol. Req. (mL) | Container[2] | Preservative[3,4] | Holding Time[5] |
|---|---|---|---|---|
| MBAS | 250 | P, G | Cool, 4ºC | 48 Hours |
| NTA | 50 | P, G | Cool, 4ºC | 24 Hours |

1. More specific instructions for preservation and sampling are found with each procedure as detailed in this manual. A general discussion on sampling water and industrial wastewater may be found in ASTM, Part 31, p. 72-82 (1976) Method D-3370.

2. Plastic (P) or Glass (G). For metals, polyethylene with a polypropylene cap (no liner) is preferred.

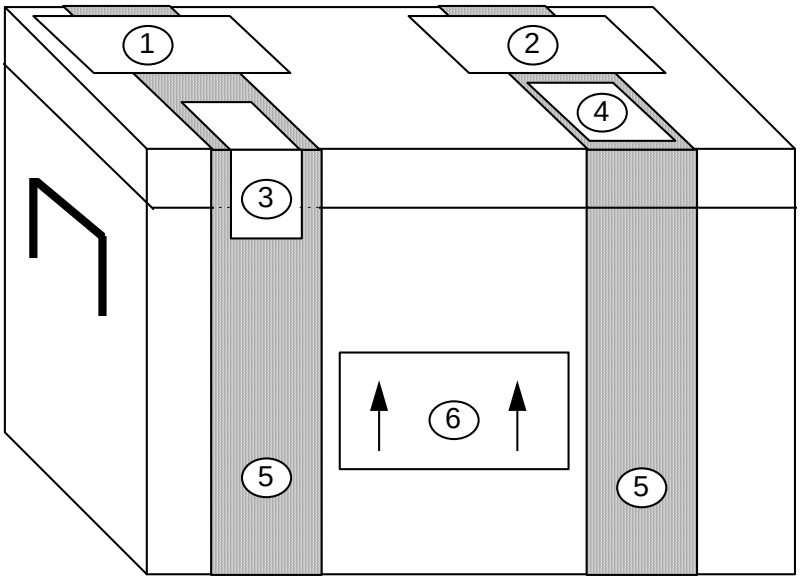
3. Sample preservation should be performed immediately upon sample collection. For composite samples each aliquot should be preserved at the time of collection. When use of an automated sampler makes it impossible to preserve each aliquot, then samples may be preserved by maintaining at 4ºC until compositing and sample splitting is completed.

4. When any sample is to be shipped by common carrier or sent through the United States Mail, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. for the preservation requirements of Table 1, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentration of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid ($HNO_3$) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid ($H_2SO_4$) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

5. Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before analysis and still considered valid. Samples may be held for longer periods only if the permittee, or monitoring laboratory, has data on file to show that the specific types of sample under study are stable for the longer time, and has received a variance from the Regional Administrator. Some samples may not be stable for the maximum time period given in the table. A permittee, or monitoring laboratory, is obligated to hold the sample for a shorter time if knowledge exists to show this is necessary to maintain sample stability.

6. Should only be used in the presence of residual chlorine.

# Attachment 5
# Non-Hazardous Material Cooler Marking Figure for Shipment from Outside the Continental United States




1. **AIR BILL/COMMERCIAL INVOICE**
2. **USDA PERMIT (Letter to Laboratory from USDA)**
3. **CUSTODY SEAL**
4. **USDA 2" X 2" SOIL IMPORT PERMIT**
5. **WATERPROOF STRAPPING TAPE**
6. **DIRECTION ARROWS STICKER - TWO REQUIRED**

# Attachment 6
# Commercial Invoice – Soil

| | |
|---|---|
| DATE OF EXPORTATION<br>1/1/94 | EXPORT REFERENCES (i.e., order no., invoice no., etc.)<br><CTO #> |
| SHIPPER/EXPORTER (complete name and address)<br>Joe Smith<br>Ogden<br>c/o <hotel name><br><hotel address> | CONSIGNEE<br>Sample Receipt<br><Lab Name><br><Lab Address> |
| COUNTRY OF EXPORT<br>Guam, USA | IMPORTER - IF OTHER THAN CONSIGNEE |
| COUNTRY OF ORIGIN OF GOODS<br>Guam, USA | |
| COUNTRY OF ULTIMATE DESTINATION<br>USA | |
| INTERNATIONAL AIR WAYBILL NO. | (NOTE: All shipments must be accompanied by a Federal Express International Air Waybill) |

| MARKS/NOS | NO. OF PKGS | TYPE OF PACKAGING | FULL DESCRIPTION OF GOODS | QTY | UNIT OF MEASURE | WEIGHT | UNIT VALUE | TOTAL VALUE |
|---|---|---|---|---|---|---|---|---|
| | 3 | coolers | Soil samples for laboratory analysis only | | | | $1.00 | $3.00 |

| TOTAL NO. OF PKGS. | TOTAL WEIGHT | TOTAL INVOICE VALUE |
|---|---|---|
| 3 | | $3.00 |

Check one
☐ F.O.B.
☐ C&F
☐ C.I.F.

THESE COMMODITIES ARE LICENSED FOR THE ULTIMATE DESTINATION SHOWN.

DIVERSION CONTRARY TO UNITED STATES LAW IS PROHIBITED.

I DECLARE ALL THE INFORMATION CONTAINED IN THIS INVOICE TO BE TRUE AND CORRECT

SIGNATURE OF SHIPPER/EXPORTER (Type name and title and sign)

| Joe Smith, Ogden | Joe Smith | 1/1/94 |
|---|---|---|
| Name/Title | Signature | Date |



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# Attachment 7
# Commercial Invoice – Water

| | |
|---|---|
| DATE OF EXPORTATION<br>1/1/94 | EXPORT REFERENCES (i.e., order no., invoice no., etc.)<br><COC #> |
| SHIPPER/EXPORTER (complete name and address)<br>Joe Smith<br>Ogden<br>c/o <hotel name><br><hotel address> | CONSIGNEE<br>Sample Receipt<br><Lab Name><br><Lab Address> |
| COUNTRY OF EXPORT<br>Guam, USA | IMPORTER - IF OTHER THAN CONSIGNEE |
| COUNTRY OF ORIGIN OF GOODS<br>Guam, USA | |
| COUNTRY OF ULTIMATE DESTINATION<br>USA | |

INTERNATIONAL AIR WAYBILL NO. _____ (NOTE: All shipments must be accompanied by a Federal Express International Air Waybill)

| MARKS/NOS | NO. OF PKGS | TYPE OF PACKAGING | FULL DESCRIPTION OF GOODS | QTY | UNIT OF MEASURE | WEIGHT | UNIT VALUE | TOTAL VALUE |
|---|---|---|---|---|---|---|---|---|
| | 3 | coolers | Water samples for laboratory analysis only | | | | $1.00 | $3.00 |
| | TOTAL NO. OF PKGS. | | | | | TOTAL WEIGHT | | TOTAL INVOICE VALUE |
| | 3 | | | | | | | $3.00 |

Check one
☐ F.O.B.
☐ C&F
☐ C.I.F.

THESE COMMODITIES ARE LICENSED FOR THE ULTIMATE DESTINATION SHOWN.

DIVERSION CONTRARY TO UNITED STATES LAW IS PROHIBITED.

I DECLARE ALL THE INFORMATION CONTAINED IN THIS INVOICE TO BE TRUE AND CORRECT

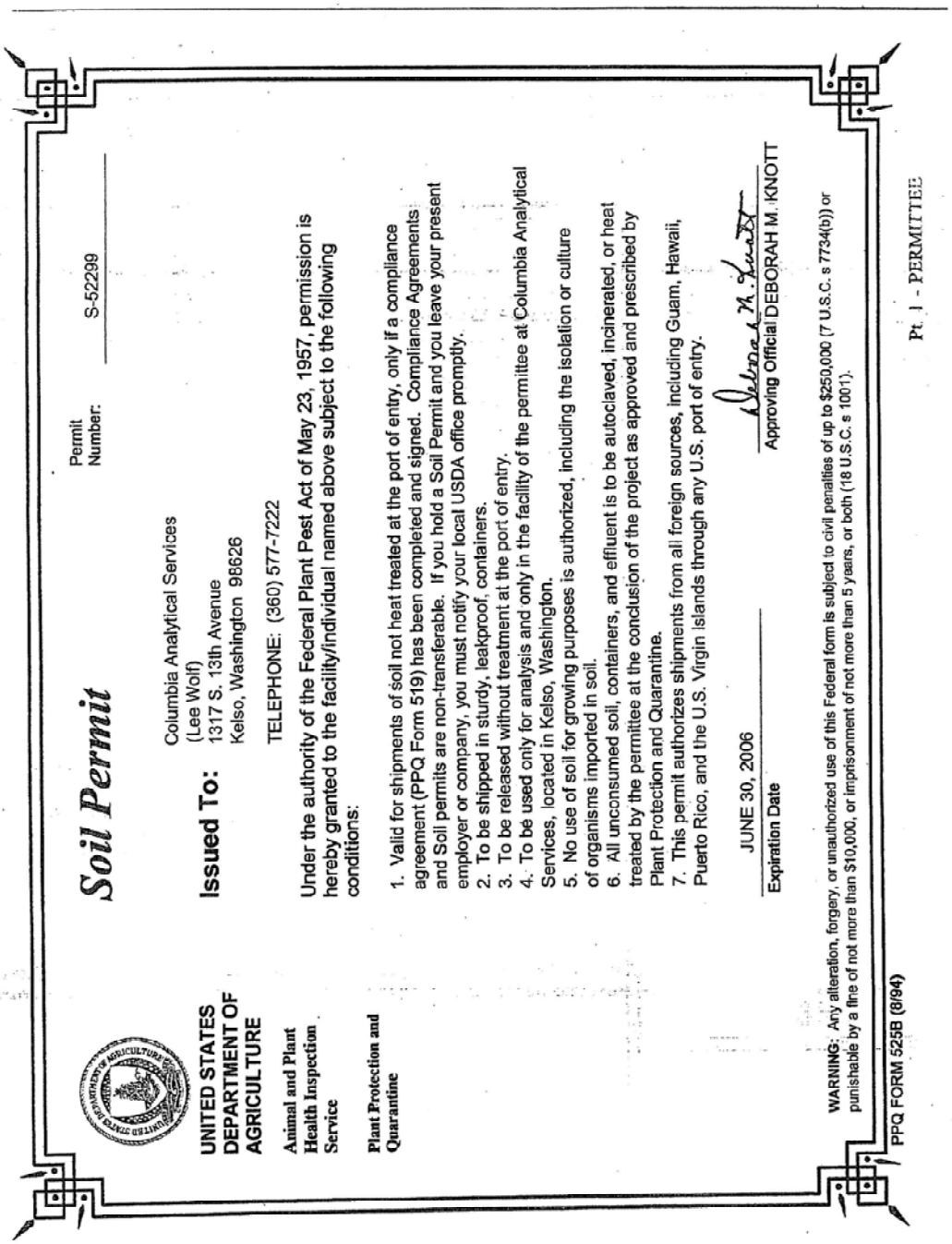
SIGNATURE OF SHIPPER/EXPORTER (Type name and title and sign)

Joe Smith, Ogden _____ Joe Smith _____ 1/1/94 _____



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# Attachment 8
# Soil Import Permit



UNITED STATES
DEPARTMENT OF
AGRICULTURE

Animal and Plant
Health Inspection
Service

Plant Protection and
Quarantine

## Soil Permit

Permit
Number: S-52299

**Issued To:** Columbia Analytical Services
(Lee Wolf)
1317 S. 13th Avenue
Kelso, Washington 98626

TELEPHONE: (360) 577-7222

Under the authority of the Federal Plant Pest Act of May 23, 1957, permission is hereby granted to the facility/individual named above subject to the following conditions:

1. Valid for shipments of soil not heat treated at the port of entry, only if a compliance agreement (PPQ Form 519) has been completed and signed. Compliance Agreements and Soil permits are non-transferable. If you hold a Soil Permit and you leave your present employer or company, you must notify your local USDA office promptly.
2. To be shipped in sturdy, leakproof, containers.
3. To be released without treatment at the port of entry.
4. To be used only for analysis and only in the facility of the permittee at Columbia Analytical Services, located in Kelso, Washington.
5. No use of soil for growing purposes is authorized, including the isolation or culture of organisms imported in soil.
6. All unconsumed soil, containers, and effluent is to be autoclaved, incinerated, or heat treated by the permittee at the conclusion of the project as approved and prescribed by Plant Protection and Quarantine.
7. This permit authorizes shipments from all foreign sources, including Guam, Hawaii, Puerto Rico, and the U.S. Virgin Islands through any U.S. port of entry.

JUNE 30, 2006
Expiration Date

Approving Official DEBORAH M. KNOTT

**WARNING:** Any alteration, forgery, or unauthorized use of this Federal form is subject to civil penalties of up to $250,000 (7 U.S.C. s 7734(b)) or punishable by a fine of not more than $10,000, or imprisonment of not more than 5 years, or both (18 U.S.C. s 1001).

PPQ FORM 525B (8/94)

Pt. 1 - PERMITTEE



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# Attachment 9
# Soil Samples Restricted Entry Labels

**U.S. DEPARTMENT OF AGRICULTURE**

**ANIMAL AND PLANT HEALTH INSPECTION SERVICE**

**PLANT PROTECTION AND QUARANTINE**

**HYATTSVILLE, MARYLAND 20782**

**SOIL SAMPLES**

**RESTRICTED ENTRY**

The material contained in this package is imported under authority of the Federal Plant Pest Act of May 23, 1957.

For release without treatment if addressee is currently listed as approved by Plant Protection and Quarantine.

PPQ FORM 550 *Edition of 12/77 may be used*

(JAN 83)


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# Investigation-Derived Waste Management

# Procedure 3-05

## 1.0 Purpose and Scope

This standard operating procedure (SOP) describes activities and responsibilities of the United States Army Corp of Engineers (USACE), New England District, with regard to management of investigation-derived waste (IDW).
The purpose of this procedure is to provide guidance for the minimization, handling, labelling, temporary storage, inventory, classification, and disposal of IDW generated under the ER Program. This procedure will also apply to personal protective equipment (PPE), sampling equipment, decontamination fluids, non-IDW trash, non-indigenous IDW, and hazardous waste generated during implementation of removal or remedial actions. The information presented will be used to prepare and implement work plans (WPs) for IDW-related field activities. The results from implementation of WPs will then be used to develop and implement final IDW disposal plans.

If there are procedures whether it be from AECOM, state and/or federal that are not addressed in this SOP and are applicable to IDW then those procedures may be added as an appendix to the project specific SAP.

This procedure shall serve as management-approved professional guidance and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by both the Project Manager and the Quality Assurance (QA) Manager or Technical Director, and documented.

This procedure was developed to serve as management-approved professional guidance for the management of IDW generated. It focuses on the requirements for minimizing, segregating, handling, labeling, storing, and inventorying IDW in the field. Certain drum inventory requirements related to the screening, sampling, classification, and disposal of IDW are also noted in this procedure.

## 2.0 Safety

The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the project Accident Prevention Plan (APP). In the absence of a APP, work will be conducted according to the WP and/or direction from the **Site Safety and Health Officer (SSHO)**.

All **Field Personnel** responsible for IDW management must adhere to the APP and must wear the PPE specified in the site-specific APP. Generally, this includes, at a minimum, steel-toed boots or steel-toed rubber boots, safety glasses, American National Standards Institute-standard hard hats, and hearing protection (if heavy equipment is in operation). If safe alternatives are not achievable, discontinue site activities immediately.

## 3.0 Terms and Definitions

None.


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## 4.0 Training and Qualifications

4.1 The **Project Manager** is responsible for ensuring that IDW management activities comply with this procedure. The **Project Manager** is responsible for ensuring that all personnel involved in IDW management shall have the appropriate education, experience, and training to perform their assigned tasks.

4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

4.3 The **Site Supervisor** is responsible for ensuring that all IDW is managed according to this procedure.

4.4 All **Field Personnel** are responsible for the implementation of this procedure.

## 5.0 Equipment and Supplies

The equipment and supplies required for implementation of this SOP include the following:

- Containers for waste (e.g., [U.S. Department of Transportation] DOT approved 55-gallon open and closed top drums) and material to cover waste to protect from weather (e.g., plastic covering);
- Hazardous /non-hazardous waste drum labels (weatherproof);
- Permanent marking pens;
- Inventory forms for project file;
- Plastic garbage bags, zip lock storage bags, roll of plastic sheeting; and
- Steel-toed boots, chemical resistant gloves, coveralls, safety glasses, and any other PPE required in the HASP.

## 6.0 Procedure

The following procedures are used to handle the IDW.

### 6.1 Drum Handling

6.1.1 IDW shall be containerized using DOT approved drums. The drums shall be made of steel or plastic, have a 55-gallon capacity, be completely painted or opaque, and have removable lids (i.e., United Nations Code 1A2 or 1H2). Typically 55-gallon drums are used, however small drums may be used depending on the amount of waste generated. New steel drums are preferred over recycled drums.

6.1.2 Recycled drums should not be used for hazardous waste, PCBs or other regulated shipments. For short-term storage of liquid IDW prior to discharge, double-walled bulk steel or plastic storage tanks may be used. For this scenario, consider the scheduling and cost-effectiveness of this type of bulk storage, treatment, and discharge system versus longer-term drum storage.

6.1.3 For long-term IDW storage at other project locations, the DOT approved drums with removable lids are recommended. Verify the integrity of the foam or rubber sealing ring located on the underside of some drum lids prior to sealing drums containing IDW liquids.

6.1.4 If the ring is only partially attached to the drum lid, or if a portion of the ring is missing, select another drum lid with a sealing ring that is in sound condition.

6.1.5 To prepare IDW drums for labeling, wipe clean the outer wall surfaces and drum lids of all material that might prevent legible and permanent labeling. If potentially contaminated material adheres to the outer surface of a drum, wipe that material from the drum, and segregate the paper towel or rag used to remove the material with visibly soiled PPE and


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disposable sampling equipment. Label all IDW drums and place them on pallets prior to storage.

## 6.2 Labeling

6.2.1 Containers used to store IDW must be properly labelled. Two general conditions exist: 1) from previous studies or on-site data, waste characteristics are known to be either hazardous or nonhazardous; or 2) waste characteristics are unknown until additional data are obtained.

6.2.2 For situations where the waste characteristics are known, the waste containers should be packaged and labelled in accordance with state regulations and any federal regulations that may govern the labelling of waste.

6.2.3 The following information shall be placed on all non-hazardous waste labels:

- Description of waste (i.e., purge water, soil cuttings);
- Contact information (i.e., contact name and telephone number);
- Date when the waste was first accumulated.

6.2.4 The following information shall be placed on all hazardous waste labels:

- Description of waste (i.e., purge water, soil cuttings);
- Generator information (i.e., name, address, contact telephone number);
- EPA identification number (supplied by on-site client representative);
- Date when the waste was first accumulated.

6.2.5 When the final characterization of a waste is unknown, a notification label should be placed on the drum with the words “waste characterization pending analysis” and the following information included on the label:

- Description of waste (i.e., purge water, soil cuttings);
- Contact information (i.e., contact name and telephone number);
- Date when the waste was first accumulated.

6.2.6 Once the waste has been characterized, the label should be changed as appropriate for a nonhazardous or hazardous waste.

6.2.7 Waste labels should be constructed of a weatherproof material and filled out with a permanent marker to prevent being washed off or becoming faded by sunlight. It is recommended that waste labels be placed on the side of the container, since the top is more subject to weathering. However, when multiple containers are accumulated together, it also may be helpful to include labels on the top of the containers to facilitate organization and disposal.

6.2.8 Each container of waste generated shall be recorded in the field notebook used by the person responsible for labelling the waste. After the waste is disposed of, either by transportation off-site or disposal on-site in an approved disposal area, an appropriate record shall be made in the same field notebook to document proper disposition of IDW.


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## 6.3 Types of Site Investigation Waste

Several types of waste are generated during site investigations that may require special handling. These include solid, liquid, and used PPE, as discussed further below.

Solid Waste

Soil cuttings from boreholes will typically be placed in containers unless site specific requirements allow for soil cuttings to be placed back into the borehole after drilling is complete. Drilling mud generated during investigation activities shall be collected in containers. Covers should be included on the containers and must be secured at all times and only open during filling activities. The containers shall be labelled in accordance with this SOP. An inventory containing the source, volume, and description of material put in the containers shall be logged on prescribed forms and kept in the project file.

Non-hazardous solid waste can be disposed on-site in the designated site landfill or in a designated evaporation pond if it is liquefied. Hazardous wastes must be disposed off-site at an approved hazardous waste landfill.

Liquid Waste

Groundwater generated during monitoring well development, purging, and sampling can be collected in truck-mounted containers and/or other transportable containers (i.e., 55-gallon drums). Lids or bungs on drums must be secured at all times and only open during filling or pumping activities. The containers shall be labelled in accordance with this SOP. Non-hazardous liquid waste can be disposed of in one of the designated lined evaporation ponds on-site. Hazardous wastes must be handled separately and disposed off-site at an approved hazardous waste facility.

Personal Protective Equipment

PPE that is generated throughout investigation activities shall be placed in plastic garbage bags. If the solid or liquid waste that was being handled is characterized as hazardous waste, then the corresponding PPE should also be disposed as hazardous waste. If not, all PPE should be disposed as non-hazardous waste in the designated on-site landfill. Trash that is generated as part of field activities may be disposed of in the landfill as long as the trash was not exposed to hazardous media.

## 6.4 Waste Accumulation On-Site

6.4.1 Solid, liquid, or PPE waste generated during investigation activities that are classified as nonhazardous or “characterization pending analysis” should be disposed of as soon as possible. Until disposal, such containers should be inventoried, stored as securely as possible, and inspected regularly, as a general good practice.

6.4.2 Solid, liquid, or PPE waste generated during investigation activities that are classified as hazardous shall not be accumulated on-site longer than 90 days. All hazardous waste containers shall be stored in a secured storage area. The following requirements for the hazardous waste storage area must be implemented:

- Proper hazardous waste signs shall be posted as required by any state or federal statutes that may govern the labelling of waste;
- Secondary containment to contain spills;
- Spill containment equipment must be available;
- Fire extinguisher;
- Adequate aisle space for unobstructed movement of personnel.


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6.4.3 Weekly storage area inspections shall be performed and documented to ensure compliance with these requirements. Throughout the project, an inventory shall be maintained to itemize the type and quantity of the waste generated.

6.5 **Waste Disposal**

6.5.1 Solid, liquid, and PPE waste will be characterized for disposal through the use of client knowledge, laboratory analytical data created from soil or groundwater samples gathered during the field activities, and/or composite samples from individual containers.

6.5.2 All waste generated during field activities will be stored, transported, and disposed of according to applicable state, federal, and local regulations. All wastes classified as hazardous will be disposed of at a licensed treatment storage and disposal facility or managed in other approved manners.

6.5.3 In general, waste disposal should be carefully coordinated with the facility receiving the waste. Facilities receiving waste have specific requirements that vary even for non-hazardous waste, so characterization should be conducted to support both applicable regulations and facility requirements.

6.6 **Regulatory Requirements**

The following federal and state regulations shall be used as resources for determining waste characteristics and requirements for waste storage, transportation, and disposal:

- Code of Federal Regulations (CFR), Title 40, Part 261;
- CFR, Title 49, Parts 172, 173, 178, and 179.

6.7 **Waste Transport**

A state-certified hazardous waste hauler shall transport all wastes classified as hazardous. Typically, the facility receiving any waste can coordinate a hauler to transport the waste. Shipped hazardous waste shall be disposed of in accordance with all RCRA/USEPA requirements. All waste manifests or bills of lading will be signed either by the client or the client's designee.

## 7.0 Quality Control and Assurance

7.1 Management of IDW must incorporate quality control measures to ensure conformance to these and the project requirements.

## 8.0 Records, Data Analysis, Calculations

8.1 Maintain records as required by implanting the procedures in this SOP.

8.2 Deviations from this procedure or the sampling and analysis plan shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

## 9.0 Attachments or References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual.* Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/-fedfac/pdf/ufp_qapp_v1_0305.pdf.

Department of Energy, United States (DOE). 1994. *The Off-Site Rule*. EH-231-020/0194. Office of Environmental Guidance. March.


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1992b. *Guide to Management of Investigative-Derived Wastes*. Quick reference fact sheet. OSWER Dir. 9345.3-03FS. Office of Solid Waste and Emergency Response. January.

1997a. *Sending Wastes Off Site? OSC and RPM Responsibilities under the Off-Site Rule*. EPA/540-F-97-006, Office of Solid Waste and Emergency Response. September.

1997b. *Test Methods for Evaluating Solid Waste, Physical/Chemical Methods, SW-846.* 3rd ed., Final Update IIIA. Office of Solid Waste. Updates available: www.epa.gov/epaoswer/hazwaste/test/new-meth.htm.

1998. *Management of Remediation Waste under RCRA*. EPA/530-F-98-026. Office of Solid Waste and Emergency Response. October.

(No Date). *Compliance with the Off-Site Rule During Removal Actions.* Office of Regional Counsel (Region 3). Hendershot, Michael.

| Author | Reviewer | Revisions (Technical or Editorial) |
|---|---|---|
| Mark Kromis<br>Program Chemist | Chris Barr<br>Program Quality Manager | Rev 0 – Initial Issue (May 2012) |

# Equipment Decontamination

## Procedure 3-06

## 1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes methods of equipment decontamination, to be used for activities where samples for chemical analysis are collected or where equipment will need to be cleaned before leaving the site or before use in subsequent activities.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

## 2.0 Safety

It is the responsibility of the **Site Safety and Health Officer (SSHO)** to set up the site zones (i.e., exclusion, transition, and clean) and decontamination areas. Generally the decontamination area is located within the transition zone, upwind of intrusive activities, and serves as the washing area for both personnel and equipment to minimize the spread of contamination into the clean zone. Typically, for equipment, a series of buckets are set up on a visqueen-lined bermed area. Separate spray bottles containing cleaning solvents as described in this procedure or the Work Plan (WP) and distilled water are used for final rinsing of equipment. Depending on the nature of the hazards and the site location, decontamination of heavy equipment, such as augers, pump drop pipe, and vehicles, may be accomplished using a variety of techniques.

All **Field Personnel** responsible for equipment decontamination must adhere to the site-specific accident prevention plan (APP) and Site Safety and Health Plan (SSHP) and must wear the personal protective equipment (PPE) specified in the site-specific APP/SSHP. Generally this includes, at a minimum, Tyvek® coveralls, steel-toed boots with boot covers or steel-toed rubber boots, safety glasses, American National Standards Institute-standard hard hats, and hearing protection (if heavy equipment is in operation). Air monitoring by the **SSHO** may result in an upgrade to the use of respirators and cartridges in the decontamination area; therefore, this equipment must be available on site. If safe alternatives are not achievable, discontinue site activities immediately.

In addition to the aforementioned precautions, the following sections describe safe work practices that will be employed.

2.1 **Chemical Hazards associated with Equipment Decontamination**

- Avoid skin contact with and/or incidental ingestion of decontamination solutions and water.
- Utilize PPE as specified in the site-specific HSP to maximize splash protection.
- Refer to material safety data sheets, safety personnel, and/or consult sampling personnel regarding appropriate safety measures (i.e., handling, PPE including skin and respiratory).
- Take the necessary precautions when handling detergents and reagents.

2.2 **Physical Hazards associated with Equipment Decontamination**

- To avoid possible back strain, it is recommended to raise the decontamination area 1 to 2 feet above ground level.


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- To avoid heat stress, over exertion, and exhaustion, it is recommended to rotate equipment decontamination among all site personnel.
- Take necessary precautions when handling field sampling equipment.

## 3.0 Terms and Definitions

None.

## 4.0 Training and Qualifications

4.1 The **Project Manager** is responsible for ensuring that decontamination activities comply with this procedure. The **Project Manager** is responsible for ensuring that all personnel involved in equipment decontamination shall have the appropriate education, experience, and training to perform their assigned tasks.

4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

4.3 The **Site Supervisor (SS)** is responsible for ensuring that all field equipment is decontaminated according to this procedure.

4.4 All **Field Personnel** are responsible for the implementation of this procedure.

## 5.0 Procedure

Decontamination of equipment used in soil/sediment sampling, groundwater monitoring, well drilling and well development, as well as equipment used to sample groundwater, surface water, sediment, waste, wipe, asbestos, and unsaturated zone, is necessary to prevent cross-contamination and to maintain the highest integrity possible in collected samples. Planning a decontamination program requires consideration of the following factors:

- Location where the decontamination procedures will be conducted
- Types of equipment requiring decontamination
- Frequency of equipment decontamination
- Cleaning technique and types of cleaning solutions appropriate to the contaminants of concern
- Method for containing the residual contaminants and wash water from the decontamination process
- Use of a quality control measure to determine the effectiveness of the decontamination procedure

The following subsections describe standards for decontamination, including the frequency of decontamination, cleaning solutions and techniques, containment of residual contaminants and cleaning solutions, and effectiveness.

5.1 **Decontamination Area**

Select an appropriate location for the decontamination area at a site based on the ability to control access to the area, the ability to control residual material removed from equipment, the need to store clean equipment, and the ability to restrict access to the area being investigated. Locate the decontamination area an adequate distance away and upwind from potential contaminant sources to avoid contamination of clean equipment.

5.2 **Types of Equipment**

Drilling equipment that must be decontaminated includes drill bits, auger sections, drill-string tools, drill rods, split barrel samplers, tremie pipes, clamps, hand tools, and steel cable. Decontamination of monitoring well development and groundwater sampling equipment includes submersible pumps, bailers, interface probes, water level meters, bladder pumps, airlift pumps, peristaltic pumps, and lysimeters.


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Other sampling equipment that requires decontamination includes, but is not limited to, hand trowels, hand augers, slide hammer samplers, shovels, stainless-steel spoons and bowls, soil sample liners and caps, wipe sampling templates, composite liquid waste samplers, and dippers. Equipment with a porous surface, such as rope, cloth hoses, and wooden blocks, cannot be thoroughly decontaminated and shall be properly disposed of after one use.

## 5.3 Frequency of Equipment Decontamination

Decontaminate down-hole drilling equipment and equipment used in monitoring well development and purging prior to initial use and between each borehole or well. Down-hole drilling equipment, however, may require more frequent cleaning to prevent cross-contamination between vertical zones within a single borehole. When drilling through a shallow contaminated zone and installing a surface casing to seal off the contaminated zone, decontaminate the drilling tools prior to drilling deeper. Initiate groundwater sampling by sampling groundwater from the monitoring well where the least contamination is suspected. Decontaminate groundwater, surface water, and soil sampling devices prior to initial use and between collection of each sample to prevent the possible introduction of contaminants into successive samples.

## 5.4 Cleaning Solutions and Techniques

Decontamination can be accomplished using a variety of techniques and fluids. The preferred method of decontaminating major equipment, such as drill bits, augers, drill string, and pump drop-pipe, is steam cleaning. To steam clean, use a portable, high-pressure steam cleaner equipped with a pressure hose and fittings. For this method, thoroughly steam wash equipment and rinse it with potable tap water to remove particulates and contaminants.

A rinse decontamination procedure is acceptable for equipment such as bailers, water level meters, new and re-used soil sample liners, and hand tools. The decontamination procedure shall consist of the following: (1) wash with a non-phosphate detergent (Alconox®, Liquinox®, or other suitable detergent) and potable water solution; (2) rinse with potable water; (3) spray with laboratory-grade isopropyl alcohol; (4) rinse with deionized or distilled water; and (5) spray with deionized or distilled water. If possible, disassemble equipment prior to cleaning. Add a second wash at the beginning of the process if equipment is very soiled.

Decontaminating submersible pumps requires additional effort because internal surfaces become contaminated during usage. Decontaminate these pumps by washing and rinsing the outside surfaces using the procedure described for small equipment or by steam cleaning. Decontaminate the internal surfaces by recirculating fluids through the pump while it is operating. This recirculation may be done using a relatively long (typically 4 feet) large-diameter pipe (4-inch or greater) equipped with a bottom cap. Fill the pipe with the decontamination fluids, place the pump within the capped pipe, and operate the pump while recirculating the fluids back into the pipe. The decontamination sequence shall include: (1) detergent and potable water; (2) potable water rinse; (3) potable water rinse; and (4) deionized water rinse. Change the decontamination fluids after each decontamination cycle.

Solvents other than isopropyl alcohol may be used, depending upon the contaminants involved. For example, if polychlorinated biphenyls or chlorinated pesticides are contaminants of concern, hexane may be used as the decontamination solvent; however, if samples are also to be analyzed for volatile organics, hexane shall not be used. In addition, some decontamination solvents have health effects that must be considered. Decontamination water shall consist of distilled or deionized water. Steam-distilled water shall not be used in the decontamination process as this type of water usually contains elevated concentrations of metals. Decontamination solvents to be used during field activities will be specified in the CTO WP.

Rinse equipment used for measuring field parameters, such as pH (indicates the hydrogen ion concentration – acidity or basicity), temperature, specific conductivity, and turbidity with deionized or distilled water after each measurement. Also wash new, unused soil sample liners and caps with a fresh


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detergent solution and rinse them with potable water followed by distilled or deionized water to remove any dirt or cutting oils that might be on them prior to use.

5.5 **Containment of Residual Contaminants and Cleaning Solutions**

A decontamination program for equipment exposed to potentially hazardous materials requires a provision for catchment and disposal of the contaminated material, cleaning solution, and wash water.

When contaminated material and cleaning fluids must be contained from heavy equipment, such as drill rigs and support vehicles, the area must be properly floored, preferably with a concrete pad that slopes toward a sump pit. If a concrete pad is impractical, planking can be used to construct solid flooring that is then covered by a nonporous surface and sloped toward a collection sump. If the decontamination area lacks a collection sump, use plastic sheeting and blocks or other objects to create a bermed area for collection of equipment decontamination water. Situate items, such as auger flights, which can be placed on metal stands or other similar equipment, on this equipment during decontamination to prevent contact with fluids generated by previous equipment decontamination. Store clean equipment in a separate location to prevent recontamination. Collect decontamination fluids contained within the bermed area and store them in secured containers as described below.

Use wash buckets or tubs to catch fluids from the decontamination of lighter-weight drilling equipment and hand-held sampling devices. Collect the decontamination fluids and store them on site in secured containers, such as U.S. Department of Transportation-approved drums, until their disposition is determined by laboratory analytical results. Label containers in accordance with Procedure 3-05, *IDW Management*.

## 6.0 Quality Control and Assurance

A decontamination program must incorporate quality control measures to determine the effectiveness of cleaning methods. Quality control measures typically include collection of equipment blank samples or wipe testing. Equipment blanks consist of analyte-free water that has been poured over or through the sample collection equipment after its final decontamination rinse. Wipe testing is performed by wiping a cloth over the surface of the equipment after cleaning. These quality control measures provide "after-the fact" information that may be useful in determining whether or not cleaning methods were effective in removing the contaminants of concern.

## 7.0 Records, Data Analysis, Calculations

Any project where sampling and analysis is performed shall be executed in accordance with an approved sampling and analysis plan. This procedure may be incorporated by reference or may be incorporated with modifications described in the plan.

Deviations from this procedure or the sampling and analysis plan shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

## 8.0 Attachments or References

8.1 ASTM Standard D5088. 2008. *Standard Practice for Decontamination of Field Equipment Used at Waste Sites.* ASTM International, West Conshohocken, PA. 2008. DOI: 10.1520/D5088-02R08. www.astm.org.

8.2 NAVSEA T0300-AZ-PRO-010. *Navy Environmental Compliance Sampling and Field Testing Procedures Manual*. August 2009.

8.3 Procedure 3-05, *IDW Management*.


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# Land Surveying

## Procedure 3-07

## 1.0 Purpose and Scope

1.1 The purpose of this document is to define the standard operating procedure (SOP) for acquiring land surveying data to facilitate the location and mapping of geologic, hydrologic, geotechnical data, and analytical sampling points and to establish topographic control over project sites.

1.2 This procedure is the Program-approved professional guidance for work performed by AECOM.

1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review. If there are procedures whether it be from AECOM, state and/or federal that are not addressed in this SOP and are applicable to surface water sampling then those procedures may be added as an appendix to the project specific SAP.

1.4 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Program Quality Manager. Deviations to this SOP will be documented in the field records.

1.5 If there are procedures, whether it be from AECOM, state and/or federal, that are not addressed in this SOP and are applicable to land surveying then those procedures may be added as an appendix to the project specific Sampling and Analysis Plan (SAP).

## 2.0 Safety

2.1 Depending upon the site-specific contaminants, various protective programs must be implemented prior to conducting fieldwork. All **field sampling personnel** must review the project-specific Accident Prevention Plan (APP) with Site-Safety and Health Plan (SSHP), paying particular attention to the control measures planned for the specific field tasks. Conduct preliminary area monitoring to determine the potential hazard to field sampling personnel. If significant contamination is observed, minimize contact with potential contaminants in both the vapor and liquid phase through the use of respirators and disposable clothing.

2.2 In addition, observe standard health and safety practices according to the project-specific APP/SSHP. Suggested minimum protection includes inner disposable vinyl gloves, outer chemical-protective nitrile gloves, rubberized steel-toed boots, and an American National Standards Institute-standard hard hat. Half-face respirators and cartridges and Tyvek® suits may be necessary depending on the contaminant concentrations, and shall always be available on site.

2.3 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the **Site Safety and Health Officer (SSHO)** or designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the APP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSHO.

2.4 The health and safety considerations for the work associated with land surveying include:

- Slip, trips and falls associated with work in the field;


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- Biological hazards associated with work in the field; and,
- Potential hazards associated with contaminants of concern (COC) that may be located in the survey area,

## 3.0 Terms and Definitions

### 3.1 Boundary Survey

Boundary surveys are conducted by Certified Land Surveyors in order to delineate a legal property line for a site or section of a site.

### 3.2 Global Positioning System (GPS)

A system of satellites, computers, and receivers that is able to determine the latitude and longitude of a receiver on Earth by calculating the time difference for signals from different satellites to reach the receiver.

## 4.0 Interferences

4.1 Commercially available GPS units typically have a level of precision of (±) 3 to 5 meters. Field corrections can be made as described in Section 8.3 below.

## 5.0 Training and Qualifications

### 5.1 Qualifications and Training

5.1.1 The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

### 5.2 Responsibilities

5.2.1 The **Project Manager** is responsible for ensuring that land surveying activities comply with this procedure. The Project Manager is responsible for ensuring that all field sampling personnel involved in land surveying shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.2.3 The **Site Supervisor (SS)** is responsible for ensuring that all field personnel follow these procedures. In virtually all cases, subcontractors will conduct these procedures. The SS or designee is responsible for overseeing the activities of the subcontractor and ensuring that sampling points and topographic features are properly surveyed.

## 6.0 Equipment and Supplies

6.1 The following equipment list contains materials that may be needed in carrying out the procedures outlined in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Personal protective equipment (PPE) and other safety equipment, as required by the APP;
- Commercially available GPS unit; and,
- Field Logbook.


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## 7.0 Calibration or Standardization

7.1 An authorized manufacturer's representative shall inspect and calibrate survey instruments in accordance with the manufacturer's specifications regarding procedures and frequencies. At a minimum, instruments shall be calibrated no more than six months prior to the start of the survey work.

7.2 Standards for all survey work shall be in accordance with National Oceanic and Atmospheric Administration standards and, at a minimum, with accuracy standards set forth below. The horizontal accuracy for the location of all grid intersection and planimetric features shall be (±) 0.1 feet. The horizontal accuracy for boundary surveys shall be 1 in 10,000 feet (1:10,000). The vertical accuracy for ground surface elevations shall be (±) 0.1 feet. Benchmark elevation accuracy and elevation of other permanent features, including monitoring wellheads, shall be (±) 0.01 feet.

## 8.0 Procedure

### 8.1 Theodolite/Electronic Distance Measurement (EDM)

Follow the procedures listed below during theodolite/EDM land surveying:

- A land surveyor registered in the state or territory in which the work is being performed shall directly supervise all surveying work.
- Reference surveys to the local established coordinate systems and base all elevations and benchmarks established on U.S. Geological Survey datum, 1929 general adjustment.
- Reference surveyed points to Mean Sea Level (Lower Low Water Level).
- Jointly determine appropriate horizontal and vertical control points prior to the start of survey activities. If discrepancies in the survey (e.g., anomalous water level elevations) are observed, the surveyor may be required to verify the survey by comparison to a known survey mark. If necessary, a verification survey may be conducted by a qualified third party.
- All field notes, sketches, and drawings shall clearly identify the horizontal and vertical control points by number designation, description, coordinates, and elevations. Map all surveyed locations using a base map or other site mapping, as specified by the project Work Plan or SAP.
- Begin and end all surveys at the designated horizontal and vertical control points to determine the degree of accuracy of the surveys.
- Iron pins used to mark control points shall be made of reinforcement steel or an equivalent material and shall be 18 inches long with a minimum diameter of 5/8 inch. Drive pins to a depth of 18 inches into the soil.
- Stakes used to mark survey lines and points shall be made from 3-foot lengths of 2-inch by 2-inch lumber and pointed at one end. Clearly mark them with brightly colored weatherproof flagging and paint.
- Clearly mark the point on a monitoring well casing or well riser that is surveyed by filing grooves into the casing/riser on either side of the surveyed point, or by marking the riser with a permanent ink marker.

### 8.2 Global Positioning System (GPS) to Conduct Land Survey

Follow the procedures listed below during land surveying using GPS:

- A land surveyor registered in the state or territory in which the work is being performed shall directly supervise all surveying work.
- Reference surveys to the local established coordinate systems and base all elevations and benchmarks established on U.S. Geological Survey datum, 1929 general adjustment.

- All field notes, sketches, and drawings shall clearly identify the horizontal and vertical control points by number designation, description, coordinates, and elevations. Map all surveyed locations using a base map or other site mapping, as specified in the project Work Plan or SAP.
- Begin and end all surveys at the designated horizontal and vertical control points (as applicable) to determine the degree of accuracy of the surveys.
- Iron pins used to mark control points shall be made of reinforcement steel or an equivalent material and shall be 18 inches long with a minimum diameter of 5/8 inch. Drive pins to a depth of 18 inches into the soil.
- Stakes used to mark survey lines and points shall be made from 3-foot lengths of 2-inch by 2-inch lumber and pointed at one end. Clearly mark them with brightly colored weatherproof flagging and paint.
- Clearly mark the point on a monitoring well casing that is surveyed by filing grooves into the casing on either side of the surveyed point.

## 8.3 Global Positioning System (GPS) to Position Sample Locations or Locate Site Features

Experienced field personnel may use a GPS system unit to position sample locations (e.g. grid positioned samples, soil boring locations) at a site. The decision to use field personnel or a licensed land surveyor will depend on the objectives of the survey (e.g. vertical elevation is not required) and the levels of precision required. Typically when a level of precision greater than (±) 3 to 5 meters is required, a licensed surveyor will be required. When a level of precision of (±) 3 to 5 meters is sufficient to meet project requirements (i.e. when laying sampling grids, identifying significant site features, or locating features identified in GIS figures) experienced field personnel may use commercially available, consumer-grade GPS units. Follow the procedures listed below to locate samples or site features using GPS:

- A commercially available GPS unit with Wide Angle Averaging System (WAAS), topographic map display, and waypoint storage capabilities should be used.
- If waypoints are to be imported into a GIS database, the same grid projection system should be used.
- If a permanent reference point near the site is available, it is recommended that a waypoint at this location be taken every day waypoints are stored.
- When laying out a sampling grid from a GIS map, upload the coordinates from GIS to the GPS unit, including coordinates for an easily identified, permanent, nearby feature (i.e. building corner, roadway intersection, or USGS benchmark).
- If during the initial site walk, the permanent feature identified does not overlay within (±) 5 meters as identified in the GPS unit, field corrections of the waypoints should be made.
- Field corrections can be made by adding/subtracting the difference in x,y coordinates between the field measurement of the permanent site feature and the anticipated x,y coordinates. This correction should then be applied to the x,y coordinates for each sampling location to be marked. Corrected x,y coordinates can then be uploaded into the GPS unit.
- Sampling points and site features can then be located in the field using the GPS units “Go To” function. When the distance to the sampling point or feature remains close to zero, the location can be marked.
- If no field corrections to the sampling location need to be made, or if sampling locations are to be surveyed by a licensed surveyor at a later date, no additional waypoints need to be taken. If significant changes to the sampling location are made, GPS coordinates at the corrected location shall be stored and labeled.


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- It is recommended that GPS coordinates be uploaded to a storage device such as PC at the end of each day.
- Field logs shall indicate manufacturer and model number for GPS unit used, map datum and projection used, and any field corrections made. If the GPS unit cannot lock onto a WAAS system at the site, this should also be noted.

## 9.0 Quality Control and Assurance

None.

## 10.0 Data and Records Management

The surveyor shall record field notes daily using generally accepted practices. The data shall be neat, legible, in indelible ink, and easily reproducible. Copies of the surveyor's field notes and calculation forms generated during the work shall be obtained and placed in the project files.

Surveyor's field notes shall, at a minimum, clearly indicate:

- The date of the survey;
- General weather conditions;
- The name of the surveying firm;
- The names and job titles of personnel performing the survey work;
- Equipment used, including serial numbers; and,
- Field book designations, including page numbers.

A land surveyor registered in the state or territory in which the work was done shall sign, seal, and certify the drawings and calculations submitted by the surveyor.

Dated records of land surveying equipment calibration shall be provided by the surveyor and placed in the project files. Equipment serial numbers shall be provided in the calibration records.

## 11.0 Attachments or References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

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# GEOPHYSICS

# Procedure 3-09

## 1.0 Purpose and Scope

1.1 This Standard Operating Procedure (SOP) introduces the general methodologies, terms, and procedures for geophysical techniques. Geophysics deploys artificially induced signals or naturally occurring signals to investigate the physical properties of materials through arrays of airborne, surface, or subsurface sensors, and examines how these properties vary spatially and temporally.

A large number of geophysical techniques are employed in the industry, and some applications are rapidly evolving. Accordingly, this SOP describes in broad terms the main methods available, quality control procedures, and interpretation guidelines for subsurface environmental assessments. Project-specific criteria, including performance standards, are specified in Sampling and Analysis Plans (SAPs) or Work Plans (WPs), while further details on emerging technologies may be surmised in a supplemental SOP. Ultimately, the implementation of geophysical technologies should generally be reserved for locations where standard subsurface invasive investigation techniques (e.g., digging, drilling, puncturing, etc.) are deemed too costly or unsafe without supplemental information captured from the geophysical surveys. Even when used in favorable locations, however, geophysical techniques have inherent limitations that must be carefully considered in their deployment.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical plans and reviews, inclusive of direct notification from at least one of the two program-level geophysicists within Resolution Consultants: (1) Larry Hughes, PG [lhughes@EnSafe.com] and (2) Brian Brunette, PGP [brian.brunette@aecom.com].

## 2.0 Safety

2.1 The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the project Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP). In the absence of an APP/SSHP, work will be conducted according to the Work Plan (WP) and/or direction from the Site Safety and Health Officer (SSHO).

2.2 Some geophysical techniques, especially those with active transmitters (e.g., resistivity, radar, etc.), pose method-specific hazards. The hazards and procedures for minimizing risk must be explicitly stated in the HASP for all project sites; unexploded ordnance (UXO) sites may require additional Explosive Safety Submission or Hazards of Electromagnetic Radiation to Ordnance certifications.

## 3.0 Terms and Definitions

3.1 **Available Technologies**. Geophysical methods commonly applied to environmental issues generally fall into three broad categories: seismic (using a vibration/acoustic signal), electrical (using direct-current, inductive, or naturally occurring electromagnetic field sources), and potentiometric (using natural gravity or magnetic properties). These methods can be applied in boreholes (downhole logging), at the surface, underwater, within subsurface voids, from airborne platforms, and from space, or in various combinations of these configurations. Typical methods include (referring to definitions in Section 3.2):

3.1.1 **Reflection seismic:** Creates a seismic wave using an impact source (hammer on a plate, weight drop, explosive, vibrating device), and measures amplitudes and arrival times of reflected seismic waves from subsurface geology though geophones either planted in the soil or dragged along the surface ("streaming" array). Typically used to map deep structure and lithology for energy exploration, but in recent decades, evolving technology has allowed work in the sub-10 meter depth

range of interest in many environmental investigations. Overall, perhaps the most powerful, highest-resolution geophysical method, though infrequently used for environmental issues.

3.1.2 **Refraction seismic:** Uses an impact source (typically hammer on a plate) and detects refracted waves from a higher-velocity material at depth. Typical application is mapping bedrock at depths of less than 30 meters. Refraction delivers reasonably high resolution. Limitations can arise from the large source-receiver spread, which can extend beyond the bounds of the survey area or be interrupted by surface features.

3.1.3 **Surface wave seismic:** Uses an impact source (typically hammer on a plate) to induce surface waves in the shallow subsurface to measure shear-wave velocity variations, often indicative of matrix stiffness. Used to evaluate landfills, engineering properties of the ground, and map shallow geology. The dominant method is multichannel analysis of surface waves (MASW). Occasionally passive MASW (refraction microtremor, or ReMi) is used to monitor deeper seismic activity, for example from oilfield fracking operations, or image geology in a manner similar to MASW.

3.1.4 **Electrical Resistivity (ER):** Uses multiple grounded electrodes to transmit low-frequency electrical current and receive voltage responses, which are used to construct resistivity images of the subsurface; a less commonly used, shallower application employs capacitively-coupled (ungrounded) electrodes as a towed array. ER uses either frequency-domain or time-domain technologies, which deliver similar results; typical depths of exploration are 1 to 100 meters (but up to 1,000 meters for specially designed surveys). Commonly used in environmental applications, particularly in mapping hydrogeology and karst structure. In addition to its surface-based applications, resistivity is a standard borehole tool. Resistivity has limited effectiveness in areas with highly conductive surface material (e.g., surface water inundation or saturated clays) due to current channeling.

3.1.5 **Induced polarization (IP):** A more powerful version of ER that, in addition to the resistivity parameter, measures voltages at multiple frequencies or time gates to infer the capacitive effect, or electrical polarization, due to certain materials such as clays, sulfide minerals, and alteration environments. Sometimes IP is called spectral induced polarization or complex resistivity. Less frequently used than ER for environmental issues, despite its superior qualities, which are especially useful in landfill and leachate delineation. Applications include hydrogeology, karst, 3D landfill characterization, and alteration from contaminants or remedial processes.

3.1.6 **Spontaneous potential (SP):** A passive method measuring potential differences due to electrochemical effects from variations in lithology, geochemical alteration, or mineralization; or, alternatively, measuring electrokinetic-flow phenomena from leaky membranes such as dams or liners in landfills or ponds. SP uses simple equipment consisting of a high-impedance digital voltmeter, insulated cable, and several nonpolarizing electrodes. In addition to its surface-based applications, SP is a standard borehole tool.

3.1.7 **Frequency domain electromagnetic (FDEM):** Pulses a small coil with a current (typically around 10 kiloHertz) and measures the response from subsurface conductors in a second coil. The response is separated into two components: quadrature (giving the conductivity of the ground) and in-phase (related to metal responses). FDEM is reliable only for low induction numbers (ground resistivity greater than 10 ohm-meters). Generally used to characterize the bulk conductivity of the ground, though some configurations allow limited depth profiling; typical depth penetration is to 5 meters. Surface-based deployment is fast and efficient. Airborne FDEM is commonly used for mining, less so for smaller-sized environmental projects.

3.1.8 **Transient electromagnetic methods:** These typically pulse an antenna with a sharp current and measure the ground's response in a second antenna after current turn-off. Transient methods roughly divide into two categories according to measurement times, which affect depths of investigation: **transient electromagnetics (TEM)** and **metal detectors**. TEM measures the signal decay

immediately after current turnoff to investigate subsurface hydrogeology; this method is excellent for finding conductive features but poor for resistive features. Metal detectors analyze the decay curves at later times, after the signals due to natural geology should have dissipated to zero, for sustained signals from metal objects. The latter application is sometimes called time domain electromagnetics (TDEM), often used with a simple antenna configuration at limited time "windows" for fast ground coverage to map metal utilities, drums, tanks, etc. within the top several meters. UXO-focused TEM analyzes a broad time range to detect UXO, discriminate it from inert scrap, and determine the type and burial geometry of the ordnance; these often use 3-axis antennas and sophisticated software. These applications deploy TEM at the ground level or on airborne platforms. Electromagnetic limitations include discerning individual items in cluttered areas, working close to large metal features, and detecting deeper items due to deteriorating signal-to-noise ratios.

3.1.9 **Controlled source audiofrequency magnetotellurics (CSAMT):** Current is injected into a distant array of electrodes; measurements of electric field voltages and the magnetic field are used to map subsurface resistivity patterns. CSAMT is typically used for deeper energy-sector exploration, but occasionally to map aquifers for environmental applications. Natural source variants magnetotellurics (low frequency, deep) and audiofrequency magnetotellurics (intermediate depths) are rarely used in environmental work. A distant cousin to CSAMT, very low frequency, is occasionally used to map shallow bedrock fracturing in water studies.

3.1.10 **Ground penetrating radar (GPR):** GPR transmits signals in the low-MegaHertz (MHz) to GigaHertz range and measures the response due to changes in subsurface dielectric properties, which are largely driven by water content. GPR is a moderate to high resolution method commonly used to map stratigraphy, water saturation, permafrost, and anthropogenic features such as utilities, tanks, and drums. These applications require close coupling of antennas and the ground surface; an adaptation using non-coupled ("air launched") antennas is used for roadway delamination studies, and satellite-based radar (often in the form of synthetic aperture radar) is used for remote sensing. Depth penetration is limited to nearly zero in heavy clay environments, water inundated areas, or reinforced concreted, but can be tens of meters in dry sands.

3.1.11 **Gravity:** A passive method that measures local variations in the earth's gravitational field due to subsurface density changes. Classic applications include mapping voids beneath paved surfaces, caves and other karst features (such as sinkholes), mine shafts and tunnels, and depth to bedrock. Environmental applications typically demand very high precision, for which the term "microgravity" is often applied; the work requires expensive equipment and accurate elevation surveying, making the cost per station rather high.

3.1.12 **Magnetics:** A passive method that measures local variations in the earth's magnetic field due to subsurface changes in ferrous metal. Classic applications include mapping UXO, drums, underground storage tanks, and old building artifacts. The method is specific to ferrous metal and is less effective in high-magnetic environs such as volcanic areas. Anomalies are usually dipolar in nature, complicating interpretation with respect to TEM; but processing often can identify target positions and depths. In ground use, magnetics is often deployed in the vertical gradient mode, which uses two vertically-stacked magnetometers to distinguish local magnetic changes from regional ones. Airborne magnetics is sometimes used, typically on UXO projects, though TEM is more common for UXO.

3.1.13 **Emergent technologies:** Several promising technologies are in research stages, particularly nuclear magnetic resonance, a sensitive detector of water content with ties to geotechnical properties. Ultrasonic methods have been used for mapping fine-scale delamination and voids in concrete, and are being expanded to other targets relevant to environmental interests.


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Global positioning system (GPS) equipment is often used for geophysical positioning; GPS standards are covered in SOP 3-07.

3.2 **Definitions:** Geophysical terms are numerous enough to fill an industry dictionary, but some common terms used in environmental work are:

3.2.1 **Arrival:** The return of a transmitted signal after passing through a material.

3.2.2 **Culture:** Anthropogenic features such as fences, pipelines, powerlines, metal well casings, buried debris, etc. that interfere with imaging a target.

3.2.3 **Geophysics:** A collection of techniques that utilize physical property contrasts in the subsurface to detect or image features of interest.

3.2.4 **MEC:** Munitions and explosives of concern.

3.2.5 **Reflection:** The bounce of waves from an interface. Use of the term usually implies the wavelength is much smaller than the target dimensions and depth.

3.2.6 **Refraction:** The bending of waves (usually seismic in geophysics) as the pass between media of different densities.

3.2.7 **UXO:** Unexploded ordnance, an older term still commonly used in geophysics but supplanted by "MEC" in military circles.

## 4.0 Interferences

4.1 Seismic methods (surface applications):

- Poor geophone coupling, for example in loose sands.
- Connection problems in stressed geophone cables.
- Poor source signal amplitude or frequency.
- High vibrational noise due to surface vibrations or wind.
- Strong topographic relief (surface-wave methods).
- Inadequate gain or stacking in the field.
- Poor target-to-surroundings velocity contrast.
- Terrain, vegetation, water bodies, hazards, site size, and other obstructions to deployment of contiguous lines.

4.2 Electrical methods (direct coupled, surface applications):

- Poor (high impedance) electrode contact.
- Electromagnetic coupling between transmitting and receiving cables (IP systems, especially frequency domain).
- Inadequate hardware and software to reliably record IP data (IP surveys only).
- Strong, undocumented changes in line orientations or electrode spacings; undocumented terrain changes.
- Inadequate signal amplitude for array size.
- Culture, especially parallel to lines, networked, or near electrodes.
- Anthropogenic signals, especially powerlines with poor frequency regulation and cathodically protected pipelines.
- Noise from local or global thunderstorms.
- Inadequate gain or stacking in the field.
- Poor target-to-surroundings resistivity/chargeability contrast.
- Highly conductive surface layer.
- Terrain, vegetation, water bodies, hazards, and obstructions to deployment.

4.3 SP (surface applications):

- Nonpolarizing electrodes insufficiently planted in soil, unprotected from drying or large temperature changes.
- Uncharacterized regional SP drift because of failure to monitor a reference electrode or base station.
- Depending on project objective, interference from redox-alteration effects, electrokinetic (active flow) effects, or biological effects (e.g., algae).
- Poor target-to-surroundings SP contrast.
- Terrain, vegetation, water bodies, hazards, and obstructions to deployment.

4.4 Electromagnetic methods, FDEM (simple surface applications, FDEM):

- Failure to properly set up and verify operation of the instrument according to manufacturer's recommendations.
- Highly conductive geology violates the low induction number assumption.
- Extreme cultural signals such as major overhead powerlines.
- Surface/subsurface clutter and culture (when not the survey objective).
- For subtle targets requiring high data precision and density: acquisition speed too high (leveling errors), line-direction (reciprocity) bias, unmonitored instrument drift, inadequate GPS-positioning accuracy with respect to station spacings.
- Inadequate spatial coverage for size of targets sought.
- Target too small or deep for method.
- Poor target-to-surroundings contrast.
- Terrain, vegetation, water bodies, hazards, and obstructions to deployment.

4.5 Electromagnetic methods, TDEM (surface applications, simple target searches):

- Failure to properly set up and verify operation of the instrument according to manufacturer's recommendations; failure to null the instrument in a nonmetallic area.
- Extreme cultural signals such as major overhead powerlines.
- Metal clutter and culture (when not the survey objective).
- For subtle targets requiring high data precision and density: acquisition speed too high (leveling errors), line-direction (reciprocity) bias, unmonitored instrument drift, inadequate GPS-positioning accuracy with respect to station spacing.
- Inadequate spatial coverage for size of targets sought.
- Target too small or deep for method.
- Poor target-to-surroundings contrast.
- Terrain, vegetation, water bodies, hazards, and obstructions to deployment.

4.6 Electromagnetic methods, TEM (surface applications):

- Failure to properly set up and verify operation of the instrument according to manufacturer's recommendations.
- Extreme cultural signals such as major overhead powerlines.
- Metal clutter and culture, especially culture not symmetric with antenna configurations.
- Target too small or deep for method.
- Poor target-to-surroundings resistivity contrast.
- Unsuitable target, especially a smaller resistive target in a conductive environment.
- Conductivity-thickness ambiguity for a thin conductive layer.
- Inadequate quality control procedures, especially for UXO detection and discrimination (e.g., library target responses, in situ seed target calibrations, noise studies, etc.).
- Inadequate or incorrect application of processing.
- Terrain, vegetation, water bodies, hazards, and obstructions to deployment.

4.7 CSAMT:

- Improper survey design of transmitting antenna location(s) to maximize far-field data.
- Inadequate transmitter signal.
- Infrequent magnetic field characterization in geology where magnetic field changes.
- Use of scalar data for 3-dimensional targets.
- Culture, especially parallel to lines, networked, or near electrodes.
- Anthropogenic signals, especially powerlines with poor frequency regulation and cathodically protected pipelines.
- Natural signals from regional thunderstorms.
- Target too shallow for expected skin depth range.
- Inadequate gain or stacking in the field.
- Terrain, vegetation, water bodies, hazards, and obstructions to deployment.

4.8 GPR:

- Failure to verify the GPR unit is licensed by the Federal Communications Commission or similar agencies for use in the designated country.
- Failure to coordinate high-powered GPR transmissions with nearby airports.
- At UXO sites: failure to verify that GPR is safe to operate in the presence of potentially live electronically-fused ordnance.
- Failure to properly set up and verify operation of the instrument according to manufacturer's recommendations.
- Survey design (antenna frequency/signal wavelength, separation) inadequately matched to expected target.
- Surface/subsurface clutter causing multiple signals.
- Airwaves from nearby trees or structures (particularly for antenna frequencies below 200 MHz).
- Strong radio transmissions nearby (occasional problem).
- Response shifts with changes in ground saturation.
- Inadequate penetration in conductive environments.
- Target too small or deep for method.
- Poor target-to-surroundings dielectric contrast.
- Terrain, vegetation, water bodies, hazards, and obstructions to deployment.

4.9 Gravity:

- Failure to properly set up and verify operation of the instrument according to manufacturer's recommendations.
- Inadequate protection of gravimeter during transport; failure to maintain internal heater temperature in the days preceding and during use.
- Inadequate leveling before acquisition.
- Inadequate base ties to correct instrument drift.
- Survey design (station spacing) inadequately matched to expected target size.
- Surrounding buildings and structures perturbing the gravitational field.
- Inadequate accuracy of station elevations.
- Poor target-to-surroundings density contrast.
- Terrain, vegetation, water bodies, hazards, and obstructions to deployment.

4.10 Magnetics (surface based):

- Failure to properly set up and verify operation of the instrument according to manufacturer's recommendations.
- Heading error when using alkali vapor instruments.
- Application in high magnetic noise environments such as heavy culture (including reinforced concrete pavement), or in areas with magnetic surface geology (e.g., volcanics or sedimentary outwash of volcanic fragments).
- Magnetic items on operator (belt, keys, steel-toed boots).
- Survey design (station spacing) inadequately matched to expected target size.
- Inadequate characterization of ambient magnetic field drift (for total field surveys).
- Metal targets are not ferrous.
- Poor target-to-surroundings ferrous-metal contrast.
- Terrain, vegetation, water bodies, hazards, and obstructions to deployment.

4.11 Airborne FDEM, TEM, Magnetics (in addition to ground-based interferences):

- Inability to minimize flight elevation due to trees and other obstructions.
- Inadequate accuracy of sensor elevation and orientation.
- Improper survey design (flight speed, line spacing, data redundancy and ties, etc.).
- Inadequate correction for helicopter-induced noise.
- Safety issues such as weather, remoteness of the site, flight hazards, etc.

# 5.0 Training and Qualifications

## 5.1 Qualifications and Training

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

## 5.2 Responsibilities

5.2.1 **Project Managers** are responsible for issuing SAPs that reflect the procedures and specifications presented in this procedure. The **Project Manager** shall be familiar with current local and state regulations, and ensure that these regulations are followed. The **Project Manager** is responsible for ensuring that all personnel involved in geophysics shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.2.3 The **Site Supervisor** is responsible for direct supervision of geophysical acquisition and ensuring that procedures and specifications are implemented in the field in accordance with the approved SAP. The qualifications for the **Field Manager** must be in accordance with local jurisdictions with authority over the operations conducted.

5.2.4 All field personnel are responsible for the implementation of this procedure.

# 6.0 Equipment and Supplies

6.1 Materials provided by either AECOM or its subcontractors shall be sufficient to accomplish the survey objectives. The SS shall have, at a minimum:

- Personal protective equipment for all personnel as required by the APP/SSHP.
- Planning documents including the site-specific APP/SSHP and SAP.
- Copies of other plans and agreements, for example, those in conjunction with UXO sites.
- Field logbook/field forms/site maps.
- Sufficient tools to analyze data adequacy on site.

# 7.0 Procedure

**7.1** **General Note**: because of the wide range of available geophysical techniques and even wider range of variations, as well as varying project objectives, details of required survey procedures appear in individual project SAPs. The following are intended as overall guidelines in executing and interpreting geophysical data.

**7.2 Survey Design**

- Work through the data quality objectives (DQOs): determine the overall project objectives, define the information desired from geophysics, define specific geophysical targets, and determine how the positive or negative outcome of the geophysics will impact resolution of the project objectives.
- Considering the target's anticipated physical properties, depth, size, and environs, develop a short list of potentially applicable techniques. If appropriate, run a forward model for each considered technology to evaluate the probability of detection/characterization in the presence of expected interferences; run multiple models if there is uncertainty in any of the input parameters. An alternative to modeling is hand-calculations based on expected target geometry and properties, or professional experience based on those properties.
- Determine the most appropriate technology to use. Establish a preliminary level of effort and ballpark cost. Then ask the question: is there a simpler, more cost-effective, or less ambiguous way to define the target with a non-geophysical approach? If not, based on the chosen technology, does geophysics merely add *data* (stuff to go in a report appendix) or does it add *information* (decision-making value)? If the latter, proceed with the survey design.
- Begin the survey design using best professional practices to ensure the target is adequately characterized. Examples of factors to consider: sample density with respect to the smallest likely target size (apply spatial aliasing criteria); adequate signal characteristics to resolve target; adequate depth penetration to reliably sample at the deepest likely target depth; signal-to-noise; interferences; best choice of equipment type and supplier for the site; robust survey logistics to meet challenges such as terrain, obstructions, and property constraints; quality control and verification procedures. Restate these in terms of data quality objectives.
- Envision how the report will be written if everything goes well: how will your project summary materially enhance project decisions? What can be changed now, in the survey-design stage, to maximize the decision-making impact?
- Incorporate these determinations in a SAP, stating performance criteria such as data density, repeatability, and verification.

## 7.3 Field Execution

- Determine if the field work will be done by Resolution Consultants directly or by a subcontractor. Follow standard procurement procedures for ordering equipment or selecting a subcontractor. Subcontracting requires a Statement of Work. All personnel, including subcontractors, must follow the field execution procedures outlined below.
- Equipment must be assembled and tested for correct functioning according to the manufacturer's recommendations. Initial tests may consist of, as examples: internal or external calibrations; comparing instrument response to a known regional response; testing response over visible cultural or geologic features; or tests over buried "seed" items of known physical characteristics. The tests should be sufficient to demonstrate that the equipment is operating within normal and project-specified tolerances before data acquisition begins. Tests should consider both precision and accuracy, as appropriate to the method and project objectives.
- For appropriate applications and methods (e.g., FDEM, TDEM, gravity and total-field magnetometry), establish a base station in a nominally responsive area on or near the site. Repeat measurements at the base station before, during, and after data collection to ensure proper functioning of the instrument and to establish a response curve for later correction of instrument or field drift. The frequency of base

station ties depends upon the variability of the drift being monitored and the DQOs of the survey. For some surveys, particularly total-field magnetometry, a continuously recording base station monitor is desirable. In other cases, such as GPR, the "base station" might be a base line, over which data are repeated to determine effects of rain on target delineation and penetration depth. Base station data are considered part of the official project electronic data record.

- Obtain data in a manner that adheres to the SAP or WP, constitutes reasonable and customary professional geophysical practice, and is continually focused on meeting project objectives.
- Check and document battery levels periodically. Some systems have an incipient data bias as battery voltage drops below a certain threshold, making it difficult to determine what parts of the data are reliable and what parts are not.
- All data should be stored electronically, if practical, and circumstances of field logistics and anything affecting data quality recorded in the field notebook (see Section 9.0).

## 7.4 Data Processing

- All raw data files downloaded from the instrument must be preserved without modification. Processing is to be performed on *copies* of the raw files.
- The processing stream, including filename protocol and processing algorithms used, must be documented sufficiently to be understandable to and reproducible by a geophysicist with no previous knowledge of the project.
- The level of effort in processing should be appropriate to the project DQOs.
- Whenever possible, data processing should incorporate ground truth information to achieve a more accurate solution. Joint processing of multi-method data sets may be similarly productive.
- A summary of data processing procedures and their rationale should be presented in the project report.

# 8.0 Quality Control and Assurance

8.1 Field personnel will follow specific quality assurance guidelines as outlined in the SAP and any additional procedures identified in the field as necessary to maintain the integrity of the data.

8.2 System calibration, checks, and live tests shall be analyzed in the field before and during data collection to ensure data accuracy and precision.

# 9.0 Records, Data Analysis, Calculations

All geophysical data should be stored in a data recorder or laptop during acquisition, if practical. At the earliest practical time, and at least at the conclusion of each field day, data should be downloaded to a separate computer and backed up via external drive or email attachments.

Field notes will be recorded in the field logbook, which is a primary document of record for the project. Accordingly, any circumstances potentially affecting the interpretability of the data should be recorded in the notebook as they occur. Examples: times of arrival/departure and key field activities; health and safety factors and pre-work safety meeting (in addition to the required daily safe work assessment and permit form); weather; calibration/test results; records of base station ties; illustrations of instrument setup; details of instrument deployment; survey lines or points acquired; data results as appropriate; identification of anomalies encountered; records of interfering factors such as culture or ambient noise; descriptions of problems encountered, the data blocks affected, and remedy achieved; sketch maps; notes for subsequent processing; and any deviations from the procedures in this SOP and other project plans.

## 10.0 Attachments or References

10.1 Butler, D.K., Ed., 1991. Near-Surface Geophysics: Investigations in Geophysics no.13, Society of Exploration Geophysicists.

10.2 Dobrin, M. B., and C. H. Savit, 1988. *Introduction to Geophysical Prospecting*: McGraw-Hill Publishing Environmental.

10.3 Nabighian, M.N., Ed., 1991. Electromagnetic Methods in Applied Geophysics: Investigations in Geophysics no.3, Society of Exploration Geophysicists.

10.4 Sheriff, R. E., 1991. *Encyclopedic Dictionary of Exploration Geophysics*: Society of Exploration Geophysicists.

10.5 Telford, W. M., L. P. Geldart, R. E. Sheriff, and D.A. Keys, 1998. *Applied Geophysics*: Cambridge University Press.

10.6 Ward, S.H., Ed., 1990. Geotechnical and Environmental Geophysics: Investigations in Geophysics no.5, Society of Exploration Geophysicists.

| Author | Reviewer | Revisions (Technical or Editorial) |
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# Surface Water and Liquid Sampling

## Procedure 3-10

## 1.0 Purpose and Scope

1.1 The purpose of this document is to define the standard operating procedure (SOP) for surface water and liquid sampling (for example, liquid characterization sampling). This SOP describes the equipment, field procedures, materials, and documentation procedures necessary to surface water samples from shallow and deep water using a variety of samplers. Specific information regarding coring locations can be found in the associated Sampling and Analysis Plan (SAP).

1.2 This procedure is the Program-approved professional guidance for work performed by AECOM under contract to the United States Army Corp of Engineers (USACE).

1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review. If there are procedures whether it be from Resolution Consultants, state and/or federal that are not addressed in this SOP and are applicable to surface water sampling then those procedures may be added as an appendix to the project specific SAP.

1.4 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Program Quality Manager. Deviations to this SOP will be documented in the field records.

## 2.0 Safety

2.1 Depending upon the site-specific contaminants, various protective programs must be implemented prior to sampling the first surface water sampling location. All **field sampling personnel** responsible for sampling activities must review the project-specific Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP) paying particular attention to the control measures planned for the sampling tasks. Conduct preliminary area monitoring to determine the potential hazard to field sampling personnel. If significant contamination is observed, minimize contact with potential contaminants in both the vapor and liquid phase through the use of respirators and disposable clothing.

2.2 In addition, observe standard health and safety practices according to the project-specific APP/ SSHP. Suggested minimum protection during well sampling activities includes inner disposable vinyl gloves, outer chemical-protective nitrile gloves, rubberized steel-toed boots, and an American National Standards Institute-standard hard hat. Half-face respirators and cartridges and Tyvek® suits may be necessary depending on the contaminant concentrations, and shall always be available on site.

2.3 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the **Site Safety and Health Officer (SSHO)** or designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the APP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSHO.


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2.4 The health and safety considerations for the work associated with surface water sampling include:

- Proper selection of personal protective equipment for work around water bodies (e.g., personal flotation devices [PFDs]), as specified in the project-specific APP.
- Appropriate health and safety protocols for working in a boat (if applicable), as specified in the project-specific APP.
- Proper lifting techniques when retrieving surface water samplers, large muscles of the legs should be used, not the back.
- Stay clear of all moving equipment and avoid wearing loose fitting clothing.
- To avoid slip/trip/fall hazards as a result of working on wet surfaces, wear work boots/work boot covers with textured soles.
- To avoid heat/cold stress as a result of exposure to extreme temperatures and PPE, drink electrolyte replacement fluids (1 to 2 cups per hour is recommended), and in cases of extreme cold, wear fitted insulated clothing

## 3.0 Terms and Definitions

None.

## 4.0 Interferences

None.

## 5.0 Training and Qualifications

5.1 **Qualifications and Training**

5.1.1 The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 **Responsibilities**

5.2.1 The **Project Manager** is responsible for ensuring that surface water sampling activities comply with this procedure. The Project Manager or designee shall review all surface water sampling forms on a minimum monthly basis. The Project Manager is responsible for ensuring that all field sampling personnel involved in surface water sampling shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.2.3 The **Site Supervisor (SS)** is responsible for ensuring that all field sampling personnel follow these procedures.

5.2.4 **Field sampling personnel** are responsible for the implementation of this procedure. Minimum qualifications for field sampling personnel require that one individual on the field team shall have a minimum of 6 months of experience with surface water sampling.

5.2.5 The **field sampler and/or task manager** is responsible for directly supervising the surface water sampling procedures to ensure that they are conducted according to this procedure, and for recording all pertinent data collected during sampling. If deviations from the procedure are required because of anomalous field conditions, they must first be approved by the Program Quality Manager and then documented in the field logbook and associated report or equivalent document.


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## 6.0 Equipment and Supplies

The following equipment list contains materials that may be needed in carrying out the procedures outlined in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Work Plan
- Maps/Plot plan
- Tape measure
- Survey stakes, flags, or buoys
- Camera and film
- Stainless steel, plastic, or other appropriate composition (e.g., Teflon) bucket
- Laboratory supplied sampling containers
- Ziploc plastic bags for samples, and sample jars
- Logbook
- Labels
- Chain of Custody (COC) forms
- Site description forms
- Cooler(s)
- Ice
- Equipment/Apparatus
- Decontamination supplies/equipment
- Spade or shovel
- Spatula
- Scoop
- Trowel
- Task specific surface water sampling equipment

## 7.0 Calibration or Standardization

None.

## 8.0 Procedure

### 8.1 Selection of Sampling Techniques

Proper selection of sampling points and collection methodology are essential to meeting the objectives of a surface water sampling program. Sampling points should be selected for collection of surface water samples on the basis of characteristics of the body of surface water body to be monitored, the location of the body of surface water, and its hydrologic boundaries with respect to the site. Other considerations include the contaminants of concern, logistical considerations, such as access to the surface water body, the direction of flow, and determination of a background location.


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Methods of collecting surface water samples vary from hand sampling procedures at a single point to sophisticated, multipoint sampling techniques. The number and type of samples to be collected depends on the characteristics of the body of water, the amount of suspended sediment that a moving body carries, the size of the discharge area at the site, and other factors. Multipoint sampling techniques apply to larger bodies of water; the samples are composited to provide a more representative sample.

Whenever possible, the sampling device, either disposable or constructed of a nonreactive material, should hold at least 500 milliliters to minimize the number of times the liquid must be disturbed, thus reducing agitation of any sediment layers. A 1-liter polypropylene or stainless steel beaker with a pour spout and handle works well. Any sampling device might contribute contaminants to a sample. The correct sampling device will not compromise the integrity of the sample and will give the desired analytical results.

### 8.1.1 Shallow Water Body Surface Water Sample Collection

A dip or grab sample is appropriate for a small body of water, or for collecting near-surface samples in a larger surface water body. The sampling method involves filling a sample container by submerging it either just below the surface, or by lowering the container to a desired depth by using a weighted holder. For shallow bodies of surface water, hold the sample container carefully just beneath the water surface to avoid disturbing the streambed and stirring the sediment. Position the container's mouth so that it faces upstream, while the sampling personnel are standing downstream. Any preservative added to the sample should be added after sample collection to avoid loss of preservative. Alternatively, a transfer device may be dipped into the water, and then the contents transferred to the appropriate container containing the preservative. For near-surface sample collection in a large surface water body, a pond sampler may be used if an extended reach is required to collect a representative sample. A pond sampler consists of a single use sample container attached to a telescoping, heavy-duty, aluminium pole via an adjustable clamp attached to the end. The collection technique for shallow surface water samples can be used for near-surface samples in a large surface water body.

### 8.1.2 Deep Surface Water Sample Collection

For deeper surface water bodies, either sample containers or transfer devices may be used to collect a sample. A weighted holder that allows either a sample transfer device or a sample container to be lowered, opened for filling, closed, and returned to the surface is suggested for sampling deeper surface water bodies. This is because concentrations of constituents near the surface of a deeper body of surface water might differ from the total concentration distributed throughout the water column cross section and thus a surface sample would not be representative of the water body. An open container that is lowered and raised to the surface at a uniform rate so that the bottle is just filled on reaching the surface is appropriate for deeper stagnant water bodies, however this method does not collect a truly representative sample in deeper flowing surface water bodies.

**Kemmerer Samplers**. Collect samples near the shore unless sampling from a boat is feasible and permitted. If a boat is used, the body of water should be cross-sectioned and samples should be collected at various depths across the water in accordance with the project specific SAP. The Kemmerer Sampler consists of a glass, plastic, or Teflon bottle, a weighted sinker, a bottle stopper, and a line that is used to open the bottle and to lower and raise the sampler during sampling. The general procedure for using the sampler is as follows (or refer to manufacturer's instructions):

1. Obtain the sampler and check the knot at the bottom of the sampler for tightness and size. The knot should be sufficiently large so that it will not pull through the central tube of the sampler.
2. Assemble the weighted bottle sampler for making the cast by pulling the trip head into the trip plate. This can be done by holding the top and bottom stoppers and giving a short, hard pull to the bottom stopper.
3. Measure and mark the desired depth on the sampling line. Tie the free end of the line to the railing of the vessel to prevent accidental dropping of the sampler.


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4. Gently lower the sampler to the desired depth so as not to remove the stopper prematurely.
5. Pull out the stopper with a sharp jerk of the sampler line or by lowering a messenger down the line to trip the stoppers.
6. Allow the bottle to fill completely, as evidenced by the cessation of air bubbles.
7. Raise the sampler and cap the bottle. Untie the line from the railing and carry the sampler to your sampling station.
8. Transfer water into appropriate sample containers. Preserve the sample, if necessary, following guidelines in the project-specific SAP. In most cases, place preservatives in sample containers before sample collection to avoid overexposure of samples and overfilling of bottles during collection.
9. Check that a Teflon liner is present in the cap, if required. Secure the cap tightly.
10. Fill out the sample label and record all relevant information in the sample collection form, the field logbook, and/or the field laptop/tablet. In addition, the chain of custody form should be filled out as soon as possible. These procedures should be done in accordance with SOP 3-03 Recordkeeping, Sample Labeling, and Chain of Custody.
11. Immediately place the properly labeled sample bottle(s) in a cooler with ice.
12. Wipe the sample clean and decontaminate if necessary for the collection of additional samples. Decontaminate according to the procedures in SOP 3-06 Equipment Decontamination.
13. Always store the sampler in the open position (stoppers not in the tube).

**Teflon Bailers.** Teflon bailers can also been used to collect samples in deep bodies of water. When the use of Teflon bailers is deemed appropriate for sampling water from a specific depth, the bailers shall be equipped with a check valve that closes during sample retrieval.

1. Attach a line that is premeasured to the appropriate sampling depth to the dedicated Teflon bailer and lower to the desired depth.
2. Ensure that the check valve is engaged tugging on the line with a sharp jerk.
3. Raise the bailer and transfer the water to sample containers. Preserve the sample, if necessary, following guidelines in the project-specific SAP. In most cases, place preservatives in sample containers before sample collection to avoid overexposure of samples and overfilling of bottles during collection.
4. Check that a Teflon liner is present in the cap, if required. Secure the cap tightly.
5. Fill out the sample label and record all relevant information in the sample collection form, the field logbook, and/or the field laptop/tablet. In addition, the chain of custody form should be filled out as soon as possible. These procedures should be done in accordance with SOP 3-03 Recordkeeping, Sample Labeling, and Chain of Custody.
6. Immediately place the properly labeled sample bottle(s) in a cooler with ice.
7. A new dedicated bailer and new line should be used for each sampling location.

**Peristaltic Pump**. Another method of extending the reach of sampling efforts is to use a small peristaltic pump. In this method, the sample is drawn through heavy-wall Teflon tubing and pumped directly into the sample container. This system allows the operator to reach into the liquid body, sample from depth, or sweep the width of narrow streams.

If medical-grade silicon tubing is used in the peristaltic pump, the system is suitable for sampling almost any analyte, including most organics. Some volatile stripping may occur; due to the relatively high flow rate of the pump. Therefore, avoid pumping methods for sampling volatile organics. Battery-operated peristaltic pumps are available and can be easily carried by hand or with a shoulder sling, as needed. It is necessary in most situations to change both the Teflon suction line and the silicon pump tubing between sampling locations to avoid cross contamination. This action requires maintaining a sufficiently large stock of material to avoid having to clean the tubing in the field.


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Peristaltic pumps work especially well for sampling large bodies of water when a near-surface sample will not sufficiently characterize the body as a whole. When sampling a liquid stream that exhibits a considerable flow rate, it may be necessary to weight the bottom of the suction line.

Use the following procedures for collecting samples using peristaltic pumps:

1. Install clean, silicone tubing in the pump head, per the manufacturer's instructions. Pharmaceutical-grade silicone tubing (e.g., PharMed tubing) may be required for some projects depending on the analyses required. Refer to the project specific SAP for specific tubing requirements. Allow sufficient tubing on the discharge side to facilitate convenient dispensation of liquid into sample bottles but only enough on the suction end for attachment to the intake line. This practice will minimize sample contact with the silicone pump tubing. (Some types of thinner Teflon tubing may be used.).
2. Select the length of suction intake tubing necessary to reach the required sample depth and attach it to the tubing on the intake side of the pump. If necessary, a small weight composed of inert material (e.g., stainless steel) which will not react with chemicals of concern may be used to weight the intake tubing. Heavy-wall Teflon of a diameter equal to the required pump tubing will suit most applications. (A heavier wall will allow for a slightly greater lateral reach.)
3. A purge volume that is at a minimum equal to the tubing volume should be passed through the system prior to sample collection. Collect this purge volume in a bucket. Once the sample has been collected, the purged water volume can be returned to the water body.
4. Fill necessary sample bottles by allowing pump discharge to flow gently down the side of bottle with smooth laminar flow and minimal entry turbulence. Cap each bottle as it is filled.
5. Preserve the sample, if necessary, following guidelines in the project-specific SAP. In most cases, place preservatives in sample containers before sample collection to avoid overexposure of samples and overfilling of bottles during collection.
6. Check that a Teflon liner is present in the cap, if required. Secure the cap tightly.
7. Fill out the sample label and record all relevant information in the sample collection form, the field logbook, and/or the field laptop/tablet. In addition, the chain of custody form should be filled out as soon as possible. These procedures should be done in accordance with SOP 3-03 Recordkeeping, Sample Labeling, and Chain of Custody.
8. Immediately place the properly labeled sample bottle in a cooler with ice.
9. Allow the system to drain thoroughly, and then disassemble.

## 8.2 Transfer Devices

Samples from various locations and depths can be composited if project quality objectives indicate that it is appropriate; otherwise, collect separate samples. Identify approximate sampling points on a sketch of the water body. Use the following procedures for collecting samples using transfer devices:

1. Submerge a stainless steel dipper or other suitable device, causing minimal disturbance to the surface of the water and the sediment at the floor of the surface water body. Note the approximate depth and location of the sample source (e.g., 1 foot up from bottom or just below the surface).
2. Allow the device to fill slowly and continuously.
3. Retrieve the dipper or device from the surface water with minimal disturbance.
4. Remove the cap from the sample bottle and slightly tilt the mouth of the bottle below the dipper or device edge.
5. Empty the dipper or device slowly, allowing the sample stream to flow gently down the side of the bottle with smooth laminar flow and minimal entry turbulence.
6. Continue delivery of the sample until the bottle is filled.
7. If necessary, preserve the sample according to guidelines in the project-specific SAP. In most cases, place preservatives in sample containers before sample collection to avoid overexposure of samples and overfilling of bottles during collection.


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8. Check that a Teflon liner is present in the cap, if required. Secure the cap tightly.
9. Fill out the sample label and record all relevant information in the sample collection form, the field logbook, and/or the field laptop/tablet. In addition, the chain of custody form should be filled out as soon as possible. These procedures should be done in accordance with SOP 3-03 Recordkeeping, Sample Labeling, and Chain of Custody.
10. Dismantle the sampler and decontaminate according to the procedures in SOP 3-06 Equipment Decontamination.

Multipoint sampling techniques that represent both dissolved and suspended constituents and both vertical and horizontal distributions are applicable to larger bodies of water. Subsequent to sample collection, multipoint sampling techniques may require a compositing and sub-sampling process to homogenize all the individual samples into the number of subsamples required to perform the analyses of interest. Homogenizing samples is discouraged for samples collected for volatile organic analysis, because aeration causes a loss of volatile compounds. If collection of composite samples is required, then include the procedure for compositing in the project-specific work plan.

The sampling devices selected must not compromise sample integrity. Collect samples with either disposable devices, or devices constructed of a nonreactive material, such as glass, stainless steel, or Teflon. The device must have adequate capacity to minimize the number of times the liquid must be disturbed, reducing agitation of any sediment layers. Further, the device must be able to transfer the water sample into the sample container without loss of volatile compounds. A single- or double-check valve or stainless steel bailer made of Teflon equipped with a bottom discharging device may be utilized.

All equipment used for sample collection must be decontaminated before and after use in accordance with Procedure 3-06 – Equipment Decontamination.

## 9.0 Quality Control and Assurance

9.1 Field personnel will follow specific quality assurance (QA) guidelines as outlined in the project-specific SAP. The goal of the QA program should be to ensure precision, accuracy, representativeness, completeness, and comparability in the project sampling program.

9.2 Quality Control (QC) requirements for sample collection are dependent on project-specific sampling objectives. The project-specific SAP will provide requirements for sample preservation, holding times, container types, as well as various QC samples such as trip blanks, field blanks, equipment blanks, and field duplicates.

## 10.0 Data and Records Management

10.1 Field notes will be kept during sampling activities in accordance with SOP 3-03 – Recordkeeping, Sample Labeling, and Chain of Custody. During the completion of sampling activities, fill out the sample logbook and transmit forms to the CTO Manager for storage in project files.

10.2 Deviations to the procedures detailed in the SOP should be recorded in the field logbook.

## 11.0 Attachments or References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Environmental Protection Agency, United States (EPA). 1987. *A Compendium of Superfund Field Operations Methods*. EPA/540/P-87/001, EPA, Office of Emergency and Remedial Response, Washington, D.C.


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# Monitoring Well Installation

## Procedure 3-12

## 1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the methods to be used during the installation of groundwater monitoring wells. It describes the components of monitoring well design and installation and sets forth the rationale for use of various well installation techniques in specific situations.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

## 2.0 Safety

2.1 The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the project Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP). In the absence of a APP/SSHP, work will be conducted according to the Contract Task Order (CTO) Work Plan (WP) and/or direction from the **Site Safety and Health Officer (SSHO)**.

2.2 Before well installation commences, appropriate entities (e.g. DigSafe, local public works departments, company facilities) must be contacted to assure the anticipated well locations are marked for utilities, including electrical, telecommunications, water, sewer, and gas.

2.3 Physical Hazards Associated with Well Installation

- Stay clear of all moving equipment and avoid wearing loose fitting clothing.
- When using an approved retractable-blade knife, always cut away from one self and make sure there are no other people in the cutting path or the retractable-blade knife.
- To avoid slip/trip/fall conditions during drilling activities, keep the area clear of excess soil cuttings and groundwater. Use textured boots/boot cover bottoms in muddy areas.
- To avoid heat/cold stress as a result of exposure to extreme temperatures and personal protective equipment (PPE), drink electrolyte replacement fluids (1 to 2 cups per hour is recommended) and, in cases of extreme cold, wear fitted insulating clothing.
- To avoid hazards associated with subsurface utilities, ensure all sampling locations have been properly surveyed as described in SOP 3-01, Utility Clearance.
- Be aware of restricted mobility caused by PPE.


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## 3.0 Terms and Definitions

3.1 **Annulus:** The annulus is the down-hole space between the borehole wall and the well casing and screen.

3.2 **Bridge:** A bridge is an obstruction in the drill hole or annulus. A bridge is usually formed by caving of the wall of the well bore, by the intrusion of a large boulder, or by the placement of filter pack materials during well completion. Bridging can also occur in the formation during well development.

3.3 **Filter Pack:** Filter pack is sand or gravel that is smooth, uniform, clean, well-rounded, and siliceous. It is placed in the annulus of the well between the borehole wall and the well screen to prevent formation materials from entering the well and to stabilize the adjacent formation.

3.4 **Grout:** Grout is a fluid mixture of cement and water that can be forced through a tremie pipe and emplaced in the annular space between the borehole and casing to form an impermeable seal. Various additives, such as sand, bentonite, and polymers, may be included in the mixture to meet certain requirements.

3.5 **Heaving (Running) Sands:** Loose sands in a confined water-bearing zone or aquifer which tend to rise up into the drill stem when the confining unit is breached by the drill bit. Heaving sands occur when the water in the aquifer has a pressure head great enough to cause upward flow into the drill stem with enough velocity to overcome the weight of the sand.

3.6 **Sieve Analysis:** Sieve analysis is the evaluation of the particle-size distribution of a soil, sediment, or rock by measuring the percentage of the particles that will pass through standard sieves of various sizes.

## 4.0 Interferences

4.1 Heaving sands may be problematic in unconsolidated sands encountered below the water table.

4.2 Rotary drilling methods requiring bentonite-based drilling fluids should be used with caution to drill boreholes that will be used for monitoring well installation. The bentonite mud builds up on the borehole walls as a filter cake and permeates the adjacent formation, potentially reducing the permeability of the material adjacent to the well screen.

4.3 If water or other drilling fluids have been introduced into the boring during drilling or well installation, samples of these fluids should be obtained and analyzed for chemical constituents that may be of interest at the site. In addition, an attempt should be made to recover the quantity of fluid or water that was introduced, either by flushing the borehole prior to well installation and/or by overpumping the well during development.

4.4 Track-mounted drill rigs are suitable for travelling on many types of landscapes that truck-mounted units cannot access, but may have limitations on extremely uneven or soft terrain.

4.5 Care should be taken to prevent cross-contamination between well locations. All drilling equipment coming in contact with potentially contaminated soil and/or groundwater will be decontaminated by the drilling subcontractor prior to initial drilling activities and between drilling locations in accordance with SOP 3-06, Equipment Decontamination.

## 5.0 Training and Qualifications

5.1 **Qualifications and Training**

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.


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5.2 **Responsibilities**

5.2.1 **Project Managers** are responsible for issuing sampling and analysis plans (SAPs) that reflect the procedures and specifications presented in this procedure. Individual municipalities, county agencies, and possibly state regulatory agencies enforce regulations that may include well construction and installation requirements. The **Project Manager** shall be familiar with current local and state regulations, and ensure that these regulations are followed. The **Project Manager** is responsible for ensuring that all personnel involved in monitoring well installation shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.2.3 The **Site Supervisor (SS)** is responsible for direct supervision of the installation of monitoring wells and ensuring that procedures and specifications are implemented in the field in accordance with the approved SAP and well installation permits. The qualifications for the **SS** must be in accordance with local jurisdictions with authority over the operations conducted.

5.2.4 All field personnel are responsible for the implementation of this procedure.

5.2.5 The on-site hydrogeologist/engineer is expected to obtain a description of the lithologic samples obtained during the excavation and construction of a monitoring well. These data are often required to provide guidance regarding the installation of specific components of the monitoring well. Guidance for lithologic sample collection and sample description is contained within SOP 3-16, Soil and Rock Classification.

## 6.0 Equipment and Supplies

6.1 Materials provided by the drilling contractor may include:

- Drill rig, drill rods, hollow stem augers, etc.
- Decontamination equipment (e.g., steam cleaner, high-pressure washer, brushes, etc.)
- Decontamination pad materials
- Well screen/riser pipe with flush-threaded couplings including riser and bottom caps
- Clean, filter sand
- Bentonite chips or pellets
- Cement grout and tremie pipe
- Portland cement for well pad completion
- Steel protective riser covers and locking caps
- Weighted calibrated tape
- Split-spoon samplers
- 55-gallon drums or containers for drill cuttings, decontamination fluids, etc.

6.2 In addition to those materials provided by the drilling contractor, equipment and materials required by the project geologist/engineer may include, but is not limited to, the following:

- Photoionization Detector (PID)
- Spill kit, including at a minimum sorbent pads and shovel (if not provided by subcontractor)


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- Plastic sheeting
- Teaspoon or spatula
- Resealable plastic bags
- Boring Log Records
- Decontamination materials (per SOP No. 3-06 - Equipment Decontamination)
- Weighted measuring tape for depth measurement
- Soil logging materials (e.g. USCS classification field card, millimeter rule, hand lens, etc.)
- Survey lathes or pin flags
- Digital camera
- PPE as required by the APP/SSHP
- Planning documents including the site-specific APP/SSHP and SAP
- Large indelible ink or paint pen
- Field logbook/field forms/site maps (water proof)

# 7.0 Procedure

## 7.1 General Procedures

- Specific drilling, sampling, and installation equipment and methodology will be dictated by the type of well to be installed (e.g., single case (Type II), double case (Type III), bedrock, etc.), geologic characteristics of the site, the type of contaminants being monitored, and local and state regulations.
- For access to locations when travelling over difficult terrain, an appropriate line should be chosen before mobilizing the drill rig or other support vehicles. If clearing of trees or ground cover is required, perform these activities in advance to avoid down time. Avoid wet or soft areas where possible or use ground mats and/or timbers to aid in supporting the rig as it travels. If drilling on soft material, place geomatting and ground mats under the rig tracks or stabilizers prior to drilling.
- A utility locate must be conducted to identify all underground utilities at the site prior to drilling (refer to SOP 3-01, Utility Clearance). Proper clearance procedures for aboveground/overhead utilities must also be followed as specified in the APP/SSHP.
- Although new well materials (well screen and riser pipe) generally arrive at the site boxed and sealed within plastic bags, it is sometimes necessary to decontaminate the materials prior to their use. Well materials should be inspected by the project geologist/engineer upon delivery to check for cleanliness. If the well materials appear dirty, or if local or regional regulatory guidance requires decontamination, then well material decontamination should be performed by the drilling subcontractor in accordance with SOP 3-06, Equipment Decontamination.
- The diameter of the borehole must be a minimum of 2 inches greater than the outside diameter of the well screen or riser pipe used to construct the well. This is necessary so that sufficient annular space is available to install filter packs, bentonite seals, and grout seals, and allow the passage of tremie pipe where grouting at depth is required. Bedrock wells may require reaming after coring in order to provide a large enough borehole diameter for well installation.
- When soil sampling is required (refer to the SAP), soil samples will be collected for visual logging by advancing split-spoon samplers through the augers. The soil will be visually logged by a field geologist and include lithologic characteristics (i.e., soil type, color, density, moisture content, etc.) using the the

methods described in SOP 3-16, Soil and Rock Classification. This information will be recorded on a boring/well log form, along with well construction details.

## 7.2 Drilling Techniques

Drilling of monitoring well boreholes may be accomplished by a variety of methods as described below. Preferred methods include those that temporarily case the borehole during drilling (i.e., hollow stem auger and sonic methods) using an override system. Other methods can be used where specific subsurface conditions or well design criteria dictate.

- Hollow stem auger (HSA) – Borings are advanced by rotating steel hollow stem augers with an attached cutting head. Soil cuttings are displaced by the cutting head and transported to the surface via continuous spiral flights attached to each auger stem. This method is widely used for unconsolidated soils that have a tendency to collapse within the boring. A bottom plug can be placed in the bottom auger to prevent soils from entering and clogging the auger, especially in the case of heaving sands. However, a bottom plug cannot be used when soil samples are to be collected through the augers. Soil plugs that accumulate in the bottom of the auger must be removed or knocked out prior to sampling or well installation.
- Solid stem auger – This type of drilling method is similar to HSA drilling using a solid stem or sealed hollow stem auger flights to advance the boring. Solid stem, continuous flight auger use is limited to semi-consolidated sediments or to cohesive or semi-cohesive unconsolidated sediments that don't have a tendency to collapse when disturbed.
- Sonic methods – Sonic drilling consists of advancing concentric hollow drill casings (inner and outer) using rotation in conjunction with axial vibration of the drill casing. Once the casings are advanced to the appropriate depth, the inner string is removed with a core of drill cuttings while the outer casing remains in place to keep the borehole open. Cuttings are removed from the inner casing relatively intact for logging or sampling purposes. This drilling method is used for a variety of soil types, from heaving sands to consolidated or indurated formations. Smearing of the formation along the borehole walls is minimal since moderate vibration and rotation techniques are used to advance the casings. Since the total borehole diameter in sonic drilling is only incrementally larger than the inner casing diameter, care should be taken during installation of the monitoring well to ensure the well is centered and adequate space is available for annular materials.
- Rotary methods (water or mud) – Rotary drilling methods consist of drill rods coupled to a drill bit that rotates and cuts through the soils to advance the borehole. Water or drilling fluid ("mud") is forced through the hollow drill rods and drill bit as the rods are rotated. The soil cuttings are forced up the borehole with the drilling fluids to the surface and the fluids recirculated. The drilling fluid provides a hydrostatic pressure that reduces or prevents the borehole from collapsing. Clean, potable water must be used for water-rotary drilling to prevent introducing trace contaminants. A sample of the potable water should be collected during the course of well installation for analysis of the same parameters defined for the groundwater samples. If mud-rotary is used to advance boreholes, potable water and bentonite drilling mud should only be used. No chemical additives shall be mixed in the drilling fluid to alter viscosity or lubricating properties. Adequate well development is essential for removal of drilling mud and fluids from the formation materials and ensure collection of representative groundwater samples.
- Rotary methods (Air) – Air rotary methods are similar to water rotary but use high air velocities in place of drilling fluids to rotate the drill bit and carry the soil cuttings up the borehole to the surface. Care must be taken to ensure that contaminants are not introduced into the air stream from compressor oils, etc. Most compressor systems are compatible with a coalescing filter system. Cuttings exiting the borehole under pressure must be controlled, especially when drilling in a zone of potential contamination. This can be accomplished by using an air diverter with hose or pipe to carry the cuttings to a waste container. Letting the cuttings blow uncontrolled from the borehole is not acceptable.


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## 7.3 Well Construction and Installation

- If rotary drilling techniques are used, the borehole should be flushed or blown free of material prior to well installation. If hollow stem augers are used, the soil or bottom plug should be removed and the augers raised approximately six inches above the bottom of the borehole, while slowly rotating the augers to remove cuttings from the bottom of the boring. The depth of the borehole should be confirmed with a weighted, calibrated tape.
- The riser pipe and screen should be connected with flush-threaded joints and assembled wearing clean, disposable gloves. No solvent or anti-seize compound should be used on the connections. The full length of the slotted portion of the well screen and unslotted riser pipe should be measured and these measurements recorded on a well construction form (Attachment 1).
- If placed in an open borehole, the assembled well should be carefully lowered and centered in the borehole so that the well is true, straight, and vertical throughout. Centering can also be accomplished with the use of centralizers, if necessary. However, centralizers should be placed so that they do not inhibit the installation of filter sand, bentonite seal, and annular grout. Wells less than 50 deep generally do not require centralizers.
- If hollow stem augers are used, the well should be lowered through the augers and each auger flight removed incrementally as the filter sand, bentonite seal, and grout are tremmied or poured into the annular space of the well. The well should be temporarily capped before filter sand and other annular materials are installed.
- Clean, silica sand should be placed around the well screen to at least 1 foot above the top of the screen. The filter sand should be appropriately graded and compatible with the selected screen size and surrounding formation materials. In general, the filter pack should not extend more than 3 feet above the top of the screen to limit the thickness of the monitoring zone. As the filter pack is placed, a weighted tape should be lowered in the annular space to verify the depth to the top of the layer. This measurement will be recorded on the well construction form (Attachment 1). If necessary, to eliminate possible bridging or creation of voids, placement of the sand pack may require the use of a tremie pipe. Tremie pipe sandpack installations are generally suggested for deeper wells and for wells which are screened some distance beneath the water table.
- A minimum 2-foot thick layer of bentonite pellets or slurry seal will be installed immediately above the filter sand to prevent vertical flow within the boring from affecting the screened interval. Bentonite chips/pellets must be hydrated if place above the water table prior to grouting. If bridging is of concern as in the case of deep wells, powdered bentonite may be mixed with water into a very thick slurry and a tremie pipe used to place the seal to the desired depth. Placement of the bentonite seal in the borehole will be recorded on the well construction form (Attachment 1).
- The remaining annular space around the well will be grouted from the top of the bentonite seal to the surface with a grout composed of neat cement, a bentonite cement mixture, or high solids sodium bentonite grout.
- Each well riser will be secured with an expandable, locking cap (vented if possible). Optionally, a hole can be drilled in the upper portion of the riser to allow venting of the well.
- The well will be completed within a concrete well pad consisting of a Portland cement/sand mixture. Well pads are generally 3 feet by 3 feet square but may be larger or smaller depending on site conditions and state-specific well construction standards. Round concrete well pads are also acceptable. A minimum of 1 inch of the finished pad should be below grade to prevent washing and undermining by soil erosion.
- If completed as a flush-mount well, the well riser will be cut off approximately 4 to 6 inches below ground surface and an expandable, locking cap placed on the well riser. The area around the riser is dug out and a steel well vault or manhole cover placed over the riser and set almost flush to the ground


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to protect the well. The manhole cover should be water-tight and secured with bolts to prevent casual access. The well pad will then be constructed around the well vault and slightly mounded at the center and sloping away to prevent surface water from accumulating in the well vault.

- If completed as a stick-up well, the well riser is cut approximately 2.5 to 3 feet above the ground surface and an expandable, locking cap placed on the well riser. A steel guard pipe with hinged, locking cap is placed over the well riser as a protective casing. The bottom of the guard pipe will be set approximately 2 feet below ground surface and sealed by pouring concrete from the top of the annular grout around the pipe to grade. The concrete well pad should be completed at the same time. Weep holes will be drilled in the base of the guard pipe to facilitate draining of rainwater or purge water from inside the guard pipe.
- Bumper posts or bollards may be necessary for additional well protection, especially in high traffic areas. The bumper posts should be placed around the well pad in a configuration that provides maximum protection to the well and extend a minimum of 3 feet above the ground.

## 7.4 Double Cased Wells

Under certain site conditions, the use of a double-cased or telescoping (Type III) well may be necessary. Installation of double-cased wells may be required to prevent the interconnection of two separate aquifers, seal off a perched aquifer without creating a vertical hydraulic conduit, prevent cross-contamination during construction of wells in deeper aquifers hydro-stratigraphically below impacted aquifers, or case off highly impacted soils present above the aquifer to prevent potential “dragging down” of contaminants.

Similar to conventional wells, construction of double-cased wells can be accomplished using a varety of drilling methods. Well construction is initiated by “keying” a large diameter, outer casing into a stratigraphic zone of low permeability (clay layer or bedrock). The size of the outer casing should be a minimum of 2 inches greater than the outside diameter of the inner casing to allow installation of annular seal materials during well completion. A pilot borehole should be drilled through the overburden soil and/or contaminated zone into a clay confining layer or bedrock. The borehole for the outer casing should be of sufficient size to contain the outer casing with a minimum of 2 inches around the outside diameter to allow sufficient annular space for tremie or pressure grouting. The boring should extend a minimum of 2 feet into a clay layer and a minimum of 1 foot into bedrock, if possible, to ensure an adequate seal. The boring should never breach a confining layer or keyed zone under any circumstances.

Once the boring is completed, the outer casing can be set in the borehole and sealed with grout. The outer casing can be set two ways, with or without a bottom cap. If no bottom cap is applied, the casing is usually driven approximately 6 inches into the clay confining unit. A grout plug is generally placed in the bottom of the casing and once set, standing water in the casing is evacuated prior to drilling below the casing. As an alternative, a cap can be placed on the bottom of the casing and if set below the water table, the casing can be filled with clean, potable water to hold down the casing in the boring. Grouting should be conducted using tremie-grouting or pressure-grouting methods by pumping grout into the annular space between the outer casing and the borehole wall from the bottom of the casing to the ground surface. Grout around the casing should be allowed to cure at least 24 hours before attempting to drill through the bottom.

Once the grout is cured, a smaller diameter drill pipe/bit is used to bore through the grout plug or bottom cap to the desired well depth. The well is then constructed as described in Section 7.3 above.

## 7.5 Post Installation Procedures

- Wells should be permanently labelled or marked for identification. Well tags can be used to record the site name, well number, total depth, installation date, etc. At a minimum, the well number will be written in indelible marker or paint on both the outside of the protective casing and inside beneath the casing lid, as well as on the riser pipe.


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- A measuring point will be marked on the top of the riser pipe for taking water level measurements. The measuring point can be notched using a knife or saw or can be marked with a waterproof marker or paint. The measuring point will also be the point which will be surveyed for vertical elevation data.
- Upon completion, the following measurements will be taken by the field geologist/engineer and recorded on the well construction diagram.
    - Depth to static water level
    - Depth of non-aqueous phase liquid (NAPL), if present
    - Total depth of well measured from top of casing (TOC)
    - Height of well casing above ground surface
    - Height of protective casing above ground surface
- All monitoring wells will be surveyed for horizontal and vertical control by a licensed surveyor.
- Investigation-derived waste (IDW) including drill cuttings, spent materials (e.g., PPE), and decontamination water should be properly managed in accordance with SOP 3-05, IDW Management.

## 8.0 Quality Control and Assurance

8.1 Field personnel will follow specific quality assurance (QA) guidelines as outlined in the SAP. Certain quality control (QC) measures should be taken to ensure proper well installation and construction in accordance with this SOP, project specific SAP, and applicable well standards.

8.2 The borehole will be checked for total open depth, and extended by further drilling or shortened by backfilling, as required before installation of the well materials.

8.3 Water level and NAPL presence will be checked during well installation to ensure that the positions of well screen, filter sand, and seals relative to water level conform to project requirements

8.4 The depth to top of each layer of annular materials (i.e., filter sand, bentonite, grout) will be verified and adjusted as necessary for proper placement.

## 9.0 Records, Data Analysis, Calculations

All field information will be recorded in the field logbook and/or standardized field forms by field personnel. Field data recorded will include drilling contractor information, drilling methods, well material and construction information provided on the boring logs and well construction forms, observations or problems encountered during drilling, fluid level data, and any deviations from the procedures in this SOP and other project plans. Well Construction Forms (Attachment 1) will provide visual and descriptive information the monitoring well and are often the most critical form of documentation generated during the installation of a monitoring well. The field logbook is kept as a general log of activities and should not be used in place of the boring log.

## 10.0 Attachments or References

10.1 Attachment 1 – Monitoring Well Construction Form


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10.2 Environmental Protection Agency, United States (EPA). 1987. *A Compendium of Superfund Field Operations Methods*. Office of Solid Waste and Emergency Response. EPA/540/P-87/001.

10.3 EPA. 1990. *Handbook of Suggested Practices for the Design and Installation of Groundwater Monitoring Wells*. EPA/600/4-89/034. Office of Research and Development, Washington. March.

10.4 EPA. 1992. *RCRA Groundwater Monitoring Draft Technical Guidance*. EPA/530/R-93/001. Office of Solid Waste. November.

10.5 EPA, 2008. SESD Operating Procedure SESDGUID-101-R0: *Design and Installation of Monitoring Wells*. USEPA, Science and Ecosystem Support Division (SESD), Athens, Georgia. Effective Date February 18, 2008.

10.6 U.S. Army Corps of Engineers. 2008. Manual No. EM 385-1-1. *Safety and Health Requirements*. 15 November 2008. http://140.194.76.129/publications/eng-manuals/em385-1-1/2008_English/toc.html.

10.7 SOP 3-01, *Utility Clearance*.

10.8 SOP 3-05, *IDW Management*

10.9 SOP 3-06, *Equipment Decontamination*.

10.10 SOP 3-16, *Soil and Rock Classification.*

| *Author* | *Reviewer* | *Revisions (Technical or Editorial)* |
|---|---|---|
| Mark Kromis<br>Program Chemist | Chris Barr<br>Program Quality Manager | Rev 0 – Initial Issue (May 2012) |
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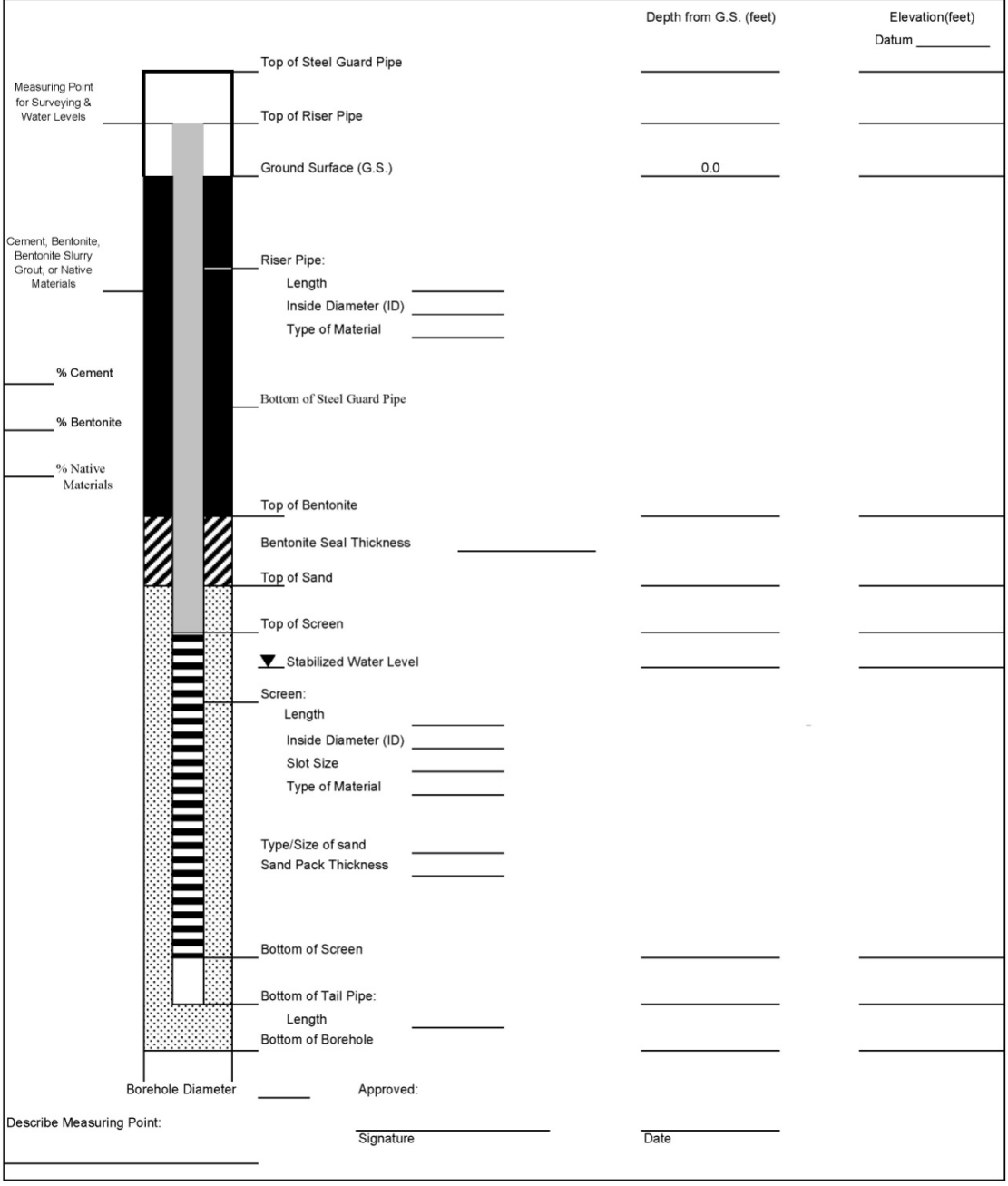


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# Attachment 1
# Monitoring Well Construction Form

| | | |
|---|---|---|
| | *Client:* | ***WELL ID:*** |
| | *Project Number:* | |
| | *Site Location:* | *Date installed:* |
| | *Well Location:* *Coords:* | *Inspector:* |
| | *Method:* | *Contractor:* |

**MONITORING WELL CONSTRUCTION DETAIL**






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# Monitoring Well Development

## Procedure 3-13

## 1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the procedures used for developing newly installed monitoring wells and/or redeveloping existing wells.

1.2 The purpose of well development is to remove interferences from a well to provide better connection between the well and the formation, to improve pumping performance of the well, and to be able to collect more representative information from the well (e.g., samples, test results, etc.). Proper well development will:

- Remove drilling residuals (e.g., water, mud) from the borehole and surrounding formations;
- Improve or restore hydraulic conductivity of the surrounding formations which may have been disturbed during the drilling process;
- Remove residual fines from the well screen and sand pack (filter pack) materials, thus reducing turbidity of groundwater and permitting the collection of more representative groundwater samples.

1.3 There may be circumstances where well development is not desirable, for example, in the presence of non-aqueous phase liquids (NAPL) or other significant contamination if development could worsen the contaminant impact. If NAPL begins to intrude during development, the development process will be halted. This situation will be considered a cause for sample modification requiring approval by the Project Manager and other stakeholders, as applicable.

1.4 The applicable well development procedures for a particular site may be subject to State or local regulatory requirements. In all cases, the project team should consult their local regulatory requirements and document the selected well development procedure in the project-specific Sampling and Analysis Plan (SAP). For project-specific information refer to the Work Plan (WP) and Sampling and Analysis Plan (SAP), which takes precedence over these procedures.

1.5 This procedure is the professional guidance for work performed by AECOM under contract to the United States Army Corp of Engineers (USACE).

1.6 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

## 2.0 Safety

2.1 The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the project-specific Accident Precention Plan (APP) and Site Safety and Health Plan (SSHP). In the absence of a APP/SSHP, work will be conducted according to the project-specific WP, SAP, and/or direction from the Site Safety and Health Officer (SSHO).

2.2 Monitoring well development may involve chemical hazards associated with potential contaminants in the soil or aquifer being characterized and may involve physical hazards associated with use of well development equipment.

## 3.0 Terms and Definitions

None.


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## 4.0 Interferences

4.1 Equipment/materials used for development may react with the groundwater during development. Appropriate development equipment has been selected for the anticipated condition of the groundwater.

4.2 Appropriate development methods such as using a surge-block to flush suspended fines in the groundwater in and out of the well screen can improve the yield of wells and improve their potential to be developed successfully. However, the effectiveness of development can be significantly reduced in wells that do not yield sufficient water to allow this flushing to take place.

4.3 For formations with a significant content of fine-grained materials (silts and clays), or wells with improperly sized screens, it may not be possible to reduce turbidity to commonly acceptable levels. Possible solutions may include collecting a sample even if excessively turbid, or installing a replacement well.

4.4 Development itself disturbs the surrounding formation and disrupts equilibrium conditions within the well. Groundwater samples will not be collected until a minimum of 24 hours after a well is developed to allow conditions to stabilize. For sites with fine-grained formations (silts and clays) and highly sorptive contamination, a longer time period between development and sampling should be considered.

## 5.0 Training and Qualifications

5.1 Qualifications and Training

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

5.2.1 The **Project Manager** is responsible for ensuring that well development activities comply with this procedure. The **Project Manager** is responsible for ensuring that all personnel involved in well development shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.2.3 The **Site Supervisor** is responsible for ensuring that all well development activities are conducted according to the either this procedure or the applicable procedure presented in the project-specific SAP.

5.2.4 **Field sampling personnel** are responsible for the implementation of this procedure.

5.2.5 The field sampler and/or task manager is responsible for directly supervising the well development procedures to ensure that they are conducted according to this procedure and for recording all pertinent data collected during sampling.

## 6.0 Equipment and Supplies

6.1 This equipment list was developed to aid in field organization and should be used in planning and preparation. Depending on the site-specific requirements and the development method selected, additional or alternative material and equipment may be necessary. In addition, for sites where groundwater is expected to be contaminated, the materials to be placed down the well and in contact with groundwater should be evaluated so that they are compatible with the chemical conditions expected in the well.

6.2 Equipment and materials used for well development may include, but is not limited to:

**Well development equipment**

- Surge block


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- Disposable Teflon bailers, appropriate to the diameter of the well(s): 1-inch to 1.5-inch for 2-inch inside diameter (ID) monitoring wells.
- Watterra® footvalve
- Electric submersible pump
- 12-volt power source for electric pump
- High density polyethylene (HDPE) tubing appropriately sized for Watterra® footvalve and/or electric submersible pump
- Drums or containers for storage of purge water
- Nephelometer to measure turbidity
- Multi-parameter water quality meter(s) to measure temperature, pH, conductivity, dissolved oxygen (DO), oxidation reduction potential (ORP)
- Instrument calibration solutions
- Water level meter
- Oil/water interface probe

**General equipment**

- Project-specific  plans including the site-specific HASP and SAP
- Field notebook/field forms/site maps
- Indelible markers/pens
- 5-gallon buckets

**Equipment decontamination supplies** (refer to SOP 3-06, Equipment Decontamination)

- Health and safety supplies, including personal protective equipment (PPE)
- Appropriate hand tools
- Keys or combinations to access monitoring wells
- Distilled/deionized water supply
- Disposable bailer string (polypropylene)
- Plastic trash bags

## 7.0 Procedure

Development generally consists of removing water and entrained sediment from the well until the water is clear (to the extent feasible) and the turbidity is reduced, which indicates the well is in good hydraulic connection with the surrounding formation.  In addition to simply removing water, development can be improved when flushing through the well screen and gravel pack takes place in both directions, that is, both into the well and into the formation.  This action breaks down sediment bridges that can occur in the formation or sand pack, which reduce the connection between the well and the formation

### 7.1 General Preparation

- All down-well equipment should be decontaminated prior to use and between well locations in accordance with SOP 3-06, Equipment Decontamination
- Although equipment is decontaminated between well locations, if wells are known or suspected to be contaminated based on observations during well installation, it is recommended that well development be conducted in order from the least contaminated to the most contaminated well to minimize the chances of cross-contamination.
- Management of investigation-derived waste (IDW), including development purge water and miscellaneous expendable materials generated during the development process, will be conducted in accordance with SOP 3-05, IDW Management.


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- Prior to accessing the well, the wellhead should be cleared of debris and/or standing water. Nothing from the ground surface should be allowed to enter the well.
- The depth to water and total well depth should be measured with a water level meter and recorded in the field logbook or on a Well Development Record (Attachment 1). This information will be used to calculate the volume of standing water (i.e., the well volume) within the well, and plan the specific details of the well development. If wells are suspected to contain NAPL, an oil/water interface probe should be used to measure liquid levels and depth to bottom of the well.
- Permanent monitoring wells will be developed no sooner than 24 hours after well installation is completed in order to allow well completion materials to set properly.

## 7.2 Monitoring Well Development Procedures

Generally, development will begin by gently surging the well with a surge block or bailer as described in Sections 7.2.1 and 7.2.2, respectively. Surging can become more vigorous as development progresses but initially the well must be gently surged to allow material blocking the screen to become suspended without damaging the well. Next, a bailer can be used to remove the sediment settled at the base of the well. A bailer, Watterra® pump, or electric submersible pump will then be used to purge the well, per Sections 7.2.2, 7.2.3, or 7.2.4, respectively. The well will be purged until the removed water becomes less turbid or per the requirements of the project-specific SAP, or State or local requirements. At this point the well will be surged again with a surge block or bailer. The well can be surged more vigorously at this point. After surging, the well will be purged again until the turbidity once again decreases. The surge/purge cycle should be completed at least three times during the development process. After the last surge, the well will be purged until the development completion criteria outlined in 7.3.2 or per the project-specific SAP are met.

### 7.2.1 Surge Block

The default method of well development is the use of a surge block in conjunction with pumping or bailing to remove sediment-laden water.

- The construction of the surge block must be appropriate for the diameter of the well. The surge block must be mounted on rods or other stiff materials to extend it to the appropriate depths and to allow for the surge block to be moved up and down in the well.
- Insert the surge block into the well and lower it slowly to the screened or open interval below the static water level. Start the surge action by slowly and gently moving the surge block up and down in the well. A slow initial surging, using plunger strokes of approximately 1 meter or 3 feet, will allow material which is blocking the screen to separate and become suspended.
- After 5 to 10 plunger strokes, remove water from the well using a separate bailer (Section 7.2.2) or pumping techniques (Sections 7.2.3 or 7.2.4). The returned water should be heavily laden with suspended fines. The water will be discharged to 5-gallon buckets or 55-gallon drums to be managed per the requirements presented in the project-specific SAP.
- In some cases, the bailer or Watterra® foot valve can act as a surge block, flushing water in and out of the well screen as groundwater is removed.
- Repeat the process of surging and pumping/bailing. As development continues, slowly increase the depth of surging to the bottom of the well screen. Surging within the riser portion of the well is neither necessary nor effective.

### 7.2.2 Bailer

- Tie a string or other cable securely to the bailer. Lower it to the screened or open interval of the monitoring well below the static water level.
- The bailer may be raised and lowered repeatedly within the screened interval to attempt to simulate the action of a surge block by pulling fines through the well screen, and pushing water out into the formation to break down bridging.


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- With the bailer full of water, remove it from the well and discharge the water into 5-gallon buckets or 55-gallon drums to be managed per the requirements presented in the project-specific SAP.
- The Watterra® system (Section 7.2.3) or electric submersible pump (Section 7.2.4) may be used as a complementary development method to the bailer, especially when removal of additional water at a faster rate is beneficial.
- Continue alternately surging and bailing, monitoring the purge water periodically (Section 7.3.1) until development completion criteria are met (Section 7.3.2).

7.2.3 Watterra® system

- Attach high-density polyethylene (HDPE) tubing to the decontaminated Watterra® pump foot valve
- Lower the foot valve and tubing assembly near the bottom of the well.
- Lift and lower the tubing to allow water to enter the Watterra® foot valve and travel up the tubing and discharge the water into 5-gallon buckets or 55-gallon drums to be managed per the requirements presented in the project-specific SAP.
- The lifting and lowering action of the Watterra® sysem will cause some surging action to aid in breaking up fine material in the surrounding formation.
- A bailer (Section 7.2.2) may be used as a complementary development method to the Watterra® system, especially during the initial stages of development when a high volume of sediment may be required to be removed.
- An electric submersible pump (Section 7.2.4) may also be used as a complementary development method to the Watterra® system, especially when more volume of water is desired to be pumped or the turbidity criteria cannot be met due to the surging action of the Watterra® system.
- Continue alternately surging and pumping, monitoring the purge water periodically (Section 7.3.1) until well development completion criteria are met (Section 7.3.2).

7.2.4 Electric Submersible Pump

- Attach HDPE tubing to the decontaminated electric submersible pump.
- Lower the pump and tubing assembly near the bottom of the well, at least a few inches above the well total depth.
- Begin pumping, discharging the water into 5-gallon buckets or 55-gallon drums to be managed per the requirements presented in the project-specific SAP.
- Continue alternately surging and pumping, monitoring the purge water discharge periodically (Section 7.3.1) until well development completion criteria are met (Section 7.3.2).

## 7.3 Discharge Monitoring

### 7.3.1 Monitoring the Progress of Development

The progress of the development is evaluated through visual observation of the suspended sediment load and measurement of the turbidity and other parameters in the purged diischarge water. As development progresses, the water should become clearer, measured turbidity should decrease, and specific capacity (pumping rate divided by drawdown) should stabilize. Water quality parameters, including DO, conductivity, ORP, pH, temperature, and turbidity may be measured and recorded periodically to determine the progress of development using the criteria outlined in Section 7.3.2 or per the project-specific SAP. Water quality parameters should be measured on each well volume removed.

### 7.3.2 Completion of Development

The well will be considered developed when the following criteria are met or per the criteria set forth in the project-specific SAP:

- A minimum of three times the standing water volume in a well (to include the well screen and casing plus saturated annulus, assuming 30 percent porosity) is removed.


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- Groundwater parameters for three consecutive standing water volumes are within the following:
    - pH – within ± 0.2 units
    - Specific conductivity – within ± 3%
    - ORP – within ± 10 mV
    - Temperature – within ±1 degree Celsius
    - Turbidity – at or below 10 nephelometric turbidity units (NTU) or within ± 10% if above 10 NTU.
- The sediment thickness remaining within the well is less than 1 percent of the screen length or less than 30 millimeters (0.1 ft) for screens equal to or less than 10 feet long.

Dissolved oxygen (DO) readings may be recorded but DO readings will not be used as development completion criteria because DO may not stabilize.

If the well has slow groundwater recharge and is purged dry, the well will be considered developed when bailed or pumped dry three times in succession and the turbidity has decreased, or per the requirements set forth in the project-specific SAP. Water quality parameters may be recorded if feasible using the flow-through cell.

If any water is added to the well's borehole during development or drilling, three times the volume of water added will also be removed during well development, or per the requirements set forth in the project-specific SAP.

7.4 Development of Wells with Low Yield

Water is the primary mechanism to remove fines and flush water through the gravel pack for effective development. Therefore, development can be a challenge in wells that do not yield sufficient water to recharge when water is removed. However, often these wells are the most in need of development to improve their performance as they are typically installed in low permeability formations with a high content of fines. Development of these wells can improve their yield.

The surging portion of the development can be successfully performed in a well with standing water regardless of its yield. It is the subsequent removal of fine materials that is hindered when insufficient water is recharged to the well. When wells go dry or drawdown significantly during development, development can be performed intermittently, allowing sufficient water to recharge prior conducting the next stage of surging. These intermittent procedures can take place hours or even days apart, depending on project-specific time constraints.

7.5 Wells containing NAPL

Additional care should be taken when planning development of wells that contain NAPL. If the NAPL is flammable, there are health and safety as well as handling issues to consider. If NAPL in excess of a persistent sheen is noted, the recharge rate will be evaluated through hand bailing. In most cases, it is generally preferable to remove NAPL by bailing to the extent practical prior to performing development. Groundwater parameters, excluding turbidity, will not be collected during well development if NAPL or excessive sheen is noticed in the purged water during development to ensure the meter probes are not fouled or destroyed. Well development will be halted.

Development by surging or pumping the well dry can result in the spreading of NAPL vertically in the soil column around the well. These methods can be used, if information exists describing the vertical thickness of the NAPL smear zone around the well, and if the methods do not result in mounding or drawdown that exceeds this thickness. Alternate methods such as bailing may also be used, but any method should not allow the well to be pumped dry or result in significant drawdown that would spread the NAPL vertically.


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7.6 Temporary Well Points

For certain projects, temporary well points (TWPs) may be installed to collect groundwater samples at a site. Since no sand pack, bentonite chips, or bentonite grout are generally used in the construction of the TWPs, development can proceed as soon as sufficient water has entered the well to static conditions. Due to the small diameter of these wells, generally ¾-inch to 1-inch ID, development will be performed using either a small diameter (0.5-inch) bailer and/or a peristaltic pump with dedicated tubing. The TWPs will have minimal water column and may purge dry during development. However, attempts will be made to remove fines from the well prior to sampling. Purging and sampling may occur as soon as approximately 80% of the static water has re-entered the TWP, or per the requirements set forth in the project-specific SAP.

## 8.0 Quality Control and Assurance

8.1 Field personnel will follow specific quality assurance (QA) guidelines as outlined in the project-specific SAP.

8.2 Quality control (QC) requirements are dependent on project-specific sampling objectives. The project-specific SAP will provide requirements for equipment decontamination (frequency and materials) and IDW handling.

## 9.0 Records, Data Analysis, Calculations

9.1 All data and information (e.g., development method used) must be documented on field data sheets (Attachment 1) or within site logbooks with permanent ink. Data recorded may include the following:

- Well Location
- Weather conditions
- Date and Time
- Purge Method
- Reading/measurements obtained

## 10.0 Attachments or References

Attachment 1 – Well Development Record

SOP 3-05, *IDW Management*.

SOP 3-06, *Equipment Decontamination*.

| *Author* | *Reviewer* | *Revisions (Technical or Editorial)* |
|---|---|---|
| Shawn Dolan<br>Senior Scientist | Chris Barr<br>Program Quality Manager | Rev 0 – Initial Issue (June 2012) |
| | | |
| | | |


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## Attachment 1
## Well Development Record

### Well/Piezometer Development Record

Well ID:

Client: _____

Project No: _____ Date: _____ Developer: _____

Site Location: _____

**Well/Piezometer Data**

Well ☐ Piezometer ☐ Diameter _____ Material _____

Measuring Point Description _____ Geology at Screen Interval (if known) _____

Depth to Top of Screen (ft.) _____

Depth to Bottom of Screen (ft.) _____ Time of Water Level Measurement _____

Total Well Depth (ft.) _____ Calculate Purge Volume (gal.) _____

Depth to Static Water Level (ft.) _____ Disposal Method _____

Headspace _____

Original Well Development ☐ Redevelopment ☐ Date of Original Development _____

**DEVELOPMENT METHOD** _____

**PURGE METHOD** _____

| Time | Total Volume Purged (gal.) | Flow Rate (gpm) | Turbidity (NTU) | Color | pH | Temp | Other |
|---|---|---|---|---|---|---|---|
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |

**ACCEPTANCE CRITERIA (from workplan)**

Minimum Purge Volume Required _____ gallons
Maximum Turbidity Allowed _____ NTUs
Stabilization of parameters _____%

| | Yes | No | N/A |
|---|---|---|---|
| Has required volume been removed | ☐ | ☐ | ☐ |
| Has required turbidity been reached | ☐ | ☐ | ☐ |
| Has parameters stabilized | ☐ | ☐ | ☐ |

If no or N/A explain below:

_____

_____

_____

Signature _____ Date: _____



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# Monitoring Well Sampling

## Procedure 3-14

## 1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the actions to be used during monitoring well sampling activities and establishes the method for sampling groundwater monitoring wells for water-borne contaminants and general groundwater chemistry. The objective is to obtain groundwater samples that are representative of aquifer conditions with as little alteration to water chemistry as possible.

1.2 This procedure is the Program-approved professional guidance for work performed by AECOM under contract to the United States Army Corp of Engineers (USACE).

1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

## 2.0 Safety

2.1 Depending upon the site-specific contaminants, various protective programs must be implemented prior to sampling the first well. All field sampling personnel responsible for sampling activities must review the project-specific Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP), paying particular attention to the control measures planned for the well sampling tasks. Conduct preliminary area monitoring of sampling wells to determine the potential hazard to field sampling personnel. If significant contamination is observed, minimize contact with potential contaminants in both the vapor phase and liquid matrix through the use of of appropriate personal protective equipment (PPE).

2.2 Observe standard health and safety practices according to the project-specific APP/SSHP. Suggested minimum protection during well sampling activities includes inner disposable vinyl gloves, outer chemical-protective nitrile gloves and rubberized steel-toed boots. Half-face respirators and cartridges and Tyvek® suits may be necessary depending on the contaminant concentrations. Refer to the project-specific APP/SSHP for the required PPE.

2.3 Physical Hazards associated with Well Sampling

- To avoid lifting injuries associated with pump and bailers retrieval, use the large muscles of the legs, not the back.
- Stay clear of all moving equipment, and avoid wearing loose fitting clothing.
- When using tools for cutting purposes, cut away from yourself. The use of appropriate, task specific cutting tools is recommended.
- To avoid slip/trip/fall conditions as a result of pump discharge, use textured boots/boot cover bottoms.
- To avoid heat/cold stress as a result of exposure to extreme temperatures and PPE, drink electrolyte replacement fluids (1 to 2 cups per hour is recommended) and, in cases of extreme cold, wear fitted insulating clothing.
- Be aware of restricted mobility due to PPE.


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## 3.0 Terms and Definitions

None.

## 4.0 Interferences

4.1 Potential interferences could result from cross-contamination between samples or sample locations. Minimization of the cross-contamination will occur through the following:

- The use of clean sampling tools at each location as necessary.
- Avoidance of material that is not representative of the media to be sampled.

## 5.0 Training and Qualifications

5.1 **Qualifications and Training**

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 **Responsibilities**

5.2.1 The **Project Manager** is responsible for ensuring that monitoring well sampling activities comply with this procedure. The **Project Manager** is responsible for ensuring that all field sampling personnel involved in monitoring well sampling shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.2.3 The **Site Supervisor (SS)** is responsible for ensuring that all field sampling personnel follow these procedures.

5.2.4 **Field sampling personnel** are responsible for the implementation of this procedure.

5.2.5 The field sampler and/or task manager is responsible for directly supervising the groundwater sampling procedures to ensure that they are conducted according to this procedure and for recording all pertinent data collected during sampling.

## 6.0 Equipment and Supplies

6.1 Purging and Sampling Equipment

- Pump (Peristaltic, Portable Bladder, Submersible)
- Polyethylene or Teflon bladders (for portable bladder pumps)
- Bladder pump controller (for portable bladder pumps)
- Air compressor (for portable bladder pumps)
- Nitrogen cylinders (for portable bladder pumps)
- 12-volt power source
- Polyethylene inlet and discharge tubing (except for VOC analysis which requires Teflon tubing)
- Silicone tubing appropriate for peristaltic pump head
- Teflon bailer appropriately sized for well

- Disposable bailer string (polypropylene)
- Individual or multi-parameter water quality meter(s) with flow-through cell to measure temperature, pH, specific conductance, dissolved oxygen (DO), oxidation reduction potential (ORP), and/or turbidity
- Turbidity meter
- Water level meter
- Oil/water interface probe

6.2 General Equipment

- Sample kit (i.e., bottles, labels, preservatives, custody records and tape, cooler, ice)
- Sample Chain-of-Custody (COC) forms
- Sample Collection Records
- Sample packaging and shipping supplies
- Waterproof marker or paint
- Distilled/deionized water supply
- Water dispenser bottles
- Flow measurement cup or bucket
- 5-gallon buckets
- Instrument calibration solutions
- Stopwatch or watch
- Disposable Nitrile gloves
- Paper towels
- Trash bags
- Zipper-lock bags
- Equipment decontamination supplies
- Health and safety supplies (as required by the APP/SSHP)
- Approved plans such as: project-specific APP/SSHP and SAP
- Well keys or combinations
- Monitoring well location map(s)
- Field project logbook/pen

## 7.0 Calibration or Standardization

7.1 Field instruments will be calibrated daily according to the requirements of the SAP and manufacturer's specifications for each piece of equipment. Equipment will be checked daily with the calibration solutions at the end of use of the equipment. Calibration records shall be recorded in the field logbook or appropriate field form.

7.2 If readings are suspected to be inaccurate, the equipment shall be checked with the calibration solutions and/or re-calibrated.


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# 8.0 Procedure

## 8.1 Preparation

### 8.1.1 Site Background Information

Establish a thorough understanding of the purposes of the sampling event prior to field activities. Conduct a review of all available data obtained from the site and pertinent to the water sampling. Review well history data including, but not limited to, well locations, sampling history, purging rates, turbidity problems, previously used purging methods, well installation methods, well completion records, well development methods, previous analytical results, presence of an immiscible phase, historical water levels, and general hydrogeologic conditions.

Previous groundwater development and sampling logs give a good indication of well purging rates and the types of problems that might be encountered during sampling, such as excessive turbidity and low well yield. They may also indicate where dedicated pumps are placed in the water column. To help minimize the potential for cross-contamination, well purging and sampling and water level measurement collection shall proceed from the least contaminated to the most contaminated well as indicated by previous analytical results. This order may be changed in the field if conditions warrant it, particularly if dedicated sampling equipment is used. A review of prior sampling procedures and results may also identify which purging and sampling techniques are appropriate for the parameters to be tested under a given set of field conditions.

### 8.1.2 Groundwater Analysis Selection

Establish the requisite field and laboratory analyses prior to water sampling. Decide on the types and numbers of quality assurance/quality control (QA/QC) samples to be collected (refer to the project-specific SAP), as well as the type and volume of sample preservatives, the type and number of sample containers, the number of coolers required, and the quantity of ice or other chilling materials. The field sampling personnel shall ensure that the appropriate number and size sample containers are brought to the site, including extras in case of breakage or unexpected field conditions. Refer to the project-specific SAP for the project analytical requirements.

## 8.2 Groundwater Sampling Procedures

Groundwater sampling procedures at a site shall include:

1) An evaluation of the well security and condition prior to sampling;
2) Decontamination of equipment;
3) Measurement of well depth to groundwater;
4) Assessment of the presence or absence of an immiscible phase;
5) Assessment of purge parameter stabilization;
6) Purging of static water within the well and well bore; and
7) Obtaining a groundwater sample.

Each step is discussed in sequence below. Depending upon specific field conditions, additional steps may be necessary. As a rule, at least 24 hours should separate well development and well sampling events. In all cases, consult the State and local regulations for the site, which may require more stringent time separation between well development and sampling.


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### 8.2.1 Well Security and Condition

At each monitoring well location, observe the conditions of the well and surrounding area. The following information may be noted on a Groundwater Sample Collection Record (Attachment 1) or in the field logbook:

- Condition of the well's identification marker.
- Condition of the well lock and associated locking cap.
- Integrity of the well – well pad condition, protective outer casing, obstructions or kinks in the well casing, presence of water in the annular space, and the top of the interior casing.
- Condition of the general area surrounding the well.

### 8.2.2 Decontamination of Equipment

Where possible, dedicated supplies should be used at each well location to minimize the potential for cross-contamination and minimize the amount of investigation derived waste (IDW) fluids resulting from the decontamination process. If decontamination is necessary, establish a decontamination station before beginning sampling. The station shall consist of an area of at least 4 feet by 2 feet covered with plastic sheeting and be located upwind of the well being sampled. The station shall be large enough to fit the appropriate number of wash and rinse buckets, and have sufficient room to place equipment after decontamination. One central cleaning area may be used throughout the entire sampling event. The area around the well being sampled shall also be covered with plastic sheeting to prevent spillage. Further details are presented in SOP 3-06, Equipment Decontamination.

Decontaminate each piece of equipment prior to entering the well. Also, conduct decontamination prior to sampling at a site, even if the equipment has been decontaminated subsequent to its last usage. Additionally, decontaminate each piece of equipment used at the site prior to leaving the site. It is only necessary to decontaminate dedicated sampling equipment prior to installation within the well. Do not place clean sampling equipment directly on the ground or other contaminated surfaces prior to insertion into the well. Dedicated sampling equipment that has been certified by the manufacturer as being decontaminated can be placed in the well without on-site decontamination.

### 8.2.3 Measurement of Static Water Level Elevation

Before purging the well, measure water levels in all of the wells within the zone of influence of the well being purged. The best practice, if possible, is to measure all site wells (or wells within the monitoring well network) prior to sampling. If the well cap is not vented, remove the cap several minutes before measurement to allow water levels to equilibrate to atmospheric pressure.

Measure the depth to standing water and the total depth of the well to the nearest 0.01 foot to provide baseline hydrologic data, to calculate the volume of water in the well, and to provide information on the integrity of the well (e.g., identification of siltation problems). If not already present, mark an easily identified reference point for water level measurements which will become the measuring point for all water level measurements. This location and elevation must be surveyed.

The device used to measure the water level surface and depth of the well shall be sufficiently sensitive and accurate in order to obtain a measurement to the nearest 0.01 foot reliably. An electronic water level meter will usually be appropriate for this measurement; however, when the groundwater within a particular well is highly contaminated, an inexpensive weighted tape measure can be used to determine well depth to prevent adsorption of contaminants onto the meter tape. The presence of light, non-aqueous phase liquids (LNAPLs) and/or dense, non-aqueous phase liquids (DNAPLs) in a well requires measurement of the elevation of the top and the bottom of the product, generally using an interface probe. Water levels in such wells must then be corrected for density effects to accurately determine the elevation of the water table.


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At each location, measure water levels several times in quick succession to ensure that the well has equilibrated to atmospheric conditions prior to recording the measurement. As stated above, measure all site wells (or wells within the monitoring well network) prior to sampling whenever possible. This will provide a water level database that describes water levels across the site at one time (a synoptic sampling). Prior to sampling, measure the water level in each well immediately prior to purging the well to ascertain that static conditions have been achieved prior to sampling.

### 8.2.4 Detection of Immiscible Phase Layers

Complete the following steps for detecting the presence of LNAPL and DNAPL before the well is purged for conventional sampling. These procedures may not be required for all wells. Consult the project-specific SAP to determine if assessing the presence of LNAPL and/or DNAPL is necessary.

1) Sample the headspace in the wellhead immediately after the well is opened for organic vapors using either a PID or an organic vapor analyzer, and record the measurements.

2) Lower an interface probe into the well to determine the existence of any immiscible layer(s), LNAPL and/or DNAPL, and record the measurements.

3) Confirm the presence or absence of an immiscible phase by slowly lowering a clear bailer to the appropriate depth, then visually observing the results after sample recovery.

4) In rare instances, such as when very viscous product is present, it may be necessary to utilize hydrocarbon- and water-sensitive pastes for measurement of LNAPL thickness. This is accomplished by smearing adjacent, thin layers of both hydrocarbon- and water-sensitive pastes along a steel measuring tape and inserting the tape into the well. An engineering tape showing tenths and hundredths of feet is required. Record depth to water, as shown by the mark on the water-sensitive paste, and depth to product, as shown by the mark on the product-sensitive paste. In wells where the approximate depth to water and product thickness are not known, it is best to apply both pastes to the tape over a fairly long interval (5 feet or more). Under these conditions, measurements are obtained by trial and error and may require several insertions and retrievals of the tape before the paste-covered interval of the tape encounters product and water. In wells where approximate depths of air-product and product-water interfaces are known, pastes may be applied over shorter intervals. Water depth measurements should not be used in preparation of water table contour maps until they are corrected for depression by the product.

5) If the well contains an immiscible phase, it may be desirable to sample this phase separately. Section 8.2.6 presents immiscible phase sampling procedures. It may not be meaningful to conduct water sample analysis of water obtained from a well containing LNAPLs or DNAPLs. Consult the **Project Manager** and **Program Quality Manager** if this situation is encountered.

### 8.2.5 Purging Equipment and Use

**General Requirements**

The water present in a well prior to sampling may not be representative of in situ groundwater quality and shall be removed prior to sampling. Handle all groundwater removed from potentially contaminated wells in accordance with the IDW handling procedures in SOP 3-05, IDW Management. Purging shall be accomplished by methods as indicated in the project-specific SAP or by those required by State requirements. For the purposes of this SOP, purging methods will be described by removing groundwater from the well using low-flow techniques.

According to the U.S. Environmental Protection Agency (EPA) (EPA, 1996), the rate at which groundwater is removed from the well during purging ideally should be less than 0.2 to 0.3 liters/minute. EPA further states that wells should be purged at rates below those used to develop the well to prevent further development of the well, to prevent damage to the well, and to avoid disturbing accumulated


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corrosion or reaction products in the well. EPA also indicates that wells should be purged at or below their recovery rate so that migration of water in the formation above the well screen does not occur.

Realistically, the purge rate should be low enough that substantial drawdown in the well does not occur during purging. In addition, a low purge rate will reduce the possibility of stripping volatile organic compounds (VOCs) from the water, and will reduce the likelihood of increasing the turbidity of the sample due to mobilizing colloids in the subsurface that are immobile under natural flow conditions.

The field sampler shall ensure that purging does not cause formation water to cascade down the sides of the well screen. Wells should not be purged to dryness if recharge causes the formation water to cascade down the sides of the screen, as this will cause an accelerated loss of volatiles. This problem should be anticipated based on the results of either the well development task or historical sampling events. In general, place the intake of the purge pump in the middle of the saturated screened interval within the well to allow purging and at the same time minimize disturbance/overdevelopment of the screened interval in the well. Water shall be purged from the well at a rate that does not cause recharge water to be excessively agitated unless an extremely slow recharging well is encountered where complete evacuation is unavoidable. During the well purging procedure, collect water level and/or product level measurements to assess the hydraulic effects of purging. Sample the well when it recovers sufficiently to provide enough water for the analytical parameters specified. If the well is purged dry, allow the well to recover sufficiently to provide enough water for the specified analytical parameters, and then sample it.

Evaluate water samples on a regular basis during well purging and analyze them in the field preferably using in-line devices (i.e., flow through cell) for temperature, pH, specific conductivity, dissolved oxygen (DO), and oxidation-reduction (redox) potential. Turbidity should be measured separately (outside of the flow-through cell) with a nephelometer or similar device.

Readings should be taken every 2 to 5 minutes during the purging process. These parameters are measured to demonstrate that the natural character of the formation waters has been restored.

Purging shall be considered complete per the requirements set forth in the project-specific SAP, State requirements, or when three consecutive field parameter measurements of temperature, pH, specific conductivity, DO and ORP stabilize within approximately 10 percent and the turbidity is at or below 10 nephelometric turbidity units (NTU) or within ± 10% if above 10 NTU. This criterion may not be applicable to temperature if a submersible pump is used during purging due to the heating of the water by the pump motor. Enter all information obtained during the purging and sampling process into a groundwater sampling log. Attachment 1 shows an example of a groundwater sampling log and the information typically included in the form. Whatever form is used, all blanks need to be completed on the field log during field sampling.

Groundwater removed during purging shall be stored according to the project-specific SAP or per SOP 3-05, IDW Management.

**Purging Equipment and Methods**

***Submersible Pump***

A stainless steel submersible pump may be utilized for purging both shallow and deep wells prior to sampling the groundwater for semivolatile and non-volatile constituents, but are generally not preferred for VOCs unless there are no other options (e.g., well over 200 feet deep). For wells over 200 feet deep, the submersible pump is one of the few technologies available to feasibly accomplish purging under any yield conditions. For shallow wells with low yields, submersible pumps are generally inappropriate due to overpumpage of the wells (<1 gallon per minute), which causes increased aeration of the water within the well.

Steam clean or otherwise decontaminate the pump and discharge tubing prior to placing the pump in the well. The submersible pump shall be equipped with an anti-backflow check valve to limit the amount of


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water that will flow back down the drop pipe into the well. Place the pump in the middle of the saturated screened interval within the well and maintain it in that position during purging.

***Bladder Pump***

A stainless steel bladder pump can be utilized for purging and sampling wells up to 200 feet in depth for volatile, semivolatile, and non-volatile constituents. Use of the bladder pump is most effective in low to moderate yield wells and are often the preferred method for low-flow sampling. When sampling for VOCs and/or SVOCs, Teflon bladders should be used. Polyethylene bladders may be used when sampling for inorganics.

Either compressed dry nitrogen or compressed dry air, depending upon availability, can operate the bladder pump. The driving gas utilized must be dry to avoid damage to the bladder pump control box. Decontaminate the bladder pump prior to use.

***Centrifugal, Peristaltic, or Diaphragm Pump***

A centrifugal, peristaltic, or diaphragm pump may be utilized to purge a well if the water level is within 20 feet of ground surface. New or dedicated tubing is inserted into the midpoint of the saturated screened interval of the well. Water should be purged at a rate that satisfies low-flow requirements (i.e., does not cause drawdown). Centrifugal, peristaltic, or diaphragm pump are generally discouraged for VOCs sampling; however, follow methods allowed per the project-specific SAP or State requirements.

***Air Lift Pump***

Airlift pumps are not appropriate for purging or sampling.

***Bailer***

Avoid using a bailer to purge a well because it can result in overdevelopment of the well and create excessive purge rates. If a bailer must be used, the bailer should either be dedicated or disposable. Teflon-coated cable mounted on a reel is recommended for lowering the bailer in and out of the well.

Lower the bailer below the water level of the well with as little disturbance of the water as possible to minimize aeration of the water in the well. One way to gauge the depth of water on the reel is to mark the depth to water on the bailer wire with a stainless steel clip. In this manner, less time is spent trying to identify the water level in the well.

### 8.2.6 Monitoring Well Sampling Methodologies

**Sampling Light, Non-Aqueous Phase Liquids (LNAPL)**

Collect LNAPL, if present, prior to any purging activities. The sampling device shall generally consist of a dedicated or disposable bailer equipped with a bottom-discharging device. Lower the bailer slowly until contact is made with the surface of the LNAPL, and to a depth less than that of the immiscible fluid/water interface depth as determined by measurement with the interface probe. Allow the bailer to fill with LNAPL and retrieve it.

When sampling LNAPLs, never drop bailers into a well and always remove them from the well in a manner that causes as little agitation of the sample as possible. For example, the bailer should not be removed in a jerky fashion or be allowed to continually bang against the well casing as it is raised. Teflon bailers should always be used when sampling LNAPL. The cable used to raise and lower the bailer shall be composed of an inert material (e.g., stainless steel) or coated with an inert material (e.g., Teflon).

**Sampling Dense, Non-Aqueous Phase Liquids (DNAPL)**

Collect DNAPL prior to any purging activities. The best method for collecting DNAPL is to use a double-check valve, stainless steel bailer, or a Kemmerer (discrete interval) sampler. The sample shall be collected by slow, controlled lowering of the bailer to the bottom of the well, activation of the closing device, and retrieval.


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**Groundwater Sampling Methodology**

The well shall be sampled when groundwater within it is representative of aquifer conditions per the methods described in Section 8.2.5. Prior to sampling the flow-through cell shall be removed and the samples collected directly from the purge tubing. Flow rates shall not be adjusted once aquifer conditions are met. Additionally, a period of no more than 2 hours shall elapse between purging and sampling to prevent groundwater interaction with the casing and atmosphere. This may not be possible with a slowly recharging well. Measure and record the water level prior to sampling in order to monitor drawdown when using low-flow techniques and gauge well volumes removed and recharged when using non-low-flow techniques.

Sampling equipment (e.g., especially bailers) shall never be dropped into the well, as this could cause aeration of the water upon impact. Additionally, the sampling methodology utilized shall allow for the collection of a groundwater sample in as undisturbed a condition as possible, minimizing the potential for volatilization or aeration. This includes minimizing agitation and aeration during transfer to sample containers, minimizing exposure to sunlight, and immediately placing the sample on ice once collected.

Sampling equipment shall be constructed of inert material. Equipment with neoprene fittings, polyvinyl chloride (PVC) bailers, Tygon® tubing, silicon rubber bladders, neoprene impellers, polyethylene, and Viton® are not acceptable when sampling for organics. If bailers are used, an inert cable/chain (e.g., fluorocarbon resin-coated wire or stainless steel wire or cable) shall be used to raise and lower the bailer. Dedicated equipment is highly recommended for all sampling programs.

***Submersible Pumps***

The submersible pump must be specifically designed for groundwater sampling (i.e., pump composed of stainless steel and Teflon, sample discharge lines composed of Teflon) and must have a controller mechanism allowing the required low-flow rate. Adjust the pump rate so that flow is continuous and does not pulsate to avoid aeration and agitation within the sample discharge lines. Run the pump for several minutes at the low-flow rate used for sampling to ensure that the groundwater in the lines was obtained at the low-flow rate.

***Bladder Pumps***

A gas-operated stainless steel bladder pump with adjustable flow control and equipped with a Teflon bladder and Teflon-lined tubing can be effectively utilized to collect a groundwater sample and is considered to be the best overall device for sampling inorganic and organic constituents. If only inorganics are being sampled, polyvinyl bladders and tubing may be used. Operate positive gas displacement bladder pumps in a continuous manner so that they minimize discharge pulsation that can aerate samples in the return tube or upon discharge.

When using a compressor, take several precautions. If the compressor is being powered by a gasoline generator, position the generator downwind of the well. Ground fault circuit interrupters (GFCIs) should always be used when using electric powered equipment. Do not connect the compression hose from the compressor to the pump controller until after the engine has been started.

When all precautions are completed and the compressor has been started, connect the compression hose to the pump controller. Slowly adjust the control knobs to discharge water in the shortest amount of time while maintaining a near constant flow. This does not mean that the compressor must be set to discharge the water as hard as possible. The optimal setting is one that produces the largest volume of purge water per minute (not per purge cycle) while maintaining a near constant flow rate.

Prior to sampling, adjust the flow rate (purge rate) to yield 100 to 300 mL/minute. Avoid settings that produce pulsating streams of water instead of a steady stream if possible. Operate the pump at this low flow rate for several minutes to ensure that drawdown is not occurring. At no time shall the sample flow rate exceed the flow rate used while purging.


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For those samples requiring filtration, it is recommended to use an in-line high capacity filter after all non-filtered samples have been collected.

***Peristaltic Pumps*:**

A peristaltic pump is a type of positive displacement pump that moves water via the process of peristalsis. The pump uses a flexible hose fitted inside a circular pump casing. A rotor with cams compresses the flexible tube as the rotor turns, which forces the water to be pumped to move through the tube. In peristaltic pumps, no moving parts of the pump are in contact with the water being pumped. Displacement is determined by tube size, so delivery rate can only be changed during operation by varying pump speed. Peristaltic pumps are simple and quite inexpensive for the flow rates they provide.

There are several methods available for transferring the sample into the laboratory containers. The selected method may vary based on State requirements and should be documented in the project-specific SAP. Samples typically can be collected directly from the discharge end of the Teflon tubing, after it has been disconnected from the flow through cell. For volatile analyses, the sampler should make sure that the pump is set such that a smooth laminar flow is achieved. In all cases, the project team should consult their local regulatory requirements and document the selected sample collection procedure in the project-specific SAP.

***Bailers***

A single- or double-check valve Teflon or stainless steel bailer equipped with a bottom discharging device can be utilized to collect groundwater samples. Bailers have a number of disadvantages, however, including a tendency to alter the chemistry of groundwater samples due to degassing, volatilization, and aeration; the possibility of creating high groundwater entrance velocities; differences in operator techniques resulting in variable samples; and difficulty in determining where in the water column the sample was collected. Therefore, use bailers for groundwater sampling only when other types of sampling devices cannot be utilized for technical, regulatory, or logistical reasons.

Dedicated or disposable bailers should always be used in order to eliminate the need for decontamination and to limit the potential of cross-contamination. Each time the bailer is lowered to the water table, lower it in such a way as to minimize disturbance and aeration of the water column within the well.

### 8.2.7 Sample Handling and Preservation

Many of the chemical constituents and physiochemical parameters to be measured or evaluated during groundwater monitoring programs are chemically unstable and require preservation. The U.S. EPA document entitled, *Test Methods for Evaluating Solid Waste – Physical/Chemical Methods (SW-846)* (EPA 1997), includes a discussion of appropriate sample preservation procedures. In addition, SW-846 provides guidance on the types of sample containers to use for each constituent or common set of parameters. In general, check with specific laboratory or State requirements prior to obtaining field samples. In many cases, the laboratory will supply the necessary sample bottles and required preservatives. In some cases, the field sampling personnel may add preservatives in the field.

Improper sample handling may alter the analytical results of the sample. Therefore, transfer samples in the field from the sampling equipment directly into the container that has been prepared specifically for that analysis or set of compatible parameters as described in the project-specific SAP. It is not an acceptable practice for samples to be composited in a common container in the field and then split in the laboratory, or poured first into a wide mouth container and then transferred into smaller containers.

Collect groundwater samples and place them in their proper containers in the order of decreasing volatility and increasing stability. A preferred collection order for some common groundwater parameters is:

1. VOCs and total organic halogens (TOX)


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2. Dissolved gases, total organic carbon (TOC), total fuel hydrocarbons
3. Semivolatile organics, pesticides
4. Total metals, general minerals (unfiltered)
5. Dissolved metals, general minerals (filtered)
6. Phenols
7. Cyanide
8. Sulfate and chloride
9. Nitrate and ammonia
10. Radionuclides

When sampling for VOCs, collect water samples in vials or containers specifically designed to prevent loss of VOCs from the sample. The analytical laboratory performing the analysis shall provide these vials. Collect groundwater from the sampling device in vials by allowing the groundwater to slowly flow along the sides of the vial. Sampling equipment shall not touch the interior of the vial. Fill the vial above the top of the vial to form a positive meniscus with no overflow. No headspace shall be present in the sample container once the container has been capped. This can be checked by inverting the bottle once the sample is collected and tapping the side of the vial to dislodge air bubbles. Sometimes it is not possible to collect a sample without air bubbles, particularly water that has high concentrations of dissolved gasses. In these cases, the field sampling personnel shall document the occurrence in the field logbook and/or sampling worksheet at the time the sample was collected. Likewise, the analytical laboratory shall note in the laboratory analysis reports any headspace in the sample container(s) at the time of receipt by the laboratory.

**Special Handling Considerations**

In general, samples for organic analyses should not be filtered. However, high turbidity samples for PCB analysis may require filtering. Consult the project-specific SAP for details on filtering requirements. Samples shall not be transferred from one container to another because this could cause aeration or a loss of organic material onto the walls of the container. TOX and TOC samples should be handled in the same manner as VOC samples.

When collecting total and dissolved metals samples, the samples should be collected sequentially. The total metals sample is collected from the pump unfiltered. The dissolved metals sample is collected after filtering with a 0.45-micron membrane in-line filter. Allow at least 500 mL of effluent to flow through the filter prior to sampling to ensure that the filter is thoroughly wetted and seated in the filter capsule. If required by the project-specific SAP, include a filter blank for each lot of filters used and always record the lot number of the filters.

**Field Sampling Preservation**

Preserve samples immediately upon collection. Ideally, sampling containers will be pre-preserved with a known concentration and volume of preservative. Certain matrices that have alkaline pH (greater than 7) may require more preservative than is typically required. An early assessment of preservation techniques, such as the use of pH strips after initial preservation, may therefore be appropriate. Guidance for the preservation of environmental samples can be found in the U.S. EPA *Handbook for Sampling and Sample Preservation of Water and Wastewater* (EPA 1982). Additional guidance can be found in other U.S. EPA documents (EPA 1992, 1996).

**Field Sampling Log**

A groundwater sampling log provided as Attachment 1 shall document the following:

- Identification of well


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- Well depth
- Static water level depth and measurement technique
- Presence of immiscible layers and detection method
- Well yield
- Purge volume and pumping rate
- Time that the well was purged
- Sample identification numbers
- Well evacuation procedure/equipment
- Sample withdrawal procedure/equipment
- Date and time of collection
- Types of sample containers used
- Preservative(s) used
- Parameters requested for analysis
- Field analysis data
- Field observations on sampling event
- Name of sampler
- Weather conditions

## 9.0 Quality Control and Assurance

9.1 Field personnel will follow specific quality assurance (QA) guidelines as outlined in the project-specific SAP. The goal of the QA program should be to ensure precision, accuracy, representativeness, completeness, and comparability in the project sampling program.

9.2 Quality control (QC) requirements for sample collection are dependent on project-specific sampling objectives. The project-specific SAP will provide requirements for sample preservation and holding times, container types, sample packaging and shipment, as well as requirements for the collection of various QC samples such as trip blanks, field blanks, equipment rinse blanks, and field duplicate samples.

## 10.0 Data and records management

10.1 Records will be maintained in accordance with SOP 3-03, Recordkeeping, Sample Labelling, and Chain-of-Custody. Various forms are required to ensure that adequate documentation is made of the sample collection activities. These forms may include:

- Sample Collection Records;
- Field logbook;
- Chain-of-custody forms; and
- Shipping labels.


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10.2 Sample collection records (Attachment 1) will provide descriptive information for the purging process and the samples collected at each monitoring well.

10.3 The field logbook is kept as a general log of activities and should not be used in place of the sample collection record.

10.4 Chain-of-custody forms are transmitted with the samples to the laboratory for sample tracking purposes.

10.5 Shipping labels are required is sample coolers are to be transported to a laboratory by a third party (courier service).

## 11.0 Attachments or References

Attachment 1 – Groundwater Sampling Collection Record

ASTM Standard D5088. 2008. *Standard Practice for Decontamination of Field Equipment Used at Waste Sites.* ASTM International, West Conshohocken, PA. 2008. DOI: 10.1520/D5088-02R08. www.astm.org.

Environmental Protection Agency, United States (EPA). 1982. *Handbook for Sampling and Sample Preservation of Water and Wastewater.* EPA-600/4-82-029. Cincinnati: EPA Office of Research and Development, Environmental Monitoring and Support Laboratory.

EPA. 1992. *RCRA Groundwater Monitoring Draft Technical Guidance*. EPA/530/R-93/001. Office of Solid Waste. November.

EPA. 1996. *Ground Water Issue: Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures*. EPA/540/S-95/504. Office of Solid Waste and Emergency Response. April.

EPA. 1997. *Test Methods for Evaluating Solid Waste, Physical/Chemical Method (SW-846)*. 3rd ed., Final Update IIIA. Office of Solid Waste. Online updates at: http://www.epa.gov/epaoswer/hazwaste/test/new-meth.htm.

SOP 3-03, *Recordkeeping, Sample Labelling, and Chain-of-Custody*.

SOP 3-05, *IDW Management.*

SOP 3-06, *Equipment Decontamination*.

| *Author* | *Reviewer* | *Revisions (Technical or Editorial)* |
|---|---|---|
| Mark Kromis<br>Program Chemist | Chris Barr<br>Program Quality Manager | Rev 0 – Initial Issue (May 2012) |
| | | |
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## Attachment 1
## Groundwater Sample Collection Record

Well ID:

### Groundwater Sample Collection Record

Client: _____ Date: _____ Time: Start _____ am/pm
Project No: _____ Finish _____ am/pm
Site Location: _____
Weather Conds: _____ Collector(s): _____

1. **WATER LEVEL DATA: (measured from Top of Casing)**
   a. Total Well Length _____ c. Length of Water Column _____ (a-b)
   b. Water Table Depth _____ d. Calculated Well Volume (see back) _____
   Casing Diameter/Material _____

2. **WELL PURGEABLE DATA**
   a. Purge Method: _____
   b. Acceptance Criteria defined (see SAP or Work Plan)
   - Minimum Required Purge Volume (@ _____ well volumes) _____
   - Maximum Allowable Turbidity _____ NTUs
   - Stabilization of parameters _____ %
   c. Field Testing Equipment used: Make Model Serial Number

| Time (min) | Volume Removed (gal) | Temp. (°C) | pH s.u. | Spec. Cond. (µS/cm) | DO (mg/L) | ORP (mV) | Turbidity (NTU) | Flow Rate (ml/min) | Drawdown (m) | Color/Odor/etc. |
|---|---|---|---|---|---|---|---|---|---|---|
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(continued on back)

   d. Acceptance criteria pass/fail

| | Yes | No | N/A |
|---|---|---|---|
| Has required volume been removed | ☐ | ☐ | ☐ |
| Has required turbidity been reached | ☐ | ☐ | ☐ |
| Have parameters stabilized | ☐ | ☐ | ☐ |

   If no or N/A - Explain below.
   _____

3. **SAMPLE COLLECTION:** Method: _____

| Sample ID | Container Type | No. of Containers | Preservation | Analysis Req. | Time |
|---|---|---|---|---|---|
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Comments _____

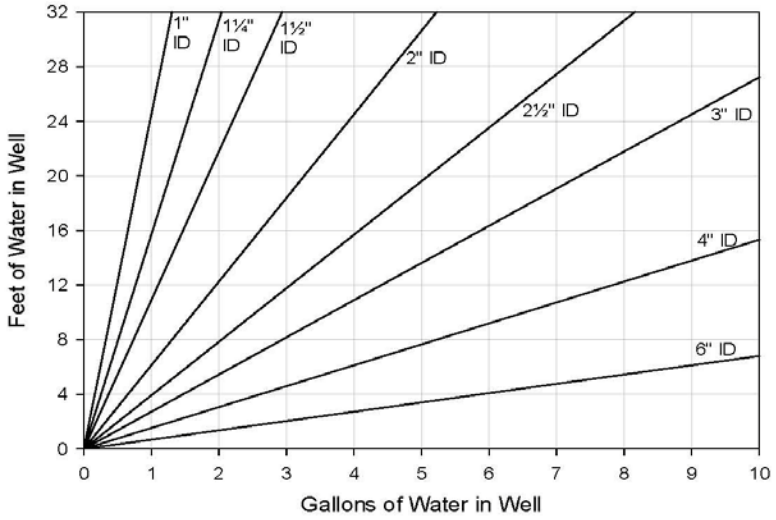
Signature _____ Date _____

Page 1 of 2


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**Purge Volume Computation**

Well ID:




| Volume / Linear Ft. of Pipe | | |
|---|---|---|
| **ID (in)** | **Gallon** | **Liter** |
| ¼ | 0.0025 | 0.0097 |
| 3/8 | 0.0057 | 0.0217 |
| ½ | 0.0102 | 0.0386 |
| ¾ | 0.0229 | 0.0869 |
| 1 | 0.0408 | 0.1544 |
| 1¼ | 0.0637 | 0.2413 |
| 1½ | 0.0918 | 0.3475 |
| 2 | 0.1632 | 0.6178 |
| 2½ | 0.2550 | 0.9653 |
| 3 | 0.3672 | 1.3900 |
| 4 | 0.6528 | 2.4711 |
| 6 | 1.4688 | 5.5600 |

(continued from front)

| Time (min) | Volume Removed (gal) | Temp. (°C) | pH s.u. | Spec. Cond. (µS/cm) | DO (mg/L) | ORP (mV) | Turbidity (NTU) | Flow Rate (ml/min) | Drawdown (m) | Color/Odor/etc. |
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Signature _____ Date _____





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# Monitoring Well and Borehole Abandonment

## Procedure 3-15

## 1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the methods used for the abandonment of groundwater monitoring wells, piezometers, and direct-push boreholes.

1.2 This procedure is the Program-approved professional guidance for work performed by AECOM under the United States Army Corp of Engineers (USACE).

1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

## 2.0 Safety

2.1 The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the project Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP). In the absence of a APP/SSHP, work will be conducted according to the Work Plan (WP) and/or direction from the Site Safety Health Officer (SSHO).

2.2 Physical hazards associated with well installation include:

- To avoid lifting injuries associated with well abandonment practices, use the large muscles of the legs, not the back. The drilling contractor should use the drill rig wenching cables and appropriate heavy equipment to minimize manual lifting.
- Stay clear of all moving equipment and avoid wearing loose fitting clothing.
- When using an approved retractable-blade knife, cut away from one self.
- To avoid slip/trip/fall conditions during site activities, keep the area clear of excess soil cuttings and formation groundwater and use textured boots/boot cover bottoms in muddy areas.
- To avoid heat/cold stress because of exposure to extreme temperatures and PPE, drink electrolyte replacement fluids (1 - 2 cups per hour is recommended) and, in cases of extreme cold, wear fitted insulating clothing.
- Be aware of restricted mobility caused by PPE.

## 3.0 Terms and Definitions

3.1 **Annulus:** The annulus is the down-hole space between the borehole wall and the well casing and screen.

3.2 **Bridge:** A bridge is an obstruction in the drill hole or annulus. A bridge is usually formed by caving of the wall of the well bore, by the intrusion of a large boulder, or by the placement of filter pack materials during well completion. Bridging can also occur in the formation during well development.

3.3 **Filter Pack:** Filter pack is sand or gravel that is smooth, uniform, clean, well-rounded, and siliceous. It is placed in the annulus of the well between the borehole wall and the well screen to prevent formation materials from entering the well and to stabilize the adjacent formation.

3.4 **Grout:** Grout is a fluid mixture of cement and water that can be forced through a tremie pipe and emplaced in the annular space between the borehole and casing to form an impermeable seal. Various


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additives, such as sand, bentonite, and polymers, may be included in the mixture to meet certain requirements.

## 4.0 Interferences

4.1 The total depth of the monitoring well will be measured and the measurement will be compared to the original well completion log prior to abandonment.

4.2 A map with the location of the well to be abandoned and the surrounding wells, if any, will be utilized in the field to confirm the location of the well to be abandoned.

4.3 Information from the well identification tags/markings will be noted and the information compared to both the well completion log and the total depth measurement obtained in the field to confirm the identity of the well being abandoned.

## 5.0 Training and Qualifications

5.1 Qualifications and Training

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

5.2.1 The **Project Manager** is responsible for ensuring that well abandonment activities comply with this procedure. The **Project Manager** is responsible for ensuring that all personnel involved in well abandonment shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.2.3 The **Site Supervisor** is responsible for ensuring that all well abandonment activities are conducted according to the either this procedure or the applicable procedure presented in the project-specific SAP.

5.2.4 **Field sampling personnel** are responsible for the implementation of this procedure.

5.2.5 The field sampler and/or task manager is responsible for directly supervising the well abandonment procedures to ensure that they are conducted according to this procedure and for recording all pertinent data collected during sampling.

## 6.0 Equipment and Supplies

6.1 Equipment and materials used during monitoring well and piezometer abandonment include the following:

- Drill rig or trailer-mounted mixer and grout pump
- Filter pack material
- Pure sodium bentonite with no additives
- Bentonite pellets/chips
- Bentonite grout
- Portland Type II cement
- Water from an approved source
- Weighted tape measure


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- Flexible hose
- Tremie pipe (small-diameter, rigid polyvinyl chloride [PVC] pipe)
- Weatherproof bound field logbook with numbered pages
- Appropriate health and safety equipment

## 7.0 Procedure

7.1 General Procedures

The following procedure applies to the abandonment of wells aborted prior to completion, existing wells determined to be ineffective or otherwise in need of closure, temporary wells, or boreholes (with the exception that boreholes will not have casing and pipe in place). Prior to abandoning any developed well, you may need to acquire a permit from the State or local governing body in which you are working. The permit application may require a detailed design of the well abandonment. In addition, prior to abandonment, all obstructions (e.g., pumps, lost equipment) must be removed from the well. Some States are strict in requiring the removal of all lost equipment prior to abandonment and will not allow the closure of a well with lost equipment in it. The State may require the removal of all objects to allow a proper seal during abandonment. Great lengths must be taken to reclaim lost items, such as the use of downhole video cameras to inspect and aid in the recovery of items. Prior to abandonment, confirm that the well selected for abandonment is properly located and identified to avoid abandoning the wrong well.

At locations where a well log is not available, the following procedure shall be implemented:

- The casing should be pulled, drilled out, or thoroughly pierced.
- With the use of a tremie pipe, grout should be placed from the bottom of the hole to within 3 feet of the ground surface.
- The material should be allowed to settle for 24 hours.
- The remainder of the hole should be filled with concrete.
- All historical sample data and abandonment procedures should be included in the records of work.

At locations where a well completion log is available, the following procedure shall be implemented:

- With the use of a tremie pipe, grout should be placed from the bottom of the hole to within 3 feet of the ground surface.
- The material should be allowed to settle for 24 hours.
- The remainder of the hole should be filled with concrete.
- All boring logs, historical sample data, completion records, and abandonment procedures should be included in the records of work.

Depending on the regulatory body under which you are working, the procedures listed above may differ. All work shall be performed by a licensed well driller in the State work is being performed. The licensed well driller is responsible for documenting the abandonment of the monitoring well with the appropriate State agency.

7.2 Replacement Wells

Replacement wells (if any) should normally be offset at least 15 feet from any abandoned well in an upgradient or crossgradient groundwater flow direction. Site-specific conditions may necessitate variation of this placement requiring the replacement well to be located either closer or further in proximity to the original well. To avoid potential issues related to grout migration into a well filter pack and/or screen section, replacement wells should be installed after the original/adjacent well is properly abandoned.


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7.3 Grout

Bentonite grout is preferred for the abandonment of monitoring wells. Cement grout, if used for abandonment, should be composed of the following by weight:

- 20 parts cement (Portland cement, Type II or V)
- 0.4 to 1 part (maximum) (2 to 5 percent) bentonite
- 8 gallons (maximum) approved water per 94-pound bag of cement

Neither additives nor borehole cuttings should be mixed with the grout. Bentonite should be added after the required amount of cement has been mixed with the water. All grout material should be combined in an aboveground container and mechanically blended to produce a thick, lump-free mixture. The mixed grout should be recirculated through the grout pump prior to placement. The mixture can be combined and recirculated through a drill rig equipped for mud rotary drilling or through a mixer and grout pump mounted on a trailer.

Grout should be placed with the use of a commercially available grout pump and a rigid tremie pipe. Casing and grouting should be removed in stages, aquifer by aquifer, sealing the boring from the bottom to ground surface. This should be accomplished by placing a tremie pipe to the bottom and pumping grout through the pipe until undiluted grout reaches the bottom of the next higher section of casing or, for the topmost section, until grout flows from the boring at the ground surface.

After 24 hours, the abandoned drilling site should be checked for grout settlement. Any settlement depression should be filled with grout and rechecked 24 hours later. This process should be repeated until firm grout remains at the ground surface.

Be aware that when the drillers are finished, they will need a large supply of water to rinse out their equipment. This wash water must be containerized as IDW in accordance with SOP 3-05, *IDW Management*. Also, any materials (such as the removed protective casing, manhole covers, and concrete collars) shall be disposed of properly, or per the requirements of the project-specific SAP.

## 8.0 Quality Control and Assurance

8.1 Field personnel will follow specific quality assurance (QA) guidelines as outlined in the project-specific SAP.

8.2 Quality Control (QC) measures should be taken to ensure proper well abandonment in accordance with this SOP, project-specific SAP, and applicable well standards.

## 9.0 Records, Data Analysis, Calculations

9.1 All field information must be documented in the field logbook and/or on field data sheets with permanent ink. Data recorded may include the following:

- Date/time
- Well/piezometer location
- Personnel/subcontractor on site
- Abandonment method
- Depth of well/piezometer
- Materials used to seal each stratum
- Detailed description of procedure
- Date/time of return visit(s)
- Activities performed on return visit(s)
- Observations or problems encountered during abandonment


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## 10.0 Attachments or References

Environmental Protection Agency, United States (EPA). 1987. *A Compendium of Superfund Field Operations Methods*. Office of Solid Waste and Emergency Response. EPA/540/P-87/001.

SOP 3-05, *IDW Management*.

| *Author* | *Reviewer* | *Revisions (Technical or Editorial)* |
|---|---|---|
| Shawn Dolan<br>Senior Scientist | Chris Barr<br>Program Quality Manager | Rev 0 – Initial Issue (June 2012) |
| | | |
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# Soil and Rock Classification

## Procedure 3-16

## 1.0 Purpose and Scope

1.1 The purpose of this document is to define the standard operating procedure (SOP) to thoroughly describe the physical characteristics of the sample and classify it according to the Unified Soil Classification System (USCS).

1.2 This procedure is the Program-approved professional guidance for work performed by AECOM under United States Army Corp of Engineers (USACE) contracts.

1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review. If there are procedures whether it be from AECOM, state and/or federal that are not addressed in this SOP and are applicable to surface water sampling then those procedures may be added as an appendix to the project specific SAP.

1.4 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Program Quality Manager. Deviations to this SOP will be documented in the field records.

## 2.0 Safety

2.1 Depending upon the site-specific contaminants, various protective programs must be implemented prior to sampling. All **field sampling personnel** responsible for sampling activities must review the project-specific Accident Prevention Plan (APP), with a Site-Safety and Health Plan (SSHP) attachment, paying particular attention to the control measures planned for the sampling tasks. Conduct preliminary area monitoring to determine the potential hazard to field sampling personnel. If significant contamination is observed, minimize contact with potential contaminants in both the vapor and liquid phase through the use of respirators and disposable clothing.

2.2 In addition, observe standard health and safety practices according to the project-specific APP. Suggested minimum protection during well sampling activities includes inner disposable vinyl gloves, outer chemical-protective nitrile gloves, rubberized steel-toed boots, and an American National Standards Institute-standard hard hat. Half-face respirators and cartridges and Tyvek® suits may be necessary depending on the contaminant concentrations, and shall always be available on site.

2.3 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the **Site Safety and Health Officer (SSHO)** or designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the APP/SSHP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSHO.

2.4 The health and safety considerations for the work associated with soil classification include:


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- At no time during classification activities are personnel to reach for debris near machinery that is in operation, place any samples in their mouth, or come in contact with the soils/rocks without the use of gloves.
- Stay clear of all moving equipment and be aware of pinch points on machinery. Avoid wearing loose fitting clothing.
- When using cutting tools, cut away from yourself. The use of appropriate, task specific cutting tools is recommended.
- To avoid heat/cold stress as a results of exposure to extreme temperatures and PPE, drink electrolyte replacement fluids (1 to 2 cups per hour is recommended) and in case of extreme cold, wear insulating clothing.

## 3.0 Terms and Definitions

None.

## 4.0 Interference

None.

## 5.0 Training and Qualifications

5.1 The **Project Manager** is responsible for ensuring that the soil and rock classification procedures comply with this procedure. The **Project Manager** is responsible for ensuring that all personnel involved in soil and rock classification shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.3 The **Site Supervisor** is responsible for ensuring that all project **field personnel** follow these procedures.

5.4 Field personnel are responsible for the implementation of this procedure. Minimum qualifications for **field sampling personnel** require that one individual on the field team shall have a minimum of 6 months of experience with soil and rock classification.

5.5 The **project geologist** and/or **task manager** is responsible for directly supervising the soil and rock classification procedures to ensure that they are conducted according to this procedure, and for recording all pertinent data collected. If deviations from the procedure are required because of anomalous field conditions, they must first be approved by the **Program Quality Manager** and then documented in the field logbook and associated report or equivalent document.

## 6.0 Equipment and Supplies

6.1 The following equipment list contains materials which may be needed in carrying out the procedures outlined in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Personal protective equipment (PPE) and other safety equipment, as required by the APP/SSHP
- Field log book and pen with indelible ink
- Boring log

- Munsell Soil Color Chart
- Scoopula, spatula, and/or other small hand tools
- California Sampler
- Hand-held penetrometer

## 7.0 Calibration or Standardization

None.

## 8.0 Procedure

### 8.1 Soil Classification

The basic purpose of the classification of soil is to thoroughly describe the physical characteristics of the sample and to classify it according to an appropriate soil classification system. The USCS was developed so that soils could be described on a common basis by different investigators and serve as a "shorthand" description of soil. A classification of a soil in accordance with the USCS includes not only a group symbol and name, but also a complete word description.

Describing soil on a common basis is essential so that soil described by different site qualified personnel is comparable. Site individuals describing soil as part of site activities *must* use the classification system described herein to provide the most useful geologic database for all present and future subsurface investigations and remedial activities.

The site geologist or other qualified individual shall describe the soil and record the description in a boring log, logbook, and/or electronic field data collection device. The essential items in any written soil description are as follows:

- Classification group name (e.g., silty sand)
- Color, moisture, and odor
- Range of particle sizes and maximum particle size
- Approximate percentage of boulders, cobbles, gravel, sand, and fines
- Plasticity characteristics of the fines
- In-place conditions, such as consistency, density, and structure
- USCS classification symbol

The USCS serves as ”shorthand“ for classifying soil into 15 basic groups:

GW[1] Well graded (poorly sorted) gravel (>50 percent gravel, <5percent fines)

GP[1] Poorly graded (well sorted) gravel (>50percent gravel, <5percent fines)

GM[1] Silty gravel (>50 percent gravel, >15 percent silt)

GC[1] Clayey gravel (>50 percent gravel, >15 percent clay)

SW[1] Well graded (poorly sorted) sand (>50 percent sand, <5 percent fines)

SP[1] Poorly graded (well sorted) sand (>50 percent sand, <5 percent fines)

[1] If percentage of fine is 5 percent to 15 percent, a dual identification shall be given (e.g., a soil with more than 50 percent poorly sorted gravel and 10 percent clay is designated GW-GC.


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SM[1] Silty sand (>50 percent sand, >15 percent silt)

SC[1] Clayey sand (>50 percent sand, >15 percent clay)

ML[2] Inorganic, low plasticity silt (slow to rapid dilatancy, low toughness, and plasticity)

CL[2] Inorganic, low plasticity (lean) clay (no or slow dilatancy, medium toughness and plasticity)

MH[2] Inorganic elastic silt (no to slow dilatancy, low to medium toughness and plasticity)

CH[2] Inorganic, high plasticity (fat) clay (no dilatancy, high toughness, and plasticity)

OL Organic low plasticity silt or organic silty clay

OH Organic high plasticity clay or silt

PT Peat and other highly organic soil

Figure 8-1 defines the terminology of the USCS. Flow charts presented in Figure 8-2 and Figure 8-3 indicate the process for describing soil. The particle size distribution and the plasticity of the fines are the two properties of soil used for classification. In some cases, it may be appropriate to use a borderline classification (e.g., SC/CL) if the soil has been identified as having properties that do not distinctly place the soil into one group.

### 8.1.1 Estimation of Particle Size Distribution

One of the most important factors in classifying a soil is the estimated percentage of soil constituents in each particle size range. Being proficient in estimating this factor requires extensive practice and frequent checking. The steps involved in determining particle size distribution are listed below:

1. Select a representative sample (approximately 1/2 of a 6-inch long by 2.5-inch diameter sample liner).
2. Remove all particles larger than 3 inches from the sample. Estimate and record the percent by volume of these particles. Only the fraction of the sample smaller than 3 inches is classified.
3. Estimate and record the percentage of dry mass of gravel (less than 3 inches and greater than 1/4 inch).
4. Considering the rest of the sample, estimate, and record the percentage of dry mass of sand particles (about the smallest particle visible to the unaided eye).
5. Estimate and record the percentage of dry mass of fines in the sample (do not attempt to separate silts from clays).
6. Estimate percentages to the nearest 5 percent. If one of the components is present in a quantity considered less than 5 percent, indicate its presence by the term “trace”.
7. The percentages of gravel, sand, and fines must add up to 100 percent. “Trace” is not included in the 100 percent total.

### 8.1.2 Soil Dilatancy, Toughness, and Plasticity

#### *8.1.2.1 Dilatancy*

To evaluate dilatancy, follow these procedures:

[2] If the soil is estimated to have 15 percent to 25 percent sand or gravel, or both, the words “with sand” or “with gravel” (whichever predominates) shall be added to the group name (e.g., clay with sand, CL; or silt with gravel, ML). If the soil is estimated to have 30 percent or more sand or gravel, or both, the words “sandy” or “gravely” (whichever predominates) shall be added to the group name (e.g., sandy clay, CL). If the percentage of sand is equal to the percent gravel, use “sandy.”


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1. From the specimen, select enough material to mold into a ball about 1/2 inch (12 millimeters [mm]) in diameter. Mold the material, adding water if necessary, until it has a soft, but not sticky, consistency.
2. Smooth the soil ball in the palm of one hand with the blade of a knife or small spatula. Shake horizontally, striking the side of the hand vigorously against the other hand several times. Note the reaction of water appearing on the surface of the soil. Squeeze the sample by closing the hand or pinching the soil between the fingers, and note the reaction as none, slow, or rapid in accordance with the criteria in Table 8-1. The reaction is the speed with which water appears while shaking, and disappears while squeezing.

**Table 8-1: Criteria for Describing Dilatancy**

| Description | Criteria |
|---|---|
| None | No visible change in specimen. |
| Slow | Water appears slowly on the surface of the specimen during shaking and does not disappear or disappears slowly upon squeezing. |
| Rapid | Water appears quickly on the surface of the specimen during shaking and disappears quickly upon squeezing. |

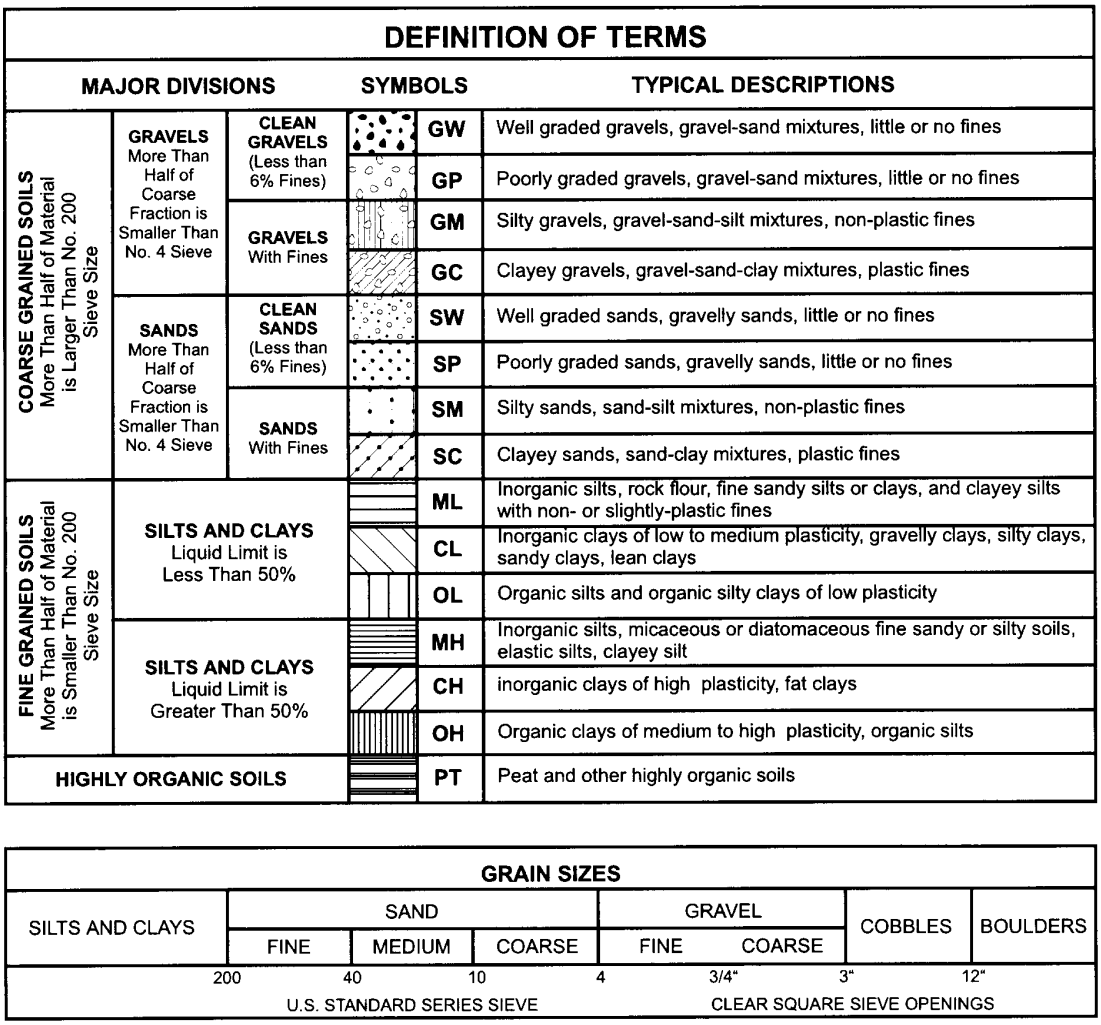
*8.1.2.2 Toughness*

Following the completion of the dilatancy test, shape the test specimen into an elongated pat and roll it by hand on a smooth surface or between the palms into a thread about 1/8 inch (3 mm) in diameter. (If the sample is too wet to roll easily, spread it into a thin layer and allow it to lose some water by evaporation.) Fold the sample threads and re-roll repeatedly until the thread crumbles at a diameter of about 1/8 inch. The thread will crumble at a diameter of 1/8 inch when the soil is near the plastic limit. Note the pressure required to roll the thread near the plastic limit. Also, note the strength of the thread. After the thread crumbles, lump the pieces together and knead it until the lump crumbles. Note the toughness of the material during kneading. Describe the toughness of the thread and lump as low, medium, or high in accordance with the criteria in Table 8-2.

**Table 8-2: Criteria for Describing Toughness**

| Description | Criteria |
|---|---|
| Low | Only slight pressure is required to roll the thread near the plastic limit. The thread and the lump are weak and soft. |
| Medium | Medium pressure is required to roll the thread near the plastic limit. The thread and the lump have medium stiffness. |
| High | Considerable pressure is required to roll the thread near the plastic limit. The thread and the lump have very high stiffness. |


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| DEFINITION OF TERMS | | | | | |
|---|---|---|---|---|---|
| MAJOR DIVISIONS | | | SYMBOLS | | TYPICAL DESCRIPTIONS |
| COARSE GRAINED SOILS More Than Half of Material is Larger Than No. 200 Sieve Size | GRAVELS More Than Half of Coarse Fraction is Smaller Than No. 4 Sieve | CLEAN GRAVELS (Less than 6% Fines) | | GW | Well graded gravels, gravel-sand mixtures, little or no fines |
| | | | | GP | Poorly graded gravels, gravel-sand mixtures, little or no fines |
| | | GRAVELS With Fines | | GM | Silty gravels, gravel-sand-silt mixtures, non-plastic fines |
| | | | | GC | Clayey gravels, gravel-sand-clay mixtures, plastic fines |
| | SANDS More Than Half of Coarse Fraction is Smaller Than No. 4 Sieve | CLEAN SANDS (Less than 6% Fines) | | SW | Well graded sands, gravelly sands, little or no fines |
| | | | | SP | Poorly graded sands, gravelly sands, little or no fines |
| | | SANDS With Fines | | SM | Silty sands, sand-silt mixtures, non-plastic fines |
| | | | | SC | Clayey sands, sand-clay mixtures, plastic fines |
| FINE GRAINED SOILS More Than Half of Material is Smaller Than No. 200 Sieve Size | SILTS AND CLAYS Liquid Limit is Less Than 50% | | | ML | Inorganic silts, rock flour, fine sandy silts or clays, and clayey silts with non- or slightly-plastic fines |
| | | | | CL | Inorganic clays of low to medium plasticity, gravelly clays, silty clays, sandy clays, lean clays |
| | | | | OL | Organic silts and organic silty clays of low plasticity |
| | SILTS AND CLAYS Liquid Limit is Greater Than 50% | | | MH | Inorganic silts, micaceous or diatomaceous fine sandy or silty soils, elastic silts, clayey silt |
| | | | | CH | inorganic clays of high plasticity, fat clays |
| | | | | OH | Organic clays of medium to high plasticity, organic silts |
| HIGHLY ORGANIC SOILS | | | | PT | Peat and other highly organic soils |

| GRAIN SIZES | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| SILTS AND CLAYS | SAND | | | GRAVEL | | COBBLES | BOULDERS | |
| | FINE | MEDIUM | COARSE | FINE | COARSE | | | |
| 200 | 40 | 10 | 4 | 3/4" | 3" | 12" | | |
| U.S. STANDARD SERIES SIEVE | | | | CLEAR SQUARE SIEVE OPENINGS | | | | |

**Figure8-1: Unclassified Soil Classification System (USCS)**



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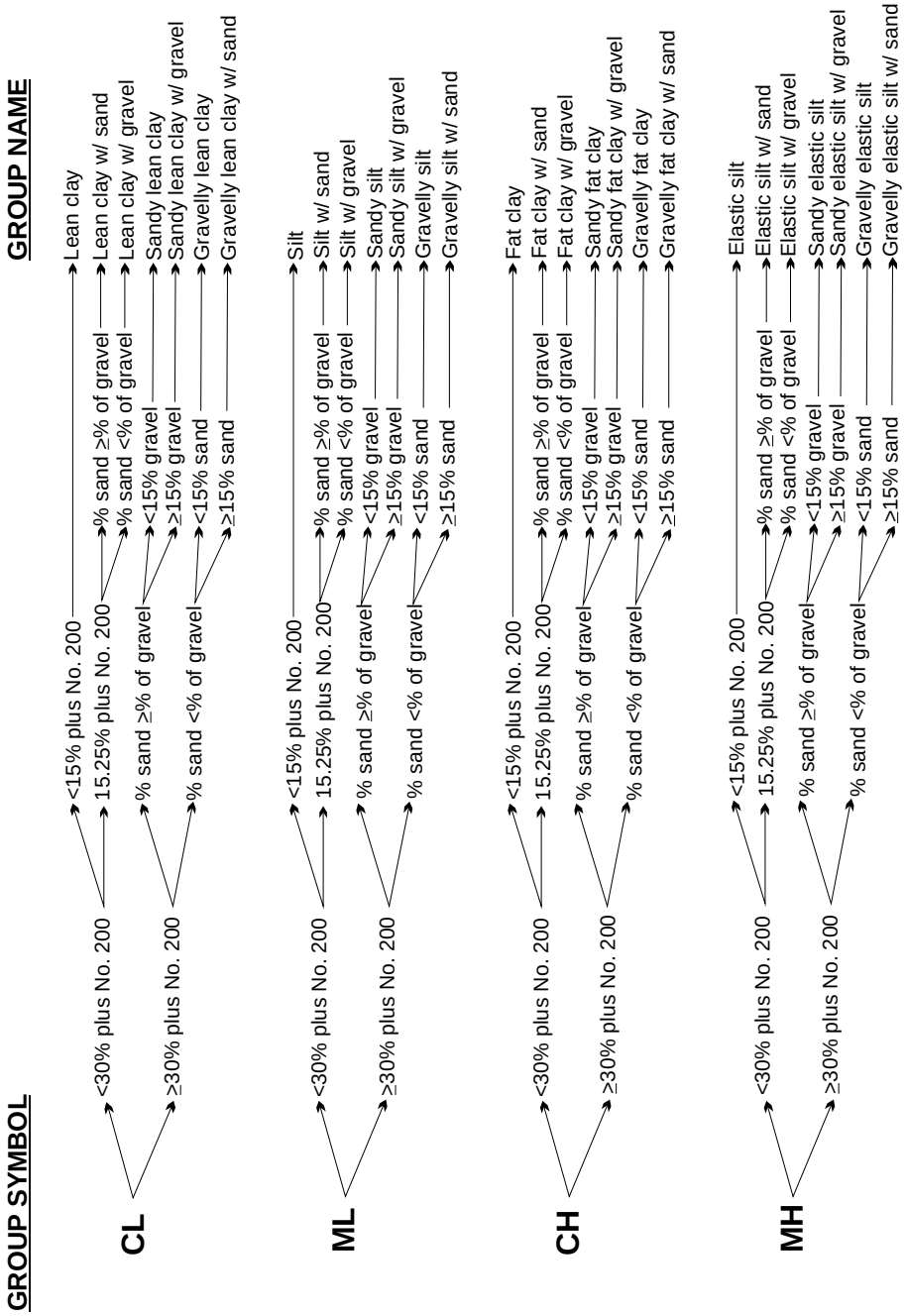



**Figure 8-2: Flow Chart for Fine Grain Soil Classification**


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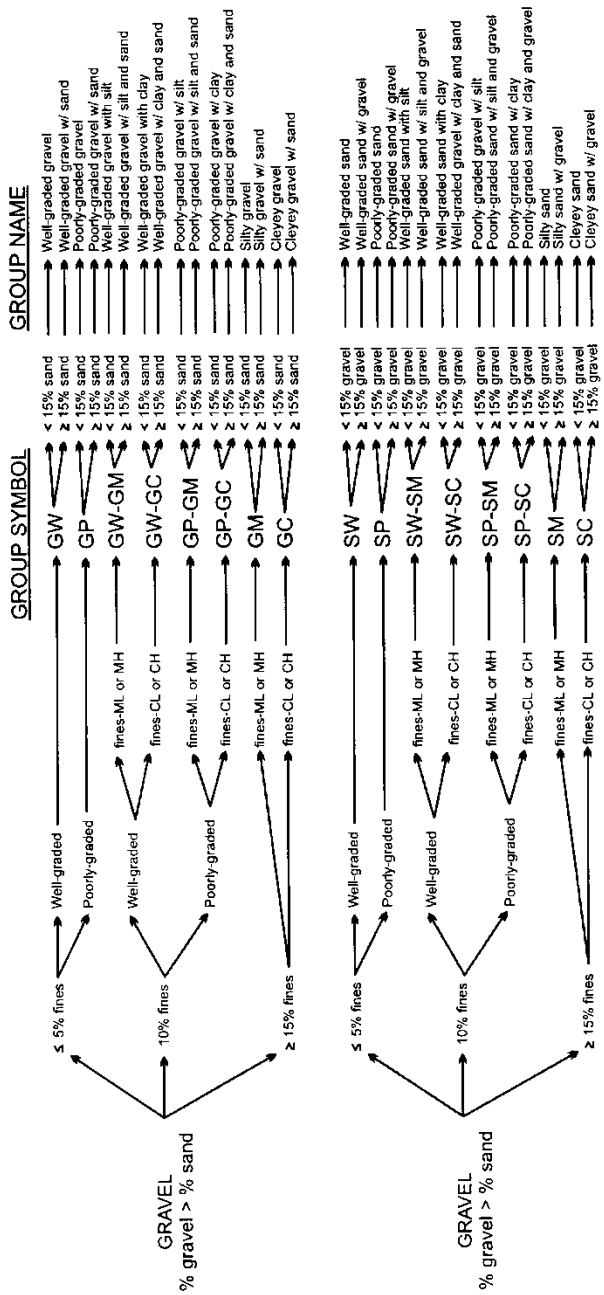



**Figure 8-3: Flow Chart for Soil with Gravel**


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#### *8.1.2.3 Plasticity*

The plasticity of a soil is defined by the ability of the soil to deform without cracking, the range of moisture content over which the soil remains in a plastic state, and the degree of cohesiveness at the plastic limit. The plasticity characteristic of clays and other cohesive materials is defined by the liquid limit and plastic limit. The liquid limit is defined as the soil moisture content at which soil passes from the liquid to the plastic state as moisture is removed. The test for the liquid limit is a laboratory, not a field, analysis.

The plastic limit is the soil moisture content at which a soil passes from the plastic to the semi-solid state as moisture is removed. The plastic limit test can be performed in the field and is indicated by the ability to roll a 1/8-inch (0.125-inch) diameter thread of fines, the time required to roll the thread, and the number of times the thread can be re-rolled when approaching the plastic limit.

The plasticity tests are not based on natural soil moisture content, but on soil that has been thoroughly mixed with water. If a soil sample is too dry in the field, add water prior to performing classification. If a soil sample is too sticky, spread the sample thin and allow it to lose some soil moisture.

Table 8-3 presents the criteria for describing plasticity in the field using the rolled thread method.

**Table 8-3: Criteria for Describing Plasticity**

| Description | Criteria |
|---|---|
| Non-Plastic | A 1/8-inch thread cannot be rolled. |
| Low Plasticity | The thread can barely be rolled. |
| Medium Plasticity | The thread is easy to roll and not much time is required to reach the plastic limit. |
| High Plasticity | It takes considerable time rolling the thread to reach the plastic limit. |

### 8.1.3 Angularity

The following criteria describe the angularity of the coarse sand and gravel particles:

- **Rounded** particles have smoothly-curved sides and no edges.
- **Subrounded** particles have nearly plane sides, but have well-rounded corners and edges.
- **Subangular** particles are similar to angular, but have somewhat rounded or smooth edges.
- **Angular** particles have sharp edges and relatively plane sides with unpolished surfaces. Freshly broken or crushed rock would be described as angular.

### 8.1.4 Color, Moisture, and Odor

The natural moisture content of soil is very important. Table 8-4 shows the terms for describing the moisture condition and the criteria for each.

**Table 8-4: Soil Moisture Content Qualifiers**

| Qualifier | Criteria |
|---|---|
| Dry | Absence of moisture, dry to the touch |
| Moist | Damp but no visible water |
| Wet | Visible water, usually soil is below water table |

Color is described by hue and chroma using the Munsell Soil Color Chart (Munsell 2000). For uniformity, all site geologists shall utilize this chart for soil classification. Doing so will facilitate correlation of geologic units between boreholes logged by different geologists. The Munsell Color Chart is a small booklet of numbered color chips with names like “5YR 5/6, yellowish-red.” Note mottling or banding of colors. It is particularly important to note and describe staining because it may indicate contamination.


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In general, wear a respirator if strong organic odors are present. If odors are noted, describe them if they are unusual or suspected to result from contamination. An organic odor may have the distinctive smell of decaying vegetation. Unusual odors may be related to hydrocarbons, solvents, or other chemicals in the subsurface. An organic vapor analyzer may be used to detect the presence of volatile organic contaminants.

### 8.1.5 In-Place Conditions

Describe the conditions of undisturbed soil samples in terms of their density/consistency (i.e., compactness), cementation, and structure utilizing the following guidelines:

#### *8.1.5.1 Density/Consistency*

Density and consistency describe a physical property that reflects the relative resistance of a soil to penetration. The term “density” is commonly applied to coarse to medium-grained sediments (i.e., gravels, sands), whereas the term “consistency” is normally applied to fine-grained sediments (i.e., silts, clays). There are separate standards of measure for both density and consistency that are used to describe the properties of a soil.

The density or consistency of a soil is determined by observing the number of blows required to drive a 1 3/8-inch (35 mm) diameter split barrel sampler 18 inches using a drive hammer weighing 140 lbs (63.5 kilograms [kg]) dropped over a distance of 30 inches (0.76 meters). Record the number of blows required to penetrate each 6 inches of soil in the field boring log during sampling. The first 6 inches of penetration is considered to be a seating drive; therefore, the blow count associated with this seating drive is recorded, but not used in determining the soil density/consistency. The sum of the number of blows required for the second and third 6 inches of penetration is termed the “standard penetration resistance,” or the “N-value.” The observed number of blow counts must be corrected by an appropriate factor if a different type of sampling device (e.g., Modified California Sampler with liners) is used. For a 2 3/8-inch inner diameter (I.D.) Modified California Sampler equipped with brass or stainless steel liners and penetrating a cohesionless soil (sand/gravel), the N-value from the Modified California Sampler must be divided by 1.43 to provide data that can be compared to the 1 3/8-inch diameter sampler data.

For a cohesive soil (silt/clay), the N-value for the Modified California Sampler should be divided by a factor of 1.13 for comparison with 1 3/8-inch diameter sampler data.

Drive the sampler and record blow counts for each 6-inch increment of penetration until one of the following occurs:

- A total of 50 blows have been applied during any one of the three 6-inch increments; a 50-blow count occurrence shall be termed “refusal” and noted as such on the boring log.
- A total of 150 blows have been applied.
- The sampler is advanced the complete 18 inches without the limiting blow counts occurring, as described above.

If the sampler is driven less than 18 inches, record the number of blows per partial increment on the boring log. If refusal occurs during the first 6 inches of penetration, the number of blows will represent the N-value for this sampling interval. Table 8-5 and Table 8-6 present representative descriptions of soil density/consistency vs. N-values.


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**Table 8-5: Measuring Soil Density with a California Sampler – Relative Density (Sands, Gravels)**

| Description | Field Criteria (N-Value) | |
|---|---|---|
| | 1 3/8 in. ID Sampler | 2 in. ID Sampler using 1.43 factor |
| Very Loose | 0–4 | 0–6 |
| Loose | 4–10 | 6–14 |
| Medium Dense | 10–30 | 14–43 |
| Dense | 30–50 | 43–71 |
| Very Dense | > 50 | > 71 |

**Table 8-6: Measuring Soil Density with a California Sampler – Fine Grained Cohesive Soil**

| Description | Field Criteria (N-Value) | |
|---|---|---|
| | 1 3/8 in. ID Sampler | 2 in. ID Sampler using 1.13 factor |
| Very Soft | 0–2 | 0–2 |
| Soft | 2–4 | 2–4 |
| Medium Stiff | 4–8 | 4–9 |
| Stiff | 8–16 | 9–18 |
| Very Stiff | 16–32 | 18–36 |
| Hard | > 32 | > 36 |

For undisturbed fine-grained soil samples, it is also possible to measure consistency with a hand-held penetrometer. The measurement is made by placing the tip of the penetrometer against the surface of the soil contained within the sampling liner or shelby tube, pushing the penetrometer into the soil a distance specified by the penetrometer manufacturer, and recording the pressure resistance reading in pounds per square foot (psf). The values are as follows (Table 8-7):

**Table 8-7: Measuring Soil Consistency with a Hand-Held Penetrometer**

| Description | Pocket Penetrometer Reading (psf) |
|---|---|
| Very Soft | 0–250 |
| Soft | 250–500 |
| Medium Stiff | 500–1000 |
| Stiff | 1000–2000 |
| Very Stiff | 2000–4000 |
| Hard | >4000 |

Consistency can also be estimated using thumb pressure using Table 8-8.

**Table 8-8: Measuring Soil Consistency Using Thumb Pressure**

| Description | Criteria |
|---|---|
| Very Soft | Thumb will penetrate soil more than 1 inch (25 mm) |
| Soft | Thumb will penetrate soil about 1 inch (25 mm) |
| Firm | Thumb will penetrate soil about 1/4 inch (6 mm) |
| Hard | Thumb will not indent soil but readily indented with thumbnail |
| Very Hard | Thumbnail will not indent soil |


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*8.1.5.2 Cementation*

Cementation is used to describe the friability of a soil. Cements are chemical precipitates that provide important information as to conditions that prevailed at the time of deposition, or conversely, diagenetic effects that occurred following deposition. Seven types of chemical cements are recognized by Folk (1980). They are as follows:

- Quartz – siliceous
- Chert – chert-cemented or chalcedonic
- Opal – opaline
- Carbonate – calcitic, dolomitic, sideritic (if in doubt, calcareous should be used)
- Iron oxides – hematitic, limonitic (if in doubt, ferruginous should be used)
- Clay minerals – if the clay minerals are detrital or have formed by recrystallization of a previous clay matrix, they are not considered to be a cement. Only if they are chemical precipitates, filling previous pore space (usually in the form of accordion-like stacks or fringing radial crusts) should they be included as “kaolin-cemented,” “chlorite-cemented,” etc.
- Miscellaneous minerals – pyritic, collophane-cemented, glauconite-cemented, gypsiferous, anhydrite-cemented, baritic, feldspar-cemented, etc.

The degree of cementation of a soil is determined qualitatively by utilizing finger pressure on the soil in one of the sample liners to disrupt the gross soil fabric. The three cementation descriptors are as follows:

- Weak – friable; crumbles or breaks with handling or slight finger pressure
- Moderate – friable; crumbles or breaks with considerable finger pressure
- Strong – not friable; will not crumble or break with finger pressure

*8.1.5.3 Structure*

This variable is used to qualitatively describe physical characteristics of soil that are important to incorporate into hydrogeological and/or geotechnical descriptions of soil at a site. Appropriate soil structure descriptors are as follows:

- Granular – spherically shaped aggregates with faces that do not accommodate adjoining faces
- Stratified – alternating layers of varying material or color with layers at least 6 mm (1/4 inch) thick; note thickness
- Laminated – alternating layers of varying material or color with layers less than 6 mm (1/4 inch) thick; note thickness
- Blocky – cohesive soil that can be broken down into small angular or subangular lumps that resist further breakdown
- Lensed – inclusion of a small pocket of different soil, such as small lenses of sand, should be described as homogeneous if it is not stratified, laminated, fissured, or blocky. If lenses of different soil are present, the soil being described can be termed homogeneous if the description of the lenses is included
- Prismatic or Columnar – particles arranged about a vertical line, ped is bounded by planar, vertical faces that accommodate adjoining faces; prismatic has a flat top; columnar has a rounded top
- Platy – particles are arranged about a horizontal plane


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*8.1.5.4 Other Features*

- Mottled – soil that appears to consist of material of two or more colors in blotchy distribution
- Fissured – breaks along definite planes of fracture with little resistance to fracturing (determined by applying moderate pressure to sample using thumb and index finger)
- Slickensided – fracture planes appear polished or glossy, sometimes striated (parallel grooves or scratches)

8.1.6 **Development of Soil Description**

Develop standard soil descriptions according to the following examples. There are three principal categories under which all soil can be classified. They are described below.

*8.1.6.1 Coarse-grained Soil*

Coarse-grained soil is divided into sands and gravels. A soil is classified as a sand if over 50 percent of the coarse fraction is "sand-sized." It is classified as a gravel if over 50 percent of the coarse fraction is composed of "gravel-sized" particles.

The written description of a coarse-grained soil shall contain, in order of appearance: Typical name including the second highest percentage constituent as an adjective, if applicable (underlined); grain size of coarse fraction; Munsell color and color number; moisture content; relative density; sorting; angularity; other features, such as stratification (sedimentary structures) and cementation, possible formational name, primary USCS classification, secondary USCS classification (when necessary), and approximate percentages of minor constituents (i.e., sand, gravel, shell fragments, rip-up clasts) in parentheses.

Example: POORLY-SORTED SAND WITH SILT, medium- to coarse-grained, light olive gray, 5Y 6/2, saturated, loose, poorly sorted, subrounded clasts, SW/SM (minor silt with approximately 20 percent coarse-grained sand-sized shell fragments, and 80 percent medium-grained quartz sand, and 5 percent to 15 percent ML).

*8.1.6.2 Fine-grained Soil*

Fine-grained soil is further subdivided into clays and silts according to its plasticity. Clays are rather plastic, while silts have little or no plasticity.

The written description of a fine-grained soil should contain, in order of appearance: Typical name including the second highest percentage constituent as an adjective, if applicable (underlined); Munsell color; moisture content; consistency; plasticity; other features, such as stratification, possible formation name, primary USCS classification, secondary USCS classification (when necessary), and the percentage of minor constituents in parentheses.

Example: SANDY LEAN CLAY, dusky red, 2.5 YR 3/2, moist, firm, moderately plastic, thinly laminated, CL (70 percent fines, 30 percent sand, with minor amounts of disarticulated bivalves [about 5 percent]).

*8.1.6.3 Organic Soil*

For highly organic soil, describe the types of organic materials present as well as the type of soil constituents present using the methods described above. Identify the soil as an organic soil, OL/OH, if the soil contains enough organic particles to influence the soil properties. Organic soil usually has a dark brown to black color and may have an organic odor. Often, organic soils will change color, (e.g., from black to brown) when exposed to air. Some organic soils will lighten in color significantly when air-dried. Organic soils normally will not have a high toughness or plasticity. The thread for the toughness test will be spongy.

8.2 Example: ORGANIC CLAY, black, 2.5Y, 2.5/1, wet, soft, low plasticity, organic odor, OL (100 percent fines), weak reaction to HCl.

## 8.3 Rock Classification



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The purpose of rock classification is to thoroughly describe the physical and mineralogical characteristics of a specimen and to classify it according to an established system. The generalized rock classification system described below was developed because, unlike the USCS for soils, there is no universally accepted rock classification system. In some instances, a more detailed and thorough rock classification system may be appropriate. Any modifications to this classification system, or the use of an alternate classification system should be considered during preparation of the site work plan. Both the CTO Manager and the QA Manager or Technical Director must approve any modifications to this classification system, or the use of another classification system.

Describing rock specimens on a common basis is essential so that rocks described by different site geologists are comparable. Site geologists describing rock specimens as a part of investigative activities must use the classification system described herein, or if necessary, another more detailed classification system. Use of a common classification system provides the most useful geologic database for all present and future subsurface investigations and remedial activities.

In order to provide a more consistent rock classification between geologists, a rock classification template has been designated as shown in Figure 8-4. The template includes classification of rocks by origin and mineralogical composition. When classifying rocks, all site geologists shall use this template.

The site geologist shall describe the rock specimen and record the description in a boring log or logbook. The items essential for classification include (i.e., metamorphic foliated):

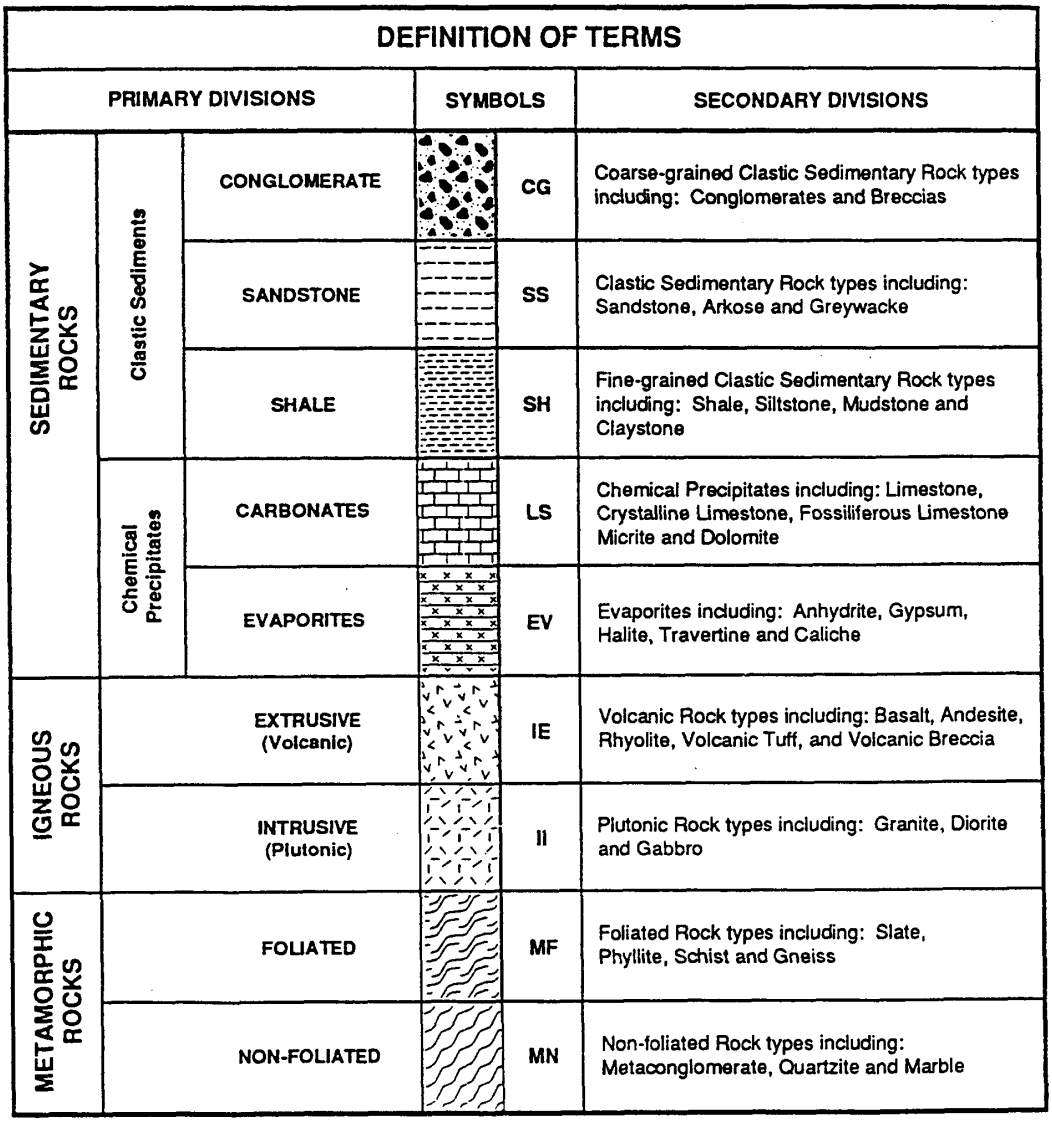
- Classification Name (i.e., schist)
- Color
- Mineralogical composition and percent
- Texture/Grain size (i.e., fine-grained, pegmatitic, aphlitic, glassy)
- Structure (i.e., foliated, fractured, lenticular)
- Rock Quality Designation (sum of all core pieces greater than two times the diameter of the core divided by the total length of the core run, expressed as a percentage)
- Classification symbol (i.e., MF)

Example: Metamorphic foliated schist: Olive gray, 5Y, 3/2, Garnet 25 percent, Quartz 45 percent, Chlorite 15 percent, Tourmaline 15 percent, Fine-grained with Pegmatite garnet, highly foliated, slightly wavy, MF.

## 9.0 Quality Control and Assurance

None


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| DEFINITION OF TERMS | | | | | |
|---|---|---|---|---|---|
| PRIMARY DIVISIONS | | | SYMBOLS | | SECONDARY DIVISIONS |
| SEDIMENTARY ROCKS | Clastic Sediments | CONGLOMERATE | | CG | Coarse-grained Clastic Sedimentary Rock types including: Conglomerates and Breccias |
| | | SANDSTONE | | SS | Clastic Sedimentary Rock types including: Sandstone, Arkose and Greywacke |
| | | SHALE | | SH | Fine-grained Clastic Sedimentary Rock types including: Shale, Siltstone, Mudstone and Claystone |
| | Chemical Precipitates | CARBONATES | | LS | Chemical Precipitates including: Limestone, Crystalline Limestone, Fossiliferous Limestone Micrite and Dolomite |
| | | EVAPORITES | | EV | Evaporites including: Anhydrite, Gypsum, Halite, Travertine and Caliche |
| IGNEOUS ROCKS | | EXTRUSIVE (Volcanic) | | IE | Volcanic Rock types including: Basalt, Andesite, Rhyolite, Volcanic Tuff, and Volcanic Breccia |
| | | INTRUSIVE (Plutonic) | | II | Plutonic Rock types including: Granite, Diorite and Gabbro |
| METAMORPHIC ROCKS | | FOLIATED | | MF | Foliated Rock types including: Slate, Phyllite, Schist and Gneiss |
| | | NON-FOLIATED | | MN | Non-foliated Rock types including: Metaconglomerate, Quartzite and Marble |

**Figure 8-4: Rock Classification System**


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## 10.0 Data and Records Management

10.1 Document soil classification information collected during soil sampling onto the field boring logs, field trench logs, and into the field notebook. Copies of this information shall be sent to the **CTO Manager** for the project files.

10.2 Field notes will be kept during coring activities in accordance with SOP 3-03 – Recordkeeping, Sample Labeling, and Chain of Custody. The information pertinent to soil classification activities includes chronology of events, sample locations (x,y,z), time/date, sampler name, methods (including type of core liner/barrel, if applicable), sampler penetration and acceptability, sample observations, and the times and type of equipment decontamination. Deviations to the procedures detailed in the SOP should be recorded in the field logbook.

## 11.0 Attachments or References

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| *Author* | *Reviewer* | *Revisions (Technical or Editorial)* |
|---|---|---|
| Robert Shoemaker<br>Senior Scientist | Naomi Ouellette, Project Manager | Rev 0 – Initial Issue |
| | | |
| | | |


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# Direct Push Sampling Techniques

# Procedure 3-17

## 1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) provides guidance on the use of direct push techniques for the United States Army Corp of Engineers (USACE).

1.2 This procedure is the Program-approved professional guidance for work performed by AECOM for USACE.

1.3 This procedure shall serve as management-approved professional guidance for the Program and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by both the Project Manager and the Quality Assurance (QA) Manager or Technical Director, and documented.

1.4 If there are procedures whether it be from AECOM, state and/or federal that are not addressed in this SOP and are applicable to direct push sampling then those procedures may be added as an appendix to the project-specific SAP.

## 2.0 Safety

2.1 Field personnel shall perform work in accordance with the site-specific Accident Prevention Plan (APP) and Site-Safety and Health Plan (SSHP). During monitoring well installation, subcontractors in direct contact with potentially contaminated media shall wear the proper personal protective equipment (PPE) as outlined in the site-specific health and safety plan. Failure to comply will result in disciplinary action.

2.2 If circumstances warrant, a real-time immediate response instrument, such as a Miniram Dust Monitor, organic vapor analyzer, HNu, Thermo, Draeger or Sensidyne tubes, or explosimeter, should be used to monitor the work area. When real/time instrument response exceeds the permissible exposure limit, personnel shall don the appropriate PPE and alternate control measures to ensure personnel safety. If safe control measures are not achievable, field activities shall be discontinued immediately. Company-specific APP/SSHPs offer guidelines on air surveillance and on selection of PPE. In addition, the site-specific APP/SSHP includes an air monitoring program and suggested PPE.

2.3 In addition to the aforementioned precautions and depending upon the type of contaminant expected, employ the following safe work practices:

Particulate or Metal Compounds

1. Avoid skin contact and/or incidental ingestion of soil.
2. Wear protective clothing, steel-toed boots, gloves, safety glasses, and hearing protection as warranted.

VOCs

1. Avoid breathing constituents venting from holes by approaching upwind, and/or by use of respiratory protection.
2. Pre-survey the area with a flame ionization detector (FID) or photoionization detector (PID) prior to sampling.


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3. If monitoring results indicate organic vapors that exceed action levels as specified in the site-specific APP/SSHP, sampling activities may need to be conducted in Level C protection. At a minimum, skin protection will be required by use of gloves and Tyvek or other media that is protective against the media being encountered.

Flammable or Explosive Conditions

1. Monitor explosive gases as continuously as possible using an explosimeter and oxygen meter.
2. Place all ignition sources upwind or crosswind of the borehole.
3. If explosive gases exceed the designated action levels as specified in the site-specific APP/SSHP, cease operations and evaluate conditions.

Physical Hazards Associated With Soil Sampling

1. To avoid possible back strain associated with sample collection, use the large muscles of the legs, not the back, when retrieving soil samplers.
2. Stay clear of all moving equipment, and avoid wearing loose fitting clothing.
3. To avoid slip/trip/fall hazards, be wary of open trenches, pits, or holes.
4. Be aware of restricted mobility due to PPE.
5. To avoid hand, wrist, arm, shoulder, and back trauma due to the use of slide hammers or hand augers, rotate sampling among field personnel

## 3.0 Terms and Definitions

3.1 Direct push techniques are methods for subsurface sampling or monitoring that involve the application of downward pressure (usually supplied through hydraulic means) without the benefit of cutting tool rotation to enter soil. A variety of systems are available under several trade names, such as GeoProbe®. Equipment may be skid-mounted, trailered, or mounted directly on the frame of a vehicle.

## 4.0 Interferences

4.1 Potential interferences could result from cross-contamination between samples or sample locations. Minimization of the cross contamination will occur through the following:

- The use of clean sampling tools at each location as necessary.
- Avoidance of material that is not representative of the media to be sampled.

## 5.0 Training and Qualifications

### 5.1 Qualifications and Training

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

### 5.2 Responsibilities

5.2.1 The **Project Manager** is responsible for ensuring that these standard direct push technique procedures are followed during projects conducted under the Program and that a qualified individual conducts or supervises the projects. A qualified individual for subsurface sampling or monitoring using direct push techniques is defined as a person with a degree in geology, hydrogeology, or geotechnical/civil engineering with at least 1 year of experience supervising soil boring construction using conventional drilling or direct push techniques. The Project Manager or designee is responsible for ensuring that all personnel involved in direct push


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sampling techniques shall have the appropriate education, experience, and training to perform their assigned tasks as specified in Chief of Naval Operations Instruction 5090.1c (DON 2007).

5.2.2 The Program Quality Manager is responsible for ensuring overall compliance with this procedure.

5.2.3 The Site Supervisor is responsible for ensuring that all field personnel follow these procedures.

5.2.4 All Field Personnel are responsible for the implementation of this procedure.

5.2.5 The Field Personnel and/or Field Manager is responsible for directly supervising the direct push sampling procedures to ensure that they are conducted according to this procedure, and for recording all pertinent data collected during sampling.

## 6.0 Equipment and Supplies

In addition to those materials provided by the subcontractor, the project **Field Manager/Field Personnel** will require:

- Boring Logs;
- Spoons or scoops;
- Sample kit (bottles, labels, custody records and tape, cooler, ice), if laboratory analysis is required;
- Sample collection pan;
- Folding rule or tape measure;
- Plastic sheeting;
- Utility knife;
- Equipment decontamination materials (as described in SOP 3-06, *Equipment Decontamination*);
- Health and safety equipment (as required by APP/SSHP); and
- Field project notebook/pen.

## 7.0 Procedure

Direct push techniques may be used as a cost-effective alternative to conventional drilling techniques for obtaining subsurface soil and groundwater samples and for monitoring subsurface conditions.

### 7.1 Method Selection

Base the decision to use direct push techniques on: (1) their ability to achieve the required information at the required level of quality control and (2) their cost-effectiveness compared to conventional drilling methods. Major limitations of direct push techniques are their inability to penetrate rock or cobbles and a shallow maximum depth of penetration. The capabilities of direct push systems vary significantly among vendors. Consider these differences in capabilities when evaluating the method for a subsurface exploration program.

Use direct push techniques to obtain groundwater samples for confirmatory analyses only if the screen placement method protects the screen from clogging during installation and allows the installation of a sand-pack around the exterior of the well screen.

### 7.2 Inspection of Equipment

Inspect direct push equipment prior to use for signs of fluid leakage, which could introduce contaminants to the soil. If, at any time during equipment operation, fluid is observed leaking from the rig, cease operations and immediately repair or contain the leak. Collect, containerize, and label soil and other materials affected by the leak for proper disposal (see SOP 3-05, *IDW Management*).


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### 7.3 Preparation of Work Site

Inspect the work site prior to commencing operations to ensure that no overhead hazards exist that could impact the direct push equipment, and the work area should cleared and/or marked by the local underground utility locating service (e.g., DigSafe). In addition, clear locations planned for subsurface exploration using either geophysical methods and/or hand excavate locations to a depth of 2 to 3 feet prior to soil penetration, unless it is certain (by virtue of subsurface clearing activities) that no utilities or other hazardous obstructions will be encountered in the first 2 to 3 feet. Hand excavation may be waived when it is not practical.

Locate the direct push rig so that it is downslope from the penetration point, if the work is to be performed on a grade. Locate the rig downwind or crosswind of the penetration point, if possible. Cover the area surrounding, and in the vicinity of, the penetration point with plastic. Establish required exclusion zones using plastic tape or cones to designate the various areas.

### 7.4 Equipment Decontamination

To avoid cross-contamination, thoroughly decontaminate equipment used for direct push exploration and sampling as described in SOP 3-06, *Equipment Decontamination*. Decontaminate sampling tools and downhole equipment between each sampling event and between penetration points. At a minimum, steam clean or wash and rinse the equipment. Collect, containerize, and label all wash and rinse water for proper disposal. Clean equipment (e.g., drive rods and samplers) shall not come into contact with contaminated soils or other contaminated materials. Keep equipment on plastic or protect it in another suitable fashion. Store push rods and other equipment removed from a hole on plastic sheeting until properly decontaminated.

### 7.5 Soil Sampling

This SOP assumes that the subcontractor will perform sampling; therefore, detailed procedures regarding sample acquisition are not provided. Vendors of direct push equipment offer a variety of sampling systems designed specifically for their equipment. Both continuous and discreet soil samples may be obtained using sampling equipment similar to that described in Procedure 3-21, *Surface and Subsurface Soil Sampling*. The preferred methods for soil sampling using direct push techniques use brass or stainless steel split-tube samplers that are driven through the horizon to be sampled. Use plastic sample tubes (e.g., Macro-Core Samplers) only for screening purposes or, in the case of confirmatory sampling, if samples will not be analyzed for volatile organic compounds (VOCs) or semivolatile organic compounds (SVOCs).

### 7.6 Groundwater Sampling

Direct push vendors offer numerous methods for obtaining groundwater samples. Key differences among methods involve: (1) the maximum well diameter achievable; (2) the ability to protect the well screen from exposure to contaminated overburden soils during installation; (3) the ability to install packing around the screen; (4) flexibility in the size, materials of construction, and design of well screens; and (5) the ability to convert sampling points into permanent monitoring wells. The limitations and abilities of a given system must be thoroughly understood and matched to the needs of the project before committing to the collection of groundwater samples using direct push techniques.

Use direct push techniques only to collect screening samples unless it is confirmed that the system:

1. Effectively protects the well screen from exposure to contaminated overburden soils during installation
2. Allows the installation of effective packing around the well screen
3. Allows the well screen to be effectively sealed against the downward infiltration of overlying groundwater or surface precipitation
4. Is constructed of materials compatible with the intended sampling and analysis goals of the project


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5. Allows the use of a well screen properly sized and slotted for the needs of the project

Additional information on the collection of groundwater samples can be found in SOP 3-14 Monitoring Well Sampling.

It is the responsibility of the **Project Manager** to evaluate and determine the appropriateness of direct push systems prior to committing to their use on any project involving groundwater sampling. As part of this evaluation, it is recommended to obtain concurrence from regulatory authorities in advance for the method selection.

### 7.7 Borehole Abandonment

Methods for abandoning boreholes created with direct push systems will vary among vendors. Coordinate the desired method for abandonment with the vendor in the planning stages of the project to ensure proper abandonment.

Some direct push boreholes will close naturally as the drive rods and sampling tools are withdrawn. This may occur in loose, unconsolidated soils, such as sands. Close all boreholes using one of the procedures described in this procedure, unless natural caving precludes such closure.

The three methods for closing direct push boreholes are:

1. Add granulated or pelletized bentonite and hydrate in layers, proceeding from the bottom of the hole to the surface.
2. Pour premixed cement/water (or cement/water/bentonite) mixture into the hole.
3. Fill the entire hole with granular or pelletized bentonite and hydrate by means of a previously emplaced water tube that is gradually withdrawn as water is supplied to the bentonite.

The second method is recommended. For shallow holes less than 10 feet in depth, pour a cement/water/bentonite mix directly into the opening using a funnel. For deeper holes, use a conductor (tremie) pipe to carry the grout mix to the far reaches of the borehole. Lower the conductor pipe to within 2 inches of the bottom and gradually withdraw it as grout is added, keeping the lower end of the pipe submerged in grout at all times.

The recommended grout mixture for well abandonment is 7 to 9 gallons of water per 94-pound bag of Portland cement, with 3 percent to 5 percent by weight of powdered bentonite added to the mixture. Commercial products, such as Volcay are acceptable with pre-approval of the **Project Manager**.

Seal boreholes to within 0.5 to 2.0 feet of the surface. Inspect the abandoned borehole after 24 hours to ensure that grout shrinkage does not occur. If significant shrinkage has occurred, re-grout the borehole. Fill the remaining portion of the hole with local topsoil or appropriate paving materials.

## 8.0 Quality Control and Assurance

8.1 Collection of representative samples will be ensured through adherence to the procedures in this SOP and the sampling strategy outlined in the SAP. The field quality control samples identified in the SAP must be collected. These samples may include field duplicates, equipment rinsate blanks, trip blanks, and matrix spike/matrix spike duplicates

## 9.0 Records, Data Analysis, Calculations

9.1 Various forms are required to ensure that adequate documentation is made of the sample collection activities. These forms may include:

- Boring logs;
- Field logbook;


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- Sample collection records;
- Chain-of-custody forms; and
- Shipping labels.

9.2 Boring logs (Attachment 1) will provide visual and descriptive information for samples collected at each soil boring and are often the most critical form of documentation generated during a soil sampling program.

9.3 The field logbook is kept as a general log of activities and should not be used in place of the boring log.

9.4 Chain-of-custody forms are transmitted with the samples to the laboratory for sample tracking purposes.

9.5 Shipping labels are required is sample coolers are to be transported to a laboratory by a third party (courier service).

## 10.0 Attachments or References

10.1 Attachment 1 – Boring Log

10.2 Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

10.3 SOP 3-05, *IDW Management.*

10.4 SOP 3-06, *Equipment Decontamination.*

10.5 SOP 3-21, *Surface and Subsurface Soil Sampling.*

| Author | Reviewer | Revisions (Technical or Editorial) |
|---|---|---|
| Mark Kromis<br>Program Chemist | Chris Barr<br>Program Quality Manager | Rev 0 – Initial Issue (May 2012) |


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# Attachment 1
# Boring Log

**Boring ID:**

Page 1 of _____

| | | |
|---|---|---|
| Project Name: | Drilling Company: | Type of Surface Material: |
| Project Number: | Drilling Method: | Patching Material: |
| Date Started Drilling: | Rig Type: | Drilling Water Level: |
| Date Finished Drilling: | Core Size: | Boring Total Depth (bgs): |
| Physical Location: | | Logged By: |

(Note: bgs = below ground surface)

| Depth Range | Recovery ft/ft | PID (ppm) | Moisture Content | GA Class. | USCS | GA Class: Garfield Avenue Sites classification & Modified Unified Soil Clasiffication System | |
|---|---|---|---|---|---|---|---|
| | | | | | | Ground Surface Cover and Thickness: | Sample name & #: |
| 0-1 | | | | | | | |
| 1-2 | | | | | | | |
| 2-3 | | | | | | | |
| 3-4 | | | | | | | |
| 4-5 | | | | | | | |
| 5-6 | | | | | | | |
| 6-7 | | | | | | | |
| 7-8 | | | | | | | |
| 8-9 | | | | | | | |
| 9-10 | | | | | | | |
| 10-11 | | | | | | | |
| 11-12 | | | | | | | |
| 12-13 | | | | | | | |
| 13-14 | | | | | | | |
| 14-15 | | | | | | | |
| 15-16 | | | | | | | |
| 16-17 | | | | | | | |
| 17-18 | | | | | | | |
| 18-19 | | | | | | | |
| 19-20 | | | | | | | |

| Stratigraphic Unit Intervals: | | Comments: |
|---|---|---|
| 1.) | 5.) | |
| 2.) | 6.) | |
| 5.) | 6.) | |


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# Operation and Calibration of a Photoionization Detector

# Procedure 3-20

## 1.0 Purpose and Scope

### 1.1 Purpose and Applicability

1.1.1 This standard operating procedure (SOP) describes the procedures that will be followed by field staff for operation and calibration of a photoionization detector (PID). The PID is primarily used by AECOM personnel for safety and survey monitoring of ambient air, determining the presence of volatiles in soil and water, and detecting leakage of volatiles.

1.1.2 PIDs routinely used by field personnel include the Photovac Microtip, Thermoelectron 580EZ, and MiniRAE 2000. Personnel responsible for using the PID should first read and thoroughly familiarize themselves with the instrument instruction manual.

### 1.2 Principle of Operation

1.2.1 The PID is a non-specific vapor/gas detector. The unit generally consists of a hand-held probe that houses a PID, consisting of an ultraviolet (UV) lamp, two electrodes, and a small fan which pulls ambient air into the probe inlet tube. The probe is connected to a readout/control box that consists of electronic control circuits, a readout display, and the system battery. Units are available with UV lamps having an energy from 9.5 electron volts (eV) to 11.7 eV.

1.2.2 The PID analyzer measures the concentration of trace gas present in the atmosphere by photoionization. Photoionization occurs when an atom or molecule absorbs a photon of sufficient energy to release an electron and become a positive ion. This will occur when the ionization potential of the molecule (in electron volts (eV)) is less than the energy of the photon. The source of photons is an ultraviolet lamp in the probe unit. Lamps are available with energies ranging from 9.5 eV to 11.7 eV. All organic and inorganic vapor/gas compounds having ionization potentials lower than the energy output of the UV lamp are ionized and the resulting potentiometric change is seen as a positive reading on the unit. The reading is proportional to the concentration of organics and/or inorganics in the vapor.

1.2.3 Sample gases enter the probe through the inlet tube and enter the ion chamber where they are exposed to the photons emanating from the UV lamp. Ionization occurs for those molecules having ionization potentials near to or less than that of the lamp. A positive- biased polarizing electrode causes these positive ions to travel to a collector electrode in the chamber. Thus the ions create an electrical current which is amplified and displayed on the meter. This current is proportional to the concentration of trace gas present in the ion chamber and to the sensitivity of that gas to photoionization.

1.2.4 In service, the analyzer is first calibrated with a gas of known composition equal to, close to, or representative of that to be measured. Gases with ionization potentials near to or less than the energy of the lamp will be ionized. These gases will thus be detected and measured by the analyzer. Gases with ionization potentials greater than the energy of the lamp will not be detected. The ionization potentials of the major components of air, i.e., oxygen, nitrogen, and carbon dioxide, range from about 12.0 eV to 15.6 eV and are not ionized by any of the lamps available. Gases with ionization potentials near to or slightly higher than the lamp are partially ionized, with low sensitivity.

### 1.3 Specifications

1.3.1 Refer to the manufacturer's instructions for the technical specifications of the instrument being used. The operating concentration range is typically 0.1 to 2,000 ppm isobutylene equivalent.


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## 2.0 Safety

2.1 The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the project Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP). In the absence of a APP, work will be conducted according to the Work Plan (WP) and/or direction from the **Site Safety and Health Officer (SSHO)**.

2.2 Only PIDs stamped Division I Class I may be used in explosive atmospheres. Refer to the project APP/SSHP for instructions pertaining to instrument use in explosive atmospheres.

## 3.0 Terms and Definitions

None.

## 4.0 Interferences

4.1 Regardless of which gas is used for calibration, the instrument will respond to all analytes present in the sample that can be detected by the type of lamp used in the PID.

4.2 Moisture will generate a positive interference in the concentration measured for a PID and is characterized by a slow increase in the reading as the measurement is made. Care must be taken to minimize uptake of moisture to the extent possible. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

4.3 Uptake of soil into the PID must be avoided as it will compromise instrument performance by blocking the probe, causing a positive interference, or dirtying the PID lamp. Refer to the manufacturers' instructions for care, cleaning, and maintenance.

4.4 The user should listen to the pitch of the sampling pump. Any changes in pitch may indicate a blockage and corrective action should be initiated.

## 5.0 Training and Qualifications

5.1 **Qualifications and Training**

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 **Responsibilities**

5.2.1 The Project Manager is responsible for ensuring that the operation and calibration activities comply with this procedure. The Project Manager is responsible for ensuring that all personnel involved in the operation and calibration shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The Program Quality Manager is responsible for ensuring overall compliance with this procedure.

5.2.3 The Site Supervisor is responsible for ensuring that all operation and calibration activities are conducted according to this procedure.

5.2.4 All Field Personnel are responsible for the implementation of this procedure.

## 6.0 Equipment and Supplies

- Calibration Gas: Compressed gas cylinder of isobutylene in air or similar stable gas mixture of known concentration. The selected gas should have an ionization potential similar to that of the vapors to be monitored, if known. The concentration should be at 50-75% of the range in which the instrument is to be calibrated;


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- Regulator for calibration gas cylinder;
- Approximately 6 inches of Teflon® tubing;
- Tedlar bag (optional);
- Commercially-supplied zero grade air (optional);
- "Magic Marker" or “Sharpie” or other waterproof marker;
- Battery charger;
- Moisture traps;
- Spare lamps;
- Manufacturer’s instructions; and
- Field data sheets or logbook/pen.

# 7.0 Procedure

## 7.1 Preliminary Steps

7.1.1 Preliminary steps (battery charging, check-out, calibration, maintenance) should be conducted in a controlled or non-hazardous environment.

## 7.2 Calibration

7.2.1 The PID must be calibrated in order to display concentrations in units equivalent to ppm. First a supply of zero air (ambient air or from a supplied source), containing no ionizable gases or vapors is used to set the zero point. A span gas, containing a known concentration of a photoionizable gas or vapor, is then used to set the sensitivity.

7.2.2 Calibrate the instrument according to the manufacturer’s instructions. Record the instrument model and identification number, the initial and adjusted meter readings, the calibration gas composition and concentration, and the date and the time in the field records.

7.2.3 If the calibration cannot be achieved or if the span setting resulting from calibration is 0.0, then the lamp must be cleaned (Section 7.4).

## 7.3 Operation

7.3.1 Turn on the unit and allow it to warm up (minimum of 5 minutes). Check to see if the intake fan is functioning; if so, the probe will vibrate slightly and a distinct sound will be audible when holding the probe casing next to the ear. Also, verify on the readout display that the UV lamp is lit.

7.3.2 Calibrate the instrument as described in Section 7.2, following the manufacturer’s instructions. Record the calibration information in the field records.

7.3.3 The instrument is now operational. Readings should be recorded in the field records.

7.3.4 When the PID is not being used or between monitoring intervals, the unit may be switched off to conserve battery power and UV lamp life; however, a “bump” test should be performed each time the unit is turned on and prior to taking additional measurements. To perform a bump test, connect the outlet tubing from a Tedlar bag containing a small amount of span gas to the inlet tubing on the unit and record the reading. If the reading is not within the tolerance specified in the project plan, the unit must be recalibrated.

7.3.5 At the end of each day, recheck the calibration. The check will follow the same procedures as the initial calibration (Section 7.2) except that no adjustment will be made to the instrument. Record the information in the field records.


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7.3.6 Recharge the battery after each use (Section 7.4).

7.3.7 When transporting, ensure that the instrument is packed in its stored condition in order to prevent damage.

7.4 **Routine Maintenance**

7.4.1 Routine maintenance associated with the use of the PID includes charging the battery, cleaning the lamp window, replacing the detector UV lamp, replacing the inlet filter, and replacing the sample pump. Refer to the manufacturer's instructions for procedures and frequency.

7.4.2 All routine maintenance should be performed in a non-hazardous environment.

7.5 **Troubleshooting Tips**

7.5.1 One convenient method for periodically confirming instrument response is to hold the sensor probe next to the tip of a magic marker. A significant reading should readily be observed.

7.5.2 Air currents or drafts in the vicinity of the probe tip may cause fluctuations in readings.

7.5.3 A fogged or dirty lamp, due to operation in a humid or dusty environment, may cause erratic or fluctuating readings. The PID should never be operated without the moisture trap in place.

7.5.4 Moving the instrument from a cool or air-conditioned area to a warmer area may cause moisture to condense on the UV lamp and produce unstable readings.

7.5.5 A zero reading on the meter should not necessarily be interpreted as an absence of air contaminants. The detection capabilities of the PID are limited to those compounds that will be ionized by the particular probe used.

7.5.6 Many volatile compounds have a low odor threshold. A lack of meter response in the presence of odors does not necessarily indicate instrument failure.

7.5.7 When high vapor concentrations enter the ionization chamber in the PID the unit can become saturated or "flooded". Remove the unit to a fresh air environment to allow the vapors to be completely ionized and purged from the unit.

## 8.0 Quality Control and Assurance

8.1 The end use of the data will determine the quality assurance requirements that are necessary to produce data of acceptable quality. These quality assurance requirements will be defined in the site-specific workplan or Sampling and Analysis Plan (SAP), hereafter referred to as the project plan.

8.2 Calibration of the PID will be conducted at the frequency specified in the project plan. In the absence of project-specific guidance, calibration will be performed at the beginning of each day of sampling and will be checked at the end of the sampling day or whenever instrument operation is suspect. The PID will sample a calibration gas of known concentration. The instrument must agree with the calibration gas within ±10%. If the instrument responds outside this tolerance, it must be recalibrated.

8.3 Checks of the instrument response (Section 7.5) should be conducted periodically and documented in the field records.

## 9.0 Records, Data Analysis, Calculations

Safety and survey monitoring with the PID will be documented in a bound field logbook, or on standardized forms, and retained in the project files. The following information is to be recorded:

- Project name and number;
- Instrument manufacturer, model, and identification number;


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- Operator's signature;
- Date and time of operation;
- Calibration gas used;
- Calibration check at beginning and end of day (meter readings before adjustment);
- Span setting after calibration adjustment;
- Meter readings (monitoring data obtained);
- Instances of erratic or questionable meter readings and corrective actions taken; and
- Instrument checks and response verifications – e.g., battery check, magic marker response (Section 7.5) or similar test.

## 10.0 Attachments or References

United States Environmental Protection Agency. Environmental Investigations Standard Operating Procedures and Quality Assurance Manual (EISOPQAM). USEPA, Region 4, SESD, Enforcement and Investigations Branch, Athens, GA. November 2001.

| Author | Reviewer | Revisions (Technical or Editorial) |
|---|---|---|
| Robert Shoemaker<br>Senior Scientist | Chris Barr<br>Program Quality Manager | Rev 0 – Initial Issue (May 2012) |


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# Surface and Subsurface Soil Sampling Procedures

# Procedure 3-21

## 1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the procedures for soil sampling. The procedure includes surface and subsurface sampling by various methods using hand auguring, test pit, direct-push, and split-spoon equipment.

1.2 The procedure includes soil sampling for volatile organic compounds (VOCs). For project specific information (e.g. sampling depths, equipment to be used, and frequency of sampling), refer to the Sampling and Analysis Plan (SAP), which takes precedence over these procedures. Surface soil sampling, typically considered to be up to two feet below ground surface by EPA standards, is typically accomplished using hand tools such as shovels or hand augers. Test pit samples are considered subsurface samples, although normally collected via hand tools similar to surface soil sampling or by excavation machinery. Direct-push and split-spoon sampling offer the benefit of collecting soil samples from a discrete or isolated subsurface interval, without the need of extracting excess material above the target depth. These methods dramatically reduce time and cost associated with disposal of material from soil cuttings when compared to test pit sampling. In addition, direct-push and split-spoon sampling methods can obtain samples at targeted intervals greater than 15 feet in depth, allowing for discrete depth soil sampling while speeding up the sampling process. Direct-push methods work best in medium to fine-grained cohesive materials such as medium to fine sands, silts, and silty clay soils. Split-spoon sampling works well in all types of soil, but is somewhat slower than direct-push methods. Samples are composited so that each sample contains a homogenized representative portion of the sample interval. Due to potential loss of analytes, samples for volatile analysis are not composited. Samples for chemical analysis can be collected by any of the above-mentioned sampling methods, as disturbed soil samples. Undisturbed samples are collected, sealed, and sent directly to the laboratory for analysis. For undisturbed samples, the samples are not homogenized.

## 2.0 Safety

2.1 The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the project-specific Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP). In the absence of a APP/SSHP, work will be conducted according to the Work Plan (WP) and/or direction from the **Site Safety and Health Officer (SSHO)**.

2.2 Before soil sampling commences, appropriate entities (e.g. DigSafe, local public works departments, company facilities) must be contacted to assure the anticipated soil sampling locations are marked for utilities, including electrical, telecommunications, water, sewer, and gas.

## 3.0 Terms and Definitions

None.

## 4.0 Interferences

4.1 Low recovery of soil from sampling equipment will prevent an adequate representation of the soil profile and sufficient amount of soil sample. If low recovery is a problem, the hole may be offset and re-advanced, terminated, or continued using a larger diameter sampler.


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4.2 Asphalt in soil samples can cause false positive results for hydrocarbons. To ensure samples are free of asphalt, do not collect samples that may contain asphalt. If the collection of samples potentially containing asphalt is unavoidable, note the sampling depths at which the presence of asphalt are suspected.

4.3 Instrumentation interferences addressed in SOPs for Calibration of the Photoionization Detector (PID), Headspace Screening for Total Volatile Organics, and Equipment Decontamination must also be considered.

4.4 Cross contamination from sampling equipment must be prevented by using sampling equipment constructed of stainless steel that is adequately decontaminated between samples.

# 5.0 Training and Qualifications

5.1 **Qualifications and Training**

The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 **Responsibilities**

5.2.1 The Project Manager is responsible for ensuring that soil sampling activities comply with this procedure. The Project Manager is responsible for ensuring that all personnel involved in soil sampling shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The Program Quality Manager is responsible for ensuring overall compliance with this procedure.

5.2.3 The Field Manager is responsible for ensuring that all soil sampling activities are conducted according to this procedure.

5.2.4 All Field Personnel are responsible for the implementation of this procedure.

# 6.0 Equipment and Supplies

The depth at which samples will be collected and the anticipated method of sample collection (direct-push, split-spoon, hand auger, shovel, or test pits) will be presented in the SAP. The following details equipment typically needed for soil sampling, based on the various methods. See the SAP for specific detail of equipment and supply needs.

6.1 Depending on the nature of suspected contamination, field screening instrumentation may be used for direct sampling. Appropriate instrumentation and calibration standards should be available. If volatile organic contaminants are suspected and a PID will be used, refer to the equipment and instrumentation listed in SOP 3-20 Operation and Calibration of a Photoionization Detector. Equipment in this SOP includes but is not limited to:

- PID/FID;
- Calibration gas; and
- Tedlar® gas bags (for calibration).

6.2 If field screening methods include jar headspace screening for volatile organics, refer to the equipment and procedure in SOP 3-19 Headspace Screening for Total VOCs. Equipment in this SOP includes but is not limited to:

- Clean soil (“drillers jars”) jars; and
- Aluminium foil.


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6.3 Appropriate decontamination procedures must be followed for sampling equipment. Refer to SOP 3-06 Equipment Decontamination. Equipment in this SOP includes but is not limited to:

- Phosphate-free detergent;
- Isopropyl Alcohol;
- Tap water;
- Deionized Ultra-Filtered (DIUF) Water;
- Plastic buckets or washbasins;
- Brushes; and
- Polyethylene sheeting.

6.4 The following general equipment is needed for all soil sampling, regardless of method:

- Stainless steel bowls;
- Stainless steel trowels;
- Appropriate sample containers for laboratory analysis;
- Personal Protective Equipment (PPE);
- Logbook;
- Cooler and ice for preservation; and
- Stakes and flagging to document sampling location.

6.5 The following additional equipment is needed for volatile organic sampling:

- Electronic pan scale and weights for calibration; and
- Syringes or other discrete soil core samplers.

6.6 The following additional equipment may be needed for surface and test pit soil sampling:

- Hand Auger

6.7 The following additional equipment may be needed for soil sampling from direct push and/or split-spoon equipment:

- Tape measure or folding carpenter's rule for recording the length of soil recovered.

Note: All subsurface drilling equipment will be provided and maintained by the subcontractor.

# 7.0 Procedure

7.1 **General Soil Sampling Procedure for All Soil Sampling Methods**

7.1.1 Record the weather conditions and other relevant on-site conditions.

7.1.2 Select the soil sampling location, clear vegetation if necessary, and record the sampling location identification number and pertinent location details.

7.1.3 Verify that the sampling equipment is properly decontaminated, in working order, and situated at the intended sampling location.


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7.1.4 Place polyethylene sheeting on the ground and assemble all necessary sampling equipment on top of it. Cover surfaces onto which soils or sampling equipment will be placed (i.e. tables with polyethylene sheeting).

7.1.5 Follow the appropriate procedures listed below for either surface, split-spoon, direct push, or test pit sample collection (7.2, 7.3, 7.4, and 7.5 respectively).

7.1.6 Collect soil samples according to procedures listed in Section 7.6 depending on project specific analyses.

7.1.7 Record date/time, sample ID, and sample descriptions in the field logbook or field form. A sketch or description of the location may also be recorded so the sample location can be re-constructed, especially if the location will not be recorded using global positioning satellite (GPS) equipment.

7.1.8 Immediately label the sample containers and place them on ice, if required for preservation. Complete the chain-of-custody form(s) as soon as possible.

7.1.9 Dispose of all excess excavated soil in accordance with the SAP.

7.1.10 If required, mark the sample location with a clearly labelled wooden stake or pin flag. If the location is on a paved surface, the location may be marked with spray paint.

7.1.11 Decontaminate the sampling equipment according to SOP 3-06 Equipment Decontamination.

## 7.2 Surface Sampling

7.2.1 The criteria used for selecting surface soil locations for sampling may include the following:

- Visual observations (soil staining, fill materials);
- Other relevant soil characteristics;
- Site features;
- Screening results;
- Predetermined sampling approach (i.e. grid or random); and
- Sampling objectives as provided in the SAP.

7.2.2 The following procedures are to be used to collect surface soil samples. Surface soils are considered to be soils that are up to two feet below ground surface, though state regulations and project objectives may define surface soils differently; therefore, the SAP should be consulted for direction on the depth from which to collect the surface soil samples. Sampling and other pertinent data and information will be recorded in the field logbook and/or on field forms. Photographs may be taken as needed or as specified in the SAP.

1. Gently scrape any vegetative covering until soil is exposed. Completely remove any pavement.
2. Remove soil from the exposed sampling area with a trowel, hand auger, or shovel. Put soils within the sampling interval in a stainless steel bowl for homogenizing. Monitor the breathing zone and sampling area as required in the HASP.
3. For VOC analyses, collect representative soil samples directly from the recently-exposed soil using a syringe or other soil coring device (e.g., TerraCore®, EnCore®). Follow procedures in Section 7.6.1 for VOC sampling.
4. Collect sufficient soil to fill all remaining sample jars into a stainless steel bowl. Homogenize the soil samples to obtain a uniform soil composition which is representative of the total soil sample collected according to the following procedure:
    a) Remove all rocks and non-soil objects using a stainless steel spoon or scoop.


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b) Form a cone shaped mound with the sample material, then flatten the cone and split the sample into quarters.

c) Use the stainless steel spoon/scoop to mix the quarter samples that are opposite.

d) After mixing the opposite quarters, reform the cone shaped mound.

e) Repeat this procedure a minimum of five (5) times, removing any non-soil objects and breaking apart any clumps.

## 7.3 Split-Spoon Sampling

7.3.1 At each boring location, the frequency and depth of split-spoon samples will be determined from the SAP. Split-spoon samples may be collected continuously, intermittently, or from predetermined depths.

7.3.2 Split-spoon samplers shall be driven into undisturbed soil by driving the spoon ahead of the drill augers/casing. In cohesive soils, or soils where the borehole remains open (does not collapse), two split-spoon samples may be taken prior to advancing the augers/casing.

7.3.3 After split-spoons are retrieved, open the split-spoon and measure the recovery of soil. If a PID will be used for screening, immediately scan the recovered sample for VOCs using the PID. Scan the recovered soil boring by making a hole in the soil with a decontaminated trowel and placing the PID inlet very close to the hole. Be very careful not to get soil on the tip of the PID. Take PID readings every 6 inches along the split-spoon and/or in any areas of stained or disturbed soil. Record the highest PID reading and the depth at which it was observed along with all other pertinent observations. If required in the SAP, VOC and headspace samples should be collected (see Section 7.6.1) prior to logging the sample.

7.3.4 If headspace screening for VOCs is required in the SAP, collect a soil sample (as defined in the SAP) and perform headspace screening according to SOP 3-19 Headspace Screening for Total VOCs.

7.3.5 Soils collected using the split-spoon sampler will be logged by the field representative using the procedure required in the SAP.

7.3.6 Collect the remainder of the sample volume required into a stainless steel bowl. Homogenize the soil so the material is uniform in composition and representative of the total soil sample collected. Follow homogenizing techniques as described in Section 7.2.

7.3.7 The SAP may specify that intervals to be sent to the laboratory be determined by visual observation and/or highest PID screening or headspace results, which can only be determined once the boring is complete. In this instance, a VOC sample should be collected at each interval. The remainder of the soil from that interval will be set aside in a clearly labelled stainless steel bowl covered with aluminium foil. Once the boring has been completed and the sample interval has been determined, the remainder of the soil can be homogenized according to Section 7.2 and submitted for laboratory analysis.

7.3.8 Once a boring is complete and all required samples have been collected, the boring must be completed as specified in the SAP (e.g., completed as a monitoring well, backfilled with bentonite, etc).

## 7.4 Direct Push Sampling

At each boring location, the frequency of direct-push samples will be determined from the SAP. Typically, samples with direct-push equipment are collected in 4 foot (ft) intervals, but smaller (e.g., 2 ft) and larger (e.g., 5 ft) intervals are also possible.

1. Sample using Macro-Core samplers with acetate liners to obtain discrete soil samples at the depths specified in the SAP.

2. Cut open the acetate liner. If required in the SAP, immediately scan the recovered soil boring for VOCs using a PID by making a hole in the soil with a decontaminated trowel and placing the PID inlet very close to the hole. Be very careful not to get soil on the tip of the PID. Take PID readings every 6 inches along the split-spoon and/or in any areas of stained or disturbed soil. Record the


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highest PID reading and the depth at which it was observed along with all other pertinent observations. VOC and headspace samples, if required in the SAP should be collected (see Section 7.6.1) prior to logging the sample.

3. If required in the SAP, collect a soil sample (as defined in the SAP) and perform headspace screening according to SOP 3-19 Headspace Screening for Total VOCs.

4. Soils collected using the direct-push sampler will be logged by the by the field representative using the procedure required in the SAP.

5. Collect the remainder of the sample into a stainless steel bowl. Homogenize the soil collected so that the material is uniform in composition and representative of the total soil sample collected. Follow homogenizing techniques as described in Section 7.2.

6. Once a boring is complete and all required samples have been collected, the boring must be completed as specified in the SAP (e.g., completed as a monitoring well, backfilled with bentonite, etc).

## 7.5 Test Pit Sampling

7.5.1 Excavate the test pit to the desired depth.

7.5.2 Using the excavator bucket, collect soil samples as specified in the SAP. Collect a sample and perform screening analyses as required by the SAP. If VOCs contamination is suspected, perform headspace screening according to SOP 3-19 Headspace Screening for Total VOCs.

7.5.3 Collect the sample from center of the bucket to avoid potential contamination from the bucket.

7.5.4 VOC samples should also be collected from an undisturbed section soil in the excavator bucket. The top layer of exposed soil should be scraped away just prior to collecting the VOC samples.

7.5.5 Collect the remainder of the sample volume required into a stainless steel bowl. Homogenize the soil so the material is uniform in composition and representative of the total soil sample collected. Follow homogenizing techniques as described in Section 7.2.

7.5.6 Dispose of all excavated soil according to the SAP.

## 7.6 Sample Collection Methods

7.6.1 Volatile Organics Sampling

For soils collected for analyses of volatile organics, including Volatile Petroleum Hydrocarbons (VPH) or other purgable compounds, a closed system is maintained. From collection through analysis, the sample bottles are not opened. The bottle kit for a routine field sample for these analyses will typically include three 40-mL VOA vials and one soil jar. Two 40-mL VOA vials will contain either 5 mL reagent water or 5 mL sodium bisulfate and magnetic stir bars (i.e., low level vials). The third VOA vial will contain 15 mL methanol with no magnetic stir bar (i.e., high level vial). These vials are usually provided by the laboratory and are pre-weighed, with the tare weight recorded on the affixed sample label. No additional sample labels are affixed to the VOA vials, as addition of a label would alter the vial weight. All information is recorded directly on the sample label using an indelible marker. The soil jar is provided for percent solids determination. For VOC or VPH analyses, samples are collected prior to sample homogenization. Collect the VOC sample in accordance with the procedure described below.

1. Determine the soil volume necessary for the required sample weight, typically 5 grams:

   a) Prepare a 5 mL sampling corer (e.g., Terra Core®) or cut-off plastic syringe.

   b) Tare the sampler by placing it on the scale, and zeroing the scale.

   c) Draw back the plunger to the 5 gram mark or 5mL (5cc) mark on cut-off syringe, and insert the open end of the sampler into an undisturbed area of soil with a twisting motion, filling the


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sampler with soil. Note the location of the plunger with respect to the milliliter (cc) or other graduation printed on the sampler.

d) Weigh the filled sampler, and remove or add soil until the desired weight is obtained. Note the location of the plunger which corresponds to this weight. Do not use this sample for laboratory analysis.

2. Once the required soil volume has been determined, pull the plunger back to this mark and hold it there while filling the syringe for each sample.

3. Collect 5 grams of soil using the cut-off syringe or Terra Core® sample device. Extrude the 5-grams of soil into one of the low level 40-mL VOA vials. Quickly wipe any soil from the threads of the VOA vial with a clean Kimwipe® and immediately close the vial. It is imperative that the threads be free from soil or other debris prior to replacing the cap on the vial in order to maintain the closed system necessary for the analysis.

4. Gently swirl the vial so that all of the soil is fully wetted with the preservative.

5. Fill the other low level 40 mL VOA vial in this manner.

6. Repeat the process for the high level VOA vials, only for the high level VOA vial three 5 gram aliquots (i.e., 15 grams total) should be extruded into the high level VOA vial.

   NOTE: Depending on the laboratory, some high level VOA vials only contain 5 mL or 10 mL of methanol. If this is the case, either 5 grams total or 10 grams total, respectively, should be extruded into the high level VOA vial. In other words, the mass of soil in grams should be identical to the volume of methanol in mL (i.e., 1:1 ratio of soil to methanol).

7. Collect any additional QC sample collected (e.g., field duplicate, MS, and MSD) in the same manner as above.

8. Fill the 4-oz glass jar with soil from the same area for percent moisture determination.

7.6.2 Soil Sampling Method (All other analyses except VOC/VPH)

When all the required soil for a sampling location has been obtained, the soil can be homogenized as described in section 7.2. Collect sufficient volume to fill all of the remaining sample containers at least ¾ full for all other analyses. Homogenize the soil in a decontaminated stainless steel bowl, removing rocks, sticks, or other non-soil objects and breaking apart any lumps of soil prior to filling the remaining sample containers.

NOTE: Soil samples must contain greater than 30% solids for the data to be considered valid.

## 8.0 Quality Control and Assurance

8.1 Sampling personnel should follow specific quality assurance guidelines as outlined in the SAP. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements outlined in the SAP typically suggest the collection of a sufficient quantity of field duplicate, field blank, and other samples.

8.2 Quality control requirements are dependent on project-specific sampling objectives. The SAP will provide requirements for equipment decontamination (frequency and materials), sample preservation and holding times, sample container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.


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## 9.0 Records, Data Analysis, Calculations

All data and information (e.g., sample collection method used) must be documented on field data sheets, boring logs, or within site logbooks with permanent ink. Data recorded may include the following:

- Weather conditions;
- Arrival and departure time of persons on site;
- Instrument type, lamp (PID), make, model and serial number;
- Calibration gas used;
- Date, time and results of instrument calibration and calibration checks;
- Sampling date and time;
- Sampling location;
- Samples collected;
- Sampling depth and soil type;
- Deviations from the procedure as written; and
- Readings obtained.

## 10.0 Attachments or References

SOP 3-06, Equipment Decontamination

SOP 3-19, Headspace Screening for Total VOCs

SOP 3-20, Operation and Calibration of a Photoionization Detector

| Author | Reviewer | Revisions (Technical or Editorial) |
|---|---|---|
| Robert Shoemaker<br>Senior Scientist | Chris Barr<br>Program Quality Manager | Rev 0 – Initial Issue (May 2012) |


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# Standard Operating Procedure 3-24
# Water Quality Parameter Testing for Groundwater Sampling

## 1.0 PURPOSE

This standard operating procedure (SOP) represents minimum standard of practice. State and federal requirements may vary, and this SOP does not replace state and federal requirements that must be consulted before work begins. Further, if a project-specific work plan has been created, the work plan should be considered the ruling document. This SOP may be modified to meet specific regulatory, client, or project specific criteria.

If there are procedures whether it be from AECOM, state and/or federal that are not addressed in this SOP and are applicable to water quality parameter testing, then those procedures may be added as an appendix to the project-specific Sampling and Analysis Plan (SAP).

## 2.0 SCOPE

This procedure provides guidance for expected sampling methods and protocols by all personnel related to the measurement of water quality parameters.

Field measurements of water quality parameters are commonly performed to evaluate surface water and groundwater. These tests are often performed to evaluate basic water quality parameters, to evaluate natural attenuation parameters, and to assess the presence of pore water entering a well.

As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by either the Project Manager or the Quality Assurance (QA) Manager, and documented.

## 3.0 DEFINITIONS

### 3.1 Barometric Pressure (BP)

The density of the atmosphere, which varies according to altitude and weather conditions.

### 3.2 Conductivity/Specific Conductance

A measure of the ability of water to pass electrical current, which increases with the amount of dissolved ionic substances (i.e., salts). Conductivity is inversely related to the resistance of a solution and is measured in units of mhos per centimeter (mhos/cm) (inverse ohms/cm, Siemens/cm). The conductivity of water increases with increasing temperature.

*Specific Conductance is corrected for 25 degrees Celsius (°C); for this reason, it is best to record Specific Conductance. If Conductivity is recorded, the temperature of the sample MUST recorded.*

### 3.3 Dissolved Oxygen (DO)

The amount of oxygen present in water and available for respiration. DO is typically measured in milligrams per liter (mg/L). Oxygen is less soluble in warm and salty waters, so the instrument compensates the apparent percent saturation for changes in temperature and conductivity. Most probes measure the current resulting from the electrochemical reduction of oxygen (at a gold cathode) diffusing through a selective membrane. Because oxygen is being removed from the sample to perform the measurement, sample flow is required to prevent false low readings due to depletion of oxygen in the solution in front of the probe. Optical DO probes do not remove oxygen from the sample and are less affected by salts. The common range of DO in groundwater is 0.0 to 3.0 mg/L. Measurements outside of this range suggest that the meter may not be operating correctly.

### 3.4 Nephelometric Turbidity Unit (NTU)

The measurement of light passing through a sample based on the scattering of light caused by suspended particles.

### 3.5 pH

A measure of acidity and alkalinity of a solution using a logarithmic scale on which a value of 7 represents neutrality, lower numbers indicate increasing acidity, and higher numbers are increasingly basic.

### 3.6 Oxidation-Reduction Potential (ORP)

Also known as redox or eH, ORP is a measurement of the potential for a reaction to occur, which generally indicates the oxygen status of a sample. The probe consists of a platinum electrode, the potential of which is measured with respect to a reference electrode that rapidly equilibrates with the potential of the sample solution. A positive value indicates that oxygen is present. A negative value indicates an anaerobic environment or reducing condition. For this reason, negative ORP readings should be associated with DO readings of less than 0.5 mg/l; with negative ORP readings the water may exhibit a sulfur odor or gray color. Positive ORP readings should be associated with DO readings greater than 0.5 mg/L and lack of sulfur odors. Because of the complex relationship between ORP and temperature, no compensation is attempted; it is thus best to report both the ORP and temperature of a water sample.


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### 3.7 Total Dissolved Solids

A measure of the quantity of materials in water that are either dissolved or too small to be filtered.

### 3.8 Turbidity

Measure of the clarity of water in NTUs. Potable water typically has NTU values between 0.0 and 0.3 NTUs, depending on the state or regulatory program.

## 4.0 RESPONSIBILITIES

The Porject Manager, or designee, is responsible for ensuring that these standard groundwater sampling activities are followed and shall review all groundwater sampling forms at the conclusion of a sampling event. The CTO Manager is responsible for ensuring that all personnel involved in monitoring well sampling shall have the appropriate education, experience, and training to perform their assigned tasks. The QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure. The Field Manager is responsible for ensuring that all project field staff follows these procedures.

Field sampling personnel are responsible for the implementation of this procedure. Personnel are required to be knowledgeable of the procedures in this SOP. Training and familiarization with this SOP shall be documented in the training file for each employee. The field sampler and/or Field Manager is responsible for directly supervising the calibration procedures to ensure that they are conducted according to this procedure, and for recording all pertinent data. If deviations from the procedure are required because of anomalous field conditions, they must first be approved by the Project Manager, QA Manager, or Technical Director and then documented in the field logbook and associated report or equivalent document.

## 5.0 PROCEDURES

### 5.1 Purpose

The procedures will vary depending on parameters being measured, method of sampling, and the method of measurement used. The information here is a general guidance and the site-specific documents and manufacturer manuals supersede these procedures.

### 5.2 Cautions

Improper use of water quality testing equipment could result in equipment damage or compromised sampling results. Personnel should be trained to operate the test equipment being used for a field operation and should be trained in the proper techniques for collecting and

logging water quality parameters. Personnel should also be able to recognize problems with test equipment and have someone available for basic troubleshooting and repair.

## 5.3 Interferences

During field testing, water quality data that is documented from field testing equipment may be influenced by certain outside factors that are unrelated to the actual site water quality. Such parameters and equipment include the following:

### pH Meters

- Coatings of oils, greases, and particles may impair the electrode's response. Pat the electrode bulb dry with lint-free paper or cloth and rinse with de-ionized water. For cleaning hard-to-remove films, use isopropyl alcohol very sparingly so that the electronic surface is not damaged.

- Poorly buffered solutions with low specific conductance (less than 200 microsiemens per centimeter) may cause fluctuations in the pH readings. Equilibrate electrode by immersing in several aliquots of sample before taking pH.

### Dissolved Oxygen

- Dissolved gases (e.g., hydrogen sulfide, halogens, sulfur dioxide) are a factor with the performance of DO probes. The effect is less pronounced on optical DO meters. Meter type and potential interferences should be considered based on potential sulfate/sulfide or nitrate/nitrite reducing environments.

- Exposure of the sample to the atmosphere will cause elevated DO measurements.

### Turbidity Meter

- If the weather is warm and humidity is high, condensation may collect on the cuvet. To avoid this, allow the sample to warm and dry the outside of the cuvet before making the measurement. One method used to accomplish this is to place the cuvet against one's body (armpits work well).

### Temperature

- Sample temperature will change rapidly when there are significant differences between the sample and ambient air.


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## 5.4 Apparatus and Materials

Field personnel shall consult the site work plan and SAP to review the equipment requirements for the sampling procedures to be followed during the sampling effort. The specific apparatus and materials required will depend on the water quality parameters being monitored. Table 1 shows the common equipment used in water quality parameter testing.

**Table 1**
**Water Quality Parameter Testing — Common Equipment**

| Water Quality Parameter Instrument | Calibration Standards Required | Other Equipment |
|---|---|---|
| pH Meter | Yes - 2 or 3 Point Standards depending on groundwater range. Calibration must cover the range to be measured. If samples are above or below typical buffer standards (4, 7 and 10), special order buffers that fall outside groundwater pH range. | Container or flow thru cell for holding sample |
| Specific Conductance | Yes | Container or flow thru cell for holding sample |
| ORP Meter | Yes | Container or flow thru cell for holding sample |
| Turbidity Meter | Yes | Container or flow thru cell for holding sample |
| DO | No | Container or flow thru cell for holding sample |
| Thermometer | No | Container or flow thru cell for holding sample |
| Flow Rate | No | Calibrated Container |

***Notes:***
ORP = Oxidation-Reduction Potential
DO = Dissolved Oxygen

## 5.5 Instrument or Method Calibration

Most monitoring instruments require calibration before use, and this calibration must be conducted in the field under the ambient climatic conditions that will be present during field sampling. Calibration of monitoring instruments shall be performed in accordance with the manufacturer's specifications and recorded in the provided form in Attachment 1. Site-specific instrument calibration requirements should be specified in the SAP. The following minimum calibration requirements apply to the various types of meters used to gather water quality measurements.

**Initial Calibration (IC):** Before use, the instrument or meter electronics are adjusted (manually or automatically) to a theoretical value (e.g., DO saturation) or a known value of a

calibration standard. An IC is performed in preparation for the first use of an instrument or if a calibration verification does not meet acceptance criteria.

**Initial Calibration Verification (ICV):** The instrument or meter calibration is checked or verified directly following IC by measuring a calibration standard of known value as if it were a sample and comparing the measured result to the calibration acceptance criteria for the instrument/parameter. If an ICV fails to meet acceptance criteria, immediately recalibrate the instrument using the applicable initial calibration procedure or remove it from service.

**Continuing Calibration Verification (CCV):** After use, the instrument or meter calibration is checked or verified by measuring a calibration standard of known value as if it were a sample and comparing the measured result to the calibration acceptance criteria for the instrument/parameter.

### 5.5.1 Calibration Checks

Calibration checks are conducted by measuring a known standard. They must be completed after calibration and should be performed at least one other time (i.e., after lunch) and anytime suspect measurements are encountered. Table 2 provides general acceptance ranges to be used during calibration checks. If a meter is found to be outside of the acceptance range, the meter **must** be recalibrated. If the meter remains out of range, the project manager and/or the supplier of the meter should be contacted to determine alternative measures.

**Table 2**
**Calibration Check Acceptance Limits**

| Parameter | Acceptance Criteria |
|---|---|
| Dissolved Oxygen | ±0.3 mg/L of the theoretical oxygen solubility |
| Oxidation-Reduction Potential | ±10 mv from the theoretical standard value at that temperature |
| pH | ±0.2 Standard pH Units |
| Specific Conductance | ±5% of the standard |
| Turbidity | 0.1 to 10 NTU: ±10% of the standard<br>11 to 40 NTU: ±8% of the standard<br>41 to 100 NTU: ±6.5% of the standard |

*Notes:*
mg/L = milligrams per liter
mv = millivolts
NTU = nephelometric turbidity units


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### 5.5.2 Possible and Suspected Ranges

The concentration for each parameter range should be known so that concentrations outside of the range can be noted. Table 3 presents the maximum range of the parameter in groundwater. The table also presents the suspected range. Measurements outside of the maximum/minimum range should be considered in error and the measurement method should be checked. Concentrations outside the normal range should be treated as suspect but may be the result of contaminant impact. For example, a pH of 2.0 would be out of the normally suspected range for groundwater but not at a site impacted with an acid.

**Table 3**
**Minimum and Maximum Result Ranges**

| Parameter | Units | Possible Min | Possible Max | Normal Min | Normal Max | Notes |
|---|---|---|---|---|---|---|
| Dissolved Oxygen | mg/L | 0.0 | 14.6 (0°C )<br>10.1 (15°C)<br>8.3 (2°C) | 0.0 | 5 | The colder the sample, the higher the DO reading.<br><br>DO greater than 1 mg/L, ORP positive should not have sulfur odor, sulfide, ferrous iron and/or gray color.<br><br>DO less than 1 mg/L, ORP negative, may have sulfur odor, sulfide, ferrous iron and/or gray color. |
| pH | SU | 0 | 14 | 5 | 9 | pH values exceeding 10 could indicate grout contamination |
| ORP | mv | | | | | DO greater than 1 mg/L, ORP positive should not have sulfur odor, sulfide, ferrous iron and/or gray color.<br><br>DO less than 1 mg/L, ORP negative, may have sulfur odor, sulfide, ferrous iron and/or gray color. |
| Specific Conductance | µS/cm | | | varies | varies | |
| Temperature | °C | 0 | 100 | 5 | 30 | |
| Turbidity | NTU | 0 | Greater than 1,000 | 0 | Greater than 1,000 | 50 NTU or greater suggests cloudiness. |

***Notes:***

mg/L = milligrams per liter
°C = degrees Celsius
DO = dissolved oxygen
SU = standard units
ORP = oxidation reduction potential
mv = millivolts
mS/cm = micro Siemens per cm
NTU = nephelometric turbidity units


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### 5.5.3 Field Instruments and Calibration Criteria

The calibration acceptance criteria for each instrument are summarized in Table 4 along with special considerations related to each field instrument.

**Table 4**
**Calibration Check Acceptance Limits**

| Parameter | Acceptance Criteria |
|---|---|
| Dissolved Oxygen | ±0.3 mg/L of the theoretical oxygen solubility. |
| Oxidation-Reduction Potential | ±10 mv from the theoretical standard value at that temperature. |
| pH | ±0.2 Standard pH Units |
| Specific Conductance | ±5% of the standard |
| Turbidity | 0.1 to 10 NTU: ±10% of the standard<br>11 to 40 NTU: ±8% of the standard<br>41 to 100 NTU: ±6.5% of the standard |

***Notes:***
mg/L = milligrams per liter
mv = millivolts
NTU = nephelometric turbidity units

**pH Meters**

- For the most accurate of pH measurements, pH meters should receive a three-point calibration. However, if a two-point calibration will bracket the groundwater pH of the site, a two-point calibration is acceptable. Three-point calibrations typically include calibrating to solutions of pH 7.00, 4.00, and 10.00. If groundwater pH is outside the calibration range of the solution standards, special buffers must be ordered to bracket the pH. Some meters will report the slope of the calibration and this may be used in checking the meter calibration (refer to the meter's manual). When performing an ICV, the result must be within +/- 0.2 pH units of the stated buffer value.

- pH meters should be calibrated across the range of values to be measured. The maximum and minimum calibration solutions shall be outside the range of anticipated values. For example, if the expected range is between 7.50 and 9.00, the 7.00 and the 10.00 standard should be used for calibration. Perform the IC using at least two buffers, and always use the pH 7.00 buffer first. A reading that is above the maximum (or below the minimum) calibration standard is an estimate only and is not valid. This condition requires obtaining a new standard that is above (or below) the reported value, depending on the measurement.

- A percent slope of less than 90 percent indicates a bad electrode that must be changed or repaired. If percent slope cannot be determined, or the manufacturer's optimum specifications are different, follow the manufacturer's recommendation for maintaining optimum meter performance.

**Specific Conductivity Meters**

- For IC, when the sample measurements are expected to be 100 microsiemens per centimeter (µS/cm) or greater, use two standard potassium chloride (KCl) solutions that bracket the range of expected sample conductivities. Calibrate the instrument with the first standard. Verify the calibration of the instrument with the second standard, bracketing the range of expected sample values.

- If the instrument can be calibrated with more than one standard, choose additional calibration standards within the range of expected sample values.

- When the sample measurements are expected to be less than 100 µS/cm, a lower bracket is not required, but one standard (KCl) solution that is within the range of expected measurements must be used for the IC and the ICV.

- Accept the calibration if the meter reads within +/- 5 percent of the value of any calibration standard used to verify the calibration.

- Most field instruments read conductivity directly. Record all readings and calculations in the calibration records.

- For CCV, check the meter with at least one KCl standard with a specific conductance in the range of conductivity measured in environmental samples. The reading for the calibration verification must also be within +/- 5 percent of the standard value.

- If new environmental samples are encountered outside the range of the IC, verify the instrument calibration with two standards bracketing the range of sample values. If these calibration verifications fail, recalibrate the instrument.

**Dissolved Oxygen Meters**

- Before calibrating, check the probe membrane for bubbles, tears, or wrinkles. These conditions require replacement of the membrane in accordance with the manufacturer's directions.

- If the meter provides readings that are off-scale, will not calibrate, or drift, check the leads, contacts, etc., for corrosion and/or short circuits. These conditions require replacement maintenance in accordance with the manufacturer's directions.
- Most DO meters must be calibrated based on an environment of 100 percent humidity and a known elevation and barometric pressure (BP).

- For 100 percent humidity, place the probe in the calibration container with a moist towel and allow the probe to remain, undisturbed, for 10 to 20 minutes.

- The IC is an air calibration at 100% saturation. Before use, verify the meter calibration in water-saturated air to make sure it is properly calibrated and operating correctly. Make a similar verification at the end of the day or sampling event. Follow the manufacturer's instructions for your specific instrument. Allow an appropriate warm up period before IC. Wet the inside of the calibration chamber with water, pour out the excess water (leave a few drops), wipe any droplets off the membrane/sensor and insert the sensor into the chamber (this ensures 100 percent humidity). Allow adequate time for the DO sensor and the air inside the calibration chamber to equilibrate. Once the probe/calibration chamber is stable at ambient temperature, check the air temperature and determine, from the DO versus temperature table (see Attachment 2) what DO should measure. The acceptance criterion for DO ICV is +/- 0.3 mg/L.

- Use the same procedure as above for CCV.

**ORP Meters**

- Verify electrode response before use in the field.

- Equilibrate the standard solution to the temperature of the sample. The standard solution is based on a 25°C temperature; however, the calibration solution standard's value will require adjustment based on the temperature.

- Immerse the electrodes and gently stir the standard solution in a beaker (or flow cell). Turn the meter on, placing the function switch in the millivolt (mv) mode.

- Let the electrode equilibrate and record the reading to the nearest millivolt. The reading must be within ±10 mv from the theoretical redox standard value at that temperature. If not, determine the problem and correct it before proceeding. Switch to temperature display and read the value.

- Record the mv reading and temperature in the field notebook or in form. Rinse the electrode with distilled water and proceed with the sample measurement, unless using a flow cell. If a flow cell is used, rinse between sample locations.

**Turbidity Meters**

- Perform an initial calibration using at least two primary standards.

- If the instrument cannot be calibrated with two standards, calibrate the instrument with one standard and verify with a second standard.

- Perform an ICV by reading at least one primary standard as a sample. The acceptance criterion for the ICV depends on the range of turbidity of the standard value:

    1. Standard Value = 0.1 to 10 NTU: the response must be within 10 percent of the standard;

    2. Standard Value = 11 to 40 NTU: the response must be within 8 percent of the standard;

    3. Standard Value = 41 to 100 NTU: the response must be within 6.5 percent of the standard; and

    4. Standard Value greater than 100 NTU: the response must be within 5 percent of the standard.

- Determining the Values of Secondary Standards: Use only those certified by the manufacturer for a specific instrument. Secondary standards may be used for CCVs.

To initially determine the value of a secondary standard, assign the value that is determined immediately after an ICV or verification with primary standards. This is done by reading the secondary standard as a sample. This result must be within the manufacturer's stated tolerance range and +/- 10 percent of the assigned standard value. If the +/- 10 percent criterion is not met, assign this reading as the value of the standard. If the reading is outside the manufacturer's stated tolerance range, discard the secondary standard.

- CCV: Perform a CCV using at least one primary or secondary standard. The calibration acceptance criteria are the same as those for an ICV.

## 5.6 Direct Measurements

Direct measurements with meters are the most common methods and can be accomplished by placing a sample in a container with the probe or by allowing the water to flow past the probe in a flow cell. The use of a flow-through cell improves measurement quality by allowing the constant flow of water over the probes and reduces interaction of the sample with the atmosphere. Sample cups should be avoided. The quantity of samples, timing, and methodology should be described in the project SAP.

Following calibration of required probes, connect the bottom flow-cell port to the discharge line of the pump. Connect the top port to a discharge line directed to a bucket to collect the purge water. Allow the flow cell to completely fill. As the water flows over the probe, record the measurements. Continue to record the measurements at regular intervals, as specified in the SAP.

When the ambient air temperatures are much higher or lower than the temperature of the water sample, it is best to keep the length of tubing between the wellhead and the flow cell as short as possible to prevent heating or cooling of the water. Tubing and flow-through cell should not be exposed to direct sunlight, particularly in the summer, if at all possible, to avoid heating of water samples.

## 5.7 Data Acquisitions, Calculations, and Data Reduction

### 5.7.1 Specific Conductivity Correction Factions

If the meter does not automatically correct for temperature (i.e., read Specific Conductivity) record Conductivity and adjust for temperature upon returning to the office. The following equation can be used to convert Conductivity to Specific Conductivity.

$$K = \frac{(Km)(C))}{1 + 0.0191(\mathrm{T} - 25)}$$

Where:

K = Conductivity in μmhos/cm at 25°C

Km = Measured conductivity in μmhos/cm at T degrees Celsius

C = Cell constant

T = Measured temperature of the sample in degrees Celsius;

If the cell constant is 1, the formula for determining conductivity becomes:

$$K = \frac{(Km)}{1 + 0.0191(\mathrm{T} - 25)}$$

### 5.7.2 Percentage Difference Calculation

For evaluating slope of readings from either a flow cell or a sample cup.

$$\%Difference = \frac{(Highest\ Value - Lowest\ Value)}{(Highest\ Value)}\ x\ 100$$

### 5.7.3 Convert mm mercury (mmHG) to inches mercury (inHG)

$$mmHG = inHG\ x\ 25.4$$

### 5.7.4 True Barometric Pressure

For converting BP obtained from a public domain source that is expressed in BP at sea level to BP at the subject site.

$$TrueBP = (BP) - \frac{(2.5\ x\ [Local\ Altitude])}{100}$$

Where: BP is in mmHG and Local Altitude is in feet

Example: BP at site A is 30.49 inHg and elevation is 544 feet, calculate TrueBP



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Convert inHG to mmgHG:

mmHg = 30.49 inHg x 25.4 = 774.4 mmHg

Calculate True BP:

TrueBP = (774.4 mmHg) – [2.5 * (544 /100)] = 774.4-13.6 = 760.8 mmHg

## 6.0 RECORDS

Data will be recorded promptly, legibly, and in indelible ink on the appropriate logbooks and forms. At the completion of a field effort, all logbooks, field data forms, and calibration logs shall be scanned and made electronically available to the project team. The original field forms, calibrations logs, and log book will be maintained in the project file.

## 7.0 HEALTH AND SAFETY

Detailed Health and Safety requirements can be found in the site specific Health and Safety Plan. Ensure that a Safe Work Assessment and Permit form is filled out daily prior to any work in the field and reviewed with all project personnel in a daily safety brief.

Safety glasses with side shields or goggles and disposable gloves shall be worn during calibration activities.

## 8.0 REFERENCES

None

## 9.0 ATTACHMENTS

Attachment 1: Example Field Instrument Calibration Form
Attachment 2: Solubility of Oxygen at Given Temperatures
Attachment 3: Example Field Data Form


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**Attachment 1**
**Example Field Instrument Calibration Form**

# Field Instrument Calibration Form

Calibrated by: _____ Equipment (Make/Model/Serial#): _____

Date: _____ Equipment (Make/Model/Serial#): _____

## pH (su) — Standard: ± 0.2 standard units

**Initial Calibration / Initial Calibration Verification**

| | Hach SL | Reading | Pine SL | Reading |
|---|---|---|---|---|
| pH7 | | | | |
| pH4 | | | | |

**Continuing Calibration Verification**

| | Hach SL | Reading | Deviation | Acceptable Variance (Y/N) |
|---|---|---|---|---|
| pH7 | | | | |
| pH4 | | | | |

## DO (mg/L) — Standard: ± 0.3 mg/L of theoretical*

**IC (Temp: )** / **ICV (Temp: )**

| Saturation (%) | Reading (%) | Theoretical (mg/L) | Reading (mg/L) |
|---|---|---|---|
| 100 | | | |

**CCV (Temp: )**

| Saturation (%) | Reading (%) | Deviation | Acceptable Variance (Y/N) |
|---|---|---|---|
| 100 | | | |

| Theoretical (mg/L) | Reading (mg/L) | Deviation | Acceptable Variance (Y/N) |
|---|---|---|---|
| | | | |

## ORP (mV) — Standard: NA

**IC (Zobell SL: )** / **ICV (Pine SL: )**

| TCS (Std/Temp) | Reading | TCS (Std/Temp) | Reading |
|---|---|---|---|
| | | | |

**CCV (Zobell SL: )**

| TCS (Std/Temp) | Reading | Deviation | Acceptable Variance (Y/N) |
|---|---|---|---|
| | | | |

## Turbidity (ntu) — Standard: ±10% of Standard

**Initial Calibration**

| Standard | Reading |
|---|---|
| | |

**Continuing Calibration Verification**

| Standard | Reading | Deviation | Acceptable Variance (Y/N) |
|---|---|---|---|
| | | | |

## Conductivity ($ms^{C}/cm$) — Standard: ± 5% of standard value

**IC (YSI SL: )** / **ICV (Pine SL: )**

| Standard | Reading | Standard | Reading |
|---|---|---|---|
| | | | |

**CCV (YSI SL: )**

| Standard | Reading | Deviation | Acceptable Variance (Y/N) |
|---|---|---|---|
| | | | |

## Comments:

*Notes:*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SL | solution lot | | su | standard units | | ntu | Nephelometric Turbidity Units |
| TCS | temperature corrected standard | | mV | millivolts | | °C | degrees Celsius |
| Std | standard | | % | percent | | $ms^{C}/cm$ | millisiemens per centimeter (temperature corrected) |
| Temp | temperature | | mg/L | milligrams per liter | | * | Theoretical value |

**Attachment 2**
**Solubility of Oxygen at Given Temperatures**

## Field Measurement of Dissolved Oxygen

| Solubility of Oxygen in Water at Atmospheric Pressure | | | |
|---|---|---|---|
| **Temperature** | **Oxygen Solubility** | **Temperature** | **Oxygen Solubility** |
| **°C** | **mg/L** | **°C** | **mg/L** |
| 0.0 | 14.621 | 26.0 | 8.113 |
| 1.0 | 14.216 | 27.0 | 7.968 |
| 2.0 | 13.829 | 28.0 | 7.827 |
| 3.0 | 13.460 | 29.0 | 7.691 |
| 4.0 | 13.107 | 30.0 | 7.559 |
| 5.0 | 12.770 | 31.0 | 7.430 |
| 6.0 | 12.447 | 32.0 | 7.305 |
| 7.0 | 12.139 | 33.0 | 7.183 |
| 8.0 | 11.843 | 34.0 | 7.065 |
| 9.0 | 11.559 | 35.0 | 6.950 |
| 10.0 | 11.288 | 36.0 | 6.837 |
| 11.0 | 11.027 | 37.0 | 6.727 |
| 12.0 | 10.777 | 38.0 | 6.620 |
| 13.0 | 10.537 | 39.0 | 6.515 |
| 14.0 | 10.306 | 40.0 | 6.412 |
| 15.0 | 10.084 | 41.0 | 6.312 |
| 16.0 | 9.870 | 42.0 | 6.213 |
| 17.0 | 9.665 | 43.0 | 6.116 |
| 18.0 | 9.467 | 44.0 | 6.021 |
| 19.0 | 9.276 | 45.0 | 5.927 |
| 20.0 | 9.092 | 46.0 | 5.835 |
| 21.0 | 8.915 | 47.0 | 5.744 |
| 22.0 | 8.743 | 48.0 | 5.654 |
| 23.0 | 8.578 | 49.0 | 5.565 |
| 24.0 | 8.418 | 50.0 | 5.477 |
| 25.0 | 8.263 | | |

***Notes:***

The table provides three decimals to aid interpolation

Under equilibrium conditions, the partial pressure of oxygen in air-saturated water is equal to that of the oxygen in water saturated

°C = degrees Celsius

mg/L = milligrams per liter

**Attachment 3**
**Example Field Data Form**

## WELL DEVELOPMENT & GROUNDWATER SAMPLING FORM

| | | |
|---|---|---|
| DATE: | JOB NUMBER: | EQUIPMENT (Make/Model #/Serial #): |
| PROJECT: | EVENT: | / / |
| WELL ID: | LOCATION: | / / |
| WEATHER CONDITIONS: | AMBIENT TEMP: | / / |
| REVIEWED BY: | PERSONNEL: | / / |

| | | |
|---|---|---|
| WELL DIA: | **WELL DEVELOPMENT** | |
| TOTAL DEPTH from TOC (ft.): | START: | FINISH: |
| DEPTH TO WATER from TOC (ft.): | VOLUME PURGED (gal): | |
| LENGTH OF WATER COL. (ft.): | **GROUNDWATER SAMPLING** | |
| 1 VOLUME OF WATER (gal): | START: | FINISH: |
| 3 VOLUMES OF WATER (gal): | VOLUME PURGED (gal): | |
| | ANALYSIS: | |

| WELL DEVELOPMENT PARAMETERS | | GW SAMPLING PARAMETERS | |
|---|---|---|---|
| Temperature: | ± 1.0° C | Temperature: | ± 0.2° C |
| pH: | ± 0.5 standard units | pH: | ± 0.2 standard units |
| Specific Conductance: | ± 10% of the past measurement | Specific Conductance: | ± 5% of the past measurement |
| Turbidity: | relatively stable | DO: | ≤ 20% saturation |
| | | ORP: | ± 10 millivolts |
| | | Turbidity: | ≤ 10 NTU |

### IN-SITU TESTING

| Circle one: DEVELOPMENT SAMPLING | | | | | | | ☐ Bailer ☐ Pump | | Description: | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Time (hh:mm): | | | | | | | | | | | | |
| pH (units): | | | | | | | | | | | | |
| Conductivity (mS/cm): | | | | | | | | | | | | |
| Turbidity (NTU): | | | | | | | | | | | | |
| DO (mg/L): YSI 556 | | | | | | | | | | | | |
| DO (mg/L): YSI 550 | | | | | | | | | | | | |
| Temperature (C°): | | | | | | | | | | | | |
| ORP (mV): | | | | | | | | | | | | |
| Volume Purged (gal): | | | | | | | | | | | | |
| Depth to Water (ft): | | | | | | | | | | | | |
| | | | | | | | | | | | | |
| | | | | | | | | Well Goes Dry While Purging ☐ | | | | |

### SAMPLE DATA

☐ Bailer ☐ Pump Description:

| Sample ID | Date (m/d/y) | Time (hh:mm) | Bottles (total to lab) | Filtered (0.45 µm) | Remarks |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| Purging/Sampling Device Decon Process: | | | | | |

COMMENTS:

Purge water placed in drum#_____

# Chip Sampling

## Project Operating Procedure 001

## 1.0 Scope and Applicability

**1.1** This Project Operating Procedure (POP) defines the procedures for the collection of chip samples to determine surficial contamination on porous surfaces (e.g., cement, brick, wood). These procedures are intended for samples to be analyzed for non-volatile analyses (e.g., PCBs, TCDD, and TCDF), and should not be used for volatile organic compound (VOC) analysis. Sample points should be carefully chosen and should be based on site history, manufacturing processes, personnel practices, obvious contamination, and available surface area. Suggested sampling points include floors near process vessels and storage tanks, loading dock areas, etc. The sampling area should be large enough to provide a sufficient amount of sample for analysis (smaller sample volumes cause higher detection limits). To facilitate the calculations once the analytical data is received, the area sampled should be measured.

## 2.0 Health and Safety Considerations

**2.1** The health and safety considerations for the work associated with this POP, including both potential physical and chemical hazards, will be addressed in the site-specific Accident Prevention Plan (APP) and Site Safety and Health Plan (SSHP). In the absence of a site-specific APP, work will be conducted according to the AECOM Health and Safety Policy and Procedures Manual and/or direction from the Regional Health and Safety Manager.

## 3.0 Interferences

**3.1** Cross contamination from sampling equipment will be prevented by using sampling equipment constructed of stainless steel that is adequately decontaminated between samples.

## 4.0 Equipment and Materials

To collect a chip sample, the following equipment is needed:

- Ruler, measuring tape, measuring wheel, or other similar measuring device
- Chalk
- Disposable nitrile gloves, safety glasses, and other PPE required in the site-specific APP.

- Decontaminated beryllium copper or stainless steel chisel
- Hammer or electric hammer
- Dedicated natural bristle brush and a dust pan lined with aluminum foil or one that is dedicated, decontaminated and constructed of a pre-approved material which will not interfere with the contaminants of concern
- Glass sample containers
- Field logbook and pen with indelible ink

## 5.0 Procedures

**5.1** Mark off the sample collection location with chalk and measure the area.

**5.2** Don safety glasses, a new pair of disposable gloves, and any other PPE required in the site-specific APP.

**5.3** Using the decontaminated chisel and hammer, break up the surface of the location to be sampled. An effort should be made to avoid scattering pieces out of the marked sampling area boundary. Any pieces that fall outside the sampling area should not be used. The area should be chipped to less than ¼" and preferably ⅛".

**5.4** Record how deep chips were taken in the field logbook or field data sheet.

**5.5** Collect the chipped pieces using a dedicated, decontaminated dustpan and natural bristle brush and transfer the sample directly into the sample container.

**5.6** Repeat the process for each location to be sampled. Use new or decontaminated equipment at each location. Outer gloves must be changed before each sample is collected.

**5.7** Decontaminate the sampling equipment in accordance with *SOP 3-06 Equipment Decontamination*.

## 6.0 Quality Assurance / Quality Control

**6.1** Sampling personnel should follow specific quality assurance guidelines as outlined in the QAPP and/or Work Plan. Proper quality assurance requirements should be provided which will allow for collection of representative samples from representative sampling points. Quality assurance requirements outlined in the QAPP and/or Work Plan typically suggest the collection of a sufficient quantity of field duplicate, field blank, and other samples.

**6.2** Quality control requirements are dependent on project-specific sampling objectives. The QAPP and/or Work Plan will provide requirements for equipment decontamination (frequency and materials), sample preservation and holding times, sample container types, sample packaging and shipment, as well as requirements for the collection of various quality assurance samples such as trip blanks, field blanks, equipment blanks, and field duplicate samples.

## 7.0 Data and Records Management

**7.1** All data and information (e.g., sample collection method used) must be documented on field data sheets or within site log books with permanent ink.

**7.2** Unanticipated changes to the procedures or materials described in this POP (deviations) will be appropriately documented in the project records.

**7.3** Records associated with the activities described in this POP will be maintained according to the document management policy for the project.

## 8.0 Personnel Qualifications and Training

**8.1** Qualifications and training

**8.1.1** The individual executing these procedures must have read, and be familiar with, the requirements of this POP.

**8.1.2** The entire sampling team should read and be familiar with the site Health and Safety Plan, all relevant POPs, and the QAPP and/or Work Plan (and the most recent amendments) before going onsite for the sampling event. It is recommended that the field sampling leader attest to the understanding of these site documents and that it is recorded.

**8.2** Responsibilities

**8.2.1** The project manager is responsible for providing the project team with the materials, resources and guidance necessary to properly execute the procedures described in this POP.

**8.2.2** The individual performing the work is responsible for implementing the procedures as described in this POP and any project-specific work plans.

## 9.0 References

United States Environmental Protection Agency. 2001. Guidance for Preparing Standard Operating Procedures (SOPs). EPA QA/G-6. EPA/240/B-01/004. USEPA Office of Environmental Information, Washington, DC. March 2001.

New Jersey Department of Environmental Protection (NJDEP), August 2005. Field Sampling Procedures Manual.

AECOM SOP 3-06 Decontamination of Field Equipment

## 10.0 Revision History

| Revision | Date | Changes |
|---|---|---|
| 0 | June 2010 | Original POP |

# Appendix B

# Quality Assurance Project Plan

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**FINAL**

# APPENDIX B
# QUALITY ASSURANCE PROJECT PLAN

## Remedial Investigation
## Former Camp Hero, Montauk, New York

**Revision: 0**

**Prepared for:**

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**June 2016**

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ATTACHMENT A RTI Laboratories Corporate Quality Assurance Plan and Lab Certifications
ATTACHMENT B RTI Laboratories SOPs
ATTACHMENT C References

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## ACRONYMS AND ABBREVIATIONS

| | |
|---|---|
| ºC | degrees Celsius |
| AA | Atomic Absorption |
| ASTM | American Society for Testing and Materials |
| AOC | Area of Concern |
| BS | blank spike |
| CAS | Chemical Abstracts Service |
| CCB | Continuing Calibration Blank |
| CCV | Continuing Calibration Verification |
| CERCLA | Comprehensive Environmental Response, Compensation, and Liability Act |
| CFR | Code of Federal Regulation |
| CLP | Contract Laboratory Program |
| COC | chain of custody |
| COPC | chemical of potential concern |
| CRQL | contract-required quantitation limit |
| CV | Calibration Verification |
| CVAA | cold vapor atomic absorption |
| DDT | dichlorodiphenyltrichloroethane |
| DL | detection limit |
| DO | Dissolved Oxygen |
| DoD | Department of Defense |
| DPT | Direct-Push Technology |
| DQA | data quality assessment |
| DQI | data quality indicator |
| DQO | data quality objective |
| ECD | electron capture device |
| EDD | electronic data deliverable |
| EDL | estimated detection limit |
| ELAP | Environmental Laboratory Accreditation Program |
| EPA | Environmental Protection Agency |
| EPH | Extractable Petroleum Hydrocarbon |
| FID | flame ionization detector |
| GC | gas chromatograph |
| GC-ECD | gas chromatograph-electron capture detector |
| GPS | global positioning system |

| | |
|---|---|
| HAZWOPER | Hazardous Waste Operations and Emergency Response |
| HHRA | Human Health Risk Assessment |
| HTW | Hazardous and Toxic Waste |
| ICAL | initial calibration |
| ICB | initial calibration blank |
| ICP | inductively coupled plasma |
| ICV | initial calibration verification |
| ID | identification |
| IDL | instrument detection limit |
| IDW | investigation-derived waste |
| ISCAB | interference check sample |
| LCS | laboratory control sample |
| LCSD | laboratory control sample duplicate |
| LOD | limit of detection |
| LOQ | limit of quantitation |
| MB | method blank |
| MCL | maximum contaminant level |
| MDL | method detection limit |
| MEC | Munitions and Explosives of Concern |
| MPC | measurement performance criteria |
| MS | Mass Spectrometer |
| MS | matrix spike |
| MSD | matrix spike duplicate |
| OC | Organochlorine |
| OES | optical emission spectrometry |
| N/A | not applicable |
| NPL | National Priorities List |
| NTU | nephelometric turbidity unit |
| NYDEH | New York Department of Health |
| NYSDEC | New York State Department of Environmental Conservation |
| OSHA | Occupational Safety and Health Administration |
| PAH | polycyclic aromatic hydrocarbons |
| PARCC | precision, accuracy, representativeness, completeness, and comparability |
| PCB | polychlorinated biphenyl |
| PDF | portable document format |
| PQL | practical quantitation limit |
| PQO | project quality objective |

| | |
|---|---|
| QA | quality assurance |
| QAO | quality assurance officer |
| QAPP | Quality Assurance Project Plan |
| QC | quality control |
| QSM | Quality Systems Manual |
| RCI | reactivity (cyanide and sulfide), corrosivity, ignitability |
| RCRA | Resource Conservation and Recovery Act |
| RDL | reporting detection limit |
| RI | remedial investigation |
| RL | reporting limit |
| RLVS | reporting limit verification standard |
| RPD | relative percent difference |
| RPM | Remedial Project Manager |
| RSD | relative standard deviation |
| RSL | regional screening levels |
| RTI | Research Technologies International |
| S&A | sampling and analysis |
| SAP | Sampling and Analysis Plan |
| SDG | sample delivery group |
| SEDD | Staged Electronic Data Deliverable |
| SLRA | Screening Level Risk Assessment |
| SOP | standard operating procedure |
| SOW | Statement of Work |
| SQL | sample quantitation limit |
| SVOA | Semi-Volatile Organic Analysis |
| TBD | to be determined |
| TO | Task Order |
| UFP | Uniform Federal Policy |
| UPLC | Ultra Performance Liquid Chromatography |
| USACE | United States Army Corps of Engineers |
| UST | Underground Storage Tank |
| VOA | Volatile Organic Analysis |
| VPH | Volatile Petroleum Hydrocarbon |
| WP | Work Plan |

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**Worksheet #1 Title and Approval Page**

**Document Title**: Remedial Investigation, Feasibility Study at the Camp Hero

**Document Control Number**: TBD

**Lead Organization**: U.S. Army Corps of Engineers (USACE), New England District

**Preparer's Name and Organizational Affiliation**: Devon Chicoine, AECOM

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**Preparation Date**: 02/26/2016

**Investigative Organization's Project Manager**: _____
Mark MacEwan, Project Manager, AECOM

**Investigative Organization's QA Chemist**: _____
Devon Chicoine, Project Chemist, AECOM

**Approval Signatures**: _____
Gregory Goepfert, USACE New York District

_____
Megan Cullen, USACE New England District

**Worksheet #2 QAPP Identifying Information**

**Site Number/Code**: C02NY002403 Contract no. W912DR-13-D-0016-BD01, Task Order (TO) DB01

**Operable Unit**: N/A

**Contractor Name**: AECOM

**Contractor Number**: N/A

**Contract Title**: Remedial Investigation and Feasibility Study

**Work Assignment Number**: 60443903

1. **Identify guidance used to prepare QAPP**: EPA Requirements for Quality Assurance Project Plans (QA/R-5) (March 2001),EPA Guidance for Quality Assurance Project Plans (QA/G-5) (February 1998), and Uniform Federal Policy for Quality Assurance Project Plans (March 2012)

2. **Identify regulatory program**: Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), also referred to as Superfund

3. **Identify approval entity**: USACE New England District

4. **This Quality Assurance Project Plan (QAPP) is a**: Site-Specific QAPP

5. **List dates of scoping sessions that were held**: see Worksheet #9

6. **List dates and titles of QAPP documents written for previous work, if applicable**:

7. **List organizational partners (stakeholders) and connection with lead organization**: United States Environmental Protection Agency (USEPA) Region I, New York State Department of Environmental Conservation (NYSDEC), New York State Department of Health (NYSDOH), and the New York State Office of Parks, Recreation and Historic Preservation.

8. **List data users**: USEPA Region I, USACE and USACE contractors.

9. **If any required QAPP elements and required information are not applicable to the project, then circle the omitted QAPP elements and required information on the attached table. Provide an explanation for their exclusion below**: None.

A cross-reference from the required QAPP elements/information to the QAPP worksheets is presented in Table 2-2 below.

**Table 2-2**
**Crosswalk to QAPP Information**

| Required QAPP Element(s) and Corresponding UFP-QAPP Manual Section(s) | Required Information | QAPP Worksheet # |
|---|---|---|
| **Project Management and Objectives** | | |
| 2.1 Title and Approval Page | - Title and Approval Page | 1 |
| 2.2 Document Format and Table of Contents<br>2.2.1 Document Control Format<br>2.2.2 Document Control Numbering System<br>2.2.3 Table of Contents<br>2.2.4 QAPP Identifying Information | - Table of Contents<br>- QAPP Identifying Information | 2 |
| 2.3 Distribution List and Project Personnel Sign-Off Sheet<br>2.3.1 Distribution List<br>2.3.2 Project Personnel Sign-Off Sheet | - Distribution List<br>- Project Personnel Sign-Off Sheet | 3<br>4 |
| 2.4 Project Organization<br>2.4.1 Project Organizational Chart<br>2.4.2 Communication Pathways<br>2.4.3 Personnel Responsibilities and Qualifications<br>2.4.4 Special Training Requirements and Certification | - Project Organizational Chart<br>- Communication Pathways<br>- Personnel Responsibilities and Qualifications Table<br>- Special Personnel Training Requirements Table | 5<br>6<br>7<br>8 |
| 2.5 Project Planning/Problem Definition<br>2.5.1 Project Planning (Scoping)<br>2.5.2 Problem Definition, Site History, and Background | - Project Planning Session Documentation (including Data Needs tables)<br>- Project Scoping Session Participants Sheet<br>- Problem Definition, Site History, and Background<br>- Site Maps (historical and present) | 9<br>10 |
| 2.6 Project Quality Objectives (PQOs) and Measurement Performance Criteria<br>2.6.1 Development of Project Quality Objectives Using the Systematic Planning Process<br>2.6.2 Measurement Performance Criteria | - Site-Specific PQOs<br>- Measurement Performance Criteria Table | 11<br>12 |
| 2.7 Secondary Data Evaluation | - Sources of Secondary Data and Information<br>- Secondary Data Criteria and Limitations Table | 13 |
| 2.8 Project Overview and Schedule<br>2.8.1 Project Overview<br>2.8.2 Project Schedule | - Summary of Project Tasks<br>- Reference Limits and Evaluation Table<br>- Project Schedule/Timeline Table | 14<br>15<br>16 |

**Table 2-2**
**Crosswalk to QAPP Information**

| Required QAPP Element(s) and Corresponding UFP-QAPP Manual Section(s) | Required Information | QAPP Worksheet # |
|---|---|---|
| **Measurement/Data Acquisition** | | |
| 3.1 Sampling Tasks<br>3.1.1 Sampling Process Design and Rationale<br>3.1.2 Sampling Procedures and Requirements<br>3.1.2.1 Sampling Collection Procedures<br>3.1.2.2 Sample Containers, Volume, and Preservation<br>3.1.2.3 Equipment/Sample Containers Cleaning and Decontamination Procedures<br>3.1.2.4 Field Equipment Calibration, Maintenance, Testing, and Inspection Procedures<br>3.1.2.5 Supply Inspection and Acceptance Procedures<br>3.1.2.6 Field Documentation Procedures | - Sampling Design and Rationale<br>- Sample Location Map<br>- Sampling Locations and Methods/SOP Requirements Table<br>- Analytical Methods/SOP Requirements Table<br>- Field Quality Control Sample Summary Table<br>- Sampling SOPs<br>- Project Sampling SOP References Table<br>- Field Equipment Calibration, Maintenance, Testing, and Inspection Table | 17<br>18<br>19<br>20<br>21<br>22 |
| 3.2 Analytical Tasks<br>3.2.1 Analytical SOPs<br>3.2.2 Analytical Instrument Calibration Procedures<br>3.2.3 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Procedures<br>3.2.4 Analytical Supply Inspection and Acceptance Procedures | - Analytical SOPs<br>- Analytical SOP References Table<br>- Analytical Instrument Calibration Table<br>- Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table | 23<br>24<br>25 |
| **Measurement/Data Acquisition** | | |
| 3.3 Sample Collection Documentation, Handling, Tracking, and Custody Procedures<br>3.3.1 Sample Collection Documentation<br>3.3.2 Sample Handling and Tracking System<br>3.3.3 Sample Custody | - Sample Collection Documentation Handling, Tracking, and Custody SOPs<br>- Sample Container Identification<br>- Sample Handling Flow Diagram<br>- Example Chain-of-Custody Form and Seal | 26<br>27 |
| 3.4 Quality Control Samples<br>3.4.1 Sampling Quality Control Samples<br>3.4.2 Analytical Quality Control Samples | - QC Samples Table<br>- Screening/Confirmatory Analysis Decision Tree | 28 |

**Table 2-2**
**Crosswalk to QAPP Information**

| Required QAPP Element(s) and Corresponding UFP-QAPP Manual Section(s) | Required Information | QAPP Worksheet # |
|---|---|---|
| 3.5 Data Management Tasks<br>3.5.1 Project Documentation and Records<br>3.5.2 Data Package Deliverables<br>3.5.3 Data Reporting Formats<br>3.5.4 Data Handling and Management<br>3.5.5 Data Tracking and Control | - Project Documents and Records Table<br>- Analytical Services Table<br>- Data Management SOPs | 29<br>30 |
| **Assessment/Oversight** | | |
| 4.1 Assessments and Response Actions<br>4.1.1 Planned Assessments<br>4.1.2 Assessment Findings and Corrective Action Responses | - Assessments and Response Actions<br>- Planned Project Assessments Table<br>- Audit Checklists<br>- Assessment Findings and Corrective Action Responses Table | 31<br>32 |
| 4.2 QA Management Reports | - QA Management Reports Table | 33 |
| 4.3 Final Project Report | | |
| **Data Review** | | |
| 5.1 Overview | | |
| 5.2 Data Review Steps<br>5.2.1 Step I: Verification<br>5.2.2 Step II: Validation<br>5.2.2.1 Step IIa Validation Activities<br>5.2.2.2 Step IIb Validation Activities<br>5.2.3 Step III: Usability Assessment<br>5.2.3.1 Data Limitations and Actions from Usability Assessment<br>5.2.3.2 Activities | - Verification (Step I) Process Table<br>- Validation (Steps IIa and IIb) Process Table<br>- Validation (Steps IIa and IIb) Summary Table<br>- Usability Assessment | 34<br>35<br>36 |
| **Data Review** | | |
| 5.3 Streamlining Data Review<br>5.3.1 Data Review Steps To Be Streamlined<br>5.3.2 Criteria for Streamlining Data Review<br>5.3.3 Amounts and Types of Data Appropriate for Streamlining | | 37 |

QC quality control
SOP standard operating procedure
PQO project quality objective

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## Worksheet #3 Distribution List

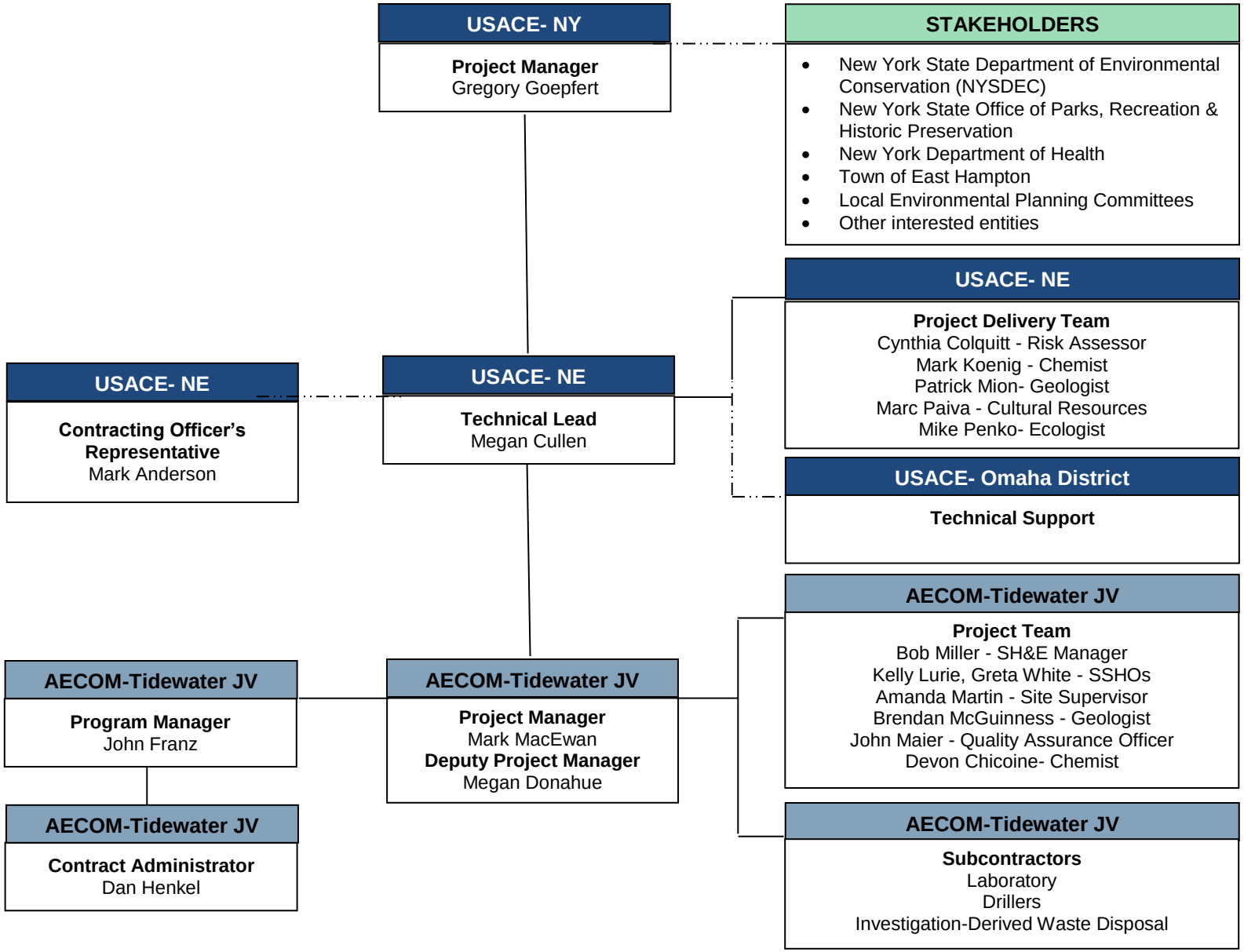
The following individuals and their organizations require copies of the approved QAPP and any subsequent revisions and any site specific Work Plans (WPs), QAPP Addendums, or Sampling and Analysis Plans (SAPs), including all persons responsible for implementation. The number of required copies of the approved QAPP and any revisions is provided with the distribution list below.

| QAPP Recipients | Title | Organization | Telephone Number | Fax Number | Email Address |
|---|---|---|---|---|---|
| Gregory Goepfert | USACE PM | USACE-NY | 917-790-8235 | - | Gregory.J.Goepfert@usace.army.mil |
| Megan Cullen | Technical Lead | USACE-NE | 978-318-8423 | - | Megan.E.Cullen@usace.army.mil |
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| Mike Penko | Ecologist | USACE-NE | 978-318-8139 | - | Michael.Penko@ usace.army.mil |
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| Greta White | Alternate SSHO | AECOM | 518-951-2341 | - | Greta.White@aecom.com |
| Amanda Martin | Site Supervisor | AECOM | 703-339-3953 | 703-682-4901 | Amanda.martin@aecom.com |
| Naoum Tavantzis | Data Validator | AECOM | 443-737-1299 | - | Naoum.Tavantzis@aecom.com |

## Worksheet #4 Project Personnel Sign-Off Sheet

| Name | Organization / Title / Role | Telephone Number | Signature | Date QAPP Read |
|---|---|---|---|---|
| Mark MacEwan | AECOM/ Project Manager | 703-682-9092 | | |
| Megan Donahue | AECOM / Deputy Project Manager | 703-682-9142 | | |
| Amanda Martin | AECOM / Site Supervisor | 703-339-3953 | | |
| Devon Chicoine | AECOM / Project Chemist | 703-682-9069 | | |
| John Maier | AECOM / QA Officer | 703-682-3110 | | |
| Kathy Griffin | RTI Laboratories/ Laboratory QA Manager | 734-422-8000 | | |
| Naoum Tavantzis | Data Validator | 443-737-1299 | | |

## Worksheet #5 Project Organizational Chart



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## Worksheet #6 Communication Pathways

| Communication Drivers | Responsible Entity | Name | Phone Number | Procedure (Timing, Pathways, etc.) |
|---|---|---|---|---|
| Point of Contact with USACE | AECOM Project Manager | Mark MacEwan | 703-682-9092 | Reporting of project information to the USACE Project Manager through WPs, monthly progress reports, e-mail updates, teleconference calls, and meetings. |
| Manage All Project Phases | AECOM Project Manager<br>AECOM Field Sampling Team Leader | Mark MacEwan<br>Amanda Martin | 703-682-9092<br>703-339-3953 | Primary modes of communication are telephone, e-mail, letter, document submittal; timing dependent on nature of communication and predefined schedules, as applicable and as requested by agencies. |
| QAPP changes in the field | AECOM Field Sampling Team Leader | Amanda Martin | 703-339-3953 | Notify AECOM Project Manager and Project Chemist of changes to QAPP in the field and rationale for changes. Document changes in field daily progress reports and memoranda to AECOM and USACE Project Managers. |
| Daily Field Progress Reports | AECOM Field Sampling Team Leader | Amanda Martin | 703-339-3953 | Field Sampling Team Leader will complete daily field progress reports and forward to AECOM and USACE Project Managers on a weekly or as needed basis. |
| Field Corrective Action | AECOM Project Chemist | Devon Chicoine | 703-682-9069 | Need for field corrective action will be determined by the Project Chemist and will be communicated to the Field Sampling Team Leader and in memoranda to AECOM and USACE Project Managers. |

## Worksheet #6 Communication Pathways (Continued)

| Communication Drivers | Responsible Entity | Name | Phone Number | Procedure (Timing, Pathways, etc.) |
|---|---|---|---|---|
| Reporting Laboratory Data Quality Issues | RTI Laboratories Project Manager | Kathy Griffin | 734-422-8000 | All QA/QC issues with project field samples will be reported by the laboratory to the Project Chemist/QA Officer. |
| Laboratory Analytical Corrective Actions | AECOM Project Chemist<br>RTI Laboratories Project Manager | Devon Chicoine<br>Kathy Griffin | 703-682-9069<br>734-422-8000 | Need for laboratory corrective actions will be determined by the Project Chemist and/or laboratory Project Manager or QA Manager and will be documented in memoranda to AECOM and USACE Project Managers. |
| Data Tracking and Management | AECOM Project Chemist | Devon Chicoine | 703-682-9069 | Project Chemist (or delegated representative) will track data from collection of samples through login at laboratory to delivery by technical report/sample data group and electronic data delivery into database. |
| Release of Analytical Data | AECOM Project Chemist | Devon Chicoine | 703-682-9069 | Final analytical data cannot be released until validation is complete and Project Chemist has approved release. |
| QAPP Amendments | AECOM Project Chemist | Devon Chicoine | 703-682-9069 | Changes to the QAPP will be approved by the AECOM and USACE Project Managers. |
| Data Validation Issues | AECOM Data Validator | Naoum Tavantzis | 443.737.1299 | The Data Validator will coordinate with the Project Chemist and analytical laboratory to ensure data packages provided by the laboratory are complete. The Data Validator will immediately notify the Project Chemist of data that are qualified as rejected, or R-flagged. |

## Worksheet #7 Personnel Responsibilities and Qualifications

| Name | Title | Organizational Affiliation | Responsibilities | Education and Experience Qualifications |
|---|---|---|---|---|
| Mark MacEwan | Project Manager | AECOM | Provides overall management of the contract including cost, schedule and technical quality. Manages project staffing, day-to-day project operations and activities, deliverable completion, field investigations, quality control, and health and safety. Acts as the single point of contact for the contract. Maintains communication and coordination with USACE for the duration of the project, including progress and detailed cost reporting. Oversees the management and coordination between Contractor staff, subcontractors, and USACE. | B.S. Chemical Engineering, and 31 years' experience. |
| Amanda Martin | Field Sampling Team Leader | AECOM | Responsible for assisting Project Manager and providing senior technical support on CERCLA process documents, sampling program design and implementation, and project team coordination. | B.S. Environmental Science; M.S. Environmental Engineering, and 3 years' experience. |
| Megan Donahue | Project Quality Manager (Deputy) | AECOM | Responsible for program quality management, including training and programmatic quality processes and controls. Provides senior technical support on CERCLA process documents and sampling program design and implementation. | B.S. Geology; M.S. Geology, and 26 years' experience. |

## Worksheet #7 Personnel Responsibilities and Qualifications (Continued)

| Name | Title | Organizational Affiliation | Responsibilities | Education and Experience Qualifications |
|---|---|---|---|---|
| Devon Chicoine | Project Chemist | AECOM | Manages analytical and data validation subcontractors. Negotiates project specifications and coordinates the sample collection activity with laboratory capacity. Tracks all samples from collection through analysis, data validation, and report generation. Serves as the primary chemist for all analytical issues. Initiates corrective actions as deemed appropriate. Supervises the electronic loading for all analytical data to ensure compliance with contract requirements. | B.S., Chemistry; M.S. Environmental Studies; and 13 years' experience. |
| Yemane Yohannes | Laboratory Director | RTI Laboratories | Supervises all laboratory personnel and provides guidance and direction as needed. Responsible for ensuring compliance and integration of facility operation with corporate and regulatory policies and procedures. | B.A Chemistry; and 30 years' experience. |
| Kathy Griffin | Laboratory Project Manager | RTI Laboratories | Serves as the laboratory's primary contact for the project. Utilizes a variety of project management tools for forecasting and production status tracking. Assures laboratory compliance with project needs in both QC and project deliverables. | B.S., Concentration Environmental Science – Geology; Minor Psychology; and 18 years' experience. |

## Worksheet #7 Personnel Responsibilities and Qualifications (Continued)

| Name | Title | Organizational Affiliation | Responsibilities | Education and Experience Qualifications |
|---|---|---|---|---|
| Chuck O'Bryan | QA Director | RTI Laboratories | Overall responsibility for the development, implementation and maintenance of the laboratory's quality system and QC activities. Performs internal system and technical audits. Creates corrective action plans and recommends projects for process improvement. Troubleshoots and resolves problems and provides technical and administrative guidance to laboratory staff. Obtains and maintains laboratory license and permits and oversees laboratory accreditation and certification programs. The selected laboratory shall have the DoD Environmental Laboratory Accreditation Program (ELAP) certification. Serves as the liaison between the laboratory and regulatory offices. | M.S. Environmental and Industrial Health, B.S. Medical Technology, B.S. Biology; and 31 years' experience. |
| Naoum Travantzis | Data Validator | - | Performs data validation for analytical analyses under this contract, in accordance with the EPA National Functional Guidelines for Data Validation. | - |

## Worksheet #8 Special Personnel Training Requirements Table

| Project Function | Specialized Training By Title or Description of Course | Training Provider | Training Date | Personnel / Groups Receiving Training | Personnel Titles Organizational Affiliation | Location of Training Records/Certificates[2] |
|---|---|---|---|---|---|---|
| Field Sampling Team Leader | 40-Hour Occupational Safety and Health Administration (OSHA) Hazardous Waste Site Worker and Emergency Response (HAZWOPER) Training; 8-Hour OSHA Refresher Training | AECOM or Registered Training Organization – Various[1] | Varies | All | Various | Certificates available upon request and maintained at project office. |
| Field Technicians, Geologists, Environmental Scientists, Engineers, and UXO Technicians | 40-Hour OSHA HAZWOPER Training; 8-Hour OSHA Refresher Training | AECOM or Registered Training Organization – Various[1] | Varies | All | All team personnel assisting in the performance of this contract. | Certificates available upon request and maintained at project office. |
| Sample Analysis | Trained in DoD Quality System Manual Version 5.0<br>SW-846, ASTM, DOE, and EPA methods | On-site training | varies | RTI Laboratories | All personnel | RTI Laboratories, Michigan |
| Data Review and Validation | Trained in DoD Quality System Manual Version 5.0<br>Validation of Data using the National Functional Guidelines, DOE, and EPA method specific data validation SOPs | On-site training | varies | Data Validator | All personnel used of project work | Certificates available upon request and maintained at project office. |

1 Training Provider and date of training will vary from person to person due to individual scheduling of training.
2 Training records and/or certificates are on file at the Contractor's office.

## Worksheet #9 Project Scoping Session Participants Sheet

**Project Name:** RI/FS/PP/DD at Camp Hero
**Site Name:** Camp Hero
**Projected Date(s) of Sampling:** April-June 2016
**Site Location:** Montauk, NY
**Project Manager (Contractor):** Mark MacEwan
Megan Donahue
**Date of Session:** January 20, 2016
**Location of Session:** Montauk, NY
**Scoping Session Purpose:** Coordination Meeting

| Name | Title | Affiliation | Phone # | E–Mail Address | Project Role |
|---|---|---|---|---|---|
| Gregory J. Goepfert | Project Manager | USACE- New York District | 917-790-8235 | Gregory.J.Goepfert@usace.army.mil | USACE Project Manager |
| Megan Cullen, P.E. | Technical Lead | USACE- New England District | 978-318-8423 | Megan.E.Cullen@usace.army.mil | USACE Technical Lead |
| Patrick Mion | Geologist | USACE- New England District | 978-318-8437 | Patrick.J.Mion@usace.army.mil | Geologist |
| Mark Koenig | Chemist | USACE- New England District | 978-318-8312 | Mark.R.Koenig@usace.army.mil | Chemist |
| Cynthia Colquitt | Risk Assessor | USACE- New England District | 978-318-8042 | Cynthia.A.Colquitt@usace.army.mil | Risk Assessor |
| John M (Michael) Penko | Ecologist | USACE- New England District | 978-318-8139 | Michael.Penko@usace.army.mil | Environmental Specialist |
| Marcos Paiva | Cultural Resources | USACE- New England District | 978-318-8769 | Marcos.A.Paiva@ usace.army.mil | Cultural Resources |
| Tom Dess | Superintendent | Montauk Downs State Park | 631-668-2765 | Thomas.Dess@parks.ny.gov | Superintendent |
| Nick Acampora | Environmental Program Specialist II | NYDEC- Response Section Supervisor, Division of Environmental Remediation | 631-444-0322 | Nick.Acompora@nydec.gov | Technical Support |
| Steven Karpinski | Technical Support | NYDEH | 518-402-7860 | Steven.Karpinski@health.ny.gov | Technical Support |
| John B. Swartwout, P.E. | Technical Support | NYSDEC | 518-402-9620 | john.swartwout@dec.ny.gov | Technical Support |
| Walter Parish | Hazardous Materials | NYS Department of Environmental Conservation | 631-444-0241 | Walter.Parish@dec.ny.gov | Technical Support |

## Worksheet #9 Project Scoping Session Participants Sheet (Continued)

**Project Name:** RI/FS/PP/DD at Camp Hero
**Site Name:** Camp Hero
**Projected Date(s) of Sampling:** April-June 2016
**Site Location:** Montauk, NY
**Project Manager (Contractor):** Mark MacEwan
Megan Donahue
**Date of Session:** January 20, 2016
**Location of Session:** Montauk, NY
**Scoping Session Purpose:** Coordination Meeting

| Name | Title | Affiliation | Phone # | E–Mail Address | Project Role |
|---|---|---|---|---|---|
| August Muff, R.A. | Associate Architect | NYS Office of Parks, Recreation & Historic Preservation - LI Region | 631-331-3507 | August.Muff@parks.ny.gov | Technical Support |
| Mark MacEwan, P.E. | Project Manager | AECOM | D 703-682-9092<br>C 202-375-9353 | mark.macewan@aecom.com | AECOM Project Manager |
| Megan Donahue, P.G. | Deputy Project Manager | AECOM | D 703-682-9142<br>C 808-375-0410 | megan.donahue@aecom.com | AECOM Deputy Project Manager |
| Brendan McGuinness, P.G. | Project Geologist | AECOM | D 703-682-1564<br>C 571-215-407 | Brendan.McGuinness@aecom.com | AECOM Technical Support |
| Amanda Martin | Engineer | AECOM | D 703-399-3953<br>C 434-664-8047 | Amanda.Martin@aecom.com | AECOM Field Leader |

This initial project review meeting with above attendees included a review of the status of support documents (Admin Record, Draft Final RI, and GIS files); the Camp Hero field investigation strategy (surveying, vegetation clearance, staging area, activities, and soil and groundwater sampling); site visit schedule; overall project schedule; and other miscellaneous project items.

**Comments/Decisions:** Scoping sessions and status review meetings will be an ongoing feature of the project as project activities progress. These future sessions/ meeting will include AECOM, USACE, USEPA Region I, and other stakeholders, as necessary, to discuss the following:

- Summary of project progress;
- Key milestones / deliverables;
- Upcoming site activities;

- Issues; and
- Status of action items.

**Action Items:** None

**Consensus Decisions:** Not applicable

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## Worksheet #10 Problem Definition

### 10.1 Site Background and Description

Camp Hero State Park, consisting of 469 acres, is located on the eastern tip of the south fork of Long Island, New York, approximately 5 miles east of the Village of Montauk. The Camp Hero State Park is split into two large subareas: the former Military Area (the Site) and the 'Sanctuary Area.' The Camp is located in Suffolk County, NY.

The Former Camp Hero was established in early 1942 as a Coastal Defense Installation to defend the approaches to New York and was named in honor of Major General Andrew Hero. Three self-sufficient batteries (Battery 112, 113, and 216) and supporting facilities were constructed which included barracks, mess halls, hospital facilities, a motor repair shop, a recreation facility, sentry boxes, and water supply and sewage facilities. A total of 600 enlisted men and 37 officers were stationed at the Camp. Battery 216 (identified as Bunker 216 on maps) contained two 6-inch shielded guns that were delivered to the battery in January 1943. Battery 113 (identified as Bunker 113 on maps) consisted of two Navy 16-inch casemated guns that were completed on June 5, 1943. Additionally, 37mm weapons and .50-caliber antiaircraft weapon platoons were assigned to protect the Camp from air attack. The Camp's weaponry was periodically fired to practice over water but was never fired as a result of an act of hostility.

The Camp was placed on inactive status on July 31, 1947 and ultimately declared surplus by the Department of the Army on December 31, 1949. Simultaneously a portion of the Camp Hero lands was also transferred to the Department of the Air Force for an aircraft control and warning station. On January 24, 1951 the Former Camp Hero was withdrawn from surplus and designated for use as a firing range and field exercise area for antiaircraft artillery from Fort Totten, NY. Arrangements were made for the permanent Army cadre at the Camp and 90mm and quad .50-caliber antiaircraft artillery began firing exercises from firing positions established in the southern bluff overlooking the Atlantic Ocean.

In 1952 the Air Force property was renamed the Montauk Air Force Station and was occupied by the Aircraft Control and Warning Squadron (ACWS). Training continued using 90mm and 120 mm guns, 3.5-inch rockets, and .50 caliber guns occurred until 1957. The facility was inactive until October 1958 when the ACWS was re-designated as the Radar Squadron with a new mission to provide surveillance data of air traffic in the area. In order to accomplish this mission, an advanced Specific Frequency Diversity Search Radar was built in late 1960s.

The facility was closed in 1982. Between 1974 and 1984 all site lands were transferred to State, Local, and other Federal agencies. The current Camp Hero State Park consists of 415.35 acres and is owned by the State of New York (NY), New York State Parks Commission.

## 10.2 Historical Activities

A detailed explanation of the historical investigation activities can be found in Section 2 of the Camp Hero RI WP.

## 10.3 Problems to be Addressed by Project

Soil and groundwater data gaps in the upcoming RI characterization effort at the Former Camp Hero site will be identified by the upcoming RI field efforts. No sampling has been conducted at the established 44 Camp Hero AOCs to determine if the Chemicals of Potential Concern (COPCs) have been released into the environment. A list of the Camp Hero AOCs can be found in Table 10-1. The data gaps and lack of detailed remedial history prevent a complete understanding of the nature and extent of COPCs at the site. A more detailed explanation of the activities to be completed can be found in section 6 of the Camp Hero RI WP or section 2 of the SAP.

**Table 10-1**
**Areas of Concern at Camp Hero**

| **Area of Concern** | | | |
|---|---|---|---|
| Battery 113 | Building 3001 (Tank-E) | H-4 and H-6 | Plotting Room 113 |
| Former Building 203 | Pump House (Tank F) | H-5 | Camp Hero State Park Bluffs |
| Building 2010 | Pump House (Tank G) | H-7, H-8, H-9 | AGC Sites 1 -4 |
| Building F100C | Battery 112 | H-11 | |
| AST-35 | Building 107 | H-12 | |
| Distribution Line for AST-35 | Building 201 | H-14, H-15 | |
| Building 20 (Tank-A) | Site-Wide Abandoned Waste Disposal | H-16 | |
| Building 22 (Tank-B) | Motor Pool | H-17, H-21 | |
| Building 2 (Tank-C) | Engineering Field Office | H-19 | |
| Building 104R (Tank-D) | H-1, H-2, H-3, H-18, H-20, H-22 | Battery 216 | |

## Worksheet #11 Project Quality Objectives/Systematic Planning Process Statements

### 11.1 Data Quality Objectives

The Data Quality Objectives (DQOs) for the RI site characterization at Camp Hero were developed to ensure that the data generated during the execution of the program are of appropriate quality to support the anticipated end use of the data. DQOs seek to ensure that the right type, amount, and quality of data are collected to accomplish the objectives of the project.

The USEPA has a seven-step process for establishing DQOs as published in "Guidance on Systematic Planning Using the Data Quality Objective Process" (EPA, 2006). To the extent practicable, each of the seven steps was considered in determining the DQOs for the RI data gap investigation at Camp Hero site as described below.

As outlined in the WP, the RI at Camp Hero is a multi-phased approach. Data from Phase 1 which will determine if COPCs exist at the AOC (presence or absence) will be used to develop the approach for Phase 2, which will characterize the AOC (extent of contamination). The Phase 1 samples are biased to the potential source area of contaminants. The Phase 2 sample results will be compared to background concentrations as discussed in the RI WP.

While these DQOs were prepared to determine the nature and extent of contamination at AOCs located on Camp Hero, they will be revisited, updated, as needed, and documented in the WP Addendum. This reiterative process will ensure that the DQO approach will address any changes to the AOC resulting from the Phase 1 investigation- including COPCs, media, or the conceptual site model.

**Step 1: Problem Statement** - As discussed in Worksheet #10, soil and groundwater data gaps have been identified, and the purpose of the Remedial Investigation (RI) is to delineate the nature and extent of contamination at the AOCs listed in table 10-1. These data gaps prevent a complete understanding of the nature and extent of COPCs at the AOCs. Therefore, the problem statement is: "Have COPCs been released at the established Camp Hero AOCs to soil and groundwater and at concentrations that may impact human health and the environment?"

The purpose of this project is to conduct a RI to 1) determine the nature and extent of the contamination in soil and groundwater, 2) update/refine the current CSM, and 3) perform a baseline human health risk assessment (HHRA) and ecological screening level risk assessment (SLRA).

**Step 2: Goal of the Study** - The goal of the RI is to characterize the nature and extent of threat from hazardous substances, the fate and transport of the hazardous substances, and to gather data necessary to assess the extent to which the release poses a threat to human health or the

environment at the AOCs at Camp Hero. Data will be gathered to support the potential future FS analysis, if warranted, by assessing the following factors:

- Physical Characteristics of the property;
- Characteristics/classification of surface soil, subsurface soil, and groundwater;
- General characteristics of potential sources/waste (e.g., quantities, concentration, toxicity, persistence, mobility, depth, nature, and extent, etc.);
- The extent to which the source(s) can be characterized;
- Actual and potential exposure pathways through environmental media; and
- Actual and potential exposure routes (e.g., inhalation and ingestion).

**Step 3: Identify Inputs to the Decision** - The primary data inputs to resolve the nature and extent of COPC data gaps at the site include:

- Results of the soil and/or sediment sampling;
- Results of the groundwater and/or surface water sampling;
- Results of liquid characterization sampling;
- Results of concrete chip sampling;
- Results of wipe sampling;
- Geological conditions as recorded during the installation of the temporary wells (Phase 1) and permanent monitoring wells (Phase 2) as well as the test pits; and
- Soil and groundwater screening criteria (see Worksheet #15).

The chemical-specific screening levels for each medium will be based on the lowest of the following criteria:

***Soil and Sediment***

- USEPA RSLs for Residential Soil, based on (1) a carcinogenic risk level of 10-6 or (2) a non-carcinogenic hazard quotient (HQ) of 0.1 (USEPA, 2015b). The RSLs for non-carcinogens are

based on a HQ of 1; however, they will be lowered by a factor of 10 to account for potential cumulative effects from multiple non-carcinogens.

- NYCRR Chapter 6 Part 375-1: Remedial Soil Cleanup Objectives (NYCRR 2015)
- NYSDEC CP-51: Soil Cleanup Guidance (NYSDEC 2010)

***Groundwater and Surface Water***

- USEPA RSLs for Tap Water, based on (1) a carcinogenic risk level of 10-6 or (2) a non-carcinogenic HQ of 0.1 (USEPA, 2015b). The RSLs for non-carcinogens are based on a HQ of 1; however, they will be lowered by a factor of 10 to account for potential cumulative effects from multiple non-carcinogens.; or
- USEPA Drinking Water Standards MCLs (USEPA, 2015b).
- A RSL has not been developed for lead in tap water. The USEPA action level for lead in drinking water of 15 µg /L will be used.
- NYSDEC TOGS, 1.1.1 Ambient Water Quality Standards and Guidance Values (NYSDEC 2004)

Table 2-1 in the SAP lists media, analyses, and number of samples proposed for Phase 1 of this investigation. The data from Phase 1 will be reviewed and a modification to the WP will be prepared to identify the additional inputs needed for the RI.

**Step 4: Define the Study Boundaries** – The boundaries of the 47 AOCs being investigated as part of this RI are based on the Camp Hero Feasibility Study/Hazardous Materials Survey, prepared by NY State Parks contractor, Cashin Associates, in 1998 (Cashin, 1998), and a historical records search conducted by AECOM-Tidewater JV as part of this project. The vertical boundaries of the extent of contamination will be determined through direct push drilling and test pitting as part of this investigation.

**Step 5: Develop an Analytical Approach** -

As shown in Table 2-1 of the SAP, both surface and subsurface (from direct push borings and test pits) soil samples will be collected and analyzed for the AOC-specific COPCs. Groundwater will be collected from temporary and permanent monitoring wells and will also be analyzed for AOC-specific COPCs.

Chemical concentrations will first be compared to Project Screening Levels (PSLs). A chemical with an exceedance of the PLS does not necessarily indicate that the chemical poses significant environmental concerns, only that an additional evaluation is warranted.

The decision rules for the investigation are as follows:

1. If the concentrations of detected constituents are below PSLs or exceed PSLs but are within established background levels, then the AOC will be recommended for 'No Further Action.'

2. If the concentrations of detected constituents exceed screening levels, then further evaluation will be recommended for further investigation under the CERCLA process.

As discussed in Section 5.3 of the RI WP, background samples will be collected during Phase I of the RI for the following media: surface soil and subsurface soil. Based on the Phase I RI results, the site specific groundwater flow direction, and the site specific surface water and sediment features at AOCs, additional background samples will be obtained for groundwater, sediment and surface water during Phase II sampling. Background samples will be collected to establish site-specific background levels for naturally occurring constituents, such as metals, and anthropogenic impacts, such as PAHs. One or more of the following methods will be used to determine whether chemical constituents detected at the AOCs are within background levels, or exceed background and may potentially be site-related.

- Two-sample (one-sided) Hypotheses Tests (Student's t test, Wilcoxon-Mann Whitney (WMW) test, and Gehan Test) – These statistical tests compare concentrations of two populations to determine if the concentrations of one population (site concentrations) are within the concentrations of the other population (background concentrations). The tests require at least 10 samples results. In general, the Student's t test is used in cases where data are normally distributed in both site and background, while the WMW and Gehan tests are non-parametric tests that may be used for a wide variety of data distributions.

- Comparison to Background Limit –The site concentration will be compared to the lower of the maximum background concentration or twice the mean background concentration. If one or more site concentrations exceed its background limit, the site concentrations may be considered to be above background levels. This comparison will be conducted for environmental media where less than 10 background samples are collected.

- Graphical Displays – multiple side-by-side box plots and other graphical displays will be used as needed to supplement the above methods. The graphical displays will be evaluated to discern potential for ratio trends within the background media.

**Step 6: Specify Tolerable Limits on Decision Errors** – Analytical results will meet the project-specific tolerable limits for the investigation, including those identified or referenced in the following worksheets:

- Laboratory Measurement Performance Criteria (Worksheet #12)
- Summary of Project Tasks (Worksheet #14)
- Laboratory Measurement Limits (Worksheet #15)
- Sampling Locations and Methods (Worksheet #18)
- Analytical SOP Requirements (Worksheet #19)
- Project Sampling Procedures References Table (Worksheet #21)
- Field Equipment Calibration, Maintenance, Testing, and Inspection Table (Worksheet #22)
- Analytical SOP References Table (Worksheet #23)
- Analytical Instrument Calibration Table (Worksheet #24)
- Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table (Worksheet #25)
- QC Samples Table (Worksheet #28)
- Sampling and Analysis Verification (Step I) Process Table (Worksheet 34)
- Validation (Steps IIa and IIb) Process Table (Worksheet 35)
- Validation (Steps IIa and IIb) Summary Table (Worksheet 36)
- Data Useability Assessment (Worksheet 37)

**Step 7: Optimize the Design** –As part of the RI, AECOM will utilize a multi-phase, biased sampling program of discrete samples to efficiently fill data gaps in the various sub-areas. An allowance of both additional soil samples and temporary monitoring wells has been accounted for in the program design to maximize flexibility to achieve DQOs. Worksheet #17 and the SAP provide further detail on the field investigation procedures that will be implemented to collect the required data.

## 11.2 Systematic Planning Process Statements

The project's data quality requirements are based on the environmental decisions that need to be made and the level of data quality needed to ensure that those decisions are based on sound scientific data. This section identifies the type, quantity, and quality of data required to support this decision-making process. The answers to the questions below will provide a framework for the performance requirements/acceptance criteria that will be used to ensure sufficient data quality is achieved.

- Who Will Use the Data? – The ultimate users of the data are the USACE, USEPA Region I, NYSDEC and supporting contractors.

- What Will the Data Be Used For? – The data will be used to define the nature and extent of COPCs in soil and groundwater. Additionally, the data will also be used to assess risk to human and ecological receptors at these sites.

- What Type of Data Are Needed? – Required data includes soil and groundwater sample results for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs) including polycyclic aromatic hydrocarbons (PAHs), PCBs, and metals. The data will be used for the preparation of an RI Report that will present information on the extent of contamination in the 44 AOCs. A more detailed list of sample locations and analysis will be found in the WP.

- How "Good" Does the Data Need To Be To Support the Decision? – The quality of the data must be useable (as discussed in Worksheet #37) including meeting the identified reference limits (Worksheet #15) when possible to limit the uncertainty in the evaluation of the nature and extent of contamination and risk. Only data meeting the specified performance/acceptance criteria in this QAPP will be used in the decision making process.

- How Much Data Is Needed? –The quantity of sample data needed to resolve these data gaps is identified in Section 2 of the SAP.

- Where, When, and How Should the Data Be Collected/Generated? – See Worksheet #17.

- Who Will Collect and Generate the Data? – AECOM will collect and generate the RI data in coordination with USACE, USEPA Region I and NYSDEC and with the cooperation of the Office of Parks, Recreation, and Historic Preservation .

- How Will the Data Be Reported? – Ultimately, the validated data will be reported in text, tables, and figures in the RI Report. Since this approach to the RI is a multi-phase approach, preliminary data will be used to prepare the WP Addendum and the Field Report.

- How Will the Data Be Archived? – AECOM will ensure that the multimedia (i.e., both paper and electronic format) project repository and/or administrative record is kept up-to-date of all project-related information to ensure that pertinent documentation and data are available for project reviews, and to provide a clear record of the performance based contract approach to support final decisions and phase completion..

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## Worksheet #12.1 Measurement Performance Criteria Water

| QC Sample | Analytical Group | Frequency | Data Quality Indicators (DQIs) | MPCs |
|---|---|---|---|---|
| Rinsate Blank | VOCs | One per 20 field samples(1) | Accuracy/ Bias/ Contamination | No target analytes ≥ ½ LOQ (>LOQ for common laboratory contaminants), unless target analytes in field samples are > 10x those in rinsate blank. |
| Field Duplicates | VOCs, SVOCs, Metals, PCBs, energetics, | One per 10 field samples | Precision | RPD ≤ 30%. If sample results are < 2x LOQ, professional judgment is used. |
| | Metals (Total and Dissolved) | One per 10 field samples | Precision | Values ≥ 5x LOQ: RPD ≤ 30%.<br>Values < 5x LOQ: Absolute Difference ≤ 2x LOQ. |
| Trip Blank | VOCs | One per cooler | Accuracy/ Bias/ Contamination | No target analytes ≥ ½ LOQ (>LOQ for common laboratory contaminants), unless target analytes in field samples are > 10x those in trip blank. |
| Cooler Temperature Indicator | VOCs, SVOCs, Metals, PCBs, energetics, and Metals (Total and Dissolved) | One per cooler | Representativeness | Temperature must be above freezing and ≤ 6 $^{o}$C. |

**Notes:**
(1) Collect only if non-dedicated, non-disposable equipment is used.

## Worksheet #12.2 Measurement Performance Criteria Soil

| QC Sample | Analytical Group | Frequency | Data Quality Indicators (DQIs) | MPCs |
|---|---|---|---|---|
| Rinsate Blank | VOCs, SVOCs, Metals, PCBs, Energetics | One per 20 field samples(1) | Accuracy/ Bias/ Contamination | No target analytes ≥ ½ LOQ (>LOQ for common laboratory contaminants), unless target analytes in field samples are > 10x those in rinsate blank. |
| Field Duplicates | VOCs, SVOCs, Metals, PCBs, Energetics | One per 10 field samples | Precision | RPD ≤ 50%. If sample results are < 2x LOQ, professional judgment is used. |
| Trip Blank | VOCs | One per cooler | Accuracy/ Bias/ Contamination | No target analytes ≥ ½ LOQ (>LOQ for common laboratory contaminants), unless target analytes in field samples are > 10x those in trip blank. |
| Cooler Temperature Indicator | VOCs, SVOCs, Metals, PCBs, energetics | One per cooler | Representativeness | Temperature must be above freezing and ≤ 6 $^{o}$C. |

**Notes:**
(1) Collect only if non-dedicated, non-disposable equipment is used.

## Worksheet #13 Secondary Data Criteria and Limitations Table

| Secondary Data | Data Source (Originating Organization, Report Title, and Date) | Data Generator(s) (Originating Organization, Data Types, Data Generation / Collection Dates) | How Data Will Be Used | Limitations On Data Use |
|---|---|---|---|---|
| No secondary data identified at Camp Hero. | | | | |

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## Worksheet #14 Summary of Project Tasks

| Definable Feature of Work | Tasks |
|---|---|
| Mobilization/Site Preparation | • Project plan preparation<br>• Verify personnel qualifications<br>• Equipment set-up and checkout<br>• Vegetation removal |
| Site-specific Training | • Initial orientation and training; review of RI WPs and SOPs; Munitions Recognition Training |
| Geophysical Surveying | • Magnetometer surveys to locate subsurface anomalies |
| Vegetation Removal | • Removal of vegetation for access to areas for geophysical surveying and drilling activities |
| Soil Sampling | • Subsurface Soil Sampling using direct push technology (DPT)<br>• investigation-derived waste (IDW) management<br>• Sample custody and shipment |
| Groundwater Sampling from Direct Push Rig (Grab-Sampling) | • Low flow sampling using a peristaltic pump<br>• Field water quality parameters will be monitored using an YSI 600 series (or similar) meter coupled with a flow through cell. Turbidity will be measured separately using a LaMotte Model 2020 or equivalent nephelometer.<br>• IDW management<br>• Sample custody and shipment |
| Liquid Sampling | • Liquid characterization sampling using non-dedicated equipment (peristaltic pump/ disposable tubing or a sample dipper). |
| Concrete Chip Sampling | • Collection of concrete chip samples<br>• Sample custody and shipment |
| Wipe Sampling | • Collection of wipe samples<br>• Sample custody and shipment |
| Monitoring Well Installation and Development (Phase 2 Only) | • Installation of permanent monitoring wells<br>• Development using a monsoon pump<br>• Field water quality parameters will be monitored using an YSI 600 series (or similar) meter coupled with a flow through cell. Turbidity will be measured separately using a LaMotte Model 2020 or equivalent nephelometer.<br>• IDW management |
| Groundwater Sampling from Permanent Monitoring Wells (Phase 2 Only) | • Low flow sampling using a peristaltic or bladder pump<br>• Samples collected for dissolved metals analysis will be filtered in the field using a new, disposable in-line 0.45 micron (pore size) filter and a pump.<br>• Field water quality parameters will be monitored using an YSI 600 series (or similar) meter coupled with a flow through cell. Turbidity will be measured separately using a LaMotte Model 2020 or equivalent nephelometer.<br>• IDW management<br>• Sample custody and shipment |
| Test Pitting (Phase 2 Only) | • Excavation and stockpiling of soil.<br>• Photoionization (PID) usage to screen soil.<br>• Scrap metallic debris removal. |

| | |
|---|---|
| Demobilization | • Complete all field forms<br>• Close-out field log books<br>• Return equipment<br>• Provide all field documentation to USACE PM |

## Worksheet #15.1a Reference Limits and Evaluation
## SVOCs by SW-846 Method 8270D (Aqueous)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | MCL | NYDEC TOGS-Drinking Water | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous |
| | | µg/L | µg/L | µg/L | µg/L | µg/L | µg/L | % | RPD< |
| Acenaphthene * | 83-32-9 | 530 | - | **20** | 1 | 0.5 | 0.197 | 45-110 | 25 |
| Acenaphthylene * | 208-96-8 | - | - | - | 1 | 0.5 | 198 | 50-105 | 25 |
| Anthracene | 120-12-7 | 1800 | - | **50** | 1 | 0.5 | 0.243 | 55-110 | 25 |
| *Benz(a)anthracene * | 56-55-3 | 0.012 | - | **0.002** | 1 | 0.5 | 0.202 | 53-131 | 25 |
| *Benzo(b)fluoranthene * | 205-99-2 | 0.034 | - | **0.002** | 1 | 0.5 | 0.221 | 45-120 | 25 |
| *Benzo(k)fluoranthene * | 207-08-9 | 0.34 | - | **0.002** | 1 | 0.5 | 0.221 | 45-125 | 25 |
| Benzoic acid | 65-85-0 | - | - | - | 25 | 10 | 3.717 | 36-121 | 25 |
| Benzo(g,h,i)perylene * | 191-24-2 | - | - | - | 1 | 0.5 | 0.285 | 40-125 | 25 |
| *Benzo(a)pyrene * | 50-32-8 | **0.0034** | 0.2 | ND | 1 | 0.5 | 0.173 | 54-128 | 25 |
| Benzyl alcohol | 100-51-6 | **2000** | - | - | 25 | 0.5 | 0.391 | 30-110 | 25 |
| Bis(2-chlorethoxy)methane | 111-91-1 | 59 | - | **5** | 5 | 0.5 | 0.302 | 45-105 | 25 |
| *Bis(2-chloroethyl) ether* | 111-44-4 | **0.014** | - | 1 | 1 | 0.5 | 0.232 | 35-110 | 25 |
| Bis(2-chloroisopropyl) ether | 108-60-1 | - | 6 | **5** | 5 | 0.5 | 0.236 | 25-130 | 25 |
| Bis(2-Ethylhexyl)phthalate | 117-81-7 | 5.6 | 6 | **5** | 5 | 0.5 | 0.266 | 40-125 | 25 |
| 4-Bromophenyl phenyl ether | 101-55-3 | - | - | - | 5 | 0.5 | 1.011 | 50-115 | 25 |
| Butyl benzyl phthalate | 85-68-7 | **16** | - | 50 | 5 | 0.5 | 0.243 | 45-115 | 25 |
| Carbazole | 86-74-8 | - | - | - | 5 | 0.5 | 0.25 | 50-115 | 25 |

Notes: Bold indicated the most conservative of the screening criteria.
* Asterisk indicates that compounds to be analyzed by the Method 8270 D SIM to achieve lower LOD/LOQ. See Worksheet #15.2a.
Italics indicate all the target analytes where screening criteria are lower than the LOQs. In the instance where Method 8270 D SIM is not available, the LOQ will be the PSL.

## Worksheet #15.1a Reference Limits and Evaluation (Continued)
## SVOCs by SW-846 Method 8270D (Aqueous)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | MCL | NYDEC TOGS-Drinking Water | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous |
| | | µg/L | µg/L | µg/L | µg/L | µg/L | µg/L | % | RPD< |
| *4-Chloroaniline* | 106-47-8 | **0.37** | - | 5 | 10 | 2.5 | 1.611 | 15-110 | 25 |
| 4-Chloro-3-methylphenol | 59-50-7 | **1400** | - | - | 5 | 0.5 | 0.245 | 45-110 | 25 |
| 2-Chloronaphthalene | 91-58-7 | 750 | - | **10** | 5 | 0.5 | 0.692 | 50-105 | 25 |
| 2-Chlorophenol | 95-57-8 | **91** | - | - | 5 | 0.5 | 0.19 | 35-105 | 25 |
| 4-Chlorophenyl phenyl ether | 7005-72-3 | - | - | - | 5 | 0.5 | 0.19 | 50-110 | 25 |
| *Chrysene* | 218-01-9 | 3.4 | - | **0.002** | 1 | 0.5 | 0.213 | 55-110 | 25 |
| *Dibenz(a,h)anthracene ** | 53-70-3 | **0.0034** | - | - | 1 | 0.5 | 0.257 | 40-125 | 25 |
| Dibenzofuran * | 132-64-9 | **7.9** | - | - | 4 | 0.5 | 0.21 | 55-105 | 25 |
| Di-n-butyl phthalate | 84-74-2 | 900 | - | **50** | 5 | 0.5 | 0.263 | 55-115 | 25 |
| 1,2-Dichlorobenzene | 95-50-1 | 300 | 600 | **5** | 1 | 0.5 | 0.232 | 35-100 | 25 |
| 1,3-Dichlorobenzene | 541-73-1 | - | - | **5** | 1 | 0.5 | 0.213 | 30-100 | 25 |
| *1,4-Dichlorobenzene* | 106-46-7 | **0.48** | 75 | 5 | 1 | 0.5 | 0.189 | 30-100 | 25 |
| *3,3'-Dichlorobenzidine* | 91-94-1 | **0.13** | - | 5 | 20 | 10 | 5.538 | 20-110 | 25 |
| 2,4-Dichlorophenol | 120-83-2 | 46 | - | **5** | 5 | 0.5 | 0.232 | 50-105 | 25 |
| Diethyl phthalate | 84-66-2 | 15000 | - | **50** | 5 | 0.5 | 0.239 | 40-120 | 25 |

Notes: Bold indicated the most conservative of the screening criteria.
* Asterisk indicates that compounds to be analyzed by the Method 8270 D SIM to achieve lower LOD/LOQ. See Worksheet #15.2a.
Italics indicate all the target analytes where screening criteria are lower than the LOQs. In the instance where Method 8270 D SIM is not available, the LOQ will be the PSL.

## Worksheet #15.1a Reference Limits and Evaluation (Continued)
## SVOCs by SW-846 Method 8270D (Aqueous)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | MCL | NYDEC TOGS-Drinking Water | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous |
| | | µg/L | µg/L | µg/L | µg/L | µg/L | µg/L | % | RPD< |
| 2,4-Dimethylphenol | 105-67-9 | 360 | - | **50** | 5 | 0.5 | 0.553 | 30-110 | 25 |
| Dimethyl phthalate | 131-11-3 | - | - | **50** | 5 | 0.5 | 0.239 | 25-125 | 25 |
| *4,6-Dintro-2-methylphenol* | 534-52-1 | **1.5** | - | - | 10 | 2.5 | 1.574 | 40-130 | 25 |
| 2,4-Dinitrophenol | 51-28-5 | 39 | - | **10** | 25 | 10 | 5.689 | 15-140 | 25 |
| *2,4-Dinitrotoluene* | 121-14-2 | **0.24** | - | 5 | 5 | 0.5 | 0.251 | 50-120 | 25 |
| *2,6-Dinitrotoluene* | 606-20-2 | **0.049** | - | 0.07 | 5 | 0.5 | 0.282 | 50-115 | 25 |
| Di-n-octyl phthalate | 117-84-0 | 200 | - | **50** | 5 | 0.5 | 0.194 | 35-135 | 25 |
| Fluoranthene * | 206-44-0 | 800 | - | **50** | 1 | 0.5 | 0.213 | 55-115 | 25 |
| Fluorene * | 86-73-7 | 290 | - | **50** | 1 | 0.5 | 0.202 | 50-110 | 25 |
| Hexachlorobenzene | 118-74-1 | 1 | - | **0.04** | 1 | 0.5 | 0.251 | 50-110 | 25 |
| Hexachlorobutadiene | 87-68-3 | **0.14** | - | 0.5 | 1 | 0.5 | 0.313 | 25-105 | 25 |
| Hexachloroethane | 67-72-1 | **0.33** | - | 5 | 5 | 0.5 | 0.234 | 30-95 | 25 |
| *Indeno(1,2,3-cd)pyrene * * | 193-39-5 | 0.034 | - | **0.002** | 1 | 0.5 | 0.252 | 45-125 | 25 |
| Isophorone | 78-59-1 | 78 | - | **50** | 5 | 0.5 | 0.97 | 50-110 | 25 |
| 2-Methylnaphthalene * | 91-57-6 | **36** | - | 42 | 1 | 0.5 | 0.246 | 45-105 | 25 |
| 2-Methylphenol | 95-48-7 | **930** | - | - | 5 | 0.5 | 0.19 | 40-110 | 25 |

Notes: Bold indicated the most conservative of the screening criteria.
* Asterisk indicates that compounds to be analyzed by the Method 8270 D SIM to achieve lower LOD/LOQ. See Worksheet #15.2a.
Italics indicate all the target analytes where screening criteria are lower than the LOQs. In the instance where Method 8270 D SIM is not available, the LOQ will be the PSL.

## Worksheet #15.1a Reference Limits and Evaluation (Continued)
## SVOCs by SW-846 Method 8270D (Aqueous)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | MCL | NYDEC TOGS-Drinking Water | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous |
| | | µg/L | µg/L | µg/L | µg/L | µg/L | µg/L | % | RPD< |
| 3-methylphenol & 4-methylphenol | 65794-96-9 | **1900** | - | - | 10 | 1 | 0.385 | 30-110 | 25 |
| *Naphthalene ** | 91-20-3 | **0.17** | - | 10 | 1 | 0.5 | 0.211 | 40-100 | 25 |
| 2-Nitroaniline | 88-74-4 | 190 | - | **5** | 5 | 0.5 | 0.243 | 50-115 | 25 |
| *3-Nitroaniline* | 99-09-2 | - | - | 5 | 10 | 0.5 | 0.344 | 20-125 | 25 |
| *4-Nitroaniline* | 100-01-6 | **3.8** | - | 5 | 10 | 0.5 | 0.281 | 35-120 | 25 |
| *Nitrobenzene* | 98-95-3 | **0.14** | - | 0.4 | 3 | 0.5 | 0.263 | 45-110 | 25 |
| 2-Nitrophenol | 88-75-5 | - | - | - | 5 | 0.5 | 0.24 | 40-115 | 25 |
| 4-Nitrophenol | 100-02-7 | - | - | - | 25 | 10 | 4.586 | 47-122 | 25 |
| *N-Nitrosodimethylamine* | 62-75-9 | **0.00011** | - | - | 5 | 0.5 | 0.314 | 25-110 | 25 |
| N-Nitrosodiphenylamine | 86-30-6 | - | - | **50** | 5 | 0.5 | 0.157 | 50-110 | 25 |
| N-Nitrosodi-n-propylamine | 621-64-7 | **0.011** | - | - | 5 | 0.5 | 0.318 | 35-130 | 25 |
| *Pentachlorophenol* | 87-86-5 | **0.041** | 1 | ND | 1 | 0.5 | 1.635 | 40-115 | 25 |
| Phenanthrene * | 85-01-8 | - | - | **50** | 1 | 0.5 | 0.135 | 50-115 | 25 |
| Phenol | 108-95-2 | - | - | - | 5 | 0.5 | 0.14 | 19-47 | 25 |
| Pyrene * | 129-00-0 | 120 | - | **50** | 1 | 0.5 | 0.295 | 50-130 | 25 |
| *1,2,4-Trichlorobenzene* | 120-82-1 | **1.2** | 70 | 5 | 5 | 0.5 | 0.259 | 35-105 | 25 |
| 2,4,5-Trichlorophenol | 95-95-4 | **1200** | - | - | 5 | 0.5 | 0.264 | 50-110 | 25 |

Notes: Bold indicated the most conservative of the screening criteria.
* Asterisk indicates that compounds to be analyzed by the Method 8270 D SIM to achieve lower LOD/LOQ. See Worksheet #15.2a.
Italics indicate all the target analytes where screening criteria are lower than the LOQs. In the instance where Method 8270 D SIM is not available, the LOQ will be the PSL.

## Worksheet #15.1a Reference Limits and Evaluation (Continued)
## SVOCs by SW-846 Method 8270D (Aqueous)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | MCL | NYDEC TOGS-Drinking Water | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous |
| | | µg/L | µg/L | µg/L | µg/L | µg/L | µg/L | % | RPD< |
| 2,4,6-Trichlorophenol | 88-06-2 | **4.1** | - | - | 4 | 0.5 | 0.295 | 50-115 | 25 |
| 2-Fluorophenol (Surrogate) | 367-12-4 | | | | | | | 20-110 | |
| 2,4,6-Tribromophenol (Surrogate) | 118-79-6 | | | | | | | 40-125 | |
| Nitrobenzene-d5 (Surrogate) | 4165-60-0 | | | | | | | 40-110 | |
| Phenol-d5 (Surrogate) | 4165-62-2 | | | | | | | 10-115 | |
| Terphenyl-d-14 (Surrogate) | 1718-51-0 | | | | | | | 50-135 | |
| 2-Fluorobiphenyl (Surrogate) | 321-60-8 | | | | | | | 50-110 | |

–Notes: These (Method Detection Limit – MDL and Limit of Quantitation – LOQ) were obtained from RTI Laboratories RTI Labs (2016) and are meant to be recommended project values. The QA/QC criteria presented in this table reflect the most recently promulgated values as reported by the laboratory.
The PSL references are MCLs, RSLs, or either TOGS 1.1.1 =NYSDEC Technical and Operational Guidance 1.1.1 Ambient Water Quality Standards and Guidance Values, or Tapwater based on the USEPA Regional Screening Level for Water (November 2015).
Bold indicated the most conservative of the screening criteria.* Asterisk indicates that compounds to be analyzed by the Method 8270 D SIM to achieve lower LOD/LOQ. See Worksheet #15.2a.
Italics indicate all the target analytes where screening criteria are lower than the LOQs. In the instance where Method 8270 D SIM is not available, the LOQ will be the PSL.

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## Worksheet #15.1b Reference Limits and Evaluation
## SVOCs by SW-846 Method 8270D (Soil)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | NYDEC CP-51 Unrestricted Use | NYSDEC ELC 376-6 Soil Cleanup Objectives | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| | | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | % | RPD< |
| Acenaphthene * | 83-32-9 | 3600000 | **20000** | **20000** | 160 | 16.67 | 7.404 | 45-110 | 25 |
| Acenaphthylene * | 208-96-8 | - | **100000** | **100000** | 160 | 16.67 | 7.105 | 45-105 | 25 |
| Anthracene | 120-12-7 | 18000000 | **100000** | **100000** | 160 | 16.67 | 8.13 | 55-105 | 25 |
| Benz(a)anthracene * | 56-55-3 | 160 | **1000** | **1000** | 160 | 16.67 | 10.999 | 53-131 | 25 |
| Benzo(b)fluoranthene * | 205-99-2 | 160 | **1000** | **1000** | 160 | 16.67 | 9.081 | 45-115 | 25 |
| Benzo(k)fluoranthene * | 207-08-9 | 1600 | **800** | **800** | 160 | 33.33 | 17.329 | 45-125 | 25 |
| Benzoic acid | 65-85-0 | - | - | - | 1000 | 333.33 | 134.769 | N/A | 25 |
| Benzo(g,h,i)perylene * | 191-24-2 | - | **100000** | **100000** | 160 | 16.67 | 11.797 | 40-125 | 25 |
| *Benzo(a)pyrene * | 50-32-8 | **16** | 1000 | 1000 | 160 | 16.67 | 10.065 | 50-110 | 25 |
| Benzyl alcohol | 100-51-6 | **6300000** | - | - | 160 | 16.67 | 8.031 | 20-125 | 25 |
| Bis(2-chlorethoxy)methane | 111-91-1 | **190000** | - | - | 160 | 16.67 | 6.934 | 45-110 | 25 |
| Bis(2-chloroethyl) ether | 111-44-4 | **230** | - | - | 160 | 33.33 | 17.897 | 40-105 | 25 |
| Bis(2-chloroisopropyl) ether | 108-60-1 | - | - | - | 160 | 16.67 | 7.613 | 20-115 | 25 |
| Bis(2-Ethylhexyl)phthalate | 117-81-7 | **39000** | - | - | 160 | 33.33 | 24.438 | 45-125 | 25 |
| 4-Bromophenyl phenyl ether | 101-55-3 | - | - | - | 160 | 83.325 | 42.476 | 52-115 | 25 |
| Butyl benzyl phthalate | 85-68-7 | **290000** | - | - | 160 | 33.33 | 19.679 | 50-125 | 25 |
| Carbazole | 86-74-8 | - | - | - | 160 | 16.67 | 11.471 | 45-115 | 25 |

Notes: Bold indicated the most conservative of the screening criteria.
* Asterisk indicates that compounds to be analyzed by the Method 8270 D SIM to achieve lower LOD/LOQ. See Worksheet #15.2a.
Italics indicate all the target analytes where screening criteria are lower than the LOQs. In the instance where Method 8270 D SIM is not available, the LOQ will be the PSL.

## Worksheet #15.1b Reference Limits and Evaluation (Continued)
## SVOCs by SW-846 Method 8270D (Soil)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | NYDEC CP-51 Unrestricted Use | NYSDEC ELC 376-6 Soil Cleanup Objectives | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| | | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | % | RPD< |
| 4-Chloroaniline | 106-47-8 | **2700** | - | - | 160 | 83.325 | 25.123 | 28-80 | 25 |
| 4-Chloro-3-methylphenol | 59-50-7 | **6300000** | - | - | 160 | 33.33 | 17.397 | 45-115 | 25 |
| 2-Chloronaphthalene | 91-58-7 | **4800000** | - | - | 160 | 16.67 | 11.126 | 45-105 | 25 |
| 2-Chlorophenol | 95-57-8 | **360000** | - | - | 160 | 83.33 | 34.795 | 45-105 | 25 |
| 4-Chlorophenyl phenyl ether | 7005-72-3 | - | - | - | 160 | 16.67 | 10.093 | 45-110 | 25 |
| Chrysene * | 218-01-9 | 16000 | **1000** | **1000** | 160 | 16.67 | 9.398 | 55-110 | 25 |
| *Dibenz(a,h)anthracene ** | 53-70-3 | **16** | 330 | 330 | 160 | 33.33 | 26.431 | 40-125 | 25 |
| Dibenzofuran | 132-64-9 | **73000** | - | - | 160 | 16.67 | 8.486 | 50-105 | 25 |
| Di-n-butyl phthalate | 84-74-2 | 6300000 | **100000** | - | 160 | 33.33 | 17.976 | 55-110 | 25 |
| 1,2-Dichlorobenzene | 95-50-1 | **1800000** | - | - | 160 | 0.6 | 0.24 | 45-95 | 25 |
| 1,3-Dichlorobenzene | 541-73-1 | - | - | - | 160 | 0.6 | 0.237 | 40-100 | 25 |
| 1,4-Dichlorobenzene | 106-46-7 | **2600** | - | - | 160 | 0.6 | 0.189 | 35-105 | 25 |
| 3,3'-Dichlorobenzidine | 91-94-1 | **1200** | - | - | 1000 | 666.67 | 426.346 | 24-101 | 25 |
| 2,4-Dichlorophenol | 120-83-2 | 190000 | **100000** | - | 160 | 166.67 | 94.847 | 45-110 | 25 |
| Diethyl phthalate | 84-66-2 | **5.1E+07** | - | - | 160 | 16.67 | 12.227 | 50-115 | 25 |

Notes: Bold indicated the most conservative of the screening criteria.
* Asterisk indicates that compounds to be analyzed by the Method 8270 D SIM to achieve lower LOD/LOQ. See Worksheet #15.2a.
Italics indicate all the target analytes where screening criteria are lower than the LOQs. In the instance where Method 8270 D SIM is not available, the LOQ will be the PSL.

## Worksheet #15.1b Reference Limits and Evaluation (Continued)
## SVOCs by SW-846 Method 8270D (Soil)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | NYDEC CP-51 Unrestricted Use | NYSDEC ELC 376-6 Soil Cleanup Objectives | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| | | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | % | RPD< |
| 2,4-Dimethylphenol | 105-67-9 | **1300000** | - | - | 330 | 83.33 | 31.905 | 30-105 | 25 |
| Dimethyl phthalate | 131-11-3 | - | **100000** | - | 330 | 16.67 | 11.126 | 50-110 | 25 |
| 4,6-Dintro-2-methylphenol | 534-52-1 | **5100** | - | - | 320 | 83.325 | 47.948 | 30-135 | 25 |
| 2,4-Dinitrophenol | 51-28-5 | 130000 | **100000** | - | 1600 | 166.67 | 94.847 | 15-130 | 25 |
| 2,4-Dinitrotoluene | 121-14-2 | **1700** | - | - | 160 | 16.67 | 14.512 | 50-115 | 25 |
| 2,6-Dinitrotoluene | 606-20-2 | **360** | 1030 | - | 160 | 16.67 | 15.811 | 50-110 | 25 |
| Di-n-octyl phthalate | 117-84-0 | 630000 | **100000** | - | 160 | 33.33 | 11.375 | 40-130 | 25 |
| Fluoranthene * | 206-44-0 | 2400000 | **100000** | **100000** | 160 | 16.67 | 16.021 | 55-115 | 25 |
| Fluorene * | 86-73-7 | 2400000 | **30000** | **30000** | 160 | 16.67 | 9.406 | 50-110 | 25 |
| Hexachlorobenzene | 118-74-1 | **210** | 410 | - | 160 | 16.67 | 9.406 | 52-107 | 25 |
| Hexachlorobutadiene | 87-68-3 | **1200** | - | - | 160 | 16.67 | 15.212 | 40-115 | 25 |
| Hexachloroethane | 67-72-1 | **1800** | - | - | 160 | 16.67 | 7.676 | 35-110 | 25 |
| Indeno(1,2,3-cd)pyrene * | 193-39-5 | **160** | 500 | 500 | 160 | 33.33 | 8.575 | 40-120 | 25 |
| Isophorone | 78-59-1 | 570000 | **100000** | - | 160 | 16.67 | 6.907 | 45-110 | 25 |
| 2-Methylnaphthalene | 91-57-6 | 240000 | **410** | - | 160 | 16.67 | 8.167 | 45-105 | 25 |
| 2-Methylphenol | 95-48-7 | **3200000** | - | - | 160 | - | - | 40-105 | 25 |

Notes: Bold indicated the most conservative of the screening criteria.
* Asterisk indicates that compounds to be analyzed by the Method 8270 D SIM to achieve lower LOD/LOQ. See Worksheet #15.2a.
Italics indicate all the target analytes where screening criteria are lower than the LOQs. In the instance where Method 8270 D SIM is not available, the LOQ will be the PSL.

## Worksheet #15.1b Reference Limits and Evaluation (Continued)
## SVOCs by SW-846 Method 8270D (Soil)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | NYDEC CP-51 Unrestricted Use | NYSDEC ELC 376-6 Soil Cleanup Objectives | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| | | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | % | RPD< |
| 3-methylphenol & 4-methylphenol | 65794-96-9 | **6300000** | - | - | - | - | - | 40-105 | 25 |
| Naphthalene * | 91-20-3 | **3800** | 12000 | 12000 | 160 | 16.67 | 6.47 | 40-105 | 25 |
| 2-Nitroaniline | 88-74-4 | 630000 | **400** | - | 80 | 16.67 | 8.112 | 45-120 | 25 |
| 3-Nitroaniline | 99-09-2 | - | **500** | - | 80 | 16.67 | 11.657 | 25-110 | 25 |
| 4-Nitroaniline | 100-01-6 | **27000** | - | - | 80 | 83.325 | 24.018 | 35-115 | 25 |
| Nitrobenzene | 98-95-3 | 5100 | **370** | - | 80 | 16.67 | 10.349 | 40-115 | 25 |
| 2-Nitrophenol | 88-75-5 | - | **300** | - | 160 | 83.33 | 41.274 | 40-110 | 25 |
| *4-Nitrophenol* | 100-02-7 | - | **100** | - | 830 | 333.33 | 239.145 | 15-140 | 25 |
| *N-Nitrosodimethylamine* | 62-75-9 | **2** | - | - | 160 | 16.67 | 8.109 | 20-115 | 25 |
| N-Nitrosodiphenylamine | 86-30-6 | - | - | - | 160 | 16.67 | 8.063 | 50-115 | 25 |
| N-Nitrosodi-n-propylamine | 621-64-7 | **110000** | - | - | 160 | 16.67 | 9.261 | 40-115 | 25 |
| *Pentachlorophenol* | 87-86-5 | **1000** | - | - | 1600 | 83.33 | 62.698 | 25-120 | 25 |
| Phenanthrene * | 85-01-8 | - | **100000** | **100000** | 160 | 16.67 | 8.806 | 50-110 | 25 |
| Phenol | 108-95-2 | - | - | - | 160 | 83.33 | 35.747 | 40-100 | 25 |
| Pyrene * | 129-00-0 | 1800000 | **100000** | **100000** | 160 | 16.67 | 10.156 | 45-125 | 25 |
| 1,2,4-Trichlorobenzene | 120-82-1 | **24000** | - | - | 160 | 16.67 | 9.33 | 45-110 | 25 |
| 2,4,5-Trichlorophenol | 95-95-4 | **6300000** | - | - | 160 | 33.33 | 16.476 | 50-110 | 25 |

Notes: Bold indicated the most conservative of the screening criteria
* Asterisk indicates that compounds to be analyzed by the Method 8270 D SIM to achieve lower LOD/LOQ. See Worksheet #15.2a.
Italics indicate all the target analytes where screening criteria are lower than the LOQs. In the instance where Method 8270 D SIM is not available, the LOQ will be the PSL.

## Worksheet #15.1b Reference Limits and Evaluation (Continued)
## SVOCs by SW-846 Method 8270D (Soil)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | NYDEC CP-51 Unrestricted Use | NYSDEC ELC 376-6 Soil Cleanup Objectives | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| | | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | % | RPD< |
| 2,4,6-Trichlorophenol | 88-06-2 | - | **10000** | - | 160 | 33.3 | 18.581 | 45-110 | 25 |
| 2-Fluorophenol (Surrogate) | 367-12-4 | | | | | | | 35-105 | - |
| 2,4,6-Tribromophenol (Surrogate) | 118-79-6 | | | | | | | 35-125 | - |
| Nitrobenzene-d5 (Surrogate) | 4165-60-0 | | | | | | | 35-100 | - |
| Phenol-d5 (Surrogate) | 4165-62-2 | | | | | | | 40-100 | - |
| Terphenyl-d-14 (Surrogate) | 1718-51-0 | | | | | | | 30-125 | - |
| 2-Fluorobiphenyl (Surrogate) | 321-60-8 | | | | | | | 45-105 | - |

N–otes: These (Method Detection Limit – MDL and Limit of Quantitation – LOQ) were obtained from RTI Laboratories RTI Labs (2016) and are meant to be recommended project values.
The QA/QC criteria presented in this table reflect the most recently promulgated values as reported by the laboratory.
The PSL references for soil are: CP-51 = NYSDEC Commissioner Policy-51 Soil Cleanup Guidance, NYSDEC CP-51 Petroleum Impacted Soil Guidance or, Residential RSL – USEPA Regional Screening Level for Soil (November 2015).
Bold indicated the most conservative of the screening criteria.
* Asterisk indicates that compounds to be analyzed by the Method 8270 D SIM to achieve lower LOD/LOQ. See Worksheet #15.2a.
Italics indicate all the target analytes where screening criteria are lower than the LOQs. In the instance where Method 8270 D SIM is not available, the LOQ will be the PSL.

## Worksheet #15.2a Reference Limits and Evaluation
## SVOCs by SW-846 Method 8270D SIM (Aqueous)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | MCL | NYDEC TOGS-Drinking Water | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous |
| | | µg/L | µg/L | µg/L | µg/L | µg/L | µg/L | % | RPD< |
| 1-Methylnaphthalene | 90-12-0 | - | - | - | 0.02 | 0.02 | 0.02 | 45-110 | 25 |
| 2-Methylnaphthalene | 91-57-6 | 240000 | **410** | - | 0.02 | 0.02 | 0.02 | 30-117 | 25 |
| Acenaphthene | 83-32-9 | 530 | - | **20** | 0.02 | 0.02 | 0.02 | 41-130 | 25 |
| Acenaphthylene | 208-96-8 | - | - | - | 0.02 | 0.02 | 0.02 | 50-130 | 25 |
| Anthracene | 120-12-7 | - | - | **-** | 0.02 | 0.02 | 0.02 | 50-130 | 25 |
| Benz(a)anthracene | 56-55-3 | 0.012 | - | **0.002** | 0.02 | 0.02 | 0.02 | 54-128 | 25 |
| Benzo(a)pyrene | 50-32-8 | **0.0034** | 0.2 | ND | 0.02 | 0.02 | 0.02 | 54-128 | 25 |
| Benzo(b)fluoranthene | 205-99-2 | 0.034 | - | **0.002** | 0.02 | 0.02 | 0.02 | 50-134 | 25 |
| Benzo(e)pyrene | 192-97-2 | - | - | - | 0.02 | 0.02 | 0.02 | 40-125 | 25 |
| Benzo(g,h,i)perylene | 191-24-2 | - | - | - | 0.02 | 0.02 | 0.02 | 57-129 | 25 |
| Benzo(k)fluoranthene | 207-08-9 | 0.34 | - | **0.002** | 0.02 | 0.02 | 0.02 | 30-110 | 25 |
| Chrysene | 218-01-9 | 3.4 | - | **0.002** | 0.02 | 0.02 | 0.02 | 59-127 | 25 |
| Dibenz(a,h)anthracene | 53-70-3 | **0.0034** | - | - | 0.02 | 0.02 | 0.02 | 45-134 | 25 |
| Dibenzofuran | 132-64-9 | **7.9** | - | - | 0.02 | 0.02 | 0.02 | 25-130 | 25 |
| Fluoranthene | 206-44-0 | 800 | - | **50** | 0.02 | 0.02 | 0.02 | 40-125 | 25 |
| Fluorene | 86-73-7 | 290 | - | **50** | 0.02 | 0.02 | 0.02 | 50-115 | 25 |
| Indeno(1,2,3-cd)pyrene | 193-39-5 | 0.034 | - | **0.002** | 0.02 | 0.02 | 0.02 | 45-115 | 25 |
| Naphthalene | 91-20-3 | **0.17** | - | 10 | 0.02 | 0.02 | 0.02 | 45-121 | 25 |
| Phenanthrene | 85-01-8 | - | - | **50** | 0.02 | 0.02 | 0.02 | 50-130 | 25 |
| Pyrene | 129-00-0 | 120 | - | **50** | 0.02 | 0.02 | 0.02 | 50-130 | 25 |

Notes: Bold indicated the most conservative of the screening criteria.

## Worksheet #15.2b Reference Limits and Evaluation
## SVOCs by SW-846 Method 8270D SIM (Soil)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | NYDEC CP-51 Unrestricted Use | NYSDEC ELC 376-6 Soil Cleanup Objectives | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| | | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | % | RPD< |
| 1-Methylnaphthalene | 90-12-0 | - | **-** | **-** | 0.67 | 0.67 | 0.67 | 45-110 | 25 |
| 2-Methylnaphthalene | 91-57-6 | 240000 | **410** | - | 0.67 | 0.67 | 0.67 | 47-123 | 25 |
| Acenaphthene | 83-32-9 | 3600000 | **20000** | **20000** | 0.67 | 0.67 | 0.67 | 55-105 | 25 |
| Acenaphthylene | 208-96-8 | - | **100000** | **100000** | 0.67 | 0.67 | 0.67 | 53-131 | 25 |
| Anthracene | 120-12-7 | - | - | **-** | 0.67 | 0.67 | 0.67 | 50-130 | 25 |
| Benz(a)anthracene | 56-55-3 | 160 | **1000** | **1000** | 0.67 | 0.67 | 0.67 | 45-115 | 25 |
| Benzo(a)pyrene | 50-32-8 | 160 | **1000** | **1000** | 0.67 | 0.67 | 0.67 | 45-125 | 25 |
| Benzo(b)fluoranthene | 205-99-2 | 1600 | **800** | **800** | 0.67 | 0.67 | 0.67 | 45-132 | 25 |
| Benzo(e)pyrene | 192-97-2 | - | - | - | 0.67 | 0.67 | 0.67 | 40-125 | 25 |
| Benzo(g,h,i)perylene | 191-24-2 | - | **100000** | **100000** | 0.67 | 0.67 | 0.67 | 40-125 | 25 |
| Benzo(k)fluoranthene | 207-08-9 | 0.34 | - | **0.002** | 0.67 | 0.67 | 0.67 | 47-132 | 25 |
| Chrysene | 218-01-9 | 16000 | **1000** | **1000** | 0.67 | 0.67 | 0.67 | 50-124 | 25 |
| Dibenz(a,h)anthracene | 53-70-3 | **16** | 330 | 330 | 0.67 | 0.67 | 0.67 | 45-134 | 25 |
| Dibenzofuran | 132-64-9 | **73000** | - | - | 0.67 | 0.67 | 0.67 | 44-127 | 25 |
| Fluoranthene | 206-44-0 | 2400000 | **100000** | **100000** | 0.67 | 0.67 | 0.67 | 50-127 | 25 |
| Fluorene | 86-73-7 | 2400000 | **30000** | **30000** | 0.67 | 0.67 | 0.67 | 43-125 | 25 |
| Indeno(1,2,3-cd)pyrene | 193-39-5 | **160** | 500 | 500 | 0.67 | 0.67 | 0.67 | 45-133 | 25 |
| Naphthalene | 91-20-3 | **3800** | 12000 | 12000 | 0.67 | 0.67 | 0.67 | 35-123 | 25 |
| Phenanthrene | 85-01-8 | - | **100000** | **100000** | 0.67 | 0.67 | 0.67 | 50-121 | 25 |
| Pyrene | 129-00-0 | 1800000 | **100000** | **100000** | 0.67 | 0.67 | 0.67 | 47-127 | 25 |

Notes: Bold indicated the most conservative of the screening criteria.

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## Worksheet #15.3a Reference Limits and Evaluation
## VOCs by SW-846 Method 8260C (Aqueous)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | MCL | NYDEC TOGS-Drinking Water | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous |
| | | µg/l | µg/L | µg/l | µg/l | µg/l | µg/l | % | RPD< |
| *1,1,1,2-Tetrachloroethane* | 630-20-6 | **0.57** | - | 5 | 1 | 0.6 | 0.265 | 78-124 | 25 |
| 1,1,1-Trichloroethane | 71-55-6 | 800 | 200 | **5** | 1 | 0.6 | 0.159 | 74-131 | 25 |
| *1,1,2,2-Tetrachloroethane* | 79-34-5 | **0.076** | - | 5 | 1 | 0.6 | 0.286 | 71-121 | 25 |
| *1,1,2-Trichloroethane* | 79-00-5 | **0.28** | 5 | 1 | 1 | 0.6 | 0.266 | 80-119 | 25 |
| 1,1-Dichloroethane | 75-34-3 | **2.8** | - | 5 | 1 | 0.6 | 0.247 | 77-125 | 25 |
| 1,1-Dichloroethene | 75-35-4 | - | 7 | **5** | 1 | 0.6 | 0.193 | 71-131 | 25 |
| *1,2,3-Trichloropropane* | 96-18-4 | **0.00075** | - | 0.04 | 1 | 0.6 | 0.794 | 69-129 | 25 |
| *1,2-Dibromo-3-chloropropane* | 96-12-8 | **0.0004** | 0.2 | 0.04 | 1 | 0.6 | 0.249 | 80-120 | 25 |
| *1,2-Dibromoethane* | 106-93-4 | **0.0075** | 0.05 | | 1 | 0.6 | 0.18 | 77-121 | 25 |
| *1,2-Dichloroethane* | 107-06-2 | **0.017** | 5 | 5 | 2 | 1.6 | 0.189 | 73-128 | 25 |
| *1,2-Dichloropropane* | 78-87-5 | **0.56** | 5 | 1 | 1 | 0.6 | 0.347 | 78-122 | 25 |
| 2-Butanone | 78-93-3 | 5600 | - | **50** | 1 | 0.6 | - | 56-143 | 25 |
| 2-Hexanone | 591-78-6 | **38** | - | 50 | 1 | 0.6 | - | 57-139 | 25 |
| Acetone | 67-64-1 | 14000 | - | **50** | 10 | 4 | 0.436 | 39-160 | 25 |
| *Benzene* | 71-43-2 | **0.46** | 5 | 1 | 1 | 0.6 | 0.195 | 79-120 | 25 |

Notes: Bold indicated the most conservative of the screening criteria
Italics indicate all the target analytes where the screening criteria are lower than the LOQs. In this instance, the LOQ will be the PSL.

## Worksheet #15.3a Reference Limits and Evaluation (Continued)
## VOCs by SW-846 Method 8260C (Aqueous)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | MCL | NYDEC TOGS-Drinking Water | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous |
| | | µg/l | µg/L | µg/l | µg/l | µg/l | µg/l | % | RPD< |
| Bromodichloromethane | 75-27-4 | **0.13** | 80 | 50 | 1 | 0.6 | 0.185 | 79-125 | 25 |
| Bromoform | 75-25-2 | **3.3** | 80 | 50 | 1 | 0.6 | - | 66-130 | 25 |
| Carbon disulfide | 75-15-0 | **810** | - | - | 1 | 0.6 | 0.153 | 64-133 | 25 |
| Carbon tetrachloride | 56-23-5 | - | **5** | **5** | 1 | 0.6 | 0.364 | 72-136 | 25 |
| Chlorobenzene | 108-90-7 | 78 | 100 | **5** | 1 | 0.6 | 0.225 | 82-118 | 25 |
| Chloroethane | 75-00-3 | 21000 | - | **5** | 2 | 1 | 0.415 | 71-131 | 25 |
| Chloroform | 67-66-3 | - | 80 | **7** | 1 | 0.6 | 0.187 | 60-138 | 25 |
| *cis-1,3-Dichloropropene* | 10061-01-5 | - | - | **0.3** | 1 | 0.6 | 0.187 | 78-123 | 25 |
| Dibromochloromethane | 124-48-1 | - | - | **50** | 1 | 0.6 | 0.21 | 74-126 | 25 |
| Cis-1,2-dichloroethene | 156-59-2 | - | - | **5** | 1 | 0.6 | 0.21 | 78-123 | 25 |
| Dichlorodifluoromethane | 75-71-8 | 200 | - | **5** | 1 | 0.6 | 0.239 | 32-152 | 25 |
| Ethyl benzene | 100-41-4 | - | 700 | **5** | 1 | 0.6 | 0.197 | 79-121 | 25 |
| Methyl chloride | 74-87-3 | - | - | **5** | 1 | 0.6 | - | 74-121 | 25 |
| Methylene chloride | 75-09-2 | 13 | **5** | **5** | 1 | 0.6 | - | 74-121 | 25 |
| Styrene | 100-42-5 | 1200 | **100** | 930 | 1 | 0.6 | 0.2 | 78-123 | 25 |
| Tetrachloroethene | 127-18-4 | 11 | **5** | **5** | 1 | 0.6 | 0.265 | 74-129 | 25 |
| Toluene | 108-88-3 | 1100 | 1000 | **5** | 1 | 0.6 | 0.196 | 80-121 | 25 |
| trans-1,2-Dichloroethene | 156-60-5 | 400 | 100 | **5** | 1 | 0.6 | 0.185 | 75-124 | 25 |
| *trans-1,3-Dichloropropene* | 10061-02-6 | - | - | **0.4** | 1 | 0.6 | 0.199 | 73-127 | 25 |
| *Trichloroethene* | 79-01-6 | **0.96** | 5 | 5 | 1 | 0.6 | 0.269 | 79-123 | 25 |
| Trichlorofluoromethane | 75-69-4 | 5200 | - | **5** | 1 | 0.6 | 0.255 | 65-141 | 25 |
| Vinyl acetate | 108-05-4 | - | - | - | 1 | 0.6 | - | 71-131 | 25 |
| *Vinyl chloride* | 75-01-4 | **0.019** | 2 | 2 | 1 | 0.6 | 0.242 | 58-137 | 25 |
| Xylenes, Total | 1330-20-7 | **190** | 10000 | - | 3 | 1.8 | 0.663 | 79-121 | 25 |

## Worksheet #15.3a Reference Limits and Evaluation (Continued)
## VOCs by SW-846 Method 8260C (Aqueous)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | MCL | NYDEC TOGS-Drinking Water | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous |
| | | µg/l | µg/L | µg/l | µg/l | µg/l | µg/l | % | RPD< |
| 1,2-Dichloroethane-d4 (surrogate) | - | - | - | - | - | - | - | 70-120 | 25 |
| Chlorobenzene-d5 (surrogate) | - | - | - | - | - | - | - | 80-120 | 25 |
| Fluorobenzene (surrogate) | - | - | - | - | - | - | - | 80-120 | 25 |
| Toluene-d8 (surrogate) | - | - | - | - | - | - | - | 80-120 | 25 |

NOTE - These (Method Detection Limit – MDL and Limit of Quantitation – LOQ) were obtained from RTI Laboratories RTI Labs (2016) and are meant to be recommended project values.
The QA/QC criteria presented in this table reflect the most recently promulgated values as reported by the laboratory.
The PSL references are MCLs, RSLs, or either TOGS 1.1.1 =NYSDEC Technical and Operational Guidance 1.1.1 Ambient Water Quality Standards and Guidance Values, or Tapwater based on the USEPA Regional Screening Level for Water (November 2015).
Bold indicated the most conservative of the screening criteria.
Italics indicate all the target analytes where the screening criteria are lower than the LOQs. In this instance, the LOQ will be the PSL.

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## Worksheet #15.3b Reference Limits and Evaluation
## VOCs by SW-846 Method 8260C (Soil)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | NYDEC CP-51 Unrestricted Use | NYSDEC ELC 376-6 Soil Cleanup Objectives | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| | | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | % | RPD< |
| 1,1,1,2-Tetrachloroethane | 630-20-6 | 2000 | **60** | - | 1 | 0.6 | 0.241 | 78-125 | 25 |
| 1,1,1-Trichloroethane | 71-55-6 | **8100000** | - | - | 1 | 0.6 | 0.164 | 73-130 | 25 |
| 1,1,2,2-Tetrachloroethane | 79-34-5 | **600** | 35000 | - | 1 | 0.6 | 0.306 | 70-124 | 25 |
| 1,1,2-Trichloroethane | 79-00-5 | **1100** | - | - | 1 | 0.6 | 0.211 | 78-121 | 25 |
| 1,1-Dichloroethane | 75-34-3 | **3600** | - | - | 1 | 0.6 | 0.208 | 76-125 | 25 |
| 1,1-Dichloroethene | 75-35-4 | **230000** | - | - | 1 | 0.6 | 0.213 | 70-131 | 25 |
| 1,2,3-Trichloropropane | 96-18-4 | **5.1** | 80000 | - | 1 | 0.6 | 0.468 | 73-125 | 25 |
| 1,2-Dibromo-3-chloropropane | 96-12-8 | **5.3** | - | - | 2 | 1 | 0.855 | 61-132 | 25 |
| 1,2-Dibromoethane | 106-93-4 | **36** | - | - | 1 | 0.6 | 0.232 | 78-122 | 25 |
| Cis-1,2-dichloroethene | 156-59-2 | 16000 | - | 250 | 1 | 0.6 | 0.2214 | 77-123 | 25 |
| 1,2-Dichloroethane | 107-06-2 | **460** | - | - | 1 | 0.6 | 0.184 | 73-128 | 25 |
| 1,2-Dichloropropane | 78-87-5 | **1000** | 700000 | - | 1 | 0.6 | 0.271 | 76-123 | 25 |
| 2-Butanone | 78-93-3 | 27000000 | **300** | - | 10 | 5 | 0.679 | 51-133 | 25 |
| 2-Hexanone | 591-78-6 | **200000** | - | - | 5 | 0.6 | 0.34 | 53-145 | 25 |
| Acetone | 67-64-1 | **6100000** | - | - | 5 | 4 | 0.543 | 36-164 | 25 |
| Benzene | 71-43-2 | 1200 | **60** | **60** | 0.6 | 0.6 | 0.163 | 77-121 | 25 |

Notes: Bold indicated the most conservative of the screening criteria

## Worksheet #15.3b Reference Limits and Evaluation (Continued)
## VOCs by SW-846 Method 8260C (Soil)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | NYDEC CP-51 Unrestricted Use | NYSDEC ELC 376-6 Soil Cleanup Objectives | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| | | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | % | RPD< |
| Bromodichloromethane | 75-27-4 | **290** | - | - | 1 | 0.6 | 0.158 | 75-127 | 25 |
| Bromoform | 75-25-2 | **19000** | - | - | 1 | 0.6 | 0.21 | 67-132 | 25 |
| Carbon disulfide | 75-15-0 | 770000 | **2700** | - | 1 | 0.6 | 0.454 | 63-132 | 25 |
| Carbon tetrachloride | 56-23-5 | **650** | - | 760 | 1 | 0.6 | 0.193 | 70-135 | 25 |
| Chlorobenzene | 108-90-7 | 280000 | - | **1100** | 1 | 0.6 | 0.172 | 79-120 | 25 |
| Chloroethane | 75-00-3 | **1.4E+07** | - | - | 1 | 0.6 | 1.79 | 59-139 | 25 |
| Chloroform | 67-66-3 | **320** | - | 370 | 1 | 0.6 | 0.164 | 78-123 | 25 |
| cis-1,3-Dichloropropene | 10061-01-5 | - | - | - | 1 | 0.6 | 0.143 | 74-126 | 25 |
| Dibromochloromethane | 124-48-1 | - | **10000** | - | 1 | 0.6 | 0.167 | 74-126 | 25 |
| Dichlorodifluoromethane | 75-71-8 | **87000** | - | - | 1 | 0.6 | 0.196 | 29-149 | 25 |
| Ethyl benzene | 100-41-4 | 5800 | **1000** | **1000** | 1 | 0.6 | 0.208 | 76-122 | 25 |
| Methyl chloride | 74-87-3 | - | - | - | 5 | 2 | - | 56-143 | 25 |
| Methylene chloride | 75-09-2 | **57000** | - | - | 1 | 0.6 | 0.435 | 70-128 | 25 |
| Styrene | 100-42-5 | **6000000** | - | - | 1 | 0.6 | 0.159 | 76-124 | 25 |
| Tetrachloroethene | 127-18-4 | **24000** | - | - | 1 | 0.6 | 0.234 | 73-128 | 25 |
| Toluene | 108-88-3 | 4900000 | **700** | **700** | 1 | 0.6 | 0.207 | 77-121 | 25 |
| trans-1,2-Dichloroethene | 156-60-5 | 1600000 | - | **100000** | 1 | 0.6 | 0.161 | 74-125 | 25 |
| trans-1,3-Dichloropropene | 10061-02-6 | - | - | - | 1 | 0.6 | 0.203 | 71-130 | 25 |
| Trichloroethene | 79-01-6 | **940** | - | 21000 | 1 | 0.6 | 0.383 | 77-123 | 25 |
| Trichlorofluoromethane | 75-69-4 | **2.3E+07** | - | - | 1 | 0.6 | 0.199 | 62-140 | 25 |
| Vinyl acetate | 108-05-4 | - | - | - | 25 | 0.6 | 0.409 | 50-151 | 25 |
| Vinyl chloride | 75-01-4 | **59** | - | - | 0.8 | 0.6 | 0.196 | 56-135 | 25 |
| Xylenes, Total | 1330-20-7 | - | **26000** | 100000 | 3 | 1.5 | 0.611 | 78-124 | 25 |

## Worksheet #15.3b Reference Limits and Evaluation (Continued)
## VOCs by SW-846 Method 8260C (Soil)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | NYDEC CP-51 Unrestricted Use | NYSDEC ELC 376-6 Soil Cleanup Objectives | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| | | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | % | RPD< |
| 1,2-Dichloroethane-d4 (surrogate) | 17060-07-0 | - | - | - | - | - | - | 80-120 | 25 |
| Chlorobenzene-d5 (surrogate) | 3114-55-4 | - | - | - | - | - | - | 80-120 | 25 |
| Fluorobenzene (surrogate) | 462-06-6 | - | - | - | - | - | - | 80-120 | 25 |
| Toluene-d8 (surrogate) | 2037-26-5 | - | - | - | - | - | - | 85-115 | 25 |

NOTE - These (Method Detection Limit – MDL and Limit of Quantitation – LOQ) were obtained from RTI Laboratories RTI Labs (2016) and are meant to be recommended project values. The QA/QC criteria presented in this table reflect the most recently promulgated values as reported by the laboratory.
The PSL references for soil are: CP-51 = NYSDEC Commissioner Policy-51 Soil Cleanup Guidance, NYSDEC CP-51 Petroleum Impacted Soil Guidance or, Residential RSL – USEPA Regional Screening Level for Soil (November 2015).
Bold indicated the most conservative of the screening criteria

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## Worksheet #15.4a Reference Limits and Evaluation
## Metals by SW-846 Methods 6020C (Aqueous)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | MCL | NYDEC TOGS-Drinking Water | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous |
| | | µg/l | µg/L | µg/l | µg/l | µg/l | µg/l | % | RPD< |
| Aluminum | 7429-90-5 | 20000 | - | **2000** | 0.5 | 0.5 | 0.277 | 86-115 | 20 |
| Antimony | 7440-36-0 | 7.8 | **6** | - | 0.5 | 0.2 | 0.104 | 88-113 | 20 |
| *Arsenic* | 7440-38-2 | **0.052** | 10 | 50 | 0.3 | 0.2 | 0.122 | 87-113 | 20 |
| Barium | 7440-39-3 | 3800 | **2000** | **2000** | 5 | 0.1 | 0.037 | 88-113 | 20 |
| Beryllium | 7440-41-7 | **2.5** | 4 | 3 | 0.2 | 0.1 | 0.05 | 89-113 | 20 |
| Cadmium | 7440-43-9 | 9.2 | **5** | 10 | 0.2 | 0.1 | 0.054 | 88-113 | 20 |
| Calcium | 7440-70-2 | - | - | - | 200 | 25 | 18.061 | 87-113 | 20 |
| Chromium | 7440-47-3 | - | **100** | **100** | 2 | 0.1 | 0.061 | 88-113 | 20 |
| Cobalt | 7440-48-4 | **6** | - | - | 1 | 0.1 | 0.024 | 89-114 | 20 |
| Copper | 7440-50-8 | **800** | 1300 | 1000 | 1 | 0.1 | 0.049 | 88-113 | 20 |
| Iron | 7439-89-6 | 14000 | - | 600 | 40 | 25 | 9.541 | 87-115 | 20 |
| Lead | 7439-92-1 | **15** | **15** | 50 | 0.2 | 0.1 | 0.048 | 86-115 | 20 |
| Magnesium | 7439-95-4 | - | - | 35000 | 100 | 25 | 8.126 | 88-113 | 20 |
| Manganese | 7439-96-5 | 430 | - | 600 | 1 | 0.1 | 0.053 | 90-114 | 20 |
| Nickel | 7440-02-0 | 390 | - | **200** | 2 | 0.1 | 0.041 | 88-113 | 20 |
| Potassium | 9/7/7440 | - | - | - | 100 | 25 | 21.143 | 88-113 | 20 |
| Selenium | 7782-49-2 | 100 | **50** | - | 1 | 0.5 | 0.291 | 88-113 | 20 |

Bold indicated the most conservative of the screening criteria
Italics indicate all the target analytes where the PSLs are lower than the LOQs

## Worksheet #15.4a Reference Limits and Evaluation (Continued)
## Metals by SW-846 Methods 6020C (Aqueous)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | MCL | NYDEC TOGS-Drinking Water | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous |
| | | µg/l | µg/L | µg/l | µg/l | µg/l | µg/l | % | RPD< |
| Silver | 7440-22-4 | **94** | - | 100 | 25 | | 11.506 | 84-115 | 20 |
| Sodium | 7440-23-5 | - | - | - | 0.1 | | 0.033 | 87-115 | 20 |
| Vanadium | 7440-62-2 | **86** | - | - | 0.5 | | 0.351 | 90-111 | 20 |
| Zinc | 7440-66-6 | **6000** | - | - | 25 | | 11.506 | 87-115 | 20 |

NOTE - These (Method Detection Limit – MDL and Limit of Quantitation – LOQ) were obtained from RTI Laboratories RTI Labs (2016) and are meant to be recommended project values.
The QA/QC criteria presented in this table reflect the most recently promulgated values as reported by the laboratory.
The PSL references are MCLs, RSLs, or either TOGS 1.1.1 =NYSDEC Technical and Operational Guidance 1.1.1 Ambient Water Quality Standards and Guidance Values, or Tapwater based on the USEPA Regional Screening Level for Water (November 2015).
Bold indicated the most conservative of the screening criteria.

## Worksheet #15.4b Reference Limits and Evaluation
## Metals by SW-846 Methods 6020C (Soil)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | NYDEC CP-51 Unrestricted Use | NYSDEC ELC 376-6 Soil Cleanup Objectives | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| | | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | % | RPD< |
| Aluminum | 7429-90-5 | **7.7E+07** | - | - | 5000 | 2000 | 749.9 | 78-124 | 20 |
| Antimony | 7440-36-0 | **31000** | - | - | 1000 | 500 | 375.66 | 72-124 | 20 |
| *Arsenic* | 7440-38-2 | **680** | - | 13000 | 2000 | 1000 | 725.5 | 80-120 | 20 |
| Barium | 7440-39-3 | 15000000 | - | **350000** | 10000 | 5000 | 297.26 | 80-120 | 20 |
| Beryllium | 7440-41-7 | 1600000 | - | **7200** | 250 | 50 | 12.67 | 80-120 | 20 |
| Cadmium | 7440-43-9 | 2100000 | - | **2500** | 250 | 50 | 32.99 | 84-116 | 20 |
| Calcium | 7440-70-2 | - | - | - | 50000 | 10000 | 2939.8 | 80-120 | 20 |
| Chromium | 7440-47-3 | - | - | - | 500 | 400 | 82.31 | 80-120 | 20 |
| Cobalt | 7440-48-4 | **420000** | - | - | 1000 | 250 | 89.97 | 80-120 | 20 |
| Copper | 7440-50-8 | 3100000 | - | **50000** | 5000 | 1000 | 415.51 | 84-119 | 20 |
| Iron | 7439-89-6 | **5.5E+07** | - | - | 15000 | 5000 | 3125.31 | 81-124 | 20 |
| Lead | 7439-92-1 | 400000 | - | **63000** | 5000 | 1000 | 622.71 | 84-118 | 20 |
| Magnesium | 7439-95-4 | - | - | - | 50000 | 5000 | 3495.02 | 80-123 | 20 |
| Manganese | 7439-96-5 | 1800000 | - | **1600000** | 1000 | 250 | 184.52 | 80-120 | 20 |
| Nickel | 7440-02-0 | 15000000 | - | **30000** | 5000 | 1000 | 282.03 | 83-114 | 20 |
| Potassium | 9/7/7440 | - | - | - | 20000 | 10000 | 2329.15 | 85-119 | 20 |
| Selenium | 7782-49-2 | 390000 | - | **3900** | 2000 | 1500 | 1163.51 | 80-119 | 20 |

Bold indicated the most conservative of the screening criteria
Italics indicate all the target analytes where the PSLs are lower than the LOQs

## Worksheet #15.4b Reference Limits and Evaluation (Continued)
## Metals by SW-846 Methods 6020C (Soil)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | NYDEC CP-51 Unrestricted Use | NYSDEC ELC 376-6 Soil Cleanup Objectives | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| | | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | % | RPD< |
| Silver | 7440-22-4 | 390000 | - | **2000** | 1000 | 250 | 81.75 | 83-118 | 20 |
| Sodium | 7440-23-5 | - | - | - | 50000 | 5000 | 2040.53 | 79-125 | 20 |
| Vanadium | 7440-62-2 | **390000** | - | - | 2500 | 1000 | 126.78 | 82-116 | 20 |
| Zinc | 7440-66-6 | 23000000 | - | **109000** | 5000 | 500 | 386.5 | 82-119 | 20 |

NOTE - These (Method Detection Limit – MDL and Limit of Quantitation – LOQ) were obtained from RTI Laboratories RTI Labs (2016) and are meant to be recommended project values.
The QA/QC criteria presented in this table reflect the most recently promulgated values as reported by the laboratory.
The PSL references for soil are: CP-51 = NYSDEC Commissioner Policy-51 Soil Cleanup Guidance, NYSDEC CP-51 Petroleum Impacted Soil Guidance or, Residential RSL – USEPA Regional Screening Level for Soil (November 2015).
Bold indicated the most conservative of the screening criteria
Italics indicate all the target analytes where the PSLs are lower than the LOQs

## Worksheet #15.5a Reference Limits and Evaluation

## Explosives/Energetics by SW-846 Method 8330A/B (Aqueous)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | MCL | NYDEC TOGS-Drinking Water | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous |
| | | µg/l | µg/L | µg/l | µg/l | µg/l | µg/l | % | RPD< |
| HMX | 2691-41-0 | **100** | - | - | 0.2 | 0.1 | 0.026 | 80-115 | 20 |
| RDX | 121-82-4 | **0.7** | - | - | 0.2 | 0.1 | 0.028 | 50-160 | 20 |
| 1,3,5-Trinitrobenzene | 99-35-4 | 59 | - | **5** | 0.2 | 0.1 | 0.019 | 73-125 | 20 |
| 1,3-Dinitrobenzene | 99-65-0 | **0.2** | - | 5 | 0.2 | 0.1 | 0.025 | 78-120 | 20 |
| *Nitrobenzene* | 98-95-3 | **0.14** | - | 0.4 | 0.2 | 0.1 | 0.049 | 65-134 | 20 |
| Tetryl | 479-45-8 | **3.9** | - | - | 0.2 | 0.1 | 0.088 | 20-175 | 20 |
| 2,4,6-Trinitrotoluene | 118-96-7 | **2.5** | - | 5 | 0.2 | 0.1 | 0.018 | 71-127 | 20 |
| 4-Amino-2,6-dinitrotoluene | 1946-51-0 | - | - | - | 0.2 | 0.1 | 0.023 | 76-125 | 20 |
| 2-Amino-4.6-dinitrotoluene | 35572-78-2 | **3.9** | - | - | 0.2 | 0.1 | 0.023 | 76-125 | 20 |
| *2,6-Dinitrotoluene* | 606-20-2 | **0.048** | - | 5 | 0.2 | 0.1 | 0.028 | 76-127 | 20 |
| 2,4-Dinitrotoluene | 121-14-2 | **0.24** | - | 5 | 0.2 | 0.1 | 0.03 | 78-120 | 20 |
| 2-Nitrotoluene | 88-72-2 | **0.31** | - | 5 | 0.2 | 0.1 | 0.025 | 70-127 | 20 |
| 4-Nitrotoluene | 99-99-0 | **4.2** | - | 5 | 0.2 | 0.1 | 0.06 | 70-127 | 20 |
| *3-Nitrotoluene* | 99-08-1 | **0.17** | - | 5 | 0.2 | 0.1 | 0.023 | 73-125 | 20 |
| 1,2-Dinitrobenzene (Surrogate) | 528-29-0 | - | - | - | - | - | - | 70-122 | - |

NOTE - These (Method Detection Limit – MDL and Limit of Quantitation – LOQ) were obtained from RTI Laboratories RTI Labs (2016) and are meant to be recommended project values. The QA/QC criteria presented in this table reflect the most recently promulgated values as reported by the laboratory.
The PSL references are MCLs, RSLs, or either TOGS 1.1.1 =NYSDEC Technical and Operational Guidance 1.1.1 Ambient Water Quality Standards and Guidance Values, or Tapwater based on the USEPA Regional Screening Level for Water (November 2015).
Bold indicated the most conservative of the screening criteria
Italics indicate all the target analytes where the screening criteria are lower than the LOQs. In this instance, the LOQ will be the PSL.

## Worksheet #15.5b Reference Limits and Evaluation

## Explosives/Energetics by SW-846 Method 8330A/B (Soil)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | NYDEC CP-51 Unrestricted Use | NYSDEC ELC 376-6 Soil Cleanup Objectives | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| | | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | % | RPD< |
| HMX | 2691-41-0 | **390000** | - | - | 80 | 40 | 2.707 | 75-125 | 20 |
| RDX | 121-82-4 | **6100** | - | - | 80 | 40 | 3.376 | 70-135 | 20 |
| 1,3,5-Trinitrobenzene | 99-35-4 | **220000** | - | - | 80 | 40 | 7.003 | 80-116 | 20 |
| 1,3-Dinitrobenzene | 99-65-0 | **630** | - | - | 80 | 40 | 17.736 | 73-119 | 20 |
| Nitrobenzene | 98-95-3 | **5100** | - | - | 80 | 40 | 8.918 | 67-129 | 20 |
| Tetryl | 479-45-8 | **16000** | - | - | 80 | 40 | 2.903 | 10-150 | 20 |
| 2,4,6-Trinitrotoluene | 118-96-7 | **21000** | - | - | 80 | 40 | 4.528 | 71-120 | 20 |
| 4-Amino-2,6-dinitrotoluene | 1946-51-0 | **-** | - | - | 80 | 40 | 8.908 | 64-127 | 20 |
| 2-Amino-4.6-dinitrotoluene | 35572-78-2 | **15000** | - | - | 80 | 40 | 13.613 | 71-123 | 20 |
| 2,6-Dinitrotoluene | 606-20-2 | **360** | - | - | 80 | 40 | 12.759 | 79-117 | 20 |
| 2,4-Dinitrotoluene | 121-14-2 | **1700** | - | - | 80 | 40 | 10.836 | 80-125 | 20 |
| 2-Nitrotoluene | 88-72-2 | **3200** | - | - | 80 | 40 | 10.309 | 70-124 | 20 |
| 4-Nitrotoluene | 99-99-0 | **34000** | - | - | 80 | 40 | 14.741 | 71-124 | 20 |
| 3-Nitrotoluene | 99-08-1 | **630** | - | - | 80 | 40 | 10.373 | 67-129 | 20 |
| 1,2-Dinitrobenzene (Surrogate) | 528-29-0 | - | - | - | - | - | - | 70-122 | - |

NOTE - These (Method Detection Limit – MDL and Limit of Quantitation – LOQ) were obtained from RTI Laboratories RTI Labs (2016) and are meant to be recommended project values. The QA/QC criteria presented in this table reflect the most recently promulgated values as reported by the laboratory.
The PSL references for soil are: CP-51 = NYSDEC Commissioner Policy-51 Soil Cleanup Guidance, NYSDEC CP-51 Petroleum Impacted Soil Guidance or, Residential RSL – USEPA Regional Screening Level for Soil (November 2015).
Bold indicated the most conservative of the screening criteria

## Worksheet #15.6a Reference Limits and Evaluation
## PCBs by SW-846 Method 8082A (Aqueous)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | MCL | NYDEC TOGS-Drinking Water | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous |
| | | µg/L | µg/L | µg/L | µg/L | µg/L | µg/L | % | RPD< |
| Aroclor 1016 | 12674-11-2 | **0.22** | - | - | 0.1 | 0.04 | 0.032 | 25-140 | 25 |
| *Aroclor 1221* | 11104-28-2 | **0.0047** | - | - | 0.1 | 0.04 | 0.03 | 60-130 | 25 |
| *Aroclor 1232* | 11141-16-5 | **0.0047** | - | - | 0.2 | 0.04 | 0.041 | 65-125 | 25 |
| *Aroclor 1242* | 53469-21-9 | **0.0078** | - | - | 0.2 | 0.04 | 0.037 | 45-135 | 25 |
| *Aroclor 1248* | 12672-29-6 | **0.0078** | - | - | 0.1 | 0.04 | 0.031 | 65-125 | 25 |
| *Aroclor 1254* | 11097-69-1 | **0.0078** | - | - | 0.2 | 0.04 | 0.04 | 60-125 | 25 |
| *Aroclor 1260* | 11096-82-5 | **0.0078** | - | - | 0.2 | 0.04 | 0.035 | N/A | N/A |
| Aroclor 1262 | 37324-23-5 | - | - | - | 0.2 | 0.1 | 0.051 | 25-150 | 25 |
| Aroclor 1268 | 11100-14-4 | - | - | - | 0.1 | 0.04 | 0.028 | 35-140 | 25 |
| *Total PCBs* | 1336-36-3 | **0.044** | 0.5 | 0.09 | 0.2 | 0.1 | 0.051 | 45-140 | 25 |

NOTE - These (Method Detection Limit – MDL and Limit of Quantitation – LOQ) were obtained from RTI Laboratories RTI Labs (2016) and are meant to be recommended project values.
The PSL references are MCLs, RSLs, or either TOGS 1.1.1 =NYSDEC Technical and Operational Guidance 1.1.1 Ambient Water Quality Standards and Guidance Values, or Tapwater based on the USEPA Regional Screening Level for Water (November 2015).
Bold indicated the most conservative of the screening criteria.
Italics indicate all the target analytes where the screening criteria are lower than the LOQs. In the instance where Method 8270 D SIM is not available, the LOQ will be the PSL.

## Worksheet #15.6b Reference Limits and Evaluation
## PCBs by SW-846 Method 8082A (Soil)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | NYDEC CP-51 Unrestricted Use | NYSDEC ELC 376-6 Soil Cleanup Objectives | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| | | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | % | RPD< |
| Aroclor 1016 | 12674-11-2 | **6700** | - | - | 33 | 6.67 | 3.007 | 45-140 | 25 |
| Aroclor 1221 | 11104-28-2 | **200** | - | - | 33 | 6.67 | 2.993 | 60-125 | 25 |
| Aroclor 1232 | 11141-16-5 | **170** | - | - | 33 | 6.67 | 4.491 | 60-125 | 25 |
| Aroclor 1242 | 53469-21-9 | **230** | - | - | 33 | 6.67 | 3.722 | 55-130 | 25 |
| Aroclor 1248 | 12672-29-6 | **230** | - | - | 33 | 6.67 | 3.514 | 65-120 | 25 |
| Aroclor 1254 | 11097-69-1 | **240** | - | - | 33 | 6.67 | 4.226 | 65-125 | 25 |
| Aroclor 1260 | 11096-82-5 | **240** | - | - | 33 | 6.67 | 2.925 | 53-140 | 25 |
| Aroclor 1262 | 37324-23-5 | - | - | - | 33 | 6.67 | 2.925 | 30-135 | 25 |
| Aroclor 1268 | 11100-14-4 | - | - | - | 33 | 6.67 | 2.4416 | 70-125 | 25 |
| Total PCBs | 1336-36-3 | - | - | **100** | 33 | 6.67 | 2.925 | 45-140 | 25 |

NOTE - These (Method Detection Limit – MDL and Limit of Quantitation – LOQ) were obtained from RTI Laboratories RTI Labs (2016) and are meant to be recommended project values.
The QA/QC criteria presented in this table reflect the most recently promulgated values as reported by the laboratory.
The PSL references for soil are: CP-51 = NYSDEC Commissioner Policy-51 Soil Cleanup Guidance, NYSDEC CP-51 Petroleum Impacted Soil Guidance or, Residential RSL – USEPA Regional Screening Level for Soil (November 2015).
Bold indicated the most conservative of the screening criteria

## Worksheet #15.7a Reference Limits and Evaluation
## Thallium by SW-846 Method 6020A (Aqueous)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | MCL | NYDEC TOGS-Drinking Water | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous | Aqueous |
| | | µg/l | µg/L | µg/l | µg/l | µg/l | µg/l | % | RPD< |
| Thallium | 7440-28-0 | **0.2** | 2.0 | 0.5 | 2 | 0.5 | 0.165 | 82-116 | 20 |

NOTE - These (Method Detection Limit – MDL and Limit of Quantitation – LOQ) were obtained from RTI Laboratories RTI Labs (2016) and are meant to be recommended project values.
The QA/QC criteria presented in this table reflect the most recently promulgated values as reported by the laboratory.
The PSL references are MCLs, RSLs, or either TOGS 1.1.1 =NYSDEC Technical and Operational Guidance 1.1.1 Ambient Water Quality Standards and Guidance Values, or Tapwater based on the USEPA Regional Screening Level for Water (November 2015).
Bold indicated the most conservative of the screening criteria.

## Worksheet #15.7b Reference Limits and Evaluation
## Thallium by SW-846 Method 6020A (Soil)

| Analyte | CAS Number | Project Screening Levels | | | Achievable Laboratory Limits | | | Precision and Accuracy Method Performance Criteria | |
|---|---|---|---|---|---|---|---|---|---|
| | | RSLs | NYDEC CP-51 Unrestricted Use | NYSDEC ELC 376-6 Soil Cleanup Objectives | LOQ | LOD | MDL | LCS/MS/MSD Recovery Limits | LCS/MS/MSD Precision |
| | | Soil | Soil | Soil | Soil | Soil | Soil | Soil | Soil |
| | | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | µg/kg | % | RPD< |
| Thallium | 7440-28-0 | 780 | **5.0** | - | 100 | 50 | 48.44 | 80-120 | 20 |

NOTE - These (Method Detection Limit – MDL and Limit of Quantitation – LOQ) were obtained from RTI Laboratories RTI Labs (2016) and are meant to be recommended project values.
The QA/QC criteria presented in this table reflect the most recently promulgated values as reported by the laboratory.
The PSL references for soil are: CP-51 = NYSDEC Commissioner Policy-51 Soil Cleanup Guidance, NYSDEC CP-51 Petroleum Impacted Soil Guidance or, Residential RSL – USEPA Regional Screening Level for Soil (November 2015).
Bold indicated the most conservative of the screening criteria

## Worksheet #16 Project Schedule/Timeline Table

The project schedule is included under Section 1-4 of the WP. The following table presents a summary of the RI WP and RI WP Addendum, field investigations (Phase I and Phase II), and reporting schedule.

| Activities | Dates | | Deliverable |
|---|---|---|---|
| | Anticipated Date(s) of Initiation | Anticipated Date of Completion | |
| Prepare RI WP, SAP (with QAPP), and APP (with SSHP) | December 2015 | May 2016 | RI WP |
| RI Field Operations – Phase 1 | June 2016 | June 2016 | None |
| Laboratory Analysis | July 2016 | July 2016 | None |
| RI WP Addendum | July 2016 | August 2016 | RI WP Addendum |
| RI Field Operations – Phase 2 | September 2016 | September 2016 | None |
| Laboratory Analysis | October 2016 | November 2016 | None |
| Prepare RI Report | September 2016 | August 2017 | RI Report |

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## Worksheet #17 Sampling Design and Rationale

### 17.1 Sampling Objective

The overall objective of the Camp Hero RI field efforts is to characterize the nature and extent of contamination. As noted previously in Worksheet #10, impacts from COPC to the soil and groundwater at the Former Camp Hero site have not been fully understood and identified. These data gaps prevent a complete characterization of the nature and extent of COPCs at the site.

### 17.2 Data Needs

Data needed to characterize the impacts from the activities at the Former Camp Hero include geophysical and visual surveys of select AOCs such as the drum disposal areas, soil and groundwater analytical data from the AOCs, ,analytical data from select background locations, concrete chip samples and wipe samples for PCB analysis, and characterization of liquids that may be present in buildings, transformers (Building 107, for example), or present in drums (AOCs H1, H2, and H3, for example).

### 17.3 Sampling Scope

The field sampling and analysis tasks that will be conducted at the Former Camp Hero site achieve project objectives and fill data needs include:

- Collection of surface and subsurface soil samples using direct-push technology (DPT);
- Collection of grab groundwater samples from temporary well points;
- Collection of groundwater samples from existing potable water wills and monitoring wells;
- Collection of wipe samples and concrete chip samples;
- Installation and development of permanent monitoring wells (Phase 2 only), followed by collection of groundwater samples from permanent monitoring wells (Phase 2 only);
- Test pitting to identify subsurface anomalies (Phase 2 only, if necessary);
- Collection of surface water and sediment samples (Phase 2 only, if necessary); and
- Analysis of soil and groundwater samples for VOCs, SVOCs (including PAHs), metals, PCBs, and/or explosives/energetics. See Table 2-1 of the SAP for additional information on the analytical requirements for each AOC.

The field sampling activities will be conducted in two separate phases:

- An initial phase (Phase I) including soil sampling to resolve sub-area horizontal and vertical COPC data gaps based on historical documentation, and one round of groundwater sampling of existing site monitoring wells and the newly installed temporary wells; to confirm the presence or absence of suspected CERCLA DoD waste at an AOC; and,

- An addendum to this WP will be prepared summarizing the results from the Phase 1 sampling event and outlining the activities to be conducted during the Phase 2 event which will characterize the nature and extent of contamination at AOCs where COPCs were detected at concentrations that may impact human health and the environment.

**Worksheet #18 Sampling Locations and Methods/SOP Requirements Table**

The soil and groundwater sample locations for each AOC are presented in Section 2.0_of the WP. See Worksheet #21 for additional details on project sampling procedures including SOPs.

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## Worksheet #19 Analytical SOP Requirements Table

Worksheet #19 is used to provide the project-specific sample containers, preservation, and holding time requirements. Sample containers will be certified pre-cleaned according to EPA protocols. The purity of preservation chemicals will be guaranteed by the manufacturer.

Field sampling personnel will obtain sample containers from vendors who specialize in environmental sampling supplies and will inspect them prior to use. Containers that have not been pre-cleaned according to EPA protocols or do not meet the requirements of Worksheet #19 will not be used and will be discarded. Each sample will be collected into a new, unused container.

| Matrix | Analytical Group | Analytical and Preparation Method/SOP Reference | Containers (Number, Size, and Type) | Sample Volume (Units) | Preservation Requirements (Chemical, Temperature, Light Protected) | Maximum Holding Time (Preparation/ Analysis) |
|---|---|---|---|---|---|---|
| Soil | VOCs | 8260C_010815_R9_1_v2 | 4-40 ml VOA Vial | 3 – 5 g<br>1 - 10 g | <6° C , DI water, Sodium bisulfate (2), Methanol | 14 days |
| | SVOCs SIM | 3550C_040215_R9.2<br>3546_010616_R2_v1<br>8270D_110713_R13_v1 | 1-125 ml Glass | 100 g | <6° C, light protected | 14 days to extraction, 40 days post extraction |
| | Metals | 3050_110512_R11<br>6010C_100713_R3.2_4_v1<br>6020_081313_R11_v1<br>7470A_7471A_022014_R7 | 1-125 ml Glass | 30 g | <6° C | 180 days<br>28 days Hg |
| | Polychlorinated biphenyls | 8081_8082_030314_R10_v1 | 1-125 ml Glass | 100 g | <6° C, light protected | 365 days to extraction, 365 days post extraction |
| | Explosives/Energetics | 8330B_030615_R5_r1 | 1-125 ml Glass | 50 g | <6° C, light protected | 14 days |

## Worksheet #19 Analytical SOP Requirements Table (Continued)

| Matrix | Analytical Group | Analytical and Preparation Method/SOP Reference | Containers (Number, Size, and Type) | Sample Volume (Units) | Preservation Requirements (Chemical, Temperature, Light Protected) | Maximum Holding Time (Preparation/ Analysis) |
|---|---|---|---|---|---|---|
| IDW Soil | TCLP | 1311_030514_R5.1<br>1311ZHE_030514_R3.1 | 2- 8 oz. (250 ml) Glass | 200 g | <6° C, light protected | 14 days to TCLP preparation – analysis holding times according to analytical group for waters above. |
| | Ignitability | 1010A_051812_R3 | 1-125 ml Glass | 100 g | <6° C, light protected | Not established |
| | Corrosivity - pH | 4500 H-B_050912_R3 | 1-125 ml Glass | 50 g | <6° C | Not established |
| | Reactivity | No method available | 1-125 ml Glass | 100 g | <6° C | Not established |
| Water | VOCs | 8260C_010815_R9_1_v2 | 2-40 ml VOA Vials | 80 ml | <6° C , HCl | 14 days |
| | SVOCs SIM | 3510C_022814_R8<br>8270D_110713_R13_v1 | 2-1 L Amber glass | 2 L | <6° C, light protected | 14 days to extraction, 40 days post extraction |
| | Metals | 3020A_050313_R11_2<br>6010C_100713_R3.2_4_v1<br>6020_081313_R10_v2<br>7470A_7471A_022014_R7 | 1-250 ml plastic | 250 ml | <6° C , HNO3 | 180 days<br>28 days Hg |
| | Polychlorinated biphenyls | 8081_8082_030314_R10 | 2-1 L Amber glass | 2000 ml | <6° C, light protected | 365 days to extraction, 365 days post extraction |
| | Explosives/ Energetics | 8330B_030615_R5 | 2-1 L Amber glass | 1 L | <6° C, light protected | 14 days to extraction, 40 days post extraction |

## Worksheet #19 Analytical SOP Requirements Table (Continued)

| Matrix | Analytical Group | Analytical and Preparation Method/SOP Reference | Containers (Number, Size, and Type) | Sample Volume (Units) | Preservation Requirements (Chemical, Temperature, Light Protected) | Maximum Holding Time (Preparation/ Analysis) |
|---|---|---|---|---|---|---|
| IDW Water | TCLP | 1311_030514_R5.1<br>1311ZHE_030514_R3.1 | 2 L Amber glass | 2000ml | <6° C, light protected | 14 days to TCLP preparation – analysis holding times according to analytical group for waters above. |
| | Ignitability | 1010A_051812_R3 | 1-125 ml Glass | 100 ml | <6° C, light protected | Not established |
| | Corrosivity - pH | 4500 H-B_050912_R3 | 1-125 ml Plastic | 50 ml | <6° C | Not established |
| | Reactivity | No method available | 1-125 ml Glass | 100 ml | <6° C | Not established |
| Concrete | Polychlorinated biphenyls | 8081_8082_030314_R10_v1 | 1-125 ml Glass | 30 g | <6° C, light protected | 365 days to extraction, 365 days post extraction |
| Wipe | Polychlorinated biphenyls | 8081_8082_030314_R10_v1 | 1-125 ml Glass w/hexane saturated gauze | NA | <6° C, light protected | 365 days to extraction, 365 days post extraction |

* Laboratory specific analytical SOP
[1] The reference analytical methods associated with these SOPs can be found in Worksheet #23
[2] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

## Worksheet #20 Field Quality Control Sample Summary Table

| Matrix | Analytical Group | Analytical and Preparation SOP Reference[1] | No. of Field Duplicate Pairs | No. of MS/MSD |
|---|---|---|---|---|
| Aqueous | SVOCs SIM | 8270D_110713_R13_v1 | 1 per 10 samples | 1 per 20 samples |
| Soil | SVOCs SIM | 3550C_022814_R8_v1 | 1 per 10 samples | 1 per 20 samples |
| Aqueous | VOCs | 8260C_010815_R9_1_v2 | 1 per 10 samples | 1 per 20 samples |
| Soil | VOCs | 8260C_010815_R9_1_v2 | 1 per 10 samples | 1 per 20 samples |
| Aqueous | PCBs | 8081_8082_030314_R10_v1 | 1 per 10 samples | 1 per 20 samples |
| Soil | PCBs | 8081_8082_030314_R10_v1 | 1 per 10 samples | 1 per 20 samples |
| Aqueous | Metals | 6010C_100713_R3.2_4_v1 | 1 per 10 samples | 1 per 20 samples |
| Soil | Metals | 6010C_100713_R3.2_4_v1 | 1 per 10 samples | 1 per 20 samples |
| Aqueous | Thallium | 6020_081313_R11_v1 | 1 per 10 samples | 1 per 20 samples |
| Soil | Thallium | 6020_081313_R11_v1 | 1 per 10 samples | 1 per 20 samples |
| Aqueous | Explosives/Energetics | 8330B_030615_R5_r1 | 1 per 10 samples | 1 per 20 samples |
| Soil | Explosives/Energetics | 8330B_030615_R5_r1 | 1 per 10 samples | 1 per 20 samples |

Notes:
[1]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23 ).
MS/MSD matrix spike/matrix spike duplicate

## Worksheet #21 Project Sampling Procedures References Table

| Reference Number | Title, Revision Date, and/or Number | Originating Organization | Equipment Type | Modified for Project Work? (Y/N) | Comments |
|---|---|---|---|---|---|
| 1 | *SAP Section 3.11 for Grab Groundwater Sampling* | AECOM | Peristaltic pump, tubing, water quality meter, water level meter | N | See SAP for detailed sampling methodology |
| 2 | *SAP Section 3.11 for Low-Flow Groundwater Sampling* | AECOM | Pump, pump controller, tubing, water quality meter, water level meter | N | See SAP for detailed sampling methodology |
| 3 | *SAP Section 3.11 – Surface and Sub-surface Soil Sampling* | AECOM | DPT drill rig or hand auger, coring barrel with dedicated sleeve | N | See SAP for detailed sampling methodology |
| 4 | *SAP Section 3.17 Investigation Derived Waste* | AECOM | Bailer or drum thief | N | See SAP for detailed sampling methodology |
| 5 | *SOP 3-02 Logbooks (Field Documentation)* | AECOM | Field logbook and field forms | N | See SOP for detailed procedures |
| 6 | *SOP 3-03 Field Sample Numbering SAP Section 3.13* | AECOM | Sample labels, pen with indelible ink, and sample attribute forms | N | See SAP or SOP for detailed procedures |
| 7 | *SOP G-4 Quality Assurance/Quality Control Sampling; SAP Section 3.12* | AECOM | ASTM Type II reagent-grade water | N | See SOP for detailed procedures |
| 8 | *SOP 3-06 Decontamination* | AECOM | Plastic sheeting, buckets, potable water, DI water, isopropanol, nitric acid | N | See SOP for detailed procedures |
| 9 | *SOP 3-05 Management of IDW* | AECOM | DOT-approved drums or other containers, 5 gallon buckets, PID, labeling material | N | See SOP for detailed procedures |
| 10 | *SOP 3-03 Sample Chain-of-Custody* | AECOM | Chain of Custody (COC) forms, plastic resealable bags, COC seals, labels, pens, tape | N | See SOP for detailed procedures |
| 11 | *SOP 3-04 Sample Packing and Shipping* | AECOM | COC, custody seals, ice, cooler, resealable bags, bubble wrap, air bills | N | See SOP for detailed procedures |
| 12 | *SOP 3-07 Surveying* | AECOM | Surveying equipment | N | See SOP for detailed procedures |
| 13 | *SOP 3-17 Soil Sampling Using Direct-Push Technology* | AECOM | DPT drill rig, field logbook, ruler, tape measure, grain size chart, Munsell color chart, sapling device, trowels, bowls | N | See SOP for detailed procedures |

## Worksheet #21 Project Sampling Procedures References Table (Continued)

| Reference Number | Title, Revision Date, and/or Number | Originating Organization | Equipment Type | Modified for Project Work? (Y/N) | Comments |
|---|---|---|---|---|---|
| 14 | *SOP 3-21 Soil Sampling* | AECOM | Sampling trowels, PID stainless steel bowls, field logbook, flagging, sample jars | N | See SOP for detailed procedures |
| 15 | *SOP 3-15 Borehole/Well Abandonment* | AECOM | Plastic sheeting, buckets, water | N | See SOP for detailed procedures |
| 16 | *SOP 3-14 Low Stress (Low Flow) Groundwater Purging and Sampling* | AECOM | Submersible pump, tubing, water level meter, water quality meter, power source | N | See SOP for detailed procedures |
| 17 | *SOP 3-12 Groundwater Monitoring Well Installation* | AECOM | DPT drill rig, PID, water level meter, water quality meter, well screen, casing, riser, submersible pump | N | See SOP for detailed procedures |
| 18 | *SOP 3-13 Water Level and Well Depth Measurements* | AECOM | Water level meter, PID, field logbook | N | See SOP for detailed procedures |

## Worksheet #22 Field Equipment Calibration, Maintenance, Testing, and Inspection Table

| Field Equipment | Calibration / Inspection Activity | Maintenance Activity | Testing Activity | Inspection Activity | Frequency | Acceptance Criteria | Corrective Action | Responsible Person | Sampling Procedure Reference |
|---|---|---|---|---|---|---|---|---|---|
| pH probe (YSI) | Calibrate daily using auto-calibration standard solutions<br>Calibration check at the end of the day | NA | NA | NA | Daily before use, at the end of the day, and when drift is identified or suspected or readings are unstable | pH reads <=0.2 Standards of 4.0, 7.0, or 10.0 (at least 2 of 3) | Clean probe with deionized water and recalibrate. Do not use if unable to calibrate properly | Field Team Leader | 1, 2 |
| Specific conductance probe (YSI) | Calibrate daily using auto-calibration standard solutions<br>Calibration check at the end of the day | NA | NA | NA | Daily before use, at the end of the day, and when drift is identified or suspected or readings are unstable | Conductivity is uS ± 3% of standard solution | Clean probe with deionized water and recalibrate. Do not use if unable to calibrate properly | Field Team Leader | 1, 2 |
| Oxidation-reduction potential probe (YSI) | Calibrate daily using auto-calibration standard solutions<br>Calibration check at the end of the day | NA | NA | NA | Daily before use, at the end of the day, and when drift is identified or suspected or readings are unstable | Within calibration range | Clean probe with deionized water and recalibrate. Do not use if unable to calibrate properly | Field Team Leader | 1, 2 |
| Turbidity probe (YSI) | Calibrate daily using auto-calibration standard solutions<br>Calibration check at the end of the day | NA | NA | NA | Daily before use, at the end of the day, and when drift is identified or suspected or readings are unstable | Std = 11-40 NTU, < ± 8% Std = 41-100 NTU, < ± 6.5% Std > 100 NTU, < ± 5% | Clean probe with deionized water and recalibrate. Do not use if unable to calibrate properly | Field Team Leader | 1, 2 |

## Worksheet #22 Field Equipment Calibration, Maintenance, Testing, and Inspection Table (continued)

| Field Equipment | Calibration / Inspection Activity | Maintenance Activity | Testing Activity | Inspection Activity | Frequency | Acceptance Criteria | Corrective Action | Responsible Person | Sampling Procedure Reference |
|---|---|---|---|---|---|---|---|---|---|
| Temperature and dissolved oxygen (DO) probes (YSI) | Calibration check at the end of the day | NA | During calibration of instrument, check temperature and DO against ambient | NA | Daily before use, at the end of the day, and when drift is identified or suspected or readings are unstable | Calibrate at saturation with acceptance criteria of ± 0.3 mg DO/L | Clean probe with deionized water and recalibrate. Do not use if unable to calibrate properly | Field Team Leader | 1, 2 |
| MiniRAE 3000 PID | Calibrate for organic vapors using standard gas | Charge battery, allow complete discharge before recharging | Self-Test; Test against standard gas during use | NA | Daily before use and as needed during day | NA | Replace with another unit | Field Team Leader | 1, 2, 3 |
| Groundwater sampling pumps and tubing | NA | NA | NA | NA | Regularly | Maintain in good working order per manufacturer instructions | Replace items | Field Team Leader | 1, 2 |

## Worksheet #23 Analytical SOP References Table

| Lab SOP Number | Title, Revision Date, and/or Number | Definitive or Screening Data | Analytical Group | Instrument | Organization Performing Analysis | Modified for Project Work? (Y/N) |
|---|---|---|---|---|---|---|
| 8260C_010815_R9_1_v2 | ANALYSIS OF VOLATILE ORGANIC COMPOUNDS by GCMS Revision 9, 01/8/2015 | Definitive | Soil/Water – Volatile Organic Compounds | GC/MS | RTI | N |
| 3550C_022814_R8_v1 | SONICATION EXTRACTION PROCEDURE FORSEMI – VOLATILE ORGANICS Revision 8 02/282014 | Preparation | Soil - Semi-Volatile Organic Compounds | Prep | RTI | N |
| 3510C_022814_R8_1_v1 | LIQUID-LIQUID EXTRACTION PROCEDURE FOR SEMI – VOLATILE ORGAINC COMPOUNDS Revision 8 08/28/2014 | Preparation | Water - Semi-Volatile Organic Compounds | Prep | RTI | N |
| 8270D_110713_R13_v1 | ANALYSIS OF SEMI-VOLATILE ORGANIC COMPOUNDS GCMS Revision 13, 11/7/2013 | Definitive | Soil/Water – Semi-Volatile Organic Compounds | GC/MS | RTI | N |
| 3050_110512_R11_v2 | ACID DIGESTION OF SOLID SAMPLESFOR THE ANALYSIS OF TOTAL METALS Revision 11, 11/5/2012 | Preparation | Soil – Metals | Prep | RTI | N |
| 6010C_100713_R3.2_4_v1 | ANALYSIS OF ELEMENTS BYINDUCTIVELY COUPLED PLASMA - OPTICAL EMISSION SPECTROMETRY (ICP-OES) Revision 3.2, 8/11/2014 | Definitive | Water/Soil/TCLP – Metals | ICP/OES | RTI | N |
| 3010A_081114_R0_v1 | ACID DIGESTION OF AQUEOUS SAMPLES FOR THE ANALYSIS OF TOTAL METALS | Preparation | Water – Metals | ICP/MS | RTI | N |
| 3020A_050313_R11_2_v1 | ACID DIGESTION OF AQUEOUS SAMPLES FOR THE ANALYSIS OF TOTAL METALS Revision11, 5/3/2013 | Preparation | Water – Metals | ICP/MS | RTI | N |

## Worksheet #23 Analytical SOP References Table (Continued)

| Lab SOP Number | Title, Revision Date, and/or Number | Definitive or Screening Data | Analytical Group | Instrument | Organization Performing Analysis | Modified for Project Work? (Y/N) |
|---|---|---|---|---|---|---|
| 6020_081313_R10_v2 | ANALYSIS OF ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY (ICP/MS) Revision 10, 8/13/2013 | Definitive | Water – Metals | ICP/MS | RTI | N |
| 8081_8082_030314_R10_v1 | ANALYSIS OF PESTICIDES AND POLYCHLORINATED BIPHENYLS (PCBs) Revision 10, 03/3/2014 | Definitive | Soil/Water – PCBs | GC/ECD | RTI | N |
| SW-846 8015D | Nonhalogenated Organics | Definitive | Soil/Water – Nonhalogenated Organics | GC/FID | RTI | N |
| 8330B_030615_R5 | ANALYSIS OF EXPLOXIVES BY HPLC Revision 3, 2/6/2015 | Definitive | Soil/Water – Energetics/Explosives | HPLC/UV | RTI | N |

Notes:
CVAA Cold vapor atomic absorption
ECD Electron capture detector
EPA Environmental Protection Agency, United States
GC Gas Chromatograph
GC/MS Gas Chromatograph/Mass Spectrometry
ICP Inductively Coupled Plasma

## Worksheet #24 Analytical Instrument Calibration Table

Identify all analytical instrumentation that requires calibration and provide the SOP reference number for each. In addition, document the frequency, acceptance criteria, and corrective action requirements on the worksheet.

| Instrument | Calibration Procedure | Frequency of Calibration | Acceptance Criteria | Corrective Action | Personnel Responsible for Corrective Action | SOP Reference |
|---|---|---|---|---|---|---|
| Agilent 5890/5972 (2), 6890/5973 (3) P&T GCMS | SW846 5035/8260C | As needed – on unacceptable CCV | <15% RSD, <30%RSD CCC compounds. cc>0.99 | Instrument maintenance as required | GCMS Analyst | 8260C_010815_R9_1_v2 |
| Agilent 6890/5973 (2), 7890/5975 GCMS | SW846 8270D | As needed – on unacceptable CCV | <20% RSD. cc>0.99 | Instrument maintenance as required | GCMS Analyst | 8270D_110713_R13_v1 |
| Perkin-Elmer ELAN DRC-e ICP/MS | SW846 6020A | Daily or each analytical event | cc>0.995 | Instrument maintenance as required | ICP/MS Analyst | 6020_081313_R10_v2 |
| Perkin-Elmer Optima 8300 ICP/OES | SW846 6010C | Daily or each analytical event | cc>0.995 | Instrument maintenance as required | ICP/OES Analyst | 6010C_100713_R3.2_4_v1 |
| Varian 3400 w/ dual ECD, HP5890 GC, HP6890 GC, HP 6890N GC | SW846 8081A, 8082A | As needed – on unacceptable CCV | cc>0.99 <20% RSD | Instrument maintenance as required | GC Analyst | 8081_8082_030314_R10_v1 |
| Agilent 1100 Series. Waters Acquity UPLC | SW 846 8330A | As needed – on unacceptable CCV | cc>0.99 | Instrument maintenance as required | GC Analyst | 8330B_022114_R4.1_v2 |
| Cetac M-6000a CVAA | SW846 7470A, 7471A | Daily or each analytical event | cc>0.995 | Instrument maintenance as required | Hg Analyst | 7470A_7471A_022014_R7_v1 |
| Agilent 6890, FID | SW8015 | As needed – on unacceptable CCV | $r^2$>0.99 <20% RSD | Instrument maintenance as required | GC Analyst | SW8015 |

[±]Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

Notes:

| | |
|---|---|
| AA | Atomic Absorption |
| CVAA | cold vapor atomic absorption |
| CCV | continuing calibration verification |
| ECD | electron capture detector |
| FID | flame ionization detector |
| IC | initial calibration |
| ICP | Inductively coupled plasma |
| ICV | initial calibration verification |
| SOP | standard operating procedure |
| GC | Gas Chromatograph |
| GC/MS | Gas Chromatograph/Mass Spectrometer |
| HPLC | High Performance Liquid Chromatography |
| OES | Optical Emission Spectroscopy |
| UPLC | Ultra-Performance Liquid Chromatography |

## Worksheet #25 Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

| Instrument/ Equipment | Maintenance Activity | Testing Activity | Inspection Activity | Frequency | Acceptance Criteria | Corrective Action | Responsible Person | SOP Reference |
|---|---|---|---|---|---|---|---|---|
| GCMS | Daily/Regular as specified | SW846 5035/8260C | Instrument operating parameters | Daily | Per SOP | Recalibrate/stop for service on failure | RTI/GCMSVOC Analyst | 8260C_010815_R9_1_v2 |
| GCMS | Daily/Regular as specified | SW846 8270D | Instrument operating parameters | Daily | Per SOP | Recalibrate/stop for service on failure | RTI/GCMSSVOC Analyst | 8270D_110713_R13_v1 |
| ICPMS | Daily/Regular as specified | SW846 6020A, | Instrument operating parameters | Daily | Per SOP | Recalibrate/stop for service on failure | RTI/ICPMS Analyst | 6020_081313_R10_v2 |
| ICPOES | Daily/Regular as specified | SW846 6010C | Instrument operating parameters | Daily | Per SOP | Recalibrate/stop for service on failure | RTI/ICPOES Analyst | 6010C_100713_R3.2_4_v1 |
| GCECD | Daily/Regular as specified | SW846 8081A, 8082A, 8151A | Instrument operating parameters | Daily | Per SOP | Recalibrate/stop for service on failure | RTI/GCSVOC Analyst | 8081_8082_030314_R10_v1 |
| UPLC/HPLC | Daily/Regular as specified | SW846 8330A | Instrument operating parameters | Daily | Per SOP | Recalibrate/stop for service on failure | RTI/UPLC/HPLC Analyst | 8330B_022114_R4.1_v2 |
| GCFID | Daily/Regular as specified | SW846 8015D | Instrument operating parameters | Daily | Per SOP | Recalibrate/stop for service on failure | RTI/GC Analyst | SW8015D |
| CVAA | Daily/Regular as specified | SW846 7471A, 7470A | Instrument operating parameters | Daily | Per SOP | Recalibrate/stop for service on failure | RTI/CVAA Analyst | 7470A_7471A_022014_R7_v1 |

Notes:
CVAA Cold Vapor Atomic Absorption
GC Gas Chromatograph
GC/MS Gas Chromatograph/Mass Spectrometer
HPLC High Performance Liquid Chromatography
ECD Electron capture detector
ICP Inductively coupled plasma
OES Optical Emission Spectroscopy
UPLC Ultra Performance Liquid Chromatography

## Worksheet #26 Sample Handling System

| **Sample Collection, Packaging, and Shipment** |
|---|
| Sample Collection: (Field Sampling Team Leader) / AECOM |
| Sample Packaging: / AECOM |
| Coordination of Shipment: / AECOM |
| Type of Shipment/Carrier: FedEx – Priority Overnight |
| **Sample Receipt and Analysis** |
| Sample Receipt: Kathy Griffin (Sample Control Supervisor) / RTI Laboratories |
| Sample Custody and Storage: Kathy Griffin / RTI Laboratories |
| Sample Preparation: Kathy Griffin (Operations Manager) / RTI Laboratories |
| Sample Determinative Analysis: Analytical Staff / RTI Laboratories |
| **Sample Archiving** |
| Field Sample Storage (No. of days from sample analysis): 60 days |
| Sample Extract/Digestate Storage (No. of days from extraction/digestion): 60 days |
| **Sample Disposal** |
| Personnel/Organization: Sample Disposal Staff / RTI Laboratories |
| Number of Days from Analysis: 60 days |

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## Worksheet #27 Sample Custody Requirements

### 27.1 Field Sample Custody Procedures (Sample Collection, Packaging, Shipment, and Delivery to Laboratory)

Sample handling, transport, and storage will be performed in accordance with UFP QAPP, *Sample Collection Documentation, Handling, Tracking, and Custody Procedures* (UFP QAPP, 2005). Sample custody activities will adhere to the requirements specified in the ASTM document *D4840-99 Standard Guide for Sampling Chain-of-Custody Procedures* contains information regarding chain-of-custody procedures. Samples will be placed in a cooler immediately upon collection and then transported to the laboratory within 24 to 48 hours of collection via an overnight carrier (e.g., DHL, FedEx, or Worldwide Express).

Insulated coolers will be used to store and ship the sample containers. Coolers will be chilled with ice in double, sealable bags. Samples will be placed in the lower portion of the cooler, and the ice packs will occupy the upper portion of the cooler. Material such as Styrofoam pads will line the top and bottom interior of the cooler (pads may also be placed on the sides at the discretion of field personnel). In the case of liquid samples, an absorbent material will be placed on the bottom of the cooler to help contain inadvertent spillage. Glass containers will be individually wrapped in bubble-wrap or other padded material to prevent breakage. Empty spaces between containers should be filled with "peanuts" or other appropriate padded material. To prevent leakage, water sample containers will be packed in an upright position—not on their sides or stacked. Ice will be replaced at the time of shipment to keep the inside temperature of the cooler as close to 4 degrees Celsius (°C) as possible. Additional details on sample packing are presented in Section 6.0 of the SAP and SOP G-9 of the Final Site-Wide UFP-QAPP (USACE, 2014).

***Hazardous Materials Shipment.*** Hazardous materials, as defined by the DOT, include petroleum hydrocarbons and solvents if they are present in concentrations considered to be hazardous. Samples to be collected during this RI are not anticipated to contain hazardous concentrations of these materials. Samples from this investigation are considered nonhazardous environmental media based on historical descriptions and may be shipped as nonhazardous.

***Sample Custody.*** Sample custody procedures to be followed will be those established in ASTM document *D4840-99 Standard Guide for Sampling Chain-of-Custody Procedures,* and *Sample Collection Documentation, Handling, Tracking, and Custody Procedures* (UFP QAPP, 2005).

All sample lids and caps will be covered with custody seals. Two copies of the COC forms will be placed in an adhesive plastic pouch and affixed to the inside of each sample cooler. The coolers will then be sealed with waterproof tape and labeled "Fragile," "This End Up" (with directional arrows pointing up), or other appropriate notices. Coolers will also have custody seals placed on them

according to *Sample Collection Documentation, Handling, Tracking, and Custody Procedures* (UFP QAPP, 2005).

## 27.2 Laboratory Sample Custody Procedures (Receipt of Samples, Archiving, Disposal)

Upon laboratory receipt of the coolers, the lab technician will inspect the sample containers in accordance with *Sample Collection Documentation, Handling, Tracking, and Custody Procedures* (UFP QAPP 2005). The samples will either be removed from the containers for analysis or placed in a refrigerated storage area until they are analyzed.

A list of analyses to be performed and a space to record sample condition upon receipt are located on the COC form. The sample custodian will sign the COC form and record the temperature of the samples or cooler on the COC form and on the Sample Condition Upon Receipt form. In case of breakage or discrepancies between the COC form, sample labels, or requested analysis, the sample custodian will notify the Laboratory Project Manager. A nonconformance report will be completed, and the Project Chemist will be notified within 24 hours. At the time of notification, corrective action will be chosen. The Sample Custodian will enter sample information into the laboratory system, and a log-in confirmation sheet will be sent to the Project Chemist within 48 hours. The laboratory will send the Project Chemist a written declaration of the samples in each sample delivery group.

## 27.3 Sample Identification Procedures

A sample numbering system is used to uniquely identify each sample collected and submitted for analysis. The purpose of the numbering system is to assist in the tracking of samples and facilitate retrieval of analytical results. Sample identification numbers should be used on sample labels, COC forms, field logbooks, and all other applicable documentation. A listing of all sample identification numbers should be recorded in the field logbook along with the depth of samples if collected in the subsurface. A more detailed explanation of the sample identification procedures will be found in section 2 of the SAP.

## 27.4 COC Procedures

COCs will be completed in the field according to *Sample Collection Documentation, Handling, Tracking, and Custody Procedures* (UFP QAPP, 2005) and SOP 3-04, referenced in the SAP, of the Final Site-Wide UFP-QAPP (USACE, 2014). COCs will remain with the samples until delivery to the laboratory. A record of all procedures to which a sample is subjected while in possession of the laboratory shall be maintained, in accordance Section 4.12, *Control of Records*, of the DoD QSM version 5.0 (DoD, 2013), including the following:

1. Sample preservation including appropriateness of sample container and compliance with holding time requirement.

2. Sample identification, receipt, acceptance or rejection and log-in.

3. Sample storage and tracking including shipping receipts, sample transmittal forms (COC form); and documented procedures for the receipt and retention of samples, including all provisions necessary to protect the integrity of samples.

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## Worksheet #28.1: QC Samples Table

Matrix: Water/Soil /TCLP extracts
Analytical Group: SVOC SIM/PNA
Concentration Level: Low-Medium
Sampling SOP: See Worksheet #21
Analytical Method / SOP Reference: EPA Method 8270D/8270D_072312_R13_v1
Samplers Name: TBD
Field Sampling Organization: AECOM
Analytical Organization: RTI Laboratories
No. of Sampling Locations: See Worksheet #18

| QC Sample | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Action | Data Quality Indicator | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Method Blank | One per batch of 20 or less samples | < ½ LOQ | Correct problem and then see criteria in DoD QSM 5.0. If required, re-prepare and reanalyze method blank and all samples processed with the contaminated blank. | Lab Analyst/Data Reviewer | Contamination (Accuracy/Bias) | < ½ LOQ |
| Laboratory Control Spike (LCS) | One per batch of 20 or less samples | % Recovery QSM 5.0 Limits Appendix C | Correct problem, Re-prepare and re-analyze affected samples | Lab Analyst/Data Reviewer | Accuracy | % Recovery QSM 5.0 Limits |
| Matrix Spike (MS) | One per batch of 20 or less samples | % Recovery QSM 5.0 Limits Appendix C | Investigate, consult with client and record matrix issues in case narrative | Data Reviewer | Accuracy | % Recovery QSM 5.0 Limits |
| Matrix Spike Duplicate (MSD) | One per batch of 20 or less samples | % Recovery, RPD QSM 5.0 Limits Appendix C | Investigate and record in case narrative | Data Reviewer | Precision and Accuracy | % Recovery, RPD QSM 5.0 Limits |
| Initial Calibration (ICAL) | As needed on unacceptable ICV/CCV | Consistent with QSM 5.0 Appendix B Table 4 | Correct problem and repeat ICAL | Lab Analyst | Instrument Performance | Consistent with QSM 5.0 Appendix B |

## Worksheet #28.1: QC Samples Table (continued)

| QC Sample | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Action | Data Quality Indicator | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Initial Calibration Verification (ICV) | Once after each ICAL | Consistent with QSM 5.0 Appendix B Table 4 | Correct problem, verify second source standard and rerun. If necessary repeat ICAL | Lab Analyst | Instrument Performance | Consistent with QSM 5.0 Appendix B |
| Continuing Calibration Verification (CCV) | Daily before sample analysis and every 12 hours of analysis and at the end of the analytical sequence | Consistent with QSM 5.0 Appendix B Table 4 | Correct problem and rerun. If necessary repeat ICAL | Lab Analyst | Instrument Performance | Consistent with QSM 5.0 Appendix B |
| Internal Standards | Each Sample and QC Sample | Area -50% - +100% | Re-analyze to confirm matrix interferences and note on Case Narrative | Lab Analyst | Sensitivity | Area -50% - +100% |
| RLVS | Each analytical event | 70 – 130% | Correct problem and re-analyzed samples | Lab Analyst | Sensitivity | 70 – 130% |
| Field Duplicate | 10% | < 40% for surface and ground water<br>< 70% for soil and sediment | Investigate and re-train if necessary | AECOM QA Manager | Precision | < 40% for surface and ground water<br>< 70% for soil and sediment |

RL = Reporting Limit
RPD = Relative Percent Difference
MS = Matrix Spike
MSD = Matrix Spike Duplicate
QSM = Quality Services Manual
LCS = Laboratory Control Spike
RLVS =Reporting Limit Verification Standard

## Worksheet #28.2: QC Samples Table

Matrix: Water Soil /TCLP Extracts
Analytical Group: PCBsConcentration Level: Low-Medium
Sampling SOP: See Worksheet #21
Analytical Method / SOP Reference: EPA Method 8081B/ 8081_8082_030314_R10
Samplers Name: TBD
Field Sampling Organization: AECOM
Analytical Organization: RTI Laboratories
No. of Sampling Locations: See Worksheet #18

| QC Sample | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Action | Data Quality Indicator | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Method Blank | One per batch of 20 or less samples | < ½ LOQ | Correct problem, then see criteria in DoD QSM 5.0, Box D-1. If required, re-prep and reanalyze method blank and all samples processed with the contaminated blank. | Lab Analyst/Data Reviewer | Contamination (Accuracy/Bias) | < ½ LOQ |
| Laboratory Control Spike (LCS) | One per batch of 20 or less samples | % Recovery QSM 5.0 Limits Appendix C | Correct problem, Re-prepare and re-analyze affected samples | Lab Analyst/Data Reviewer | Accuracy | % Recovery QSM 4.2 Limits |
| Matrix Spike (MS) | One per batch of 20 or less samples | % Recovery QSM 5.0 Limits Appendix C | Investigate, consult with client and record matrix issues in case narrative | Data Reviewer | Accuracy | % Recovery QSM 4.2 Limits |
| Matrix Spike Duplicate (MSD) | One per batch of 20 or less samples | RPD QSM 5.0 Limits | Investigate and record in case narrative | Data Reviewer | Precision and Accuracy | RPD QSM 5.0 Limits |

## Worksheet #28.2: QC Samples Table (continued)

| QC Sample | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Action | Data Quality Indicator | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Initial Calibration (ICAL) | As needed on unacceptable ICV/CCV | RSD<20%<br>Linear cc>0.995,<br>Quadratic cc>0.99<br>Consistent with QSM 5.0 Table 1 | Correct problem and repeat ICAL | Lab Analyst | Instrument Performance | RSD<20%<br>Linear cc>0.995,<br>Quadratic cc>0.99<br>Consistent with QSM 5.0 Table 1 |
| Initial Calibration Verification (ICV) | Once after each ICAL | ±20%<br>Consistent with QSM 5.0 Table 1 | Correct problem, verify second source standard and rerun. If necessary repeat ICAL | Lab Analyst | Instrument Performance | ±20%<br>Consistent with QSM 5.0 Table 1 |
| Continuing Calibration Verification (CCV) | Daily before sample analysis, after every 10 samples and at the end of the analytical sequence | ±20%<br>Consistent with QSM 5.0 Table 1 | Correct problem and rerun. If necessary repeat ICAL | Lab Analyst | Instrument Performance | ±20%<br>Consistent with QSM 5.0 Table 1 |
| PEM | Daily before sample analysis and every 12 hours of analysis | <15% of the total degradation for DDT or Endrin | Perform injection port maintenance | Lab Analyst | Instrument Performance | <15% of the total degradation for DDT or Endrin |
| CRQL | Each analytical event | 80 – 120% | Correct problem and rerun. If necessary repeat ICAL | Lab Analyst | Sensitivity | 80 – 120% |
| Field Duplicate | 10% | < 40% for surface and ground water<br>< 70% for soil and sediment | Investigate and re-train if necessary | AECOM QA Manager | Precision | < 40% for surface and ground water<br>< 70% for soil and sediment |

RL = Reporting Limit
RPD = Relative Percent Difference
MS = Matrix Spike
MSD = Matrix Spike Duplicate
QSM = Quality Services Manual
LCS = Laboratory Control Spike
RLVS=Reporting Limit Verification Standard

## Worksheet #28.3: QC Samples Table

Matrix: Water/Soil /TCLP Extracts
Analytical Group: VOC
Concentration Level: Low-Medium
Sampling SOP: See Worksheet #21
Analytical Method / SOP Reference: EPA Method 8260C / 8260C_121613_R8_3
Samplers Name: TBD
Field Sampling Organization: AECOM
Analytical Organization: RTI Laboratories
No. of Sampling Locations: See Worksheet #18

| QC Sample | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Action | Data Quality Indicator | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Trip Blank | One per shipping cooler | < ½ LOQ | Data reviewer/validator will consider | Data Reviewer | Contamination (Accuracy/Bias) | < ½ LOQ |
| Method Blank | One per batch of 20 or less samples | < ½ LOQ | Correct problem, then see criteria in DoD QSM 5.0, Box D-1. If required, re-prepare and reanalyze method blank and all samples processed with the contaminated blank. | Lab Analyst/Data Reviewer | Contamination (Accuracy/Bias) | < ½ LOQ |
| Laboratory Control Spike (LCS) | One per batch of 20 or less samples | % Recovery QSM 5.0 Limits Appendix C | Correct problem, Re-prepare and re-analyze affected samples | Lab Analyst/Data Reviewer | Accuracy | % Recovery QSM 5.0 Limits |
| Matrix Spike (MS) | One per batch of 20 or less samples | % Recovery QSM 5.0 Limits Appendix C | Investigate, consult with client and record matrix issues in case narrative | Data Reviewer | Accuracy | % Recovery QSM 5.0 Limits |
| Matrix Spike Duplicate (MSD) | One per batch of 20 or less samples | RPD QSM 5.0 Limits Appendix C | Investigate and record in case narrative | Data Reviewer | Precision and Accuracy | RPD QSM 5.0 Limits |

## Worksheet #28.3: QC Samples Table (continued)

| QC Sample | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Action | Data Quality Indicator | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Initial Calibration (ICAL) | As needed on unacceptable ICV/CCV | Consistent with QSM 5.0 Appendix B Table 4 | Correct problem and repeat ICAL | Lab Analyst | Instrument Performance | Consistent with QSM 5.0 Appendix B |
| Initial Calibration Verification (ICV) | Once after each ICAL | Consistent with QSM 5.0 Appendix B Table 4 | Correct problem, verify second source standard and rerun. If necessary repeat ICAL | Lab Analyst | Instrument Performance | Consistent with QSM 5.0 Appendix B |
| Continuing Calibration Verification (CCV) | Daily before sample analysis and every 12 hours of analysis | Consistent with QSM 5.0 Appendix B Table 4 | Correct problem and rerun. If necessary repeat ICAL | Lab Analyst | Instrument Performance | Consistent with QSM 5.0 Appendix B |
| Internal Standards | Each Sample and QC Sample | Area -50% - +100% | Re-analyze to confirm matrix interferences and note on Case Narrative | Lab Analyst | Sensitivity | Area -50% - +100% |
| RLVS | Each analytical event | 70 – 130% | Correct problem and re-analyzed samples | Lab Analyst | Sensitivity | 70 – 130% |
| Field Duplicate | 10% | < 40% for surface and ground water<br>< 70% for soil and sediment | Investigate and re-train if necessary | AECOM QA Manager | Precision | < 40% for surface and ground water<br>< 70% for soil and sediment |

RL = Reporting Limit
RPD = Relative Percent Difference
MS = Matrix Spike
MSD = Matrix Spike Duplicate
QSM = Quality Services Manual
LCS = Laboratory Control Spike
RLVS=Reporting Limit Verification Standard

## Worksheet #28.4: QC Samples Table

Matrix: Water/Soil /TCLP Extracts
Analytical Group: Metals Concentration Level: Low-Medium
Sampling SOP: See Worksheet #21
Analytical Method / SOP Reference: EPA Method 6020A/7470/ EPA 200.8
Samplers Name: TBD
Field Sampling Organization: AECOM
Analytical Organization: RTI Laboratories
No. of Sampling Locations: See Worksheet #18

| QC Sample | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Action | Data Quality Indicator | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Method Blank | One per batch of 20 or less samples | < ½ LOQ | Correct problem, then see criteria in DoD QSM 5.0, Box D-1. If required, re-prepare and reanalyze method blank and all samples processed with the contaminated blank. | Lab Analyst/Data Reviewer | Contamination (Accuracy/Bias) | < ½ LOQ |
| Laboratory Control Spike (LCS) | One per batch of 20 or less samples | % Recovery QSM 5.0 Limits Appendix C | Correct problem, Re-prepare and re-analyze affected samples | Lab Analyst/Data Reviewer | Accuracy | % Recovery QSM 5.0 Limits Appendix C |
| Matrix Spike (MS) | One per batch of 20 or less samples | % Recovery QSM 5.0 Limits Appendix C | Investigate, consult with client and record matrix issues in case narrative | Data Reviewer | Accuracy | % Recovery QSM 5.0 Limits Appendix C |
| Matrix Spike Duplicate (MSD) | One per batch of 20 or less samples | % Recovery QSM 5.0 Limits Appendix C RPD <20% | Investigate and record in case narrative | Data Reviewer | Precision and Accuracy | % Recovery QSM 5.0 Limits Appendix C RPD <20% |
| Initial Calibration (ICAL) | Daily or on each use | cc >0.995 | Correct problem and repeat ICAL | Lab Analyst | Instrument Performance | cc >0.995 |

## Worksheet #28.4: QC Samples Table (continued)

| QC Sample | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Action | Data Quality Indicator | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Initial Calibration Verification (ICV) | Once after each ICAL | 90 – 110% | Correct problem, verify second source standard and rerun. If necessary repeat ICAL | Lab Analyst | Instrument Performance | 90 – 110% |
| Continuing Calibration Verification (CCV) | Daily before sample analysis and every 10 samples and at end of analytical sequence | 90 – 110% | Correct problem and rerun. If necessary repeat ICAL | Lab Analyst | Instrument Performance | 90 – 110% |
| CRQL | Beginning and end of each analytical event | 80 – 120 % | Correct problem and re-analyzed samples | Lab Analyst | Sensitivity | 80 - 120% |
| Field Duplicate | 10% | < 40% for surface and ground water<br>< 70% for soil and sediment | Investigate and re-train if necessary | AECOM QA Manager | Precision | < 40% for surface and ground water<br>< 70% for soil and sediment |

RL = Reporting Limit
RPD = Relative Percent Difference
MS = Matrix Spike
MSD = Matrix Spike Duplicate
QSM = Quality Services Manual
LCS = Laboratory Control Spike
CRQL =Contract Required Quantification Limit

## Worksheet #28.5: QC Samples Table

Matrix: Water/Soil / TCLP Extracts
Analytical Group: Metals
Concentration Level: Low
Sampling SOP: See Worksheet #21
Analytical Method / SOP Reference: EPA Method 6010C/7470A/7471A/; 6010C_100713_R3.2_4_v1;7470A_7471A_022014_R7
Samplers Name: TBD
Field Sampling Organization: AECOM
Analytical Organization: RTI Laboratories
No. of Sampling Locations: See Worksheet #18

| QC Sample | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Action | Data Quality Indicator | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Method Blank | One per batch of 20 or less samples | < ½ LOQ | Correct problem, then see criteria in DoD QSM 5.0, Box D-1. If required, re-prepare and reanalyze method blank and all samples processed with the contaminated blank. | Lab Analyst/Data Reviewer | Contamination (Accuracy/Bias) | < ½ LOQ |
| Laboratory Control Spike (LCS) | One per batch of 20 or less samples | % Recovery QSM 5.0 Limits Appendix C | Correct problem, Re-prepare and re-analyze affected samples | Lab Analyst/Data Reviewer | Accuracy | % Recovery QSM 5.0 Limits Appendix C |
| Matrix Spike (MS) | 5% - 1 per batch of 20 or less samples | % Recovery QSM 5.0 Limits Appendix C | Flag data Investigate, consult with client and record matrix issues in case narrative | Data Reviewer | Accuracy | % Recovery QSM 5.0 Limits Appendix C |
| Matrix Spike Duplicate (MSD) | 5% - 1 per batch of 20 or less samples | % Recovery QSM 5.0 Limits Appendix C RPD <20% | Investigate and record in case narrative | Data Reviewer | Precision and Accuracy | % Recovery QSM 5.0 Limits Appendix C RPD <20% |

## Worksheet #28.5: QC Samples Table (continued)

| QC Sample | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Action | Data Quality Indicator | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Initial Calibration (ICAL) | Daily or on each use | cc >0.995 | Correct problem and repeat ICAL | Lab Analyst | Instrument Performance | cc >0.995 |
| Initial Calibration Verification (ICV) | Daily immediately following calibration | 90 – 110% | Repeat calibration | Lab Analyst | Instrument Performance | 90 – 110% |
| Continuing Calibration Verification (CCV) | After ICSAB and every 10 samples | 90 – 110% of True Value | Repeat CCV and all samples preceding a CCV failure – recalibrate if problem persists | Lab Analyst | Instrument Performance | 90 – 110% |
| ICB | After ICV | <LOD | Stop, repeat – determine cause and correct | Lab Analyst | Contamination (Accuracy/Bias) | <DL |
| ICSA/ICSAB | After ICB | Non interfering analytes <LOD in ICSA, +/-20% of expected in ICSAB | Stop, repeat – determine cause and correct | Lab Analyst | Accuracy Sensitivity | Non interfering analytes <LOD in ICSA, +/-20% of expected in ICSAB |
| CCB | After CCV and every 10 samples | <LOD | Stop, repeat – determine cause and correct | Lab Analyst | Contamination (Accuracy/Bias) | <DL |
| Duplicate Samples | 5% - 1 per batch of 20 or less samples | RPD <20% | Investigate and repeat as necessary | Lab Analyst | Precision | RPD <20% |
| CRQL | After CCB and at the end of the sample set | 80 – 120 % | Investigate, determine cause and correct. Repeat samples analyzed prior to unacceptable CRQL | Lab Analyst | Sensitivity | 80 - 120% |
| Field Duplicate | 10% | < 40% for surface and ground water<br>< 70% for soil and sediment | Investigate and re-train if necessary | AECOM QA Manager | Precision | < 40% for surface and ground water<br>< 70% for soil and sediment |

RL = Reporting Limit
RPD = Relative Percent Difference
MS = Matrix Spike
MSD = Matrix Spike Duplicate
QSM = Quality Services Manual
LCS = Laboratory Control Spike
CRQL =Contract Required Quantification Limit

## Worksheet #28.6: QC Samples Table

Matrix: Water/Soil /TCLP extracts
Analytical Group: Explosives/Energetics
Concentration Level: Low-Medium
Sampling SOP: See Worksheet #21
Analytical Method / SOP Reference: EPA Method 8330B+(nitroglycerin & PETN)
Samplers Name: TBD
Field Sampling Organization: AECOM
Analytical Organization: RTI Laboratories
No. of Sampling Locations: See Worksheet #18

| QC Sample | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Action | Data Quality Indicator | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Method Blank/Soil Grinding Blank | One per batch of 20 or less samples | < ½ LOQ | Correct problem, then see criteria in DoD QSM 5.0, Box D-1. If required, re-prepare and reanalyze method blank and all samples processed with the contaminated blank. | Lab Analyst/Data Reviewer | Contamination (Accuracy/Bias) | < ½ LOQ |
| Laboratory Control Spike (LCS) | One per batch of 20 or less samples | % Recovery QSM 5.0 Limits Appendix C | Correct problem, Re-prepare and re-analyze affected samples | Lab Analyst/Data Reviewer | Accuracy | % Recovery QSM 5.0 Limits Appendix C |
| Matrix Spike (MS) | One per batch of 20 or less samples | % Recovery QSM 5.0 Limits Appendix C | Investigate, consult with client and record matrix issues in case narrative | Data Reviewer | Accuracy | % Recovery QSM 5.0 Limits Appendix C |
| Matrix Spike Duplicate (MSD) | One per batch of 20 or less samples | % Recovery QSM 5.0 Limits Appendix C, RPD <20% | Investigate and record in case narrative | Data Reviewer | Precision and Accuracy | % Recovery QSM 5.0 Limits Appendix C, RPD <20% |

## Worksheet #28.6: QC Samples Table (continued)

| QC Sample | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Action | Data Quality Indicator | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Initial Calibration (ICAL) | As needed on unacceptable ICV/CCV | Consistent with QSM 5.0 Table 3 | Correct problem and repeat ICAL | Lab Analyst | Instrument Performance | Consistent with QSM 4.2 Table F-3 |
| Initial Calibration Verification (ICV) | Once after each ICAL | Consistent with QSM 5.0 Table 3 | Correct problem, verify second source standard and rerun. If necessary repeat ICAL | Lab Analyst | Instrument Performance | Consistent with QSM 5.0 Table 3 and Table F-3 |
| Continuing Calibration Verification (CCV) | Daily before sample analysis and every 12 hours of analysis | Consistent with QSM 5.0 Table 3 | Correct problem and rerun. If necessary repeat ICAL | Lab Analyst | Instrument Performance | Consistent with QSM 5.0 Table 3 and Table F-3 |
| Second Column Confirmation | Positive Results | PRD <40% | Re-analyze to confirm matrix interferences and note on Case Narrative | Lab Analyst | Sensitivity | RPD <40% |
| RLVS | Each analytical event | 70 – 130% | Correct problem and re-analyzed samples | Lab Analyst | Sensitivity | 70 – 130% |
| Field Duplicate | 10% | < 70% for soil and sediment | Investigate and re-train if necessary | AECOM QA Manager | Precision | < 70% for soil and sediment |

RL = Reporting Limit
RPD = Relative Percent Difference
MS = Matrix Spike
MSD = Matrix Spike Duplicate
QSM = Quality Services Manual
LCS = Laboratory Control Spike
RLVS =Reporting Limit Verification Standard

## Worksheet #28.7: QC Samples Table

Matrix: Water Soil /TCLP Extracts
Analytical Group: Nonhalogenated Organics
Concentration Level: Low-Medium
Sampling SOP: See Worksheet #21
Analytical Method / SOP Reference: EPA Method 8015/SW8015
Samplers Name: TBD
Field Sampling Organization: AECOM
Analytical Organization: RTI Laboratories
No. of Sampling Locations: See Worksheet #18

| QC Sample | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Action | Data Quality Indicator | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Method Blank/Soil Grinding Blank | One per batch of 20 or less samples | < ½ LOQ | Correct problem, then see criteria in DoD QSM 5.0, Box D-1. If required, re-prep and reanalyze method blank and all samples processed with the contaminated blank. | Lab Analyst/Data Reviewer | Contamination (Accuracy/Bias) | < ½ LOQ |
| Laboratory Control Spike (LCS) | One per batch of 20 or less samples | % Recovery QSM 5.0 Limits Appendix C | Correct problem, Re-prepare and re-analyze affected samples | Lab Analyst/Data Reviewer | Accuracy | % Recovery QSM 5.0 Limits Appendix C |
| Matrix Spike (MS) | One per batch of 20 or less samples | % Recovery QSM 5.0 Limits Appendix C | Investigate, consult with client and record matrix issues in case narrative | Data Reviewer | Accuracy | % Recovery QSM 5.0 Limits Appendix C |
| Matrix Spike Duplicate (MSD) | One per batch of 20 or less samples | % Recovery QSM 5.0 Limits Appendix C, RPD <20% | Investigate and record in case narrative | Data Reviewer | Precision and Accuracy | % Recovery QSM 5.0 Limits Appendix C, RPD <20% |

## Worksheet #28.7: QC Samples Table (continued)

| QC Sample | Frequency / Number | Method / SOP QC Acceptance Limits | Corrective Action | Person(s) Responsible for Corrective Action | Data Quality Indicator | Measurement Performance Criteria |
|---|---|---|---|---|---|---|
| Initial Calibration Verification (ICV) | Once after each ICAL | Consistent with QSM 5.0 Table 1 | Correct problem, verify second source standard and rerun. If necessary repeat ICAL | Lab Analyst | Instrument Performance | Consistent with QSM 5.0 Table 1 |
| Continuing Calibration Verification (CCV) | Daily before sample analysis and every 12 hours of analysis | Consistent with QSM 5.0 Table 1 | Correct problem and rerun. If necessary repeat ICAL | Lab Analyst | Instrument Performance | Consistent with QSM 5.0 Table 1 |
| Second Column Confirmation | Positive Results | PRD <40% | Re-analyze to confirm matrix interferences and note on Case Narrative | Lab Analyst | Sensitivity | RPD <40% |
| RLVS | Each analytical event | 70 – 130% | Correct problem and re-analyzed samples | Lab Analyst | Sensitivity | 70 – 130% |
| Field Duplicate | 10% | < 40% for surface and ground water<br>< 70% for soil and sediment | Investigate and re-train if necessary | AECOM QA Manager | Precision | < 40% for surface and ground water<br>< 70% for soil and sediment |

RL = Reporting Limit
RPD = Relative Percent Difference
MS = Matrix Spike
MSD = Matrix Spike Duplicate
QSM = Quality Services Manual
LCS = Laboratory Control Spike
RLVS=Reporting Limit Verification Standard

## Worksheet #29 Project Documents and Records Table

| Sample Collection Documents and Records | On-site Analysis Documents and Records | Off-site Analysis Documents and Records | Data Assessment Documents and Records | Other |
|---|---|---|---|---|
| Field Logbook | Field Logbook | Sample receipt, custody, and tracking records | Field sampling audit records | NA |
| Chain-of-Custody Records | Field Sampling Forms | Sample prep logs | Laboratory audit records | |
| Air Bills | Equipment Inspection Forms | Equipment calibration logs | Data validation reports | |
| Custody Seals | Boring Logs | Run logs | Data useability assessment reports | |
| Corrective Action Forms | Corrective Action Forms | Equipment maintenance test, and inspection logs | Corrective Action Forms | |
| Field Sampling Forms | Daily Tailgate H&S Sign In Sheet | Corrective Action Forms | RI Report Addendum | |
| Sample location and depth data | APP/SSHP Acknowledgement | Reported analytical results | | |
| | Dig Permits | Data package completeness checklists | | |
| | | Sample disposal records | | |
| | | Extraction/cleanup records | | |
| | | Raw data | | |
| | | Staged Electronic Data Deliverables (SEDD) and EQUIS | | |

## Worksheet #30 Analytical Services Table

| Matrix | Analytical Group | Concentration Level | Sample Locations / ID Number | Analytical Method | Data Package Turnaround Time | Laboratory / Organization | Backup Laboratory/ Organization |
|---|---|---|---|---|---|---|---|
| Soil/ Aqueous | VOCs | Low | TBD; Reference SAP | SW8260C | Level IV 21 calendar days | RTI Laboratories 13715 Rider Trail North St. Louis, MO 63045 314-298-8566 (office) 314-298-8757 (fax) | Microbac Laboratories, Inc. 158 Starlite Drive Marietta, OH 45750 740-373-4071 (office) |
| | SVOCs SIM | Low | | SW8270D | | | |
| | Metals | Low | | SW6010B | | | |
| | Thallium | Low | | SW6020A | | | |
| | PCBs | Low | | SW8082A | | | |
| | Energetics/Explosives | Low | | 8330A/B | | | |

Notes:
EPA Environmental Protection Agency, United States
ID identification
PCB Polychlorinated Biphenyl
SVOC Semivolatile Organic Compounds
SAP Sampling and Analysis Plan
VOC Volatile Organic Compounds
TBD to be determined

## Worksheet #31 Planned Project Assessments Table

| Assessment Type | Frequency | Internal or External | Organization Performing Assessment | Person(s) Responsible for Performing Assessment | Person(s) Responsible for Responding to Assessment Findings | Person(s) Responsible for Identifying and Implementing Corrective Action | Person(s) Responsible for Monitoring Effectiveness of Corrective Action |
|---|---|---|---|---|---|---|---|
| Field Sampling Audit | Monthly | Internal | AECOM | Brendan McGuiness/ Project Quality Manager/ AECOM | Amanda Martin/ Field Sampling Team Leader/ AECOM | Field Sampling Team Leader/ AECOM | Megan Donahue/ Project Manager/ AECOM |
| Project Manager Review | Monthly | Internal | AECOM | Megan Donahue / Project Manager/ AECOM | Amanda Martin / Field Sampling Team Leader/ AECOM | Amanda Martin / Field Sampling Team Leader/ AECOM | Megan Donahue/ Project Manager/ AECOM |
| Review of COC forms | Daily | Internal | AECOM | Devon Chicoine/ Project Chemist/ AECOM | Amanda Martin / Field Sampling Team Leader/ AECOM | Amanda Martin / Field Sampling Team Leader/ AECOM | Devon Chicoine/ Project Chemist/ AECOM |
| Laboratory Data Assessment (validation) | Once | Internal | AECOM | Naoum Tavantzis/Data Validator | Devon Chicoine/ Project Chemist/ AECOM | Naoum Tavantzis/Data Validator | Devon Chicoine/ Project Chemist/ AECOM |
| Daily Quality Control Audits | Daily | Internal | AECOM | Amanda Martin / Field Sampling Team Leader/ AECOM | Amanda Martin / Field Sampling Team Leader/ AECOM | Amanda Martin / Field Sampling Team Leader/ AECOM | Amanda Martin/ Field Sampling Team Leader/ AECOM |
| Field Technical System Audits | Daily | Internal | AECOM | Amanda Martin / Field Sampling Team Leader/ AECOM | Amanda Martin / Field Sampling Team Leader/ AECOM | Amanda Martin / Field Sampling Team Leader/ AECOM | Amanda Martin/ Field Sampling Team Leader/ AECOM |
| Field Performance Audits | Weekly | Internal | AECOM | Megan Donahue / Project Manager/ AECOM | Amanda Martin / Field Sampling Team Leader/ AECOM | Amanda Martin / Field Sampling Team Leader/ AECOM | Megan Donahue/ Project Manager/ AECOM |

## Worksheet #32 Assessment Findings and Corrective Action Responses

| Assessment Type | Nature of Deficiencies Documentation | Individual(s) Notified of Findings | Timeframe of Notification | Nature of Corrective Action Response Documentation | Individual(s) Receiving Corrective Action Response | Timeframe for Response |
|---|---|---|---|---|---|---|
| Field Sampling Audit | Email | Amanda Martin / Field Sampling Team Leader/ AECOM<br>Megan Donahue/ Project Manager/ AECOM | Immediate | Daily QC Report/ Email | Brendan McGuiness Project Quality Manager/ AECOM<br>Megan Donahue/ Project Manager/ AECOM | 24 hours after notification |
| Project Manager Review | Email | Amanda Martin / Field Sampling Team Leader/ AECOM | Immediate | Daily QC Report/ Email | Megan Donahue/ Project Manager/ AECOM | 24 hours after notification |
| Review of COC forms | Email | Amanda Martin / Field Sampling Team Leader/ AECOM<br>Megan Donahue/ Project Manager/ AECOM | Immediate | Daily QC Report/ Email | Devon Chicoine/ Project Chemist/ AECOM | 24 hours after notification |
| Laboratory Data Assessment (validation) | Written Audit Report | Kathy Griffin/ Laboratory QA Manager/ RTI Laboratories; Devon Chicoine/ Project Chemist/ AECOM | Within 24 hours after audit | Email | Naoum Tavantzis/Data Validator<br>Devon Chicoine/Project Chemist/ AECOM | Up to 1 Week after notification |
| Daily Quality Control Audits | Email/ Daily QC Report | Amanda Martin / Field Sampling Team Leader/ AECOM<br>Megan Donahue/ Project Manager/ AECOM | Immediate | Daily QC Report/ Email | Megan Donahue / Project Manager/ AECOM | 24 hours after notification |
| Field Technical System Audits | Email/ Daily QC Report | Amanda Martin / Field Sampling Team Leader/ AECOM<br>Megan Donahue/ Project Manager/ AECOM | Immediate | Daily QC Report/ Email | Megan Donahue / Project Manager/ AECOM | 24 hours after notification |
| Field Performance Audits | Email | Amanda Martin / Field Sampling Team Leader/ AECOM | Immediate | Daily QC Report/ Email | Megan Donahue / Project Manager/ AECOM | 24 hours after notification |

## Worksheet #33 QA Management Reports

| Type of Report | Frequency (Daily, Weekly Monthly, Quarterly, Annually, Etc.) | Projected Delivery Date(s) | Person(s) Responsible for Report Preparation | Report Recipient(s) |
|---|---|---|---|---|
| Data Validation Report | Once, after all data are generated | July 2016 | Naoum Tavantzis, Data Validator | Megan Donahue, Project Manager, AECOM |
| Data Useability Assessment Report | Once, after data is validated | July 2016 | Devon Chicoine, Project Chemist, AECOM | Megan Donahue, Project Manager, AECOM |
| Final RI Addendum Report | Once, after data useability and risk assessments are completed | July 2016 | Megan Donahue, Project Manager, AECOM | Greg Goefport, Project Manager, USACE; Megan Cullen, Project Manager, USACE |

## Worksheet #34 Sampling and Analysis Verification (Step I) Process Table

| Verification Input | Description | Internal / External | Responsible for Verification |
|---|---|---|---|
| Review of field notes | Determine whether field procedures are performed in accordance with this QAPP and prescribed procedures. Notes allow reconstruction of activities and identification of sampling locations. | Internal | Amanda Martin , AECOM |
| Review of COC forms | Determine whether samples are labeled and handled in accordance with this QAPP and prescribed procedures, and the correct analysis is selected. | Internal | Devon Chicoine, AECOM |
| Analytical Data Package | All analytical data packages will be verified internally by the laboratory performing the work for completeness prior to submittal of the data to the Data Validator. | External | Kathy Griffin, RTI Laboratories |
| Laboratory Data Assessment | Determine whether electronic and hard copy data upon receipt are comparable and contain the proper reporting format. The assessment will consist of reviewing both types of data to verify that data were delivered in proper fields and that all required fields are populated correctly. | External / Internal | Naoum Tavantzis and Devon Chicoine, AECOM |
| Laboratory Electronic Data Deliverables | Review files for correctness and completeness. Verify that SEDDs and EQUIS EDDs (http://www.dec.ny.gov/chemical/62440.html) meet the reporting requirements. | External / Internal | Naoum Tavantzis, AECOM |

## Worksheet #35 Validation (Steps IIa and IIb) Process Table

| Step IIa/IIb | Validation Input | Description | Responsible for Validation |
|---|---|---|---|
| IIb | Onsite data | All onsite data will be reviewed against QAPP requirements for completeness and accuracy based on the field calibration requirements (see Worksheet # 22). | Amanda Martin , AECOM |
| IIa | Sampling Procedures | Ensure that all sampling procedures were followed. | Megan Donahue, AECOM |
| IIa | COC | Examine traceability of data from sample collection to generation of project data. | Devon Chicoine, AECOM |
| IIb | QLs | Review QLs achieved as outlined in the QAPP and verify that the laboratory successfully analyzed a standard at the QL. | Devon Chicoine, AECOM<br>Naoum Tavantzis, AECOM |
| IIb | QAPP | Determine whether the number and type of samples specified in Worksheet #20 were collected and analyzed. | Devon Chicoine, AECOM |
| IIa | QAPP and Laboratory SOW | Determine whether all analytes specified in Worksheet #15 were analyzed and reported by the laboratory. | Devon Chicoine, AECOM |
| IIa & IIb | Laboratory Data and QAPP requirements | Assess and document the performance of the analytical process. A summary of all QC samples and results will be verified for measurement performance criteria and completeness. Full verification will be performed on 10% of the data and standard level verification will be performed on 90% of the data. | Naoum Tavantzis, AECOM |
| IIb | Methods, Field QC logbook and QAPP requirements | Determine impacts of any deviations from methods and corrective actions implemented during sampling and analysis. | Amanda Martin , AECOM<br>Devon Chicoine, AECOM |

## Staged Electronic Data Deliverable File Specifications

The staged electronic data deliverable (SEDD) consists of three separate, comma-delimited ASCII text files or Excel XML, or Excel comma separated value (CSV) files (two, if instrument calibration information is not required by the project). Each file corresponds to a database table. The tables are identified as the Analytical Results Table (Table A1), Laboratory Instrument Table (Table A2), and Sample Analysis Table (Table A3). Each file follows the naming convention of using the Laboratory Reporting Batch ID (sample delivery group [SDG]) followed by the table identifier (A1, A2, or A3), and then a ".txt" or ".csv" extension. For example, the EDD file names for a laboratory reporting batch identified as SDG001 that includes instrument calibration data would be as follows:

- SDG001A1.txt or SDG001A1.csv

- SDG001A2.txt or SDG001A2.csv (A2 file is optional)
- SDG001A3.txt or SDG001A3.csv

The USACE Automated Data Review (ADR) web-based program (ADR.net) developed by Laboratory Data Consultants will be used for this project. AECOM will request its contract laboratory (Earth Toxics, Inc. and its subcontractor, RTI Laboratories ) to provide ADR library and EDDs for the analytical results of the project samples.

## A.1 Analytical Results Table (A1 File)

The Analytical Results Table contains results and related information on an analyte level for field samples and associated quality control (QC) samples (excluding calibrations and tunes). A result record must exist for each analyte reported in a method (specified in the project library) for every field sample and laboratory method blank analyzed by that method. Laboratory control samples (LCSs) and matrix spikes (MSs) must have a result record for every spiked analyte and surrogate (if applicable) specified in the project library. Table A1 lists the field names and descriptions for the Analytical Results Table (A1). The project library is a reference table that both the SEDD error checker and validation applications use when processing the SEDD. The project library is populated with information from the project quality assurance project plan (QAPP).

## A.2 Laboratory Instrument Table (A2 File)

The Laboratory Instrument table contains results and related information on an analyte level for instrument initial calibration standards, initial calibration verification standards, continuing calibration standards, and gas chromatography (GC)/MS tunes. A record must exist for each target analyte reported in a method (specified in the project library), for every calibration type (QCType) associated to samples reported in the SEDD. Initial calibrations, initial calibration verifications, and associated samples are linked to each other using a unique Run Batch ID for every distinct initial calibration. Continuing calibrations and associated samples are linked to each other using a unique Analysis Batch ID for every distinct continuing calibration. GC/MS tunes are linked to initial and continuing calibrations (and hence samples) using the Run Batch and Analysis Batch IDs respectively. Depending on the level of validation required by the data user, the Laboratory Instrument table may not be requested in the deliverable. Table G.2-2 lists field names and descriptions for the Laboratory Instrument Table (A2).

## A.3 Sample Analysis Table (A3 File)

The Sample Analysis table contains information related to sample and QC analyses (excluding calibrations and tunes), analytical methods, batch IDs, and sample preparation on a sample basis. A record exists for each sample/method/matrix/analysis type combination. Table A3 lists field names and descriptions for the Sample Analysis Table (A3).

## A.4 SEDD Field Elements

The SEDD Field Elements listed in Table A1, A2, and A3, respectively, specify the type of electronic information from the analytical laboratories for populating the fields each file. These include the field name and sequence, field name description, and field type and length for each table. Field elements in the SEDD are sequenced according to the order they appear in Tables A1, A2, and A3. For example, in the Analytical Result Table (the A1 file), the field "ClientSampleID" will always be the first piece of information to start a new line of data (or database record), followed by the fields "LabAnalysisRefMethodID", "AnalysisType", and so on.

The name, description, data type, character length, and standard value requirements for each field are listed in Tables A1, A2, and A3, respectively. Field standard values are listed in Table B. Table C lists standard values for methods and analytes. Certain fields in each file require information for a given combination of sample, matrix, method, analyte type, and calibration or QC type records. These are required fields. Tables D1, D2, and D3 indicates the required fields for each table according to the instrument category (method), matrix, analyte type, sample, and QC or calibration type record.

When creating an EDD as a text file, use the ASCII character set in a file of lines terminated by a carriage return and line feed. No characters are allowed after the carriage return and line feed. Enclose each data field in double quotes (") and separate each field by commas (comma delimited). Data fields with no information (null) may be represented by two consecutive commas. For example, in the Sample Analysis Table, since the "Collected", "ShippingBatchID", and "Temperature" fields do not apply to laboratory generated quality assurance (QA)/QC samples, the record for a LCS by Method 8270C would be entered as follows. Note that the first two fields ("ProjectNumber" and "ProjectName") are omitted in this example.

"LCSW100598",,"AQ","LCSW100598","LCS",,"8270C",… (and so on)

Do not pad fields with leading or trailing spaces if a field is populated with less than the maximum allowed number of characters. In the above example, although the "MatrixID" field can accommodate up to 10 characters, only 2 characters were entered in this field.

## B. ADR Standard Values for Methods

A method name must exist in standard value table before it can be added to a project library. The project library controls what is accepted in the SEDD. Table C lists all the methods built into the ADR standard value table. Additional methods can be added to this table if necessary. If a particular method specified in the QAPP or used by the laboratory is not listed in this table, it must be added to the standard value table before that method can be built into a project library. Methods added to a project library become standard values for the Lab Reference Method ID field (method field) in any SEDD processed through the error checker when selecting that project library as reference.

### B.1 Standard Values for Analytes

A CAS number and analyte name must exist in the standard value table before it can be added to a method in a project library. The ADR standard value table contains records for several thousand compound names and their CAS numbers. Additional analyte name records can be added if necessary. Analyte names and CAS numbers added to a method within a project library become standard values for the Analyte Name and Client Analyte ID (CAS number) fields in any SEDD processed through the error checker when selecting that project library as reference.

## Worksheet #36 Validation (Steps IIa and IIb) Summary Table

| Step IIa/IIb | Matrix | Analytical Group | Validation Criterion | Responsible |
|---|---|---|---|---|
| IIa/IIb | Soil / Aqueous | VOCs SW8260; SVOCs SW8270; ICP Metals SW6010; Explosives/Energetics SW8330; PCBs SW8082 | Project validation criteria in accordance with QAPP Worksheets #12, 15, 19, 28, and 37 within this document and cited USEPA SW-846 methodology. Validation qualifiers applied in accordance with *National Functional Guidelines* for organic and inorganic data review. Methods for which no data validation guidelines exist will be validated following the NFG deemed most appropriate by the data validator | Naoum Tavantzis, AECOM |

Notes:
EPA Environmental Protection Agency, United States
N/A not applicable
UFP-QAPP Uniform Federal Policy – Quality Assurance Program Plan
IIa Compliance with methods, procedures, and contracts (see Table 10, page 117, UFP-QAPP manual, V.1, March 2005)
IIb Comparison with measurement performance criteria in the QAPP (see Table 11, page 118, UFP-QAPP manual, V.1, March 2005)

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## Worksheet #37 Data Usability Assessment

A data assessment will be performed in accordance with USEPA guidance QA/G-9R, *Data Quality Assessment, A Reviewer's Guide* (EPA/240/B-06/002) dated February 2006. In accordance with USEPA guidance, a data assessment is intended to provide documentation to clearly demonstrate that the collected data are of the right type, quality, and quantity to meet the objectives of the project. A comprehensive evaluation of how the data meet precision, accuracy, representativeness, comparability, and completeness (PARCC) objectives will also be performed. All soil, sediment, surface water, and groundwater analytical data will be validated in-house and the data packages to be presented in the RI report.

The data usability assessment will reconcile the DQOs of this UFP-QAPP to the results of the data collection and analytical results, data validation evaluation (as applicable), and field QC results.

Data quality indicators, such as precision, accuracy, completeness, representativeness, and comparability measurements, aid in the evaluation process and are discussed in the following subsections.

### Precision

The most commonly used estimates of precision are the RPD for cases in which only two measurements are available and the percent relative standard deviation (%RSD) when three or more measurements are available. The latter is especially useful in normalizing environmental measurements to determine acceptability ranges for precision because it effectively corrects for the wide variability in sample analyte concentration indigenous to samples.

Precision is represented as the RPD between measurement of an analyte in duplicate samples or in duplicate spikes. RPD is defined as follows:

$$RPD = \frac{|C_1 - C_2|}{(C_1 + C_2)/2} \times 100$$

Where:

C1 = First measurement value

C2 = Second measurement value

The %RSD is calculated by the standard deviation of the analytical results of the replicate determinations relative to the average of those results for a given analyte. This method of precision measurement can be expressed by the formula:

$$\%RSD = \sqrt{\frac{\sum_{i=1}^{n} x_i^2 - \left[\sum_{i=1}^{n} x_i\right]^2 / n}{n-1}} \times 100 / RF$$

Where:

RF = Response factor

N = Number of measurements

Precision control limits for evaluation of sample results are established by the analysis of control samples. The control samples can be method blanks fortified with surrogates (e.g., for organics), or LCS purchased commercially or prepared at the laboratory. The LCS is typically identified as blank spikes (BS) for organic analyses. For multi-analyte methods, the LCS or BS may contain only a representative number of target analytes rather than the full list.

The RPD for duplicate investigative sample analysis provides a tool for evaluating how well the method performed for the respective matrices.

**Accuracy/Bias**

Accuracy control limits are established by the analysis of control samples, which are water and/or solid/waste matrices. For organic analyses, the LCS may be a surrogate compound in the blank or a select number of target analytes in the BS. The LCS is subjected to all sample preparation steps. When available, a solid LCS may be analyzed to demonstrate control of the analysis for soil. The amount of each analyte recovered in an LCS analysis is recorded and entered into a database to generate statistical control limits. These empirical data are compared with available method reference criteria and available databases to establish control criteria.

The % R for spiked investigative sample analysis (e.g., matrix spike) provides a tool for evaluating how well the method worked for the matrix. These values are used by the USACE to assess a reported result within the context of the project DQOs. For results that are outside control limits provided as requirements in the UFP-QAPP, corrective action appropriate to the project will be

taken and the deviation will be noted in the case narrative accompanying the sample results. The %R is defined as follows:

$$\% R = \frac{(A_T - A_O)}{A_F} \times 100$$

Where:

AT = Total amount recovered in fortified sample

A0 = Amount recovered in unfortified sample

AF = Amount added to sample

Accuracy for some procedures is evaluated as the degree of agreement between a new set of results and a historical database or a table of acceptable criteria for a given parameter. This degree of agreement is measured as %D from the reference value and is primarily used by the laboratory as a means for documenting acceptability of continuing calibration.

The %D is calculated by expressing, as a percentage, the difference between the original value and new value relative to the original value. This method for precision measurement can be expressed by the formula:

$$\% D = \frac{C1 - C2}{C_1} \times 100$$

Where:

C1 = Concentration of analyte in the initial aliquot of the sample.

C2 = Concentration of analyte in replicate.

**Completeness**

Site-wide completeness goals account for all aspects of sample handling, from collection through data reporting. The level of completeness can be affected by loss or breakage of samples during transport, as well as external problems that prohibit collection of the sample. The following calculation is used for determining the percent complete:

$$\text{Completeness} = \frac{A}{B} \times 100$$

Where:

A = Number of usable data points.

B = Total number of data points collected.

The formula for sampling completeness is:

$$\text{Sampling Completeness} = \frac{\text{Number of locations sampled}}{\text{Number of planned sample locations}} \times 100$$

An example formula for analytical completeness is:

$$\text{VOC Analytical Completeness} = \frac{\text{Number of Usable Data Points}}{\text{Expected Number of Usable Data Points}} \times 100$$

The ability to meet or exceed completeness objectives is dependent on the nature of samples submitted for analysis.

The following table lists the completeness goals for a project. If the completeness goal is not met because of controllable circumstances, then the samples will be recollected and reanalyzed, as necessary, to meet the completeness objective. If the completeness goal is not met because of uncontrollable circumstances, such as inaccessible sample points, matrix interferences, etc., then the deficiency will be evaluated. Note that Project Completeness Goals apply separately to each study area environmental medium.

**Project Completeness Goals**

| Task | Subtask | Completeness Goal |
|---|---|---|
| Sampling | Sample Collection | 95% (per media) |
| Field Measurements | Conductivity | 100% of collected samples (per media) |
| | pH/Turbidity/DO | 100% of collected samples (per media) |
| Analytical Measurements | All Laboratory Analyses | 95% of collected analytes (per media) |
| | | 80% of each target analyte (per media) |

## Representativeness

Data representativeness for a project is accomplished by implementing approved sampling procedures and analytical methods that are appropriate for the intended data uses, and which are established within this project-specific UFP-QAPP.

Biased samples are being collected during Phase I of the RI activities. As such, they will not be pooled with the representative samples collected during the Phase II RI activities.

**Comparability**

Comparability of data sets generated for a project will be obtained through the implementation of standard sampling and analysis procedures, by the use of traceable reference materials for laboratory standards, and by expressing the results in comparable concentration units.

**Sensitivity**

Sensitivity is the ability of the method or acceptable sensitivity instrument to detect the contaminant of concern and other target compounds at the level of interest. Quantitative MPC need to be determined for acceptable sensitivity to ensure that the quantitation limits can be routinely achieved for each matrix, analytical parameter, and concentration level. The use of standards and instrument calibration will enable the instrument to identify and differentiate between various compounds/analytes of interest and interferences.

**Assessment of Data Usability**

In addition, data assessment is considered the final step in the data evaluation process and can be performed only on data of known and documented quality. For a project, all data will be assessed for usability, regardless of the data evaluation/validation process implemented. As mentioned previously, data usability goes beyond validation because it evaluates the achievement of the DQOs based on the comparison of the specific WPs with the obtained results. The results of the data usability assessment, and particularly any changes to the DQOs necessitated by the data not meeting usability criteria, will be included in each final data quality assessment report. As noted in Worksheet #15, screening criteria for some analytes are below the LOD; however, if contaminants of concern are present, it is expected that they will be detected at concentrations that will exceed the LOD.

Primarily, the assessment of the usability will follow procedures described in appropriate USEPA guidance documents, particularly *Guidance for Data Usability in Risk Assessment* (Publication No. 9285.7-05FS, September 1992), and will be conducted according to the process outlined below.

**Sampling and Analysis Activities Evaluation**

The first step of the data usability evaluation will include a review of the sampling and analysis activities in comparison to Site-Wide data quality indicators (DQIs) and study-specific WPs. Specific limitations to the data, i.e., results that are qualified as estimated (J/UJ), or rejected (R), will be determined and documented in the database. The data acquisition and evaluation process consists of a series of procedures that were designed to maximize final data quality.

**Assessment of DQIs**

The second part of data usability pertains to the assessment of the program-specific DQIs. Each investigator will compare the performance achieved for each data quality criterion against the expected and planned performance. In general, this comparison will follow from the DQIs used to define each DQO. The comparison is the most critical component of the assessment process. Any deviation from planned performance will be documented and evaluated to determine whether corrective action is advisable. Potential corrective actions will range from resampling and/or reanalysis of data, to qualification or exclusion of the data for use in the data interpretation. In the event that corrective action is not possible, the limitations, if any, of the data with regard to achieving the DQOs will be noted.

In conjunction with the DQI achievement review, the investigators will need to make decisions for the use of qualified values, which are a consequence of the formalized evaluation/validation process. Data qualifiers will be applied to individual data results. Data usability decisions will be made based on the assessment of the usability of each of these results for the intended purpose. Evaluation will describe the uncertainty (e.g., bias, imprecision) of the qualified results. Cumulative QC exceedances from the DQIs may require technical judgment to determine the overall effect on the usability of the data. Decisions about usability of qualified data for use in risk assessment will be based on the USEPA document mentioned, which allows for the use of estimated values. Finally, data users may choose to determine final data usability qualifiers as a result of the overall examination and decision process.

**Achievement of DQOs**

The third step in the data usability process concerns achievement of the DQOs. After the data set has been assessed to be of known quality, data limitations have been documented, and overall result applicability/usability for its intended purpose has been determined, the final data assessment can be initiated by considering the answers to the following questions:

- Are the data adequate to determine the extent to which hazardous substances have migrated or to what extent they are expected to migrate from potential hazardous substance source areas?
- Do the data collected adequately characterize the nature and extent of potential hazardous substance source areas at the site?
- Are the data statistically adequate to allow evaluation on a per chemical and per media basis?
- Do the data collected allow assessment of hydrogeological factors, which may influence contaminant migration/distribution?

- Is the sample set sufficient to develop site-specific removal and disposal treatment methodologies?
- Have sufficient data been collected to evaluate how factors, including physical characteristics of the site and climate and water table fluctuations, affect contaminant fate and transport?
- Have sufficient data been collected to determine the toxicity, environmental fate, and other significant characteristics of each hazardous substance present?
- Has an adequate amount of information been gathered to determine groundwater characteristics and current and potential groundwater uses for locations close to the site?
- Is the data set sufficient to evaluate the potential extent and risk of future releases of hazardous substances, which may remain as residual contamination at the source facility?

The principal investigators, in conjunction with the project team, will formulate solutions if data gaps are found as a result of problems, biases, or trends in the analytical data or if conditions exist that were not anticipated in the development of the DQOs. It is particularly important that each data usability evaluation specifically address any limitations on the use of the data that may result from a failure to achieve the stipulated DQO.

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# Attachment A

# RTI Laboratories Corporate
# Quality Assurance Plan and Lab Certifications

# RTI Laboratories, Inc.
# LABORATORY QUALITY ASSURANCE PLAN

**RTI Laboratories, Inc.**
**31628 Glendale**
**Livonia, Michigan 48150**

**Issue Date: June 18, 2012**
**Revision 12**

Reviewed and Approved by

| | |
|---|---|
| Charles O'Bryan - Director, Quality Management | Date: June 18, 2012 |
| Fred Hoitash – Director, Environmental Sciences | Date: June 18, 2012 |
| Lloyd Kaufamn – Director Materials Sciences | Date: June 18, 2012 |

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# 1.0 INTRODUCTION

## 1.1 POLICY STATEMENT

RTI Laboratories, Inc. is committed to providing quality service to our clients. All levels of management, laboratory staff, and associated administrative personnel adhere to the guidelines detailed in this Quality Assurance Plan (QAP).

The management system established by RTI Laboratories is designed to ensure that the quality policies and procedures are adequate for compliance with all regulatory and accreditation requirements and are responsible for implementing, monitoring and enforcing all aspects of the program.

RTI Laboratories' goals are to protect our clients' interests by providing them with fully verifiable, legally defensible data that can be used for sound scientific decisions; shelter our company's two most important resources, our people and our reputation, by maintaining an environment that fosters excellence and; guard against and correct performance shortcomings which could compromise data or technical quality. All work will be performed in a professional manner and all data will be scientifically valid, of known precision and accuracy, and of a level of quality control (QC) to support the objectives of individual projects.

This program will be reviewed and revised as needed (or as a minimum annually) to address special client or project requirements and to keep pace with developing technologies, good laboratory practices and quality management. This document will remain current under the responsibility of the Director, Quality Management. A review of the QAP by the Director, Quality Management, Director, Environmental Sciences and Director, Materials Sciences will occur at least once per year.

All employees are provided a copy of this QAP electronically and are required by signature to acknowledge receipt. In addition, by signing the appropriate document employees attest that they will read, understand and comply with all policies contained in this document.

### 1.1.1 Ethics Policy Statement

Employees are expressly forbidden from accepting any form of compensation (financial or otherwise) directly or indirectly from clients in exchange for data alterations, special performance or any other service that would constitute a conflict of interest.

All data and any proprietary information pertaining to a client is considered strictly confidential and must not be disseminated to anyone that is not authorized by the client to receive such data or information.

Laboratory management will maintain an environment in which staff can perform its duties free from both internal and external influences, and at high levels of quality.

## Ethical Practices Statement

RTI Laboratories, Inc. is committed to providing an atmosphere that promotes good science and ethical behavior. The Laboratory Director and others as designated by the Director are required to complete the 8-hour online training through the American Council of Independent Laboratories (ACIL), or an equivalent program. All other employees are given 2 to 4 hours of annual ethics and data integrity training to eliminate unethical practices and instruction how to remain free of any pressures, internal or external, commercial or financial that may affect the quality of RTI data. Part of this training is the continuing affirmation to all employees that no one can personally gain from unethical behavior, and that all individuals at RTI are dependant on the actions of others for livelihood and profession in this organization and the community. After training, the employee is required to sign a statement agreeing to abide by RTI's ethics policies.

Data integrity will be continually monitored through a system of peer review, supervisory review and review by Quality Assurance personnel. Review procedures are specified in detail in Section 9 of this document.

RTI follows the ACIL Code of Ethics as the basis for training and operations. It is reprinted below.

1. To cooperate in elevating and maintaining the professional status of independent scientific, engineering and testing firms and in securing recognition of the value of services rendered by them.

2. To assert competency only in work for which adequate equipment and personnel are available or adequate preparation has been made.

3. To have a clear understanding with the client as to the extent and kind of services to be rendered, especially in fields where different grades or characters of services are offered.

4. To endeavor in reports to make clear the significance and limitations of findings reported.

5. To safeguard reports as far as possible against misinterpretation or misuse, and to contend against such misinterpretation or misuse.

6. To oppose and to refrain from incompetent and fraudulent inspection, sampling, analysis, testing, consultation, development and research work.

7. To deal honestly and fairly in all business and financial matters with employees, clients and the public.

RTI maintains a zero tolerance of unethical behavior from any employee, manager or

officer. An 'open door' policy among employees and managers provides an environment where any individual can approach management or the Director to discuss any condition that appears to be either unethical or unsafe. Key to this policy is the ability of the individual to come forward without fear of repercussion or loss of job responsibilities and/or employment. RTI recognizes that a positive approach and recognition of proper practices is the best deterrent for unethical practices.

## 1.2 FACILITY DESCRIPTION

1.2.1 Floor plans for the laboratory are maintained at the facility and are available on request.

1.2.2 RTI's two main laboratories are located in Livonia, Michigan. RTI's laboratories are full service laboratories involved in the analysis of Air, Soil, Groundwater, Waste, Metallurgy and Industrial samples. Satellite offices are located in Gaylord, Michigan and Columbia, Maryland.

## 1.3 PROGRAM OBJECTIVES

1.3.1 This QAP outlines the fundamental guidelines for Laboratory operation. The following sections will provide the foundation for ensuring that all aspects of the laboratories meet basic Quality Assurance criteria and generate analytical data of the highest quality achievable.

1.3.2 Establish a system through documented policies and procedures designed to ensure data quality and client satisfaction. Asses and document the effectiveness through meeting notes, corrective action plan, internal and external audits and proficiency testing.

1.3.3 Laboratory management is committed ensuring effective implementation of the policies and procedures established and to continual improvements in the quality program. Meeting client expectations and ensuring that the laboratory provides data that complies with statutory requirements is an integral part of the RTI quality assurance program (Refer also to Sec 2.1).

1.1.3.1 The Directors communicate these goals to staff during quarterly meetings that assess laboratory performance against established criteria.

1.1.3.2 The Client Services Manager monitors client satisfaction through client feedback from the LIMS Flashpoint system and direct communication with clients.

1.1.3.3 Weekly management meetings provide the forum for discussion of quality and production related issues and emerging or changing regulatory requirements that enable supervisors to communicate these items with staff.

1.1.3.4 Data review practices ensure compliance with data integrity procedures.

1.1.3.5 Periodic staff meetings provide the mechanism for disseminating information to all personnel.

1.3.4 The RTI QAP provides the basis for developing standard operating procedures (SOPs) specific to the method/analyte of interest. These SOPs delineate the specifications for the appropriate analytical technique and contain method specific QA/QC protocols and evaluation of QC samples.

1.3.5 This and other supplemental documents have been established to comply with ISO17025-2005, DoD QSM Version 4.2 June 5, 2003, NELAC TNI Standard 2009 and various State specific certification requirements and all other applicable regulatory, accreditation or certification requirements.

## 1.4 TESTING SCOPE

1.4.1 RTI maintains primary and secondary accreditation for several programs and accreditation bodies. The list of methods for which accreditation testing is performed is maintained in the individual scopes for each authority and are incorporated by reference in this document. The scopes of each accreditation with the applicable methods are maintained on the RTI web site for review.

## 1.4 SUPPLEMENTAL OPERATIONAL DOCUMENTS

1.4.1 In addition to this QAP, other documents have been developed to address operational aspects required by RTI or regulation. These include the ethics program document, the Employee Handbook and the Chemical Hygiene Plan. These documents are maintained to supplement the information in this QAP and are available to all employees.

## 1.5 DEPARTURES FROM POLICIES AND PROCEDURES

1.5.1 Departures from documented policies and procedures are not allowed unless requested directly to the Director, Quality Management and approved in writing by the Director.

1.5.2 All SOPs both administrative and technical will not contain language, procedures or policies that would conflict with or override any of the policies of guidelines in this document.

## 1.6 NOTIFICATION TO ACCREDITING BODIES

1.6.1 Accrediting bodies will be notified within 30 day of any significant changes in:

16.1.1 Legal, commercial, ownership or organizational status.
16.1.2 Top management or key personnel – defined as Director level personnel.
16.1.3 Main policies – defined as policy changes that would affect the accreditation status of the laboratory.
16.1.4 Resources or premises – defined as loss of physical resources that would affect the ability to perform procedures under the scope of accreditation.
16.1.5 Scope of accreditation.
16.1.6 Any matter that may affect the ability of the laboratory to fulfill accreditation requirements.

# 2.0 ORGANIZATION AND RESPONSIBILITY

## 2.1 LABORATORY OPERATIONS

RTI Laboratories' Statement of Qualifications folder electronically maintains the company organization chart and resumes listing the qualifications and experience summaries for key professionals within RTI. The Directors and Managers are responsible for and work in conjunction to set the policies and procedures for the Laboratory and have the authority and resources to fully implement the quality system. This includes but is not limited to laboratory documents pertaining to the operation of the Laboratory (i.e. QAP, SOPs, etc.). These policies and procedures are communicated to all laboratory staff through staff meetings, individual instructions, posting of documents electronically and providing copies as applicable. Laboratory staff have accessibility to management personnel for discussing any issues pertaining to the work being performed. The laboratory will maintain sufficient supervisory and management personnel in a ratio to the analytical staff that ensures adequate supervision and compliance with established policies. The Laboratory currently maintains staff to supervisor ratios in the range of 2:1 – 7:1.

### 2.1.1 TECHNICAL DIRECTOR (DIRECTOR, ENVIRONMENTAL SCIENCES/ DIRECTOR, MATERIALS SCIENCES)

2.1.1.1 The Director (Technical/Laboratory Director) is a full time member of the staff and has overall responsibility for laboratory operations. This position requires education and experience that meet the requirements of Accreditation Bodies. The Director is responsible for ensuring that all personnel strictly adhere to policies and procedures enacted to maintain laboratory data integrity, client confidentiality, the quality standards set forth in this document and compliance with accreditation Standards specified in Sec. 1.3.5. The Director manages the technical aspects of the operation either directly or through appointed supervisors reporting to the Director, is responsible for providing the resources required to comply with the policies contained in this QAP and monitors laboratory performance with regard to quality assurance adherence to ensure data accuracy. The Director maintains oversight of all personnel and ensures that the qualifications and experience are suited to the position of the employees. The Director approves all staff training and authorizes individuals to perform the tasks assigned. Staff oversight is documented through required signature on hiring and method approval. The Director maintains the organization structure of the staff through formulation of organization charts and direct assignment of duties. Other duties include special project management, client consultation and oversight of laboratory safety.

### 2.1.2 **DIRECTOR, QUALITY MANAGEMENT**

2.1.2.1 The Director, Quality Management (QA Director) reports to the General Manager and is responsible for establishing, implementing and maintaining the Quality Assurance Program, defining the policies required to comply with the objectives of the program and ensuring that achievement of the objectives can be documented. The Director maintains the authority to cease the production of laboratory data that does not conform to the objectives of this QAP and the freedom from influences either internal or external that could compromise the duties of this position. Other duties include auditing QC functions to ensure compliance with the laboratory protocols, reviewing record keeping and ancillary documents, maintaining quality control materials, and management of proficiency testing samples to ensure that the these sample are analyzed and reported in accordance with the program requirements. The Director is additionally responsible for:

- Ensuring that all personnel understand the objectives of the program and their part in contributing to the effectiveness of the quality system.
- Maintaining communication with all levels of staff to monitor the effectiveness of the program.
- Using the measures incorporated in the QAP (i.e. internal audits, PT studies, control charts, corrective action, client complaints and all other available tools) to monitor trends and continually improve the system

### 2.1.3 **SUPERVISOR, LABORATORY OPERATIONS**

2.1.3.1 The Supervisor reports to the Technical Director and is responsible for supervision of laboratory analytical staff, daily scheduling, monitoring work progress and tracking work orders. The Supervisor is responsible for ensuring that samples arriving at the laboratory are received in accordance with acceptable sampling programs and for timely logging and storage of samples. The Supervisor tracks and schedules work throughout the laboratory in order to ensure compliance with hold time requirements and client expectations. The Operations Supervisor is responsible for working with the Director, Quality Management in generating, approving and reviewing laboratory SOPs, technical compliance with the SOPs and assessment and evaluation of instrumentation. The Supervisor is further responsible for investigating analytical problems, formulating and implementing corrective actions when required and monitoring the efficacy of the corrective actions. The Supervisor works closely with the QA Director to ensure corrective actions are sufficient to both solve the initial problem and prevent future occurrences. Other duties include client consultation on technical project requirements and

review and approval of laboratory reports.

### 2.1.4 GROUP LEADER/DEPARTMENT COORDINATOR

2.1.4.1 Group Leaders/Departments Coordinators report to the Supervisor, Laboratory Operations on matters regarding the status and progress of work in progress and those pertaining to technical aspects of the operation. Group Leaders are responsible for overseeing the work performed by the technical staff. Responsibilities include coordination with the Supervisor on workload scheduling, supervision of senior staff, technical monitoring of method performance, client consultation and select project management, supply procurement and approval and, in conjunction with the QA Director, reviewing, evaluating and implementing corrective actions.

### 2.1.5 DOCUMENT CONTROL OFFICER

2.1.5.1 The Document Control Officer reports to the Technical Director and is responsible for maintaining and reviewing all documents (either internal or external) relating to the production and quality of data generated by the laboratory. The Document Control Officer maintains a master listing of all documents in current use by the laboratory and ensures that obsolete documents have been removed from use. The Document Control Officer further reviews documents for completion, adherence to correct procedures for entering and correcting information transcribed and approves (or obtains approval from the QA Director) prior to issuance of new or revised documents.

### 2.1.6 LABORATORY INFORMATION MANAGEMENT SYSTEMS (LIMS) ADMINISTRATOR

2.1.6.1 The LIMS Administrator reports to the General Manager and is responsible for maintaining the computer based laboratory management information system. The LIMS Administrator ensures the proper functioning of the system, maintains the databases within the LIMS, performs, verifies and maintains the required backup of electronic data, programs the LIMS for customized changes and verifies both system performance and modifications to the LIMS. The LIMS Administrator is further responsible for maintaining the security of the system, assignment of rights within the system (in concert with the Directors) and ensuring that all electronic data is maintained in a manner that protects data integrity and client confidentially. The LIMS Administrator is additionally charged with training of employees in both the basic use of the system and when updates or revisions are made to the LIMS. The LIMS Administrator is responsible for documenting the verification process on installation and when

revisions or modifications are made to the system.

### 2.1.7 **CHEMISTS/ANALYSTS/TECHNICIANS**

#### 2.1.7.1 Senior Staff

2.1.7.1.1 Chemists or Analysts that have the perquisite academic and practical experience are considered capable of functioning independently and supervising technicians and laboratory assistants in the performance of laboratory procedures related to their area of expertise. Senior staff will report to a Manager or Department Coordinator. Senior staff are responsible for notifying the QA Director of any situation that may impact data quality, institute corrective action procedures and implement appropriate actions according to instructions by a Manager or Director. As a general policy staff do not directly communicate with clients. However, in special instances or specific areas of expertise senior staff may consult with clients on matters regarding the status and progress of work in progress and those pertaining to technical aspects of the operation.

#### 2.1.7.2 Chemists/Analysts/Technicians

2.1.7.2.1 Personnel in these positions report to the assigned individual and are responsible for the preparation and analysis of samples or ancillary duties relating to the functioning of the laboratory.

## 2.2 ADMINISTRATIVE OPERATIONS

### 2.2.1 **GENERAL MANAGER**

2.2.1.1 The General Manager maintains responsibility for the overall operation of the facility. The main areas of responsibility are strategic planning, business development, resource allocation, and profit and loss. It is the General Manager's responsibility to obtain and develop financial resources in an effort to maintain quality services and to match resources with the market demands.

### 2.2.2 **ADMINISTRATIVE/OFFICE MANAGER**

2.2.2.1 The Administrative Manager reports to the General Manager and is responsible for maintaining personnel files, general accounting related to the business activities of RTI Laboratories, Inc., managing accounts receivable and payable and supervising the administrative

support staff.

### 2.2.3 CLIENT SERVICES MANAGER (DIRECTOR, PROJECT MANAGEMENT)

2.2.3.1 The Client Services Manager is responsible for communicating with clients or designating appropriate staff to consult with clients to ensure that all project requirements meet client specifications. The Manager oversees client requests for services, issues price quotations, manages the sample receiving staff, assigns and supervises request for sample containers and serves as that point of contact for client inquiries. The Client Services Managers works with the Technical Director/Supervisor to verify that resources and personnel are sufficient to successfully manage projects. The Manager receives and if needed delegates client requests from the on-line client service module (Omega – Flashpoint). The Manager will receive client concerns and complaints and in conjunction with the laboratory staff will address all client issues.

## 2.3 POSITION DESCRIPTIONS

2.3.1 RTI maintains job descriptions and position classifications for Laboratory and Administrative personnel.

2.3.1.1 Job descriptions detail the primary duties and responsibilities of personnel working in a particular position classification.

2.3.1.2 Position classifications set forth the minimum academic and experience qualifications necessary to qualify for a specific position.

2.3.1.3 Technical Directors are responsible for formulating and maintaining the position descriptions.

## 2.4 TRAINING

2.4.1 RTI personnel are provided with the necessary training essential to the performance of the duties assigned. In general all Laboratory employees receive and are required to abide by the policies set forth in the following documents:

2.4.1.1 RTI Policy Handbook.
2.4.1.2 Laboratory Quality Assurance Plan.
2.4.1.3 Chemical Hygiene Plan.
2.4.1.4 Method SOPs

2.4.2 Analytical personnel are trained in both general laboratory practice and specific test methods. In the latter instance, a training form (Figure 2-1) is completed to document proficiency in particular methodologies. Training forms will be maintained in the analyst's file with appropriate demonstration of proficiency and must be

approved by the Technical and QA Directors. In addition, the file will contain a list of methods for which the analyst is approved. This approval authorizes the analyst to operate the equipment and instrumentation specified in the laboratory SOP for that procedure. Elements of the training program include:

2.4.2.1 Review of applicable SOPs
2.4.2.2 Review of method references
2.4.2.3 Demonstration of method familiarity
2.4.2.4 Demonstration of method proficiency
2.4.2.5 Specific requirements for methods or accreditation/certification programs

2.4.3 During training analysts will work under the supervision of an experienced analyst that will assume responsibility for the data generated as documented by the electronic signature in the LIMS analytical sequences. Analysts undergoing training will not be provided direct access to the LIMS or computer workstations and will be unable to enter analytical data under their name.

2.4.4 In addition to internal training, RTI employees are provided with opportunities for auxiliary training. Examples of this type of training are:

2.4.3.1 Manufacturer's instrument training
2.4.3.2 Organizational courses
2.4.3.3 Seminars, conferences and workshops
2.4.3.4 Internal in-service sessions

## 2.5 CONTINGENCY PLAN FOR ABSENCE OF PERSONNEL

2.5.1 In the event the Technical Director and/or QA Director is/are absent from the laboratory, the Director will designate individuals to assume the duties of these positions as required. Generally the Technical Director and QA Director (both maintain the qualification for either position) will assume the duties of both positions in the absence of the other for any period of time. Extended absences may require the appointment of senior staff or managers to assist with the responsibilities of the absent Director. Full-time employees that are required to assume Director responsibilities will be chosen based on the ability to meet the accreditation qualifications for the position. If the absence of the Technical Director exceeds 65 consecutive calendar days the Accreditation Bodies will be informed in writing.

# Figure 2-1
# RTI Laboratories, Inc.
# ANALYST TRAINING FORM

Analyst: _____

Date:_____

Method/Test Name/Matrix/Parameters: _____

Method Reference: _____

---

Approval for this method is based on the following completed program.

____ Has read and understood the RTI Standard Operating Procedure (SOP) for the test/method.

____ Has read the official method referenced above.

____ Has become familiar with this method by observing an experienced analyst at work,

____ Has performed the method while being observed by an experienced analyst.

Has demonstrated analytical proficiency in the method by completing one or more of the following options as noted:

____ Performed a one (1) time demonstration of analytical proficiency in accordance with the precision and accuracy specifications of the official reference method.

____ Successfully analyzed ten (10) daily batches including method blanks, laboratory control samples, duplicate and spiked samples.

____ Successfully analyzed a blind performance evaluation sample.

Other Specify: _____

RTI Laboratories, Inc. certifies:

That the analyst identified on this form, using the cited test method, which is in use at this facility for the analyses of samples under the National Environmental Laboratory Accreditation Program, has met the Demonstration of Capability.
The test method was performed by the analyst identified on this form.
A copy of the test method and the laboratory-specific SOP is available for all personnel on-site.
The data associated with the demonstration of capability are true, accurate complete and self-explanatory.
All raw data (including a copy of this form) necessary to reconstruct and validate these analyses have been retained at this facility, and the associated information is organized and available for review by authorized assessors.
The approval signature below authorizes the analyst to perform the procedures and operate the equipment associated with the method.

---

Analyst`: _____
Signature Date

Approved By: _____
Signature Title Date

Approved By: _____
Signature Title Date

# 3.0 QUALITY ASSURANCE TARGETS FOR PRECISION, ACCURACY, REPRESENTATIVENESS, COMPARABILITY AND UNCERTAINTY

RTI strives to achieve the highest level of quality attainable. The targets listed below pertain to goals for assessment of sample, matrix or method criteria. Strict adherence to calibration protocols (Section 6.0), data evaluation (Section 13.0 and 9.0) and compliance with the requirements documented in the QAP are fundamental to successfully monitoring the items below. The following are assessed through specific routines described in Section 12.0. These guidelines in conjunction with the generation of Standard Operating Procedures as specified in Section 7.0 form the process for planning, implementing and assessing work performed by RTI Laboratories, Inc.

## 3.1 PRECISION

3.1.1 Precision is defined as the variation between multiple measurements made on a single sample. This defines the ability of a measurement method to produce data that has a statistically determined closeness between replicate analyses.

3.1.2 The laboratory objectives for precision are:

3.1.2.1 The laboratory strives to develop methods capable of producing the highest degree of precision attainable.

3.1.2.2 Establish statistical control limits not to exceed the precision data published in the applicable method.

3.1.2.3 In the absence of published data the laboratory adopts a target of 20% and a maximum limit of 40% with respect to internally generated precision data.

3.1.2.4 Internally developed methods or published methods that have not assessed precision of the method may generate data that exceeds 40%. The QA Director will evaluate these methods prior to use by the laboratory.

3.1.3 Precision data for individual analytes can be found in the specific SOPs and in the associated LIMS test codes.

3.1.4 Monitoring of precision is accomplished through the use of duplicate measurements on a sample or a duplicate spiked sample and calculation of the relative percent difference (RDP) for the two results (refer to Section 12.0 for additional details). RDP limits for duplicates (Omega sample types DUP, MSD and LCSD) are incorporated in the LIMS for the individual test codes in the ‘Specs’ tab for the above designated sample types. Default limits of 20% are entered in the applicable fields until statistical or required limits can be calculated, reviewed and adopted. The QA Director will review the LIMS calculated control limits. Obvious anomalous data points that are typically found due to sample homogeneity issues, high variation associated

with results near the MDL or other problems that cause extreme elevation in the control limit will be excluded at the discretion of the reviewer.

3.1.5 Precision data for MSD samples are evaluated against the RPD values published in the most current version of the DoD QSM for analytes cited in that document. Laboratory precision data must demonstrate compliance with the QSM limits by being as stringent as the QSM limits or demonstrating that the data points fall within the QSM limits. QSM limits are adopted and entered in the applicable test code.

3.1.6 For analytes or methods that by the nature of the testing procedure consistently produce RDP statistical limits in excess of 50% RTI may continue to use the default limit of 20% for control purposes. This will be based on review of the data set where the statistical data is influenced by some matrix affected samples or induced by variation that impacts the standard deviation yet produces results generally less than 20 – 40 % RPD. This decision will reside with the QA Director and will be consistent with RTI policy for striving to produce precise data, maintain the strictest practical control limits and allow for stringent review of data generated.

## 3.2 ACCURACY

3.2.1 Accuracy is defined as the ability of a measurement system to produce data that reflects the true value of the analyte in a sample.

3.2.2 The laboratory objectives for accuracy are:

3.2.2.1 Develop methods capable of producing the highest degree of accuracy attainable.

3.2.2.2 Establish statistical control limits not to exceed the precision data published in the applicable method.

3.2.2.3 In the absence of published data the laboratory adopts accuracy criteria of 80-120% recovery of the spiked concentration for laboratory control samples and 75 - 125 % recovery of the spiked concentration for matrix spikes.

3.2.2.4 Internally developed methods or published methods that have not assessed method accuracy may exceed the criteria in 3.2.2.3. The QA Manager, prior to use by the laboratory, will evaluate the accuracy data generated by the laboratory.

3.2.3 Accuracy data for individual analytes can be found in specific SOPs and in the associated LIMS test codes.

3.2.4 Monitoring of accuracy is accomplished through the use of spiked measurements on a sample or laboratory matrix and calculation of the percent recovery (refer to Section 12.0 for additional details). Recovery limits for laboratory control samples or spikes (Omega sample types MS, MSD, LCS and LCSD) are incorporated in the LIMS for the individual test codes in the 'Specs' tab for the above designated sample types. Default method limits of 80-120% and 75 – 125% (or less) are entered in the applicable fields until statistical limits can be calculated, reviewed and adopted. The QA Director will review the LIMS calculated control limits. Obvious anomalous data points that are typically found due to sample matrix issues, high variation associated with some analytes or other problems that cause extreme elevation in the control limits will be excluded at the discretion of the reviewer.

3.2.5 Accuracy data for LCS samples are evaluated against the control limits published in the most current version of the DoD QSM for the analytes cited in that document. Laboratory accuracy data must demonstrate compliance with the QSM limits by being as stringent as the QSM limits or demonstrating that the data points fall within the QSM limits. QSM limits are adopted and entered in the applicable test code for LCS and MS/MSD recovery limits.

3.2.6 For analytes or methods that by the nature of the testing procedure consistently produce extremely wide statistical limits or are cited as problem analytes in the QSM RTI may continue to use or establish default limits for control purposes. This will be based on review of the data set where the statistical data is influenced by some matrix affected samples or induced by variation that impacts the standard deviation yet produces results more consistent with the default/method limits. This decision will reside with the QA Director and will be consistent with RTI policy for striving to produce accurate data, maintain the strictest practical control limits and allow for stringent review of data generated.

## 3.3 REPRESENTATIVENESS

3.3.1. Representativeness is defined as data that accurately depicts the distinguishing characteristics of the sample source.

3.3.2 Laboratory objectives are to produce data representative of the sample submitted.

3.3.2.1 This is accomplished by standard operating procedures that ensure a representative portion of the sample is used for analysis.

3.3.2.2 Representativeness is assessed by duplicate analysis of a method-defined percentage of the samples analyzed.

## 3.4 COMPARABILITY

3.4.1 Comparability is defined as the agreement of analytical data between similar sample sets.

3.4.2 Laboratory objectives for comparability are to produce data with a high degree of precision and accuracy so that similar sample sets will demonstrate the field objectives for comparability.

3.4.2 The laboratories assess comparability through routines to assess precision and accuracy and through quality control checks.

3.4.3 The Omega LIMS has the ability to produce sample historical data.

## 3.5 UNCERTAINTY

3.5.1 Uncertainty is defined as the component of the measurement process that produces a dispersion of values that are attributed to the analytical event.

3.5.2 Laboratory objectives are to produce data with a high degree of accuracy and precision that will in turn minimize the uncertainty associated with analyses.

3.5.3 The Laboratory assesses uncertainty through the analysis of laboratory control samples with calculation of mean recovery, standard deviation and control limits. For certain procedures LCS samples may not applicable. In these instances the published uncertainty in the method will be used.

3.5.4 When applicable or required (routinely for environmental samples) analytical reports will be issued with LCS quality control summary data.

3.5.5 For methods with specific limits and specification for presentation of reported values uncertainty measurements do not apply provided the test method and reporting instructions are followed.

3.5.6 Reported sample results that are below the laboratory reporting limit but above the established MDL are flagged with a J qualifier on the analytical report. The case narrative notes that J flagged results have greater uncertainty associated with the values reported.

3.5.7 For instances where a sample result exceeds the upper calibration range and additional analysis cannot be performed to dilute the sample into range the result is flagged with an E qualifier on the analytical report. The case narrative will note that E flagged results have greater uncertainty associated with the values reported.

3.5.8 Field sampling procedures are monitored for uncertainty through manufacturer

specifications (i.e. ISCO samplers), instrument control samples (i.e. field meters) and field duplicate measurements.

# 4.0 SAMPLING PROCEDURES

RTI will perform field-sampling services for some clients and projects. Sampling services include providing personnel to assist in sampling events, collection of wastewater samples and limited air monitoring. In the above instances RTI staff adhere to guidelines and protocols established by the site/project manager or client representative and conform to established standard procedures that ensure sample integrity and a high level of quality control throughout the sampling event.

The laboratory frequently consults with clients regarding sampling methods, procedures and supplies. Sampling procedures are available in the laboratory and are used as a basis for providing clients with proper materials and methods for the collection of samples. Sampling instructions are maintained on the server in - RtiStorage on Glendaless\User\Customer and Field Services\Customer Service\Sampling instructions.

Collection procedures for drinking water samples supplied by the Michigan DNRE are maintained and provided to clients for sample collection.

The following sub-sections contain information on sample handling, materials, containers, preservatives, and shipping. This information is available to all clients requesting assistance for sampling projects and is used by RTI staff during collection of samples when required.

## 4.1 GENERAL SAMPLING GUIDELINES

4.1.1 Sample containers that are provided by the laboratory may contain measured volumes of preservative. Such containers should not be rinsed prior to filling with sample.

4.1.2 Sample containers for volatile organic analyses (VOA), pH, dissolved oxygen and TOX must be completely filled with no headspace. All other sample analyte containers should be filled to approximately 95% capacity.

4.1.3 VOA samples must be collected in a manner that minimizes disturbance of the sample and potential for volatilization. Vials are filled until the formation of a convex meniscus at the top of the vial. The septum cap is carefully placed on the vial and the vial is inverted and checked for the presence of air bubbles.

4.1.4 Field sampling equipment should be appropriately decontaminated before and after use to prevent cross contamination of samples.

4.1.5 During the collection of samples appropriate personal protective items should be worn. Gloves and safety glasses are generally the minimum acceptable level of PPE to be worn.

4.1.6 Pre-cleaned, laboratory prepared sampling containers should be used for the collection of samples whenever possible.

4.1.7 Air sampling media is maintained and provided to clients. This includes solid

sorbent tubes, membrane filters (tared, untared or treated) and impinger solutions. This media should be used in conjunction with the appropriate method using the recommended flow rate and volume guidelines.

## 4.2 SAMPLING CONTAINERS

4.2.1 The measurement of trace constituents in environmental samples demands methods capable of maximum precision and sensitivity. The selection and proper care of laboratory glassware and sample containers is an important part of the quality control program to eliminate errors due to contamination from improper cleaning procedures.

4.2.2 Only containers constructed of materials that are compatible with and non-reactive with the material to be sampled will be used. RTI uses commercial sample containers that are certified pre-cleaned to EPA standards. These containers are shipped in sealed boxes with custody seals and certificates of compliance.

Table 4-1 lists the container types, volume requirements and preservative. Also refer to specific analyte/method SOPs for additional information or for analytes/matrices not listed below.

4.2.3 The laboratory purchases air-sampling media consistent with method requirements. Cassettes used with membrane filter sampling are stored and assembled in a manner to avoid potential contamination. Cassettes are re-used only if visible soiling or damage is absent and are stringently cleaned according to procedures used for laboratory glassware (Section 6.0) prior to use.

4.2.4 Pre-weighed membrane filters are provided for gravimetric determinations. Both pre and post weighing are performed under conditions designed to obviate temperature and humidity effects.

4.2.5 Treated filters are prepared in the laboratory according to method specifications, stored under appropriate conditions and assigned an expiration date, where applicable. Purchased treated filters with expiration dates are discarded if not used by the specified date.

4.2.6 Sorbent tubes are stored under manufacturers' recommended conditions and used by the stamped expiration date or discarded on expiration.

4.2.7 Sampling containers or media for microbiological assays are prepared and stored in a manner that maintains sterility. Sampling media can be prepared for specific project requirements in consultation with the laboratory microbiologist.

4.2.8 Summa canisters are cleaned according to method requirements and are

analyzed at a frequency of >10% to ensure proper cleaning. Evacuated canisters are leak checked prior to use or shipping. Documentation of clean checks are maintained for canister tracking and provided with the canisters supplied for sampling.

4.2.9 BottleVac containers are cleaned in batches of 20 according to the SOP and are check at a frequency of 1 per batch to ensure proper cleaning. Evacuated BottleVacs are leak checked prior to use or shipping. Documentation of clean checks are maintained for container tracking and provided with the BottleVacs supplied for sampling.

## 4.3 SAMPLE PRESERVATION

4.3.1 Cooling, pH control, and chemicals to retard biological activity or to stabilize the chemical species of a sample are means to preserve the integrity of samples. Sample kits prepared by the laboratory include sample containers with the appropriate type and volume of preservative for the analyte(s) of interest. Addition of preservative to samples in the field is not normally required when using the prepared containers. This procedure minimizes the potential for incorrect or inadequate sample preservation.

4.3.2 The most common form of preservation is cooling the sample to 4$^{o}$ C using ice or refrigeration. Other common preservatives used include:

4.3.2.1 Hydrochloric acid
4.3.2.2 Nitric acid
4.3.2.3 Sulfuric acid
4.3.2.4 Sodium hydroxide
4.3.2.5 Sodium thiosulfate - for de-chlorination.
4.3.2.6 Methanol for volatile organics.
4.3.2.7 Sodium bisulfate for low level volatile organics
4.3.2.8 Brominemonochloride for low level mercury
4.3.2.9 Other preservative as stipulated by the Method (Refer to Table 4-1).

## 4.4 SAMPLE DOCUMENTATION

4.4.1 The laboratory provides sample kits containing pre-labeled and preserved sample containers. Each sample collected should be clearly labeled using waterproof ink with the following information:

4.4.1.1 Client name
4.4.1.2 Date and time of collection
4.4.1.3 Sample source
4.4.1.4 Preservative
4.4.1.5 Name(s) of sampler
4.4.1.6 Analyses requested
4.4.1.7 Sample identification

4.4.2 When assisting with or performing field sampling, personnel maintain complete and accurate records of all field activities. Bound field notebooks and/or field logs specific to the project are completed during sampling. All pertinent information on the sampling event is included in the field record.

4.4.3 Chain-of-custody - A completed chain-of custody form must accompany all samples when shipped or hand delivered to the laboratory. Information required on the chain-of-custody includes:

4.4.3.1 Name(s) of sampler(s)
4.4.3.2 Company reporting information
4.4.3.2 Sample ID
4.4.3.3 Project name and number
4.4.3.4 Analyses requested
4.4.3.5 Number of sample containers per sample
4.4.3.6 Signature and date of all individuals who have custody of the samples
4.4.3.7 Sample date and time
4.4.3.8 Requested turnaround time

## 4.5 SAMPLING EQUIPMENT DECONTAMINATION

4.5.1 In instances where field-sampling equipment is provided by the laboratory all items are appropriately pre-cleaned prior to use. Phosphate free detergent, hot tap water, and analyte free rinse water is used for this cleaning. Cleaned equipment should be wrapped or enclosed to maintain cleanliness during transport to the field. Adequate quantities of sampling equipment should be available for each sampling event to minimize the need for field decontamination.

4.5.2 Decontamination procedures for sampling equipment may include:

4.5.2.1 Phosphate-free detergent and tap water wash.
4.5.2.2 Rinse with tap water.
4.5.2.3 For equipment to be used for trace metals sampling rinse with 1:1 reagent grade nitric acid solution. **Do not rinse stainless steel sampling equipment with nitric acid.**
4.5.2.4 For equipment used for low level mercury sampling rinse with 5% hydrochloric acid.
4.5.2.4 Rinse thoroughly with deionized water.
4.5.2.5 Rinse with isopropanol or methanol.
4.5.2.6 Thoroughly rinse with analyte-free water (if available).
4.5.2.7 Air dry.
4.5.2.8 Wrap securely to prevent contamination if equipment is to be stored or transported.

4.5.3 Information on specific decontamination procedures is available in sampling and analytical manuals and references maintained at the laboratory. Special decontamination procedures will be addressed as necessary, based upon contaminants encountered.

4.5.4 Equipment that is heavily soiled may require steam cleaning and/or high-pressure washing. Drilling equipment and other heavy equipment used in field sampling activities will likely require this type of cleaning. If equipment cannot be adequately decontaminated, it should be discarded.

## 4.6 FIELD WASTE DISPOSAL PRACTICES

4.6.1 Field generated waste is disposed as required by project specifications and in accordance with applicable local, state, and federal requirements. Wastes commonly generated include drill cuttings, drilling fluids, well development water, well purge water, decontamination fluids, and contaminated personal protective equipment.

4.6.2 Based upon site and project specific requirements, liquid wastes may be containerized for characterization and disposal or discharged directly to an appropriate discharge location. Solid wastes may be containerized and left on-site for disposal or, if appropriate, disposed as general refuse.

4.6.3 Prior to initiating any sampling activity the waste handling requirements should be determined to ensure timely disposal in compliance with regulatory requirements.

## 4.7 SAMPLE SHIPPING

4.7.1 When shipping of samples is necessary all samples should be packaged in a manner to prevent damage in transit.

4.7.2 When sample refrigeration is required, samples should be shipped in a container with wet ice and in a time frame (overnight courier) designed to maintain proper temperature.

4.7.3 Analytes that are photosensitive should be immediately packaged to minimize light exposure. This is in addition to collection procedures (foil wrapping, amber bottles, etc.) required to minimize sample degradation.

4.7.4 All coolers used for transporting samples will contain a temperature blank prepared by filling a 4 oz plastic bottle with tap water (on request a 40 ml VOC vial will be used for the temperature blank).

## Table 4-1

# Sample Containers and Preservation

## CONVENTIONAL - WATER

| PARAMETER | MINIMUM VOLUME (ml) | CONTAINER TYPE | PRESERVATIVE |
|---|---|---|---|
| Acidity | 100 | P, G | Cool, 4°C |
| Alkalinity | 100 | P, G | Cool, 4°C |
| Fixed Solids (ASH) @ 550 Degrees | 100 | P, G | Cool, 4°C |
| Ash Content @ 750 Degrees | 100 | P, G | Cool, 4°C |
| Biochemical Oxygen Demand | 120 | P, G | Cool, 4°C |
| Bromide | 25 | P, G | Cool, 4°C |
| BTU | 100 | P, G | Cool, 4°C |
| Formaldehyde | 500 | G | Cool, 4°C |
| Chloride | 25 | P, G | Cool, 4°C |
| Chlorine, Total Residual | 100 | P, G | Cool, 4°C |
| Cyanide | 250 | P, G | Cool, 4°C, NaOH pH>12 |
| Cyanide, Amenable to Chlorination | 250 | P, G | Cool,,4°C,NaOH pH>12 |
| Cyanide, Available | 100 | Amber G | Ascorbic acid, NaOH pH≥12,≤12.5 |
| Chemical Oxygen Demand | 25 | G | Cool, 4°C, $H_2SO_4$, pH<2 |
| Color, Platinum-Cobalt | 50 | P, G | Cool, 4°C |
| Coliform, Fecal * | 120 | P, G | Cool, 4°C, $Na_2S_2O_3$ |
| Fecal Streptococcus * | 120 | P, G | Cool, 4°C, $Na_2S_2O_3$ |
| Coliform, Total * | 120 | P, G | Cool, 4°C, $Na_2S_2O_3$ |
| Specific Conductance | 100 | P, G | Cool, 4°C |
| Corrosivity | 250 | P, G | Cool, 4°C |
| Corrosivity (pH) | 40 | P, G | Cool, 4°C |
| Chromium, Trivalent | 200 | P, G | Cool, 4°C, $HNO_3$, pH<2 |
| Chromium, Hexavalent | 100 | P, G | Cool, 4°C NaOH, pH>8 |
| Dissolved Oxygen | 300 | G | Cool, 4°C |
| Fluoride | 25 | P, G | Cool, 4°C |
| Ignitability | 75 | P, G | Cool, 4°C |
| Fluoride, Total (Dist.) | 300 | P, G | Cool, 4°C |
| Hardness | 100 | P, G | Cool, 4°C, HNO3, pH<2 |
| Iodide | 100 | P, G | Cool, 4°C |
| Surfactants (MBAS) | 100 | Amber G | Cool, 4°C |
| Coliform Fecal (MF) * | 100 | P, G | Cool, 4°C $Na_2S_2O_3$ |
| Nitrogen, Ammonia | 100 | P, G | Cool, 4°C, $H_2SO_4$, pH<2 |
| Nitrogen, Nitrite | 50 | P, G | Cool, 4°C |
| Nitrogen, Nitrate | 50 | P, G | Cool, 4°C |
| Nitrogen, Nitrate-Nitrite | 50 | P, G | Cool, 4°C, $H_2SO_4$, pH<2 |
| Nitrogen, Organic (TKN/NH3) | 250 | P, G | Cool, 4°C, $H_2SO_4$, pH<2 |

* $Na_2S_2O_3$ is required when chlorine may present in the sample.

## Table 4-1 Cont'd

# Sample Containers and Preservation

## CONVENTIONAL - WATER

| PARAMETER | MINIMUM VOLUME (ml) | CONTAINER TYPE | PRESERVATIVE |
|---|---|---|---|
| Threshold Odor | 1000 | G | Cool, 4°C |
| Oil and Grease | 1000/500** | G | Cool, 4°C, $H_2SO_4$, pH<2 |
| Petroleum Hydrocarbons | 1000/500** | G | Cool, 4°C, $H_2SO_4$, pH<2 |
| Percent Moisture | 25 | P, G | Cool, 4°C |
| Percent Solids | 25 | P, G | Cool, 4°C |
| Paint Filter Liquids Test | 25 | P, G | Cool, 4°C |
| Phenolics, Total | 500 | G | Cool, 4°C, $H_2SO_4$, pH<2 |
| Phosphorus, Total | 50 | P, G | Cool, 4°C, $H_2SO_4$, pH<2 |
| pH Lab | 40 | P, G | Cool, 4°C |
| Orthophosphate | 50 | P, G | Cool, 4°C |
| Reactivity, Cyanide | 10 | P, G | Cool, 4°C |
| Reactivity, Sulfide | 10 | P, G | Cool, 4°C |
| Settleable Solids | 1000 | P, G | Cool, 4°C |
| Silica, Dissolved | 100 | P | Cool, 4°C |
| Specific Gravity | 50 | P, G | Cool, 4°C |
| Total (Organic) Sulfur | 100 | P, G | Cool, 4°C |
| Sulfide | 500 | P, G | Cool,4°C,Zinc Acetate, NaOH,pH>9 |
| Total Dissolved Solids | 100 | P, G | Cool, 4°C |
| Nitrogen, Total Kjeldahl | 50 | P, G | Cool, 4°C, $H_2SO_4$, pH<2 |
| Total Organic Carbon | 50 | G, Amber | Cool, 4°C, $H_2SO_4$, pH<2 |
| Total Organic Halides (subcontracted) | 100 | G, Amber | Cool, 4°C, $H_2SO_4$, pH<2 |
| Total Solids | 100 | P, G | Cool, 4°C |
| Total Suspended Solids | 100 | P, G | Cool, 4°C |
| Turbidity | 50 | P, G | Cool, 4°C |
| Volatile Dissolved Solids | 100 | P, G | Cool, 4°C |
| Total Volatile Solids | 100 | P, G | Cool, 4°C |
| Volatile Suspended Solids | 100 | P, G | Cool, 4°C |
| Volatile Acids | 150 | P, G | Cool, 4°C |

* 500 ml used for select wastewater sampling

## VOLATILE ORGANIC (VOA) - WATER

| PARAMETER | MINIMUM VOLUME | CONTAINER TYPE | PRESERVATIVE |
|---|---|---|---|
| EPA 600 or 8000 Series | 40 ml | G<br>Septa Caps | Cool, 4°C, HCl, pH<2 |

## Table 4-1 Cont'd

# Sample Containers and Preservation

## SEMIVOLATILE ORGANIC - WATER

| PARAMETER | MINIMUM VOLUME | CONTAINER TYPE | PRESERVATIVE |
|---|---|---|---|
| EPA 600 or 8000 Series | 1000 ml | Amber G | Cool, 4°C |
| Petroleum Hydrocarbons | 1000 ml | Amber G | Cool, 4° C, $H_2SO_4$, pH<2 |

## METALS - WATER

| PARAMETER | MINIMUM VOLUME | CONTAINER TYPE | PRESERVATIVE |
|---|---|---|---|
| All Metals (26) | 250 ml | P, G | $HNO_3$, pH<2 |
| Mercury | 100 ml | P, G | $HNO_3$, pH<2 |
| Chromium, Hexavalent | 100 ml | P, G | Cool, 4°C, NaOH pH>8 |

## TCLP - WATER

| PARAMETER | MINIMUM VOLUME | CONTAINER TYPE | PRESERVATIVE |
|---|---|---|---|
| TCLP Volatiles | 250 ml | G | Cool, 4°C |
| TCLP Semi-Volatiles | 1000 ml | G | Cool, 4°C |
| TCLP Pesticides | 1000 ml | G | Cool, 4°C |
| TCLP Herbicides | 1000 ml | G | Cool, 4°C |
| TCLP Metals | 500 ml | G | Cool, 4°C |

## AIR ANALYSES

| PARAMETER | MEDIA |
|---|---|
| Metals | Mixed Cellulose Ester Filter |
| Total Dust | PVC Tared or Matched Weight (37mm) |
| Welding Fumes | MCEF Tared or Matched Weight (37mm) |
| Alkalinity (Sodium Hydroxide & Potassium Hydroxide) | Mixed Cellulose Ester Filter |
| Cyanide Aerosol (Cyanide gasses absorbing solution) | MCEF Untared (37mm) |
| Respirable Dust | Poly Vinyl Chloride |
| Silica | PVC Tared (37mm) |
| Chromium IV | Poly Vinyl Chloride PVC Untared (37mm) |
| Coal Tar Pitch Volatiles (Benzene Solubles) | Glass fiber |
| Oil Mist (by Weight or IR) | GF Tared (37mm) |
| Fluoride - Set | Untared MCEF & Treated pad (2 37mm cassettes) |

## Table 4-1 Cont'd

# Sample Containers and Preservation

## AIR ANALYSES

| PARAMETER | MEDIA |
|---|---|
| Cyanide, gas | 15mls, 0.1 N KOH |
| Gluteraldehyde | Treated filter |
| Isocyanates (MDI,TDI,HDI) | Treated filter |
| Sulfur (Dioxide/ Oxides of sulfur) | Treated filter |
| Acids | Cleaned silica gel sorbent tube |
| Particulates TSP | Glass Fiber Filter (8" x 10") - Tared |
| Particulates PM10 | Quartz Fiber Filter (8" x 10") - Tared |
| Volatile Organics Solvents - Common IH | Coconut Shell Charcoal Sorbent Tubes |
| Volatile Organics - Ambient Air | Summa Canisters, BottleVacs and Carbo Trap 300 Tubes |
| Volatile Organics - Other | Silica Gel, XAD Resins, etc., (Consult Appropriate Method) |
| Formaldehyde - IH<br>15ml 1% Sodium Bisulfate | Treated - XAD-2 (i.e., Orbo 23/24) |
| Formaldehyde - Ambient Air | DMPH Solution or DMPH Coated Cartridges |
| Polynuclear Aromatic Hydrocarbons - IH | Teflon Filter + XAD-2 Sorbent Tube |
| Polynuclear Aromatic Hydrocarbons - Ambient Air | Glass Fiber Filter /PUF/XAD/PUF |
| Polychlorinated Biphenols (PCB's) - IH | Glass Fiber Filter + Fluorosil |
| Polychlorinated Biphenols (PCB's) - Ambient Air | Glass Fiber Filter + PUF |
| Pesticides - IH | Glass Fiber Filter (May Require other media, Consult Method) |
| Pesticides - Ambient Air | Glass Fiber Filter + PUF |
| Other Semi-Volatile Organics | Various Media (Consult Method) |
| Microbiological sampling media | Prepared as requested |

**NOTE:**

**Tared filters have a 5 digit number affixed to the cassette**

1. P - Polyethylene (preferred when acceptable).
2. G = Borosilicate glass with Teflon lined cap.
3. Triple the volumes above for MS/MSD samples.
4. For treated filters or impinger solutions please contact the lab.

## Soils

**Soil sample containers are generally wide mouth glass (4-8 oz.). Soil volatile organics require methanol preservation or low-level preservation techniques (refer to 8260 SOP).**

# 5.0 SAMPLE RECEIPT AND CUSTODY PROCEDURES

## 5.1 SAMPLE CUSTODY DEFINITION

5.1.1 A sample or evidence file is in a person's custody if one or more of the following occur.

5.1.1.1 The item is in actual possession.
5.1.1.2 The item is in view following actual possession.
5.1.1.3 The item was in actual possession but is locked up to prevent tampering.
5.1.1.4 The item is in a designated and identified secure area.

5.1.2 RTI Laboratories are maintained as secure locations with controlled access.

5.1.3 Under normal custody procedures all samples are considered in the possession of the sample custodian or laboratory personnel that have received the sample transfer as documented in the LIMS sample tracker module.

5.1.4 Custody procedures include:

5.1.4.1 Samples maintained under limited access conditions (sample custodian or designated personnel only have access until the samples are ready for preparation or analysis).

5.1.4.2 All transfers of samples will be documented.

5.1.4.3 The LIMS system provides for sample tracking and strict internal transfers of samples with appropriate documentation of the transfers

5.1.4.4 Procedures for legal/evidentiary chain of custody are established and specified in the SOP for sample receipt and custody.

## 5.2 SAMPLE RECEIPT

5.2.1 All samples received are accepted by and signed in the "received by Laboratory" section of the chain of custody by Laboratory personnel.

5.2.2 Samples or sample containers are delivered directly to sample log in immediately upon receipt.

5.2.3 RTI personnel that are assigned to pick up samples from a client location are required to ensure that the samples have been signed as relinquished, verify sample containers agree with the Chain of Custody and sign for receipt on the Chain of Custody. These personnel will then relinquish the samples to the Laboratory sample custodian.

5.2.4 Personnel that are assigned to collect samples will initiate and complete a Chain of Custody form and follow all appropriate procedures.

## 5.3 VERIFICATION AND INSPECTION

5.3.1 The sample custodian verifies that custody seals are in place (where applicable), notes any damage to exterior containers or to samples and ensures all documents have been included.

5.3.1.1 Damaged samples or containers are moved to a hood and a supervisor is notified.

5.3.1.2 Damage is assessed and samples are either rejected or accepted at the supervisor's discretion. The client is notified if samples are rejected or if the damage may affect the analytical process.

5.3.1.3 Temperatures of samples are taken upon opening and recorded in the checklist for each work order. Checklists are maintained electronically in the LIMS for each work order and contain all the necessary information required to assess sample acceptance.

5.3.1.4 For damaged soil jars noted in containers originating from regulated areas (foreign or US regulated areas) under the United States Department of Agriculture (USDA) Compliance Agreement any loose material must be transferred to a container, segregated with the accompanying samples and disposed according to the procedures in Section 5.6.

5.3.2 The sample custodian verifies that the identification and number of samples match the chain of custody and that the chain of custody has been properly filled out. Any problems are brought to the attention of the client or sampler before proceeding.

5.3.3 The sample custodian compares the request for analysis to the samples received. The following are checked:

5.3.3.1 The proper container was used and enough volume submitted.

5.3.3.2 Methods requested by the client. If a method requested is inappropriate or out of date the client must be contacted.

5.3.3.3 Holding times have not been exceeded.

5.3.3.4 Preservative is noted on containers where appropriate to the analytical request.

5.3.3.5 Free chlorine determinations are conducted for analyses requiring the checking for the presence of free chlorine and noted on the sample receipt form.

NOTE: Proper preservation is verified on sample receipt. A small volume of sample is transferred to a separate container and the pH, chlorine concentration or other parameters as needed are checked and documented on the chain of custody and sample receipt check list. Under no circumstances will any device be introduced directly into the sample. This procedure does not apply to samples submitted for volatiles or other analyses that require maintenance of zero headspace. Preservation checking will be preformed following analysis of the sample.

5.3.4 The sample receipt checklist attached to the work order in the LIMS is completed and the notification form sent to the client when required.

## 5.4 SAMPLE LOG IN AND STORAGE

5.4.1 The sample custodian logs all samples into the Laboratory LIMS (Laboratory Information Management System - Omega) according to the SOP for Sample Receipt and Custody (SRC001-A).

5.4.2 The appropriate information is entered into Omega.

5.4.3 Sample numbers are automatically assigned by the LIMS and are unique for each sample and fraction. In addition the LIMS provides the ability to designate the number of containers associated with a sample and assigns a unique Container X of X designation for each container.

5.4.4 Sample labels and log sheets are printed.

5.4.5 Sample labels containing the Laboratory identification number are placed on the corresponding sample. This number will be used to track the sample through the analytical process. Samples received under the USDA soil permit are clearly labeled as such and segregated.

5.4.5.1 All necessary analytical sub sets taken from the original sample container will include this number.

5.4.5.2 All digestion solutions, extracts or other sample preparation aliquots will have this number on the appropriate containers.

5.4.5.3 Information entered into logbooks, computer data files, instrument data handling systems or any other will contain the applicable sample number.

5.4.5.4 Analytical data imported or entered into the LIMS will occur via the associated sample number.

5.4.5.5 This number will be used to track and identify the sample throughout the analytical process.

5.4.6 The Client Services Manager or designated personnel will log review all work orders for accurate logging of the samples submitted and enter the date of review in Omega. Required corrections to the work order will be made prior to completing log review. Once the log review process has been completed, changes to the work order cannot be made without the necessary authority assigned through specified user credentials incorporated in the LIMS. A Director/Manager or the LIMS Administrator are the only individuals with the authority to change a work order that has been log reviewed.

5.4.7 Samples are placed in the walk-in refrigerator, designated area in the laboratory or segregated storage. Designated sample storage areas are incorporated into the LIMS and used to track the location of samples. Sample storage areas are under direct surveillance of the sample custodian or assigned laboratory personnel and are securely maintained.

## 5.5 INTERNAL TRANSFERS

5.5.1 All internal transfers are documented in the Sample Tracker module of the LIMS.

5.5.2 All persons taking possession of the sample will document the transfer by posting the change in the Sample Tracker.

5.5.3 All transfers will contain the person or location that the samples were transferred from and the individual that is initiating the transfer.

5.5.4 Samples are tracked from log in through disposal.

## 5.6 SAMPLE RETENTION/DISPOSAL

5.6.1 Samples and extracts will be stored in designated areas within the laboratory and all samples will be able to be tracked through the LIMS.

5.6.2 Sample and/or sample extracts are stored for a period of thirty (30) days (or as stipulated by contract). Exceptions are samples/extracts that are completely consumed or used for analysis (i.e., thermally desorbed air samples), carbon disulfide desorbed charcoal (no storage time beyond analysis).

5.6.3 Sample disposal logs are generated by the LIMS and supplied to the individual designated for disposing of samples/sample extracts.

5.6.4 At the expiration of the storage period, samples are disposed by the following means. All waste disposals, hazardous or otherwise, comply with all local, state and federal regulations.

5.6.4.1 Soil samples are composited and disposed to a sanitary landfill or composited into drums and disposed by a subcontracted disposal company.

5.6.4.2 Surface water, ground water and drinking water samples are discharged to the local POTW.

5.6.4.3 Highly acidic or basic extracts are composited in acid waste and alkaline waste drums respectively and disposed by a subcontract disposal company.

5.6.4.4 Organic solvents are composited in an appropriate metal drum and disposed by a subcontract disposal company.

5.6.4.5 Asbestos waste is double bagged in labeled asbestos bags and sent to an appropriate landfill.

5.6.4.6 Soil/solid samples received under the USDA soil permit (Refer also to SOP SRC001-A_R1) are disposed as follows:

5.6.4.6.1 Samples are heated in a drying oven for one of the specified times and temperatures below:

| | | |
|---|---|---|
| 5.6.4.6.1.1 | 100 – 120.5 | degrees C for 16 hours |
| 5.6.4.6.1.2 | 121 – 154 | degrees C for 2 hours |
| 5.6.4.6.1.3 | 154.5 – 192.5 | degrees C for 30 minutes |
| 5.6.4.6.1.4 | 193 – 220 | degrees C for 4 minutes |
| 5.6.4.6.1.5 | 221 – 232 | degrees C for 2 minutes |

5.6.4.6.2 The heating time and temperature are recorded in the disposal logbook.

5.6.4.6.3 Samples are removed from the oven, allowed to cool and re-heated following steps 5.6.4.6.1 and 5.6.4.6.2 above.

5.6.4.6.4 Following heat treatment, samples are disposed according to 5.6.4.1.

5.6.5 The laboratory maintains manifest records for applicable waste disposal.

5.6.6 RTI maintains an EPA small generator number and is registered with local, state and federal agencies maintaining jurisdiction over waste disposal practices.

## 5.7 SAMPLE SECURITY

5.7.1 Sample storage areas are located within the laboratory portion of the individual facilities. Laboratories are controlled access areas within the facilities.

5.7.2 The main sample storage refrigerators are under strict controlled access and surveillance. Only selected personnel have access to the sample storage units and the area is monitored by the sample custodian or designated individual. All samples, extracts and digests will be stored in secured segregated areas.

## 5.8 LABORATORY BUILDING SECURITY

5.8.1 All access doors to the buildings, with the exception of the main entrances are posted with signs that state “No Admittance, Employees Only” and instruct all visitors and vendors to the main entrance. Only select RTI employees have keys to the access doors to the buildings. The main entrance is unlocked only on business days between the hours of 8:00 AM and 5:00 PM. The facilities are also equipped with electronic alarm systems and employees are assigned unique pass codes for entry.

5.8.2 Employee Access

5.8.2.1 Employees enter and leave the building through the main entrance and log the times of arrival and departure on the log located in the main lobby. Employees sign/initial the log with each entry. Keys and pass codes are required for the main entrance during non business hours.

5.8.3 Visitors, Vendors and Deliveries

5.8.3.1 All visitors to the office or laboratory must enter the main lobby through the main entrance and check in with the receptionist. A sign in log is located at the reception station. Visitors must be escorted at all times and in all areas of the facility.

5.8.3.2 Vendors and delivery personnel after check in may be directed to use the door to the Shipping and Receiving area. An RTI employee will provide access to this door and, upon entrance, the visitor must be escorted at all times.

## 5.9 SAMPLE SUBCONTRACTING/SHIPPING

5.9.1 For certain projects, it may be necessary for RTI to subcontract some analyses. Prior arrangements will have been made with the client or the client is contacted regarding the need to subcontract samples. Notification of sub-contracting will be provided to the client in writing (in cases were sample analyses are routinely sub-contracted and the client has approved the arrangements subsequent written notifications are not necessary). Client approvals for sub-contracting will be preferably maintained in written form and attached to the client electronic file in the liked files section in Omega. Samples will be shipped to the contracted laboratory in approved sample containers. Samples requiring refrigeration will be shipped in coolers

containing a combination of ice packs and wet ice to maintain the temperature at 4$^{o}$C.

5.9.2 All Chain of Custody forms and any pertinent paperwork will be included with the samples.

5.93 Subcontracted analyses will be sent to a laboratory specified by the client or when not specified to a laboratory that maintains the required certification (NELAC, DoD ELAP, etc.) applicable to the project.

5.9.4 Procurement of subcontract laboratories will occur by verifying the laboratory's certifications. The laboratory maintains a listing of sub-contractors in the vendor section of the LIMS with any notations of certifications or any required documentation. For analyses that are either outside of the scope of the certifying authority or that do not require a specific certification the laboratory will be chosen based on one or more of the following:

5.9.4.1 Ability to perform the required methodology.
5.9.4.2 Prior experience with the laboratory.
5.9.4.3 Laboratory reputation or client recommendation.
5.9.4.4 Review of PE data (where applicable).
5.9.4.5 Review of laboratory QAP and/or SOP's.
5.9.4.6 On-site review of the laboratory.

5.9.5 Projects performed under certain programs or agencies (i.e. DoD, USACE, CLP, etc) require subcontracted work to be sent to laboratories approved by the agency or the client of the agency. In these instances all documentation pertaining to the approval and subsequent subcontracting will be maintained.

## 5.10 CLIENT COMMUNICATIONS

5.10.1 Client contracts are reviewed by the General Manager, Director, Sales and Marketing or Laboratory Director to ensure that the laboratory can meet the requirements for a particular project.

5.10.2 RTI will maintain a strict policy of client confidentiality. Any information, results or communication with a client will not be disseminated to any outside party without authorization in writing from the client.

5.10.3 Procedures for client complaints and communication:

5.10.3.1 Identify and document client concern either within the LIMS work order, on the work order summary sheet or chain of custody.

5.10.3.2 Retrieve any necessary pertinent information.

5.10.3.3 Discuss problem with the Technical Director or appropriate management personnel.

5.10.3.4 A Director, a Manager or designated individual will contact the client to discuss the findings of the laboratory.

5.10.3.5 If a change to the analytical report is required, the changes will be made (and if appropriate any changes on raw data logs will be initialed and dated by the person making such changes) and the report will be issued with a notation of revised report.

5.10.4 A Director, Manager or designated individual will consult with the client on matters pertaining to project data quality objectives. These will include situations where incorrect methods may be requested, instances where sample matrix or type may impact method performance, clarification on project DQOs and issues regarding sample collection and handling.

# 6.0 CALIBRATION PROCEDURES, STANDARDS AND REAGENTS

## 6.1 INSTRUMENT CALIBRATION

6.1.1 Calibration procedures for specific instrumentation are documented in the method specific SOP. The initial calibration (including required number of data points), initial calibration verification and continuing calibration procedures and frequencies are specified. (See summary Table 6-2 – in cases of inconsistencies with method specific SOPs, the procedures in the SOP with take precedence over the Table). In all instances the calibration requirements of the reference method, accreditation program or project specifications will be followed.

6.1.1.1 Proper use and operation of testing equipment is ensured through:

6.1.1.1.1 Instructions provided by the manufacturer on installation of equipment.

6.1.1.1.2 External training where applicable.

6.1.1.1.3 Internal training by supervisors or senior staff experienced in the proper operation of the equipment.

6.1.1.1.4 Quality control procedures designed to monitor equipment performance and detect deviations that could jeopardize analytical results.

6.1.1.1.5 Compliance with accreditation standards, regulatory requirements and reference methods. In instances where it is not apparent which standard is more stringent the requirements of the regulation or test method will be followed.

6.1.2 At a minimum all instruments undergo a calibration or calibration verification daily or with each use.

6.1.3 Initial calibrations must be performed using continuous standard data points. Dropping non-contiguous calibration standards is not allowed unless technical justification is documented. Standards used for calibration must be obtained from a vendor certified by ISO Guide 34.

6.1.4 The lowest standard in a calibration must be at a level equal to or less than the Limit of Quantification (LOQ)/ Reporting Limit (RL).

6.1.5 The criteria for evaluating the calibration (i.e. linearity, %RSD) and the acceptance values are contained within the appropriate section of the SOP and conform to method specifications where applicable.

6.1.6 All initial calibrations are verified with an independently prepared calibration verification solution at a concentration between the mid-point of the calibration curve and the lowest calibration standard. The second source standard must be from a different vendor unless no other source is available. In the case that a second vendor is not available for a particular standard a different lot from the calibration standards must be obtained. Standards used for verification must be obtained from a vendor certified by ISO Guide 34. If a second source standard is not available for a specific analyte a calibration verification standard is prepared independently from the calibration standards by a different person.

6.1.7 Continuing calibration verification is performed after every ten samples analyzed unless specified otherwise in the method SOP.

6.1.8 All raw data records to allow reconstruction of the calibration and calibration verification will be maintained for 7 years.

6.1.9 Sample data must be quantified from the current and applicable initial calibration.

6.1.10 Calibration records are maintained for all initial calibrations performed and are able to be traced to any samples analyzed using that calibration.

6.1.11 Instruments under service contract are serviced and calibrated at least yearly by a service engineer. Instruments not covered are serviced by RTI staff according to the manufacturers recommended guidelines and documented in instrument logs (section 6.2)

6.1.12 Balances are cleaned and calibrated annually by a subcontracted firm. Balances are checked on each use and the weight recorded. Check weights must be within the criteria specified in Table 6-2.

6.1.13 Thermometers are verified once per year against a NIST standard thermometer. The NIST thermometers are calibrated once per year by an outside vendor. Verifications will be performed at two temperatures bracketing the temperature of use. Electronic thermometers are verified on a quarterly basis at two temperatures bracketing the range of use.

6.1.13.1 Thermometer verifications that result in the necessity to apply correction factors will be recorded and the applicable factor applied to the readings.

6.1.13.2 Thermometers must meet specifications listed in Table 6-2

6.1.14 Prior to each use balances, ovens, refrigerators, freezers, water baths and hot blocks will be checked in the range of use. Checks will be documented on the appropriate log that will contain the acceptance criteria and date and person performing the verification. Specifications are listed in Table 6-2.

6.1.15 Equipment used in the analytical processes (extraction apparatus, distillers, autoclaves, etc) must be calibrated and verified at least annually. Documentation of the calibration/verification must be maintained in the Omega maintenance logs or on the applicable bench logs.

6.1.16 Ovens, refrigerators and incubators used for sample storage or preparation have temperatures recorded daily at a minimum and more often if necessary.

6.1.17 Class A volumetric measuring devices (micro liter syringes are considered as Class A) must have a certificate with the accuracy determined by the manufacturer. Devices that do not have certificates must be assessed for acceptability of use by the laboratory and documented. Other measuring devices (Class B and non-volumetric) must be verified according to Table 6-2.

6.1.18 Mechanical measuring devices such as pipettes must be checked quarterly. This is performed by verifying the volume at the maximum of the device with ten readings. The mean of the ten reading must be within 2% of the expected volume. Additional checks at volumes in the mid range and the low level are performed by taking 5 readings.

6.1.19 For autoclaves the temperature, cycle time and pressure must be monitored for suitability by appropriate indicators and recording of readings.

6.1.20 Instrumentation that has been deemed to be inoperable due to failure to meet the calibration requirements specified in the method or has demonstrated a condition that requires it to be removed from operation will be tagged to indicate that this instrument is not currently operable and cannot be used for any sample analyses.

6.18.1.1 Information will be visibly displayed to indicate that the equipment is “Out of Service” and the date that the instrument was removed from operation. Once the instrument has been tagged out of service only the QA Director, Laboratory Supervisor or Laboratory Director can remove the tag following verification of the appropriate corrective action measures.

6.18.1.2 Any samples that were analyzed during a instrument malfunction are to be designated for re-analysis either by a backup instrument or by the original instrument when it becomes satisfactorily operational.

6.18.1.3 All corrective actions taken to restore an instrument to an operational condition will be documented in the LIMS maintenance logs. The QA Director, Laboratory Supervisor or Laboratory Director will review the corrective actions and verify that adequate calibration is attainable.

6.18.1.4 Acceptable corrective actions will be initialed by the QA Director, Laboratory Supervisor or Laboratory Director who will then remove the out of service tag from the instrument.

6.1.21 All apparatus and consumable supplies will be assessed to ensure that the requirements and specifications of any testing procedure will be met. Records of the verifications will be maintained. Procedures for ensuring materials are suitable for use include:

6.1.21.1 Certificates from the manufacturer reviewed for compliance.

6.1.21.2 Laboratory verifications for materials that are not certified by the manufacturer that ensure that the material is acceptable for use including volume checks, contamination checks, purity verification and any other required by the reference method.

6.1.20 Equipment services are provided by instrument manufacturer's technicians or other service representatives possessing the necessary qualifications and experience to service equipment. Laboratory management is responsible for securing the appropriate service companies.

## 6.2 EQUIPMENT/INSTRUMENT LOGS

6.2.1 All instruments are logged in the Omega LIMS with the applicable information for each instrument. Some analytical instruments may have logs that were initiated on installation or initial use (appropriate information is transferred to the LIMS with initial logs maintained for reference). The Omega instrument files contain any routine procedures and specified frequency required to maintain the instrument. Information in these files include:

6.2.1.1 Instrument identification
6.2.1.2 Serial Number
6.2.1.3 Installation Date
6.2.1.4 Notations for required maintenance and date
6.2.1.5 Maintenance (preventative or problematic) performed either internally or by a manufacturer's service engineer.

## 6.3 CHEMICALS, STANDARDS AND STANDARD LOGS

6.3.1 All chemicals received at the laboratory are logged in the Omega LIMS chemical inventory and assigned a unique number that will be used to reference any uses of this material. The information in the chemical inventory will be entered completely and include identity, date received, lot number, expiration data and containers.

6.3.2 LIMS logs will include all information regarding the traceability, purity, dates of

preparation, expiration dates, person preparing and unique identification. Expiration and storage information is specified in the applicable method SOP.

6.3.1 Upon receipt standards are immediately delivered to the area of the laboratory in which they will be used.

6.3.2 A supervisor or analyst will place the date received on the label and put the standard in the designated storage area and log the standard in the LIMS.

6.3.3 Standards will be segregated as to type (i.e. organics, acids, etc.) and stored under proper conditions. For example, volatile organic standards are stored in a separate freezer from samples or any other standard materials or reagents.

6.3.4 Certifications or lot analyses containing purity assays accompanying the standards are kept on file in the laboratory in proximity to the standard material or scanned and linked in Omega (in which case the hard copy certificate is not retained).

6.3.5 MSDS sheets provided with standards or reagents are filed in the laboratory and accessible to all laboratory personnel.

6.3.6 Standard logs are maintained electronically in the LIMS to document the preparation of stock, intermediate and working standards. All standards will be assigned a unique standard identification. These logs will contain as a minimum:

6.3.6.1 Standard Name
6.3.6.2 Analyte and lot number
6.3.6.3 Amount used
6.3.6.4 Dilution volume
6.3.6.5 Final concentration
6.3.6.6 Initials and date
6.3.6.7 Expiration date

6.3.7 Standards are purchased as neat materials, commercially prepared solutions or certified standard reference materials.

6.3.7.1 When neat materials are used to prepare a stock standard the appropriate information is noted on the standards section of the LIMS including the purity of the reference material.

6.3.7.2 Commercially prepared solutions used as stock standards are logged in the LIMS with the appropriate information on the standard log.

6.3.7.3 LIMS standard logs include primary (stock), secondary, tertiary and neat standards. All information for the preparation of the standards

including any reagents used will be recorded in the LIMS standard log. Certificates of analysis are electronically attached in the LIMS standard log.

6.3.7.4 Standards are required to be obtained from a vendor certified by ISO Guide 34. Certification is noted in the Vendor Section of the LIMS.

6.3.8 All intermediate and working standards prepared are logged in the LIMS. The preparation of the appropriate standard and the shelf life are specified in SOP for the particular analyte.

6.3.9 All standards used for the analysis of samples are logged in the analytical sequence for each analytical event. All sample analysis will be able to be traced to the standards used for calibration and calibration verification.

6.3.10 Standards used in the preparation of quality control samples (LCS, MS/MSD) will be logged in the sample preparation section of the LIMS for each batch or in the analytical sequence if sample preparation is not a part of the procedure. All batch QC samples will be able to be traced to the standards used for the preparation of the quality control samples.

## 6.4 CONTROL OF PURCHASED ITEMS AND SERVICES

6.4.1 Laboratory vendors are chosen based on the quality of items provided and the ability to service the laboratory's need. All decisions to use any particular vendor are made by laboratory management.

6.4.2 Analysts submit requisitions for supplies to a Department Coordinator, Supervisor or Director for approval. The Office Administrator assigns a purchase order number and orders the requested items from the vendors used by the Laboratory. Individual items in excess of $500 require approval by the General Manager/President.

6.4.3 Vendors are qualified based on their ability to:

6.4.3.1 Stock and deliver the items normally requested by the Laboratory.

6.4.3.2 Possess the items required by the Laboratory in the necessary purity and level of quality required by the Laboratory.

6.4.3.3 Provide the most competitive price for the items and required level of quality.

6.4.3.4 Meet any applicable accreditation requirements.

6.4.4 Reagents and standards must meet the minimum requirements specified in

the method or at minimum be within the specification noted below and within acceptable general laboratory practices.

## 6.5 REAGENTS

6.5.1 Upon receipt, reagents are immediately delivered to the area of the laboratory in which they will be used.

6.5.2 A supervisor or analyst will place the date received on the label and put the reagent in the designated storage area and enter the appropriate information in the LIMS chemical inventory as specified in Sec, 6.3.1.

6.5.3 Reagents will be segregated as to type (i.e. organics, acids, etc.) and stored under proper conditions. For example, volatile organics are stored in a cabinet designed for flammable materials, separated from samples or any other standard materials or reagents.

6.5.4 Certifications or lot analyses accompanying the reagents are electronically attached in the LIMS.

6.5.5 The grade of reagent purchased is consistent with the intended need for the method being employed. Ultra pure chemicals (i.e. acids and solvents) are used for trace analyses (i.e. ICP/MS, Trace volatile analyses, etc.) Most other reagents are reagent grade (AR) or conform to method specifications.

6.5.6 MSDS sheets provided with reagents are filed in the laboratory and accessible to all laboratory personnel.

6.5.7 The LIMS reagent section is used to document the preparation of various solutions used in certain methodologies. Reagent preparation information is completed in the LIMS with traceability to the chemicals logged in the chemical inventory.

6.5.8 Reagent storage conditions are specified in the analytical SOP.

6.5.9 All reagents and standards prepared must be logged in the LIMS and labeled with a minimum:

6.5.9.1 Identity of the material
6.5.9.2 Concentration of the solution
6.5.9.3 Date prepared
6.5.9.4 Initials of analyst preparing the solution
6.5.9.5 Expiration date.

## 6.6 GLASSWARE/STORAGE CONTAINERS

6.6.1 The type of glassware, pipettes, storage containers, etc. required for each method is specified in the SOP. In general, designated Class A volumetric glassware and pipettes are used for the following applications:

6.6.1.1 Preparation of primary standards

6.6.1.2 Preparation and dilution of stock standards

6.6.1.3 Reagent standardization

6.6.1.4 As specified in the method

6.6.2 All reusable glassware is scrupulously cleaned before reuse. Table 6-1 summarizes the general glassware cleaning procedures. This procedure is posted in the glassware washing area.

**TABLE 6-1**

# LAB GLASSWARE CLEANING PROCEDURES

| Analysis/Parameter | | Cleaning Procedure (in order specified) |
|---|---|---|
| Extractable Organics (including Pesticides and Herbicides) | | 1-3, 6, 7, 13 |
| Volatile Organics | | Use either disposable glassware or steps 1, 2, 3, 16, 4 |
| Trace Metals - | glass | 1-6, |
| | plastic | 1-4, 15, 6 |
| Nutrients | | 1-4, 12 |
| Minerals, COD, BOD, Radiochemistry, Cyanide, Phenols | | 1-4, 12 |
| Residues | | 1-4, 9 or 10, 12 |
| MBAS | | 1-4, 14, 12 |
| Petroleum Hydrocarbons | | 1-4, 7, 14, 13 |
| Oil & Grease | | 1-4, 7, 14, 9, 13 |

Cleaning Procedures (bottles and septa):

1. Remove all labels using sponge or acetone.
2. Wash with hot tap water and a brush to scrub inside of glassware, stopcocks, and other small pieces, if possible, using a suitable laboratory-grade detergent.
   - Organics - Liquinox, Alconox or equivalents
   - Inorganic anions - Liquinox or equivalent
   - Inorganic cations - Liquinox, Alconox, Micro or equivalents
   - Bacteriologicals - must pass an inhibitory residue test
3. Rinse thoroughly with hot tap water.
4. Rinse thoroughly with deionized water.
5. Rinse or soak with 10% Nitric Acid.
6. Rinse 3 times with deionized water.
7. Rinse thoroughly with pesticide grade Acetone.
8. Rinse thoroughly with pesticide grade Hexane.
9. Bake at 105 $^{o}$C for 3-4 hours.
10. Bake at 180 $^{o}$C for 3-4 hours (prior to use as per method).
11. After use, rinse with last solvent used.
12. Store inverted or capped with suitable material or suitable container stopper.
13. Last step (prior to use) should be a rinse with the solvent used in analysis.
14. Rinse thoroughly with acetone.
15. Rinse or soak with 1:1 HCl (Hydrochloric Acid).
16. Rinse with purge and trap grade Methanol.

# Table 6 -2
# INSTRUMENT CALIBRATION SUMMARY

| Instrument | Method Reference | # Standards Initial Calibration | Acceptance Rejection Criteria – Initial Calibration | Frequency of Calibration | Frequency of Initial Calibration Verification | Acceptance/Rejection Criteria - Initial Calibration Verification | Frequency of Continuing Calibration Verification | Acceptance/Rejection Criteria – Continuing Calibration Verification |
|---|---|---|---|---|---|---|---|---|
| **Thermometers** | Dod QSM, Version 4.2 | Two temperatures that bracket the target temp. | +/- 0.1 degree C or correction factor applied | On receipt | | | Annually for liquid in glass. Quarterly for electronic devices. | +/- 0.1 degree C or correction factor applied |
| **Refrigerators/freezers** | Dod QSM, Version 4.2 | | Refrigerators – 0-6 degrees C<br>Freezers - < -10 degrees C | On receipt | | | Daily (7 day per week) | Refrigerators – 0-6 degrees C<br>Freezers - < -10 degrees C |
| **Class B Volumetric Glassware or Class A when required for verification** | Dod QSM, Version 4.2 | | 3% of expected, <3% RSD, based on 10 replicates | Each lot before first use. | On evidence of deterioration | | | |
| **Non Volumetric Glassware** | Dod QSM, Version 4.2 | | 2% of expected, <1% RSD, based on 10 replicates | Each lot before first use. | On evidence of deterioration | | | |
| **Mechanical Pipettes** | Dod QSM, Version 4.2 | | 2%of expected – precision <1%RSD, based on 10 replicates | Quarterl | | | | |
| **Ovens** | Dod QSM, Version 4.2 | | Within 5% of set temp. | On receipt | | | Each use | Within 5% of set temp, |
| **Balances** | Dod QSM, Version 4.2 | | Passes service specifications | Annually | | | Daily (each use) | The larger of +/-0.1% or +/- 0.05 mg –Analytical<br>The larger of +/- 2% or +/- 0.02 g – Top loading |
| **Balnace weights** | Dod QSM, Version 4.2 | | | Annually | | Certificate from accredited vendor | | |
| AA | EPA 200 series<br>SW-846 7000 series | 3-5 | Correlation coefficient must be $\geq$ 0.995 | At least daily, or as required (when CCV fails acceptance criteria) | Every Calibration | 90-110%R | Every 10 analytical samples | 80-120%R |

| Instrument | Method Reference | # Standards Initial Calibration | Acceptance Rejection Criteria – Initial Calibration | Frequency of Calibration | Frequency of Initial Calibration Verification | Acceptance/Rejection Criteria - Initial Calibration Verification | Frequency of Continuing Calibration Verification | Acceptance/Rejection Criteria – Continuing Calibration Verification |
|---|---|---|---|---|---|---|---|---|
| | NIOSH/OSHA | 3-5 | Correlation coefficient must be $\geq$ 0.995 | At least daily, or as required (when CCV fails acceptance criteria) | Every Calibration | 90-110%R | Every 10 analytical samples | 80-120%R |
| CVAA | SW-846 | 3-5 | Correlation coefficient must be $\geq$ 0.995 | At least daily, or as required (when CCV fails acceptance criteria) | Every Calibration | 90-110%R | Every 10 analytical samples | 90-110%R |
| | EPA CWA | 3-5 | Correlation coefficient must be $\geq$ 0.995 | At least daily, or as required (when CCV fails acceptance criteria) | Every Calibration | 95-105%R | Every 10 analytical samples | 90-110%R |
| | CLP SOW 5.3 | 5 | Correlation coefficient must be $\geq$ 0.995. Low standard at or below the CRQL | At least daily, or as required (when CCV fails acceptance criteria) | Every Calibration | 80-120%R | Every 10 analytical samples | 80-120%R |
| ICP, ICP/MS | SW-846 | 2<br>3 plus a blank | One point calibration or Correlation coefficient must be $\geq$ 0.995 for multi point calibration. | At least daily, or as required (when CCV fails acceptance criteria) | Every Calibration | 90-110%R | Every 10 analytical samples | 90-110%R |
| | EPA CWA 200.7/200.8 | 2 | One point calibration or Correlation coefficient must be $\geq$ 0.995 for multi point calibration. | At least daily, or as required (when CCV fails acceptance criteria) | Every Calibration | 90-110%R | Every 10 analytical samples | 90-110%R |

| Instrument | Method Reference | # Standards Initial Calibration | Acceptance Rejection Criteria – Initial Calibration | Frequency of Calibration | Frequency of Initial Calibration Verification | Acceptance/Rejection Criteria - Initial Calibration Verification | Frequency of Continuing Calibration Verification | Acceptance/Rejection Criteria – Continuing Calibration Verification |
|---|---|---|---|---|---|---|---|---|
| | CLP SOW 5.3 | 2 | One point calibration or Correlation coefficient must be $\geq$ 0.995 for multi point calibration. | At least daily, or as required (when CCV fails acceptance criteria) | Every Calibration | 90-110%R | Every 10 analytical samples | 90-110%R |
| GFAA | SW-846 | 3-5 | Correlation coefficient must be $\geq$ 0.995. Low standard at or below the RL | At least daily, or as required (when CCV fails acceptance criteria) | Every Calibration | 90-110%R | Every 10 analytical samples | 80-120%R |
| | EPA CWA | 3-5 | Correlation coefficient must be $\geq$ 0.995. Low standard at or below the RL | At least daily, or as required (when CCV fails acceptance criteria) | Every Calibration | 95-105%R | Every 10 analytical samples | 80-120%R |
| | NIOSH/OSHA | 3-5 | Correlation coefficient must be $\geq$ 0.995. Low standard at or below the RL | At least daily, or as required (when CCV fails acceptance criteria) | Every Calibration | 90-110%R | Every 10 analytical samples | 80-120%R |
| pH Meter | SW-846 | 3 | $\pm$ 0.1 STD units of true value | Daily | | $\pm$ 0.1 STD units of true value | Daily | $\pm$ 0.1 STD units of true value |
| GC/MS Volatiles | SW-846 8260 | 5 | %RSD<30% (CCC) 1,1-dichloroethene; chloroform 1,2-dichloropropene; toluene Ethyl benzene; Vinyl chloride RF>0.10 (SPCC) Chloromethane; 1,1-Dichloroethane; Bromoform; >0.3 1,1,2,2- Tetrachloroethene; Chlorobenzene | As needed | As needed following ICAL | CCC %D <20% same SPCC criteria as initial calibration<br>$\pm$ 20%D All Target compounds | Daily and every 12 hr. | CCC%D <20% same SPCC criteria as initial calibration<br>$\pm$ 20%D All Target compounds |
| | 40CFR136,624 | 5 | All cmpds % RSD<35% or use calibration curve | As needed | As needed following ICAL | $\pm$ 20%D All Target Compounds | Daily 24 hr. | $\pm$ 20%D All Target Compounds |

| Instrument | Method Reference | # Standards Initial Calibration | Acceptance Rejection Criteria – Initial Calibration | Frequency of Calibration | Frequency of Initial Calibration Verification | Acceptance/Rejection Criteria - Initial Calibration Verification | Frequency of Continuing Calibration Verification | Acceptance/Rejection Criteria – Continuing Calibration Verification |
|---|---|---|---|---|---|---|---|---|
| | TO1/TO2 | 3 | % RSD <30% | As needed | As needed following ICAL | ± 30% Rec. | Daily and every 12 hr. | ± 30%D |
| | EPA 524.2 | 5 | % RSD <20% or use calcurve target compounds | As needed | As needed following ICAL | + 20% Rec. | Daily every 8 hr. | All compounds RF %D <30%, ISID Areas >30%, <150% of initial cal. |
| GC/NPD | N-P containing pesticide EPA 507 | 5 | RF <20% RSD or single point ( single point must be within 20% of sample concentration) | As needed when CCV > 15% diff. | As needed following ICAL | 20%D | 2 times daily. beginning and end of day | 15%D |
| | Organophosphorus pesticides SW-846 8141 | 5 | RF <20% RSD or cal. Curve CC ≥ 0.995 linear regression<br>CC ≥ 0.99 non-linear regression | As needed when CCV > 15%, 20% QSM 4.2 | As needed following ICAL | 15%D<br>QSM 4.2 – 20% D | Daily, after every 10 field samples and at the end of the run. | 15%D<br>QSM 4.2 – 20% D |
| GC/FID | SW-846 8015 | 5 | RF <20% RSD or cal. Curve CC ≥ 0.995 linear regression<br>CC ≥ 0.99 non-linear regression | As needed when CCV > 15% D | As needed following ICAL | 15%D<br>QSM 4.2 – 20% D | Daily, after every 10 field samples and at the end of the run. | 15%D<br>QSM 4.2 – 20% D |
| | NIOSH/OSHA | 5 | RF <20% RSD or cal. Curve | As needed when CCV >15%D | As needed following ICAL | 15%D | Daily, 10% ending | 15%D |
| HPLC | EPA 531.1 | 5 | RF <20% RSD or single point or calibration curve | As needed when CCV >20%D | As needed following ICAL | 20%D | Min. of 2 1 beg. 1 end | 20%D |
| | SW-846 8310, 8330B 8315 | 5 | RF <20% RSD, <15% RSD QSM 4.2 for 8330B<br>Curve CC ≥ 0.995 linear regression<br>CC ≥ 0.99 non-linear regression | As needed when CCV >15%D or every 6 months | As needed following ICAL | 15%D | Daily, after every 10 field samples and at the end of the run. | 15%D |
| | EPA 610 | 3 | RF <10% RSD or cal. Curve | When CCV >15%D | As needed following ICAL | 15%D CCV vs. cal. curve | Daily 10% | 15%D |
| | NIOSH/OSHA | 3-5 | RF <20%RSD or cal. Curve | When CCV >20%D | As needed following ICAL | 20%D CCV vs. cal. curve | Daily 10% | 20%D |

| Instrument | Method Reference | # Standards Initial Calibration | Acceptance Rejection Criteria – Initial Calibration | Frequency of Calibration | Frequency of Initial Calibration Verification | Acceptance/Rejection Criteria - Initial Calibration Verification | Frequency of Continuing Calibration Verification | Acceptance/Rejection Criteria – Continuing Calibration Verification |
|---|---|---|---|---|---|---|---|---|
| General Wet Chemistry | EPA 300/400 Methods | 5 | Correlation Coeff. (r)/ $\geq$ 0.995 | When CCV is > 10%D | As required by method or on preparation of new ICAL | 10%D | Beg. and end of each sequence | 10%D |
| | Standard Methods | Method Specified | Method Specified | Method Specified | Method Specified | Method Specified | Method Specified | Method Specified |
| | CLP SOW 5.3 | 5 | Correlation Coeff. (r) $\geq$ 0.995 | Daily on for each analytical event. | After each initial calibration | 85-115 % | After ICV and every 10 samples and at end of sequence | 85-115% |
| GC-ECD | EPA 508 | 3 | Linearity <20% RSD | Each Run | As needed following ICAL | 80-120% | Every fifth injection | Primary column %D <15. Conf column %D) <20 R.T. Shift. Capp. columns <0.3 % RT Shift Megabore Columns <1.5% Breakdown criteria: DDT <20% Endrin <20% |
| GC-ECD | EPA 608 | 3 | Linearity <20% RSD | Each Run | As needed following ICAL | 80-100%R | Every fifth injection | Primary column %D <15. Conf column %D) <20 R.T. Shift. Capp. Columns <0.3 % RT Shift Megabore Columns <1.5% Breakdown criteria: DDT <15% Endrin <15% |
| | SW-846 | 5 | RF - <20% RSD or cal. Curve CC $\geq$ 0.995 linear regression CC $\geq$ 0.99 non-linear regression | As needed when CCV > 15%, 20% QSM 4.2 | As needed following ICAL | 15%D QSM 4.2 – 20% D | Daily, after every 10 field samples and at the end of the run. | 15%D QSM 4.2 – 20% D Breakdown criteria 8081: |

| Instrument | Method Reference | # Standards Initial Calibration | Acceptance Rejection Criteria – Initial Calibration | Frequency of Calibration | Frequency of Initial Calibration Verification | Acceptance/Rejection Criteria - Initial Calibration Verification | Frequency of Continuing Calibration Verification | Acceptance/Rejection Criteria – Continuing Calibration Verification |
|---|---|---|---|---|---|---|---|---|
| | | | | | | | | DDT <15%<br>Endrin <15% |
| | NIOSH/OSHA | 5 | Linearity <20% RSD | Each Run | | 80-110%R | Every ten samples | %D <20% |
| GC-MS<br>Semi-Volatiles | EPA 8270 | 5 | RRF - <20% RSD or cal. Curve<br>CC ≥ 0.995 linear regression<br>CC ≥ 0.99 non-linear regression<br>RRF > Method Table | As needed or on ICV<br>Failure | As needed following ICAL<br>. | ± 20%D All Target compounds QSM 4.2<br>±30%D SW-846<br>Breakdown criteria: DDT <20% Pentachlorophenol/ Benzidine Tailing <2 | Every 12 Working Hours | ± 20%D All Target compounds, QSM 4.2<br>SW-846 – RF > Method Table, <20% of cmpds, >20%D<br>Breakdown criteria: DDT <20% Pentachlorophenol/ Benzidine Tailing <2 |

Note %D refers to percent difference for calibration using RSD of the response factors or percent drift when using regression calibration.

# 7.0 ANALYTICAL PROCEDURES

7.1 RTI analytical methods are based on validated agency (EPA, NIOSH, OSHA, ASTM, etc.) methodologies where applicable. Prior to analyzing samples the laboratory conducts a method validation that addresses the items in the sub-sections below. The procedure for writing SOPs (SOP for generating SOPs) in specified below and throughout this section. It is understood that some SOPs cannot conceivably address every situation that could possibly occur during Laboratory operations. RIT relies on the training, experience and judgment of its staff to handle specific situations consistent with established policies.

7.1.1 Data from the internal validation studies is compared to the published method with the goal of meeting or exceeding the performance criteria noted in that method. For methods in which no performance data is available, RTI has minimum target limits for evaluation (see Section 3.0).

7.1.2 Following successful completion of the validation studies and review by a Director, a SOP is generated reviewed and approved for use. Figure 7-2 presents the table of contents for RTI SOPs and delineates the items incorporated into all analytical SOPs. Tables 7-1 through 7-3 summarize analytical procedures.

7.1.3 SOPs based on published reference methods will specify any applicable modifications from the method. All modifications must be documented in the SOP and must be approved. Modifications must be consistent with the method techniques (for example: GC techniques cannot be substituted for LC methods) and capable of meeting method performance criteria. Projects requiring or specifying published method will require project-specific approval by the client for any modifications.

7.1.4 SOPs based on published reference methods will use the most recent approved version of the agency method.

7.1.5 Where no standard method exists the laboratory may with the approval of the Technical Director develop non-standard methods for requested testing. This will be performed in consultation with and approval by the client. Any client specifications must be clearly stated and understood prior to commencing method development. Procedures listed in the Method Validation section below will be followed in assessing the performance of laboratory developed non-standard methods. This also applies to methods requested to be used beyond their intended scope (using water specific methods for the analysis of solid samples) or standard methods that have been significantly modified (generally for a specific use only – standard RTI methods do not contain significant modifications).

7.1.6 Initial SOPs are generated either by the analyst, a Director or a supervisor in the format specified above. Draft SOPs are reviewed by the QA Director, the Technical Director or designated Supervisor. Changes are discussed with the analysts and management and incorporated into the SOP. The QA Director will generate the SOP and submit for review to the Supervisor or analyst. After all reviews and changes are completed a final SOP will be generated. The QA Director and Supervisor will sign and date the SOP approval log and the SOP will be posted electronically in the SOP section of the LIMS.

7.1.7 Revisions to SOPs are initiated by the analyst, QA Director, Technical Director or Supervisor. These revisions will follow the review process noted in 7.1.3 and will be posted electronically with the appropriate revision number. Prior versions will be removed from the current year directory.

7.1.8 SOP status is maintained by the QA Director in a spreadsheet designation the date for the next annual review. The QA Director is responsible to ensure SOPs are reviewed and approved at least once per year. As revisions are made the file name will be updated to replace the existing SOP with the applicable revision number. SOPs that have been reviewed and accepted for continuing use will retain the same file name but will have the Reviewed and Approved Date updated on the SOP cover page.

7.1.9 Approval signatures will be maintained for all SOP revisions.

7.1.10 Prior versions of the SOPs will be archived electronically in the appropriate directory.

7.1.11 SOPs are posted electronically and available for all analysts.

7.1.12 SOPs are maintained for analytical procedures and sample preparation procedures as applicable.

7.1.13 SOPs are reviewed yearly and revised as needed. When revised the new revision number and date of revision are placed on the SOP.

7.1.14 Laboratory procedural SOPs are based on the applicable reference method and conform to the specifications for that method.

7.1.15 SOPs will designate when specific laboratory environmental conditions are required for performance of a procedure. Testing will not be performed when the environmental conditions are outside of the range required in the SOP.

## 7.2 Method Validation

### 7.2.1 Linearity/Calibration Curves

7.2.1.1 Calibration curves are constructed to encompass the concentration range of interest. Initial calibration curves are based on 3 - 5 points with the lowest standard at or below the LOQ (reporting limit) and the highest standard near the upper limit of the range. Non-contiguous data points cannot be excluded from the initial calibration determination without technical justification and approval by the QA Director. Refer to method SOPs for specific requirements for successful initial calibration.

7.2.1.2 Linearity of the calibration curve is assessed by %RSD of response factors, the correlation coefficient of linear regression or other appropriate means (i.e. quadratic fit). RTI employs computer data systems and software packages that allow for various determination and evaluations of linearity. All initial calibration curves must meet method specification and/or reviewed by the Group Lead, Supervisor or QA Director.

7.2.1.3 The calibration curve defines the quantification range for the method. The lowest standard establishes the minimum reporting limit for the analyte. Results below the reporting limits but greater than the MDL are considered estimated. Concentrations measured above the highest calibration standard require dilution into the calibration range or flagging as estimated values. Refer also to Section 9.

### 7.2.2 Interferences/Environmental Conditions

7.2.2.1 Reagent, method and/or media blanks are analyzed to ensure that interferences arising from reagents, glassware, apparatus, etc., do not pose a problem. Method and manufacturer's references are reviewed for additional sources of information on potential interferences.

7.2.2.2 Test methods or procedures performed during testing that are affected by conditions within the facility will be monitored to ensure that data generated is not adversely affected. Individual SOPs will address specific requirements and the monitoring to be performed and recorded. Examples:

7.2.2.2.1 Temperatures will be monitored and recorded for tests that need to be conducted within a specified range (TCLP extractions, BOD, etc.)

7.2.2.2.2 Analysts will verify that balances are not subject to vibrations during weighing.

7.2.2.2.3 Sterility checks on media and apparatus will be conducted and recorded for microbiological assays.

7.2.2.2.4 The laboratory environment must be maintained in a state that reduces dust and maintains a clean work environment. Analysts are responsible for cleaning all work areas at the end of each working shift.

7.2.2.2.5 Segregation of areas to prevent problems related to contamination – volatile organic analyses are performed in an area separated from the rest of the laboratory, analytical balance will be located in a dedicated room and trace metals analyses are performed in a dedicated area of the laboratory. Daily monitoring of blanks and other QC samples will assess the effectiveness of contamination prevention.

7.2.2.3 Any condition that arises that results in the inability to maintain proper conditions or in cases where unexpected or uncontrolled interference is encountered will immediately be brought to the attention of Laboratory Management for investigation and corrective action.

7.2.3 Initial/Continuing Demonstration of Capability (IDC) - Accuracy/Precision

7.2.3.1 Initial accuracy and precision is demonstrated through analysis of multiple measurements of spiked (4-5) laboratory control samples. All steps in the analytical procedure and all personnel involved in the method are assessed through the IDC.

7.2.3.2 Percent recoveries and standard deviations are calculated and compared to method ranges when available or to laboratory established ranges.

7.2.3.3 The IDC must be performed whenever there is a new instrument installed, on significant changes or maintenance to an instrument, changes in personnel or changes to the method or matrix.

7.2.3.4 Continuing demonstration is assessed through quarterly LOD/LOQ verifications, annual accuracy and bias determination at the LOQ and routine assessment of QC data (LCS, Method blanks).

7.2.3.5 Continuing demonstration is additionally verified by successful analyses of PT samples.

7.2.4 Procedure for Determining DL, LOD, LOQ

7.2.4.1 DL (detection limit) and MDL (minimum detection limit) are synonymous terms and are determined according to the MDL procedure specified below. LOD refers to the Limit of Detection and is established as specified below. LOQ (limit of quantification), PQL (practical quantification limit) and RL (reporting limit) are interchangeable terms with the uses defined below.

7.2.4.2 DL/MDL Determination

7.2.4.2.1 MDLs are determined at method initiation and as required by the applicable method. MDL determinations must be re-established when the LOD fails to meet the requirements stipulated in the section below or when significant changes occur. Significant changes include:

7.2.4.2.1.1 Personnel
7.2.4.2.1.2 Instrumentation
7.2.4.2.1.3 Test Method
7.2.4.2.1.4 Sample Matrix
7.2.4.2.1.5 Significant Component Changes (detectors, columns, sample introduction technique, etc.)

7.2.4.2.2 MDLs must be generated for all applicable matrices using a matrix free of the analyte(s) of interest (for example - laboratory reagent water, clean sand, Teflon chips or glass beads for metals).

7.2.4.2.3 MDLs must be generated for all preparatory and cleanup methods used for sample analysis. For methods requiring dual column analysis MDLs must be performed and evaluated for both columns.

7.2.4.2.4 For MDLs performed on multiple instruments with identical configurations the highest MLD from the set of instruments will be entered into the applicable Omega test code. In cases where a project requires a lower MDL and the MDL data from a specific instrument supports that value the lower MDL can be cited on the analytical report provided all sample analyses were performed on that instrument.

7.2.4.2.5 The MDL is statistically defined at the 99% confidence level according to the protocol in 40 CFR Part 136 App B. Seven (7) replicates containing all of the analytes of interest at a concentration level of 1 - 5 times the estimated detection limit are analyzed and the standard deviation is calculated. The student's T value for the seven (7) replicates (3.143) is multiplied by the standard deviation to calculate the MDL.

7.2.4.2.6 MDL results are entered into the applicable Omega Test Code following review and approval by the QA Director. MDL values are considered acceptable if the following criteria are met:

7.2.4.2.6.1 The MDL is less than the required concentration that will be reported. This includes State specified TDLs, contract required quantification limits (CRQL), method specified detection limits, program requirements or client specified reporting limits.

7.2.4.2.6.2 The calculated MDL is evaluated by based on the ratio between the mean concentration of the 7 replicates and the calculated MDL. This ratio should be between 1 - 10. If the ratio exceeds the above range the spike concentration should be adjusted and the MDL repeated.

7.2.4.2.6.3 The calculated MDL must not be greater than the MDL spike concentration.

7.2.4.2.6.4 The analyte must be detected in all seven replicates.

7.2.4.2.7 In cases where the MDL procedure above is not practical for determination of the detection limit (i.e. BOD, balance measurements, microbiological procedures, pH, etc.) the MDL will be based on the sensitivity of the instrument or method or will correspond to the lowest calibration standard in the working calibration curve. In these instances the MDL and PQL values are entered in the LIMS Test Code with the same number.

7.2.4.3 LOD Determination

7.2.4.3.1 Immediately following the MDL study a LOD is determined by spiking the same type of matrix used for establishing the DL at 2-3 times the DL for single analyte methods and 1-4 times the DL for multi-analyte procedures.

7.2.4.3.2 LODs must be generated for all preparatory and cleanup methods used for sample analysis. For methods requiring dual column analysis LODs must be performed and evaluated for both columns.

7.2.4.3.3 LODs must be performed on all instruments used for the applicable method.

7.2.4.3.4 The spiking concentration establishes the LOD provided that all analytes are detected at a 3:1 signal to noise ratio and must meet the method requirements for qualitative identification of the analyte (ion abundance, confirmation on a second column, pattern matching, etc.).

7.2.4.3.5 LODs must be verified quarterly. In cases where the LOD data does not comply with the criteria in Sec. 7.2.4.3.3 a new MDL determination must be performed at a higher concentration and subsequently demonstrate two successful LOD verifications.

7.2.4.3.6 Successful LOD results are entered into the Omega LIMS test code field (LOD). For procedures specified above for which a MDL determination is not applicable the LOD filed is left blank or contains the same value as the MDL and LOQ.

7.2.4.4 LOQ (PQL/RL) Determination

7.2.4.4.1 Following MDL entry into the Test Code and successful LOD determination the LOQ (PQL field in the LIMS test code) values are entered. The PQL data in Omega will represents the Laboratory reporting limit that will be included on the final analytical report under the report heading RL.

7.2.4.4.2 The RL can be established at any value above the MDL provided that:

7.2.4.4.2.1 The level is at least 2 times the MDL.
7.2.4.4.2.2 The RL is within the working calibration range of the instrument.
7.2.4.4.2.3 The RL is greater than the LOD.

7.2.4.5 Default reporting limits are routinely established at levels at or below (this allows for dry weight corrected values to meet the TDL) the current State of Michigan OpMemo 2 TDLs.

7.2.4.6 Within the Omega LIMS reporting limits can be specified individually for clients, quotation or projects provided the criteria in Section 7.2.4.4.2 is met and the limits set are not below the default RL. Reporting limits below the standard LIMS Test Code PQL must be approved by a Director.

7.2.4.7 LOQ Verification

7.2.4.7.1 The LOQ is verified by spiking the same type of matrix used for establishing the DL at the PQL.

7.2.4.7.1 LOQs must be generated for all preparatory and cleanup methods used for sample analysis. For methods requiring dual column analysis LOQs must be performed and evaluated for both columns.

7.2.4.7.2 LOQs must be performed on all instruments used for the applicable method.

7.2.4.7.3 Based on the specific method percent recovery for the analyte in the LOQ must be within 80-120%, within the control limits cited in the DOD QSM Version 4.2 or laboratory established limits approved by the QA Director.

7.2.4.7.4 LOQs must be verified quarterly. In cases where the LOQ data does not comply with the criteria in Sec. 7.2.4.7.4 a new LOQ determination must be performed at a higher concentration until a successful LOQ is attained and the LIMS PQL must be adjusted to reflect the new LOQ.

7.2.4.7.5 Accuracy and bias at the LOQ must be established on

initial LOQ determination and annually by preparing four LOQ samples. The mean recovery must be within the limits specified above and the %RSD of the four results must be <15%.

7.2.4.8 Additionally RL levels are routinely verified with each analytical event by one or more of the following depending on the applicable method (additional information is available in method SOPs).

7.2.4.8.1 The lowest calibration standard in the linear calibration curve must be at or below the RL.
7.2.4.8.2 Analysis of a reporting limit standard prepared at a concentration equal to or less than the RL (i.e. CRQL, CRI, RLVS standards).
7.2.4.8.3 Analysis of a laboratory prepared spike carried through the entire preparation and analysis procedure at a level at or below the RL.
7.2.4.8.4 For analytes that do not have established or approved MDL values the MDL entered in the LIMS Test Code will be equal to the PQL (RL).

7.2.4.9 After a method has been validated and incorporated into use continuing capability is assessed through routine quality control sample analyses. In the event of a significant change a demonstration of capability is performed as in Section 7.2.3. All personnel involved in the analytical process with participate in the demonstration to the extent of their involvement in the method. Significant changes include:

7.2.4.9.1 Personnel
7.2.4.9.2 Instrumentation
7.2.4.9.3 Test Method
7.2.4.9.4 Sample Matrix
7.2.4.9.5 Significant Component Changes (detectors, columns, sample introduction technique, etc.)

7.2.5 Method specified parameters such as inter-element correction factors, IDLs and linear ranges for ICP/ICPMS will be assessed during method validation and updated as specified in the method SOP.

7.3 Assessment of Quality Control Samples

7.3.1 Calibration check standard must be within the guidelines specified in the Tables found in Section 6.0 or according to method specifications (if a discrepancy exists the method specifications will apply).

7.3.2 If a calibration check standard exceeds the applicable limits the standard is re-

analyzed and if the results are within the required limits analyses can proceed. If the second analysis fails to yield acceptable results the analyses is stopped and appropriate corrective actions are instituted prior to re-commencing analysis.

7.3.3 For analyses conducted under CLP protocols an unacceptable calibration check standard necessitates halting the analyses for the affected constituent, correcting the problem and re-analyzing the samples for the failed parameter(s). The only exception is the CRQL standard, which may be re-analyzed once, and if acceptable the analytical sequence can proceed.

7.3.4 Assessment of batch and method QC samples (i.e. Method Blanks, LCS samples, Matrix Spikes, Duplicates, etc) is addressed in Section 13 of the applicable SOP.

7.4 Deviations from SOPs

7.4.1 Unapproved deviations are not allowed.

7.4.2 When a deviation from a SOP is required the reason for the deviation must be documented and approved by the Technical Director or QA Director.

RTI SOP# XXXX
STATUS: ACTIVE

DATE: June 4, 2012
Revision 0

**STANDARD OPERATING PROCEDURE**

SOP# XXXX

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## Table 7-1

### Summary of Organic Analytical Procedures

| ANALYTE GROUP | LAB SOP NO. | EQUIVALENT METHOD NUMBER |
|---|---|---|
| **Matrix: Water/Soil** | | |
| Volatile Organics | 8260B_XXXXXX_RX<br>524_2_XXXXXX_Rx | EPA SW-846/5030/5035/8260/624<br>EPA 524 |
| Herbicides | 8151_XXXXXX_RX<br>515_1_XXXXXX_RX | EPA SW-846/8151<br>EPA 515.1 |
| Semi-Volatile Organics (GC/MS) | 8270D_XXXXXX_RX<br>525_2_XXXXXX_RX | EPA SW-846/8270/625<br>EPA 525 |
| Pesticides/PCB | 8081A_XXXXXX_RX<br>8082A_XXXXXX_RX<br>508_XXXXXX_RX | EPA SW-846/8081/8082<br>EPA-608<br>EPA 508 |
| Polynuclear Aromatic Hydrocarbons | 8310 (R) | EPA SW-846/8310<br>EPA/610 |
| Gasoline Range Organics (GRO) | 8015B_XXXXXX_RX | EPA SW-846/8015 |
| Diesel Range Organics (DRO) | 8015B_XXXXXX_RX | EPA SW-846/8015 |
| Aldehydes | 8315 (IP) | EPA SW-846/8315 |
| Total Petroleum Hydrocarbons | 1664_XXXXXX_RX<br>9071B_XXXXXX_RX | EPA 1664<br>SW-846/9071B |
| Sonication Extractions<br>Soxhlet Extractions<br>Pressurized Fluid Extraction | 3550B_XXXXXX_RX<br>3540 (IP)<br>3545_XXXXXX_RX | EPA SW-846/3550<br>EPA SW-846/3540<br>EPA SW-846/3545 |
| Liquid-Liquid Extractions-separatory funnel | 3510C_XXXXXX_RX | EPA SW-846/3510 |
| Haloacetic acids | 552_2_XXXXXX_RX | EPA 552.2 |
| EDB/DBCP | 504_1_XXXXXX_RX | EPA 504.1 |
| Explosives | 8330B_XXXXXX_RX | EPA 8330B |
| Nitrogen/Phosphorus Pesticides | 507_XXXXXX_RX<br>8041B_XXXXXX_RX | EPA 507<br>EPA 8141B |

## Table 7-1 (cont'd)

### Summary of Organic Analytical Procedures

| ANALYTE GROUP | LAB SOP NO. | EQUIVALENT METHOD NUMBER |
|---|---|---|
| **Matrix: Ambient Air** | | |
| Volatile Organics | TO17_XXXXXX_RX | EPA TO17 |
| Volatile Organics | TO15 (R) | EPA TO14 / TO15 |
| Aldehydes and Ketones | TO5. (R) | EPA TO5 |
| Pesticides/PCB's | TO4_XXXXXX_RX2 | EPA TO4<br>EPA TO10 |
| Phenols and Methylphenols | TO8AA.LC(R) | EPA TO8 |
| Polynuclear Aromatic Hydrocarbons | TO13AA (R) | EPA TO13 |
| Formaldehyde | TO11AA.LC(R) | EPA TO11 |
| **Matrix: Industrial Hygiene Air** | | |
| Organic Solvents | (R) | NIOSH Various<br>OSHA Various |
| Polynuclear Aromatic Hydrocarbons | (R) | NIOSH 5506/5515 |
| Polychlorinated Biphenyls | (R) | NIOSH 5503 |
| Formaldehyde | (R) | NIOSH 2541 |
| Aldehydes | (R) | OSHA DHPH (64 et al) |
| Isocyanates | (R) | OSHA 42/47 |
| Miscellaneous | (R) | NIOSH / OSHA Various |

## Table 7-2

### Summary of Analytical Procedures - Metals

| ANALYTE GROUP | LAB SOP NO. | EQUIVALENT METHOD NUMBER |
|---|---|---|
| **Matrix: Water** | | |
| Metals | 6020A_XXXXXX_RX | EPA 6020A/200.8 |
| Prep-Dissolved and Total Recoverable | ( R) | EPA 3005/3010 |
| Prep-Totals | 3020A_XXXXXX_RX | EPA 3020A |
| Metals | 6010C_XXXXXX_RX | EPA 6010C/200.7 |
| Mercury | 245.1_XXXXXX_RX<br>7470A_7471A_XXXXXX_RX<br>1631_XXXXXX_RX | EPA 245.1<br>EPA 7470<br>EPA 1631E |
| **Matrix – Soil** | | |
| Metals | 6020_XXXXXX_RX | EPA 6020A |
| Prep - Totals | 3050B_XXXXXX_RX<br>3052_XXXXXX_RX | EPA SW-846/3050B<br>EPA SW-846/3052 |
| Metals | 6010C_XXXXXX_RX | EPA 6010C |
| Mercury | 7470A_7471A_XXXXXX_RX<br>1631_XXXXXX_RX | EPA 7471<br>EPA 1631E |
| **ANALYTE GROUP** | **LAB SOP NO.** | **EQUIVALENT METHOD NUMBER** |
| **Matrix: Ambient Air** | | |
| Metals | ICP/MS – Reserved | EPA 40CFR Part 50 App. J |
| Lead | PB_TSP.AA(R) | EPA 40CFR Part 50 App. G |
| **Matrix: Industrial Hygiene Air** | | |
| Metals | (R) | NIOSH 7300/OSHA ID121 |
| Metals | (R) | NIOSH 7000 Series Various |
| Mercury | HG6009.AA | NIOSH 6009 |
| Prep - MCE Filters | P_METIH | NIOSH / OSHA Various |

**Table 7-3**
**Summary of Inorganic and Miscellaneous Analytical Procedures**

| ANALYTE GROUP | LAB SOP NO. | EQUIVALENT METHOD NUMBER |
|---|---|---|
| **Matrix: Water** | | |
| BOD | 5210B_XXXXXX_RX | SM 5210B |
| Anions | 300.0_XXXXXX_RX | EPA 300.0 |
| Nitrite | 300.0_XXXXXX_RX | EPA 300.0 |
| Nitrate | 300.0_XXXXXX_RX | EPA 300.0 |
| Phosphorus, Total | 4500-P-F_XXXXXX_RX4 | SM 45000 P-F |
| Ortho-Phosphate | 4500-P-F_XXXXXX_RX<br>300.0_XXXXXX_R_X | SM 4500 P-F<br>EPA 300.0 |
| Phenolics | 420_1_XXXXXX_RX | EPA 420.1 |
| Residual (Solids) | 2540C_XXXXXX_RX<br>2540D_XXXXXX_RX<br>2540B_XXXXXX_RX | SM 2540C<br>SM 2540D<br>SM 2540B |
| PH | 4500-H-B_XXXXXX_RX | SM 4500 H-B |
| Oil & Grease/SGT-HEM | 1664A_XXXXXX_RX | EPA 1664A |
| Specific Conductance | 120_XXXXXX_RX | EPA 120.1 |
| Cyanide | 4500-CN-E_XXXXXX_RX | SM 4500-CN E |
| Hexavalent Chromium | 7196_XXXXXX_RX | SW 846/7196, SM 3500-Cr B |
| EDTA | EDTA_XXXXXX_RX | NEM |
| Alkalinity | 2320B_XXXXXX_RX | SM 2320B |
| TKN | 351_2_XXXXXX_RX | EPA 351.2 |
| Chemical Oxygen Demand | 410_4_XXXXXX_RX | EPA 410.4 |
| Chlorine, Residual | 4500-Cl-I_052907_R0 | SM 4500-Cl I |
| Ammonia | 4500-NH3-DE_XXXXXX_RX | SM 4500-NH3 D |
| Organic Carbon | 5310B_XXXXXX_RX | SM 5310B |
| Turbidity | 180_1_XXXXXX_RX | EPA 180.1 |
| **Matrix: Ambient Air & Stationary Source** | | |
| TSP | TSP_PM10.WT | EPA 40CFR, Part 50, App. B |

| | | |
|---|---|---|
| PM10 | TSP_PM10.WT | EPA 40CFR, Part 50, App. J |
| Nitrogen Oxides | (R) | EPA Method 7 |
| Sulfur Dioxide | (R) | EPA Method 8 |
| Hydrogen Sulfide | (R) | EPA Method 11 |
| Halides | (R) | EPA Method 26 |
| **Matrix: Various -- Lead (HUD, Environmental Lead, Biological)** | | |
| Lead - Paint | (R) | EPA SW-846 6010 |
| Lead - Wipe | (R) | NIOSH 9100 / OSHA ID121 |
| Lead – Soil | (R) | EPA SW-846 6010 |
| **Matrix: Waste Characterization** | | |
| TCLP Extraction | 1311_XXXXXX_RX | EPA SW-846 1311 |
| TCLP ZHE Extraction | 1311ZHE_XXXXXX_RX | EPA SW-846 1311 |
| Ignitibility | 1010_XXXXXX_RX | EPA SW-846 1010 |
| Paint Filter Test | 9095A_XXXXXX_RX | EPA SW-846 9095A |
| Bomb Preparation | 5050_XXXXXX_RX | EPA SW-846 5050 |

SOPs are listed above with a generic designation for the SOP#. The current SOP is posted in the LIMS as …_XXXXXX(date)_RX(revision)

(IP) SOP currently in progress.
(R) Reserved for future document development or SOP based on currently used agency reference method.
(NEM) No equivalent method.

SOPs for the Materials Sciences Division are maintained by the Technical Director.

# 8.0 INTERNAL QUALITY CONTROL CHECKS

**8.1** As specified in Section 7.0 analytical procedures are documented in written SOPs. These SOPs include a section specifying the minimum QC requirement, frequency and the acceptance criteria for the QC samples. In lieu of a written SOP the minimum QC requirements will be adopted from the published method or target limits specified in Section 3 of this QAP.

**8.2** Internal Quality Control checks vary slightly with the procedure or analyte but in general include:

8.2.1 Field/Trip Blanks (when submitted). Use to assess contamination during the sampling process and evaluated by the sample submitter.

8.2.2 Method/Media Blanks. Assess the cleanliness of the sample preparation and analytical procedures. Evaluated according to the specifications in the individual SOP (Section 13). Standard criteria are values less than the reporting limit or ½ the LOQ (determined limit of quantification from Sec. 7) for QSM samples. Blank results that exceed acceptance criteria require investigation into the cause and corrective action. Samples associated with a method blank greater than the reporting limit or ½ the LOQ for QSM samples are flagged with a "B" on the analytical report.

8.2.3 Reagent/Preparation Blanks. Used to evaluate the cleanliness of the reagents used for sample preparation and the process for preparing samples. Evaluated according to the specifications in the individual SOP (Section 13). Standard acceptance criteria are values less than the MDL.

8.2.4 Instrument Blanks (Initial and Continuing Calibration Blanks). Used for assessing the cleanliness of the analytical system. Evaluated according to the specifications in the individual SOP (Section 13). Standard acceptance criteria are values less than the MDL.

8.2.5 Calibration Check Standards (Initial and Continuing). Assess the calibration status of the instrument. These standards are analyzed following initial calibration procedures and at the method and/or SOP specified frequency. Calibration Check Standards must be prepared at a concentration between the mid point of the calibration standard and the lowest level calibration standard. Sample results cannot be reported if these standards do not meet the requirements of the SOP (Section 8 and 13) or method specifications.

8.2.6 Matrix Spikes/Matrix Spikes Duplicates (media spikes for air analyses). Used to

assess matrix affects on the constituents being analyzed and accuracy and precision of the analytical method. MS/MSD evaluation is addressed in Section 12 of this document and Section 13 for the applicable SOP.

8.2.7 Surrogates (chromatography). Used to assess the efficiency of the sample preparation procedures employed for the appropriate method. Results are evaluated against established control limits and required actions are specified in Section 13 of the applicable SOP. Results exceeding control limits are flagged with an "S" on the analytical report and narrated if necessary.

8.2.8 Post Digestion Spikes/Serial Dilutions (GFAA, FLAA, ICP/ASE and ICP/MS). Assess matrix interferences on elements analyzed by the techniques above. Evaluation of results is addressed in the associated SOP (Section 13).

8.2.9 Interference Checks (ICP/ICPMS). Used to assess inter-element interference for ICP/AES and ICP/MS techniques by the analysis of check solutions.

8.2.10 Laboratory Duplicates. Assessment of method precision. Duplicate evaluation is addressed in Section 12 of this document and Section 13 for the applicable SOP. Duplicate results that exceed control limits are "R" flagged on the QC Summary reports supplied with the analytical report.

8.2.11 Laboratory Control Samples/Laboratory Control Sample Duplicates. Used to assess method accuracy. LCS/LCSD evaluation is addressed in Section 12 of this document and Section 13 for the applicable SOP. Results that exceed control limits are "S" and/or "R" flagged on the QC Summary reports supplied with the analytical report.

8.2.12 Internal Standard Areas (GC, ICP/MS). Monitored to ensure the consistency of instrument response. Evaluation is specified in Section 13 of the individual SOP. Samples associated with IS failures require re-analysis prior to reporting.

8.2.13 Mass Tuning (GC/MS, ICP/MS). Used to assed the condition of the instrument prior to beginning the analytical process. Successful tuning is required before commencing calibration or analysis.

8.2.14 Method specific quality control checks must be included in the analytical protocol and RTI SOP where required (for example grinding blanks and triplicate analyses as specified in method 8330B).

# 9.0 DATA REDUCTION, VALIDATION AND REPORTING

## 9.1 DATA REDUCTION

9.1.1 Whenever possible instruments are calibrated to display results in applicable concentration units.

9.1.2 Omega is capable of direct downloading of instrument data into the LIMS for several analytical instruments. In these instances all data reduction is performed by the LIMS.

9.1.3 Where direct interface with Omega is not possible the data export/import features of the LIMS are used. This involves exporting the samples for a specified test code into an Excel spreadsheet. The information exported will include the following fields:

9.1.3.1 Sample numbers (automatically exported)
9.1.3.2 Sample type (Samp, MS. MSD. LCS, CCV, MBLK, etc.) – automatically exported.
9.1.3.3 File number (automatically exported)
9.1.3.4 Dilution factors (default value = 1). Changed by analyst as required.
9.1.3.5 Raw Data (default value = 0 –non-detect). Actual instrument readings to be entered by the analyst.
9.1.3.6 Analysis date and time.

The analysts will enter the raw instrument readings and analysis date and time in the designated column. Following completion of data entry the Excel spreadsheet is saved to a specified file. The completed spreadsheet must be peer reviewed to ensure accurate transcription of data from the instrument print out. This file is then imported into Omega.

9.1.4 Excel bench sheets have been developed that automatically capture balance readings that are imported into a template file. This file is saved with the applicable new name and uploaded into the LIMS.

9.1.5 All information pertaining to the calculation of the final reported result is entered and stored in Omega.

9.1.5.1 For samples requiring reporting in dry weight the percent moisture value is automatically associated with the respective samples and the calculation to dry weight is performed automatically. This is verified by a change in units from – for example – ug/Kg to ug/Kg-dry.

9.1.5.2 All sample preparation information (weight, volumes, factors, etc.) is entered into the applicable prep table. This information automatically associates with the respective sample and is included in the calculation of the final result.

9.1.5.3 In cases where a dilution is required at the instrument level, this factor is noted in the instrument data system or logged on the instrument print out. If data is directly downloaded to Omega this factor will import with the data. If an Excel file is used for importing to Omega this factor is included in the spreadsheet, imported and incorporated into the final result.

9.1.6 All calculations producing final sample results, surrogate percent recoveries and QC sample percent recoveries and RPDs are performed by the LIMS.

9.1.7 RTI strives to maximize the use of direct electronic transfer of data. Whenever possible instrument data will be directly uploaded either to the LIMS or an electronic file that is imported directly into the LIMS. Most instruments and procedures have been configured to eliminate human transfer of data and as such are free of transcriptions errors. In cases where data is required to be transcribed by an analyst, that data will be reviewed by a second individual to ensure accurate data transcription. It is the goal and intent of RTI to completely eliminate transcription errors and to identify and correct all transcription mistakes prior to reporting.

9.1.8 Air volume data is logged for each sample when this information is supplied at the time of sample log in.

9.1.9 Tables within Omega contain the sampling rates for diffusive samplers and the molecular weights for analytes reported in ppm or ppb air.

9.1.10 Air sample results are provided in total mass units, mass per unit volume and ppm or ppb (where applicable) with the calculations being performed automatically by the LIMS on report generation.

9.1.11 The LIMS Administrator or a Director verifies all calculations performed by the LIMS prior to general use.

9.1.12 Instrument print out data that is not used will have a line drawn through that particular sample and a notation of “data not used” and an applicable explanation will be provided.

9.1.13 For special projects that require data handling outside of the routine LIMS functions various computer programs are available to assist in data reduction. These include:

9.1.13.1 Excel spreadsheets with associated mathematical and statistics functions.
9.1.13.2 BOD Calculator
9.1.13.3 These commercial software products used within the designed applications are considered sufficiently validated (Refer also to next section).

9.1.14 Software designed for automated data reduction processes will be verified on installation of new or updated software versions or whenever programming code is modified. Verification will include:

9.1.12.1 Data systems in use prior to January 1, 2009 have been previously verified through:

9.1.12.1 Manual calculations performed by various staff.
9.1.12.2 Third party data validation packages submitted.
9.1.12.3 Comparison to LIMS functions (i.e. CLP module).

9.1.12.2 New, updated or re-programmed systems will undergo verification by using a sample data set to verify all data operations. These calculations will be performed outside of the instrument data system using Excel or equivalent programs. Results of the verifications will be stored electronically in a designated folder.

## 9.2 DATA VALIDATION AND REVIEW

### Initial Calibration/Initial Calibration Verification

9.2.1 Analysts are responsible for evaluating the results of the initial calibration to ensure compliance with SOP requirements and items in Section 9.2.8. Sections 8 and 13 of each SOP contain the specifications for acceptable ICAL criteria and measures to be taken when these criteria are not met.

9.2.2 Analysts are responsible for ensuring that the results of all calibration verifications are within the acceptable limits specified in the SOP and assessing all items in Section 9.2.9

9.2.3 No sample data can be reported until both the ICAL results and calibration verification (CCV, ICV) results meet the criteria specified in the method SOP or any problems are addressed according to Section 9.2.10 below.

9.2.4 All calibration and initial calibration verification data including raw data files are imported into the LIMS.

9.2.4.1 Chromatography ICAL data, including raw data files, is imported in an individual analytical sequence with a designated run number. Sample and QC data are associated with the appropriate ICAL by entering the ICAL run number in the designated field in the analytical sequence.

9.2.4.2 Methods requiring daily calibration or single analyte methods will have the associated ICAL information imported into the sequence containing the sample/QC data.

9.2.4.3 In all instances the sample/QC data imported into the LIMS will be able to be tracked to the ICAL used to generate the data.

9.2.5 All ICAL and ICV data will be reviewed by a second analyst for completion, acceptability and conformance to SOP requirements (Sec. 9.2.8 and 9.2.9). Any problems noted will be immediately brought to the attention of the analyst producing the data and will be resolved prior to reporting sample results. Where this data exists in an individual sequence the initials of the reviewer and date of review will be placed in the analytical sequence comments section.

9.2.6 All ICAL and ICV data will be reviewed by the department Group Lead for compliance with method requirements (Sec. 9.2.8 and 9.2.9). Any problems noted will be immediately brought to the attention of the prior reviewers and resolved before reporting sample data. Where this data exists in an individual sequence the Group Lead will acknowledge the sequence producing a check mark in the ACK field. This person and the date of acknowledgement will appear in the analytical sequence.

9.2.7 ICAL and ICV data will be reviewed by the QA Department during final validation of analytical sequences.

9.2.8 Prior to validation ICAL data must be reviewed during the steps above for:

9.2.8.1 For procedures requiring instrument tuning – acceptable tune results prior to ICAL analysis.

9.2.8.2 Correct identification of all analytes.

9.2.8.3 Lowest standard is at or below the LOQ (RL/PQL).

9.2.8.4 Only contiguous data points are used.

9.2.8.5 Correct number of standards included in the ICAL.

9.2.8.6 Percent RSD or correlation coefficient meets requirements (or requirements of the method, technique or manufacturer are met) and where applicable minimum response factor criteria are met.

9.2.8.7 Major deviations in response from previous ICAL which would necessitate investigation.

9.2.8.8 All applicable raw data files including calibration curves when applicable are correctly imported into Omega.

9.2.8.9 ICAL standards logged into applicable analytical sequence.

9.2.8.10 Any notes or comments from the analysts or reviewers.

9.2.9 Prior to validation ICV data must be reviewed during the process above for:

9.2.9.1 Acceptable instrument tune results (where applicable).

9.2.9.2 ICV is at or below the mid point of the calibration standards.

9.2.9.3 Percent difference, drift or recovery meets requirements.

9.2.9.4 Correct evaluation of the above is applied for the curve type used. %D is used for evaluations based on average response factors. Percent drift or recovery is used for other calibration models.

9.2.9.5 Minimum response factor criteria are met (where applicable).

9.2.9.6 Internal standard responses and compound retention times are within method requirements (where applicable)

9.2.9.7 Correct identification of analytes (where applicable).

9.2.9.8 ICV meets program requirements (see below).

9.2.10 It is imperative that ICAL, ICV and CCV data be assessed according to the program under which sample data will be reported. Some methods assess continuing calibration by evaluating a subset or percentage of the compound list while specific programs require all target compounds meet designated criteria. In some instances compound lists may contain analytes that are poor performing or consistently fail to meet requirements. In these instances the following procedures are required:

9.2.10.1 Calibration ranges and verification levels can be adjusted to concentrations suitable for specific analytes provided the lower range corresponds to the required project LOQ or authorization is provided to raise the project LOQ.

9.2.10.2 Consistently problematic analytes can be designated as such and included as a variance to program requirements in project proposals.

9.2.10.3 Compounds that do not meet calibration or verification criteria can be communicated to the client project manager for authorization to proceed, with narration on the final report.

9.2.11 It is the intent of RTI to report all sample data under conditions of acceptable ICAL/calibration verification. The above procedures are applied to instances of holding time considerations, project deadlines and chronic problematic analytes that have been identified as such through laboratory investigations or method citations.

9.2.12 The above review process must be completed and any necessary comments included prior to reporting any sample data.

**Analytical Data Review**

9.2.13 On completion of an analytical event the data imported into the LIMS as described in Section 9.1 will be thoroughly reviewed by the analyst responsible for performing the testing. This initial review will encompass the following:

9.2.13.1 Verification that all samples in the analytical batch including calibration verification and QC samples are present in the LIMS analytical sequence.

9.2.13.2 Verification that all associated raw data files are correctly linked with the applicable file type in the LIMS analytical sequence. In addition to the sample associated raw files, verification that batch files (run logs, calibration evaluations, degradation checks, second column RPD reports and others as required) are correctly linked to the sequence.

9.2.13.3 Analysts will verify that all LIMS references (Blank, Spike, RPD, CCV, Second column) have the correct LIMS designated sequence number.

9.2.13.4 Confirm that the LIMIS prep batch number is linked to the sample for methods having an associated sample preparation step.

9.2.13.5 Ensure the sample preparation factors where applicable are present and correct.

9.2.13.6 Verify that dilution factors (when required) are present and correct.

9.2.13.7 Verification that continuing calibration samples are present in the correct frequency, correctly bracket samples where required and that analysis occurs within method time frames where stipulated.

9.2.13.8 After ensuring that the sequence is complete the analyst will calculate the sequence. This will result in all required calculations being performed and will change the status of the samples to complete.

9.2.13.9 The analyst will review the calculated results for obvious anomalies (dilution factor errors, incorrect units, etc.) and for results exceeding the upper calibration range (E flagged). The results for compounds exceeding the upper calibration range will be un-checked to report and repeated at a dilution unless there is insufficient volume for additional analysis. In this case a comment will be placed in the appropriate sample for inclusion in the case

narrative.

9.2.13.10 Acceptable continuing calibration results are required to proceed with sample reporting. If continuing calibration data is not achieved the analyst will repeat the analytical batch or those samples affected (not bracketed where applicable for the method) or consult with the department Group Lead on the proper course of action. Refer to guidelines on evaluating ICV results above. Analysts will review continuing calibration data for:

9.2.13.10.1 Acceptable instrument tune results (where applicable).

9.2.13.10.2 CCV is at or below the mid point of the calibration standards.

9.2.13.10.3 Percent difference, drift or recovery meets requirements.

9.2.13.10.4 Correct evaluation of the above is applied for the curve type used. %D is used for evaluations based on average response factors. Percent drift or recovery is used for other calibration models.

9.2.13.10.5 Minimum response factor criteria are met (where applicable).

9.2.13.10.6 Internal standard responses and compound retention times are within method requirements (where applicable).

9.2.13.10.7 Correct identification of analytes (where applicable).

9.2.13.10.8 CCV meets program requirements (refer to Section 9.2.10).

9.2.13.11 Standard RTI procedure requires the analysis of a standard at the LOQ. These samples are designated as CRQL or RLVS and are evaluated for continuing sensitivity at the reporting limit and to assess the effect of regression models used for calibration. RTI adopts the procedure in EPA Method 8000C which allows the use of the instrument force through zero option. RTI does not allow true forcing through zero by including a zero/zero point in the regression. As stated in Method 8000C this approach pivots the regression line and compensates for unequal weighting of the high standards. This approach improves quantification of results at the low end of the calibration range. However this procedure is not used when prohibited by program (DoD QSM). CRQL/RLVS results are evaluated against method control or default limits in the

test code and are not used to strictly assess method control since it is expected that results at this level will exhibit more variability. The judgment of the analyst, Group Lead and QA department will determine when action needs to be taken on results exceeding specified limits. Single analyte and metals analyses require results to be within limits before sample data can be reported. Multi-analyte procedures are evaluated for general suitability of data without strict guidelines. Again, the judgment and experience with the method and compounds of the reviewer determines if action is required.

9.2.13.12 Method blanks will be reviewed for positive results. An acceptable method blank will contain no results greater that ½ the LOQ. Obvious contamination present in a method blank requires re-extraction/re-digestion of the batch if sufficient volume is available. If insufficient sample remains the data must be appropriately qualified and narrated. In cases where results are slightly above the blank acceptance criteria the analyst will consult with the department Group Lead on actions to be taken.

9.2.13.13 Analysts will evaluate the LCS for acceptability. The results of the LCS must be within the test code specifications. LCS control limits are based on DoD QSM limits where available, method required limits when specified or laboratory generated limits (refer also to QAP Sections 3 and 12). Results exceeding control limits will be flagged with an S or Q. Unacceptable LCS results require re-extraction/re-digestion and re-analysis unless there is insufficient sample volume for repeat analysis. In that case the data must be appropriately flagged and narrated. Multi-analyte tests are evaluated according to the guidelines in the current TNI Standard that have been distributed to all analysts or according to program (DoD QSM) specifications.

9.2.13.14 Analysts will review Matrix Sikes (MS), Matrix Spike Duplicates (MSD) and sample Duplicates (DUP) against control limits incorporated in the associated test code. Results exceeding control limits will be flagged with an S or Q. QC data exceeding control limits will be assessed for possible matrix affects, spiking errors, analyte concentration in the parent sample or other situations that may impact these QC sample results. Significant failure of QC samples that cannot be directly attributed to sample matrix, dilution or spiking will be brought to the attention of the Group Lead for determination of additional actions.

9.2.13.15 Evaluate surrogate recoveries for applicable methods. Recoveries that exceed control limits will be flagged with an S or Q and must be assessed for possible matrix effects, spiking errors, dilution effects or other factors that may impact surrogate results. Actions

taken or narrative comments will conform to SOP guidelines or be determined by the department Group Lead.

9.2.13.16 Analysts will check to ensure that no holding time flags are present for samples analyzed in the sequence. Samples that are H flagged will require investigation to assess if the holding time has been exceeded. Samples determined to have been prepared or analyzed beyond the holding time will be brought to the attention of the Project Manager for communication to the client and any necessary action.

9.2.13.17 Verify the acceptability of internal standard responses and re-analysis for unacceptable internal standard results.

9.2.13.18 The analysts will verify that the analytical sequence has met the requirements of the method SOP.

9.2.13.19 For methods that may require manual integration the analyst will ensure that all linked raw data contains the before and after integrations, reason for the manual integration and that initials of the analyst.

9.2.14 Following review by the analyst a second peer review will be performed by a different analyst familiar with the method. All of the steps in Section 9.2.13 will be performed during the peer review. The analyst performing the peer review will place their initials and date of review in the analytical sequence comments section.

9.2.15 The department Group Lead will then review the analytical sequence to ensure and/or evaluate:

9.2.15.1 Verification that all ICAL, ICV and CCV results conform to method/program requirements and if necessary ensure that procedures specified in Section 9.2.10 have been followed.

9.2.15.2 Ascertain that the correct types and frequency of QC samples have been analyzed with the batch and all references are correct.

9.2.15.3 Ensure that all raw data files are linked correctly.

9.2.15.4 Review raw data for completeness and to assess manual integrations where applicable.

9.2.15.5 Ensure that sequences entered contain the sample preparation information where required, date and time of analysis and the analyst performing the tests.

9.2.15.6 Check for QC data flags. QC sample results are automatically

calculated by the LIMS and if values are outside of the established limits flagged as follows.

9.2.15.6.1 Q – Quality control sample result exceeds control limits (QSM DoD reporting).
9.2.15.6.2 R – RPD value exceeds control limit.
9.2.15.6.3 B – Analyte found in associated method blank.
9.2.15.6.4 J – Estimated result, analyte detected below PQL.
9.2.15.6.5 U – Undetected at the limit of detection.
9.2.15.6.6 E – Estimated result, value exceed UCL.
9.2.15.6.7 S - Quality control sample result exceeds control limits.
9.2.15.6.8 N – Non-target analyte (GCMS Tentatively Identified Compound).
9.2.15.6.9 P – Second column RPD exceeds 40%.
9.2.15.6.10 */X – Sample result exceeds the Maximum Contaminant Level (Permit or Regulatory Limit).

The Test Code database within Omega contains sections for entering applicable QC specifications including the known value of the standard or spike, the upper and lower control limits and the RPD for duplicate measurements.

9.2.15.7 The Group Lead will review the data set for any flags associated with either the sample or QC results. Q/S flags associated with calibration verification standards or LCS samples require rejection of the data, re-analysis of the affected samples or actions taken according to guidelines above. Flags appearing on matrix spikes, duplicates or other non-calibration verification QC samples will be investigated to the extent necessary (in accordance with Method and SOP specifications) and applicable comments will be noted for that sample. These comments will be automatically transferred to the Case Narrative for that particular Work Order. Batch QC data that does not meet the minimum requirements for acceptance as specified in the SOP or reference method will require rejection of the data. The Rpt check mark in the view/edit data section will be removed. This disables reporting of data for that sample and requires re-preparation and/or re-analysis of the sample batch. Similarly, individual samples with unacceptable surrogate recoveries may be rejected as above and require re-analysis. For instances in which QC results are unacceptable and there is insufficient sample for re-analysis, the appropriate notation will be made on the case narrative for that report.

9.2.15.8 Ensure that all required comments and narrations are present,

appropriate for the data and are correctly presented.

9.2.15.9 Verify that the data in the analytical sequence meets the requirements of the SOP and project data quality objectives.

9.2.15.10 During review the Group Lead will evaluate sample results for possible anomalies, missing data (PMOIST results, prep information, etc.) and any other factors affecting data quality.

9.2.15.11 When the Group Lead determines that the data set meets the required objectives the sequence will be toggled to an acknowledged status and a check mark will be placed in the ACK field of the sequence.

9.2.16 Analytical data entered into Omega requires the review and validation process specified above prior to reporting. Any data that has not been toggled as validated will result in the report being automatically flagged by the LIMS as preliminary. Acknowledged analytical data is reviewed and validated by the QA Department. Individuals with authority to validate data within Omega have a unique password that allows validation of sequences. When the QA Department Reviewer has determined that the data set meets the required objectives, the data can be toggled to a validated status by entering the appropriate password and selecting QA SEQ. This review consists of an overall review of the data set for completeness, adequate addressing of any QC issues noted and may incorporate any or all of the review steps noted above. At a minimum 10% of all data will be audited by performing a complete review of the data set during preparation of Level IV data packages. The Level IV data process encompasses:

9.2.16.1 Gathering and compilation of all work order reports, sample receiving documents and raw data for all testing performed.

9.2.16.2 Review of project data for completeness, adherence to project specifications and compliance with all method/program requirements.

9.2.16.3 Review by second individual in the QA Department.

9.2.17 Only the designated individuals have the required passwords to validate sample data and are separate from the passwords required to log onto the system. These passwords are also required to make any changes in data that has been previously validated. Once a sample or data set has been completed and validated only an individual possessing the authority can make changes. These require an explanation of the reason for the change that is automatically mandated by the LIMS.

## 9.3 DATA REPORTING

9.3.1 When the QA Department has validated all tests in a Work Order the Work Order will be changed within Omega to validated status. A final report will then be generated and reviewed by a Project Manager. Assigned individuals in the QA Department or the Technical Director can also issue reports. These individuals have been assigned electronic signatures and are designated as the approved signatories for final reports. The responsible individual will evaluate the report for the following and if acceptable validate the report and either make it available to the client via Flashpoint or issue an electronic version.

9.3.1.1 Comparison to historical data (when available) and general credibility.
9.3.1.2 Analyte correlation or other relationships.
9.3.1.3 Completeness and adherence to sample request and project objectives.
9.3.1.4 Review of case narrative to ensure comments are clear and concise. Review comments that require client notification and verify that issues have been adequately resolved or communicated. Assess comments for correct spelling and grammar.

9.3.2 Sample data is entered into and reported from the LIMS system. Reports are provided as electronic pdf documents by web based access (Flashpoint), e-mail or fax. Hard copy paper reports can be provided on request. The RTI LIMS can export data into several formats (Excel, Access, etc.) and can be customized to include the information required by the client. The individuals noted above are authorized to validate the report and electronic data deliverable (EDD) in the work order. Electronic transmission of the work order cannot occur within the LIMS unless it has been validated. The above individuals must generate and review the initial report prior to validation.

9.3.2.1 It is the standard practice of RTI Laboratories Inc. to issue reports without advertising logos or reference to certifying or accrediting bodies. References to currently held accreditations such as A2LA, NELAC or others do not appear on standard RTI reports and as such include tests and analytes within the RTI scope of services without reference to accreditation status. All test procedures are performed in accordance with current accreditation standards however RTI does not maintain accreditation for every test procedure that is reported. RTI publicly maintains its accreditation information and certificates issued by the accrediting body listing the scope on its web site. Accreditation status is readily available to all clients through the RTI web site.

9.3.2.2 Standard test reports are issued according to the formats described below and are based on ISO 17025 specifications.

9.3.2.3 In instances where a program or client mandates that reports

comply with the applicable accreditation, RTI will issue compliant data deliverables. These reports will clearly identify the accreditation status of all test procedures and will contain flags to indicate tests or analytes reported that are not included in the scope of accreditation. The report will identify the accrediting body and the RTI certification number. The report will also include any specific reporting requirements for the applicable standard. The logo of the accrediting agency generally will not be included on the report but when required will comply with the advertising policies of the accrediting body.

9.3.3 Data is reported in RTI format corresponding to Level I, II, III or IV depending on the project requirements. These reporting levels are integrated into the LIMS and are specified at sample login depending on client/project specifications.

9.3.4 A Level I standard laboratory report contains – all reports are automatically page numbered in the format Page X of X from the first page to the end of the report:

9.3.4.1 Cover page including client name and address, client designated individual receiving the report, laboratory name and address, project name/number, laboratory order #, date received, date reported, number of samples received, notes applicable to the types of samples, and signature and title of reviewer.
9.3.4.2 Title and Laboratory Order #
9.3.4.3 Sample Identification (Lab ID and Client ID)
9.3.4.4 Date and Time of Collection
9.3.4.5 Matrix
9.3.4.6 Air Volume Information – where applicable
9.3.4.7 Test Name
9.3.4.8 Method References
9.3.4.9 Analytes Reported
9.3.4.10 Final Results including surrogate recoveries and control limits – where applicable.
9.3.4.11 Detection Limits – LOQ/RL and LOD/DL when required.
9.3.4.12 Reporting Units
9.3.4.13 Date and Time Analyzed
9.3.4.14 Analyst
9.3.4.15 Dilution Factor
9.3.4.16 Qualifier Flags
9.3.4.17 Page Numbers
9.3.4.18 Sample Summary – when requested
9.3.4.19 Dates Report – when requested. Includes preparation, extraction and analysis dates for holding time verification.
9.3.4.20 Chain of Custody Record
9.3.4.21 Case Narrative
9.3.4.22 Definitions

9.3.4.23 Dates Report (optional)
9.3.4.24 Sample Summary Report (optional)
9.3.4.25 Sample Receipt Checklist (optional)

9.3.5 A Level II report contains all of the information included in Section 9.3.4 plus:

9.3.5.1 Quality Control summary that includes, where applicable, the results and control limits for:

9.3.5.1.1 Method blanks
9.3.5.1.2 Laboratory control sample
9.3.5.1.3 Matrix spike/Matrix spike duplicate
9.3.5.1.4 Duplicate sample –where applicable
9.3.5.1.5 Other QC samples as specified by project requirements (ICV, CCV, ICB, CCB, PSD, Serial Dilution, etc.)

9.3.6 A level III reports contain in addition to the material in section 9.3.3 and 9.3.4 client specified information beyond the Level II report but not including raw data. This report is generally specific to client/project requirements without containing the full data package information in a Level IV report. Information that may be included in a Level III report:

9.3.6.1 Instrument calibration and continuing calibration summaries.
9.3.6.2 Sample receipt checklists.
9.3.6.3 Other information as required by client or contract.

9.3.7 Level IV reports contain the following components:

9.3.7.1 Cover page signed by the person responsible for the report.
9.3.7.2 Table of Contents
9.3.7.3 Project receiving documents including chain of custody forms, shipping labels and information and sample receipt checklists.
9.3.7.4 Sample summary report.
9.3.7.5 Dates report.
9.3.7.6 Analytical report summary.
9.3.7.7 Quality control summary.
9.3.7.8 Forms and raw data for each analytical method – non-CLP forms.

9.3.7.8.1 Sample preparation logs (where applicable)
9.3.7.8.2 LIMS Run Log
9.3.7.8.3 LIMS Analytical Run Summary
9.3.7.8.4 LIMS Surrogates Report (where applicable)
9.3.7.8.5 LIMS Spikes Report
9.3.7.8.6 LIMS Method Blank Report
9.3.7.8.7 Raw data including as applicable to the method - injection/run logs, tune reports, CCV evaluations, chromatograms/instrument printouts, detailed compound spectra reports, library search reports, instrument

calibration evaluations and associated raw data, internal standard reports, degradation reports, manual integration reports, second column RPD reports.

9.3.7.8.8 Reports utilizing CLP equivalent forms will in place of items 9.3.7.8.2 – 9.3.7.8.6 use standard CLP forms 1 –10 for organics and forms 1 –14 for inorganics.

9.3.8 A Level IV report following the reporting format of the EPA Contract Laboratory Program (CLP) current SOW (Statement of Work) and is available on request. The LIMS contains the CLP deliverables forms that comply in equivalent format with the SOW under which analyses are performed and the cited Exhibits and Appendices for that SOW and will include:

9.3.8.1 Instrument Calibration Data
9.3.8.2 Instrument Data Printouts
9.3.8.3 Chromatograms
9.3.8.4 GC/MS Tuning Results
9.3.8.5 Preparation and Analysis Logs

9.3.8.6 A designated individual and alternate will be responsible for the preparation of the SDG (Sample Delivery Group) files to be submitted.

9.3.8.7 All documents pertaining to the SDG file as required by the SOW will be compiled, maintained in a secure location and all copies will be made in a manner that ensure legibility and completeness.

9.3.8.8 Documents pertaining to more than one SDG will be stored with the lowest SDG number and subsequent files will be stamped with the location of the copies.

9.3.8.9 All compete SDG files will be paginated with sequential numbers on each page and accompanied by a complete Form DC-2.

9.3.8.10 Completed SDG files will be reviewed by the QA Director or designated individual prior to submittal and will include review for completeness, compliance with SOW requirements, legibility of documents and delivery requirements.

9.3.8.11 Shipping of the files will be documented with what was sent, to whom, the date and the manner of shipping (i.e. carrier used). Data packages will get affixed with custody seals signed and dated.

## 9.4 RECORD RETENTION

9.4.1 Paper copies of the Chain of Custody, invoice and sample log sheet (where applicable) are maintained in Laboratory files for seven (7) years unless otherwise stipulated by contract.

9.4.2 LIMS data is stored electronically for a period of seven (7) years unless otherwise stipulated by contract.

9.4.3 Laboratory raw data, bench sheets, instrument printouts are stored for at least seven (7) years. Where available, chromatography data is stored electronically in lieu of paper.

9.4.4 All records either electronic or hard copy will be considered confidential to the client and maintained in a secure manner.

9.4.5 All records involved in the analytical process and required to reproduce the analytical activities associated with data produced will be maintained.

## 9.5 ELECTRONIC DATA SECURITY

9.5.1 Data integrity is ensured through daily backups, multi-level security and off-site storage. Access to the specific user privileges can be individually controlled.

9.5.2 Each user has an unique user name and password that allows certain privileges.

9.5.3 The LIMS Administrator is responsible for maintaining the security of the RTI server and ensuring that external sources cannot compromise the integrity of laboratory data.

9.5.4 A computer usage policy is incorporated into the RTI Employee Handbook.

9.5.5 The IT manager is responsible for the proper operation of all hardware systems and for ensuring compatibility with software, data system and instrument requirements.

# 10.0 PERFORMANCE AND SYSTEM AUDITS

## 10.1 INTERNAL LABORATORY AUDITS

10.1.1 Internal Performance Audits.

10.1.1.1 RTI participates in programs whereby samples of unknown concentration are submitted for analysis. These single blind performance audits include the following.

10.1.1.1.1 Environmental Resource Associates (ERA) WP Studies – Semi Annually.
10.1.1.1.2 ERA Soil Studies - Semi Annually.
10.1.1.1.3 ERA WS Studies - Semi Annually.

10.1.1.2 All performance evaluation samples are analyzed in a manner consistent with routine sample analysis. Every attempt is made to integrate these performance evaluation samples into normal workload. Treatment of PT (performance testing) samples in a manner that would not be used for client samples is prohibited. This includes multiple analyses that would not routinely be performed, averaging of results, eliminating or adding any steps in the sample preparation or analytical process, sub-contracting of PT samples or consultation with outside organizations during open studies and any other means designed to apply special treatment to these samples.

10.1.1.3 PT samples are a single blind program and as such are not meant to completely mimic routine samples. These samples arrive in a manner that is not consistent with client samples, contain specific preparation and reporting instructions and in containers clearly marked as PT samples that are not consistent with normal sample containers. PT samples are received and distributed by the QA department PT coordinator. PT sample are not logged in the LIMS due to the impact on company statistical tracking of laboratory performance (PT sample due dates are not representative of typical samples and can skew laboratory data). PT results are not reported through the LIMS since special forms and means are required to submit data to the PT provider. PT samples are tracked by the Laboratory Supervisor and analysts in a manner consistent with routine samples according to the assigned due date.

10.1.1.4 The QA Director evaluates the results of these studies. Corrective Action procedures as specified in Section 13.0 are undertaken to resolve deficiencies.

10.1.1.5 As part of the effort to identify and resolve deficiencies or as an additional check on Laboratory performance the QA Director or Laboratory Director may obtain additional PT samples, performance check samples from another commercial source or prepare samples internally. These samples are evaluated against the acceptance levels or laboratory control limits and corrective actions taken as necessary.

10.1.1.6 The laboratory may receive client audit or blind QC samples. These samples will be analyzed as routine samples or according to client specified procedures. Any provided feedback from the results of these samples will be used to assess laboratory performance and institute any necessary corrective actions.

10.1.2 Internal Systems/Technical Audits.

10.1.2.1 Audits will assess Laboratory compliance with the QAP, certification policy requirements and technical method requirements. Annually the QA Director will schedule an internal Laboratory system and technical audits. The audit will be conducted based on and documented using 'Audit Form.doc'. The form is used is the A2LA combined ISO/IEC 17025 and DOD checklist for laboratory site assessment and includes the requirements of the ISO Standard and DoD QSM requirements.

10.1.2.1.1 The systems audit will be conducted by the QA Director and Laboratory Director during the second calendar quarter of each year (April – June).

10.1.2.1.2 Technical audits will commence in April of each year and be completed by the end of the year and will include evaluation of each method performed by the laboratory.

10.1.2.2 The system audit encompasses Laboratory documentation on sample receiving, sample log in, sample storage, Chain of Custody procedures, sample preparation and analysis, sample tracking, report generation and any other pertinent facet of the Laboratory operation required to demonstrate compliance with QAP and accreditation/certification requirements. Records included in the review include:

10.1.2.2.1 QAP and SOPs for status of current review.
10.1.2.2.2 Training records for completeness.
10.1.2.2.3 LIMS records for compliance with QAP/SOP procedures.

10.1.2.2.4 Non-LIMS laboratory logs.

10.1.2.3 Systems audits are conducted and documented on the audit form noted each year by QA Director and Laboratory Director.

10.1.2.4 Any deficiencies noted during the audits will require investigation and corrective action implementation. Findings will be discussed with applicable personnel. If required by the finding periodic reviews will be conducted to assess completed resolution. Subsequent audits will assess the effectiveness of the corrective actions.

10.1.2.5 The QA Director and Laboratory Director are independent of the activities being audited with respect to the basic operational activities of the laboratory. While both individuals participate in report generation and compilation of data packages the ability to effectively assess these areas is not compromised since these activities incorporate data assessment of the analytical process with the end result of generating quality data. Data package compilation represents a form of data auditing whereby the QA Director reviews raw data and assesses compliance with method and program requirements. The packages generated are evaluated by an outside party for compliance. Both individuals generate routine analytical reports and are able to assess the process from an individually independent perspective and participate in LIMS system assessments to continually improve the accuracy and quality of laboratory reports.

10.1.2.6 Level IV data packages (Refer to Sec. 9) are routinely produced by the QA Director. These data packages include a review of all raw data, instrument printouts, laboratory reports and chain of custody/sample receipt for compliance with laboratory, method, client and program requirements and enable a data audit of select projects.

10.1.2.7 Technical audits are performed by the QA Director and Laboratory personnel to asses compliance with method specific requirements to ensure quality of data generated by the related technical activities. These procedures involve evaluation of all aspects of individual test methods and are documented with Appendix D – Chemical Testing and Air Testing Detailed Method Review of the audit form. Technical audits are also performed by senior staff chemists provided the method audited is not being performed by that individual. The assigned individual will be trained by the QA Director or Laboratory Director in the required aspects of the auditing process and will

be instructed to assess the assigned method according to the following guidelines. The auditor will, in conjunction with the QA Director, review the laboratory SOP to the method reference for compliance of required specifications or acceptability of modifications, audit current practices for compliance with the SOP and assess actions related to the generation of data.

10.1.2.8 All individuals involved in the auditing process will work under the direction of the QA Director.

10.1.2.9 Audit checklists used by other accrediting programs (A2LA, Client, etc.) may be used to ascertain compliance with the program policies. These checklists will supplement internal system audit documentation.

10.1.2.10 Following completion of the system audit any findings that represent instances of non-compliance will be investigated as to the cause and corrective actions implemented (Refer to Sec. 13 for addition information regarding corrective action procedures).

10.1.2.11 Any deficiencies noted during the technical audits will be immediately brought to the attention of the QA Director for investigation and corrective action implementation. Subsequent audits will assess the effectiveness of the corrective actions.

10.1.2.12 Any deficiencies noted that may have impacted the validity of reported results require notification to affected clients.

10.1.2.12.1 Clients will be notified immediately (within 24 hours) of any finding that would cause a significant change in the test results reported. Corrections to the data set will be made and a revised report issued within one to five days of notification depending on the magnitude of the change and the complexity of the report. Significant changes are defined as those that would cause a reported result to be re-evaluated with respect to a regulatory limit or represent false positive or false negative situations.

10.1.2.12.2 The above notification requirements would also apply to findings that identify major deviations from the SOP/Method that would invalidate the data (wrong reagents, incorrect volumes, inadequate or malfunctioning equipment) or quality control results that would render the data unusable.

10.1.2.12.3 Clients will be notified within 30 days of any finding that would result in minor changes to the data reported

## 10.2 EXTERNAL LABORATORY AUDITS

10.2.1 RTI willingly participates in any client or government agency audit whether project specific or required by the client or agency.

10.2.2 The Laboratory has had numerous project related audits and maintains accreditation that require periodic audits, these include.

10.2.2.1 A2LA - Every 2 years
10.2.2.2 UT NELAC – Every 2 years

# 11.0 PREVENTATIVE MAINTENANCE

## 11.1 MAINTENANCE ACTIVITIES

11.1.1 RTI maintains analytical instruments based on the manufacturer's recommendation, and/or the requirements of the reference method.

11.1.2 The laboratory is committed to maintaining instruments in proper working order and will perform preventative maintenance to ensure optimum operation.

11.1.3 Section 15 of each SOP details specific preventative maintenance activities associated with the analytical method.

11.1.4 The instrument section of the LIMS contains a table for each instrument/instrument type that specifies routine maintenance for each instrument.

11.1.5 All instruments are logged in the Omega LIMS and contain instrument description, manufacturer, serial number, date purchased and service agreement information where applicable.

11.1.6 A maintenance log is associated with each instrument in the LIMS. All instrument maintenance is recorded in these logs

## 11.2 CONTINGENCY PLANS

11.2.1 The Laboratory is equipped with multiple instruments that serve the same or similar purpose allowing for back up capabilities in most areas. Alternate accepted techniques are also available for sample analysis. The techniques can be used provided the required reporting limits can be achieved and are acceptable to the data user.

11.2.2. If samples cannot be analyzed within the holding time requirement or other factors stipulated by the project, RTI will, in consultation with the client, attempt to arrange for analysis by another Laboratory.

# 12.0 ROUTINE PROCEDURES USED TO ASSESS DATA ACCURACY, PRECISION AND COMPLETENESS

## 12.1 ACCURACY ASSESSMENT – MATRIX/MEDIA SPIKES (MS/MSA) MATRIX/MEDIA SPIKE DUPLICATE (MSD/MSDA)

12.1.1 The accuracy of analytical procedures is monitored by spiking random samples of the same matrix or type at a frequency of 5% (one (1) per batch of twenty (20)) with the analyte(s) of interest and processing through the same procedures as the samples. Spikes are prepared at a level near the middle of the calibration range. For air sample analyses media spikes are employed whereby a known amount of analyte is added to blank sample collection media (unless calibration is performed by fortifying and desorbing/eluting certain media). The amount recovered is a function of the concentration measured in the MS sample minus any sample level of analyte and is expressed as percent recovery. The calculation follows the formula:

$$\% R = (C_{MS} - C_S)/A \times 100 \qquad \text{Eq 12-1}$$

Where:

| | |
|---|---|
| % R | = Present Recovery |
| $C_{MS}$ | = Concentration of Matrix Spike |
| $C_S$ | = Sample Concentration |
| A | = Amount Spiked |

12.1.2 For most analytical procedures a MSD is required. This QC sample is used to verify MS accuracy as above and to assess precision (See 12.3). Routinely both the MS and MSD are used to assess the accuracy of the associated analytical event and statistically be used to assess the overall accuracy of the method. In specific instance when both a MS and MSD are analyzed the %R used for accuracy assessment may be calculated as the average of the %R MS and %R MSD. Air sampling procedures require routine assessment of a MSA and MSDA.

12.1.3 Recovery data is complied in Omega and used to generate control charts. Warning and control limits are based on the calculated mean recovery with two (2) and three (3) standard deviations respectfully. The following formulas are used to determine these limits:

$$X_m = \frac{\Sigma x}{n} \qquad \text{Eq 12-2}$$

$$sd = \text{sqrt} \quad \frac{\Sigma x^2 - \Sigma (x)^2}{n-1} \qquad \text{Eq 12-3}$$

| | | |
|---|---|---|
| UWL | = Xm + 2 sd | Eq 12-4 |
| LWL | = Xm - 2 sd | Eq 12-5 |
| UCL | = Xm + 3 sd | Eq 12-6 |
| LCL | = Xm - 3 sd | Eq 12-7 |

Where:

| | |
|---|---|
| $X_m$ | = Mean Recovery |
| Sx | = Sum of the values |
| n | = Number of data points |
| UWL | = Upper Warning Limit |
| LWL | = Lower Warning Limit |
| UCL | = Upper Control Limit |
| LCL | = Lower Control Limit |

Control limits should not exceed agency ranges where available and should approach the target range of 75 - 125%R. The QA Director will evaluate the data for adherence to method specifications or general acceptability.

When agency/project specific control ranges are provided the QA Director will compare the laboratory statistically calculated ranges to those provided for consistency between the two sets of values. If the laboratory range exceeds the specified range the individual data points will be compared to the range and if the results fall within the range the control limits can be adopted for used. In cases where the laboratory range exceeds the project required range and the above is not met, the client will be contacted to determine if the laboratory ranges are acceptable or the laboratory will perform corrective action procedures to bring the method control limits within the project specifications.

The laboratory currently uses the control limits published in the most recent version of the DoD QSM as the default limits in the LIMS. Laboratory data has been assessed with regard to those limits.

12.1.4 For frequently performed test procedures the warning and control limits are based on the thirty (40) data points and the control charts are updated with the calculated values. In instances where a particular method specifies an acceptable %R range (i.e. 75 - 125%R) the LIMS test code will incorporate those limits. MS/MSD data can be subject to sample matrix effects that render some individual data points unusable. The QA Director can eliminate obvious anomalous data points from data sets for calculating control limits. It is not the intent of RTI Laboratories to produce excessively wide control limits for assessing data quality and measures will be taken to ensure control limits are not broadened by matrix affected data. The QA Director maintains the authority to set reasonable control limits in cases where extreme variation exists in specific methods or for individual poor performing analytes.

12.1.5 In the case of infrequent analyses, the control limits are based on a minimum of seven (7) data points, default values of 75% - 125% (LCL & UCL) or agency ranges when available. The QA Director will determine the appropriate method for establishing the control limits on an analyte specific basis.

12.1.6 Control charts can be used to evaluate to ensure a test. Conditions that represent an out of control situation and warrant corrective action before proceeding with sample analysis include:

12.1.6.1 Mean accuracy value exceeding specified control limits.
12.1.6.2 Two (2) or more data points in a set of twenty (20) exceeding the control limits.
12.1.6.3 Five (5) consecutive data points exhibiting a trend
12.1.6.4 Five (5) consecutive data points exhibiting a shift

12.1.7 In cases where the sample concentration of analyte is high and was unknown at the time of spiking, the MS/MSD may be lost due to excessive dilutions or analyte concentration. This also applies to interferences present which may obscure the recognition and quantification of the analyte. When this occurs, the recovery is assessed by evaluation of a laboratory control sample.

## 12.2 ACCURACY ASSESSMENT - LABORATORY CONTROL SAMPLE (LCS)

12.2.1 A LCS is prepared near the mid range of the calibration curve at a frequency of one (1) per batch, by adding a known amount of analyte(s) to a known blank sample matrix (i.e. laboratory reagent water or clean solid matrix) and processing it through the same procedures as the samples. Optionally, reference samples may be purchased that have established acceptable ranges. The recovery of the LCS is calculated by:

$$\%R = A_R / A_A \times 100 \qquad \text{Eq 12-8}$$

Where:

$\%R$ = Percent Recovery
$A_R$ = Amount Recovered
$A_A$ = Amount Added

12.2.2 Control charts are generated in Omega using equations 12-1 through 12-7. When a reference sample is used as the LCS, the control charts are constructed with the upper and lower control limits based on the acceptable range. For frequently performed test procedures the warning and control limits are based on the forty (40) data points and the control charts are updated with the calculated values. In instances where a particular method specifies an acceptable %R range (i.e. 80 - 120%R) the LIMS test code will incorporate

those limits. Laboratory procedures may result in unusable data due to spiking or preparation errors. The QA Director can eliminate obvious anomalous data points from data sets for calculating control limits. It is not the intent of RTI Laboratories to produce excessively wide control limits for assessing data quality and measures will be taken to ensure control limits are not broadened by laboratory errors. The QA Director maintains the authority to set reasonable control limits in cases where extreme variation exists in specific methods or for individual poor performing analytes.

When agency/project specific control ranges are provided the QA Director will compare the laboratory statistically calculated ranges to those provided for consistency between the two sets of values. If the laboratory range exceeds the specified range the individual data points will be compared to the range and if the results fall within the range the control limits can be adopted for used. In cases where the laboratory range exceeds the project required range and the above is not met, the client will be contacted to determine if the laboratory ranges are acceptable or the laboratory will perform corrective action procedures to bring the method control limits within the project specifications.

The laboratory currently uses the control limits published in the most recent version of the DoD QSM as the default limits in the LIMS. Laboratory data has been assessed with regard to those limits.

12.2.3 In the case of infrequent analyses, the control limits are based on a minimum of seven (7) data points, default values of 80% - 120% (LCL & UCL) or agency ranges when available. The QA Director will determine the appropriate method for establishing the control limits on an analyte specific basis.

12.2.4 Control charts are evaluated to ensure the system remains in control. Conditions that represent an out of control situation and warrant corrective action before proceeding with sample analysis include:

12.2.4.1 Mean accuracy value exceeding control limits
12.2.4.2 Two (2) or more data points in a set of twenty (20) exceeding the control limits
12.2.4.3 Five (5) consecutive data points exhibiting a trend
12.2.4.4 Five (5) consecutive data points exhibiting a shift

## 12.3 PRECISION ASSESSMENT - DUPLICATES - MS/MSD

12.3.1 Assessing precision is accomplished through evaluation of the relative percent difference (RPD) of duplicate measurements. Depending on the method, this may be in the form of a duplicate (second aliquot) sample analysis, duplicate spikes (MS/MSD) or duplicate media spikes. All steps in the sample process are applied to the duplicates and are analyzed at a frequency of 5% or 10% depending on the method. The RPD of the two- (2) measurements is calculated as follows:

$$RPD = \frac{|D_1 - D_2|}{(D_1 + D_2)/2} \times 100$$

Where:

RPD = Relative Percent Difference
$D_1$ = First Measurement Value
$D_2$ = Second Measurement Value

12.3.2 Precision data is complied in Omega and can be used to generate control charts with the exception that the LWL and LCL are not applicable.

12.3.3 In the case of infrequent analyses, the control limits are based on a minimum of seven (7) data points, default values of 40% (UCL) or agency ranges when available. The QA Director will determine the appropriate method for establishing the control limits on an analyte specific basis. Data will be assessed and adopted consistent with the procedures in Sec. 12.2.2 above.

12.3.4 Control charts are evaluated to ensure the system remains in control. Conditions that represent an out of control situation and warrant corrective action before proceeding with sample analysis include:

12.3.4.1 Method precision value exceeding control limits
12.3.4.2 Two (2) or more data points in a set of twenty (20) exceeding the control limits
12.3.4.3 Five (5) consecutive data points exhibiting a trend
12.3.4.4 Five (5) consecutive data points exhibiting a shift

## 12.4 COMPLETENESS ASSESSMENT

12.4.1 Completeness can be assessed on an individual project basis, batch basis, per matrix analyzed or analytical method. In all the above instances, completeness will be the ratio of the number of useful measurements to the

total number or measurements performed and is calculated by:

$$\%C = N_U / N_T \times 100 \qquad \text{Eq 12-9}$$

Where:

- %C = Percent Complete
- $N_U$ = Number of useful values
- $N_T$ = Total values obtained

12.4.2 Assessment of completeness will be performed at the discretion of the Laboratory Director or Project Manager to assess specific projects or overall laboratory performance.

12.4.3 Completeness can also be assessed through client feedback on specific projects or overall performance.

12.4.4 LIMS tables and data can also be used to empirically assess laboratory completeness.

12.4.5 Completeness assessment when required or performed will be discussed during weekly scheduled staff meetings.

# 13.0 CORRECTIVE ACTION

13.1 The need for corrective action can arise from a myriad of sources. These include, but are not limited to, client inquiries, review of sample or QC data by management, problems encountered or noted by technical staff, instrument malfunctions, supplies and laboratory apparatus or due to the need to meet sample or method specifications.

13.2 Corrective Action Policy

13.2.1 When any situation arises that could result in the potential for compromising data quality or integrity or affects the standards of the operation, the QA Director, Laboratory Director or assigned supervisory level individual will assume the responsibility and authority for instituting the appropriate measures necessary to resolve the issue. All personnel can at any time recommend corrective actions to improve operations and/or act as preventative measures.

13.2.2 Documentation of the problem, cause and solution is required and an assessment of the significance and magnitude of the nonconformance is made by the Laboratory Director, QA Director or assigned individual. Significant problems include:

13.2.2.1 Problems that affect the accuracy of sample results.
13.2.2.2 Conditions that impact the integrity of laboratory data.
13.2.2.3 Deviations from method procedures or laboratory policies.
13.2.2.4 Quality control results that indicate a noncompliant situation.
13.2.2.5 Unethical actions by laboratory personnel.

13.2.3 In cases where procedures are deemed to be in nonconformance with essential components of the method or laboratory policies all associated work will cease until the problem is corrected. Affected laboratory data will not be issued and if results have already been submitted the client will be notified of the situation and advised to disregard the affected results pending issuing of a revision.

13.2.4 Corrective actions instituted will be designed not only to resolve the particular problem but also to prevent any reoccurrence.

13.2.5 Required changes to laboratory operations will be immediately implemented and monitored.

13.2.6 The laboratory shall continuously engage its activities toward a preventative approach designed to preclude the necessity for corrective actions through diligent monitoring and adherence to QAP policies.

## 13.3 Corrective Action Procedure

13.3.1 An investigation into the cause of problem will commence immediately on identification of a problem. The root cause investigation is the most important aspect of the procedure and may either be obvious or seemingly intractable. Problems that will necessitate initiation of the corrective action procedure include the following, however Laboratory Management may at any time require initiation of a corrective action procedure at their discretion.

13.3.3.1 Unacceptable proficiency testing data.
13.3.3.2 Incorrectly reported sample results.
13.3.3.3 Unacceptable quality control data not immediately corrected.
13.3.3.4 Analyses performed under noncompliant calibration/calibration verification conditions.
13.3.3.5 Inadequate review and comments for QC data.
13.3.3.6 Unapproved deviations from an SOP.
13.3.3.7 Problems with data sets that propagate to final reporting.
13.3.3.8 Unresolved problems with sample receiving.
13.3.3.9 Systematic or organizational problems resulting in the inability to consistently meet holding time or project deadline requirements.
13.3.3.10 Failures in proper documentation requirements, lack of proper instrument maintenance or inadequate data backup.
13.3.3.11 Conditions resulting in failure to maintain proper sample storage.
13.3.3.12 LIMS functions that result reporting problems.
13.3.3.13 Non compliance with QAP policies or accreditation standards.
13.3.3.14 Internal/external audit findings.

13.3.2 Once the cause is identified, steps will be instituted to identify the necessary corrective actions and implement the measures required to correct the problem and prevent a reoccurrence.

13.3.3 For actions prior to sample analysis RTI has procedures for identifying, documenting and resolving problems with samples submitted. The laboratory staff will assist samplers in formulating any necessary corrective actions (Sections 4.0 and 5.0).

13.3.4 Each SOP contains a section specifying acceptance criteria for QC samples and the corrective action required.

13.3.5 Problems that are resolved by repeating the appropriate QC sample(s) and sample re-analyses (if necessary) with acceptable results do not require further corrective actions. All QC failures and sample re-analyses if required are documented in the appropriate section within Omega and/or analyst logs.

13.3.6 Problems that cannot be readily resolved or QC failures that require investigation will be documented in the Corrective Action section of the Omega LIMS. The type of information recorded is provided on Figure 13-1. Sample results are not reported until all necessary corrective actions are taken and approved by the QA Director and/or the Laboratory Director. The QA Verify check box will close and lock the corrective action report. Subsequent changes can only be made by individuals with the assigned authority to unlock the form.

13.3.7 Identification of problems during data validation or assessment will require an inquiry into the nature of the problem and sample re-analysis if practical (holding time, volume etc.). If samples cannot be repeated the client is notified and actions including re-sampling, data qualifying, non-reporting of data or other necessary steps are undertaken.

13.3.8 If necessary an internal audit will be performed to ensure continued compliance with corrective actions and verification of resolution.

13.4 RTI has developed procedures and a form for documenting and addressing client complaints. Any corrective actions resulting from a client complaint/inquiry are documented (Refer also to Section 5.0).

13.5 Performance audit nonconformance is investigated and documented on the form presented in Figure 13-3. Following investigation into the cause of an unacceptable PE result and the corrective actions implemented, the QA Director will provide this information to the Laboratory Director in the quarterly report.

13.6 The QA Director will maintain and review a log of PT related corrective action forms that have been initiated will include the following information.

13.6.1 Reason for action
13.6.2 Person responsible for returning response
13.6.3 Date initiated
13.6.4 Date of expected completion
13.6.5 Date of actual completion

13.7 LIMS corrective actions are maintained in a table that is reviewed during the internal audit by the QA Director to assess completion of corrective actions and reviewed for repeat or continuing problems that would indicate inadequate resolutions for the problems.

13.8 Preventative Action

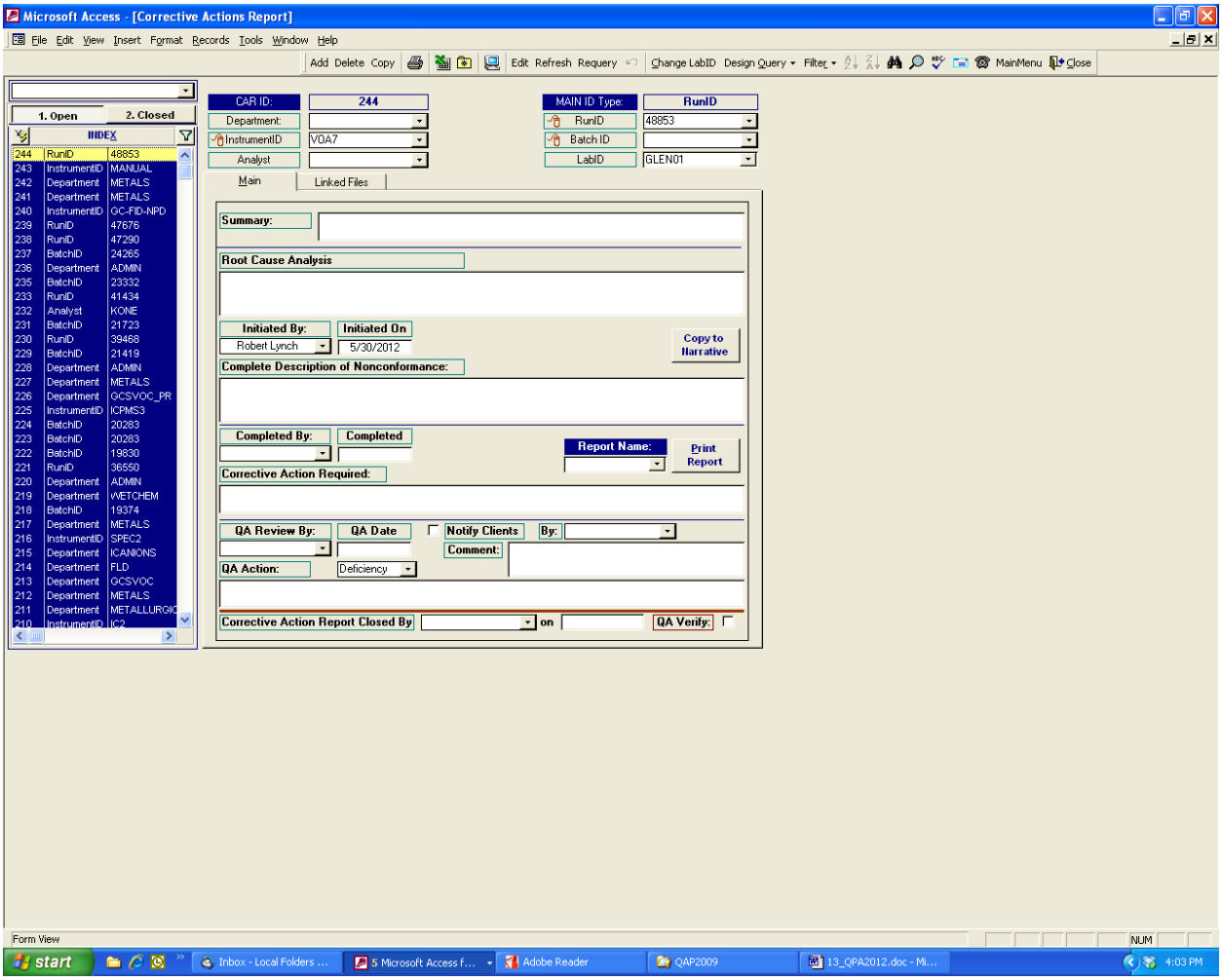
13.8.1 RTI Laboratories maintains a proactive approach toward improving the operations and reducing the likelihood of instances that would result in the necessity for instituting corrective actions. Management seeks to prevent nonconformance problems from arising through:

13.8.1.1 Frequent staff meetings to discuss areas for improvement.
13.8.1.2 Staff training in ethical practices and data integrity.
13.8.1.3 Integrated LIMS control charts to monitor QC data.
13.8.1.4 LIMS performance reports.

13.8.2 Identified preventative actions are implemented through document (i.e. SOP) revision or generation and are monitored for effectiveness through QC monitoring and performance reports.

13.8.3 Implemented preventative actions become integrated into laboratory operations and are subject to the control and review processes incorporated in this and other applicable documents.

**Figure 13-1**


Microsoft Access - [Corrective Actions Report]
File Edit View Insert Format Records Tools Window Help
Add Delete Copy Edit Refresh Requery Change LabID Design Query Filter MainMenu Close
1. Open
2. Closed
IIDEX
CAR ID:
244
Department:
InstrumentID
VOA7
Analyst
MAIN ID Type:
RunID
48853
Batch ID
LabID
GLEN01
Main
Linked Files
Summary:
Root Cause Analysis
Initiated By:
Robert Lynch
Initiated On
5/30/2012
Copy to Narrative
Complete Description of Nonconformance:
Completed By:
Completed
Report Name:
Print Report
Corrective Action Required:
QA Review By:
QA Date
Notify Clients
By:
Comment:
QA Action:
Deficiency
Corrective Action Report Closed By
on
QA Verify:
Form View
NUM
start
Inbox - Local Folders ...
5 Microsoft Access f...
Adobe Reader
QAP2009
13_QPA2012.doc - Mi...
4:03 PM

## Figure 13-2

## RTI PERFORMANCE AUDIT CORRECTIVE ACTION FORM

DATE: DATE DUE:

PT Study:

Analyte/Category:

Result Reported:
Target Value:
Acceptance Range:

Analyst:

**Reason for Error:**

**Root Cause Investigation:**

**Corrective Action:**

Analyst: Date:

Approved: Date:

# 14.0 MANAGEMENT REVIEW

14.1 Management reviews are conducted weekly during scheduled meetings attended by the following.

Environmental Sciences Division

14.1.1 General Manager
14.1.2 Director, Environmental Sciences
14.1.3 Director, Quality Management
14.1.4 Director, Client Services
14.1.5 Director, Sales and Marketing
14.1.6 Laboratory Supervisor.

Materials Sciences Division

14.1.7 General Manager
14.1.8 Director, Materials Sciences
14.1.9 Metallurgical Engineer
14.1.10 Sales, Materials Sciences

14.2 Each Director and Supervisor prepares a report that is distributed to all attendees prior to the meeting. The basic format for the report includes:

14.2.1 Items associated with the individual area of responsibility
14.2.2 Corrective and Preemptive Actions
14.2.3 Problems and Opportunities
14.2.4 Employee Concerns.

14.3 Subjects reviewed and discussed include the following:

14.3.1 Corrective actions arising from performance or system audit results or due to significant quality assurance problems.

14.3.2 Performance evaluation results

14.3.3 External audit evaluations.

14.3.4 New SOP's generated or revisions to SOP's.

14.3.5 Method validation studies when applicable.

14.3.6 Items related to quality control

14.3.7 Client communications and complaints.

14.3.8 Problems that directly affect data quality.

14.3.9 Review and/or revisions to the QAP and SOP's for suitability of policies and procedures.

14.3.10 Assessment of laboratory performance and areas of concern.

14.3.11 Instrumentation status, problems and corrective actions.

14.3.12 Resource assessment – staff and equipment

14.3.13 Workload backlog.

14.3.14 Reporting status and areas of concern.

14.3.15 Client project status.

14.3.16 Financial status.

14.3.17 Projection of projects expected including scope, volume and assessment of the ability of the laboratory to perform.

14.3.18 Assessment of ability to meet client expectations and method requirements.

14.3.19 Status of new methods or equipment under development.

14.3.20 Overall assessment of the organization or focus on areas of concern.

14.3.21 Status of significant corrective action items.

14.3.22 Preventative actions required or actions implemented and the effectiveness of the action.

14.3.23 Staff training – subjects and schedules.

14.3.24 Areas for improvement.

14.3.25 Reports provided by others as required.

14.3.26 Other factors as relevant.

# 15.0 DOCUMENT CONTROL

15.1 The functions of the Document Control Officer are currently assumed by the QA Director and performed by the QA Department.

15.2 Quality system documents (QAP, SOP's, etc) are stored electronically in manner by which only authorized personnel (QA Director, DCO, Technical Director) have access to and can make changes to the editable files. Final documents available to laboratory personnel are posted electronically in a form that does not allow changes to these documents.

15.2.1 These documents are identified uniquely with a document number that will correspond to the electronic file name.

15.2.2 Documents will contain the revision number and the date of review and approval for use. All documents must be reviewed and approved by Laboratory Management prior to posting for use.

15.2.3 Individuals responsible for approving the documents will be identified and an approved signature log will be maintained.

15.2.4 Documents will be posted in the appropriate section of the LIMS (Document and SOPs) that serves as the log for these documents.

15.2.5 The electronic posted version of the document is the current form in use and is considered as the only acceptable version. Hard copies, including hand written amended versions, are not permitted in the laboratory.

15.2.6 When documents are revised the obsolete version is immediately removed from the LIMS log and archived in a location that is not accessible to general staff. The archive directory can only be accessed by Laboratory Management with the assigned rights.

15.2.7 Archived documents are maintained for at least five years from the date of removal or as stipulated by contract.

15.2.8 Electronic files are backed up daily and restored files will maintain the same protection from access or editing.

15.2.9 These documents will be reviewed at least once per year and revised as necessary.

15.2.10 The QA Director is responsible for notifying appropriate personnel when revised SOPs are posted in the LIMS. This can occur verbally or via e-mail. It is the responsibility of the analytical staff to ensure they are familiar with and using the correct version of a SOP.

15.2.11 Personnel are notified of changes or revisions to the QAP through scheduled training sessions with concomitant signature forms attesting the notification.

15.3 When documents require review or revision by analytical staff an editable file will be provided in the accessible SOP-Documents Revisions folder. Changes will be clearly designated (i.e. changes in red) and the QA Director will review the file. Until the new document is posted in the LIMS the prior document remains the official version. The QA Director will transfer the editable file to the secure location, approve changes or maintain the file in the folder for additional revisions. When all changes have been approved and accepted the editable file will be stored in the secure location, removed from the revisions folder and the prior file transferred to the archive folder. The approved document will be posted in the LIMS in a form that does not allow changes.

15.4 Forms used in the laboratory are maintained by the QA Department in electronic form not accessible to the staff. Each form includes the form designation, date of issue and revision designation. Obsolete forms reside in electronic locations inaccessible to the general staff and are stored in marked archived folders for no less than five years.

15.5 Prior to issuing any document approval by the QA Department is required.

15.7 Laboratory notebooks are maintained for recording information that is not stored electronically in the LIMS and include but are not limited to:

15.7.1 Reagent preparation logbooks.

15.7.2 Standard receipt and preparation logs.

15.7.3 Refrigerator, oven monitoring logbooks.

15.7.4 Thermometer calibration logs.

15.7.5 Sample raw data logs for manual procedures.

15.7.6 Logbooks will contain the name of the logbook, the date initiated and the end date of for the last entry. Logbook entries will comply with the specification in Section 15.8 below.

15.7.7 Completed logbooks will be forwarded to the QA Department and a new logbook issued by the QA Department.

15.7.8 Changes to the format of the logbooks will be made by the QA Department and will contain the appropriate form designation indicating the revision. Obsolete logs or formats will be removed from use.

15.7.9 Logbooks will be maintained by the analyst while in use. Following completion the logbook will be archived in the records retention area of the facility for a minimum of seven (7) years. Access to archived records will be documented on the access log.

15.8 When any changes to logbooks are required or when mistakes need to be corrected the procedure below must be followed.

15.6.1 Any corrections to recorded information must be made by a single line through the error and the correction dated and initialed by individual making the change. Use of 'white-out' is strictly prohibited.

15.6.2 Unused portions of the form must be 'Z'd' out.

15.9 Forms must contain complete information including individual completing the form, date and information appropriate to and required for the form.

15.10 The QA Department will periodically review laboratory data forms to ensure compliance with correct record keeping procedures. Any discrepancies will be discussed with the individual using the form.

15.11 Contingency Plan for Record Retention

15.11.1 In the event of a transfer of ownership of the laboratory all records will be maintained under the new ownership arrangement. Unless instructed otherwise by a client, records will become the responsibility of the new owner and maintained under the guidelines of that organization provided these are consistent with prior arrangements agreed to with the client. Client records will be transferred to that specific client upon request.

15.11.2 Should RTI decide to cease all company operations, provisions will be made for laboratory records as below.

15.11.3 Client records will be transferred to that client or according to specific instructions provided by the client.

15.11.4 The Company General Manager/President will make arrangements for storage of records and will provide clients with the information required for record retrieval and the intended date of permanent disposal of records.

# 16.0 DEFINITIONS

**16.1** Acceptance Criteria: specified limits placed on characteristics of an item, process, or service defined in required documents.

**16.2** Accuracy: the degree of agreement between an observed value and an accepted reference value. Accuracy includes a combination of random errors (precision) and systematic errors (bias) components which are due to sampling and analytical operations; a data quality indicator.

**16.3** Analyst: the designated individual who performs the “hands-on” analytical methods and associated techniques and who is the one responsible for applying required laboratory practices and other pertinent quality controls to meet the required level of quality.

**16.4** Batch: environmental samples that are prepared and/or analyzed together with the same process and personal, using the same lot(s) of reagents. A preparation batch is composed of one to 20 samples of the same matrix. An analytical batch is composed of prepared environmental samples (extract, digestate or concentrate), which are analyzed together as a group. An analytical batch can include prepared samples originating from various environmental matrices and can exceed 20 samples. However, for analytical processes that do not include separate preparation, QC samples (MB, LCS, MS, MSD, DUP) must be prepared for each batch of 20 or less samples.

**16.5** Blank: a sample that has not been exposed to the analyzed sample stream in order to monitor contamination during sample transport, storage or analysis. The blank is subject to the usual analytical and measurement process to establish a zero baseline or background value and is sometimes used to adjust or correct routine analytical results.

**16.6** Field Blank: blank prepared in the field by filling a clean container with pure de-ionized water and appropriate preservative, if any, for the specific sampling activity being undertaken.

**16.7** Method Blank: a sample of matrix similar to the batch of associated samples (when available) that is free from the analytes of interest and is processed simultaneously with and under the same conditions as samples through all steps of the analytical procedure, and in which no target analytes or interferences are present at concentrations that impact the analytical results for sample analyses.

**16.8** Calibration (Initial Calibration – ICAL): to determine, by measurement or comparison with a standard, the correct value of each scale on a meter, instrument or other device. The levels of the applied calibration must bracket the range of planned or expected sample measurements.

**16.9** Calibration Curve: the graphical relationship between the known values, such as concentrations, of a series of calibration standards and their instrument response.

**16.10** Calibration Standard: a substance or reference material used to calibrate an instrument.

**16.11** Certified Reference Material (CRM): a reference material one or more of whose property values are certified by a technically valid procedure, accompanied by a NIST traceable certificate or other documentation which is issued by a certifying body.

**16.12** CLP – Contract Laboratory Program.

**16.13** Corrective Action: the action taken to eliminate the cause of an existing nonconformity, defect or other undesirable situation in order to prevent reoccurrence.

**16.14** Demonstration of Capability (Initial Demonstration of Method Performance - IDMP): a procedure to establish the ability of the analyst to generate acceptable accuracy.

**16.15** Detection Limit (DL, MDL): the lowest concentration or amount of the target analyte that can be identified, measured, and reported with confidence that the analyte concentration is not a false positive value.

**16.16** Dry weight: actual weight of a solid sample minus free moisture as driven off at $105^{o}C$.

**16.17** Holding Times (Maximum Allowable Holding Times): the maximum time samples may be held prior to analysis and still be considered valid or not compromised.

**16.18** Internal Standard (IS): a known amount of standard added to a test portion of a sample as reference for evaluating and controlling the precision and bias of the applied analytical method.

**16.19** Laboratory Control Sample (LCS): a sample matrix, free from the analytes of interest, spiked with verified known amounts of analytes or a material containing known and verified amounts of analytes. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

**16.20** Laboratory Duplicate: aliquots of a sample taken from the same container under laboratory conditions and processed and analyzed independently.

**16.21** Matrix: the component or substrate that contains the analytes of interest. For purposes of batch and QC requirement determinations, the following matrix distinctions shall be used:

**16.22** Aqueous: any aqueous sample excluded from the Drinking Water matrix or Saline/Estuarine source. Includes surface water, groundwater, effluents, and TCLP or other extracts.

**16.23** Drinking Water: any aqueous sample that has been designated a potable or potential potable water source.

**16.24** Saline/Estuarine: any aqueous sample from an ocean or estuary, or other salt-water source such as the Great Salt Lake.

**16.25** Non-aqueous Liquid: any organic liquid with <15% settleable solids.

**16.26** Solids: includes soils, sediments, sludges and other matrices with >15% settleable solids.

**16.27** Chemical Waste: a product or by-product of an industrial process that results in a matrix not previously defined.

**16.28** Limit of Detection (LOD): The minimum concentration of an analyte greater than or equal to the DL in a given matrix, analyzed by a specified method, on an individual instrument that can be detected at 3 or more times the noise level. The LOD verification is performed quarterly on a sample prepared in a clean matrix and processed through all steps in the procedure.

**16.29** Limit of Quantification (LOQ/RL/PQL): The minimum reporting limit of an analyte can be accurately quantified and corresponds to a level within the calibration range. The LOQ value cannot be less than the lowest calibration standard. The LOQ verification is performed quarterly on a sample prepared in a clean matrix and processed through all steps in the procedure. The value of the LOQ verification must be within the control limits of the method.

**16.30** Matrix Spike (MS, spiked sample or fortified sample): a sample prepared by adding a known amount of target analyte(s) to a specified amount of sample. Matrix spikes are used to determine the effect of the matrix on method recovery efficiency.

**16.31** Matrix Spike Duplicate (MSD, spiked sample or fortified sample duplicate): a second replicate matrix spike prepared in the laboratory and analyzed to obtain a measure of the precision.

**16.32** Method Detection Limit: the minimum concentration of a substance (an analyte) that can be measured and reported with 99% confidence that the analyte concentration is greater than zero and is determined from analysis of a sample in a given matrix containing the analyte.

**16.33** ml: milliliter or $10^{-3}$ liters.

**16.34** mg: milligram or $10^{-3}$ gram.

**16.35** ng: nanogram or $10^{-9}$ grams.

**16.36** Precision: the degree to which a set of observations or measurements of the same property obtained under similar conditions, conform to themselves; a data quality indicator. Precision is usually expressed as standard deviation, variance or range, in either absolute or relative terms.

**16.37** Preservation: refrigeration and/or reagents added at the time of sample collection (or later) to maintain the chemical and/or biological integrity of the sample.

**16.38** Post Digestion Spike (PDS): A know amount of analyte added to the digestion or extraction solution following sample preparation. Used to evaluate matrix interference.

**16.39** QAP: Quality Assurance Plan

**16.40** Quality Control: the overall system of technical activities whose purpose is to measure and control the quality of a product or service so it meets the need of the users.

**16.41** Quality Control Sample: an uncontaminated sample matrix spiked with known amounts of analytes from a source independent from the calibration standards. It is generally used to establish intra-laboratory or analyst specific precision and bias or to assess the performance of all or a portion of the measurement system.

**16.42** Quantification Limits: levels, concentrations or quantities of a target variable (e.g., target analyte) that can be reported at a specified degree of confidence.

**16.43** Range: the difference between the minimum and the maximum of a set of values.

**16.44** Reference Material: a material or substance of one or more properties of which are sufficiently well established to be used for the calibration of an apparatus, the assessment of a measurement method, or for assigning values to materials.

**16.45** Reference Method: a method of known and documented accuracy and precision issued by an organization recognized as competent to do so.

**16.46** Reference Standard: a standard, generally of the highest metrological quality available at a given location, from which measurements made at that location are derived.

**16.47** Replicate Analysis: the measurements of the variable of interest performed identically on two or more sub-samples of the same sample within a short time interval.

**16.48** Reporting Limit (RL): refer to Limit of Quantification (LOQ)

**16.49** Sample: any material that is prepared and analyzed according to the procedures outlined within this SOP. Includes, but not limited to calibration standards, laboratory control samples, blanks, matrix spikes, and client environmental samples.

**16.50** Sensitivity: the capability of a method or instrument to discriminate between measurement responses representing different levels (e.g., concentrations) of a variable of interest.

**16.51** Serial Dilution (SD): An incremental dilution of a sample extract or digestion solution, typically at 5-fold. Used to assess matrix interference.

**16.52** SOP: Standard Operating Procedure.

**16.53** SOW: Statement of Work (i.e. ILM05.3). The current CLP SOW with Exhibits and Appendices.

**16.54** Spike: a known mass of target analyte added to a blank sample or sub-sample; used to determine recovery efficiency or for other quality control purposes.

**16.55** Standardized Reference Material (SRM): a certified reference material produced by the U.S. National Institute of Standards and Technology or other equivalent organization and characterized for absolute content, independent of analytical method.

**16.56** Stock Standard Solution (SSS): a concentrated solution containing one or more method analytes prepared in the laboratory using assayed reference materials or purchased from a reputable commercial source.

**16.57** Surrogate: a substance with properties that mimic the analyte of interest. It is unlikely to be found in environmental samples and is added to them for quality control purposes.

**16.58** Traceability: the property of a result of a measurement whereby it can be related to appropriate standards, generally international or national standards, through an unbroken chain of comparisons.

**16.59** μg: microgram or $10^{-6}$ grams.

**16.60** μL: microliter or $10^{-6}$ liters.

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# RTI Laboratories Certifications

American Association for Laboratory Accreditation

# Accredited DoD ELAP Laboratory

A2LA has accredited

## RTI LABORATORIES, INC.

*Livonia, MI*

for technical competence in the field of

## Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2005, the 2009 TNI Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 5.0 of the DoD Quality System Manual for Environmental Laboratories (QSM); accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Presented this 13th day of November 2014.

President & CEO
For the Accreditation Council
Certificate Number 0570.03
Valid to October 31, 2016

*For the tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.*

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

RTI LABORATORIES, INC.
31628 Glendale
Livonia, Michigan 48150
Charles O'Bryan 734-422-8000 ext. 215
cobryan@rtilab.com

ENVIRONMENTAL

Valid To: October 31, 2016 Certificate Number: 0570.03

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2009 TNI Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 5.0 of the DoD Quality Systems Manual for Environmental Laboratories) accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

ICP/MS, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Gravimetry, High Performance Liquid Chromatography, Ion Chromatography, Methylene Blue Active Substances, Misc.- Electronic Probes (pH, $O_2$), Oxygen Demand, Hazardous Waste Characteristics Tests, Spectrophotometry (Visible), Spectrophotometry (Automated), Titrimetry, Total Organic Carbon, Turbidity

| Parameter/Analyte | Potable Water | Nonpotable Water | Solid Hazardous Waste | |
|---|---|---|---|---|
| | | | Aqueous | Solid/Chemical |
| Metals | | | | |
| Aluminum | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Antimony | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Arsenic | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Barium | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Beryllium | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Boron | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Cadmium | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Calcium | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Chromium | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Cobalt | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Copper | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Iron | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Lead | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Magnesium | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Manganese | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |



5202 Presidents Court, Suite 220 | Frederick, MD 21703-8398 | Phone: 301 644 3248 | Fax: 240 454 9449 | www.A2LA.org

| Parameter/Analyte | Potable Water | Nonpotable Water | Solid Hazardous Waste | |
|---|---|---|---|---|
| | | | Aqueous | Solid/Chemical |
| Mercury | EPA 245.1 | EPA 245.1/1631E | EPA 7470A | EPA 7471B |
| Molybdenum | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Nickel | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Potassium | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Selenium | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Silicon | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Silver | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Sodium | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Thallium | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Tin | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Titanium | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Uranium | EPA 200.8 | EPA 200.8 | EPA 6020A | EPA 6020A |
| Vanadium | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Zinc | EPA 200.8 | EPA 200.7/200.8 | EPA 6020A/6010C | EPA 6020A/6010C |
| Nutrients | | | | |
| Ammonia (as N) | SM4500 $NH_3$-D | SM4500 $NH_3$-D | - - - - - - - - - - | - - - - - - - - - - |
| Kjeldahl Nitrogen | EPA 351.2 | EPA 351.2 | - - - - - - - - - - | - - - - - - - - - - |
| Nitrate (as N) | EPA 300.0 | EPA 300.0/9056 | EPA 9056 | EPA 9056 |
| Nitrate-nitrite | EPA 300.0 | EPA 300.0/9056 | EPA 9056 | EPA 9056 |
| Nitrite (as N) | EPA 300.0 | EPA 300.0/9056 | EPA 9056 | EPA 9056 |
| Orthophosphate (as P) | SM4500 P F | EPA 300.0/9056 | EPA 9056 | EPA 9056 |
| Total Phosphorus | SM4500 P-F | SM4500 P-F | - - - - - - - - - - | - - - - - - - - - - |
| Demands | | | | |
| Biochemical Oxygen Demand | SM5210 B | SM5210 B | - - - - - - - - - - | - - - - - - - - - - |
| Carbonaceous BOD | SM5210 B | SM5210 B | - - - - - - - - - - | - - - - - - - - - - |
| Chemical Oxygen Demand | EPA 410.4 | - - - - - - - - - - | - - - - - - - - - - | - - - - - - - - - - |
| Total Organic Carbon | SM5310 B | SM5310 B | EPA 9060 | EPA 9060 |
| Wet Chemistry | | | | |
| Alkalinity (as $CaCO_3$) | SM2320 B | SM 2320B | - - - - - - - - - - | - - - - - - - - - - |
| Chloride | EPA 300.0 | EPA 300.0/9056 | EPA 9056 | EPA 9056 |
| Cyanide | SM4500 CN-E | SM4500 CN-E EPA 9012B | EPA 9012B | EPA 9012B |
| Available Cyanide | ASTM D6888-04 | ASTM D6888-04 | - - - - - - - - - - | - - - - - - - - - - |
| Fluoride | EPA 300.0 | EPA 300.0/9056 | EPA 9056 | EPA 9056 |
| Hardness | SM 2340B | SM 2340B | - - - - - - - - - - | - - - - - - - - - - |
| Hexavalent Chromium | - - - - - - - - - - | SM 3500 Cr-B | EPA 7196A | EPA 7196A/3060A |
| pH | SM4500-$H^+$ B | SM4500-$H^+$ B | EPA 9040C/9041A | EPA 9045C |
| Perchlorate | - - - - - - - - - - | EPA 6850 | EPA 6850 | EPA 6850 |
| Oil and Grease | EPA 1664A | EPA 1664A | EPA 9071B | EPA 9071B |
| Phenols | EPA 420.1 | EPA 420.1/9065 | EPA 9065 | EPA 9065 |
| Total Residue | SM2540 B | SM2540 B | - - - - - - - - - - | - - - - - - - - - - |
| Filterable Residue | SM2540 C | SM2540 C | - - - - - - - - - - | - - - - - - - - - - |

| Parameter/Analyte | Potable Water | Nonpotable Water | Solid Hazardous Waste | |
|---|---|---|---|---|
| | | | Aqueous | Solid/Chemical |
| Nonfilterable Residue | SM2540 D | SM2540 D | - - - - - - - - - - | - - - - - - - - - - |
| Specific Conductance (Conductivity) | SM2510 B | SM2510 B | EPA 9050A | EPA 9050A |
| Sulfate | EPA 300.0 | EPA 300.0/9056 | EPA 9056 | EPA 9056 |
| Turbidity | SM2130 B | SM2130 B | - - - - - - - - - - | - - - - - - - - - - |
| Purgeable Organics (volatiles) | | | | |
| Acetone | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Acetonitrile | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Acrolein | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Acrylamide | - - - - - - - - - - | EPA 624 | EPA 8260C | - - - - - - - - - - |
| Acrylonitrile | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| tert-Amyl Ethyl Ether | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Benzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Bromobenzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Bromochloromethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Bromodichloromethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 4-Bromofluorobenzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Bromoform | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Bromomethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| n-Buytlbenzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| sec-Butylbenzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| tert-Butylbenzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| tert-Butyl Ethyl Ether | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Carbon Disulfide | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Carbon Tetrachloride | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Chlorobenzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Chlorobenzene-d5 | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Chloroethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 2-Chloroethyl Vinyl Ether | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Chloroform | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Chloromethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 2-Chlorotoluene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 4-Chlorotoluene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Cyclohexane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Dibromochloromethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,2-Dibromo-3-Chloropropane (DBCP) | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Dibromofluoromethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Dibromomethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,2 Dibromomethane (EDB) | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| trans-1,4-Dichloro-2-Butene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| trans-1,4-Dichloroethene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,2-Dichlorobenzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,3-Dichlorobenzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,4-Dichlorobenzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |

| Parameter/Analyte | Potable Water | Nonpotable Water | Solid Hazardous Waste | |
|---|---|---|---|---|
| | | | Aqueous | Solid/Chemical |
| Dichlorodifluoromethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,1-Dichloroethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,2-Dichloroethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,1-Dichloroethene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| cis-1,2-Dichloroethene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| trans-1,2-Dichloroethene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,2-Dichloropropane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,3-Dichloropropane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 2,2-Dichloropropane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,1-Dichloropropene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| cis-1,3-Dichloropropene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| trans-1,3-Dichloropropene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Diethyl Ether | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,4-Difluorobenzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Ethyl Benzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Ethyl Methacrylate | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Gas Range Organics (GRO) | - - - - - - - - - - | EPA 8015D | EPA 8015D | EPA 8015D |
| 2-Hexanone | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Hexachlorobutadiene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Hexachloroethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Isopropylbenzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 4-Isopropyltoluene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Iodomethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Isopropyl Ether | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Methyl Acetate | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Methylcyclohexane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Methylene Chloride | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Methyl Ethyl Ketone (MEK) | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 2-Methylnaphthalene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 4-Methyl-2-Pentanone | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 2-Methyl-2-Propanol (MIBK) | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Methyl Tert Butyl Ether (MTBE) | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Naphthalene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Pentafluorobenzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| n-Propylbenzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Styrene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,1,1,2-Tetrachloroethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,1,2,2-Tetrachloroethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Tetrachloroethene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Tetrahydrofuran | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Toluene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Total Petroleum Hydrocarbons (TPH) | - - - - - - - - - - | EPA 1664A | EPA 1664A | EPA 9071A |
| 1,1,2-Trichloro-1,2,2-Trifluoroethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,1,1-Trichloroethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |

| Parameter/Analyte | Potable Water | Nonpotable Water | Solid Hazardous Waste | |
|---|---|---|---|---|
| | | | Aqueous | Solid/Chemical |
| 1,1,2-Trichloroethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Trichloroethene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Trichlorofluoromethane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,2,3-Trichlorobenzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,2,4-Trichlorobenzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,2,3-Trichloropropane | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,2,3-Trimethylbenzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,2,4-Trimethylbenzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| 1,3,5-Trimethylbenzene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Trihalomethanes | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Vinyl Acetate | - - - - - - - - - - | - - - - - - - - - - | - - - - - - - - - - | EPA 8260C |
| Vinyl Chloride | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Xylenes, Total | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| m,p-Xylene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| o-Xylene | - - - - - - - - - - | EPA 624 | EPA 8260C | EPA 8260C |
| Carbon Dioxide | RSKSOP-175 (GC-FID) | RSKSOP-175 (GC-FID) | RSKSOP-175 (GC-FID) | - - - - - - - - - - |
| Ethane | RSKSOP-175 (GC-FID) | RSKSOP-175 (GC-FID) | RSKSOP-175 (GC-FID) | - - - - - - - - - - |
| Ethylene (Ethene) | RSKSOP-175 (GC-FID) | RSKSOP-175 (GC-FID) | RSKSOP-175 (GC-FID) | - - - - - - - - - - |
| Methane | RSKSOP-175 (GC-FID) | RSKSOP-175 (GC-FID) | RSKSOP-175 (GC-FID) | - - - - - - - - - - |
| Extractable Organics (semivolatiles) | | | | |
| Acenaphthene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Acenaphthylene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Acetone | - - - - - - - - - - | - - - - - - - - - - | EPA 8270D | EPA 8270D |
| Acetophenone | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 4-Aminobiphenyl | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Aniline | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Anthracene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Atrazine | - - - - - - - - - - | - - - - - - - - - - | EPA 8270D | EPA 8270D |
| Benzaldehyde | - - - - - - - - - - | - - - - - - - - - - | EPA 8270D | EPA 8270D |
| Benzidine | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Benzoic Acid | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Benzo (a) Anthracene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Benzo (b) Fluoranthene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Benzo (k) Fluoranthene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Benzo (ghi) Perylene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Benzo (a) Pyrene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Benzyl Alcohol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Benzyl Chloride | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 1,1-Biphenyl | - - - - - - - - - - | - - - - - - - - - - | EPA 8270D | EPA 8270D |
| Bis (2-chloroethoxy) Methane | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |

| Parameter/Analyte | Potable Water | Nonpotable Water | Solid Hazardous Waste | |
|---|---|---|---|---|
| | | | Aqueous | Solid/Chemical |
| Bis (2-chloroethyl) Ether | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Bis (2-chloroisopropyl) Ether | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Bis (2-ethylhexyl) Phthalate | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 4-Bromophenyl Phenyl Ether | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Butyl Benzyl Phthalate | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2-sec-Butyl-4,6-Dinitrophenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Caprolactum | - - - - - - - - - - | - - - - - - - - - - | EPA 8270D | EPA 8270D |
| 4-Chloroaniline | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 4-Chloro-3-Methylphenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 1-Chloronaphthalene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2-Chloronaphthalene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2-Chlorophenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 4-Chlorophenyl Phenyl Ether | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Chrysene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Cresols | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2-Cyclohexyl-4,6-Dinitrophenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Dibenzo (a,h) Anthracene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Dibenzofuran | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 1,2-Dichlorobenzene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 1,3-Dichlorobenzene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 1,4-Dichlorobenzene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 3,3'-Dichlorobenzidine | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2,4-Dichlorophenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2,6-Dichlorophenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Diethyl Phthalate | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2,4-Dimethylphenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Dimethyl Phthalate | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Di-n-butyl Phthalate | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Di-n-octyl Phthalate | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2,4-Dinitrophenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2,4-Dinitrotoluene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2,6-Dinitrotoluene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 1,4-Dioxane | - - - - - - - - - - | - - - - - - - - - - | EPA 8270D | EPA 8270D |
| Diphenylamine | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| DRO | - - - - - - - - - - | EPA 8015D | EPA 8015D | EPA 8015D |
| Fluoranthene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Fluorene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Hexachlorobenzene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Hexachlorobutadiene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Hexachlorocyclopentadiene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Hexachloroethane | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Indeno (1,2,3-cd) Pyrene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Isophorone | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2-Methyl-4,6-Dinitrophenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2-Methylnaphthalene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |

| Parameter/Analyte | Potable Water | Nonpotable Water | Solid Hazardous Waste | |
|---|---|---|---|---|
| | | | Aqueous | Solid/Chemical |
| 2-Methylphenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 4-Methylphenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Naphthalene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2-Nitroaniline | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 3-Nitroaniline | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 4-Nitroaniline | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Nitrobenzene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2-Nitrophenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 4-Nitrophenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| N-Nitrosodi-n-propylamine | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| N-Nitrosodiphenylamine | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2, 2-oxybis(1-chloropropane) | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Pentachlorobenzene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Pentachloronitobenzene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Pentachlorophenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Phenanthrene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Phenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Polynuclear Aromatic Hydrocarbons (PAHs) | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Pyrene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Tetrachlorobenzenes | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 1,2,4,5-Tetrachlorobenzene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2,3,4,5-Tetrachlorophenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2,4,6-Tribromophenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 1,2,4-Trichlorobenzene | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2,4,5-Trichlorophenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| 2,4,6-Trichlorophenol | - - - - - - - - - - | EPA 625 | EPA 8270D | EPA 8270D |
| Pesticides/Herbicides/PCBs | | | | |
| Aldrin | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| alpha-BHC | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| beta-BHC | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| delta-BHC | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| gamma-BHC | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| Chlordane (technical) | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| 2,4-D | - - - - - - - - - - | - - - - - - - - - - | EPA 8151A Modified | EPA 8151A Modified |
| Dalapon | - - - - - - - - - - | - - - - - - - - - - | EPA 8151A Modified | EPA 8151A Modified |
| 2,4-DB | - - - - - - - - - - | - - - - - - - - - - | EPA 8151A Modified | EPA 8151A Modified |
| 4,4'-DDD | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| 4,4'-DDE | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| 4,4',-DDT | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| Dicamba | - - - - - - - - - - | - - - - - - - - - - | EPA 8151A Modified | EPA 8151A Modified |

| Parameter/Analyte | Potable Water | Nonpotable Water | Solid Hazardous Waste | |
|---|---|---|---|---|
| | | | Aqueous | Solid/Chemical |
| Dichloroprop | - - - - - - - - - - | - - - - - - - - - - | EPA 8151A Modified | EPA 8151A Modified |
| Dieldrin | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| Dinoseb | - - - - - - - - - - | - - - - - - - - - - | EPA 8151A Modified | EPA 8151A Modified |
| Endosulfan I | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| Endosulfan II | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| Endosulfan Sulfate | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| Endrin | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| Endrin Aldehyde | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| Endrin Ketone | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| Heptachlor | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| Heptachlor Epoxide | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| MCPA | - - - - - - - - - - | - - - - - - - - - - | EPA 8151A Modified | EPA 8151A Modified |
| MCPP | - - - - - - - - - - | - - - - - - - - - - | EPA 8151A Modified | EPA 8151A Modified |
| Methoxychlor | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| PCB-1016 (Aroclor) | - - - - - - - - - - | EPA 608/8082 | EPA 8082 | EPA 8082 |
| PCB-1221 | - - - - - - - - - - | EPA 608/8082 | EPA 8082 | EPA 8082 |
| PCB-1232 | - - - - - - - - - - | EPA 608/8082 | EPA 8082 | EPA 8082 |
| PCB-1242 | - - - - - - - - - - | EPA 608/8082 | EPA 8082 | EPA 8082 |
| PCB-1248 | - - - - - - - - - - | EPA 608/8082 | EPA 8082 | EPA 8082 |
| PCB-1254 | - - - - - - - - - - | EPA 608/8082 | EPA 8082 | EPA 8082 |
| PCB-1260 | - - - - - - - - - - | EPA 608/8082 | EPA 8082 | EPA 8082 |
| PCB-1262 | - - - - - - - - - - | EPA 608/8082 | EPA 8082 | EPA 8082 |
| PCB-1268 | - - - - - - - - - - | EPA 608/8082 | EPA 8082 | EPA 8082 |
| 2,4,5-T | - - - - - - - - - - | - - - - - - - - - - | EPA 8151A Modified | EPA 8151A Modified |
| 2,4,5-TP | - - - - - - - - - - | - - - - - - - - - - | EPA 8151A Modified | EPA 8151A Modified |
| Toxaphene | - - - - - - - - - - | EPA 608/8081A | EPA 8081A | EPA 8081A |
| Nitroguanidine | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |
| 1,3,5-Trinitrobenzene | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |
| 1,3-Dinitrobenzene | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |
| 2,4,6-Trinitrotoluene | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |
| 3,5-Dinitroaniline | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |
| 2,4-Dinitrotoluene | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |
| 2,6-Dinitrotoluene | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |
| 2-Amino-4,6-Dinitrotoluene | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |
| 2-Nitrotoluene | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |
| 3-Nitrotoluene | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |
| 4-Amino-2,6-Dinitrotoluene | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |
| 4-Nitrotoluene | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |
| Hexahydro-1,3,5-Trinitro-1,3,5-Triazine (RDX) | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |

| Parameter/Analyte | Potable Water | Nonpotable Water | Solid Hazardous Waste | |
|---|---|---|---|---|
| | | | Aqueous | Solid/Chemical |
| Methyl-2,4,6-Trinitrophenylnitramine (Tetryl) | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |
| Nitrobenzene | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |
| Nitroglycerin | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |
| Octahydro-1,3,5,7-Tetranitro-1,3,5,7-Tetrazocine (HMX) | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |
| PETN | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |
| Nitroglycerine | - - - - - - - - - - | - - - - - - - - - - | EPA 8330B | EPA 8330B |
| White Phosphorus | - - - - - - - - - - | - - - - - - - - - - | EPA 7580 | EPA 7580 |
| Thiodiglycol | - - - - - - - - - - | - - - - - - - - - - | RTI SOP-HPLC | RTI SOP-HPLC |
| Dimethyl Methyl Phosphonate(OMMP) | - - - - - - - - - - | - - - - - - - - - - | 8270D-Mod RTI SOP | 8270D-Mod RTI SOP |
| 1 ,4-Oxathiane | - - - - - - - - - - | - - - - - - - - - - | 8270D-Mod RTI SOP | 8270D-Mod RTI SOP |
| 1 ,4-Dithiane | - - - - - - - - - - | - - - - - - - - - - | 8270D-Mod RTI SOP | 8270D-Mod RTI SOP |
| Diisopropyl Methyl Phosphonate(OIMP) | - - - - - - - - - - | - - - - - - - - - - | 8270D-Mod RTI SOP | 8270D-Mod RTI SOP |
| Benzothiazole | - - - - - - - - - - | - - - - - - - - - - | 8270D-Mod RTI SOP | 8270D-Mod RTI SOP |
| 4-Chlorophenyl Methyl Sulfide | - - - - - - - - - - | - - - - - - - - - - | 8270D-Mod RTI SOP | 8270D-Mod RTI SOP |
| 4-Chlorophenyl Methyl Sulfoxide | - - - - - - - - - - | - - - - - - - - - - | 8270D-Mod RTI SOP | 8270D-Mod RTI SOP |
| 4-Chlorophenyl Methyl Sulfone | - - - - - - - - - - | - - - - - - - - - - | 8270D-Mod RTI SOP | 8270D-Mod RTI SOP |
| Characteristics | | | | |
| Corrosivity | - - - - - - - - - - | - - - - - - - - - - | EPA 9040C | SW 846 Ch7/ 9040C/9045C |
| Ignitability | - - - - - - - - - - | - - - - - - - - - - | EPA 1010/1030 | EPA 1010/1030 |
| Paint Filter Liquids Test | - - - - - - - - - - | - - - - - - - - - - | EPA 9095A | EPA 9095A |
| Synthetic Precipitation Leaching Procedure (SPLP) | - - - - - - - - - - | - - - - - - - - - - | EPA 1312 | EPA 1312 |
| Toxicity Characteristic Leaching Procedure | - - - - - - - - - - | - - - - - - - - - - | EPA 1311 | EPA 1311 |
| Preparation Methods | | | | |
| Metals | - - - - - - - - - - | - - - - - - - - - - | 3010A, 3020A | 3050B |
| Purgeable Organics | - - - - - - - - - - | - - - - - - - - - - | 5030B | 5035 |
| Extractable Organics | - - - - - - - - - - | - - - - - - - - - - | 3510C | 3545, 3546, 3550C |

| Analyte | Air |
|---|---|

| Analyte | Air |
|---|---|
| 1,1,1-Trichloroethane | EPA TO-15 |
| 1,1,2,2-Tetrachloroethane | EPA TO-15 |
| 1,1,2-Trichloro-1,2,2-Trifluoroethane | EPA TO-15 |
| 1,1,2-Trichloroethane | EPA TO-15 |
| 1,1-Dichloroethane | EPA TO-15 |
| 1,1-Dichloroethene | EPA TO-15 |
| 1,2,4-Trichlorobenzene | EPA TO-15 |
| 1,2,4-Trimethylbenzene | EPA TO-15 |
| 1,2-Dibromoethane | EPA TO-15 |
| 1,2-Dichlorobenzene | EPA TO-15 |
| 1,2-Dichloroethane | EPA TO-15 |
| 1,2-Dichloropropane | EPA TO-15 |
| 1,3,5-Trimethylbenzene | EPA TO-15 |
| 1,3-Butadiene | EPA TO-15 |
| 1,3-Dichlorobenzene | EPA TO-15 |
| 1,4-Dichlorobenzene | EPA TO-15 |
| 1,4-Dioxane | EPA TO-15 |
| 2-Butanone | EPA TO-15 |
| 2-Hexanone | EPA TO-15 |
| 2-Propanol | EPA TO-15 |
| 4-Methyl-2-Pentanone | EPA TO-15 |
| Acetone | EPA TO-15 |
| Benzene | EPA TO-15 |
| Benzyl chloride | EPA TO-15 |
| Bromodichloromethane | EPA TO-15 |
| Bromoform | EPA TO-15 |
| Bromomethane | EPA TO-15 |
| Carbon Disulfide | EPA TO-15 |
| Carbon Tetrachloride | EPA TO-15 |
| Chlorobenzene | EPA TO-15 |
| Chlorodibromomethane | EPA TO-15 |
| Chloroethane | EPA TO-15 |
| Chloroform | EPA TO-15 |
| Chloromethane | EPA TO-15 |
| cis-1,2-Dichloroethene | EPA TO-15 |
| cis-1,3-dichloropropene | EPA TO-15 |
| Cyclohexane | EPA TO-15 |
| Dichlorodifluoromethane | EPA TO-15 |
| Ethanol | EPA TO-15 |
| Ethyl Acetate | EPA TO-15 |
| Ethylbenzene | EPA TO-15 |
| Heptane (n-Heptane) | EPA TO-15 |
| Hexachlorobutadiene | EPA TO-15 |
| m,p-Xylene | EPA TO-15 |
| Methylene Chloride | EPA TO-15 |
| n-Hexane | EPA TO-15 |

| Analyte | Air |
|---|---|
| o-Xylene | EPA TO-15 |
| Propylene (Propene) | EPA TO-15 |
| Styrene | EPA TO-15 |
| tert-Butyl Methyl Ether | EPA TO-15 |
| Tetrachloroethene | EPA TO-15 |
| Tetrahydrofuran | EPA TO-15 |
| Toluene | EPA TO-15 |
| trans-1,3-Dichloropropene | EPA TO-15 |
| Trichloroethene | EPA TO-15 |
| Trichlorofluoromethane | EPA TO-15 |
| Vinyl Acetate | EPA TO-15 |
| Vinyl Chloride | EPA TO-15 |
| Xylenes, Total | EPA TO-15 |
| PCBs as Aroclors | |
| Aroclor 1016 | EPA TO-4A/EPA TO-10A |
| Aroclor 1221 | EPA TO-4A/EPA TO-10A |
| Aroclor 1232 | EPA TO-4A/EPA TO-10A |
| Aroclor 1242 | EPA TO-4A/EPA TO-10A |
| Aroclor 1248 | EPA TO-4A/EPA TO-10A |
| Aroclor 1254 | EPA TO-4A/EPA TO-10A |
| Aroclor 1260 | EPA TO-4A/EPA TO-10A |
| Total PCBs | EPA TO-4A/EPA TO-10A |
| Pesticides | |
| 4,4´-DDD | EPA TO-4A/EPA TO-10A |
| 4,4´-DDE | EPA TO-4A/EPA TO-10A |
| 4,4´-DDT | EPA TO-4A/EPA TO-10A |
| Aldrin | EPA TO-4A/EPA TO-10A |
| alpha-BHC | EPA TO-4A/EPA TO-10A |
| beta-BHC | EPA TO-4A/EPA TO-10A |
| gamma-BHC | EPA TO-4A/EPA TO-10A |
| Chlordane, total | EPA TO-4A/EPA TO-10A |
| Dieldrin | EPA TO-4A/EPA TO-10A |
| Endosulfan I | EPA TO-4A/EPA TO-10A |
| Endosulfan II | EPA TO-4A/EPA TO-10A |
| Endosulfan Sulfate | EPA TO-4A/EPA TO-10A |
| Endrin | EPA TO-4A/EPA TO-10A |
| Endrin Aldehyde | EPA TO-4A/EPA TO-10A |
| Endrin Ketone | EPA TO-4A/EPA TO-10A |
| Heptachlor | EPA TO-4A/EPA TO-10A |
| Heptachlor Epoxide | EPA TO-4A/EPA TO-10A |
| Hexachlorobenzene | EPA TO-4A/EPA TO-10A |
| Methoxychlor | EPA TO-4A/EPA TO-10A |
| Toxaphene | EPA TO-4A/EPA TO-10A |

NEW YORK STATE OF OPPORTUNITY. | Department of Health

ANDREW M. CUOMO
Governor

HOWARD A. ZUCKER, M.D., J.D.
Acting Commissioner

SALLY DRESLIN, M.S., R.N.
Executive Deputy Commissioner

LAB ID: 12025

April 01, 2015

MR. YEMANE YOHANNES
RTI LABORATORIES, INC
31628 GLENDALE STREET
LIVONIA, MI 48150-1827

Certificate Expiration Date:
April 01, 2016

Dear Mr. Yohannes,

Enclosed are Certificate(s) of Approval issued to your environmental laboratory for the current permit year. The Certificate(s) supersede(s) any previously issued one(s) and is(are) in effect through the expiration date listed. Please carefully examine the Certificate(s) to insure that the categories, subcategories, analytes, and methods for which your laboratory is approved are correct. In addition, verify that your laboratory's name, address, lead technical director, and identification number are accurate.

Pursuant to NYCRR Subpart 55-2.2, original certificates must be posted conspicuously in the laboratory and copies shall be made available to any client of the laboratory upon request.

Pursuant to NYCRR Subpart 55-2.6, any misrepresentation of the Fields of Accreditation (Matrix - Method - Analyte) for which your laboratory is approved may result in denial, suspension, or revocation of your certification. Any use of the Environmental Laboratory Approval Program (ELAP) or National Environmental Laboratory Accreditation Program (NELAP) name, reference to the laboratory's approval status, and/or using the NELAP logo in any catalogs, advertising, business solicitations, proposals, quotations, laboratory analytical reports, or other materials must include the laboratory's ELAP identification number and distinguish between testing for which the laboratory is approved and testing for which the laboratory is not approved.

If you have any questions, please contact ELAP at the New York State Department of Health (NYS DOH), Wadsworth Center, PO Box 509, Albany NY, 12201-0509; by phone at (518) 485-5570; by facsimile at (518) 485-5568; and by email at elap@health.ny.gov.

Sincerely,

Michael P. Ryan, M.T. (ASCP), Ph.D.
Director, Division of Laboratory Quality Certification
Environmental Laboratory Approval Program

NEW YORK STATE OF OPPORTUNITY. Department of Health

ANDREW M. CUOMO
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LAB ID: 12025

April 01, 2015

MR. YEMANE YOHANNES
RTI LABORATORIES, INC
31628 GLENDALE STREET
LIVONIA, MI 48150-1827

Dear Mr. Yohannes,

A revised certificate has been generated because of the change(s) listed below.

If your laboratory has applied for a change in the laboratory's location and/or Technical Director, the approved change(s) will be reflected on the certificate.

If the changes to your certification are due to insufficient proficiency tests and/or proficiency test (PT) failures, the expired certificates must be returned to the Environmental Laboratory Approval Program (ELAP) office within 10 days of the date of this letter. In addition, your laboratory must investigate the root cause for any insufficient and/or unsatisfactory proficiency tests.

**In addition, your laboratory must investigate and document the root cause for any insufficient and/or unsatisfactory proficiency tests. If your lab lost accreditation due to two PT failures, you must submit the corrective action response to ELAP for review before accreditation will be re-instated.**

| AppCat | Analyte Name | Method Name | Comments | Date |
|---|---|---|---|---|
| NW - NELAC | Zinc, Total | EPA 6010C | Subcategory Name Changed | 03/04/2015 |
| NW - NELAC | Zinc, Total | EPA 6020A | Subcategory Name Changed | 03/04/2015 |
| NW - NELAC | Iron, Total | EPA 6020A | Subcategory Name Changed | 03/04/2015 |
| NW - NELAC | Antimony, Total | EPA 6020A | Subcategory Name Changed | 03/04/2015 |
| NW - NELAC | Antimony, Total | EPA 6010C | Subcategory Name Changed | 03/04/2015 |
| NW - NELAC | Lead, Total | EPA 3020A | Subcategory Name Changed | 03/04/2015 |
| NW - NELAC | Tin, Total | EPA 3020A | Subcategory Name Changed | 03/04/2015 |
| NW - NELAC | Arsenic, Total | EPA 6020A | Subcategory Name Changed | 03/04/2015 |
| NW - NELAC | Tin, Total | EPA 6010C | Subcategory Name Changed | 03/04/2015 |
| NW - NELAC | Chromium, Total | EPA 3020A | Subcategory Name Changed | 03/04/2015 |
| NW - NELAC | Lead, Total | EPA 6010C | Subcategory Name Changed | 03/04/2015 |
| NW - NELAC | Arsenic, Total | EPA 6010C | Subcategory Name Changed | 03/04/2015 |
| NW - NELAC | Chromium, Total | EPA 6020A | Subcategory Name Changed | 03/04/2015 |
| NW - NELAC | Iron, Total | EPA 6010C | Subcategory Name Changed | 03/04/2015 |

| AppCat | Analyte Name | Method Name | Comments | Date |
|---|---|---|---|---|
| NW - NELAC | Copper, Total | EPA 6010C | Subcategory Name Changed | 03/04/2015 |
| NW - NELAC | Lead, Total | EPA 6020A | Subcategory Name Changed | 03/04/2015 |
| NW - NELAC | Tin, Total | EPA 6020A | Subcategory Name Changed | 03/04/2015 |
| NW - NELAC | Copper, Total | EPA 6020A | Subcategory Name Changed | 03/04/2015 |
| NW - NELAC | Chromium, Total | EPA 6010C | Subcategory Name Changed | 03/04/2015 |

**NEW YORK STATE DEPARTMENT OF HEALTH**
**WADSWORTH CENTER**

Expires 12:01 AM April 01, 2016
Issued April 01, 2015

## CERTIFICATE OF APPROVAL FOR LABORATORY SERVICE

*Issued in accordance with and pursuant to section 502 Public Health Law of New York State*

*MR. YEMANE YOHANNES*
*RTI LABORATORIES, INC*
*31628 GLENDALE STREET*
*LIVONIA, MI 48150-1827*

*NY Lab Id No: 12025*

*is hereby APPROVED as an Environmental Laboratory in conformance with the National Environmental Laboratory Accreditation Conference Standards (2003) for the category ENVIRONMENTAL ANALYSES NON POTABLE WATER*
*All approved analytes are listed below:*

| | |
|---|---|
| **Chlorinated Hydrocarbon Pesticides** | |
| Chlordane Total | EPA 8081B |
| Endrin | EPA 8081B |
| Lindane | EPA 8081B |
| Methoxychlor | EPA 8081B |
| Toxaphene | EPA 8081B |
| **Chlorinated Hydrocarbons** | |
| Hexachlorobenzene | EPA 8270D |
| Hexachlorobutadiene | EPA 8270D |
| **Chlorophenoxy Acid Pesticides** | |
| 2,4,5-TP (Silvex) | EPA 8151A |
| 2,4-D | EPA 8151A |
| **Metals I** | |
| Chromium, Total | EPA 6010C |
| | EPA 6020A |
| Copper, Total | EPA 6010C |
| | EPA 6020A |
| Iron, Total | EPA 6010C |
| | EPA 6020A |
| Lead, Total | EPA 6010C |
| | EPA 6020A |
| **Metals II** | |
| Antimony, Total | EPA 6010C |
| | EPA 6020A |
| Arsenic, Total | EPA 6010C |

| | |
|---|---|
| **Metals II** | |
| Arsenic, Total | EPA 6020A |
| Zinc, Total | EPA 6010C |
| | EPA 6020A |
| **Metals III** | |
| Tin, Total | EPA 6010C |
| | EPA 6020A |
| **Nitroaromatics and Isophorone** | |
| 2,4-Dinitrotoluene | EPA 8270D |
| Nitrobenzene | EPA 8270D |
| **Priority Pollutant Phenols** | |
| 2,4,5-Trichlorophenol | EPA 8270D |
| 2,4,6-Trichlorophenol | EPA 8270D |
| 2-Methylphenol | EPA 8270D |
| 3-Methylphenol | EPA 8270D |
| 4-Methylphenol | EPA 8270D |
| Pentachlorophenol | EPA 8270D |
| **Volatile Aromatics** | |
| 1,4-Dichlorobenzene | EPA 8260C |
| Benzene | EPA 8260C |
| Chlorobenzene | EPA 8260C |
| **Volatile Halocarbons** | |
| 1,1-Dichloroethane | EPA 8260C |
| 1,2-Dichloroethane | EPA 8260C |

Serial No.: 52754

Property of the New York State Department of Health. Certificates are valid only at the address shown, must be conspicuously posted, and are printed on secure paper. Continued accreditation depends on successful ongoing participation in the Program. Consumers are urged to call (518) 485-5570 to verify the laboratory's accreditation status.

**NEW YORK STATE DEPARTMENT OF HEALTH**
**WADSWORTH CENTER**

Expires 12:01 AM April 01, 2016
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*All approved analytes are listed below:*

**Volatile Halocarbons**

| | |
|---|---|
| Carbon tetrachloride | EPA 8260C |
| Chloroform | EPA 8260C |
| Tetrachloroethene | EPA 8260C |
| Trichloroethene | EPA 8260C |
| Vinyl chloride | EPA 8260C |

**Sample Preparation Methods**

| | |
|---|---|
| | EPA 5030C |
| | EPA 3510C |
| | EPA 3020A |

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*All approved analytes are listed below:*

| | |
|---|---|
| **Characteristic Testing** | |
| TCLP | EPA 1311 |
| **Chlorinated Hydrocarbon Pesticides** | |
| Chlordane Total | EPA 8081B |
| Endrin | EPA 8081B |
| Heptachlor | EPA 8081B |
| Heptachlor epoxide | EPA 8081B |
| Lindane | EPA 8081B |
| Methoxychlor | EPA 8081B |
| Toxaphene | EPA 8081B |
| **Chlorinated Hydrocarbons** | |
| Hexachlorobenzene | EPA 8270D |
| Hexachlorobutadiene | EPA 8270D |
| Hexachloroethane | EPA 8270D |
| **Chlorophenoxy Acid Pesticides** | |
| 2,4,5-TP (Silvex) | EPA 8151A |
| 2,4-D | EPA 8151A |
| **Metals I** | |
| Barium, Total | EPA 6010C |
| | EPA 6020A |
| Cadmium, Total | EPA 6010C |
| | EPA 6020A |
| Chromium, Total | EPA 6010C |
| | EPA 6020A |
| Copper, Total | EPA 6010C |

| | |
|---|---|
| **Metals I** | |
| Copper, Total | EPA 6020A |
| Lead, Total | EPA 6010C |
| | EPA 6020A |
| Silver, Total | EPA 6010C |
| | EPA 6020A |
| **Metals II** | |
| Arsenic, Total | EPA 6010C |
| | EPA 6020A |
| Mercury, Total | EPA 7471B |
| Selenium, Total | EPA 6010C |
| | EPA 6020A |
| **Nitroaromatics and Isophorone** | |
| 2,4-Dinitrotoluene | EPA 8270D |
| Nitrobenzene | EPA 8270D |
| Pyridine | EPA 8270D |
| **Priority Pollutant Phenols** | |
| 2,4,5-Trichlorophenol | EPA 8270D |
| 2,4,6-Trichlorophenol | EPA 8270D |
| 2-Methylphenol | EPA 8270D |
| 3-Methylphenol | EPA 8270D |
| 4-Methylphenol | EPA 8270D |
| Pentachlorophenol | EPA 8270D |
| **Volatile Aromatics** | |
| 1,4-Dichlorobenzene | EPA 8260C |

Serial No.: 52755

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**NEW YORK STATE DEPARTMENT OF HEALTH**
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*All approved analytes are listed below:*

| | |
|---|---|
| **Volatile Aromatics** | |
| Benzene | EPA 8260C |
| Chlorobenzene | EPA 8260C |
| **Volatile Halocarbons** | |
| 1,1-Dichloroethane | EPA 8260C |
| 1,2-Dichloroethane | EPA 8260C |
| Carbon tetrachloride | EPA 8260C |
| Chloroform | EPA 8260C |
| Tetrachloroethene | EPA 8260C |
| Trichloroethene | EPA 8260C |
| Vinyl chloride | EPA 8260C |
| **Sample Preparation Methods** | |
| | EPA 3546 |

Serial No.: 52755

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# Attachment B

# RTI Laboratories SOPs

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RTI Laboratories, Inc.
31628 Glendale
Livonia, Michigan 48150

# STANDARD OPERATING PROCEDURE

## ANALYSIS OF IGNITABILITY

| | |
|---|---|
| **Analyte:** | **Ignitability** |
| **SOP#:** | **1010A_051812_R3** |
| **Method Reference:** | **ASTM D93-94, EPA SW-846 1010A** |
| **Issue Date:** | **January 01, 1997** |
| **Revision No.:** | **3** |
| **Revision Date:** | **May 18, 2012** |

**Reviewed and Approved: April 10, 2015**

Director, Quality Management: Charles O'Bryan

Director, Environmental Services: Yemane Yohannes

**The current controlled version of this document resides electronically on the RTI Laboratories, Inc. company server. All forms of this document, hardcopy, electronic or other must be verified as the most recent version prior to any use or reference of the document**

**ANALYSIS OF IGNITABILITY**

**SOP#: 1010A_051812_R3**

**TABLE OF CONTENTS**


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## 1.0 Scope and Application:

1.1 Introduction

RTI Laboratories, Inc. has prepared this document to detail the Standard Operating Procedure (SOP) for the analysis of ignitability (flashpoint).

A detailed description of the instrumentation, calibration, run parameters and quality control procedures is included in this SOP. For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

1.2 Summary of Method

1.2.1 The method uses a Pensky-Martens closed-cup tester to determine the flashpoint of liquids and waste oils. The sample is heated at a slow rate with stirring. A small flame is directed into the cup at regular intervals with simultaneous interruption of stirring. The flashpoint is the lowest temperature at which application of the test flame ignites the vapor above the sample.

## 2.0 Safety Precautions

2.1 Samples tested using this procedure may present health and safety concerns.

2.2 This method employs natural gas and an open flame. The natural gas valve should not be opened any more than is required to just light the small flame.

2.3 Occasionally the sample flashpoint can be very intense, resulting in a forceful flame that can escape the cup. When observing the flashpoint do not place your face, hand or any other material directly over the sample cup.

## 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with RTI's Standard Operating Procedure for Sample Receipt and Custody (SRC001-A). Appropriate U. S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed.

3.1.2 Aqueous or liquid samples are collected in glass bottles not preserved and stored at 4 degrees C.

3.1.3 Sample size minimum requirements: 100 ml

3.1.4 Maximum sample holding time is 14 days.

## 4.0 MDL, LOD, LOQ Linear Range, Accuracy and Precision

4.1 MDL, LOD, LOQ determinations are not applicable for this method.

4.2 Instrument working range is room temperature (about 65 degrees F) to 212 degrees F.

4.3 Accuracy and Precision data: +/- 1 degree F.

## 5.0 Interferences

5.1 Non-representative particulates such as leaves, sticks, fish and lumps of fecal matter should be excluded from the sample if it is determined that their inclusion is not desired in the final result.

5.2 Non-flammable solvents such as methylene chloride and other highly chlorinated volatile solvents do not flash but do volatilize quickly and will “fan” the flame when they escape out the ignition hole during a flash check. This can often look like a small to moderate flash. To confirm this placebo flashpoint, carefully look down into the cup when the flash is checked. The flashpoint is confirmed only if it appears inside of the cup.

5.3 Water will begin to evaporate and volatilize from the sample when the sample heats to around 140 F and above. This water vapor will distort the flame and often douse it or extend it so that appears to be a small flash. Once again, this can be confirmed by observing the inside of the cup for a flash.

## 6.0 Apparatus and Materials

6.1 Pensky Martens flashpoint tester

6.2 Thermometer, Celsius or degrees F, measurements from 10 to 220 degrees F or equivalent.

6.3 Flashpoint tester sample cup, 75 ml.

6.4 Natural gas source.

6.5 Matches or ignition device.

## 7.0 Reagents

7.1 Flashpoint standard – p-Xylene – 81° F.

## 8.0 Preparation of Standards and Calibration Procedure

8.1 Thermometers are calibrated annually against the NIST standard thermometer.

## 9.0 Sample Preparation

9.1 Allow samples to warm to room temperature.

## 10.0 Diagram/Table

**Table 1**

| |
|---|
| Add sample to flashpoint tester cup up to the sample line (approx. 75 ml) |
| Open natural gas line. Light test flame. Start heater (max). |
| While sample is heating, set up and turn on stirrer. |
| Continue heating. Every 2 degree increase - turn off stirrer and check for flash. |
| To check for flash, rotate handle quickly and hold open for one second so that the flame is exposed to the vapors inside of the cup. If a flame is generated inside of the cup and escapes out of the top of the cup, then this is the flash point of the material. Record final temp. |

## 11.0 Analytical Procedure

11.1. Add sample to the flashpoint cup up to the line etched on the inside of the cup (75 ml).

11.2. Place cup in holder on heater mantle. Fix flashpoint cover snugly on top of cup so that slots on cover align with ridges on cup. Turn on heater. Light flashpoint test flame.

11.3. Do an initial flashpoint check before turning on stirring apparatus. Highly flammable liquids such as gasoline will quickly reach their UEL inside of the cup, often resulting in suppressed flashpoints or test flame blowouts.

11.4. Insert thermometer through appropriate hole in top of cup cover. Turn on stirrer.

11.4.1 For homogeneous liquids use the A setting for the stirrer (115 rpm).

11.4.2 For non-homogeneous liquids use the B setting for the stirrer (250 rpm).

11.5. Allow temperature of sample to increase one or two degrees and then check flash. Note: the temperature of the sample will increase slowly for the first 20 to 30 degrees of the test and then begin to ramp very quickly. Start the test with the temperature dial set to maximum, turn it down to one half of maximum at about 100° F and then turn it off completely at about 160° F. The sample will continue to heat even after the heater is turned off. Remove sample cup from apparatus prior to boil over point.

11.6. To check flash: Turn off stirrer. Rotate knob on top of cup cover until flame descends into sample cup. Hold for one second. Observe inside of cup and look for initiation of a flashpoint. Release knob to close flash test opening. Turn stirrer back on. Continue heating and repeat every 2 degrees F. Increase frequencies of flash testing near suspected flashpoint and near regulatory limits (100 - DOT and 140 - RCRA degrees F) to every 1 degree F.

11.7. A flashpoint is defined as the lowest temperature of a sample at which the vapors above the sample will ignite when the test flame is applied. A flash has occurred when the flame from the test flame causes a large flame to appear, sometimes violently and possibly blowing out the flame, while spreading over the surface of the sample. A change in color does not indicate a flash.

## 12.0 Details of Calibration and Calculations

.

12.1 Not applicable.

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 On each use the material from section 7.1is analyzed. The flashpoint should be within ±1 degree of the flashpoint for that compound.

13.1.1 Corrective action: Repeat test. Analyze a different material. Check thermometer calibration. Clean system. Repeat until the flashpoint temperature is within the acceptable range.

## 14.0 Data Reporting Requirements

14.1 Sample results are reported as temperature in degrees F.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 Flashpoint tester must be kept relatively clean, to avoid contamination of flammable compounds.

15.2 Sample cup must be cleaned out using soap and water between samples. If a highly flammable sample is tested the cup must be baked out at 100 degrees C prior to analysis of the next sample. Solvents specified in method D93 are not used for cleaning.

## 16.0 Waste Management and Pollution Prevention

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner that minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Soil samples are composited in a drum designated for incineration.

16.2.2 Disposal of materials is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, November 1986, Revision 1 November 2004. Method 1010A.

17.2 ASTM Method D93-94, Test Methods for Flashpoint by Pensky-Martens Closed Cup Tester, 1994.

17.3 RTI Laboratories, Inc. Quality Assurance Plan.

17.4 RTI Laboratories, Inc. SOP SRC001-A, Sample Receipt and Custody.

17.5 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.6 RTI Laboratories, Inc. Employee Handbook.

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# STANDARD OPERATING PROCEDURE

# TOXICITY CHARACTERISTIC AND SYNTHETIC PRECIPITATION LEACHING PROCEDURE FOR METALS AND SEMI – VOLATILE COMPOUNDS

| | |
|---|---|
| **Analyte:** | **NA** |
| **SOP#:** | **1311_030514_R5.1** |
| **Method Reference:** | **EPA SW846 1311/1312** |
| **Issue Date:** | **June 1, 1996** |
| **Revision No.:** | **5.1** |
| **Revision Date:** | **March 5, 2014** |
| **Reviewed Date:** | **March 5, 2014** |

**Reviewed and Approved March 5, 2014 by:**

| | |
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| Director, Quality Management: | Charles O'Bryan |
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**TOXICITY CHARACTERISTIC LEACHING PROCEDURE**
**FOR METALS AND SEMI – VOLATILE COMPOUNDS**

**SOP#: 1311_030514_R5.1**

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## 1.0 Scope and Application

1.1 Introduction

RTI Laboratories, Inc., has prepared this document to detail the Standard Operating Procedure (SOP) for the extraction of materials using the Toxicity Characteristic Leaching Procedure (TCLP) and Synthetic Precipitation Leaching Procedure (SPLP) specified in EPA SW846 Method 1311 and 1312

A detailed description of the instrumentation, calibration, run parameters and quality control procedures is included in this SOP. For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

.

1.2 Summary of Method

1.2.1 The TCLP and SPLP procedures are designed to determine the mobility of both organic and inorganic contaminants. Contaminants are leached from samples by rotation in a specific extraction fluid. The resulting leachate is analyzed for the parameters of interest according to the applicable analytical SOP.

## 2.0 Safety Precautions

2.1 Gloves, safety glasses protective lab apparel and a ventilation hood should be used during sample prep and chemical handling.

2.2 Toxicological properties of the samples submitted for this procedure are not always known and may present health and safety concerns. Disposable gloves, eye protection and protective clothing should be used when handling potentially hazardous waste samples.

## 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with RTI's Standard Operating Procedure for Sample Receipt and Custody (SRC001-A). Appropriate U.S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed.

3.1.1 Soil, sludge and solid samples are collected in wide mouth glass jars and stored at 4 degrees C. Aqueous samples are collected in amber bottles and stored at 4 degrees C.

3.1.2 Maximum recommended holding times from collection to extraction:

3.1.2.1 Semi-volatile organic compounds (BNA, Pesticides, Herbicides) – 14 days

3.1.2.2 Metals – 180 days.

3.1.2.3 Mercury – 28 days.

3.1.2.4 Holding times for commencement of the analytical process begin on completion of the extraction and correspond to the analytical method.

3.1.3 Minimum sample volume requirements: Soils – 250 gm. Liquids – dependent on analytical request and nature of sample.

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 Not applicable to this procedure. Refer to individual analytical SOP's.

## 5.0 Interferences

5.1 Not applicable to this procedure. Refer to individual analytical SOP's.

## 6.0 Apparatus and Materials

6.1 An apparatus that will rotate the extraction vessel in an end over end fashion at 30 +/- 2 rpm.

6.2 A laboratory balance is to be used that is accurate within +/- 0.01 grams.

6.3 A pH meter or pH strips that have a range of 0-14.

6.4 A filter holder that is capable of supporting a glass fiber filter.

6.5 Glass fiber filters, binder free, pore size 0.6 – 0.8 um.

6.6 2L Plastic bottles

## 7.0 Reagents

7.1 Deionized $H_2O$ – type 2

7.2 1.0 N hydrochloric acid

7.3 10 N Sodium Hydroxide (400 g NaOH in 1 L final volume DI water).

7.4 Glacial acetic acid.

7.5 Concentrated sulfuric acid $H_2SO_4$ – Reagent Grade.

7.6 Concentrated nitric acid $HNO_3$ – Reagent Grade.

7.7 60/40 weight percent $H_2SO_4$ / $HNO_3$: Prepared by cautiously mixing 60 g of $H_2SO_4$ with 40 g of $HNO_3$. Store at room temperature for 6 months.

7.8 Extraction fluid #1: This fluid is prepared by adding 5.7 ml of glacial acetic acid to 500ml water and 6.43 ml 10 N NaOH and diluting to a final volume of 1 liter. The pH must be 4.93+/- 0.05. Prepare fresh for each use. Record pH on extraction log.

7.9 Extraction fluid #2: This fluid is prepared by adding 5.7 ml glacial acetic acid to 1 liter deionized water. The pH must be 2.88 +/- 0.05. Prepare fresh for each use. Record pH on extraction log.

7.10 SPLP extraction fluid #1 for samples collected east of the Mississippi River: Add the 60/40 acid mixture (Sec. 7.7) to reagent water until the pH is 4.15 – 4.25. Prepare fresh for each use. Record pH on extraction log.

7.11 SPLP extraction fluid #2 for samples collected west of the Mississippi River: Add the 60/40 acid mixture (Sec. 7.7) to reagent water until the pH is 4.95 – 5.05. Prepare fresh for each use. Record pH on extraction log.

7.12 All reagents and standards prepared must be logged in the appropriate standards/reagents log labeled with a minimum:

7.12.1 Identity of the material
7.12.2 Concentration of the solution
7.12.3 Date prepared
7.12.4 Initials of analyst preparing the solution
7.12.5 Expiration date.

## 8.0 Preparation of Standards and Calibration Procedure

8.1 The agitation apparatus shall be checked daily to run at 30 +/- 2 rpm,

8.2 The balance shall be calibrated with known weights daily.

## 9.0 Sample Preparation

9.1 Wastes comprised of solids or containing significant amount of solid matter should be particle sized to </= 9.5 mm in diameter and extracted with an amount of fluid equal to 20 times the solids weight.

9.2 At least 2 separate samples of a waste should be collected. If volatile organics are of concern, a 3rd sample should be collected. The first sample is used in several preliminary evaluations (i.e., % solids). The second and third samples are extracted using the TCLP/SPLP non-volatile and volatile procedures.

9.3 Preservative should not be added to the sample. Samples should be refrigerated unless refrigeration would result in irreversible physical change to the waste.

9.4 Extracts should be prepared for analysis and analyzed as soon as possible following extraction. If they need to be stored, storage shall be at 4 degree C.

## 10.0 Diagram/Table

**Table 1**

| |
|---|
| Weigh aliquot of sample into extraction vessel. |
| Add extraction fluid at 20 x sample weight. |
| Agitate for approx. 18 hours. |
| Filter leachate. |
| Analyze for the constituent of interest. |

## 11.0 Analytical Procedure

11.1 Preliminary evaluation is performed on a minimum of 100g of sample. This 100g sample will not undergo actual TCLP/SPLP extraction.

11.1.1 Samples will be segregated and prepared as separate batches based on solid or liquid materials or the type of extraction fluid required.

11.1.2 Each sample batch must contain a method blank.

11.1.3 For cloth or oily rags refer to the reference method (1311 – Appendix A) sections 7.1.3, 7.2.10 and 7.3.6.

11.2 Percent solids must be determined on this 100g sample. Percent solids are defined as the fraction of a waste sample from which no liquid may be forced out by applied pressure. If the waste will yield no free liquid when subject to pressure filtration then the sample is considered to be 100% solids. If the sample is liquid or multi-phase, liquid/solid separation is required.

11.2.1 Pre-weigh the filter and container that will receive the filtrate.

11.2.2 Assemble the filtration apparatus.

11.2.3 Weigh out 100g of sample and record the weight.

11.2.4 Transfer the sample to the filtration device and start pressure filtration. The material in the filter holder is defined as the solid phase of the waste and the filtrate is defined as the liquid phase.

11.2.5 Determine the weight of the liquid phase by subtracting the weight of the filtrate container from the total weight of the filtrate-filled container. The weight of the solid phase of the waste sample is determined by subtracting the weight of the liquid phase from the weight of the total waste sample.

11.2.6 Percent solids = (weight of solid/total wt of waste) x 100. If the sample obviously has a significant amount of solid material the solid phase must be extracted.

11.3 Remove the solid phase and the filter from the filtration device and dry the filter and solid at 100 +/- 20C until 2 successive weighing yield the value within +/- 1 %. Record final weight.

11.3.1 Percent solids = (wt. Dry water & filter-tared wt filter/ Initial wt waste) x 100

11.3.2 If the percent dry solids is less than 0.5% the waste collected after filtration is defined as the TCLP extract. If the percent dry solids is > or = to 0.5 % then you must determine if particle sizing is required. The particles must be able to pass through a 9.5mm standard sieve.

11.4 Determine the appropriate extraction fluid on the solid portion of the sample.

11.4.1 TCLP:

11.4.1.1 Weigh out 5 g of the solid phase and place in a 500 ml beaker.

11.4.1.2 Add 96.5 ml of deionized water and cover with a watch glass. Stir vigorously for 5 min. using a magnetic stirrer.

11.4.1.3 Measure and record the pH. If the pH is <5 extraction fluid #1 is used. If the pH is >5 add 3.5 ml 1.0N HCl. Cover with a watch glass and heat to 50C. Hold at this temperature for 10 min. Let the solution cool to room temperature and record the pH. If the pH is >5 use extraction fluid #2.

11.4.2 SPLP

11.4.2.1 Use SPLP extraction fluid #1 (Sec. 7.10) for samples collected east of the Mississippi River.

11.4.2.2 Use SPLP extraction fluid #2 (Sec. 7.11) for samples collected west of the Mississippi River.

11.5 After the extraction fluid is determined acquire 100g of the solid phase. Particle size if necessary. Place the sample in an extraction vessel and the appropriate amount of extraction fluid as follows. If less than 100 g is used the reason (i.e. limited sample volume submitted) must be documented in the extraction log and in the LIMS batch comments section.

11.5.1 Weight of extraction fluid = [20 X (% solid)/100] X wt. Waste.

11.6 Tape the extraction vessel and place in the agitation apparatus.

11.7 Extract for 18+/- 2 hours at ambient temperature. Temperature is monitored during extraction period.

11.8 After extraction is complete the sample is filtered through a glass fiber filter. If compatible the liquid phase of the multiple phase sample may be combined with the TCLP extract. If they are not compatible they must be addressed separately. For the mathematical combination of incompatible waste refer to Appendix A. Section 7.3.15.

11.9 The samples are then prepared and preserved for analysis in accordance with the applicable analytical method.

11.10 MS/MSD samples for metals analysis on the TCLP extracts must be spiked prior to preservation.

## 12.0 Details of Calibration and Calculations

12.1 Not applicable to this procedure. Refer to individual analytical SOP's.

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 A Method blank is prepared with each batch of samples.

13.2 For each extraction fluid used a batch method blank must be provided for all analyses required in sufficient volume for the particular analysis.

13.3 The batch Method Blank is entered into the TCLP extraction batch in Omega, each preparation batch for the required analysis and the analytical instrument sequences.

13.4 The Method blank must be able to be traced from the TCLP extraction through analysis.

13.5 Extraction fluid is provided for each required analysis for the preparation of batch Laboratory Control Samples (LCS).

## 14.0 Data Reporting Requirements

14.1 Not applicable to this procedure. Refer to individual analytical SOP's.

14.2 For the mathematical combination of incompatible wastes refer to Appendix A, Section 7.3.15.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 Not applicable to this procedure. Refer to individual analytical

## 16.0 Waste Management and Pollution Prevention

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner that minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Acidic materials (pH<2) are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Soil samples are composited in a drum designated for incineration.

16.2.3 Disposal of materials is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, Nov. 1986, Revision 0 June 1992. Method 1311.

17.2 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, Nov. 1986, Revision 0 September 1994. Method 1312.

17.3 RTI Laboratories, Inc. Quality Assurance Plan.

17.4 RTI Laboratories, Inc. SOP SRC001-A, Sample Receipt and Custody.

17.5 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.6 RTI Laboratories, Inc. Employee Handbook.

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# STANDARD OPERATING PROCEDURE

# TOXICITY CHARACTERISTIC LEACHING PROCEDURE FOR VOLATILE ORGANIC COMPOUNDS

| | |
|---|---|
| **Analyte:** | **NA** |
| **SOP#:** | **1311ZHE_030514_R3.1** |
| **Method Reference:** | **EPA SW846/1311** |
| **Issue Date:** | **January 01, 1997** |
| **Revision No.:** | **3.1** |
| **Revision Date:** | **March 5, 2014** |
| **Reviewed Date:** | **March 5, 2014** |

**Reviewed and Approved: March 7, 2014**

| | |
|---|---|
| Director, Quality Management: | Charles O'Bryan |
| Director, Environmental Services: | Yemane Yohannes |

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**TOXICITY CHARACTERISTIC PRECIPITATION LEACHING PROCEDURE FOR VOLATILE ORGANIC COMPOUNDS**

**SOP#: 1311ZHE_030514_R3.1**

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## 1.0 Scope and Application:

1.1 Introduction

RTI Laboratories, Inc., has prepared this document to detail the Standard Operating Procedure (SOP) for the extraction of materials using the TCLP procedure specified in EPA SW846 Method 1311.

1.2 Summary of Method

1.2.1 A sub-sample of waste is extracted with the appropriate buffered acetic acid solution for 18 +- 2 hours. The leachate produced is analyzed and the concentrations determined are compared to the regulatory thresholds in 40 CFR 261.24. If the leachate contains one or more contaminants at levels above the EPA limits, then the waste is considered hazardous by characteristic for that specific analyte

1.2.2 Zero Headspace Extraction (ZHE) preparation consists of 3 main steps: Extraction of solid material, final separation of the extraction fluid from the remaining solid and testing of the TCLP extract. Extraction of the solid material involves adding the sample to a Zero Headspace Extractor and adding extraction fluid equal to 20 times the weight of the solid phase. The extractor is then rotated for 18 +- 2 hours at 30 +- 2 RPM. Separation of the leachate from the remaining solid involves compressing the ZHE piston/cylinder thus forcing the solid/leachate mix out of the extractor and through a filtering system built into the unit. The sediment free leachate is collected in 40 ml VOA vials for later analysis. The entire process is performed so as to minimize sample agitation and eliminate sample headspace, thus reducing the potential of losing the volatile components.

## 2.0 Safety Precautions

2.1.1 Chemicals and reagents using this procedure may present health and safety concerns.

2.1.2 The ZHE apparatus must be charged with compressed gas during the post-extraction sample filtering stage and at other stages during the sample setup. This compression can be up to 60psi. Verify that all fittings are attached securely and that all screws and nuts are secured. The apparatus may experience violent movements when the piston begins to move under pressure. Make certain that the apparatus is secure before charging it with high-pressure gas.

## 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with the RTI Standard Operating Procedure for Sample Log-in. Appropriate U. S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed.

3.1.1 Soil, sludge and solid samples are collected in pre cleaned wide mouth glass jars, packed to minimize headspace.

3.1.2 Aqueous samples are collected in pre cleaned HDPE bottles not preserved and stored at 4 degrees C. Collect samples to minimize headspace.

3.1.3 Sample volume requirements depend on the phases of sample present. If a sample is 100% solids, than the minimum sample size is about 30 grams (a VOA vial or a 2oz. Jar). The minimum requirement for a sample >99.5 % aqueous is either 100mls or 2 VOA vials. For organic liquids with less than 0.5% solids, the liquid fraction, after filtering, is used for analysis - therefore the minimum amount is 1 full VOA vial. For samples with an aqueous liquid content of between 1% and 99% the minimum amount of sample required is 20 divided by the decimal ratio of solid in the sample to the whole sample (i.e. – for a sample that is 50 % solid and 50 % liquid – 20/0.5 = 40 grams).

3.1.4 Maximum sample holding time is 14 days to extraction and 14 days from extraction to analysis.

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 Not applicable to this SOP.

## 5.0 Interferences

5.1 To prevent loss of volatile compounds during preparation maintain minimal agitation of the sample.

5.2 Oils are treated as solids if they will not pass through the filter in the ZHE. These oils can clog the filter and reduce filtering flow after the sample has been extracted.

## 6.0 Apparatus and Materials

6.1 Extraction vessels (Zero Headspace Extractor ZHE) - Millipore and Gelman -500 ml capacity with pressure gauges.

6.1.1 The vessel will be capable of supporting and keeping in place the glass fiber filter and be able to withstand the pressure required for separation (50 psi). If it is suspected that the glass fiber filter has been ruptured and in-line glass fiber filter may be used to filter the material within the ZHE.

6.1.2 For the ZHE to be acceptable the piston within should be able to be moved with approximately 15 psi or less. If more pressure is required the O-rings must be replaced. If this does not correct the situation the ZHE vessel cannot be used for TCLP procedures.

6.1.3 The ZHE is checked for leaks after each used. The ZHE is pressurized to 50 psi and allowed to stand for 1 hour after which the pressure is rechecked.

6.2 Drying oven, for operation at 103-105 degrees C.

6.3 Agitation apparatus: End-over-end box capable of rotating at 28 to 32 RPM.

6.4 Analytical Balance, capable of weighing to 0.1 gm.

6.5 Filters: borosilicate glass fiber filter (110 mm or 142 mm) with a pore size of 0.6 to 0.8 um

6.6 ZHE Extraction Fluid Transfer Device – capable of delivering extraction fluid to ZHE using pressurized gas.

6.7 ZHE extract collection device – Tedlar bag or 40 ml VOA vials, preserved with HCL to a pH of 2.

6.8 Vacuum filtration - with flask capable of holding the Buchner funnel (300 ml – and with use of the 100 mm glass fiber filters) with sufficient volume for receipt of the filtered liquid portion of the sample. For use with samples having solids content <10% or highly granular, liquid containing wastes.

6.9 Pressure filtration (Millipore) – internal volume of 1500 ml, capable of exerting up to and greater than 50 psi pressure (used with 142 mm glass fiber filters.

6.10 pH meter accurate to +/- 0.05 pH units.

## 7.0 Reagents

7.1 Deionized $H_2O$ – ASTM Type II. DI system includes and carbon bed and ion exchange resin bed

7.2 10 N Sodium Hydroxide – 400 g reagent grade NaOH in 1 L final volume DI water

7.3 Glacial acetic acid – reagent grade.

7.4 Extraction fluid #1 – Add 5.7 ml glacial acetic acid to 500 ml of reagent water, add 6.4 ml of 10N NaOH (40 g solid NaOH per liter of water) and dilute to a volume of 1 liter. When prepared correctly, the pH of this fluid will be 4.93 +- 0.05.

7.6 All reagents and standards prepared must be logged in the appropriate standards/reagents log labeled with a minimum:

7.6.1 Identity of the material
7.6.2 Concentration of the solution
7.6.3 Date prepared
7.6.4 Initials of analyst preparing the solution
7.6.5 Expiration date.

## 8.0 Preparation of Standards and Calibration Procedure

8.1 Not applicable

## 9.0 Sample Preparation

9.1 At least 2 separate samples of a waste should be collected. If volatile organics are of concern, a 3rd sample should be collected. The first sample is used in several preliminary evaluations (i.e., % solids) the second and third samples are extracted using the TCLP non-volatile and volatile procedures.

9.2 Preservative should not be added to the sample. Samples should be refrigerated unless refrigeration would result in irreversible physical change to the waste.

9.3 Extracts should be prepared for analysis and analyzed as soon as possible following extraction. If they need to be stored, storage shall be at 4 degree C.

9.4. Allow samples to warm to room temperature prior to proceeding with the analytical process (Sec. 11.0). Samples must not be pre-filter prior to analysis.

9.5 The number of phases present in the sample determines how the TCLP is conducted. Solid materials with no visible free liquid phase are extracted as received from the field, and the analyte concentration found in the leachate is the reported value. Liquid materials having no measurable solids content are defined as the TCLP extract and are filtered and analyzed directly.

9.5.1 Multiphase samples must be separated and each phase must be treated individually. Aqueous phases may be combined with the leachate from solid-phase materials before analysis if the two aqueous materials are compatible. If the two aqueous phases are not compatible, then each liquid must be analyzed by the appropriate methods and the results combined numerically to determine the final reported value.

9.5.2 Solids 100%: If the sample appears to be 100 % solid, record on worksheet as no free liquids (100% solids). If the sample contains more than one solid phase, record on worksheet. Record the visible presence of a solid material heavier than water.

9.5.3 Liquids 99.5%: Record the number of liquid phases observed in the sample according to their apparent density. Determine which phase is organic and which is aqueous and record on worksheet along with percentage of each phase.

9.5.4 Oils: Most oils cannot be filtered through the 0.7 micron filter. If the oil does not pass through the filter proceed as if the sample were a solid.

9.5.5 Solvent/organic liquids: Low viscosity solvents such as toluene will filter much like a water, but are hazardous to work with under high pressure or vacuum situations. If possible make the determination of leach ability visually. In most cases the solvent will have to analyze as a total, without leaching.

## 10.0 Diagram/Table

10.1 Reserved.

## 11.0 Analytical Procedure

11.1 Preliminary evaluation is performed on a minimum of 100g of sample. This 100g sample will not undergo actual TCLP extraction.

11.1.1 Samples will be segregated and prepared as separate batches based on solid or liquid materials or the type of extraction fluid required.

11.1.2 Each sample batch must contain a method blank.

11.1.3 For wastes that are obviously 100% solids proceed with Sec. 11.4.

11.1.4 Wastes comprised of solids or containing significant amount of solid matter should be particle sized to </= 9.5 mm in diameter. Particle size reduction is required unless the solid has a surface area per gram of material +/> 3.1 $cm^2$ or is smaller than 1 cm in its narrowest dimension (capable or passing through a 9.5 mm sieve). If the surface area is smaller or the particle size greater than above the waste must be prepared by cutting, crushing or grinding the material until the above requirements are met. Surface area criteria are meant for paper, cloth, oily rags or other similar materials and actual measurement of the surface area is not required.

11.2 Percent solids must be determined on a 100g sample. Percent solids are defined as the fraction of a waste sample from which no liquid may be forced when subjected to vacuum filtration. If the waste will yield no free liquid when subject to filtration then the sample is considered to be 100% solids (proceed to Sec. 11.4). If the sample is liquid or multi-phase, liquid/solid separation is required.

11.2.1 Pre-weigh the filter and container that will receive the filtrate.

11.2.2 Assemble the filtration apparatus.

11.2.3 Weigh out 100g (minimum) of sample and record the weight. Allow slurries to stand until the solid phase settles. If necessary, centrifuge the sample as an aid to filtration. Decant the liquid through the filter followed by filtration of the solid portion or the sample.

11.2.4 Quantatively transfer the sample to the filtration device. Spread the waste evenly over the surface of the filter and start filtration. The material in the filter holder is defined as the solid phase of the waste and the filtrate is defined as the liquid phase. A single glass fiber filter must be used for the entire filtration process.

11.2.5 Apply vacuum or pressure (refer to Sec. 6 for applicable device) until air or pressurized gas moves through the filter. If this point is not reached under 10 psi, and if no additional liquid has passed through the filter is any 2-minute interval slowly increase the pressure in 10 psi increments to a maximum 50 psi. After each 10 psi increase in pressure if pressurizing gas has not moved through the filter and if no additional liquid has passed through the filter in any 2-minute interval proceed to the next 10 psi increment. When pressurizing gas begins to move through the filter or when liquid flow has ceased at 50 psi (no additional filtrate collected in any 2-minute period) stop the filtration. The material in the filter is defined as the solid phase of the waste.

Apply pressure and vacuum slowly and carefully since instantaneous application of high pressure can damage the filter and may cause premature plugging.

11.2.6 If more that 1% of the original sample weight adheres to the transfer container determine the weight of this material and subtract this from the original sample weight.

11.2.7 Oily or paint wastes may contain an apparent liquid component that will not filter. This material is considered as part of the solid component of the sample.

11.2.7 Determine the weight of the liquid phase by subtracting the weight of the filtrate container from the total weight of the filtrate-filled container. The weight of the solid phase of the waste sample is determined by subtracting the weight of the liquid phase from the weight of the total waste sample.

11.2.8 Percent solids = weight of solid/total wt of waste x 100. If the sample obviously has a significant amount of solid material (=/> 0.5%) the solid phase must be extracted (proceed with Sec 11.4 after determining if particle size reduction is required according to Sec. 11.1.4)

11.3 If a small amount of solid material is observed on the filter remove the solid phase and the filter from the filtration device and dry the filter and solid at 100 +/- 20C until 2 successive weighing yield the value within +/- 1 %. Record final weight.

11.3.1 Percent solids = (wt. Dry waste & filter-tared wt filter/ Initial wt waste) x 100

11.3.2 If the percent dry solids is less than 0.5% the waste collected after filtration is defined as the TCLP extract. If the percent dry solids is > or = to 0.5 % determine whether particle size reduction is required according to Sec. 11.1.4 then proceed with Sec. 11.4.

11.3 Determine the appropriate extraction fluid based on the percent solids determination. Only extraction fluid 1 is used for TCLP determination of volatiles in the waste sample (Sec. 7.4) .

11.3.1 Weight of waste to add to ZHE = (25 X 100) / % solids, up to a maximum of 500 gm.

11.4 Add the calculated amount of sample to the ZHE unit. Fix the filter between the two metal screens and place into the top cover of the unit. Secure top of unit to piston section with the 3 metal nuts.

11.5 Apply gentle pressure to the unit from the bottom of the piston using the compressed air tank. The pressure should be just enough to get the piston inside the unit moving.

11.6 Continue the pressure until all of the headspace has been evacuated from the unit and liquid from the sample just begins to drip out. Quickly close the exit valve and turn off the pressure.

11.7 Attach a Tedlar bag or VOA vial to the exit valve of the unit and reapply pressure from the bottom of the piston in 10psi increments up to 50psi until all of the liquid in the sample has been squeezed out into the collection container. Make sure that this filtrate is stored at 4 degrees C with no headspace until it is recombined with the leachate at the conclusion of the extraction.

11.8 Record all necessary data on sample prep data worksheet.

11.9 Charge the unit with TCLP extraction fluid using the extraction fluid transfer apparatus.

11.10 Add the necessary amount of extraction fluid to the internal container as calculated using the following equation: Weight of extraction fluid (gm/ml) = 20 X % solids X weight of waste added to ZHE (gm) /100.

11.11 Purge all air from the flexible delivery tube by slowly pressurizing the fluid transfer apparatus and allowing the extraction fluid to fill the delivery tube. When the tube is filled, connect it to the top inlet valve on the ZHE.

11.12 Release the pressure valve on the bottom of the unit.

11.13 Open the valve connected to the delivery tube and slowly increase the pressure as necessary to introduce the calculated amount of fluid into the ZHE. When the ZHE has received the appropriate amount of fluid, close the fluid entry valve on the unit and shut down/depressurize the fluid delivery unit.

11.14 Apply a pressure of 10psi on the lower end of the piston of the ZHE and close the lower unit pressure release valve then manually rotate the ZHE 2 or 3 times in an end-over-end fashion.

11.15 Slowly open the liquid inlet/outlet valve in order to bleed out any trapped headspace.

11.16 Re-pressurize the unit if needed to maintain the 10 psi back pressure. This added pressure is used to monitor the air tightness of the system. There must be at least 1psi of pressure remaining at the end of the extraction to confirm the validity of the ZHE.

11.17 Attach the ZHE unit to the rotation device.

11.18 Start the rotator, noting the start time and estimated stop time on the TCLP volatiles sample prep data sheet. Allow the unit to rotate at 30 RPM for 18 +/- 2 hours at 23 +/- 2 degrees C.

11.19 Record the rotator end time and date on the worksheet as well as the final pressure reading from the gage on the bottom of the ZHE.

11.20 Extract Filtration:

11.20.1 After 18 hours turn off the rotator.

11.20.2 Remove the ZHE unit and place on its stand.

11.20.3 Attach the pressurized gas source to the bottom of the ZHE and attach an extract receiving container on the outlet valve on top of the unit or deliver the fluid into VOA vials, whichever is most appropriate.

11.20.4 Apply pressure to the unit in 10psi increments up to 50psi and collect the leachate from the opened outlet valve.

11.20.5 Continue the pressure filter process until at 50psi liquid ceases to drain out of the ZHE.

11.20.6 Record the amount of filtrate recovered, and the time of completion of the filtration.

11.21 If the liquid filtrate from the original sample and the TCLP extraction fluid extract, are soluble in each other, then combine the 2 phases in a container, gently mix with no headspace and transfer the mixture to 2 or 3 VOA vials for later analysis. If the 2 phases are not soluble then they must be analyzed separately and stored in at least 2 VOA vials per phase. The final results from the 2 phases will be mathematically combined after analysis. If the sample was 100 % solids, then the TCLP leachate is the final extract. If the sample was nearly 0% solids, then the original sample filtrate is considered the TCLP final extract.

11.22 Refer to method 8260 SOP for analytical protocol.

## 12.0 Details of Calibration and Calculations

12.1 For separate analysis of incompatible phases the analytical results for each phase are combined according to the equation below.

Final analyte concentration = (V1)(C1) + (V2)(C2) / V1 + V2

V1 – Volume of the first phase (L)
V2 – Volume or the second phase (L)
C1 – Concentration of the analyte in the first phase (mg/L)
C2 – Concentration of the analyte in the second phase (mg//L)

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 A Method blank is prepared with each batch of samples.

13.2 For each extraction fluid used a batch method blank must be provided for all analyses required in sufficient volume for the particular analysis.

13.3 The batch Method Blank is entered into the TCLP extraction batch in Omega, each preparation batch for the required analysis and the analytical instrument sequences.

13.4 The Method blank must be able to be traced from the TCLP extraction through analysis.

13.5 Extraction fluid is provided for each required analysis for the preparation of batch Laboratory Control Samples (LCS).

13.6 Matrix spikes are performed for each batch of samples according to the applicable analytical method. Matrix spikes are added after filtration of the TCLP extract and prior to preservation.

13.6.1 Spikes should be prepared near the regulatory level or if the analyte concentration is less that on half of the regulatory level at a concentration at least 5 times the MDL.

13.6.2 Spikes are prepared in the same volume of TCLP extract as that used for sample analysis.

13.6.3 Matrix spike recovery is calculated as % recovery = (conc. found in spiked sample – sample concentration)/(known spike amount) * 100.

## 14.0 Data Reporting Requirements

14.1 Not applicable to this procedure. Refer to individual analytical SOP's.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 Internal parts of ZHE that come into contact with the sample must be cleaned by washing with soap and water and placing in a drying oven for at least 1 hour, but preferably over-night.

15.2 Balances, rotary extractors, liquid introduction devices and ZHE units must be maintained as needed to meet any calibration requirements as referenced in appropriate SOP.

## 16.0 Waste Management and Pollution Prevention

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner that minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Acidic materials (pH<2) are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Soil samples are composited in a drum designated for incineration.

16.2.3 Disposal of materials is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, Nov. 1986, Revision June 1990. Method 1311

17.2 RTI Laboratories, Inc. Quality Assurance Plan.

17.3 RTI Laboratories, Inc. SOP SRC001-A, Sample Receipt and Custody.

17.4 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.5 RTI Laboratories, Inc. Employee Handbook.

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# STANDARD OPERATING PROCEDURE

# ACID DIGESTION OF AQUEOUS SAMPLES FOR THE ANALYSIS OF TOTAL METALS

| | |
|---|---|
| **Analyte:** | **Metals** |
| **SOP #:** | **3010A_081114_R0** |
| **Method Reference:** | **EPA SW846/3010A** |
| **Issue Date:** | **August 11, 2014** |
| **Revision No.:** | **0** |
| **Revision Date:** | |

**Reviewed and Approved January 28, 2015 by:**

Director, Quality Management: Charles O'Bryan

Director, Environmental Services: Yemane Yohannes

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**ACID DIGESTION OF AQUEOUS SAMPLES FOR THE ANALYSIS OF TOTAL METALS**

**SOP#: 3010A_081114_R0**

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# 1.0 Scope and Application

## 1.1 Introduction

1.1.1 This SOP details the sample preparation procedures for the acid digestion of aqueous samples for total metals analysis. This SOP applies to all metals except mercury. Following digestion the samples can be analyzed for elements by ICP/OES. For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

## 1.2 Method Summary

1.2.1 An aliquot of a well mixed sample is placed in a digestion tube. Appropriate acids are added and the sample heated until reduced to a low volume. The sample is evaporated to a low volume and diluted to volume with DI water.

1.2.2 Analytical procedures follow the appropriate SOP for the particular element(s) of interest.

# 2.0 Safety Precautions

2.1 Concentrated acids are corrosive. All digestions are performed in a fume hood designated for use with mineral acids. Proper safety equipment is worn when handling concentrated acids. Some metals are toxic and should be handled with care.

# 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with RTI Laboratories' Standard Operating Procedure for Sample Receipt and Custody (SRC001-A). Appropriate U.S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed.

3.1.1 Aqueous samples are collected in pre cleaned plastic bottles preserved with approximately 2.0 ml of 1:1 high purity nitric acid (HNO3):DI water. The pH of the sample is checked on receipt and prior to sample preparation for the presence of adequate preservative. The pH of preserved samples should be < 2. Preserved samples received at pH>2 or at sample preparation are at pH>2 are adjusted to pH<2 with additional acid and held for a minimum of 16 hours until verified to be pH<2.

3.1.2 Samples received for filtration in the laboratory or samples that have been filtered prior to receipt must be preserved and held for 24 hours prior to commencing the sample preparation procedure. The pH is checked prior to analysis.

3.1.3 Samples are refrigerated until ready for analysis.

3.1.4 Maximum sample holding time is six (6) months.

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 Not applicable. See SOP corresponding to the analytical method of interest.

## 5.0 Interferences

5.1 Diverse matrix types can pose an analytical challenge. Spiked samples should be processed to aid in determining whether this digestion procedure is applicable to the samples.

5.2 All glassware and apparatus should be scrupulously cleaned before use to avoid possible source of contamination.

5.3 Further information concerning potential interference's can be found in the SOP for the particular element(s) of interest.

## 6.0 Apparatus and Materials

6.1 Apparatus

6.1.1 250 ml Griffin Beakers

6.1.2 Watch glasses

6.1.3 Drying oven

6.1.4 Thermometer

6.1.5 Filter paper - Whatman #41 or equivalent

6.1.6 Funnels

6.1.7 Oxford/Eppendorf Pipettes

6.1.8 Graduated Cylinders – Class A

6.1.9 Hot Block

6.1.10 Plastic disposable digestion vessels - 50 ml (manufacturer certified volume)

6.1.11 Plastic watch glasses

6.1.12 Analytical balance - capable of weighing to 0.1 mg with computer interface.

6.1.13 PC with Balancelink software, Microsoft Excel and Omega LIMS.

## 7.0 Reagents

7.1 Deionized Water – Crossbow DI Express, mixed bed. – Type II

7.2 High purity concentrated $HNO_3$, trace metals grade: 1:1 solutions are prepared by adding equal volumes of the concentrated acid to DI water.

7.3 High purity concentrated HCL, trace metals grade: 1:1 solutions are prepared by adding equal volumes of the concentrated acid to DI water.

7.4 AAC-STD-2: 1000 µg/ml – Al, Sb, As, B, Mo, P, Sb, Se, Si, Sn, Ti, Zr (2% absolute $HNO_3$/0.5% HF)

7.5 AAC-STD-4: 1000 µg/ml – Ba, Be, Bi, Cd, $Cr_3$, Co, Cu, Pb, Mn, Ni, Ag, Sr, Tl, Th, V, Zn (5% absolute $HNO_3$).

7.6 AAC-STD-3: 10000 µg/ml – Ca, Mg, K, Na, Fe.

7.7 Boron – 1000 µg/ml boron

7.8 Silicon – 1000 µg/ml silicon

7.9 Lithium – 1000 µg/ml lithium

7.10 All reagents and standards prepared must be labeled with a minimum:

7.10.1 Identity of the material
7.10.2 Concentration of the solution
7.10.3 Date prepared
7.10.4 Initials of analyst preparing the solution
7.10.5 Expiration date.

## 8.0 Calibration Procedure

Pipette calibration procedure - All pipettes are calibrated daily.

8.1.1 Weigh a weighing boat and record the weight.

8.1.2 Note temperature of the water at time of weighing and enter on the Pipette Calibration Check log.

8.1.3 Draw up the desired volume of water into the pipette.

8.1.4 Deliver the $H_2O$ to the tarred weighing boat.

8.1.5 Weigh the weighing boat containing the water.

8.1.6 Repeat this procedure 3 times for the pipette volume of use.

8.1.7 Enter result in the log.

8.1.8 Calculation: Volume = mass/density.

8.1.9 The mean of the 3 measurements at the pipette volume must be within 2% of the volume setting with a percent RSD <1.

8.2 All spiking solutions for preparation of LCS, MS and MSD are maintained and prepared by the instrumentation analysts. Composition and preparation of spiking solutions is specified in the applicable analytical SOP.

## 9.0 Sample Preparation

9.1 Hot Block Digestion for 6010 analyses.

9.1.1 Turn on power

9.1.2 Set temperature to 95 +/- 5 degrees C. Check temperature with calibrated thermometer placed in a digestion vessel containing DI water.

9.1.3 Mix sample thoroughly

9.1.4 Transfer a measured volume (50 ml) of a well mixed sample to a 50 ml digestion tube.

9.1.5 Spikes (for LCS, MS and MSD)

9.1.5.1: For metals analysis (not including boron, silicon or lithium: add 25µL of Sections 7.5, 7.6, 7.7.

9.1.5.2: For metals analysis that needs boron and/or silicon: add 25µL of 7.8 for boron and/or 7.9 for silicon.

9.1.5.3: For lithium analysis. Add 25µL of 7.10.

9.1.5 Add 1.5 ml concentrated $HNO_3$ and cover with a ribbed watch glass.

9.1.6 Place vessel in the hot block digester and evaporate to approximately 5 ml.

9.1.6.1 Do not allow the sample to boil or go to dryness

9.1.7 Allow sample to cool.

9.1.8 Add another 1.5 ml of concentrated $HNO_3$.

9.1.9 Cover with a ribbed watch glass and increase temperature so that a gentile reflux occurs.

9.1.10 Continue heating and adding additional acid until the digestion is complete as indicated by a digestate that is light in color or does not change appearance with continued refluxing.

9.1.11 When digestion is complete evaporate to a low volume of approximately 3 ml with a ribbed watch glass. Do not allow any of the bottom of the vessel to go dry.

9.1.12 Cool and add 5 ml of 1:1 HCl. Cover, return to hot block and reflux for 15 min. to allow additional residue to dissolve.

9.1.13 Wash the walls of the vessel with a small amount of DI water

9.1.13 Bring sample to final volume (50 ml) with DI water and mix.

9.1.14 If solution is turbid or solids are present allow to settle overnight or centrifuge if samples will be analyzed sooner.

9.1.15 If suspended particulates are present filter sample through Whatman filter (6.1.6).

## 10.0 Diagram/Table

10.1 Reserved

## 11.0 Analytical Procedure

11.1 See SOP corresponding to the analytical method of interest.

## 12.0 Details of Calibration and Calculations

12.1 Not applicable to this SOP.

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 The following quality control samples are prepared with each batch of samples.

13.1.1 Method Blank

13.1.2 Matrix Spike – prepared at a frequency of not less than 10% (2 per batch of 20 samples for analyses by 200.7/200.8 or not less than 5% (1 per batch of 20 samples) for analyses by 6010/6020.

13.1.3 Matrix Spike Duplicate – prepared at a 5% frequency (1 per batch of 20 samples).

13.1.4 Duplicate Sample – prepared if specified in the project quality assurance plan at the frequency required

13.1.5 Laboratory control sample

13.2 Consult with appropriate SOP for spike concentration for the individual elements.

13.3 Preparation batch information is entered into the Omega LIMS.

13.4 Digestion temperature and Spike ID information in entered in the sample preparation logbook.

## 14.0 Data Reporting Requirements

14.1 Not applicable to this SOP.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 Inspect all glassware for cracks or abrasions. Discard damaged glassware.

15.2 Clean preparation area daily.

15.3 Keep surfaces clean.

15.4 Monitor fume hood for proper face velocity quarterly and record.

## 16.0 Pollution Prevention and Waste Management

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner that minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Acidic materials (pH<2) are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Disposal of materials such as regulated soil is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 EPA Test Method for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods. Method 3010A Revision 1. July 1992.

17.2 RTI Laboratories, Inc. Quality Assurance Plan.

17.3 RTI Laboratories, Inc. SOP SRC001-A, Sample Receipt and Custody.

17.4 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.5 RTI Laboratories, Inc. Employee Handbook.

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# STANDARD OPERATING PROCEDURE

# ACID DIGESTION OF AQUEOUS SAMPLES FOR THE ANALYSIS OF TOTAL METALS

| | |
|---|---|
| **Analyte:** | **Metals** |
| **SOP #:** | **3020A_050313_R11** |
| **Method Reference:** | **EPA SW846/3020A** |
| **Issue Date:** | **March 11, 1998** |
| **Revision No.:** | **11** |
| **Revision Date:** | **May 3, 2013** |

**Reviewed and Approved January 28, 2015 by:**

Director, Quality Management: Charles O'Bryan

Director, Environmental Services: Yemane Yohannes

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# ACID DIGESTION OF AQUEOUS SAMPLES FOR THE ANALYSIS OF TOTAL METALS

## SOP#: 3020A_050313_R11

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# 1.0 Scope and Application

## 1.1 Introduction

1.1.1 This SOP details the sample preparation procedures for the acid digestion of aqueous samples for total metals analysis. This SOP applies to all metals except mercury. Following digestion the samples can be analyzed for elements by ICP/MS. For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

## 1.2 Method Summary

1.2.1 An aliquot of a well mixed sample is placed in a digestion tube. Appropriate acids are added and the sample heated until reduced to a low volume. The sample is evaporated to a low volume and diluted to volume with DI water.

1.2.2 Analytical procedures follow the appropriate SOP for the particular element(s) of interest.

# 2.0 Safety Precautions

2.1 Concentrated acids are corrosive. All digestions are performed in a fume hood designated for use with mineral acids. Proper safety equipment is worn when handling concentrated acids. Some metals are toxic and should be handled with care.

# 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with RTI Laboratories' Standard Operating Procedure for Sample Receipt and Custody (SRC001-A). Appropriate U.S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed.

3.1.1 Aqueous samples are collected in pre cleaned plastic bottles preserved with approximately 2.0 ml of 1:1 high purity nitric acid (HNO3):DI water. The pH of the sample is checked on receipt and prior to sample preparation for the presence of adequate preservative. The pH of preserved samples should be < 2. Preserved samples received at pH>2 or at sample preparation are at pH>2 are adjusted to pH<2 with additional acid and held for a minimum of 16 hours until verified to be pH<2.

3.1.2 Samples received for filtration in the laboratory or samples that have been filtered prior to receipt must be preserved and held for 24 hours prior to commencing the sample preparation procedure. The pH is checked prior to analysis.

3.1.3 Samples are refrigerated until ready for analysis.

3.1.4 Maximum sample holding time is six (6) months.

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 Not applicable. See SOP corresponding to the analytical method of interest.

## 5.0 Interferences

5.1 Diverse matrix types can pose an analytical challenge. Spiked samples should be processed to aid in determining whether this digestion procedure is applicable to the samples.

5.2 All glassware and apparatus should be scrupulously cleaned before use to avoid possible source of contamination.

5.3 Further information concerning potential interference's can be found in the SOP for the particular element(s) of interest.

## 6.0 Apparatus and Materials

6.1 Apparatus

6.1.1 250 ml Griffin Beakers

6.1.2 Watch glasses

6.1.3 Drying oven

6.1.4 Thermometer

6.1.5 Filter paper - Whatman #41 or equivalent

6.1.6 Funnels

6.1.7 Oxford/Eppendorf Pipettes

6.1.8 Graduated Cylinders – Class A

6.1.9 Hot Block

6.1.10 Plastic disposable digestion vessels - 50 ml (manufacturer certified volume)

6.1.11 Plastic watch glasses

6.1.12 Analytical balance - capable of weighing to 0.1 mg with computer interface.

6.1.13 PC with Balancelink software, Microsoft Excel and Omega LIMS.

## 7.0 Reagents

7.1 Deionized Water – Crossbow DI Express, mixed bed. – Type II

7.2 High purity concentrated $HNO_3$, trace metals grade: 1:1 solutions are prepared by adding equal volumes of the concentrated acid to DI water.

7.3 High purity concentrated HCL., trace metals grade: 1:1 solutions are prepared by adding equal volumes of the concentrated acid to DI water.

7.4 Hydrogen peroxide ($H_2O_2$) 30%, reagent grade.

7.5 AAC-STD-2: 1000 µg/ml – Al, Sb, As, B, Mo, P, Sb, Se, Si, Sn, Ti, Zr (2% absolute $HNO_3$/0.5% HF)

7.6 AAC-STD-4: 1000 µg/ml – Ba, Be, Bi, Cd, $Cr_3$, Co, Cu, Pb, Mn, Ni, Ag, Sr, Tl, Th, V, Zn (5% absolute $HNO_3$).

7.7 AAC-STD-3: 10000 µg/ml – Ca, Mg, K, Na, Fe.

7.8 Boron – 1000 µg/ml boron

7.9 Silicon – 1000 µg/ml silicon

7.10 Lithium - 1000µg/ml lithium

7.11 All reagents and standards prepared must be labeled with a minimum:

7.11.1 Identity of the material
7.11.2 Concentration of the solution
7.11.3 Date prepared
7.11.4 Initials of analyst preparing the solution
7.11.5 Expiration date.

## 8.0 Calibration Procedure

Pipette calibration procedure - All pipettes are calibrated monthly.

8.1.1 Weigh a weighing boat and record the weight.

8.1.2 Note temperature of the water at time of weighing and enter on the Pipette Calibration Check log.

8.1.3 Draw up the desired volume of water into the pipette.

8.1.4 Deliver the $H_2O$ to the tarred weighing boat.

8.1.5 Weigh the weighing boat containing the water.

8.1.6 Repeat this procedure 10 times for the maximum pipette volume and 5 times for a volume at the mid to low range of the pipette.

8.1.7 Enter result in the log.

8.1.8 Calculation: Volume = mass/density.

8.1.9 The mean of the 10 measurements at the maximum pipette volume must be within 2% of the volume setting. The mean of the 5 measurements at the mid to low range must be within 3% of the pipette setting.

8.2 All spiking solutions for preparation of LCS, MS, MSD are maintained and prepared by the instrumentation analysts. Composition and preparation of spiking solutions is specified in the applicable analytical SOP.

## 9.0 Sample Preparation

9.1 Hot Block Digestion for 6020/200.8 analyses. If silver and/or antimony are part of the analytical request prepare samples as below and using the procedure in section 9.2

9.1.1 Turn on power

9.1.2 Set temperature to 95 +/- 5 degrees C. Check temperature with calibrated thermometer placed in a digestion vessel containing DI water.

9.1.3 Mix sample thoroughly

9.1.4 Transfer a measured volume (50 ml) of a well mixed sample to a 50 ml digestion tube.

9.1.5 Spikes (for LCS, MS and MSD)
9.1.5.1: For metals analysis (not including boron, silicon or lithium: add 50µL of Sections 7.5, 7.6, 7.7.

9.1.5.2: For metals analysis that needs boron and/or silicon: add 500µL of 7.8 for boron and/or 7.9 for silicon.

9.1.5.3: For lithium: lithium analysis must be a separate batch. Add 50µL of 7.10.

9.1.5 Add 1.5 ml concentrated $HNO_3$ and cover with a ribbed watch glass.

9.1.6 Place vessel in the hot block digester and evaporate to approximately 5 ml.

9.1.6.1 Do not allow the sample to boil or go to dryness

9.1.7 Allow sample to cool.

9.1.8 Add another 1.5 ml of concentrated $HNO_3$.

9.1.9 Cover with watch glass (non ribbed) and increase temperature so that a gentile reflux occurs.

9.1.10 Continue heating and adding additional acid until the digestion is complete as indicated by a digestate that is light in color or does not change appearance with continued refluxing.

9.1.11 When digestion is complete evaporate to a low volume of approximately 3 ml with a ribbed watch glass. Do not allow any of the bottom of the vessel to go dry.

9.1.12 Remove the digestion vessel and add 10 ml of DI water, mix and return to hot block for 10-15 min. to allow additional residue to dissolve.

9.1.13 Wash the walls of the vessel with a small amount of DI water

9.1.13 Bring sample to final volume (50 ml) with DI water and mix.

9.1.14 If solution is turbid or solids are present allow to settle overnight or centrifuge if samples will be analyzed sooner.

9.1.15 If suspended particulates are present filter sample through Whatman filter (6.1.6).

9.2 Hot Block Digestion for 6010/200.7 or silver and antimony for 6020/200.8. Based on the procedures specified in Methods 200.7/200.8 (3020A does not adequately address the optimization of Ag and Sb recovery).

Modifications to the 200.8 procedure include:

- Use of 10 ml of 1:1 HCl/DI water based on laboratory studies that demonstrated optimal recoveries of matrix spike sample with the excess of HCl in the digestion procedure.

- Use of 25 ml sample size to accommodate digestion vessels and ensure adequate volume of HCl for samples.

9.2.1 Turn on power

9.2.2 Set temperature to 95 +/- 5 degrees C.

9.2.3 Mix sample thoroughly

9.2.4 Transfer a measured volume (25 ml) to a digestion tube.

9.2.5 Add 10 ml of 1:1 HCl/DI water and 1 ml of 1:1 HNO3/DI water. Cover with a ribbed watch glass.

9.2.6 Place vessel in the hot block and evaporate to approximately 10 ml (approximately 2 hours).

9.2.6.1 Do not allow the sample to boil or go to dryness

9.2.6.2 After the sample reaches approximately 10 ml cover with a watch glass and gently reflux for 30 min.

9.2.7 Allow sample to cool.

9.2.8 Bring sample to final volume (25 ml) with DI water and mix.

9.2.9 If solution is turbid or solids are present allow to settle overnight or centrifuge if samples will be analyzed sooner.

9.2.10 If suspended particulates are present filter sample through Whatman filter (6.1.6)

## 10.0 Diagram/Table

10.1 Reserved

## 11.0 Analytical Procedure

11.1 See SOP corresponding to the analytical method of interest.

## 12.0 Details of Calibration and Calculations

12.1 Not applicable to this SOP.

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 The following quality control samples are prepared with each batch of samples.

13.1.1 Method Blank

13.1.2 Matrix Spike – prepared at a frequency of not less than 10% (2 per batch of 20 samples for analyses by 200.7/200.8 or not less than 5% (1 per batch of 20 samples) for analyses by 6010/6020.

13.1.3 Matrix Spike Duplicate – prepared at a 5% frequency (1 per batch of 20 samples).

13.1.4 Duplicate Sample – prepared if specified in the project quality assurance plan at the frequency required

13.1.5 Laboratory control sample

13.2 Consult with appropriate SOP for spike concentration for the individual elements.

13.3 Preparation batch information is entered into the Omega LIMS.

13.4 Digestion temperature and Spike ID information in entered in the sample preparation logbook.

## 14.0 Data Reporting Requirements

14.1 Not applicable to this SOP.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 Inspect all glassware for cracks or abrasions. Discard damaged glassware.

15.2 Clean preparation area daily.

15.3 Keep surfaces clean.

15.4 Monitor fume hood for proper face velocity quarterly and record.

## 16.0 Pollution Prevention and Waste Management

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner that minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Acidic materials (pH<2) are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Disposal of materials such as regulated soil is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 EPA Test Method for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods. Method 3020A Revision 1. July 1992.

17.2 EPA Method 200.8. Determination of Trace Elements in Water and Wastes by Inductively Coupled Plasma – Mass Spectrometry. Revision 5.4. 1994.

17.3 RTI Laboratories, Inc. Quality Assurance Plan.

17.4 RTI Laboratories, Inc. SOP SRC001-A, Sample Receipt and Custody.

17.5 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.6 RTI Laboratories, Inc. Employee Handbook.

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# STANDARD OPERATING PROCEDURE

# ACID DIGESTION OF SOLID SAMPLES FOR THE ANALYSIS OF TOTAL METALS

| | |
|---|---|
| **Analyte:** | **Metals** |
| **SOP #:** | **3050_110512_R11.1** |
| **Method Reference:** | **EPA SW846/3050B** |
| **Issue Date:** | **March 11, 1998** |
| **Revision No.:** | **11.1** |
| **Revision Date:** | **August 19, 2015** |

**Reviewed and Approved: August 19, 2015**

Director, Quality Management: Charles O'Bryan

Director, Environmental Services: Yemane Yohannes

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**ACID DIGESTION OF SOLID SAMPLES**
**FOR THE ANALYSIS OF TOTAL METALS**

**SOP#: 3050_110512_R11.1**

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# 1.0 Scope and Application

## 1.1 Introduction

1.1.1 This SOP details the sample preparation procedures for the acid digestion of solid/soil samples for total metals analysis. This SOP applies to all metals except mercury. Following digestion the samples can be analyzed for elements by ICP/MS or ICP/OES. For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

## 1.2 Method Summary

1.2.1 A representative 1-2 g aliquot of sample is digested with repeated addition of nitric acid and hydrogen peroxide. Hydrochloric acid is added to samples requiring analysis by ICP/OES or for ICP/MS analysis of antimony and/or silver. The digestate is reduced in volume while heating, diluted to volume with DI water and filtered.

1.2.2 Analytical procedures follow the appropriate SOP for the particular element(s) of interest. A procedure for preparing samples for the analysis of lead in fine and coarse fractions is detailed in Section 9.

# 2.0 Safety Precautions

2.1 Concentrated acids are corrosive. All digestions are performed in a fume hood designated for use with mineral acids. Proper safety equipment is worn when handling concentrated acids. Some metals are toxic and should be handled with care.

# 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with RTI Laboratories' Standard Operating Procedure for Sample Log-in. Appropriate U.S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed.

3.1.1 Solid samples are collected in pre cleaned 4-8 oz. wide mouth glass jars.

3.1.2 Samples are refrigerated until ready for analysis.

3.1.3 Holding time for samples is 180 days from collection.

3.1.4 Minimum sample volume – 50 g.

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 Not applicable. See SOP corresponding to the analytical method of interest.

## 5.0 Interferences

5.1 Diverse matrix types can pose an analytical challenge. Spiked samples should be processed to aid in determining whether this digestion procedure is applicable to the samples.

5.2 All glassware and apparatus should be scrupulously cleaned before use to avoid possible source of contamination.

5.3 Further information concerning potential interference's can be found in the SOP for the particular element(s) of interest.

## 6.0 Apparatus and Materials

6.1 Apparatus

6.1.1 Drying oven

6.1.2 Thermometer

6.1.3 Hot Plates

6.1.4 Filter paper - Whatman #41 or equivalent

6.1.5 Funnels

6.1.6 Oxford/Eppendorf Pipettes

6.1.7 Graduated Cylinders – Class A

6.1.8 Hot Block

6.1.9 Plastic disposable digestion vessels - 50 ml (manufacturer certified volume)

6.1.10 Plastic watch glasses

6.1.11 Aluminum weighing dishes.

6.1.12 Glass beakers.

6.1.13 Sieves (stainless steel) 10 mesh (2 mm) and 60 mesh (250 micron)

6.1.14 Mortar and pestle

6.1.15 Analytical balance - capable of weighing to 0.1 mg with computer interface.

6.1.16 PC with Balancelink software, Microsoft Excel and Omega LIMS.

## 7.0 Reagents

7.1 Deionized Water – Crossbow DI Express, mixed bed. – Type II

7.2 High purity concentrated $HNO_3$. 1:1 solutions are prepared by adding equal volumes of the concentrated acid to DI water.

7.3 High purity concentrated HCL. 1:1 solutions are prepared by adding equal volumes of the concentrated acid to DI water.

7.4 Hydrogen peroxide ($H_2O_2$) 30%, reagent grade.

7.5 1000 ppm Stock Metal Concentrates plasma pure grade.

7.6 All reagents and standards prepared must be labeled with a minimum:

7.6.1 Identity of the material
7.6.2 Concentration of the solution
7.6.3 Date prepared
7.6.4 Initials of analyst preparing the solution
7.6.5 Expiration date.

## 8.0 Calibration Procedure

8.1 Pipette calibration procedure - All pipettes are calibrated monthly.

8.1.1 Weigh a weighing boat and record the weight.

8.1.2 Note temperature of the water at time of weighing and enter on the Pipette Calibration Check log.

8.1.3 Draw up the desired volume of water into the pipette.

8.1.4 Deliver the $H_2O$ to the tarred weighing boat.

8.1.5 Weigh the weighing boat containing the water.

8.1.6 Repeat this procedure 10 times for the maximum pipette volume and 5 times for a volume at the mid to low range of the pipette.

8.1.7 Enter result in the log.

8.1.8 Calculation: Volume = mass/density.

8.1.9 The mean of the 10 measurements at the maximum pipette volume must be within 2% of the volume setting. The mean of the 5 measurements at the mid to low range must be within 3% of the pipette setting.

8.2 All spiking solutions for preparation of LCS, MS, MSD are maintained and prepared by the instrumentation analysts. Composition and preparation of spiking solutions is specified in the applicable analytical SOP.

## 9.0 Sample Preparation

9.1 Hot Block Digestion for ICP/MS analysis - For elements except silver and antimony (Refer to Section 9.2 for the preparation for Ag and Sb)

9.1.1 Turn on power

9.1.2 Set temperature to 95 +/- 5°C. Check temperature with calibrated thermometer placed in a digestion vessel containing DI water.

9.1.3 Mix sample thoroughly to achieve homogeneity and sieve if necessary through a #10 sieve.

9.1.3.1 Transfer the entire contents of the sample container to a glass beaker.

9.1.3.2 Mix sample thoroughly with a wooded tongue depressor.

9.1.3.3 If materials such as sticks, leaves, rocks, etc. are present sieve the sample with a #10 sieve.

9.1.4 Transfer 1-2 g of the as received sample weighed to 0.01 g into a digestion vessel and capture the weight into the “SampAmt” column of the Omega Prep Batch using the BalanceLink software. For samples requiring analysis on dried basis prepare according to the SOP for Sub_Sampling, take a 1g aliquot and proceed with Sec 9.1.5.

9.1.5 Add 10 ml of 1:1 $HNO_3$, mix and cover with a ribbed watch glass.

9.1.6 Place sample in the hot block and heat at 95 +/- 5 °C for 10-15 minutes without boiling.

9.1.6.1 Allow the sample to cool and add 5 ml concentrated nitric acid.

9.1.6.2 Replace the cover and reflux for 30 minutes concentrating the sample to approximately 5 ml. If brown fume are generated repeat the addition of 5 ml concentrated nitric acid over and over until no brown fumes are observed

9.1.6.3 Continue heating at 95±5 degrees C for two hours or until the volume is reduced to approximately 5 ml. Do not allow to boil and maintain a covering of solution over the bottom of the vessel at all times.

9.1.6.4 Allow the sample to cool and add 2 ml DI water and 3 ml 30% hydrogen peroxide.

9.1.6.5 Cover and heat (the peroxide reaction will commence and be evident by effervescence).

9.1.6.6 Continue to add $H_2O_2$ in 1 ml aliquots until the effervescence is minimal to a maximum of 10 ml added to the sample.

9.1.6.7 Cover and continue heating without boiling at 95±5 degrees C until the volume has been reduced to approximately 5 ml or two hours. Maintain a covering of solution on the bottom of the digestion tube at all times.

9.1.6.8 For samples to be analyzed by ICP/OES or for the ICP/MS of samples requiring silver and/or antimony proceed to section 9.2 otherwise continue with 9.1.7 – 9.1.10.

9.1.7 Allow sample to cool.

9.1.8 Wash the walls of the beaker with a small amount of DI water

9.1.9 Bring sample to a final volume of 50 ml in a digestion vessel (accuracy 50 ml +/- 0.2ml – 0.4%) with DI water and mix.

9.1.10 If solution is turbid or solids are present allow to settle overnight or centrifuge if samples will be analyzed sooner.

9.1.10 All digestates (samples and QC samples) are filtered through Whatman filter (6.1.6)

9.2 Additional Digestion for ICP/OES analysis and for ICP/MS analysis of samples requiring the analysis of silver and antimony.

9.2.1 Maintain hot block temperature at 95 +/- 5 $^{o}$C

9.2.2 To the digestate from 9.1.6.7 add 10 ml of concentrated HCl and 2.5 ml of concentrated $HNO_3$, mix and cover with a ribbed watch glass.

9.2.3 Place sample in the hot block and heat at 95 +/- 5 $^{o}$C for 10-15 minutes without boiling. Temperature must be verified using a calibrated thermometer.

9.2.3.1 Reflux for 15 minutes.

9.2.5.1 Remove from hot block and allow the sample to cool.

9.2.4 Wash the walls of the beaker with a small amount of DI water

9.2.5 Bring sample to a final volume of 50 ml with DI water using the graduated hot block digestion vessels (manufacturer certified volume) and mix.

9.2.6 Allow to settle overnight or centrifuge if samples will be analyzed sooner.

9.2.7 All digestates (samples and QC samples) are filtered through Whatman filter (6.1.6)

9.3 Procedure for the preparation of samples for Fine and Coarse Lead.

9.3.1 Remove large objects such as rocks, twigs, vegetation, etc.

9.3.2 Mix samples and sieve through a No 10 mesh (2 mm) sieve.

9.3.3 Homogenize the sample by mixing with a spatula (manually break up large soil clumps if necessary).

9.3.4 Weigh and record the weight of a numbered aluminum weighing dish.

9.3.5 Transfer approximately 20 g of the well mixed sample (50-100 g if high moisture content - >35%) to a clean, tared, labeled weighing dish.

9.3.6 Weigh and record the weight of the dish containing the sample.

9.3.7 Dry the sample at 105 degrees C +/-2 in a drying oven for 24 hours +/- 2.

9.3.8 Remove from the oven and place in a desiccator to cool for at least 1 hour.

9.3.9 Weigh and record the weight of the dish containing the dried sample.

9.3.10 Sieve the sample through a 60 mesh (250 micron) sieve using a mechanical shaker for 10 minutes.

9.3.11 Weigh and record the sieved portion of the sample.

9.3.12 Grind the sample with a mortar and pestle and place in a labeled plastic container. This portion of the sample represents the Fine Soil Fraction.

9.3.13 Weigh and record the portion of the sample that did not pass through the sieve.

9.3.14 Grind the sample with a mortar and pestle and place in a labeled plastic container. This portion of the sample represents the Coarse Soil Fraction.

9.3.15 Digest samples according to procedure specified in Section 9.1 above.

## 10.0 Diagram/Table

10.1 Reserved

## 11.0 Analytical Procedure

11.1 See SOP corresponding to the analytical method of interest.

## 12.0 Details of Calibration and Calculations

12.1 Calculate the percent solids as

% Total Solids = DWt/WWt x 100

DWt = weight of sample after drying at 105 deg. C
WWt = weight of sample prior to drying.

12.2 Calculation of Total Lead.

Total Lead (ug/Kg) = ((FF x WtF) + (CF x WtC)) / (WtF + WtC)

FF = Lead concentration (ug/Kg) in Fine Fraction
CF = Lead concentration (ug/Kg) in Coarse Fraction
WtF = Weight of Fine Fraction (Sec 9.3.12)
WtC = Weight of Coarse Fraction (Sec 9.3.14)

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 The following quality control samples are prepared with each batch of samples.

13.1.1 Method Blank

13.1.2 Matrix Spike – prepared at a frequency of not less than 5% (1 per batch of 20 samples) by spiking a solid samples chosen from the batch of samples.

13.1.3 Matrix Spike Duplicate – prepared at a 5% frequency (1 per batch of 20 samples) .by again spiking the sample chosen above.

13.1.4 Duplicate Sample – prepared if specified in project quality assurance plan, at the frequency required.

13.1.5 Laboratory control sample prepared by spiking DI water.

13.1.6 SRM – Standard Reference Material. Required for analysis of Fine/Coarse lead.

13.2 Consult with appropriate SOP for spike concentration for the individual elements.

13.3 Preparation batch information is entered into the Omega LIMS including digestion temperature and spike ID information.

## 14.0 Data Reporting Requirements

14.1 Samples are reported on a dry weight basis. A percent moisture determination is performed and entered into the LIMS. Data calculations for dry weight reporting of the sample results are performed by the LIMS following analytical data entry. Refer to the analytical SOP for calculations and reporting specifications.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 Inspect all glassware for cracks or abrasions. Discard damaged glassware.

15.2 Clean preparation area daily.

15.3 Keep surfaces clean.

15.4 Monitor fume hood for proper face velocity quarterly and record.

## 16.0 Pollution Prevention and Waste Management

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner that minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Acidic materials (pH<2) are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Soil samples are composited in a drum designated for incineration.

16.2.3 Disposal of materials is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 EPA Test Method for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods. Method 3050B Revision 2. Dec. 1996.

17.2 RTI Laboratories, Inc. Quality Assurance Plan.

17.3 RTI Laboratories, Inc. SOP SRC001-A, Sample Receipt and Custody.

17.4 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.5 RTI Laboratories, Inc. Employee Handbook.

## 18.0 Revisions

18.1 Revision 11.1 – Added Section 9.1.6.8, revised Section 9.2.

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# STANDARD OPERATING PROCEDURE

# LIQUID-LIQUID EXTRACTION PROCEDURE FOR SEMI – VOLATILE ORGAINC COMPOUNDS

| | |
|---|---|
| **Analyte:** | **Semi-volatile organic compounds** |
| **SOP #:** | **3510C_040315_R9.2** |
| **Method Reference:** | **SW-846 3510C** |
| **Issue Date:** | **August 15, 2005** |
| **Revision No.:** | **9.2** |
| **Revision Date:** | **March 15, 2016** |

**Reviewed and Approved March 15, 2016 by:**

Director, Quality Management: Charles O'Bryan

Director, Environmental Services: Yemane Yohannes

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# LIQUID-LIQUID EXTRACTION PROCEDURE FOR SEMI – VOLATILE ORGAINC COMPOUNDS

## SOP#: 3510C_040315_R9.2

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## 1.0 Scope and Application:

1.1 Introduction

RTI Laboratories has prepared this document to detail the Standard Operating Procedure (SOP) for the preparation of aqueous samples for the analysis of semi-volatile compounds by gas chromatography/mass spectrometry, pesticides and PCBs by GC/ECD and DRO by GC/FID. This SOP contains the procedures for manual liquid-liquid extraction (Method 3510C) for aqueous samples.

A detailed description of the instrumentation, calibration, run parameters and quality control procedures for analyses are not included in this SOP. For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

1.2 Summary of Method

1.2.1 A measured aliquot of a sample is added to a separatory funnel. The solvent appropriate to the analysis, surrogates and spikes (where applicable) are added and shaken. The solvent extract is removed and dried with sodium sulfate. The procedure is repeated twice and the final extract is concentrated to the desired volume.

## 2.0 Safety Precautions

2.1 Compounds applicable to this method are known or suspected carcinogens. Standard preparation is conducted in fume hoods designated for organic use.

2.2 Extraction solvents are flammable and/or toxic and must be handled with caution. All extractions are performed in a manner designed to minimize exposure to these chemicals using appropriate hoods and personal protection.

2.3 Sulfuric acid is extremely corrosive, poisonous and may cause severe burns to the skin and eyes. Always use with appropriate personal protective equipment.

2.4 Sodium hydroxide is extremely caustic, poisonous and a severe eye and skin irritant. Always use with appropriate personal protective equipment.

## 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with RTI Laboratories' Standard Operating Procedure for sample receipt. Appropriate U. S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed. Water samples are received in pre-cleaned one-liter amber glass jars with Teflon lined lids.

3.1.2 For PCB water samples the holding time is 1 year from collection to extraction and 1 year from extraction to analysis. For all other analytes covered in this SOP, the holding time for water samples is 7 days from collection to extraction and 40 days from extraction to analysis.

3.1.3 All samples are stored at 4$^{o}$ C in the walk-in cooler.

3.1.4 All sample extracts are stored in a designated freezer at <-10 degrees C.

3.1.5 Recommended minimum sample volume – 1 L.

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 Not applicable to this SOP. See the appropriate analytical SOP for details.

## 5.0 Interferences

5.1 Interferences can arise from carry over due to high sample concentrations or contamination from reagents and/or glassware. Blanks are analyzed to ensure system cleanliness in both instances. All glassware must be scrupulously cleaned before use. Phthalates are common lab contaminants and will leach from any soft plastic material used during sampling or sample preparation.

5.2 Samples containing high concentrations of non-target analytes or extremely high levels of select target analytes can result in elevated detection limits for some or all compounds. Dilution of the extract may improve the resolution and quantification of some analytes but will generally cause an elevation in the RDL. Interferences from high molecular weight organics such as oils will cause an elevated baseline. If this background is at a high concentration it will interfere with analyte identification as well as quantification.

5.3 Sample extract interferences can be cleaned up using techniques described in the SOP for sample extract cleanup (florisil cleanup, acid cleanup, sulfur cleanup or dilution (3610B, 3611A, 3620B, 3630C, 3650B, 3660B). Dilution of the extract can also be used to minimize interferences.

## 6.0 Apparatus and Materials

6.1 Analytical Balance capable of weighing to 0.1 gm.

6.2 Glass or Teflon Funnels

6.3 pH indicator paper

6.4 Test strips for residual chlorine.

6.5 Graduated cylinders. 1000mL and 100mL

6.6 Glass beakers, 250 ml size

6.7 Separatory funnels – 2 liter Teflon

6.8 Microliter syringes, 50µl, 10µl, 25µl, 1000µl, 5000µl

6.9 Volumetric glassware

6.10 Glass vials – 2ml with Teflon lined caps.

6.11 Pyrex glass wool

6.12 Pasteur pipettes

6.13 TurboVap II evaporator – Zymark

6.14 200ml concentrator tubes with a 1.0ml graduated tip- available through Caliper

6.15 Mechanical shaker, Glas-Col (3)

## 7.0 Reagents

7.1 Anhydrous sodium sulfate - cleaned and dried in a muffle furnace at 400 $^{o}$C for 4 hours.

7.2 Methylene chloride – pesticide grade

7.3 Hexane – pesticide grade

7.4 Acetone – pesticide grade

7.5 Sulfuric acid, concentrated – reagent grade.

7.6 1:1 Sulfuric acid: Slowly add 500ml of concentrated sulfuric acid (Sec. 7.5) to 500ml ASTM Type II DI water (Sec. 7.7) while mixing. CAUTION! Adding sulfuric acid to water generates a significant amount of heat. Add ~100ml of acid at a time, allowing the solution to cool before adding the next volume of acid.

7.7 ASTM Type II DI water.

7.8 Reagent water and soap for cleaning, as well as acetone for rinsing.

7.9 Sodium hydroxide – reagent grade

7.10 Sodium hydroxide solution: 10N – prepared by dissolving 100 g of NaOH in 250 ml DI water.

7.11 Nitrogen gas from a liquid nitrogen Dewar – for TurboVap.

7.12 SVOC Stock Standards

7.12.1 Base/Neutral & acid surrogate standard, Absolute, part# 25015, 4000ppm.
7.12.2 1,4-Dioxnae-d8, 2000ppm - Restek, 30614
7.12.3 8270 SVOA 64 compounds, 1000ppm - AccuStandard, M-8270-AG01-ASL
7.12.4 8270 SVOC 35 compounds, 1000ppm - Ultra, svm8271-1
7.12.5 Benzoic acid, 2000ppm – Restek, 31879
7.12.6 4-Nitrophenol, 1000ppm – Absolute, 70231
7.12.7 Benzidine Mix, 2000ppm – Restek, 31834
7.12.8 2,4-Dinitrophenol, 1000ppm – Absolute, 70159
7.12.9 1-Methylnaphthalene, 2000ppm – Absolute, 90494
7.12.10 1,4-Dionane, 2000ppm – Restek 31853
7.12.11 Hydrocarbon Standard, 2000ppm – Absolute 94367
7.12.12 Pyridine, 1000ppm – Absolute, 79091
7.12.13 Benzo(e)pyrene, 2000 ppm – Absolute 90506

7.13 SVOC spiking standards – all solutions have a 6-month expiration date.

7.13.1 BNA Surrogate spiking solution 25 ppm–

7.13.1.1 Working surrogate solution 25 ppm: prepared by adding 625 µl of Base/Neutral & acid surrogate standard (7.12.1) and 1.25 ml of 1,4-Dionane-d8 (7.12.2) to a 100 ml class A volumetric flask and dilute to the mark with pesticide grade acetone. Add 1.0mL to each sample (25 µg/ml extract).

7.13.2 BNA MS/MSD/LCS spike mix 20 µg/ml. Add the following amounts to a final volume of 50 ml in a volumetric flask. Spike each LCS, MS and MSD with 1 ml of the 20ppm spike mix (20 µg/ml extract).

| | |
|---|---|
| 2 ml | 8270 SVOA 64 compounds, 1000ppm |
| 2 ml | 8270 SVOC 35 compounds, 1000ppm |
| 1 ml | Benzoic acid, 2000ppm |
| 3 ml | 4-Nitrophenol, 1000ppm |
| 1 ml | Benzidine Mix, 2000ppm |
| 3 ml | 2,4-Dinitrophenol, 1000ppm |
| 1 ml | 1-Methylnaphthalene, 2000ppm |
| 1 ml | 1,4-Dionane, 2000ppm |
| 1 ml | Hydrocarbon Standard, 2000ppm |
| 2 ml | Pyridine, 1000ppm |
| 1 ml | Benzo(e)pyrene |

7.13.3 SIM PAH Spike mix: Add 20 µl of the stock 8270 SVOA 64 standard and 10 µl of the 1-Methylnaphthalene standard to a final volume of 50 ml Methylene chloride (400 µg/L final concentration). Spike each LCS, MS and MSD with 1 ml of the spike solution.

7.13.3.1 Add 12.5 µg/L of the BNA surrogate standard to a final volume of 100 ml Methylene chloride (500 µg/L final concentration). Add 1 ml of this surrogate solution to each sample and QC sample.

7.14 PCB/Pesticide standards:

7.14.1 Pesticide Mix 1000ug/mL, AccuStandard H-8081-SC
7.14.2 TCMX/DCB Surrogate 200ug/mL, Ultra, Part No. ISM-320
7.14.3 PCB 1016/1260 1000ug/mL, Ultra, Part No. PPM-8082
7.14.4 Pesticide ICV/CCV Intermediate standard 10ppm - prepared by adding 100µl of AccuStandard H-8081-SC (7.14.1) to a 10ml class A volumetric flask and dilute to 10ml with pest grade Hexane
7.14.5 Working TCMX/DCB Surrogate 0.1ug/mL – prepared by adding 50µl TCMX/DCB Surrogate 200ug/mL (7.14.2) to a 100ml Class A volumetric flask and diluting to mark with pesticide grade acetone. Add 1.0ml per Sample/MB/MS/MSD/LCS.
7.14.6 PCB MS/MSD/LCS spike mix 2ug/mL - prepared by adding 50µl of the PCB 1016/1260 1000ug/mL (7.14.3) to a 25ml Class A volumetric flask and diluting to mark with pesticide grade acetone. Add 1.0ml per MS/MSD/LCS.
7.14.7 Pesticide MS/MSD/LCS Working Spike 0.1ug/mL - prepared by adding 250µl of Pesticide ICV/CCV standard 10ppm (7.14.4) to a 25ml Class A volumetric flask and diluting to mark with pesticide grade acetone. Add 1.0ml per MS/MSD/LCS
7.14.8 Technical Chlordane and Toxaphene are not routinely part of the pesticide spike mixes.

7.15 DRO/ORO

7.15.1 DRO/ORO Surrogate n-Eicosane 1000µg/mL, Absolute 70973
7.15.2 DRO/ORO Surrogate Squalene 1000µg/mL, Absolute 72326
7.15.3 SAE 30W Motor Oil, 20mg/ml AccuStandard, cat#FU-018-D-40X
7.15.4 #2 Fuel Oil, 20mg/mL, AccuStandard, cat# FU-002-D-40X
7.15.5 DRO/ORO Working Surrogate 150µg/mL - prepare by adding 750µL of the DRO/ORO Surrogates (7.15.1 & 7.15.2) to a 5 ML volumetric flask and dilute to the mark with pesticide grade acetone. Add 100µL to each sample.
7.15.6 DRO/ORO MS/MSD/LCS Spike Mix 5000/10000µg/mL - add 500µl SAE 30W Motor Oil (7.15.3) and 250µL Diesel #2 Fuel Oil (7.15.4) to a final volume of 1mL with pesticide grade acetone. Add 10µL to each MS/MSD/LCS.

7.15 All reagents and standards prepared must be labeled with a minimum:

7.15.1 Identity of the material
7.15.2 Concentration of the solution
7.15.3 Date prepared
7.15.4 Initials of analyst preparing the solution
7.15.5 Expiration date.

## 8.0 Preparation of Standards and Calibration Procedure

8.1 Not applicable to this SOP.

## 9.0 Sample Preparation

9.1 Allow samples to warm to ambient temperature.

9.2 With each batch of samples prepare a method blank, LCS and LCS duplicate (LCSD – if insufficient volume for MS/MSD) by adding spiking solution specified for analytical request (section 7). If sufficient volume is supplied a MS/MSD (spiked according to section 7) is prepared with the batch of samples.

9.2.1 State of Wisconsin certification requires the preparation and analysis of MS/MSD samples at a 5% frequency with a minimum of one set per batch. If insufficient sample volume is provided to conventionally prepare the MS/MSD samples one sample in the batch must be split in thirds and spiked according to section 7. Spike factors will automatically adjust the calculated spike values in the LIMS.

9.2.2 The reported LOD and LOQ values will be proportionally higher for the parent sample in this instance.

9.3 For Pesticide samples check the pH. If the pH is not within 5-9 adjust to within this range using 1:1 H2SO4 or 10N NaOH. Record the initial pH of the sample at the time of extraction.

9.4 For DRO/ORO samples, add 1:1 $H_2SO_4$ to bring pH to a value <2.

9.5 Add the appropriate amount of surrogate and/or spike mix (Sec. 7) directly to the sample in the container for the analytical request to each sample.

9.6 Mark the meniscus of the sample on the outside of the sample jar for later determination of sample volume. Mix thoroughly and pour the entire contents of the liquid sample into the separatory funnel. Samples must be quantitatively transferred to the funnel by rinsing the sample container with the solvent used for extraction.

9.7 For BNA samples check the pH and adjust to <2 with 1:1 $H_2SO_4$ using a minimum amount of acid.

9.8 Add 60 ml of Methylene chloride to the original sample jar. Cap sample jar and shake vigorously for ten seconds. Pour this solvent into the separatory funnel containing the aqueous sample. Be careful not to rinse a plastic lid with Methylene chloride, as this may extract phthalates.

9.9 Place stopper on the funnel. Place the separatory funnel in the mechanical shaker. The separatory funnels are then shaken for 5 minutes at 130RPM, or 2 minutes by hand

9.10 Allow the organic layer to separate for ten minutes then filter the solvent through a glass funnel containing glass wool and sodium sulfate in a flask or directly into a TurboVap tube. If an emulsion forms that is greater than one third the size of the solvent layer mechanical means must be employed to achieve phase separation including stirring, filtration through glass wool, centrifugation or other physical techniques.

9.11 Add 60 ml Methylene chloride to the separatory funnel and repeat 9.7 and 9.8 two additional times combining the three extracts.

9.12 For BNA samples check the pH and adjust to >11 with 10N NaOH using a minimum amount of base. Repeat 9.7 through 9.10.

9.13 Rinse the flask (if used) with Methylene chloride, pour through a funnel and collect in a TurboVap vessel.

9.14 Rinse the sodium sulfate with Methylene chloride; clumped sodium sulfate must be broken apart before rinsing.

9.15 Transfer the container to the TurboVap concentrator. Set the TurboVap to the manufacturer's instructions (use the manual setting and tank pressure at 12 psi). Concentrate to 1.0 ml at 44 degrees C.

9.16 PCB and Pesticide extracts require a solvent exchange to hexane. When the Methylene chloride solvent extract reaches about 1 to 2 ml add 10 ml of hexane, re-concentrate to 2 ml.

9.17 BNS extract require the Acid portion to be concentrated first. Concentrate to less than 5ml and combine the Base portion and continue to concentrate to 1ml.

9.18 Transfer the concentrate to a 2 ml auto sampler vial. If the sample will not concentrate to 1 ml (oily waste) collect the extract in a 10 ml vial (or 40 ml vial if necessary) and record the final volume.

9.19 Extract cleanups when required will be performed by the instrument analyst.

## 10.0 Diagram/Table

10.1 Reserved.

## 11.0 Analytical Procedure

11.1 This section is not applicable to this SOP

## 12.0 Details of Calibration and Calculations

12.1 This section is not applicable to this SOP.

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 Prepare a method blank for each batch of twenty or less samples per matrix, using DI water.

13.2 Prepare a laboratory control sample LCS and LCSD (required for Alaska Methods AK 102 and AK 103) - laboratory control sample duplicate (if insufficient sample volume for MS/MSD) for each batch of twenty or less samples by adding the appropriate amount of the spike mix to one liter of DI water.

13.3 Prepare a matrix spike (MS) and matrix spike duplicate (MSD) for each batch of twenty or less samples per matrix, if sufficient volume is available by adding the appropriate amount of the spike mix to a representative sample.

13.4 Corrective action procedures are specified in the applicable SOP's.

## 14.0 Data Reporting Requirements

14.1 In the sample preparation log in the LIMS enter initial the sample volume in liters (1 L is the default), final extract volume (1 or 2 ml is the default) and sample matrix. Additionally enter the amount of surrogate and spike solutions added in ml.

14.2 The preparation analyst must also enter date and time of start and completion as well as analyst ID and method ID.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 Daily: Balance must be checked prior to use with the certified weights and recorded.

15.2 TurboVap: Ensure that the water bath reservoir is filled to at least above the bottom of the cutout circle on the vertical portion of the interior wall. Check to make sure that the N2 tank is not empty and that the air is flowing to the sample tube.

15.3 Check the TurboVap temperature with a calibrated thermometer on each day of use.

15.4 Following each use the separatory funnels must be thoroughly cleaned with soap and water, rinsed with DI water and solvent rinsed immediately prior to use.

## 16.0 Pollution Prevention and Waste Management

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner, which minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Organic solvents are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Soil samples are composited in a drum designated for incineration.

16.2.3 Disposal of materials is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, Nov, 1986, Revision 1 Sept, 1994. Method 3510C.

17.2 RTI Laboratories, Inc. Quality Assurance Plan.

17.3 RTI Laboratories, Inc. SOP SRC001-A, Sample Receipt and Custody.

17.4 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.5 RTI Laboratories, Inc. Employee Handbook.

## 18.0 Revisions

18.1 Revised BNA standards – Sections 7.12 and 7.13.

18.2 Section 9.7 – Replaced Swirl the solvent… with Cap sample jar and shake vigorously…

18.2 Revised Section 9.8 – Clarified procedure.

18.3 Section 9.9 – removed ...at least…, replaced filter paper with glass wool.

18.4 Section 9.14 – change temperature from 33 to 44.

18.5 Section 9.16 – removed obsolete procedure for 8310 and replaced with BNA procedure.

18.6 Revision 9.1, November 24, 2015

18.6.1 Standards – Added Benzo(e)pyrene 7.12.13, revised pesticides mix 7.14.1 and volume 7.14.4.

18.6.2 Added Section 15.4.

18.7 Revision 9.2, March 15, 2016.

187.1 Added Section 7.13.3 – PAH SIM spike solutions.

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# STANDARD OPERATING PROCEDURE

# SOIL CELL EXTRACTION (HOT BLOCK) PROCEDURE FOR SEMI – VOLATILE ORGANICS

| | |
|---|---|
| **Analyte:** | **Semi-volatile organic compounds** |
| **SOP #:** | **3546_031315_R1.1** |
| **Method Reference:** | **EPA SW-846 3546** |
| **Issue Date:** | **July 11, 2014** |
| **Revision No.:** | **1.1** |
| **Revision Date:** | **April 2, 2015** |

**Reviewed and Approved April 2, 2015 by:**

Director Quality Management: Charles O'Bryan

Director, Environmental Services: Yemane Yohannes

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**SONICATION EXTRACTION PROCEDURE FOR**
**SEMI – VOLATILE ORGANICS**

**SOP#: 3546_031315_R1.1**

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# 1.0 Scope and Application

## 1.1 Introduction

RTI Laboratories has prepared this document to detail the Standard Operating Procedure (SOP) for the preparation of solid samples for analysis of semi-volatile compounds by gas chromatography/mass spectrometry, pesticides and PCB's by GC/ECD and DRO by GC/FID. This SOP contains the procedures for extraction using elevated temperature and pressure conditions according to Method 3546 for solid samples.

A detailed description of the instrumentation, calibration, run parameters and quality control procedures used for analysis are not included in this SOP. For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

## 1.2 Summary of Method

1.2.1 A 25 to 30 g aliquot of sample is weighed and dried with anhydrous sodium sulfate. The solvent appropriate to the analysis along with surrogates and spikes (where applicable) are added to the solid sample and heated for 30 minute at 130 $^{o}$C. The solvent extract is removed and filtered through anhydrous sodium sulfate. The final extract is concentrated to the desired volume.

# 2.0 Safety Precautions

2.1 Compounds applicable to this method are known or suspected carcinogens. Standard preparation is conducted in fume hoods designated for organic use.

2.2 Extraction solvents are flammable and/or toxic and must be handled with caution. All extractions are performed in a manner designed to minimize exposure to these chemicals using appropriate hoods and personal protection (such as, gloves, lab coat, and safety glasses.

# 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with RTI's Standard Operating Procedure for Sample Receipt and Custody (SRC001-A). Appropriate U. S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed. Soil samples are collected in 2 to 9 oz. pre-cleaned wide mouth jars with Teflon lined lids.

3.2 The holding time for soil samples is 14 days from collection to extraction and 40 days from extraction to analysis.

3.3 All samples are stored at ~4° C in the walk-in cooler.

3.4 Minimum sample size – 30 g.

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 Not applicable to this SOP. See the appropriate analytical SOP for details

## 5.0 Interferences

5.1 Interferences can arise from carry over due to high sample concentrations or contamination from reagents and/or glassware. Method blanks are prepared to ensure system cleanliness in both instances. All glassware must be scrupulously cleaned before use. Phthalates are common lab contaminants and will leach from any soft plastic material used during sampling or during prep.

5.2 Samples containing high concentrations of non-target analytes or extremely high levels of select target analytes can result in elevated detection limits for some or all compounds. Dilution of the extract may improve the resolution and quantification of some analytes but will generally cause an elevation in the reporting limits. Interferences from high molecular weight organics such as oils will cause an elevated baseline. If this background is at a high concentration it will interfere with analyte identification as well as quantification.

5.3 Sample extract interferences can be cleaned up using techniques described in the SOP for sample extract cleanup (florisil cleanup, acid cleanup, sulfur cleanup or dilution (3610B, 3611A, 3620B, 3630C, 3650B, 3660B)). Dilution of the extract can also be used to minimize interferences.

## 6.0 Apparatus and Materials

6.1 Analytical Balance capable of weighing to 0.1 g.

6.2 Glass or Teflon Funnels

6.3 pH indicator paper

6.4 Residual chlorine test strips

6.4 Graduated cylinders. 1000ml and 100ml

6.5 Glass beakers, 250 ml size.

6.6 Hot Block – Environmental Express

6.7 Class A Microliter syringes, 50ul, 10 ul, 25ul, 1000µl, 5000µl.

6.8 Volumetric glassware

6.9 Glass vials – 2ml with Teflon lined screw caps.

6.10 Pyrex glass wool

6.11 Pasteur pipettes

6.12 10ml Glass graduated pipettes

6.13 TurboVap II evaporator – Zymark

6.14 200ml concentrators tubes with a 1.0ml graduated tip- available through Caliper

6.15 PC with BalanceLink software, Microsoft Excel and Omega.

## 7.0 Reagents

7.1 Anhydrous Sodium sulfate- cleaned by muffle furnace for 4 hours at 400 degrees C

7.2 Methylene chloride – pesticide grade

7.3 Hexane – pesticide grade

7.4 Acetone – pesticide grade

7.5 Hydrochloric acid – 1% in DI water

7.6 ASTM Type II DI.

7.7 Clean soil for Method Blank and LCS, this may be sand heated in a muffle furnace for 4 hours at 400 degrees C.

7.8 Dry Nitrogen – for TurboVap.

7.9 Stock Standards

7.9.1 8270 SVOA 64 component, AccuStandard, M-8270-AG01-ASL
7.9.2 8270 SVOA 35 component, Ultra, SVM 8271-1
7.9.3 Benzoic Acid, Restek, 31879
7.9.4 1,4-Dioxane-d8, Restek. 30614
7.9.5 Benzidine Mix, Restek, 31834
7.9.6 8270 Surrogate, Absolute, 25015
7.9.7 1-Methylnaphthalene, Absolute, 90494
7.9.8 1,4-Dioxane, Restek,31853
7.9.9 Hydrocarbon Standard, Absolute, 94376

7.9.10 Pyridine, Absolute, 79091
7.9.11 4-Chlorophenol, Absolute, 79061
7.9.12 Pesticide Mix 2000ug/mL, AccuStandard Z-014C-R
7.9.13 TCMX/DCB Surrogate 200ug/mL, Ultra, Part No. ISM-320
7.9.14 PCB 1016/1260 1000ug/mL, Ultra, Part No. PPM-8082
7.9.15 SAE 30W Motor Oil, 20mg/ml, Accustandard, cat# FU-018-D-40X
7.9.16 #2 Fuel Oil, 20mg/mL, Accustandard, cat# FU-002-D-40X
7.9.17 DRO/ORO Surrogate, n-Eicosane 1000µg/mL, Absolute 70973
7.9.18 DRO/ORO Surrogate Squalene, 1000µg/mL, Absolute, 72326

7.10 SVOC working standards. All solutions have a 6-month expiration date.

7.10.1 BNA Surrogate spiking solution 25 ppm–

7.10.1.1 Working surrogate solution 25 ppm - prepared by adding 0.625 mL of Surrogate Mix (7.9.6) to a 100 mL class A volumetric flask and dilute to the mark with pesticide grade acetone. Add 1 mL to each sample (25ug/extract).

7.10.2 BNA MS/MSD/LCS spike mix 20 ppm –

| Standard | Volume (µL) |
|---|---|
| 8270 SVOA 64-comp, Accustandard, M-8270-AG01-ASL | 500 |
| 8270 SVOA 35-comp, Ultra, SVM8271-1 | 500 |
| Benzoic Acid, Restek, 2000ppm, 31879 | 250 |
| 1,4-Dioxane-d8, Restek,2000ppm, 30614 | 250 |
| Benzidine Mix, 2000 ug/mL, Restek, 31834 | 250 |
| Surrogate, 4000ppm, Absolute, 25015 | 125 |
| 1-Methylnaphthalene, Absolute,2000ppm, 90494 | 250 |

| | |
|---|---|
| 1,4-Dioxane, Restek, 2000ppm,31853 | 250 |
| Hydrocarbon Standard, Absolute, 2000ppm, 94376 | 250 |
| Pyridine, Absolute,1000ppm, 79091 | 500 |
| 4-Chlorophenol, Absolute, 1000ppm,79061 | 500 |

Add 0.1ml to each LCS, MS, and MSD samples (20ug/extract).

7.11 PCB/Pesticide standards:

7.11.1 TCMX/DCB Surrogate 200ug/mL, Ultra, Part No. ISM-320.

7.11.2 PCB 1016/1260 1000ug/mL, Ultra, Part No. PPM-8082.

7.11.3 Pesticide ICV/CCV Intermediate standard 10ppm - prepared by adding 50µl of AccuStandard-z-014c-r (7.9.12) to a 10ml class A volumetric flask and dilute to 10ml with pest grade Hexane.

7.11.4 Working TCMX/DCB Surrogate 0.25ug/mL – prepared by adding 125µl TCMX/DCB Surrogate 200ug/ml (7.9.13) to a 100ml Class A volumetric flask and diluting to mark with pesticide grade acetone.

7.11.5 PCB MS/MSD/LCS spike mix 5ug/mL - prepared by adding 125µl of the PCB 1016/1260 1000ug/mL(7.9.14) to a 25ml Class A volumetric flask and diluting to mark with pesticide grade acetone. Add 1.0ml per MS/MSD/LCS.

7.11.6 Pesticide MS/MSD/LCS Working Spike 0.25ug/mL - prepared by adding 625µl of Pesticide ICV/CCV standard 10ppm (7.9.12) to a 25ml Class A volumetric flask and diluting to mark with pesticide grade acetone. Add 1.0ml per MS/MSD/LCS.

7.11.7 Technical Chlordane and Toxaphene are not routinely part of the pesticide spike mixes.

7.11.8 Spike Mixes supplied by GC department.

7.12 DRO/ORO.

7.12.1 DRO/ORO Working Surrogate 150ug/mL – prepare by adding 750 µL of the DRO/ORO Surrogates (7.9.17 & 7.9.18) to a 5mL volumetric flask and dilute to the mark with pesticide grade acetone. Add 100uL to each sample.

7.12.2 DRO/ORO MS/MSD/LCS Spike Mix 5000/10000ug/mL - add 500 ul SAE 30W Motor Oil (7.9.15) and 250uL Diesel #2 Fuel Oil (7.9.15) to a final volume of 1mL with pesticide grade acetone. Add 100uL to each MS/MSD/LCS.

7.13. All reagents and standards prepared must be labeled with a minimum:

7.13.1. Identity of the material
7.13.2. Concentration of the solution
7.13.3. Date prepared
7.13.4. Initials of analyst preparing the solution
7.13.5. Expiration date.

## 8.0 Preparation of Standards and Calibration Procedure

8.1 Refer to analytical SOP.

## 9.0 Sample Preparation

9.1 Allow samples to warm to ambient temperature.

9.2 Preparation of hot block.

9.1.1 Plug in the Hot Block. The display will turn on and show the set point and actual temperature.

9.1.2 Set the temperature to 130°C.

9.1.3 Place the cell thermometer in a position and verify the temperature

9.3 With each batch of samples prepare a method blank, LCS and LCS duplicate (LCSD) by adding spiking solution specified for analytical request (section 7). If sufficient volume is supplied a MS/MSD (spiked according to section 7) is prepared with the batch of samples.

9.4 Verify the calibration of the balance used and record the calibration in the logbook daily.

9.5 Measure 30g of well-mixed soil discarding any water layer and eliminating foreign objects such as sticks, rocks, etc. and capture the weight into the “SampAmt” column of the Omega Prep Batch using the BalanceLink software. If the sample is a wipe, place the entire wipe sample into a 250 ml beaker.

9.6 Add minimum amount of sodium sulfate and mix until the sample is free flowing like sand. If needed for a wet sample, add additional sodium sulfate. If sample is dry, less sodium sulfate may be used.

9.7 Transfer entire sample to a cell.

9.8 Spike and surrogate samples and QC as appropriate.

9.9 Add 60ml Methylene chloride to each cell.

9.10 Hand tighten the cell cap, label it, and place cell into the cell rack.

9.11 When sample preparation is complete, transfer all the cells into the Hot Block.

9.12 Heat the samples for 30 minutes.

9.13 After 30 minutes remove the cells from the hot block and allow it to cool to room temperature.

9.14 Quantitatively transfer the contents of the cell to a TurboVap concentrator tube through a funnel with a glass wool plug topped with sodium sulfate.

9.15 Set the TurboVap concentrator to at 16psi and 44°C.

9.16 Pesticide and PCB extracts require a solvent exchange to Hexane. When the Methylene chloride solvent extract reaches about 1 to 2 ml add 10 ml of Hexane and re-concentrate to 1 ml using the graduated tip of the concentrator tube. Add an additional 4.0ml of Hexane (using the 1.0ml syringe or class A graduated cylinder) to the concentrator tube. Final extract volume is 5mL for Pesticide and PCB samples. Final extract volume is 1mL for 8270.

9.17 Transfer the concentrate to a 2-ml vial auto sampler vial for 8270 samples and 8mL vial for Pesticide/PCB samples. If the sample will not concentrate to 1 to 2 ml (i.e. oily waste) collect the extract in a 10 ml vial (or 40 ml vial if necessary) and record the final volume.

9.18 The analyst will decide what cleanup technique, if any will be required.

9.19 In the sample preparation log in the LIMS enter the initial sample volume in ml (1000 ml is the default), final extract volume (1 ml is the default) and sample matrix. Additionally enter the amount of surrogate and spike solutions added in ml.

9.20 The preparation analyst must also enter date and time of start and completion as well as analyst ID and method.

9.21 Enter all applicable Reagents/Chemicals and Spikes/Standard information in the preparation form.

## 10.0 Diagram/Table

10.1 Reserved

## 11.0 Analytical Procedure

11.1 This section is not applicable to this SOP.

## 12.0 Details of Calibration and Calculations

12.1 This section is not applicable to this SOP.

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 Prepare a method blank for each batch of twenty or less samples by extracting cleaned sand.

13.2 Prepare a laboratory control sample (LCS) for each batch of twenty or less samples per matrix, by adding the appropriate amount of the spike mix to 30 g of cleaned sand.

13.3 Prepare a matrix spike (MS) and matrix spike duplicate (MSD) for each batch of twenty or less samples per matrix, if sufficient volume is available by adding the appropriate amount of the spike mix to a representative sample.

13.4 Corrective action procedures are specified in the applicable SOP's.

## 14.0 Data Reporting Requirements

14.1 Refer to applicable analytical SOP.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 At the end of the work shift, the glassware is to be cleaned and put away. The counters are to be cleaned and wiped down.

15.2 Daily: Balance must be checked prior to use with the certified weights and recorded.

15.3 TurboVap: Ensure that the water bath reservoir is filled to at least above the bottom of the cutout circle on the vertical portion of the interior wall. Check to make sure that the N2 tank is not empty and that the nitrogen is flowing to the sample tube at the proper pressures..

15.4 Check the TurboVap displayed temperature with a calibrated thermometer on each day of use.

## 16.0 Pollution Prevention and Waste Management

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner, which minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Organic solvents are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Disposal of materials is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, Nov, 1986, Method 3546, Revision 0, February 2007.

17.2 RTI Laboratories, Inc. Quality Assurance Plan.

17.3 RTI Laboratories, Inc. SOP SRC001-A, Sample Receipt and Custody.

17.4 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.5 RTI Laboratories, Inc. Employee Handbook.

## 18.0 Revisions

18.1 Reserved

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# STANDARD OPERATING PROCEDURE

# SONICATION EXTRACTION PROCEDURE FOR SEMI – VOLATILE ORGANICS

| | |
|---|---|
| **Analyte:** | **Semi-volatile organic compounds** |
| **SOP #:** | **3550C_040215_R9.2** |
| **Method Reference:** | **EPA SW-846 3550C** |
| **Issue Date:** | **December 2, 2005** |
| **Revision No.:** | **9.2** |
| **Revision Date:** | **March 15, 2016** |

**Reviewed and Approved March 15, 2016 by:**

| | |
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| Director Quality Management: | Charles O'Bryan |
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**SONICATION EXTRACTION PROCEDURE FOR**
**SEMI – VOLATILE ORGANICS**

**SOP#: 3550C_040215_R9.2**

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# 1.0 Scope and Application

## 1.1 Introduction

RTI Laboratories, Inc, has prepared this document to detail the Standard Operating Procedure (SOP) for the preparation of the preparation of solid samples for analysis of semi-volatile compounds by gas chromatography/mass spectrometry, pesticides and PCB's by GC/ECD, PNAs by HPLC and DRO by GC/FID. This SOP contains the procedures for sonication extraction (Method 3550B) for solid samples. Wipe samples (particularly for PCB's) are prepared using this procedure.

A detailed description of the instrumentation, calibration, run parameters and quality control procedures used for analysis are not included in this SOP. For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

## 1.2 Summary of Method

1.2.1 A 25 to 30 g aliquot of sample is weighed and dried with anhydrous sodium sulfate. The solvent appropriate to the analysis, surrogates and spikes (where applicable) are added to the solid sample or wipe and extracted by sonication for 3 minutes at full power. The solvent extract is removed and filtered through anhydrous sodium sulfate. The procedure is repeated three times and the final extract is concentrated to the desired volume. This method has been modified to use 50ml aliquots instead of 100ml aliquots of extraction solvent.

# 2.0 Safety Precautions

2.1 Compounds applicable to this method are known or suspected carcinogens. Standard preparation is conducted in fume hoods designated for organic use.

2.2 Extraction solvents are flammable and/or toxic and must be handled with caution. All extractions are performed in a manner designed to minimize exposure to these chemicals using appropriate hoods and personal protection (such as, gloves, lab coat, and safety glasses.

# 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with the RTI Standard Operating Procedure for Sample Receipt and Custody (SRC001-A). Appropriate U. S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed. Soil samples are collected in 2 to 9 oz. pre-cleaned wide mouth jars with Teflon lined lids.

3.2 For PCB samples the holding time is 1 year from collection to extraction and 1 year from extraction to analysis. For all other analytes covered in this SOP, the holding time for soil samples is 14 days from collection to extraction and 40 days from extraction to analysis.

3.3 All samples are stored at 4° C in the walk-in cooler.

3.4 Extracts are stored in a designated freezer at <-10 degrees C.

3.5 Minimum sample size – 30 g.

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 Not applicable to this SOP. See the appropriate analytical SOP for details

## 5.0 Interferences

5.1 Interferences can arise from carry over due to high sample concentrations or contamination from reagents and/or glassware. Method blanks are prepared to ensure system cleanliness in both instances. All glassware must be scrupulously cleaned before use. Phthalates are common lab contaminants and will leach from any soft plastic material used during sampling or during prep.

5.2 Samples containing high concentrations of non-target analytes or extremely high levels of select target analytes can result in elevated detection limits for some or all compounds. Dilution of the extract may improve the resolution and quantification of some analytes but will generally cause an elevation in the RDL. Interferences from high molecular weight organics such as oils will cause an elevated baseline. If this background is at a high concentration it will interfere with analyte identification as well as quantification.

5.3 Sample extract interferences can be cleaned up using techniques described in the SOP for sample extract cleanup (florisil cleanup, acid cleanup, sulfur cleanup or dilution (3610B, 3611A, 3620B, 3630C, 3650B, 3660B)). Dilution of the extract can also be used to minimize interferences.

## 6.0 Apparatus and Materials

6.1 Analytical Balance capable of weighing to 0.1 g.

6.2 Glass Funnels

6.3 Glass beakers, 250 ml size.

6.4 Sonicators

6.5 Class A Micro liter syringes, 50µl, 10µl, 25µl, 1000µl and 5000µl.

6.6 Volumetric glassware

6.7 Glass vials – 2ml amber crimp top auto sampler or 8 ml clear with screw cap

6.8 Glass wool

6.9 Pasteur pipettes

6.10 TurboVap II evaporator

6.11 200ml concentrators tubes with a 1.0ml graduated tip

6.12 4" x 4" gauze pads – for wipe collection.

6.13 PC with Balance Link software, Microsoft Excel and Omega.

## 7.0 Reagents

7.1 Anhydrous Sodium sulfate- clean in a muffle furnace for 4 hours at 400 degrees C

7.2 Methylene chloride – pesticide grade

7.3 Hexane – pesticide grade

7.4 Acetone – pesticide grade

7.5 90 :10 Hexane/Methylene chloride : In a 1000 ml graduated cylinder add 900 ml of Hexane and 100 ml Methylene chloride.

7.6 ASTM Type II Deionized water.

7.7 Ottawa sand for Method Blank and LCS, heated in a muffle furnace for 4 hours at 400 degrees C.

7.8 Dry Nitrogen – for TurboVap.

7.9 SVOC Stock Standards

- 7.9.1 Base/Neutral & acid surrogate standard, Absolute, part# 25015, 4000ppm.
- 7.9.2 1,4-Dioxnae-d8, 2000ppm - Restek, 30614
- 7.9.3 8270 SVOA 64 compounds, 1000ppm - AccuStandard, M-8270-AG01-ASL
- 7.9.4 8270 SVOC 35 compounds, 1000ppm - Ultra, svm8271-1
- 7.9.5 Benzoic acid, 2000ppm – Restek, 31879

7.9.6 4-Nitrophenol, 1000ppm – Absolute, 70231

7.9.7 Benzidine Mix, 2000ppm – Restek, 31834

7.9.8 2,4-Dinitrophenol, 1000ppm – Absolute, 70159
7.9.9 1-Methylnaphthalene, 2000ppm – Absolute, 90494
7.9.10 1,4-Dionane, 2000ppm – Restek 31853
7.9.11 Hydrocarbon Standard, 2000ppm – Absolute 94367
7.9.12 Pyridine, 1000ppm – Absolute, 79091
7.9.13 Benzo(e)pyrene, 2000 ppm – Absolute 90506

7.10 SVOC spiking standards – all solutions have a 6-month expiration date.

7.10.1 BNA Surrogate spiking solution 25 ppm–

7.10.1.1 Working surrogate solution 25 ppm: prepared by adding 625 µl of Base/Neutral & acid surrogate standard (7.12.1) and 1.25 ml of 1,4-Dionane-d8 (7.12.2) to a 100 ml class A volumetric flask and dilute to the mark with pesticide grade acetone. Add 1.0mL to each sample (25 µg/ml extract).

7.10.2 BNA MS/MSD/LCS spike mix 20 µg/ml. Add the following amounts to a final volume of 50 ml in a volumetric flask. Spike each LCS, MS and MSD with 1 ml of the 20ppm spike mix (20 µg/ml extract).

| | |
|---|---|
| 2 ml | 8270 SVOA 64 compounds, 1000ppm |
| 2 ml | 8270 SVOC 35 compounds, 1000ppm |
| 1 ml | Benzoic acid, 2000ppm |
| 3 ml | 4-Nitrophenol, 1000ppm |
| 1 ml | Benzidine Mix, 2000ppm |
| 3 ml | 2,4-Dinitrophenol, 1000ppm |
| 1 ml | 1-Methylnaphthalene, 2000ppm |
| 1 ml | 1,4-Dionane, 2000ppm |
| 1 ml | Hydrocarbon Standard, 2000ppm |
| 2 ml | Pyridine, 1000ppm |
| 1 ml | Benzo(e)pyrene |

7.10.3 SIM PAH Spike mix: Add 20 µl of the stock 8270 SVOA 64 standard and 10 µl of the 1-Methylnaphthalene standard to a final volume of 50 ml Methylene chloride (400 µg/L final concentration). Spike each LCS, MS and MSD with 1 ml of the spike solution.

7.10.3.1 Add 12.5 µg/L of the BNA surrogate standard to a final volume of 100 ml Methylene chloride (500 µg/L final concentration). Add 1 ml of this surrogate solution to each sample and QC sample.

7.11 PCB/Pesticide standards:

7.11.1 Pesticide Mix 1000ug/mL, AccuStandard H-8081-SC
7.11.2 TCMX/DCB Surrogate 200ug/mL, Ultra, Part No. ISM-320
7.11.3 PCB 1016/1260 1000ug/mL, Ultra, Part No. PPM-8082
7.11.4 Pesticide ICV/CCV Intermediate standard 10ppm - prepared by adding 100µl of AccuStandard H-8081-SC (7.14.1) to a 10ml class A volumetric flask and dilute to 10ml with pest grade Hexane
7.11.5 Working TCMX/DCB Surrogate 0.1ug/mL – prepared by adding 50µl TCMX/DCB Surrogate 200ug/mL (7.14.2) to a 100ml Class A volumetric flask and diluting to mark with pesticide grade acetone. Add 1.0ml per Sample/MB/MS/MSD/LCS.

7.11.6 PCB MS/MSD/LCS spike mix 2ug/mL - prepared by adding 50µl of the PCB 1016/1260 1000ug/mL (7.14.3) to a 25ml Class A volumetric flask and diluting to mark with pesticide grade acetone. Add 1.0ml per MS/MSD/LCS.
7.11.7 Pesticide MS/MSD/LCS Working Spike 0.1ug/mL - prepared by adding 250µl of Pesticide ICV/CCV standard 10ppm (7.14.4) to a 25ml Class A volumetric flask and diluting to mark with pesticide grade acetone. Add 1.0ml per MS/MSD/LCS
7.11.8 Technical Chlordane and Toxaphene are not routinely part of the pesticide spike mixes.

7.12 DRO/ORO

7.12.1 DRO/ORO Surrogate n-Eicosane 1000µg/mL, Absolute 70973
7.12.2 DRO/ORO Surrogate Squalene 1000µg/mL, Absolute 72326
7.12.3 SAE 30W Motor Oil, 20mg/ml AccuStandard, cat#FU-018-D-40X
7.12.4 #2 Fuel Oil, 20mg/mL, AccuStandard, cat# FU-002-D-40X
7.12.5 DRO/ORO Working Surrogate 150µg/mL - prepare by adding 750µL of the DRO/ORO Surrogates (7.15.1 & 7.15.2) to a 5 ML volumetric flask and dilute to the mark with pesticide grade acetone. Add 100µL to each sample.
7.12.6 DRO/ORO MS/MSD/LCS Spike Mix 5000/10000µg/mL - add 500µl SAE 30W Motor Oil (7.15.3) and 250µL Diesel #2 Fuel Oil (7.15.4) to a final volume of 1mL with pesticide grade acetone. Add 10µL to each MS/MSD/LCS.

7.13 All reagents and standards prepared must be labeled with a minimum:

7.13.1 Identity of the material
7.13.2 Concentration of the solution

7.13.3 Date prepared
7.13.4 Initials of analyst preparing the solution
7.13.5 Expiration date.

## 8.0 Preparation of Standards and Calibration Procedure

8.1 Branson Sonicator 250 – Tune according to manufacturer instructions.

8.2 Ultra sonic processor tuning procedure – Branson Sonifier 550. Tune each use.

8.2.1 The probe should not be in contact with or immersed in liquid during tuning.

8.2.2 Turn AMPLITUDE CONTROL KNOB counter-clockwise to zero

8.2.3 Press POWER SWITCH to ON (up) position. The switch will illuminate

8.2.4 When the prompt appears, press the TUNE key. The screen will read: (TUNING ---PROBE ACTIVE).

8.2.5 Turn the Amplitude Control Knob to a setting of 3.

8.2.5.1 Note the position of the Bar Graph on the LCD display as you turn the knob. DO NOT allow the reading to exceed 50%. STOP if the reading reaches 50%.

8.2.5.2 Rotate the tuning knob clockwise or counter-clockwise until a minimum reading is obtained (usually less than 10%). DO NOT force the tuning knob past where it stops.

8.2.6 Turn the Amplitude Control Knob to a setting of 6 (Note: if using a Microtip or an extender, tune at a setting of 5 only!!!)

8.2.6.1 Note the position of the Bar Graph and DO NOT exceed a reading of 50%.

8.2.6.2 Rotate the tuning knob to obtain a minimum meter reading (less than 10%).

8.2.7 Repeat 8.3.6 at a setting of 10 (DO NOT do this step if using a Microtip or an extender!!!) and minimize the meter reading one last time.

8.2.8 Press the STOP key and turn the Amplitude Control Knob back to Zero.

## 9.0 Sample Preparation

9.1 Allow samples to warm to ambient temperature.

9.2 With each batch of samples prepare a method blank, LCS, MS and MSD by adding spiking solution specified for analytical request (Section 7).

9.3 Verify the calibration of the balance used and record the calibration in the logbook daily.

9.4 Measure 30g of well-mixed soil eliminating foreign objects such as sticks, rocks, etc. and capture the weight into the "SampAmt" column of the Omega Prep Batch using the BalanceLink software. If the sample is a wipe, place the entire wipe sample into a 250 ml beaker.

9.5 Add minimum amount of sodium sulfate and mix until the sample is free flowing like sand. If needed for a wet sample, add additional sodium sulfate. If sample is dry, less sodium sulfate may be used.

9.6 Add 1.0ml of the appropriate surrogate mix (section 7.9 through 7.11) then immediately add 50 ml of Methylene chloride or Hexane for PCB\Pesticides samples.

9.7 Place the cleaned sonicator horn approximately 3-8 mm below the surface of the solvent but not in contact with the soil and sonicate for 3 min at full power with the pulse duty set to 50%. Observe the sample for active mixing with the solvent.

9.8 Decant the extracts through a funnel containing glass wool and approximately ½ inch of sodium sulfate and collect in a 200 ml TurboVap vessel. Be careful not to fill the TurboVap vessel more than 2/3 full, too much solvent in the vessel will spray out the top. After the solvent drains into the tube rinse the sodium sulfate with the appropriate solvent.

9.9 Add 50ml Methylene chloride or 90:10Hexane/Methylene chloride for PCB/Pesticides samples to the beaker and repeat 9.7 and 9.8 two additional times combining the extracts.

9.10 Transfer the container to the TurboVap concentrator. Set the TurboVap according to the manufacturer's instructions (use the manual setting and tank pressure at 12psi). Concentrate to <1.0 ml at 44 degrees C.

9.11 Remove TurboVap container and bring to volume as below.

9.11.1 BNA samples: Use a syringe filled with Methylene chloride to adjust the final volume to the 1 ml line on the TurboVap container. Transfer the extract to a 2 ml auto sampler vial with a Pasteur pipette.

9.11.2 Pesticide/PCB samples: Use a syringe filled with Hexane to adjust the final volume to the 1 ml line on the TurboVap container. Using a graduated cylinder add 4 ml of Hexane (5 ml final volume) and transfer to a 8 ml vial.

9.11.3 In cases where the sample will not concentrate to <1 ml transfer and measure the remaining volume in a graduated cylinder and adjust with the appropriate solvent to a 5 or 10 ml final volume.

9.11.4 Note any non-routine characteristics of the extract in the comments section of the sample preparation table. These would include:

9.11.4.1 Discoloration
9.11.4.2 Viscosity
9.11.4.2 Odor
9.11.4.3 Oily or other unusual appearance

9.11.5 The analyst will decide what cleanup technique, if any will be required.

9.12 In the sample preparation log in the LIMS enter initial the sample volume in g or Kg based on the test code units requirement, final extract volume in ml and sample matrix. Additionally enter the amount of surrogate and spike solutions added in ml.

9.13 The preparation analyst must also enter the date and time of start and completion, the name of the analyst and the test code designation.

9.14 Enter all applicable Reagents/Chemicals and Spikes/Standard information in the preparation form.

## 10.0 Diagram/Table

10.1 Reserved

## 11.0 Analytical Procedure

11.1 This section is not applicable to this SOP.

## 12.0 Details of Calibration and Calculations

12.1 This section is not applicable to this SOP.

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 Prepare a method blank for each batch of twenty or less samples by extracting cleaned sand.

13.2 Prepare a laboratory control sample (LCS) for each batch of twenty or less samples per matrix, by adding the appropriate amount of the spike mix to 30 g of cleaned

sand.

13.3 Prepare a matrix spike (MS) and matrix spike duplicate (MSD) for each batch of twenty or less samples per matrix, if sufficient volume is available by adding the appropriate amount of the spike mix to a representative sample.

13.4 Corrective action procedures are specified in the applicable SOP's.

## 14.0 Data Reporting Requirements

14.1 Refer to applicable analytical SOP.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 The sonicators are tuned according to the manufacturers' instructions daily or with each use. Record tuning in the maintenance log.

15.2 At the end of the work shift, the glassware is to be cleaned and put away. The counters are to be cleaned and wiped down.

15.3 Daily: Balance must be checked prior to use with the certified weights and recorded.

15.4 TurboVap: Ensure that the water bath reservoir is filled to at least above the bottom of the cutout circle on the vertical portion of the interior wall. Check to make sure that the N2 tank is not empty and that the nitrogen is flowing to the sample tube at the proper pressures..

15.5 Check the TurboVap displayed temperature with a calibrated thermometer on each day of use.

## 16.0 Pollution Prevention and Waste Management

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner, which minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Organic solvents are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Disposal of materials is addressed in the laboratory QAP (Section 5).

## 17.0 References

17.1 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, Nov, 1986, Revision 1 Sept, 1994, Method 3550C.

17.2 RTI Laboratories, Inc. Quality Assurance Plan.

17.3 RTI Laboratories, Inc. SOP SRC001-A, Sample Receipt and Custody.

17.4 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.5 RTI Laboratories, Inc. Employee Handbook.

## 18.0 Revisions

18.1 Section 7.11 revised.

18.2 Revision 9.1, November 24, 2015

18.2.1 Standards – Updated standards Section 7.0.

18.2.2 Added Section 7.5.

18.3 Revision 9.2, March 15, 2016

18.3.1 Added Section 7.10.3 – PAH SIM spike solutions.

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# STANDARD OPERATING PROCEDURE

## ANALYSIS FOR pH

| | |
|---|---|
| **Analyte:** | **pH** |
| **SOP#:** | **4500 H-B_050912_R3** |
| **Method Reference:** | **SW-846_9045/SM-4500-H-B** |
| **Issue Date:** | **May 22, 2006** |
| **Revision No.:** | **3** |
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| **Reviewed Date:** | **December 9, 2013** |

**Reviewed and Approved: December 9, 2013**

Director, Quality Management: Charles O'Bryan

Director, Environmental Services: Yemane Yohannes

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# STANDARD OPERATING PROCEDURE

## ANALYSIS FOR pH

## SOP#: 4500 H-B_050912_R3

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## 1.0 Scope and Application:

1.1 Introduction

RTI Laboratories, Inc. has prepared this document to detail the Standard Operating Procedure (SOP) for the analysis of pH (negative logarithm of hydrogen ion concentration) by electrometric method. This method is applicable to the measurement of pH in drinking, saline and surface waters, domestic, industrial wastewaters and acid rain (atmospheric deposition).

A detailed description of the instrumentation, calibration, run parameters and quality control procedures is included in this SOP. For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

1.2 Summary of Method

1.2.1 This method is used for the electrometric pH determination of a sample by using a combination electrode attached to a pH meter.

1.2.2 The samples are preferably analyzed at 25°C by calibrating the electrode using 3 buffers that bracket the expected sample pH and that are no more than 3 pH units apart.

## 2.0 Safety Precautions

2.1 Toxicological properties of the samples, chemicals and reagents used in this procedure are not always known and may present health and safety concerns. Disposable gloves, eye protection and protective clothing should be used when handling potentially hazardous chemicals.

## 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with RTI's Standard Operating Procedure for Sample Receipt and Custody (SRC001-A). Appropriate U.S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed.

3.1.1 Samples can be collected glass or plastic bottles. Aqueous samples that cannot be analyzed immediately should be preserved by refrigerating at 4°C.

3.1.2 The reference method recommends analysis of samples immediately after collection. Samples that cannot be analyzed immediately or that are delivered to the laboratory for pH determinations should be analyzed as soon as possible, preferably within 2 hours from the time of sample receipt.

## 4.0 MDL, LOD, LOQ, Linear Range, Accuracy and Precision

4.1 Method detection limit (MDL), LOD and LOQ determinations are not applicable to pH measurement.

4.2 The range for pH measurements is 1 – 14 pH units. Data that is above pH 12 is qualified on the report with an "E" flag to indicate it is above the calibration, since 12.0 is the highest pH buffer that is available to check the linearity of the calibration curve.

4.3 Accuracy is determined by monthly calibration of the pH meter and checking calibration at three levels (4.0, 7.0 and 10.0). A daily calibration check is performed at all three levels and each level must be +/- 0.05 pH units.

4.4 Precision is assessed by duplicate determinations of each sample. Expected agreement between duplicate measurements in +/- 0.1 pH units.

## 5.0 Interferences

5.1 The electrode in general is not subject to solution interferences from color, turbidity, oxidants, reducing agents or high salinity.

5.1.1 Sodium error at pH levels greater than 10 can be reduced or eliminated by using a "low sodium error" electrode.

5.2 Coatings of oily material or particulate matter can impair electrode response time. These coatings may be removed by gently wiping or washing the electrode with detergent. An additional treatment with hydrochloric acid (1:9) may necessary to remove any remaining film.

5.3 Sample pH is dependent upon the sample temperature, i.e., the true pH of a sample is different at different temperatures. The sample temperature must be recorded as part of the pH measurement process.

## 6.0 Apparatus and Materials

6.1 Corning 443i pH meter or equivalent

6.2 pH electrode "3 in 1" combo w/RJ.

6.3 Magnetic stir bars (Teflon coated) and magnetic stirrer plate, VWR or equivalent

6.4 Spray/squirt bottle (plastic)

## 7.0 Reagents

7.1. Deionized (DI) Water. This water should have conductance of less than 2 μS/cm.

7.2. pH buffers 1.0, 2.0, 4.0, 7.0,10.0 and 12.0 commercially obtained – two separate sources stored at room temperature.

7.3. pH electrode filling solution from VWR or equivalent, stored at room temperature.

7.4 All reagents and standards prepared must be labeled with a minimum:

7.4.1 Identity of the material
7.4.2 Concentration of the solution
7.4.3 Date prepared
7.4.4 Initials of analyst preparing the solution
7.4.5 Expiration date.

## 8.0 Preparation of Standards and Calibration Procedure

8.1 Calibration standards:

8.1.1 pH buffers 4.0, 7.0 and 10.0.

8.1.2 pH buffers 1.0, 2.0 and 12.0 are used for samples falling outside of the pH 4.0-10.0 range but within a pH 1.0-12.0 range. If a sample is between 1.0-4.0, a pH 1.0 buffer is tested and must be within +/-0.05 pH units. If the pH is below 1.0, the data must be qualified as outside of the calibration range. If a sample is above 10.0, a pH 12.0 buffer is tested and must be within +/-0.05 pH units. If the sample pH is above 12.0, the data must be qualified as outside of the calibration range.

8.2 Calibrating the electrode – calibration is performed monthly or as needed:

8.2.1 Follow the instructions of the manufacturer for the operation, storage and preparation of the electrode and calibrate the pH meter each time it is used.

8.2.2 Rinse the pH electrode with DI water, then place in pH 7.0 buffer and note the temperature. Adjust the meter to read pH 7.0 if necessary. Making sure the electrode is in the pH 7.0 buffer (instrument will error out otherwise), press **cal. I**t will prompt you to put the next buffer. Rinse the electrode, measure the pH of 4.0 buffer; repeat for the pH 10.0 buffer (these should generally be within +/- 0.05). Press **auto read** (if not already on) and the meter will display slope (must be between 95% and 105%).

8.2.3 Check the meter and electrode calibration as above (8.2.3) with a secondary source. The meter is equipped with auto compensators that electronically adjust for temperature differences. Reading must be within +/- 0.05 pH units.

8.3 Daily or with each use the pH meter must be checked with the three pH buffers. Readings for each buffer must be within +/- 0.05 pH units. If readings exceed the acceptance criteria the calibration procedure must be performed.

## 9.0 Sample Preparation

9.1 Allow samples to warm to ambient temperature

9.2 Aqueous samples must be homogenous.

9.3 Solid Samples:

9.3.1 Add an equal volume of DI water to a measured amount of solid/soil (i.e. 10 ml DI water to 10 g soil).

9.3.2 Stir continuously for 5 minutes.

9.3.3 Allow to settle for 1 hour. If a suspension of solids remains in the supernatant filter or centrifuge.

9.3.4 Proceed with pH measurement in Section 11.

## 10.0 Diagram/Table

10.1 Reserved.

## 11.0 Analytical Procedure

11.1 Immerse the electrode in a blank (pH 7.0 buffer, in a clean cup with a clean stir bar).

11.2 Turn the stirrer on, wait for the electrode to stabilize, note the pH meter reading and the temperature.

11.3 Repeat (11.2) for all buffers (4.0 and 10.0)

11.4 Repeat (11.2) for all samples in duplicate using separate aliquots. The difference between the readings must be less than 0.1 SU. Record the results and report the first pH reading.

11.5 If the readings differ by more than 0.1 SU repeat measurements on separate aliquots until the difference in values is <0.1 SU. In this instance the last measurement is reported.

11.6 After all the samples are analyzed, enter the data in the computer (Omega LIMS).

## 12.0 Details of Calibration and Calculations

12.1 Refer to Standard Method for information regarding pH equations.

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 The pH meter is checked daily or with each use using the three pH buffers.

13.1.1 Acceptance Criteria: All solution readings within +/- 0.05 pH units.

13.1.2 Corrective Action: Recalibrate the pH meter. If failure persists perform meter or electrode maintenance as specified by the manufacturer.

13.2 Duplicate Sample (DUP) Measurements

13.6.1 Acceptance Criteria: Duplicate measurements must be within +/- 0.1 pH units.

13.6.1 Corrective Action: Repeat until difference between successive measurements is <0.1 pH units.

## 14.0 Data Reporting Requirements

14.1 Sample results are reported as pH.

14.2 Results are entered into the Omega LIMS system.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 Maintain Corning 443i pH meter and Corning pH electrode “3 in 1” combo w/RJ according to the manufacturers’ specifications.

15.2 Rinse the electrode and maintain according to the manufacturers’ specifications.

## 16.0 Waste Management and Pollution Prevention

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner that minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Acidic materials (pH<2) are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Disposal of materials is addressed in the laboratory QAP (Section 5).

## 17.0 References

17.1 EPA Methods for Chemical Analysis of Water and Wastewater, 600/4/70/200 (Rev.3/1983) Method 150.1

17.2 EPA Test Methods for Evaluating Solid Waste, Physical/Chemical Methods. SW-846 Method 9045, Revision 4, November 2004/Method 9040, Revision 3, November 2004.

17.3 Standard Methods for the Examination of Water and Wastewater. Standard Methods On-Line, Method 4500 $H^+$ B.

17.4 RTI Laboratories, Inc. Quality Assurance Plan.

17.5 RTI Laboratories, Inc. SOP SRC001-A, Sample Receipt and Custody.

17.6 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.7 RTI Laboratories, Inc. Employee Handbook.

**RTI Laboratories, Inc.**
**31628 Glendale**
**Livonia, Michigan 48150**

# ANALYTICAL STANDARD OPERATING PROCEDURE
# ANALYSIS OF SULFIDE

| | |
|---|---|
| **Analytes:** | **Sulfide** |
| **SOP#:** | **4500 S2-D_030614_R2** |
| **Method Reference:** | **Standard Methods 4500 S2-D** |
| **Issue Date:** | **April 14, 2011** |
| **Revision No.:** | **2** |
| **Revision Date:** | **March 6, 2014** |

**Reviewed and Approved: March 6, 2014**

Director, Quality Management: Charles O'Bryan

Director, Environmental Services: Yemane Yohannes

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# STANDARD OPERATING PROCEDURE
# ANALYSIS OF ACID-VOLAILE SULFIDE IN AQUATIC SEDIMENTS

## SOP#: 4500 S2-D_030614_R2

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## 1.0 Scope and Application:

1.1 Introduction

RTI Laboratories, Inc. has prepared this document to detail the Standard Operating Procedure (SOP) for the analysis of sulfide in aqueous samples. A detailed description of the instrumentation, calibration, run parameters and quality control procedures is included in this SOP. For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

1.2 Summary of Method

1.2.1 This method is based on the reaction of sulfide ferric chloride and dimethyl-p-phenylenediamine to produce methylene blue. The resultant colored solution is measured spectrophotometrically at 665 nm. The intensity of the color produced is proportional to the concentration of sulfide in the sample. Sample quantification is determined by comparison to a standard curve.

## 2.0 Safety Precautions

2.1 Waste materials submitted for analyses may contain hazardous components. Uncharacterized waste samples should be handled in a manner that minimizes exposure and personal contact. Analysis should be performed in a fume hood.

2.2 Chemicals used should be regarded as a potential health risk. Sample preparation and analysis is performed in a manner designed to minimize exposure using routine good laboratory practices.

## 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with RTI Laboratories, Inc. Standard Operating Procedure for Sample Receipt and Custody (SRC001-A). Appropriate U. S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed.

3.1.1 Samples are collected in 250 ml plastic bottles containing 0.5 ml of zinc acetate and 2 NaOH pellets (pH >9) with minimal headspace and stored at 4$^{o}$C

3.1.2 Maximum sample holding time is 7 days.

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 The method detection limit (MDL) is statistically defined at the 99% confidence level according to 40 CFR Part 136 App. B. Seven replicates containing all of the analytes of interest at a concentration level of 1-5 times the estimated D.L. are analyzed and the standard deviation is calculated. The Student's T Value for the 7 replicates (3.143) is multiplied by the standard deviation of the analyte to calculate the MDL. MDLs are updated annually (or as needed) and are kept on file in the Laboratory. MDLs and reporting limits are incorporated into the applicable test code in the Omega LIMS.

4.2 The LOD (limit of detection) is determined by spiking reagent water at 1-4 times the MDL and prepared using the same procedure as samples. Analytes must be present at levels 3 times or greater than the blank response (greater than 3 times the signal to noise ratio). The concentration used is the LOD for that analyte. LOD determinations must be performed quarterly.

4.3 The LOQ (limit of quantification) is determined by spiking reagent water at the reporting limit (RL/CRQL) and prepared in the same manner as samples. Analyte recovery must be within 20% of the expected concentration. The concentration used and successfully recovered is the LOQ for that analyte. LOQ determinations must be performed quarterly.

4.4 Initially accuracy and precision at the LOQ is determined by spiking 4 aliquots of reagent water at the reporting limit (RL/CRQL) and prepared using the same procedure used for samples. The average recovery must be within 20% of the expected value and the %RSD must be less than 15%.

4.5 LOD/LOQ determinations that do not meet the specifications above require repeat analysis, adjustment to the spiking levels and/or reporting limits, repeating the MDL determination at adjusted concentrations if required and repeat LOD/LOQ determinations.

4.6 The accuracy and precision for this method are determined by analyzing four aliquots from a Laboratory Control Sample containing the element(s) of interest at the mid-level of the calculated range (diluted if above this range). Percent recovery, standard deviation, and the relative standard deviation are calculated for each analyte and documents are kept on file in the laboratory.

4.7 Method working range is 0.1-0.8 mg/L based on a 25mL sample.

4.8 Precision data: Duplicate RPD - <20%

4.9 Accuracy data: Spike recovery – 75-125%.

## 5.0 Interferences

5.1 Sample pigmentation and turbidity may interfere with the measurement of the methylene blue produced.

5.2 Strong reducing agents will interfere by preventing the formation of methylene blue.

5.3 Elevated concentrations of thiosulfate, iodide and sulfide will inhibit color production.

5.4 Ferrocyanide produces a blue color that will result is a positive bias.

## 6.0 Apparatus and Materials

6.1 DR 5000 Hach spectrophotometer

6.2 10mL sample cell

6.3 Volumetric glassware and pipettes.

## 7.0 Reagents

7.1 Sodium sulfide.nanohydrate, ACS, 98%min

7.2 DI water – ASTM Type II.

7.3 Zinc acetate – reagent grade.

7.4 NaOH – reagent grade.

7.5 Hach Sulfide 1 Reagent

7.6 Hach Sulfide 2 Reagent

7.7 All reagents and standards prepared are stored at room temperature except as noted and must be labeled with a minimum:

- 7.7.1 Identity of the material
- 7.7.2 Concentration of the solution
- 7.7.3 Date prepared
- 7.7.4 Initials of analyst preparing the solution
- 7.7.5 Expiration date.

## 8.0 Preparation of Standards and QC Samples

8.1 Calibration standards are made using sodium sulfide.nanohydrate.

8.1.1 A 1000 mg/L sulfide standard is prepared by adding 0.0751g of sodium sulfide to 100 ml of 1:1 SAOB: purged DI water mixture. Store in amber bottle and flush headspace with nitrogen. Make fresh weekly.

8.1.2 Prepare a series of dilutions according to the following table.

| ml 100 mg/L Sulfide standard | Sulfide Concentration (mg/l) |
|---|---|
| 0.2 | 0.8 |
| 0.15 | 0.6 |
| 0.1 | 0.4 |
| 0.05 | 0.2 |
| 0.025 | 0.1 |

8.2 Calibration check standard: 0.15 ml of 100 mg/L standard to a 25 ml volumetric flask and dilute to the mark with DI water.

8.3 Laboratory check (LCS): 0.1 ml of 100 mg/L standard to a 25 ml volumetric flask and dilute to the mark with DI water.

8.4 CRQL: 0.025 ml of100 mg/L standard to a 25 ml volumetric flask and dilute to the mark with DI water.

8.5 MS/MSD standard: 0.1mL of 100 mg/L standard to 25 ml of sample.

## 9.0 Sample Preparation

9.1 Allow sample to warm to room temperature.

## 10.0 Diagram/Table

10.1 Reserved.

## 11.0 Analytical Procedure

11.1 Turn on spectrometer and allow the self-calibration procedure to complete.

11.2 Select Method 594.

11.3 Retrieve the sulfide electronic spreadsheet from the designated folder and enter the applicable sample identifications.

11.4 Rename and save the spreadsheet.

11.5 Prepare a blank by adding 10mL of DI water to a sample cell.

11.6 Add sample, or desired amount of sample then dilute with DI water to the 10mL mark of the sample cell.

11.7 Add Sulfide 1 Reagent (~1mL: fill the dropper to the line on the dropper).

11.8 Add Sulfide 2 Reagent (~1mL: fill the dropper to the line on the dropper).

11.9 Immediately cap and invert the cell to mix.

11.10 Start the instrument timer for 5 minutes to allow the reaction to take place for that amount of time.

11.11 When the timer expires, wipe the blank and insert it in the cell holder.

11.12 Zero the instrument by pressing “Zero.”

11.13 Wipe the prepared sample and insert it in the cell holder.

11.14 Read the results by pressing the “Read” button. The results are in µg/L S2-.

11.15 Enter readings in the spreadsheet.

11.16 Import spreadsheet into the Analytical Sequence in the Omega LIMS.

11.17 Print spreadsheet to create a pdf file.

11.18 Link pdf file to the Analytical Sequence.

## 12.0 Details of Calibration and Calculations

12.1 Daily, Initial, and Continuing calibration verification is determined by the response of the standard where:

%D (percent difference)=(Known conc. – Expected conc.) / Expected conc. * 100

12.2 Percent recovery - matrix spikes and LCS

% Recovery = conc. recovered/conc. expected * 100

12.3 Relative Percent Difference

RPD = [result 1 - result 2]/average result1..result2) * 100

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 A Continuing Calibration Verification (CCV) Standard is analyzed prior sample analyses and after every 10 samples.

13.1.1 Acceptance Criteria: 90 - 110 %

13.1.2 Corrective Action: Repeat CCV and all samples preceding a CCV failure. Recalibrate if the problem persists.

13.2 Prepare a method blank for each batch of samples using DI water.

13.2.1 Acceptance Criteria: < ½ RL

13.2.2 Corrective Action: Determine the source and eliminate (see interferences). Re-analyze samples as necessary.

13.3 Prepare a matrix spike (MS) and matrix spike duplicate (MSD) for each batch of ten or less samples by spiking 0.1mL of the primary source standard (Sec. 7.2) to the solid in the boat. The expected concentration of the MS and MSD is 10 mg.

13.3.1 Acceptance Criteria: 75 – 125 % recovery.

13.3.2 Corrective Action: For results outside of laboratory established control limits attempt to determine source of the problem (matrix interferences/poor injection/instrument problems). Re-analyze and/or flag data.

13.4 Reporting limit verification standard is analyzed with each batch of samples.

13.4.1 Acceptance Criteria: 80 to 120%.

13.4.2 Corrective Action: Repeat analysis of standard and recalibrate if the problem persists.

13.5 Laboratory Control Sample (LCS): Prepared with each batch of 20 or less samples (Sec. 8.3)

13.5.1 Acceptance Criteria: 80 to 120%.

13.5.2 Corrective Action: Repeat analysis of LCS and associated samples. Recalibrate if the problem persists.

## 14.0 Data Reporting Requirements

14.1 Sulfide results are reported as mg/L.

14.2 Sample results are read as mg/L, from the instrument.

14.3 Results are entered into the Omega LIMS system including any dilution factors. Raw instruments results are entered directly into the Omega LIMS system using excel spreadsheets, direct instrument interface or manually. All calculations to derive final result are performed automatically by the LIMS. Sample preparation information

14.4 Confirm that there are no QC flags or qualifiers in the sequence. If present, investigate and repeat or reanalyze as necessary. See section 9.2 of the QAP for more detail on qualifiers.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 Maintain Hach DR 5000 Spectrophotometer according to manufacturers' specifications.

## 16.0 Waste Management and Pollution Prevention

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner that minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Acidic materials (pH<2) are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Soil samples are composited in a drum designated for incineration.

16.2.3 Disposal of materials is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 Standard Method for the Examination of Water and Wastewater. On-line edition. Method 4500-S2 D.

17.2 RTI Laboratories, Inc. Quality Assurance Plan.

17.3 RTI Laboratories, Inc. SOP SRC001-A, Sample Receipt and Custody.

17.4 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.5 RTI Laboratories, Inc. Employee Handbook.

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# ANALYTICAL STANDARD OPERATING PROCEDURE

# SAMPLE PREPARATION AND ANALYSIS OF CYANIDE

| | |
|---|---|
| **Analyte:** | **Cyanide** |
| **SOP#:** | **4500-CN_030414_R10** |
| **Method Reference:** | **Standard Methods 4500-CN C&E, SW-846 9012/9010** |
| **Issue Date:** | **February 28, 2005** |
| **Revision No.:** | **10** |
| **Revision Date:** | **March 4, 2014** |

**Reviewed and Approved: March 4, 2014**

Director, Quality Management: Charles O'Bryan

Director, Environmental Services: Yemane Yohannes

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**STANDARD OPERATING PROCEDURE**

**SAMPLE PREPARATION AND ANALYSIS OF CYANIDE**

**SOP#: 4500-CN_030414_R10**

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## 1.0 Scope and Application:

1.1 Introduction

RTI Laboratories, Inc. has prepared this document to detail the Standard Operating Procedure (SOP) for the preparation of samples for the analysis of cyanide in drinking, surface and saline waters, domestic and industrial waste and solid samples.

A detailed description of the instrumentation, calibration, run parameters and quality control procedures is included in this SOP. For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

1.2 Summary of Method

1.2.1 Cyanide is distilled from water samples for 90 minutes. The distillate is reacted with a pyridine/barbituric acid solution, in the presence of Chloramine T to give a pink/red colored complex with an absorbance measured at 575nm. Analysis is performed according to the procedures detailed in the Kone analyzer SOP and is based on Standard Methods 4500-CN E.

## 2.0 Safety Precautions

2.1 Waste materials submitted for analyses may contain hazardous components. Uncharacterized waste samples should be handled in a manner that minimizes exposure and personal contact. Analysis should be performed in a fume hood.

2.2 Cyanide is an established toxic substance and other chemicals used should be regarded as a potential health risk. Sample preparation and analysis is performed in a manner designed to minimize exposure using routine good laboratory practices.

## 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with RTI Laboratories, Inc. Standard Operating Procedure for Sample Receipt and Custody (SRC001-A). Appropriate U. S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed.

3.1.1 Samples are collected in pre-preserved (with sodium hydroxide) clean 250 – 1000 ml plastic bottles and maintained on ice at 4 degrees C following collection. Samples requiring analysis for amenable cyanide are collected in amber bottles and preserved the same as the total cyanide.

3.1.2 Soil, sludge and solid samples are collected in pre cleaned wide mouth glass jars and stored at 4 degree C.

3.1.3 Sample volume minimum requirements: 50 ml, aqueous – 10 g, solids.

3.1.4 Maximum sample holding time is 14 days.

## 4.0 MDL, LOD, LOQ, Linear Range, Accuracy and Precision

4.1 The method detection limit (MDL) is statistically defined at the 99% confidence level according to 40 CFR Part 136 App. B. Seven replicates containing all of the analytes of interest at a concentration level of 1-5 times the estimated D.L. are analyzed and the standard deviation is calculated. The Student's T Value for the 7 replicates (3.143) is multiplied by the standard deviation of the analyte to calculate the MDL. MDLs are performed on instrument set up and following significant changes to the instrument, method or personnel. MDLs are kept on file in the Laboratory. MDLs and reporting limits are incorporated into the applicable test code in the Omega LIMS.

4.2 The LOD (limit of detection) is determined by spiking reagent water at 1-4 times the MDL and prepared using the same procedure as samples. Analytes must be present at levels 3 times or greater than the blank response (greater than 3 times the signal to noise ratio). The concentration used is the LOD for that analyte. LOD determinations must be performed quarterly.

4.3 The LOQ (limit of quantification) is determined by spiking reagent water at the reporting limit (RL/CRQL) and prepared in the same manner as samples. Analyte recovery must be within 20% of the expected concentration. The concentration used and successfully recovered is the LOQ for that analyte. LOQ determinations must be performed quarterly.

4.4 Initially accuracy and precision at the LOQ is determined by spiking 4 aliquots of reagent water at the reporting limit (RL/CRQL) and prepared using the same procedure used for samples. The average recovery must be within 20% of the expected value and the %RSD must be less than 15%.

4.5 LOD/LOQ determinations that do not meet the specifications above require repeat analysis, adjustment to the spiking levels and/or reporting limits, repeating the MDL determination at adjusted concentrations if required and repeat LOD/LOQ determinations.

4.6 The accuracy and precision for this method are determined by analyzing four aliquots from a Laboratory Control Sample containing the element(s) of interest at the mid-level of the calibration range. Percent recovery, standard deviation, and the relative standard deviation are calculated for each analyte and documents are kept on file in the laboratory.

4.7 Reporting Limit = 0.01 mg/L, aqueous – 1 mg/Kg, solids. The linear range for the procedure is 0.01 – 0.5 mg/L.

## 5.0 Interferences

5.1 Known interferences are aldehydes, nitrate-nitrite, oxidizing agents such as chlorine, thiosulfate, and sulfide. Chlorine decomposes most of the cyanide. To eliminate the chlorine treat the sample with sodium thiosulfate, use only 0.1 gram per 100mL of sample.

5.2 Nitrate and nitrite present in sample will results in a positive interference. To remove nitrate-nitrite 2 grams of sulfamic acid in added per 50mL of sample.

5.3 Sulfides will interfere with the analytical procedure and can be remove by the addition of lead carbonate.

## 6.0 Apparatus and Materials

6.1 Midi-Stil Cyanide distillation unit

6.2 Cyanide glassware

6.3 Konelab Analyzer.

6.4 Volumetric Flasks, 100mL; 250mL; 500mL; and 1 Liter – Class A.

6.5 Borosilicate Glass Boiling Beads - WR 26396-630

6.6 50 mL plastic centrifuge tubes.

6.7 Vacuum Pump

6.8 Disposable cups - Gordon Food Service

6.9 Potassium Iodide-starch test paper. Lead Acetate test paper.

6.10 Stir plate

## 7.0 Reagents

7.1 Sodium Hydroxide

7.2 Cyanide Primary and Second Source Standard 1000 mg/L (two different vendors). Prepare a 50mg/L working solutions by diluting 2.5 ml of the standard to 50 ml DI water. Prepared fresh each use.

7.3 Sodium thiosulfate

7.4 Pyridine

7.5 Barbituric acid

7.6 Chloramine-T

7.7 Chloramine-T solution – (1.0g chloramine-T in 100 ml DI water). Commercially obtained. Prepare weekly and store refrigerated.

7.8 Pyridine Barbituric acid solution – (6.0g barbituric acid, 30 ml pyridine, 6mL concentrated HCl diluted to 100 ml with water). Store at 4 deg. C in dark. Discard after 1 week.

7.9 Sodium dihydrogenphosphate 13.8g of NaH2PO4.H2O in 100 ml DI water. Store refrigerated.

7.10 Sulfuric Acid - VWR JT9673-33

7.11 Magnesium chloride Solution 51% - Commercially obtained. Store at 4 deg. C.

7.12 Reagent Grade DI water.

7.13 10N NaOH solution: Dissolve 400g of NaOH in 1 Liter of DI water, caution, solution will be very hot, do not handle until cooled.

7.14 1.25N NaOH solution: 125 ml of 10N NaOH in 1 Liter of DI water.

7.15 0.25N NaOH solution: 10g of NaOH in 1 Liter of DI water – make fresh each use.

7.16 Sulfuric Acid Solution (1:1) In 500 ml volumetric flask, add 250 ml of concentrated Sulfuric acid to 250 ml of DI water, stir until cool make fresh each use.

7.17 Calcium hypochlorite (0.35M) 5g calcium hypochlorite in 100 ml DI water.

7.18 Sulfamic acid (0.4N) dissolve 4g in 1L water

7.19 Ascorbic acid

7.20 Acetic acid buffer, pH 4.0: Dissolve 243 g of sodium acetate in 400 ml DI water, add 480 g concentrated acetic acid and dilute to 1 liter final volume with DI water.

7.21 All reagents and standards prepared must be logged in the appropriate standards/reagents log labeled with a minimum:

7.21.1 Identity of the material
7.21.2 Concentration of the solution
7.21.3 Date prepared
7.21.4 Initials of analyst preparing the solution
7.21.5 Expiration date.

## 8.0 Preparation of Standards and Calibration Procedure

8.1 The correlation coefficient of the calibration curve must be >0.995 to continue with the analysis of samples. If this criterion is not met the calibration standards must be re-analyzed or new standards prepared and analyzed until an acceptable cc is obtained.

8.1.1 From the 50-mg/L working standard (Sec. 7.2), pipette 0.5 ml into a 50 ml volumetric flask and dilute to volume. The concentration of this standard is 0.5 mg/L. Program the instrument to prepare calibration standards at 0.5, 0.25, 0.1, 0.05, 0.025, 0.02 and 0.1.

8.2 A continuing calibration verification standard is prepared with each batch of samples. From the 50-mg/L working standard (Sec. 7.2), pipette 0.25 ml into a 50 ml volumetric flask and dilute to volume. The concentration of this standard is 0.25 mg/L. Process the CCV with the samples according to the procedure in Sec. 9.

8.2.1 The CCV is analyzed following calibration, at the beginning of each analytical sequence for continuing calibration verification, after every 10 samples and at the end of the analytical sequence.

8.2.2 The percent recovery for each CCV must be within 90-110%. Samples that are not bracketed by acceptable CCVs must be re-analyzed.

8.3 Reporting limit verification standard (CRQL) is prepared with each batch of samples. From the 0.5 mg/L working standard (Sec. 7.2), pipette 100 µL into a 50 ml volumetric flask and dilute to volume. The concentration of this standard is 0.01 mg/L. Process the CRQL with the samples according to the procedure in Sec. 9.

8.3.1 The CRQL is analyzed at the beginning and end of each analytical sequence.

8.3.2 The percent recovery for each CRQL must be within 80-120%.

8.4 Prepare a laboratory control sample (LCS) for each batch of twenty or less samples by adding 0.1 ml of the second source working standard solution (Section 7.2) to 50 ml DI water. Expected concentration is 0.1 mg/L.

## 9.0 Sample Preparation-Distillation

9.1 Allow samples to warm to room temperature.

9.2 Test all samples with starch iodide paper to determine if chlorine is present. If the paper turns blue add ascorbic acid until the paper no longer turns.

9.3 Test all samples for sulfide content by placing a drop of sample on lead acetate paper moistened with acetic acid buffer solution (Sec. 7.20). Darkening of the paper indicates a positive result. Add lead acetate or lead carbonate to the sample and re-test. Repeat procedure until there is no darkening of the acidified lead acetate test paper.

9.4 For amenable cyanide all steps through the treatment are done under cover to avoid the exposure of the sample to fluorescent or sunlight. To one aliquot of the sample in a beaker with stirring, add hypochlorite (7.14) drop wise until an excess of chlorine is indicated using starch iodide paper. Stir the sample continuously for one hour, maintaining the pH between 11 and 12 using sodium hydroxide (7.12). After 1 hour, add sodium thiosulfate until the KI-starch indicator paper indicates the no residual chlorine remains. Distill both the treated and an untreated aliquot.

9.5 Prepare samples for distillation by adding 50mL or an aliquot diluted to 50mL for aqueous samples to the glass cyanide tube in the rear of the mini-still.

9.6 For soil/solid materials add 2.5 g of sample to the glass cyanide tube in the rear of the mini-still and then add 50mL of water.

9.7 Add a few glass-boiling beads to the tubes containing samples and quality control samples.

9.8 To the absorption tubes in the front of the mini-still, add 50mL of 0.25N NaOH.

9.9 For the CCV (0.25mg/L) add 0.25 mL of the second source standard (Section 7.2). For the LCS 0.1 mg/L) and MS/MSD (0.25mg/L) add 0.1mL and 0.25mL of the primary solution respectively.

9.10 Assemble glassware. First, attach the distillation heads to the sample tubes in the rear of the still. Next, attach the condensers to the distillation heads. Next, connect the absorption tube heads to the absorption tubes. Finally, connect the tubing that runs from the absorption tube heads to the vacuum and distillation heads. The top tube should connect to the distillation tube head and the lower tube connects to the vacuum source located at the front of the mini-still. Make sure all fittings are seated firmly before turning on the vacuum.

9.11 Turn on the vacuum and cooling water. The cooling water should be set at 1.3 ml/min using the meter located on the left of the mini-still. Adjust the airflow through each of the samples using the adjustment knobs on the front. The flow should be approximately the same through all. If it appears that the sample will foam out of the sample cylinder and into the collection cylinder, try lowering the airflow. Is the sample still foams over it is necessary to use a smaller aliquot of the sample.

9.12 Add 5 ml of sulfamic acid through the air intake tube.

9.13 Add 5 ml of 1:1 $H_2SO_4$ and 2 ml $MgCl_2$ to the air inlet tube.

9.14 Turn on unit and bring the sample to boiling and maintain that temperature for at least 60 min.

9.15 Discontinue heating but continue airflow for 15 min.

9.16 After the distillation is complete, let the samples cool to room temperature.

9.17 When cool the distillates are quantitatively transferred to a 50 ml plastic centrifuge tube or digestion tube and brought to a final volume of 50 ml with DI water.

## 10.0 Diagram/Table

10.1 Reserved.

## 11.0 Analytical Procedure

11.1 The KONE analyzer is turned on and the cyanide program is selected. Samples are added to the sample cups and loaded into the racks. The first spot in the racks must have the CCV followed by the method blank, LCS and the samples with required MS/MSD. The KONE analyzer will run the CCV after each ten analysis and at the end of the batch. This program allows for the automatic addition and mixing of reagents, incubation and analysis of the sample.

11.2 Daily Start Up.

11.2.1 Fill the reagent water jug located in the lower purple drawer of the Konelab analyzer with DI water, being careful not to introduce any contamination to the jug or the nozzle that goes into the jug.

11.2.2 Replace the reagent water jug.

11.2.3 Discard the used cuvettes located in the top purple drawer of the Konelab analyzer.

11.2.4 Replace the discarded cuvette holder, being careful to position it correctly.

11.2.5 Turn on computer before the Konelab instrument.

11.2.6 After the Konelab software starts, turn on the Konelab unit at the rear right of the unit.

11.2.7 After the software connects the Konelab analyzer to the computer, a message should appear in yellow to the top left of the screen stating, “startup needed.”

11.2.8 To perform startup press the button on the lower left of the screen labeled ”Startup (f1)”.

11.3 Calibration.

11.3.1 Load calibration standards (see Loading Sample Segments section of this document).

11.3.2 From the main menu, select” Calibr./QC Selection (F6)”.

11.3.3 From the next screen, select the method or test you wish to calibrate by left clicking on the method name so that the name is highlighted.

11.3.4 Select, “Calibrate (F1)”.

11.3.5 Return to the main menu. To start the analysis press the green button on the keyboard where the “page up” button would normally be.

11.3.6 When the calibration is complete a message will appear

11.4 Loading Sample Segments.

11.4.1 From the main menu, select “Samples” from the top of the screen.

11.4.2 From the bottom of the screen, select “More (F8)”, this will give you the next page of menu options.

11.4.3 From the bottom of the screen, select “Sample Segment (F5)”.

11.4.4 The screen will now show 14 spaces (in the order and spacing of a sample segment).

11.4.5 Choose the correct sample segment from the menu at the top left of the screen. It is important that correct one is used because the segments have a bar coding that the instrument uses to distinguish the individual segments. The segments above the dashed line are in the instrument; those below are not in the instrument.

11.4.6 For a calibration standard or a CCV standard, use down arrow to the left of each sample location, the named standard to use will appear in a dropdown menu. The standards above the dashed line are for calibration curves; the standards below the dashed lines are control standard (CCV).

For CCV standards use a 13mm x 100mm glass test tube because each method has a CCV standard analyzed every 10 samples and a 2ml sample cup will not be enough for an average batch of samples. Also for the 13mm x 100mm glass test tubes, a sharpie marker must be used to darken the area on the test tube near the bar code on the segment so that the instrument reads the size of the test tube correctly.

11.4.7 After typing a sample name into the correct position on the segment press enter or tab to advance to the next position.

11.4.8 After naming and correctly filling the sample cups in the segment, the samples must have an analysis request assigned. To assign a request, use the mouse and left click on the first sample (not std), this will take you to another screen.

11.4.9 Notice the information in the grey area in the middle of the screen. The segment number is there, samples 1 to 14 are also there with little orange test tubes for each position that was given a sample name.

11.4.10 Left click the mouse on the first sample position and then left click on the test requested on the right window. The request should now appear on the left window with the samples name appearing at the top in a white box. It is very important to take the time and ensure the correct test is selected. IF THE WRONG TEST IS CHOSEN AND THE REAGENT VIALS FOR THE INCORRECT TEST ARE CLOSED THE SAMPLE PROBE NEEDLE COULD BREAK AND REQUIRE AN EXTENSIVE REPAIR.

11.4.11 At the bottom of this screen choose “insert segment (F2)”.

11.4.12 Follow the instructions on screen.

11.4.13 Go to the main menu by choosing main from the top right of the screen.

11.4.14 Then back to the main menu, to start the analysis press the green button on the keyboard where the “page up” button would normally be.

11.5 Loading Reagents.

11.5.1 Place the reagent tray in the reagent loading rack before starting analysis. Make sure tray is tight in the position on the rack.

11.5.2 Select method to be analyzed.

11.5.3 From the main menu, select “Reagent” from the top of the screen. Reagent box appears on the screen. This page shows all the reagents required for each method.

11.5.4 Uncap reagent vials for that particular method.

11.5.5 At the end of the day when analysis is complete all the reagents are stored in the refrigerator next to the walk in cooler.

11.6 Loading Cuvettes: Cuvettes should be loaded very carefully in the cuvette compartment (following the instructions on the cuvette wrapper). Note: Don't touch the cuvette with your fingers.

11.7 On completion of analysis, from main menu, select results. Print results.

11.8 Accept page.

11.9 From the main menu, select F4 from the bottom of the screen.

11.10 Select test.

11.11 Then click F2 for selected report or F3 for all reports.

11.12 Daily Shutdown.

11.12.1 From the main menu, select the button at the lower left labeled " standby (f2)".

11.12.2 The instrument will prompt you to insert the wash solution into the stat position labeled "wash". The wash solution is 4.5%NaOCl + NaOH <1%.

11.12.3 After completing the standby command, you will be prompted to remove the wash solution.

11.12.4 To close the Konelab software. From the main menu choose "more (f8)".

11.12.5 From the next list of menu items at the bottom of the screen choose " Management (f3)".

11.12.6 From the next list of menu items at the bottom of the screen choose " more (f8)"

11.12.7 From the next list of menu items at the bottom of the screen choose " exit (f3)". This will close the Konelab software.

11.12.8 From the Win NT desktop screen , press the" start" button and choose " shutdown" and choose shutdown and then pres ok.It is now all right to shut off the power to the Konelab analyzer at the rear of the analyzer.

## 11.13 Test Flow

### 11.13.1 Sample and dilution:

Volume(µL):100
Disp. with: Extra
Volume(µL): 20
Dilution with: Special dil. (0.25N NaOH)
Wash reagent: [None]
Raw sample disp. with: Extra
Volume(µL): 20
Special diluent: 0.25N NaOH
Diluent disp. with: Extra
Volume(µL): 20

### 11.13.2 Reagent

Reagent: CN Buffer (sodium dihydrogenphosphate)
Volume(µL): 30
Disp with: Extra
Volume(µL): 20
Wash reagent: [None]

### 11.13.3 Reagent

Reagent: CN Chlor T (Choramine T)
Volume(µL): 4
Disp. with: Extra
Volume(µL): 20
Wash reagent: [None]

### 11.13.4 Incubation

Time(sec.): 90

### 11.13.5 Endpoint

Blank
Resp. min (A): *
Resp. max (A): *

### 11.13.6 Reagent

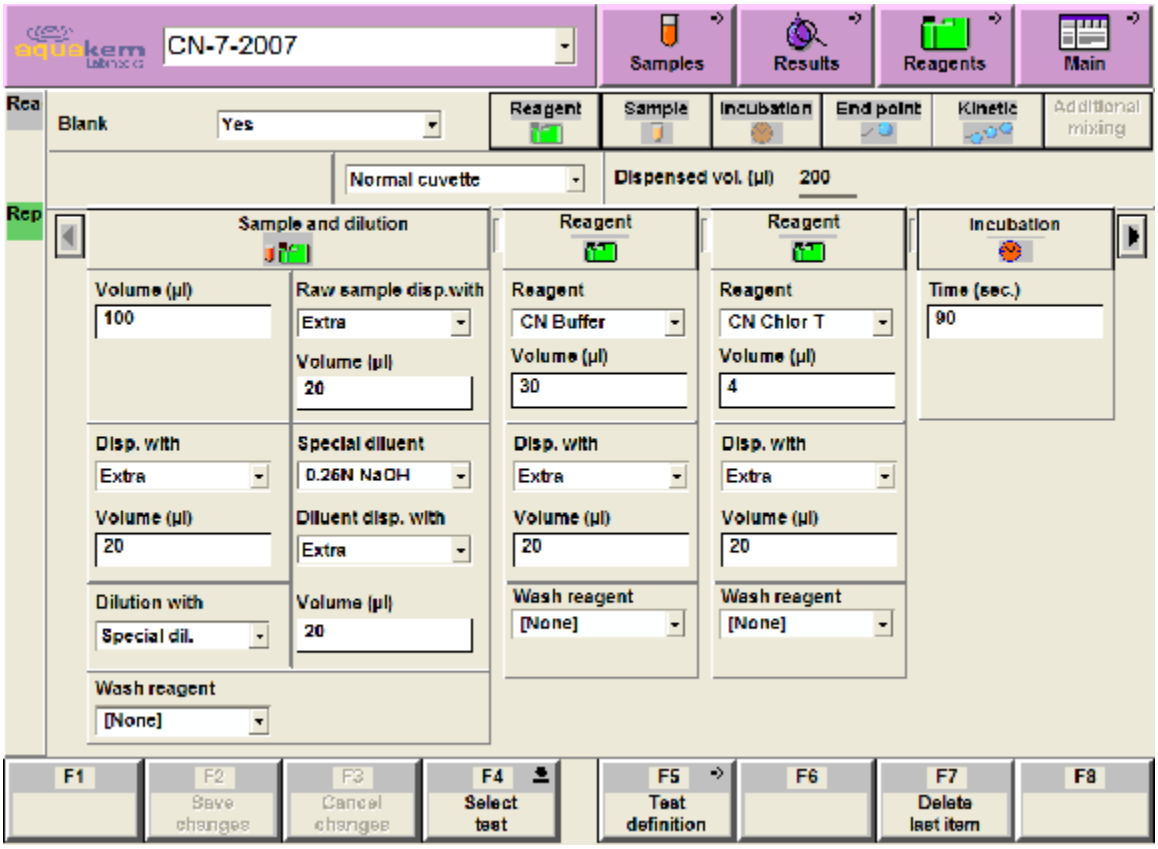
Reagent: CN Pyr Bar (Pyridine/barbituic acid solution)
Volume(µL): 10
Disp. with: Water
Volume(µL): 56
Wash reagent: [None]

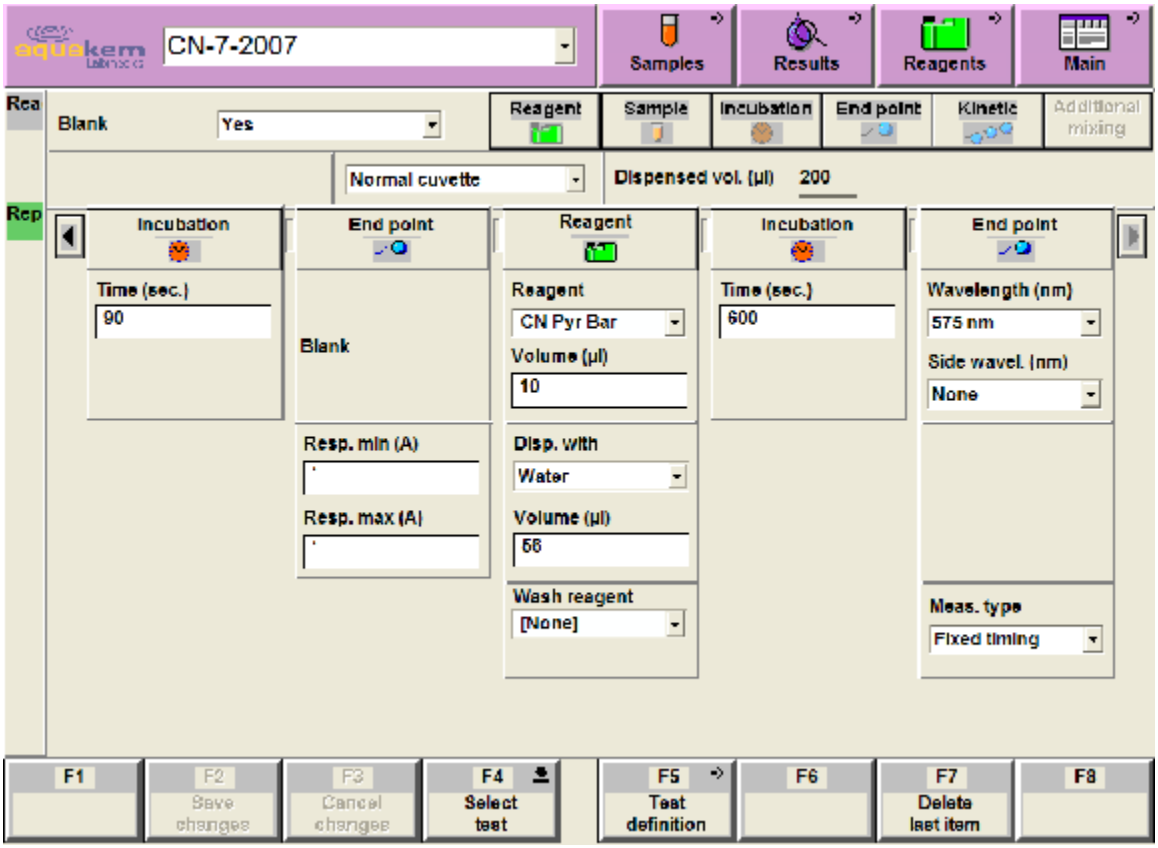
11.13.7 Incubation

Time(sec.): 600

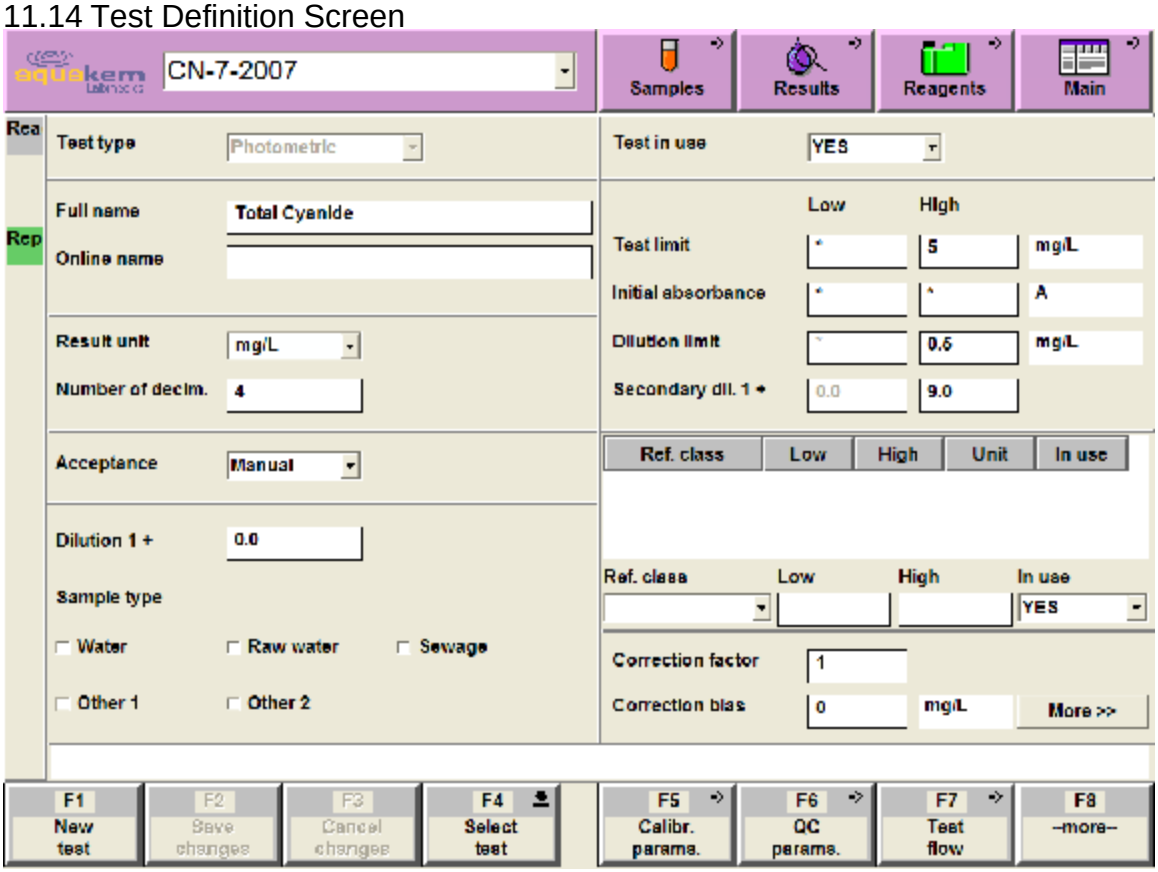
11.13.8 End point

Wavelength(nm): 540
Side wavel.(nm): None
Meas. Type: Fixed timing

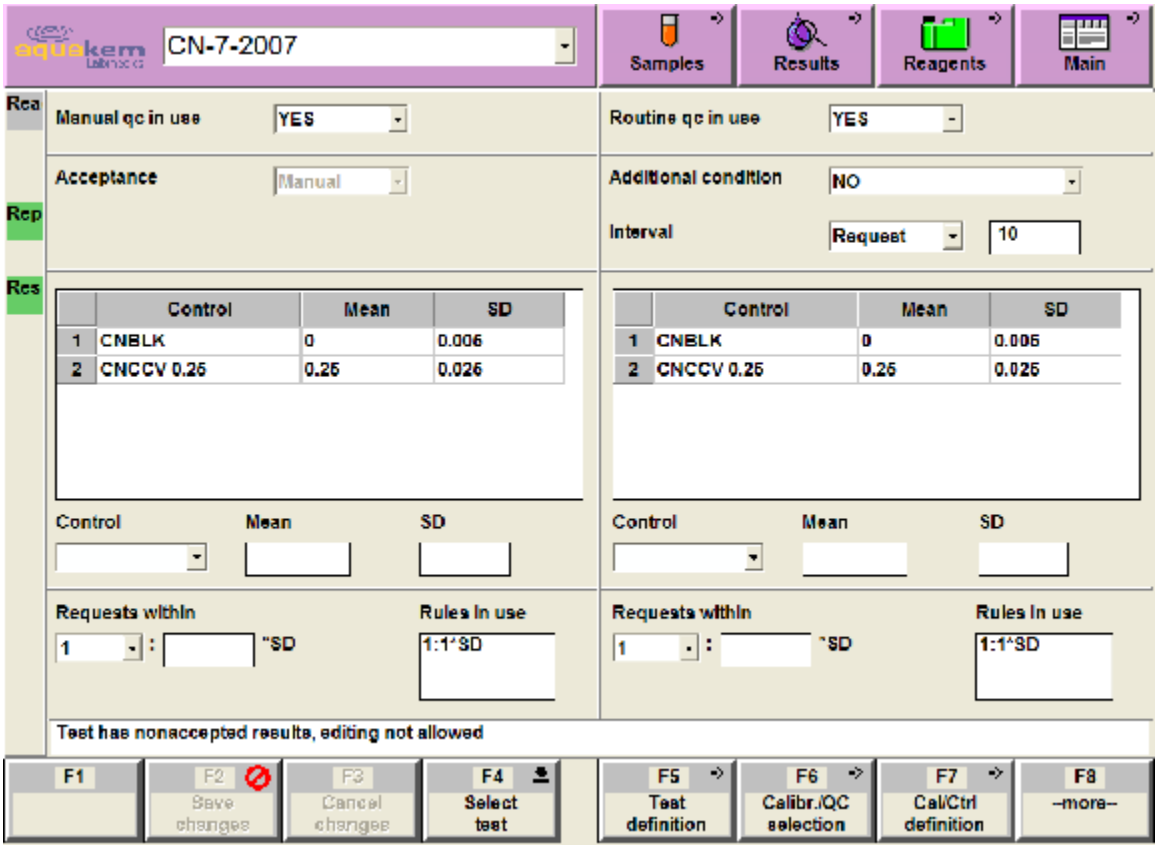




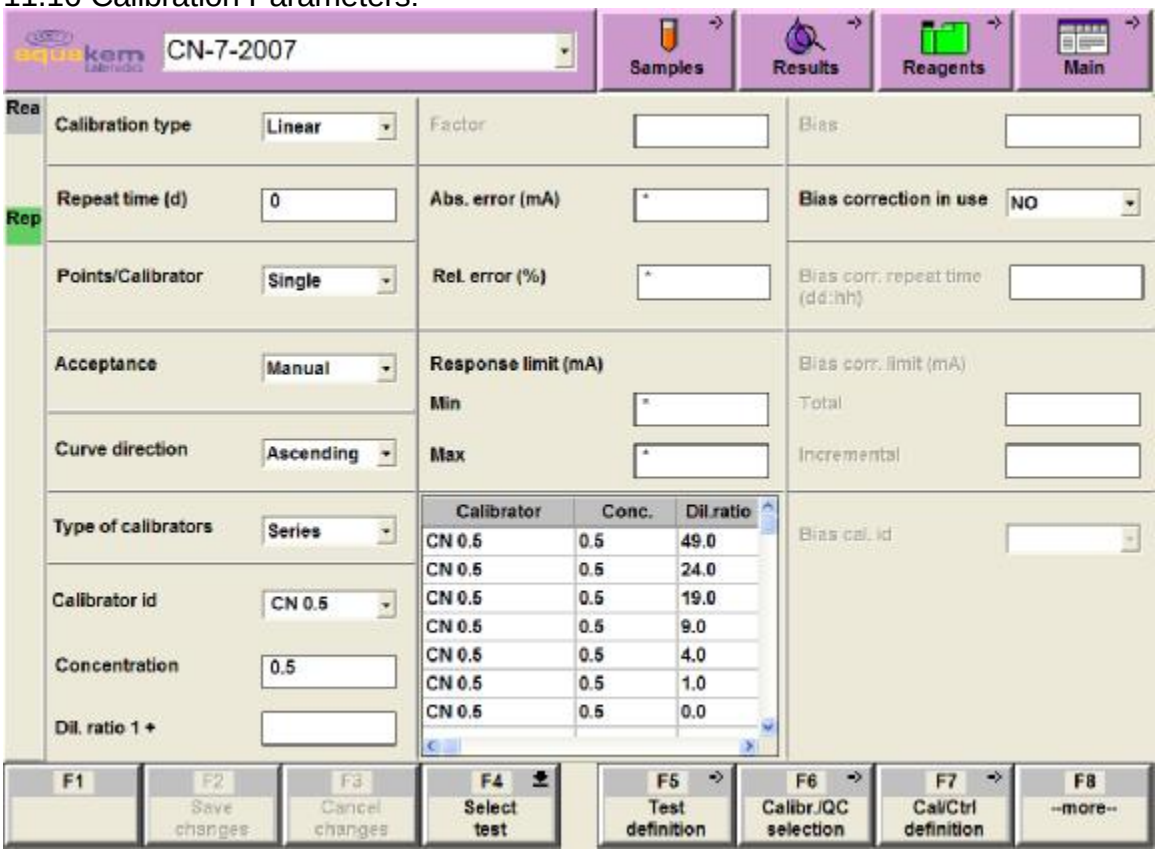

## 11.14 Test Definition Screen



## 11.15 QC Parameters:



11.16 Calibration Parameters:




## 12.0 Details of Calibration and Calculations

12.1 Final results are calculated as specified in section 14.

12.2 The CCV and CRQL standards must be analyzed at the frequency specified in Section 8 and the concentration must be within 10% or 20% respectively of the known value for confirmation of instrument calibration.

12.3 Continuing calibration standards are evaluated by:

% Recovery = actual conc./expected conc. * 100

12.4 Percent recovery - LCS

% Recovery = conc. recovered/conc. expected * 100

12.5 Relative Percent Difference – Duplicate samples

RPD = [result 1 - result 2]/average result1.result2) * 100

12.6 Initial Calibration Equation.

$y = mx + b$

y = sample absorbance
m = slope
x = sample concentration
b = intercept

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 Prepare a method blank for each batch of samples using DI water.

13.1.1 Acceptance Criteria: < **½ RL (LOQ)**

13.1.2 Corrective Action: Determine the source and eliminate (see interferences). Re-analyze samples as necessary.

13.2 Prepare a laboratory control sample (LCS) for each batch of twenty or less samples by adding 0.1 ml of the second source working standard solution (Section 7.2) to 50 ml DI water. Expected concentration is 0.1 mg/L.

13.2.1 Acceptance Criteria: **80 - 120 % Rec. –Method 4500 CN-E.**
**83 – 116 % Rec. – Method 9012 water (QSM)**
**76 – 120 % Rec. – Method 9012 soil (QSM**

13.2.2 Corrective Action: For results outside of acceptance limits determine source of the problem. Re-analyze LCS and samples.

13.3 Prepare a matrix spike (MS) and matrix spike duplicate (MSD) for each batch of twenty or less samples by adding 0.1 ml of the working standard (Section 7.2) to 50 ml final volume of a representative sample. The expected concentration is 0.1 mg/L.

13.3.1 Acceptance Criteria: **Percent recovery acceptance ranges are set to LCS limits.**

13.3.2 Corrective Action: For results outside of lab established control limits attempt to determine source of the problem (matrix interferences/poor injection/instrument problems). Re-analyze and/or flag data.

13.4 Duplicate Sample (DUP) – Optionally prepared with each batch of samples in place of or in addition to the MSD (required if no MSD is prepared)

13.4.1 Acceptance Criteria (RPD) **<20 %** or within laboratory established statistical control limits.

13.4.2 Corrective Action: Evaluate sample homogeneity and flag data if necessary.

## 14.0 Data Reporting Requirements

14.1 Sample results are reported as mg/L (aqueous samples) and mg/kg (solid samples).

14.2 Raw results are entered into Omega. Prep factors are automatically imported from sample prep logs. Dilutions are entered in the analytical sequence.

14.3 Sample results are reported as mg/kg for soil as dry weight.

mg/kg dry wt. = mg/kg wet wt.*100/percent solids

14.4 Raw instruments results are entered directly into the Omega LIMS system using excel spreadsheets, direct instrument interface or manually. All calculations to derive final result (including dry weight conversions) are performed automatically by the LIMS. Sample preparation information and percent moisture results are entered into the appropriate section of the LIMS prior to instrument data and are automatically factored into the final results.

14.5 Confirm that there are no QC flags or qualifiers in this sequence. If present, investigate and repeat or reanalyze as necessary. See section 9.2 of the QAP for more detail on qualifiers.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 Maintain distillation apparatus and all glassware in clean condition.

15.2 Refer to the Kone Analyzer for instrument maintenance procedures.

## 16.0 Waste Management and Pollution Prevention

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner that minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Acidic materials (pH<2) are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Soil samples are composited in a drum designated for incineration.

16.2.3 Disposal of materials is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 Standard Methods for the Examination of Water and Wastewater, On-line 4500-CN C&E.

17.2 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, Nov 1986, Revision 2 December 1996. Method 9012, 9010B.

17.3 RTI Laboratories, Inc. Quality Assurance Plan.

17.4 RTI Laboratories, Inc. SOP SRC001-A, Sample Receipt and Custody.

17.5 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.6 RTI Laboratories, Inc. Employee Handbook.

RTI Laboratories, Inc.
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# STANDARD OPERATING PROCEDURE

# ANALYSIS OF ELEMENTS BY INDUCTIVELY COUPLED PLASMA - OPTICAL EMISSION SPECTROMETRY (ICP-OES)

| | |
|---|---|
| **Analyte:** | **Elements** |
| **SOP#:** | **6010C_100713_R3.2** |
| **Method Reference:** | **SW 6010C, EPA 200.7** |
| **Issue Date:** | **November 8, 2012** |
| **Revision:** | **3.2** |
| **Revision Date:** | **August 11, 2014** |

**Reviewed and Approved: August 11, 2014**

Director, Quality Management: Charles O'Bryan

Director, Environmental Services: Yemane Yohannes

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**ANALYSIS OF ELEMENTS BY INDUCTIVELY COUPLED PLASMA-OPTICAL EMISSION SPECTROMETRY (ICP-OES)**

**SOP#: 6010C_100713_R3.2**

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# 1.0 Scope and Application

## 1.1 Introduction

1.1.1 This Standard Operating Procedure details the analysis of samples according to the U. S. EPA Methods 6010 and 200.7 for the elements listed in the associated Omega LIMS test code using inductively coupled plasma (ICP/OES).

1.1.2 This method applies to aqueous samples, soil/solid samples, industrial wastes and extracts.

1.1.3 Acid digestion and filtration are required prior to analysis of these samples. Analyses for dissolved metals may only require filtration.

1.1.4 Maintenance for the ICP-OES instruments can be found in the ICP-OES Optima 8300 Hardware Manuals provided with the instrument.

1.1.5 Detailed instructions on the ICP – WinLab32 software can be found in the instrument Software Manuals.

1.1.6 For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

## 1.2 Summary of Method

1.2.1. The analysis described in this method involves multi-elemental determinations by ICP-OES using sequential or simultaneous optical systems and axial or radial viewing of the plasma. The instrument measures characteristic emission spectra by optical spectrometry. Samples are nebulized and the resulting aerosol is transported to the plasma torch. Element specific emission spectra are produced by radio frequency inductively coupled plasma. The spectra are dispersed by a grating spectrometer, and the intensities of the line spectra are monitored at specific wavelengths by a photosensitive device. Photocurrents from the photosensitive device are processed and controlled by a computer system. A background correction technique is required to compensate for variable background contribution to the determination of the analytes. Background must be measured adjacent to the analyte wavelength during analysis. Various interferences must be considered and addressed appropriately.

1.2.2. Samples are prepared according to the matrix by applicable preparation procedures according to the associated SOP. Samples for dissolved metals do not require additional sample preparation procedures prior to analysis.

## 2.0 Safety Precautions

2.1 Acids used in the digestion procedure are corrosive. All digestions are performed in a fume hood designated for use with mineral acids. Proper safety equipment (gloves, lab coats, etc.) is worn when handling concentrated acids. Many elements are toxic and should be handled with care.

2.2 Good laboratory technique and safety practices should be used at all times to reduce the risks associated with chemicals and potential hazards.

2.3 The ICP/OES instrument is fully interlocked for safety purposes. Never attempt to disable these interlocks.

2.4 Spilled samples must be cleaned up immediately when they come in contact with the instrument. Neutralize all acid spills with sodium bicarbonate.

## 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with RTI Laboratory's Standard Operating Procedure for Sample Log-in (SOP: SRC001-A). Appropriate U. S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed.

3.1.1 Soil, sludge and solid samples are collected in pre cleaned wide mouth glass jars.

3.1.2 Aqueous samples are collected in pre cleaned plastic bottles preserved with approximately 2.0 ml of 1:1 high purity nitric acid:DI water. The pH of the sample is checked on receipt and prior to sample preparation for the presence of adequate preservative. The pH of preserved samples should be < 2. Preserved samples received at pH>2 or at sample preparation are at pH>2 are adjusted to pH<2 with additional acid and held for a minimum of 16 hours until verified to be pH<2.

3.1.3 Maximum sample holding time is six (6) months.

3.1.4 Samples received for filtration in the laboratory or samples that have been filtered prior to receipt must be preserved and held for 24 hours prior to commencing the sample preparation procedure. Laboratory filtration is performed by filtering a portion of the sample sufficient for analysis through a 0.45-µm filter. The pH is checked prior to analysis and if required the procedure in Sec. 3.1.2 is followed.

## 4.0 MDL, LOD, LOQ, Linear Range, Accuracy and Precision

4.1 The method detection limit (MDL) is statistically defined at the 99% confidence level according to 40 CFR Part 136 App. B. Seven replicates containing all of the analytes of interest at a concentration level of 1-5 times the estimated D.L. are analyzed and the standard deviation is calculated. The Student's T Value for the 7 replicates (3.143) is multiplied by the standard deviation of the analyte to calculate the MDL. MDLs are performed on instrument set up and following significant changes to the instrument, method or personnel. MDLs are kept on file in the Laboratory. MDLs and reporting limits are incorporated into the applicable test code in the Omega LIMS.

4.2 The LOD (limit of detection) is determined by spiking reagent water at 1-4 times the MDL and prepared using the same procedure as samples. Analytes must be present at levels 3 times or greater than the blank response (greater than 3 times the signal to noise ratio). The concentration used is the LOD for that analyte. LOD determinations must be performed quarterly.

4.3 The LOQ (limit of quantification) is determined by spiking reagent water at the reporting limit (RL/CRQL) and prepared in the same manner as samples. Analyte recovery must be within 20% of the expected concentration. The concentration used and successfully recovered is the LOQ for that analyte. LOQ determinations must be performed quarterly.

4.4 Initially accuracy and precision at the LOQ is determined by spiking 4 aliquots of reagent water at the reporting limit (RL/CRQL) and prepared using the same procedure used for samples. The average recovery must be within 20% of the expected value and the %RSD must be less than 15%.

4.5 LOD/LOQ determinations that do not meet the specifications above require repeat analysis, adjustment to the spiking levels and/or reporting limits, repeating the MDL determination at adjusted concentrations if required and repeat LOD/LOQ determinations.

4.6 The linear range for this method is element specific. Linear ranges are addressed in Section 13. If a sample falls above the linear range or highest calibration standard dilutions of the sample digestate must be made until the concentration falls within the established calibration range.

4.7 The accuracy and precision for this method are determined by analyzing four aliquots from a Laboratory Control Sample containing the element(s) of interest at the mid-level of the calibration range. Percent recovery, standard deviation, and the relative standard deviation are calculated for each analyte. Quality control limits, mean recovery values and RPD results are incorporated in the Omega LIMS.

## 5.0 Interferences

5.1. Spectral interferences encountered in ICP-OES falls into four different categories, each with its own causes and remedies:

5.1.1 A shift in background that is essentially constant over a given range. The background may shift either up or down. This can be caused by a high concentration of an interfering analyte that may emit a continuum radiation in the given wavelength range. There are two remedies: set a background correction point somewhere near, but not falling on, the profile of the analyte being measured, or select a different wavelength that is not affected by the interference. Background correction is accomplished through programmed one or two point stops around each wavelength. Under normal operations, these background filters are not adjusted. The analyst may adjust these filters in samples by overlaying the samples and standards and manually adjusting the plus, minus or both wavelength filters for samples that exhibit conflicting spectra. Any adjustments to the standard background correction will be noted for QA review.

5.1.2 A shift that occurs on only one side of the given wavelength range. This can be caused by: i) an overlapping of an analyte line by one wing of another severely broadened line nearby, or ii) a molecular emission bands that are sometimes present in the ICP discharge, especially when the plasma is not shielded from the ambient atmosphere. Since the slope of the interference is constant on either side of the peak, set two background correction points, one on either side of the peak of the analyte being measured.

5.1.3 Ideally no interfering emission line can fall directly on the analyte emission line; however, because spectral lines have a finite width and measurement systems are imperfect, direct spectral overlap does occur. Two lines may appear to be overlapped when they cannot be resolved by the spectrometer. There are two remedies: use an alternate wavelength for the analyte being measured, if available, or use the Interelement Correction (IEC) technique (refer to Sec. 13).

5.1.4 Complex Background Shift is represented by a shift in background intensity that varies significantly on either side of the analyte line. This interference is usually caused by the occurrence of a number of intense, closely spaced emission lines nearby, and perhaps directly overlapping, the analyte wavelength. There are two remedies: use an alternate wavelength for the analyte being measured, if available, or use the Multispectral component Fitting (MSF) technique.

5.2 Reagents, glassware and other sample preparation equipment may contain artifacts that will interfere with the analysis. Method blanks are routinely analyzed to demonstrate that materials are free from contamination. Sample bottles and reagents are assayed prior to use for suitability. Glass containers cannot be used for analyses requiring determination of Boron or Silicon.

5.3 Carryover can occur when a high concentration sample is analyzed. Additional rinse time may be required when encountering an elevated concentration sample to eliminate potential memory affects.

5.4 Physical interferences associated with dissolved solids content or matrix viscosity can cause suppression or enhancement of the signal. Dilution of the sample will usually eliminate the physical interference problem

## 6.0 Apparatus and Materials

6.1 ICPOES - Perkin-Elmer ICPOES Optima 8300, Cetac ASX-520 auto sampler with HP computer system (Windows 7) and WinLab 32 software – Version 5.2.0.0612.

6.2 ICPOES: Peristaltic pump tubing black/black - 0.76mm id, yellow/orange – 0.51 mm id, red/red – 1.14mm id.

6.3 Calibrated mechanical pipettes with metal free plastic pipette tips 10 – 100 µl, 100 – 1000 µl, 500 – 5000 µl, 1 – 10 ml.

6.4 50 ml plastic auto sample tubes with plastic caps and auto sample cultures plastic tubes for samples.

6.5 Beakers – various sizes.

6.6 Volumetric flasks, Class A – various volumes.

6.7 Filter Mate Filtration Devices from Environmental Express.

## 7.0 Reagents

7.1 High purity reagents, acid and water must be used at all times. Trace metals grade acids are required for this method.

7.2 5% (vol/vol) hydrochloric acid + 2% (vol/vol) nitric acid. Prepared by adding 1L of hydrochloric acid + 400 mL nitric acid to a 20 L container. Expiration date for this solution is 3 month.

7.3 Single element standards - ICP grade, 1000 ug/mL: Stock Calibration Standards Ag, Al, As, B, Ba, Be, Ca, Cd, Co, Cr, Cu, Fe, Pb, Li, Mg, Mn, Mo, Ni, K, Na, Sb, Se, Si, Sn, Sr, Ti, Tl, V, Zn.

7.4 Second Source Standard – Multi-element, Absolute Standards: 50 ug/ml Ag, As, Be, Cd, Co, Li, Mo, Sb, Se, Sn, Sr, Ti, Tl, V and B – 250 ug/ml Al, Ba, Cr, Cu, Pb, Mn, Ni, Zn – 2500 ug/ml Ca, Fe, Mg, K, Na in 5% Nitric acid/2% Hydrochloric acid.

7.5 Calibration Intermediary Stock Standards:

7.5.1 1 ppm for Ag, Be, Cd, Co, Li, Mo, Sb, Ti, V - 50 ul of 1000 ug/mL in 50 mL 5% hydrochloric acid/2% nitric acid.
7.5.2 10 ppm for As, Tl, Se, Si, Sn, Sr - 500 ul of 1000 ug/mL in 50 mL 5% hydrochloric acid/2% nitric acid.
7.5.3 20 ppm for Ba, Cr, Cu, Pb, Mn, Ni, Zn - 1mL of 1000 ug/mL in 50 mL 5% hydrochloric acid/2% nitric acid.
7.5.4 100 ppm for Al, B, Ca, Fe, Mg, K, Na - 5mL of 1000 ug/mL in 50 mL 5% hydrochloric acid/2% nitric acid.

7.6 Calibration Standards: Prepare fresh daily.

7.6.1 Calibration Standard 1/CRQL:

Made from Calibration Intermediary Stock Standard (7.5)

Dilute in 5% hydrochloric acid/ 2% nitric acid to the mark in a Class “A” 50 mL volumetric flask:

| Analyte | Std Conc. (µg/mL) | Add this amount (µL) | Final Vol. (mL) | STD1/ CRQL | Units |
|---|---|---|---|---|---|
| Aluminum | 100 | 50 | 50 | 100 | µg/L |
| Antimony | 1 | 1000 | 50 | 20 | µg/L |
| Arsenic | 10 | 200 | 50 | 40 | µg/L |
| Barium | 20 | 500 | 50 | 200 | µg/L |
| Beryllium | 1 | 250 | 50 | 5 | µg/L |
| Boron | 100 | 125 | 50 | 250 | µg/L |
| Cadmium | 1 | 250 | 50 | 5 | µg/L |
| Calcium | 100 | 500 | 50 | 1000 | µg/L |
| Chromium | 20 | 25 | 50 | 10 | µg/L |
| Cobalt | 1 | 1000 | 50 | 20 | µg/L |
| Copper | 20 | 250 | 50 | 100 | µg/L |
| Iron | 100 | 150 | 50 | 300 | µg/L |
| Lead | 20 | 250 | 50 | 100 | µg/L |
| Lithium | 1 | 500 | 50 | 10 | µg/L |
| Magnesium | 100 | 500 | 50 | 1000 | µg/L |
| Manganese | 20 | 50 | 50 | 20 | µg/L |
| Molybdenum | 1 | 500 | 50 | 10 | µg/L |
| Nickel | 20 | 250 | 50 | 100 | µg/L |

| | | | | | |
|---|---|---|---|---|---|
| Potassium | 100 | 200 | 50 | 400 | µg/L |
| Selenium | 10 | 200 | 50 | 40 | µg/L |
| Silicon | 10 | 200 | 50 | 40 | µg/L |
| Silver | 1 | 1000 | 50 | 20 | µg/L |
| Sodium | 100 | 500 | 50 | 1000 | µg/L |
| Strontium | 10 | 500 | 50 | 100 | µg/L |
| Thallium | 10 | 200 | 50 | 40 | µg/L |
| Tin | 10 | 200 | 50 | 40 | µg/L |
| Titanium | 1 | 500 | 50 | 10 | µg/L |
| Vanadium | 1 | 2500 | 50 | 50 | µg/L |
| Zinc | 20 | 250 | 50 | 100 | µg/L |

7.6.2 Calibration Standard 4: Prepared from single analyte standards (7.3). Dilute the following in 5% hydrochloric acid/ 2% nitric acid to the mark in a Class "A" 100 mL volumetric flask:

| Analyte | Std Conc. (µg/mL) | Add this amount (µL) | Final vol (mL) | STD4 | Units |
|---|---|---|---|---|---|
| Aluminum | 1000 | 500 | 100 | 5000 | µg/L |
| Antimony | 1000 | 100 | 100 | 1000 | µg/L |
| Arsenic | 1000 | 100 | 100 | 1000 | µg/L |
| Barium | 1000 | 500 | 100 | 5000 | µg/L |
| Beryllium | 1000 | 100 | 100 | 1000 | µg/L |
| Boron | 1000 | 100 | 100 | 1000 | µg/L |
| Cadmium | 1000 | 100 | 100 | 1000 | µg/L |
| Calcium | 1000 | 5000 | 100 | 50000 | µg/L |
| Chromium | 1000 | 500 | 100 | 5000 | µg/L |
| Cobalt | 1000 | 100 | 100 | 1000 | µg/L |
| Copper | 1000 | 500 | 100 | 5000 | µg/L |
| Iron | 1000 | 5000 | 100 | 50000 | µg/L |
| Lead | 1000 | 500 | 100 | 5000 | µg/L |
| Lithium | 1000 | 100 | 100 | 1000 | µg/L |
| Magnesium | 1000 | 5000 | 100 | 50000 | µg/L |
| Manganese | 1000 | 500 | 100 | 5000 | µg/L |
| Molybdenum | 1000 | 100 | 100 | 1000 | µg/L |
| Nickel | 1000 | 500 | 100 | 5000 | µg/L |
| Potassium | 1000 | 5000 | 100 | 50000 | µg/L |
| Selenium | 1000 | 100 | 100 | 1000 | µg/L |
| Silicon | 1000 | 100 | 100 | 1000 | µg/L |
| Silver | 1000 | 100 | 100 | 1000 | µg/L |
| Sodium | 1000 | 5000 | 100 | 50000 | µg/L |
| Strontium | 1000 | 100 | 100 | 1000 | µg/L |
| Thallium | 1000 | 100 | 100 | 1000 | µg/L |
| Tin | 1000 | 100 | 100 | 1000 | µg/L |
| Titanium | 1000 | 100 | 100 | 1000 | µg/L |
| Vanadium | 1000 | 100 | 100 | 1000 | µg/L |
| Zinc | 1000 | 500 | 100 | 5000 | µg/L |

7.6.3 Calibration Standard 3: Prepared from Standard 4 (7.6.2). Add 25mL to a 50 mL volumetric flask and dilute to the mark with 5% hydrochloric acid/ 2% nitric acid:

| Analyte | STD3 | Units | Analyte | STD3 | Units |
|---|---|---|---|---|---|
| Aluminum | 2500 | µg/L | Manganese | 2500 | µg/L |
| Antimony | 500 | µg/L | Molybdenum | 500 | µg/L |
| Arsenic | 500 | µg/L | Nickel | 2500 | µg/L |
| Barium | 2500 | µg/L | Potassium | 25000 | µg/L |
| Beryllium | 500 | µg/L | Selenium | 500 | µg/L |
| Boron | 2500 | µg/L | Silicon | 500 | µg/L |
| Cadmium | 500 | µg/L | Silver | 500 | µg/L |
| Calcium | 25000 | µg/L | Sodium | 25000 | µg/L |
| Chromium | 2500 | µg/L | Strontium | 500 | µg/L |
| Cobalt | 500 | µg/L | Thallium | 500 | µg/L |
| Copper | 2500 | µg/L | Tin | 500 | µg/L |
| Iron | 25000 | µg/L | Titanium | 500 | µg/L |
| Lead | 2500 | µg/L | Vanadium | 500 | µg/L |
| Lithium | 500 | µg/L | Zinc | 2500 | µg/L |
| Magnesium | 25000 | µg/L | | | |

7.6.4 Calibration Standard 2: Prepared from Standard 4 (7.6.2). Add 6.25mL to a 50 mL volumetric flask and dilute to the mark with 5% hydrochloric acid/ 2% nitric acid:

| Analyte | STD2 | Units | Analyte | STD2 | Units |
|---|---|---|---|---|---|
| Aluminum | 625 | µg/L | Manganese | 625 | µg/L |
| Antimony | 125 | µg/L | Molybdenum | 125 | µg/L |
| Arsenic | 125 | µg/L | Nickel | 625 | µg/L |
| Barium | 625 | µg/L | Potassium | 6250 | µg/L |
| Beryllium | 125 | µg/L | Selenium | 125 | µg/L |
| Boron | 625 | µg/L | Silicon | 125 | µg/L |
| Cadmium | 125 | µg/L | Silver | 125 | µg/L |
| Calcium | 6250 | µg/L | Sodium | 6250 | µg/L |
| Chromium | 625 | µg/L | Strontium | 125 | µg/L |
| Cobalt | 125 | µg/L | Thallium | 125 | µg/L |
| Copper | 625 | µg/L | Tin | 125 | µg/L |
| Iron | 6250 | µg/L | Titanium | 125 | µg/L |
| Lead | 625 | µg/L | Vanadium | 125 | µg/L |
| Lithium | 125 | µg/L | Zinc | 625 | µg/L |
| Magnesium | 6250 | µg/L | | | |

7.6.5 Calibration Blank: 5% hydrochloric acid/2% nitric acid in a 50 ml auto sampler tube.

7.7 Independent Calibration Verification (ICV) - This solution must be from a different source, different vendor than the calibration standards. ICV Standard must be prepared fresh daily.

7.7.1 Add 100 uL of the second source standard (Sec. 7.4)to a final volume of 100 ml in 5% hydrochloric acid+2% nitric acid in a Class “A” volumetric flask.

| Analyte | ICV | Units |
|---|---|---|
| Aluminum | 500 | µg/L |
| Antimony | 500 | µg/L |
| Arsenic | 500 | µg/L |
| Barium | 500 | µg/L |
| Beryllium | 500 | µg/L |
| Boron | 500 | µg/L |
| Cadmium | 500 | µg/L |
| Calcium | 500 | µg/L |
| Chromium | 500 | µg/L |
| Cobalt | 500 | µg/L |
| Copper | 500 | µg/L |
| Iron | 500 | µg/L |
| Lead | 500 | µg/L |
| Lithium | 500 | µg/L |
| Magnesium | 500 | µg/L |
| Manganese | 500 | µg/L |
| Molybdenum | 500 | µg/L |
| Nickel | 500 | µg/L |
| Potassium | 500 | µg/L |
| Selenium | 500 | µg/L |
| Silicon | 500 | µg/L |
| Silver | 500 | µg/L |
| Sodium | 500 | µg/L |
| Strontium | 500 | µg/L |
| Thallium | 500 | µg/L |
| Tin | 500 | µg/L |
| Titanium | 500 | µg/L |
| Vanadium | 500 | µg/L |
| Zinc | 500 | µg/L |

7.8 Continuing Calibration Standard - Prepared fresh daily.

Continuing Calibration Verification (CCV) standard: Prepared from single analyte standards (7.3). Dilute the following in 5% hydrochloric acid/ 2% nitric acid to the mark in a Class “A” 50 mL volumetric flask:

| Analyte | Std Conc. (µg/mL) | Add this amount (µL) | Final vol (mL) | CCV | Units |
|---|---|---|---|---|---|
| Aluminum | 1000 | 50 | 50 | 1000 | µg/L |
| Antimony | 1000 | 12.5 | 50 | 250 | µg/L |
| Arsenic | 1000 | 12.5 | 50 | 250 | µg/L |
| Barium | 1000 | 25 | 50 | 500 | µg/L |
| Beryllium | 1000 | 12.5 | 50 | 250 | µg/L |
| Boron | 1000 | 25 | 50 | 500 | µg/L |
| Cadmium | 1000 | 12.5 | 50 | 250 | µg/L |

| | | | | | |
|---|---|---|---|---|---|
| Calcium | 1000 | 100 | 50 | 2000 | µg/L |
| Chromium | 1000 | 12.5 | 50 | 250 | µg/L |
| Cobalt | 1000 | 12.5 | 50 | 250 | µg/L |
| Copper | 1000 | 12.5 | 50 | 250 | µg/L |
| Iron | 1000 | 50 | 50 | 1000 | µg/L |
| Lead | 1000 | 25 | 50 | 500 | µg/L |
| Lithium | 1000 | 12.5 | 50 | 250 | µg/L |
| Magnesium | 1000 | 100 | 50 | 2000 | µg/L |
| Manganese | 1000 | 12.5 | 50 | 250 | µg/L |
| Molybdenum | 1000 | 12.5 | 50 | 250 | µg/L |
| Nickel | 1000 | 12.5 | 50 | 250 | µg/L |
| Potassium | 1000 | 50 | 50 | 1000 | µg/L |
| Selenium | 1000 | 12.5 | 50 | 250 | µg/L |
| Silicon | 1000 | 12.5 | 50 | 250 | µg/L |
| Silver | 1000 | 12.5 | 50 | 250 | µg/L |
| Sodium | 1000 | 100 | 50 | 2000 | µg/L |
| Strontium | 1000 | 25 | 50 | 500 | µg/L |
| Thallium | 1000 | 12.5 | 50 | 250 | µg/L |
| Tin | 1000 | 12.5 | 50 | 250 | µg/L |
| Titanium | 1000 | 12.5 | 50 | 250 | µg/L |
| Vanadium | 1000 | 12.5 | 50 | 250 | µg/L |
| Zinc | 1000 | 12.5 | 50 | 250 | µg/L |

7.8 Interference check solutions (ICSA and ICSAB):

7.8.1 ICSA - Interference elements 50 ug/ml Al, Ca, Mg, Cr, Cu, Mn, Ni, Ti and V and 20 ug/ml Fe.

7.8.2 ICSAB – Elements in ICSA at same concentration (Sec. 7.9.1) - 0.5 ug/ml Sb, As, Be, B, Cd, Co, Mo, Se, Ag, Sr, Tl, Sn and Li - 1ug/ml Zn – 2.5 ug/ml Ba and Pb - 25 ug/ml K and Na.

7.9 Spiking Standards

7.9.1 AAC-STD-2: Custom standard from Inorganic Ventures, 1000µg/mL Ag, B, Se, Ti, Sb, Mo, Si, As and Sn.
7.9.2 AAC-STD-3A: Custom standard from Inorganic Ventures, 10,000µg/mL Ca, Fe, K, Mg and Na.
7.9.3 AAC-STD-4A: Custom standard from Inorganic Ventures, 1000µg/mL Ag, Ba, Be, Bi, Cd, Co, Cr, Cu, Mn, Ni, Pb, Sr, Th, Tl, V and Zn.

For each LCS soil sample, 25 µL of 7.9.1, 7.9.2 and 7.9.3 is used, with a final volume of 50 ml.

Each MS/MSD soil sample is spiked with 25 or 100 µL of each standard, with a final volume of 50 ml. 25 µL is used for samples that will not be diluted, and 100 µL is used for samples that will be diluted by a factor of 4.

For each LCS water sample, 12.5 µL of 7.9.1, 7.9.2 and 7.9.3, with a final volume of 25 ml.

Each MS/MSD water sample is spiked with 12.5 µL of each standard, with a final volume of 25 ml.

## 8.0 Preparation of Standards and Calibration Procedure

8.1 The ICP-OES must be calibrated before analysis with a blank and at least 1 standard. Sample concentrations above the highest standard require dilution until the result is within the calibration range or a high-level check standard is analyzed with concentrations exceeding the sample concentration. Percent recovery for the check standard must be within 10% of the expected value.

8.2 Standards are prepared as specified in section 7.

8.2.1 Multipoint initial calibration is performed daily:

| Analyte | STD1 | STD2 | STD3 | STD4 | STD5 | Units |
|---|---|---|---|---|---|---|
| Aluminum | 100 | 1000 | 5000 | | 10000 | µg/L |
| Antimony | 20 | 250 | 1000 | | | µg/L |
| Arsenic | 40 | 250 | 1000 | | | µg/L |
| Barium | 200 | 500 | 1000 | 5000 | 10000 | µg/L |
| Beryllium | 5 | 250 | 1000 | | | µg/L |
| Boron | 250 | 500 | 1000 | | | µg/L |
| Cadmium | 5 | 250 | 1000 | | | µg/L |
| Calcium | 1000 | 2000 | 5000 | 50000 | 100000 | µg/L |
| Chromium | 10 | 250 | 1000 | 5000 | 10000 | µg/L |
| Cobalt | 20 | 250 | 1000 | | | µg/L |
| Copper | 100 | 250 | 1000 | 5000 | 10000 | µg/L |
| Iron | 300 | 1000 | 5000 | 50000 | 100000 | µg/L |
| Lead | 100 | 500 | 1000 | 5000 | 10000 | µg/L |
| Lithium | 10 | 250 | 1000 | | | µg/L |
| Magnesium | 1000 | 2000 | 5000 | 50000 | 100000 | µg/L |
| Manganese | 20 | 250 | 1000 | 5000 | 10000 | µg/L |
| Molybdenum | 10 | 250 | 1000 | | | µg/L |
| Nickel | 100 | 250 | 1000 | 5000 | 10000 | µg/L |
| Potassium | 400 | 1000 | 5000 | 50000 | 100000 | µg/L |
| Selenium | 40 | 250 | 1000 | | | µg/L |
| Silicon | 40 | 250 | 1000 | | | µg/L |
| Silver | 20 | 250 | 1000 | | | µg/L |
| Sodium | 1000 | 2000 | 5000 | 50000 | 100000 | µg/L |
| Strontium | 100 | 500 | 1000 | | | µg/L |
| Thallium | 40 | 250 | 1000 | | | µg/L |
| Tin | 40 | 250 | 1000 | | | µg/L |
| Titanium | 10 | 250 | 1000 | | | µg/L |
| Vanadium | 50 | 250 | 1000 | | | µg/L |
| Zinc | 100 | 250 | 1000 | 5000 | 10000 | µg/L |

8.3 The correlation coefficient of the calibration standards must be >0.998 for each element. Sample data cannot be reported for elements that do not meet the minimum criteria.

8.4 Calibration is verified with a second source standard (ICV) prepared at the concentrations listed in Sec 7.9. Element concentrations must be within 5% of the expected value for analyses reported by Method 200.7 or 10% for analyses reported by Method 6010.

8.5 Calibration blanks are analyzed following initial calibration and after every 10 samples. Results must be less that the LOD.

8.6 A continuing calibration standard (CCV, Sec. 7.8) is analyzed following initial calibration and after every 10 samples. Element concentrations must be within 10% of the expected value. Sample must be bracketed by acceptable CCV results. Re-analysis of associated samples is required when CCV results exceed 10%.

8.7 A reporting limit verification sample (CRQL, Calibration Standard 1) is analyzed following initial calibration and prior to sample analysis and at the end of each analytical sequence. The results of the CRQL must be within 20% of the expected concentration.

8.8 Interference check solutions (ICSA and ICSAB) must be analyzed at the beginning of each analytical sequence following the ICV. The ICSAB must analyzed immediately following ICSA. The ICSA solution contains interferences and the ICSAB contains analytes plus interferences. The absolute value of analyte elements in the ICSA must be <LOD. If any element concentration is greater than the LOD results for that element cannot be reported. Analyte concentrations in the ICSAB must be within 20% of the true value. If any element concentration exceeds this limit the problem must be corrected and the element reanalyzed.

Acceptance Criteria
ICSA

| Element | Control Limits (ppb) | True Value (ppb) |
|---|---|---|
| Aluminum | 400000 – 600000 | 500000 |
| Calcium | 400000 – 600000 | 500000 |
| Iron | 400000 – 600000 | 500000 |
| Magnesium | 400000 – 600000 | 500000 |
| Chromium | 4000 – 60000 | 5000 |
| Copper | 4000 – 60000 | 5000 |
| Manganese | 4000 – 60000 | 5000 |
| Nickel | 4000 – 60000 | 5000 |
| Titanium | 800 – 1200 | 1000 |
| Vanadium | 800 – 1200 | 1000 |

Acceptance Criteria
ICSAB

| Element | Control Limits (ppb) | True Value (ppb) |
|---|---|---|
| Aluminum | 400000 – 600000 | 500000 |
| Calcium | 400000 – 600000 | 500000 |
| Iron | 400000 – 600000 | 500000 |
| Magnesium | 400000 – 600000 | 500000 |
| Antimony | 800 – 1200 | 1000 |
| Arsenic | 800 – 1200 | 1000 |
| Barium | 4000 – 6000 | 5000 |
| Beryllium | 800 – 1200 | 1000 |
| Boron | 800 – 1200 | 1000 |
| Cadmium | 800 – 1200 | 1000 |
| Chromium | 4000 – 6000 | 5000 |
| Cobalt | 800 – 1200 | 1000 |
| Copper | 4000 – 6000 | 5000 |
| Lead | 4000 – 6000 | 5000 |
| Manganese | 4000 – 6000 | 5000 |
| Molybdenum | 800 – 1200 | 1000 |
| Nickel | 4000 – 6000 | 5000 |
| Potassium | 40000 – 60000 | 50000 |
| Selenium | 800 – 1200 | 1000 |
| Silver | 800 – 1200 | 1000 |
| Sodium | 40000 – 60000 | 50000 |
| Strontium | 800 – 1200 | 1000 |
| Thallium | 800 – 1200 | 1000 |
| Tin | 800 – 1200 | 1000 |
| Titanium | 800 – 1200 | 1000 |
| Vanadium | 800 – 1200 | 1000 |
| Zinc | 4000 – 6000 | 5000 |
| Lithium | 800 – 1200 | 1000 |

## 9.0 Sample Preparation

9.1 Allow samples to warm to ambient temperature prior to analyzing.

9.2 Check the pH of aqueous samples prior to beginning digestion.

9.3 Prepare samples according to the appropriate SOP for the particular matrix.

## 10.0 Diagram/Table

10.1 Reserved.

## 11.0 Analytical Procedure

11.1 Open WinLab32 software. Open the workspace Plasma Startup. Initiate the plasma (click the plasma switch to ON). Carefully note the characteristics of the plasma. A stable plasma will be situated just above the inner quartz tube in the torch and will have a bright discharge of the shape An unstable plasma has an irregular shape and may have an air gap underneath. If the plasma is stable, wait one hour before running samples.

11.2 Open the workspace 1-200.7.

11.3 Open Mn method and perform Optimization using Continuous Graphic. Check gas flows and RF power using 1mg/L Mn.

11.4 Perform View X and X/Y Alignment using 1mg/L Mn for Axial view and 10 mg/L Mn for Radial view.

11.5 Insert all QC samples in their proper location. Start the run.

11.6 For instances of sample matrix interference the Method of Standard Additions (Internal Calibration Quantification) may be required for sample quantification.

11.8.1 Four identical aliquots of the extract are taken.

11.8.2 Three of the aliquots are spiked with calibration standard solution at various concentrations that would approximate 50%, 100% and 150% of the expected analyte concentration.

11.8.3 The four aliquots are analyzed and the instrument signal is plotted versus the added concentration. This may be performed directly by the instrument or by using a linear regression plot (i.e. Excel spreadsheet). The y-intercept is determined which corresponds to the concentration of the analyte in the sample.

## 12.0 Details of Calibration and Calculations

12.1 The instrument will note if excessive curvature of the calibration curve occurs. A Correlation Coefficient of 0.998 is programmed into the software for multi-standard calibration protocols when used. Deviations from this will result in the run being stopped until a successful calibration is achieved.

12.2 Continuing calibration standards are evaluated by:

$$\% \text{ Recovery} = \text{actual conc.}/\text{expected conc.} * 100$$

12.3 Percent recovery - matrix spikes, post digestion spikes and LCS

$$\% \text{ Recovery} = \text{conc. recovered-sample conc. (MS/PDS)}/\text{conc. expected} * 100$$

12.4 Relative Percent Difference

RPD = [result 1 - result 2]/average result1..result2) * 100

12.5 Serial Dilutions

% D = (original result - Dilution result)/original result * 100

12.6 Calculation for Hardness

mg/L CaCO3 = ug/L (instrument reading) x Final vol. (L) x CF/Initial vol. (ml)

CF=Conversion factor (Section 14.5)

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 On initial instrument set-up and as required due to major maintenance the following must be performed and documented.

13.1.1 Determination of background correction points (Sec. 5.1).

13.1.2 Verification of the linear range – on instrument set-up and every 6 months: Perform an initial calibration, prepare a standard at the highest calibration concentration and analyze the standard. Results for this standard must be within 10% of the expected concentration. If results exceed 10% adjust the upper calibration range and repeat the verification procedure.

13.1.3 Analysis of second source standard. Verification of calibration standards is performed by determining the mean concentrations from three analyses of the second source calibration verification standard (ICV). The mean recovery must be with 5% of the known concentration.

13.1.4 Instrument Detection Limits (IDL) must be performed initially and after significant changes to instrumentation, personnel, test method or sample matrix by the analysis of 10 calibration blanks on three non-consecutive days.

13.1.5 Establish interelement corrections (IEC): Analyze interference solutions and establish corrections using the IEC model in the instrument software. Store IEC in the method to be used for sample analysis and verify daily with the ICSA/ICSAB solutions. Repeat procedure on unacceptable results for the interference check solutions.

13.2 An initial demonstration of proficiency must be performed on instrument set-up, by all analysts performing the method or engaged in sample preparation or whenever substantial changes are made to the instrument or procedure. This is accomplished by preparing and analyzing four laboratory control samples. The average recovery must be within 20% of the expected concentration and the %RSD must be less than15%.

13.3 Method Detection Limit studies (MDL) are performed initially, on failure to achieve successful LOD/LOQ results, after significant changes to instrumentation, personnel, and test method or sample matrix.

13.4 LOD/LOQ determinations are performed quarterly as specified in Sec. 4.

13.5 ICV- must be run after a calibration. The results must be +/- 5%(Method 200.7) or +/- 10% (Method 6010) of the stated value. If the ICV is not within limits the analysis must be terminated for the elements exceeding +/- 5% or 10%.

13.6 CCV - continuing calibration verifications. This standard must be run after every 10 samples. The limits are +/- 10% of the true value. If this standard fails the problem must be corrected and the previous samples repeated.

13.7 CRQL – reporting limit verification standard, prepared at the reporting limit concentration and analyzed prior to and at the end of each analytical sample sequence. Results must be within 20% of the expected concentration. If the CRQL standard exhibits results beyond the acceptance limits sample results cannot be reported. Investigate, correct and recalibrate if necessary until acceptable CRQL results are obtained.

13.8 ICB- Initial calibration blank analyzed following calibration. The result must be less than the LOD for each element. If this standard fails, correct the problem and reanalyze the samples affected.

13.9 CCB- continuing calibration blank analyzed following calibration and every 10 samples. The result must be less than the LOD for each element. If this standard fails, correct the problem and reanalyze the samples affected.

13.10 A serial dilution (1:5) must be preformed for each batch and evaluated for elements >50 times the CRQL (LOQ). The serial dilution must agree within +/- 10% of the original reading. A post digestion spike must be analyzed for elements when the serial dilution results exceed 10%.

13.11 A post digestion spike must be prepared when the serial dilution results exceed 10%, when analyte concentrations in all samples are <50 times the LOD or when MS/MSD results exceed control limits and the sample result is less than 10 times the CRQL. The recovery should be within 80 – 120 % of the spiked value. If the PDS and SD do not produce acceptable results the affected elements are flagged as estimated.

13.11 LCS- laboratory control sample. One LCS is required per batch. The LCS must be 80-120 % of the known value. If the LCS results exceed control limits all batch associated samples must be re-analyzed and if results are not with control limits the batch must be re-digested.

13.12 Matrix Spike (MS) at a frequency of 5% - Matrix Spike Duplicate (MSD) at a frequency of 5%. For each batch of samples a MS and MSD and a second MS are prepared. The recovery and relative percent difference (RPD) are determined.

13.19.1 Acceptance Criteria Recovery **80 - 120 %**

13.19.2 Acceptance Criteria RPD **<20 %**

13.13 A Method Blank is prepared for each batch of sample. The results for each analyte must be < ½ the RL. If unacceptable results are obtained re-analyze method blank once and if unacceptable results persist terminate the analysis and correct the problem. Re-prepare sample batch if necessary.

13.14 Optional - One duplicate sample may be run per every 20 samples. A control limit of 20 % RPD should not be exceeded.

## 14.0 Data Reporting Requirements

14.1 Sample results are reported as ug/L (aqueous samples) and ug/kg (solid samples).

**NOTE:** TCLP extracts may require analysis by the method of Standard Additions and are processed according to the instrument protocol for analysis by Standard Addition (Refer to Sec. 11.8).

14.2 Raw results are entered into Omega. Prep factors are automatically imported from sample prep logs. Dilutions are entered in the analytical sequence.

14.3 Sample results are reported as ug/L for water and ug/kg for soil as dry weight.

14.4 Raw instruments results are entered directly into the Omega LIMS direct instrument interface. All calculations to derive final result (including dry weight conversions) are performed automatically by the LIMS. Sample preparation information and percent moisture results are entered into the appropriate section of the LIMS prior to instrument data and are automatically factored into the final results.

14.5 Reporting Hardness results by Standard Methods 2340B:

14.5.1 Import Calcium and Magnesium data using Omega test code EPA_200.7-HARD. Calculations are performed automatically by the LIMS using the factors 2.497 (Ca) and 4.118 (Mg) to convert instrument results to mg/L CaCO3. Converted Ca and Mg results are automatically summed by the LIMS for reporting Total Hardness (as CaCO3).

14.6 Observe and evaluate QC flags or qualifiers in the sequence. If present, investigate and repeat or reanalyze as necessary.

**Quality Control Criteria**

| CONTROL ITEM | FREQUENCY | CRITERIA | CORRECTIVE ACTION |
|---|---|---|---|
| Initial Calibration Verification (ICV) | Daily immediately following calibration | 90 – 110 % | Repeat Calibration |
| ICB | After ICV | < LOD | Stop, repeat -determine cause and correct |
| ICSA/ICSAB | After ICB | Non interfering analytes <LOD in ICSA, +/- 20% of expected in ICSAB | Stop, repeat -determine cause and correct |
| CCV | After ICSAB and every 10 samples | 90 – 110 % of True Value | Repeat CCV and all samples preceding a CCV failure – recalibrate if problem persists |
| CCB | After CCV and every10 samples | <LOD | Stop, repeat -determine cause and correct |
| CRQL | After CCB and at the end of the sample set | 80 – 120 % | Investigate, determine cause and correct. Repeat samples analyzed prior to unacceptable CRQL |
| Method Blank | 1 per batch. | <1/2RL | 1) Repeat once and if unacceptable terminate analysis, correct problem and repeat.<br>2) evaluate system<br>3)repeat batch digestion if necessary |
| LCS | 1 per batch | 80 – 120 % | Analytes with unacceptable results cannot be reported. Investigate, repeat batch as necessary. |
| MS/MSD | 5% - 1 per batch | 80 – 120 % | 1) Flag Data |
| Duplicate Samples | 5% - 1 per batch | RPD < 20% | Investigate and repeat as necessary |

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 Sample waste container must be checked daily.

15.2 Visually check the torch condition and measure for alignment daily.

15.3 Visually check for acceptable roller pressure and condition of the sample introduction tubing. Correct pump rotation and the condition of the drain tubing daily.

15.4 Visually check for torch, radial and axial lens. Clean them as needed.

15.5 Check and replace filters as needed or monthly at a minimum.

15.6 Check and replace Cu string as needed.

15.7 Check argon pressure daily.

15.8 Once in a year change chiller fluid.

## 16.0 Waste Management and Pollution Prevention

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner that minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Acidic materials (pH<2) are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Soil samples are composited in a drum designated for incineration.

16.2.3 Disposal of materials is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, Method 6010C, Revision 3, February 2007.

17.2 EPA Methods for Chemical Analysis of Water and Wastewater. Method 200.7, Revision 4.4 (1994).

17.3 RTI Laboratories, Inc. SOP 3020A – Acid Digestion of Aqueous Samples.

17.4 RTI Laboratories, Inc. SOP 3050A – Acid Digestion of Solid Sample.

17.5 RTI Laboratories, Inc. Quality Assurance Plan.

17.6 RTI Laboratories, Inc. SOP SRC001-A_R3, Sample Receipt and Custody.

17.7 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.8 RTI Laboratories, Inc. Employee Handbook.

# Appendix A – Interelement Corrections

| | Al 500 ppm | Ca 500 ppm | Cr 100 ppm | Cu 100 ppm | Fe 200 ppm | Mg 500 ppm | Mn 100 ppm | Ni 100 ppm | Ti 100 ppm | V 100 p |
|---|---|---|---|---|---|---|---|---|---|---|
| 338.289 | 0 | 0 | 18.839615 | 0 | 0 | 0 | 0 | 0 | 3.757833 | 0 |
| 396.153 | N/A | 0.34923 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 188.979 | 0 | 0 | 4.535307 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 08.889 | 0.177821 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 493.408 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 234.861 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 317.933 | 0 | N/A | 0 | 0 | 0 | 0.288293 | 0 | 0 | 0 | 0.6514 |
| 226.502 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 230.786 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 205.560 | 0 | 0 | N/A | 3.443005 | 0 | 0 | 0 | 0.896605 | 0 | 0 |
| 327.393 | 0.165735 | 0 | 0 | N/A | 0 | 0 | 0 | 0 | 0 | 0 |
| 259.939 | 0 | 0 | 0 | 0 | N/A | 0 | 0 | 0 | 0 | 0 |
| 66.490 | 0 | 0 | 0 | 0 | 0 | 0.336132 | 0 | 0 | 0 | 0 |
| 370.784 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 285.213 | 0 | 0 | 0 | 0 | 0.598408 | N/A | 0 | 0 | 0 | 0 |
| 259.372 | 0 | 0 | 0 | 0 | 1.37359 | 0 | N/A | 0 | 0 | 0 |
| 259.372 | 0 | 0 | 0 | 0 | 0.310125 | 0 | 0 | 0 | 0 | 0 |
| 589.592 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 341.476 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | N/A | 1.024119 | 0.8618 |
| 220.353 | 0 | 0 | 0 | 0.629282 | 0 | 0 | 0 | 0 | 0.772611 | 0 |
| 231.146 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 196.026 | 0 | 0 | 0 | 0 | 0.281397 | 0 | 0 | 0 | 0 | 0 |
| 251.611 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 7.43461 | 0 |
| 189.927 | 0 | 0.260685 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 407.771 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 334.940 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | N/A | 0 |
| 190.801 | 0 | 0 | 0 | 0 | 0 | 0 | 5.615419 | 0 | 4.071975 | 0.9064 |
| 92.402 | 0 | 0 | 2.344744 | 0 | 0 | 0 | 0 | 0 | 0.885925 | N/A |
| 202.548 | 0 | 0 | 1.505368 | 8.481186 | 0 | 1.051813 | 0 | 0 | 0 | 0 |

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**Livonia, Michigan 48150**

# STANDARD OPERATING PROCEDURE

# ANALYSIS OF ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY (ICP/MS)

| | |
|---|---|
| **Analyte:** | **Elements** |
| **SOP#:** | **6020_020615_R11** |
| **Method Reference:** | **SW 846/3020A/3050A/6020A**<br>**EPA 200.8, Rev. 5.4** |
| **Issue Date:** | **October 13, 2000** |
| **Revision No.:** | **11** |
| **Revision Date:** | **February 6, 2015** |

**Reviewed and Approved: February 6, 2015**

Director, Quality Management: Charles O'Bryan

Director, Environmental Services: Yemane Yohannes

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**ANALYSIS OF ELEMENTS BY INDUCTIVELY COUPLED PLASMA-MASS SPECTROMETRY (ICP/MS)**

**SOP#: 6020_020615_R11**

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# 1.0 Scope and Application

## 1.1 Introduction

1.1.1 This Standard Operating Procedure details the daily operation, optimization, tuning of the analytical system and the analysis of samples according to the U. S. EPA Methods 6020A and 200.8 for the elements listed in the associated Omega LIMS test code using inductively coupled plasma/mass spectrometry (ICP/MS).

1.1.2 This method applies to ground waters, surface waters, soil, industrial wastes, and sludge.

1.1.3 Acid digestion and filtration are required prior to analysis of these samples. Analyses for dissolved metals may only require filtration.

1.1.4 Maintenance for the ICP-MS instruments can be found in the ELAN Hardware Manuals provided with the instrument.

1.1.5 Detailed instructions on the ICP-MS software can be found in the instrument Software Manuals.

1.1.6 For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

## 1.2 Summary of Method

1.2.1 Prepared samples are nebulized into the spray chamber where a stream of argon gas carries the sample in the form of an aerosol through the quartz torch and injects it into the R.F. plasma. The sample will decompose in the plasma. The ions produced are entrained in the plasma gas and with the aid of a water-cooled, differentially pumped interface and are introduced into a high-vacuum chamber that houses the quadruple mass spectrometer. The ions are separated according to their mass-to-charge ratio, identified and quantified.

1.2.2 Samples are prepared according to the matrix by Methods 3020A, 3050B or 3052. SOPs for each of these methods are on file. Samples for dissolved metals do not require additional sample preparation procedures prior to analysis.

## 2.0 Safety Precautions

2.1 Acids used in the digestion procedure are corrosive. All digestions are performed in a fume hood designated for use with mineral acids. Proper safety equipment (gloves, lab coats, etc.) is worn when handling concentrated acids. Many elements are toxic and should be handled with care.

2.2 Good laboratory technique and safety practices should be used at all times to reduce the risks associated with chemicals and potential hazards.

2.3 The ICPMS instrument is fully interlocked for safety purposes. Never attempt to disable these interlocks.

2.4 Spilled samples must be cleaned up immediately when they come in contact with the instrument. Neutralize all acid spills with sodium bicarbonate.

## 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with RTI Laboratory's Standard Operating Procedure for Sample Log-in (SOP: SRC001-A_R3). Appropriate U. S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed.

3.1.1 Soil, sludge and solid samples are collected in pre cleaned wide mouth glass jars.

3.1.2 Aqueous samples are collected in pre cleaned plastic bottles preserved with approximately 2.0 ml of 1:1 high purity nitric acid (HNO3):DI water. The pH of the sample is checked on receipt and prior to sample preparation for the presence of adequate preservative. The pH of preserved samples should be < 2. Preserved samples received at pH>2 or at sample preparation are at pH>2 are adjusted to pH<2 with additional acid and held for a minimum of 16 hours until verified to be pH<2.

3.1.3 Maximum sample holding time is six (6) months.

3.1.4 Samples received for filtration in the laboratory or samples that have been filtered prior to receipt must be preserved and held for 24 hours prior to commencing the sample preparation procedure. Laboratory filtration is performed by filtering a portion of the sample sufficient for analysis through a 0.45 µm filter. The pH is checked prior to analysis and if required the procedure in Sec. 3.1.2 is followed.

## 4.0 MDL, LOD, LOQ, Linear Range, Accuracy and Precision

4.1 The method detection limit (MDL) is statistically defined at the 99% confidence level according to 40 CFR Part 136 App. B. Seven replicates containing all of the analytes of interest at a concentration level of 1-5 times the estimated D.L. are analyzed and the standard deviation is calculated. The Student's T Value for the 7 replicates (3.143) is multiplied by the standard deviation of the analyte to calculate the MDL. MDLs are performed on instrument set up and following significant changes to the instrument, method or personnel. MDLs are kept on file in the Laboratory. MDLs and reporting limits are incorporated into the applicable test code in the Omega LIMS.

4.2 The LOD (limit of detection) is determined by spiking reagent water at 1-4 times the MDL and prepared using the same procedure as samples. Analytes must be present at levels 3 times or greater than the blank response (greater than 3 times the signal to noise ratio). The concentration used is the LOD for that analyte. LOD determinations must be performed quarterly.

4.3 The LOQ (limit of quantification) is determined by spiking reagent water at the reporting limit (RL/CRQL) and prepared in the same manner as samples. Analyte recovery must be within 20% of the expected concentration. The concentration used and successfully recovered is the LOQ for that analyte. LOQ determinations must be performed quarterly.

4.4 Initially accuracy and precision at the LOQ is determined by spiking 4 aliquots of reagent water at the reporting limit (RL/CRQL) and prepared using the same procedure used for samples. The average recovery must be within 20% of the expected value and the %RSD must be less than 15%.

4.5 LOD/LOQ determinations that do not meet the specifications above require repeat analysis, adjustment to the spiking levels and/or reporting limits, repeating the MDL determination at adjusted concentrations if required and repeat LOD/LOQ determinations.

4.6 The linear range for this method is element specific. Linear ranges are addressed in Section 13. If a sample falls above the linear range or highest calibration standard dilutions of the sample digestate must be made until the concentration falls within the established calibration range.

4.7 The accuracy and precision for this method are determined by analyzing four aliquots from a Laboratory Control Sample containing the element(s) of interest at the mid-level of the calibration range. Percent recovery, standard deviation, and the relative standard deviation are calculated for each analyte. Quality control limits, mean recovery values and RPD results are incorporated in the Omega LIMS.

## 5.0 Interferences

5.1 Isobaric interference occurs during analysis when an isotope of one element is at the same nominal mass as an isotope of another element. To correct for this interference the intensity of the interfering element may be measured at another isotope. Using the natural abundance ratios to correct for its presence at the analytical mass of interest. Most commonly used corrections for isobaric interferences are already incorporated into the ELAN NT software. Make certain that the isotope used for correction purposes dose not suffer from overlap with other isotopes that maybe present in the sample.

5.2 ICPMS provides unit resolution at 10% of peak height. Very high ion currents of adjacent masses can contribute to ion signals at the mass of interest. A positive interference is suspected when the measured concentration of an isotope is greater than 20% of a secondary isotope.

5.3 Molecular interferences are caused when molecular species are formed in the plasma with plasma matrix ions. These interferences are corrected in the same manner as the isobaric interferences.

5.4 Reagents, glassware and other sample preparation equipment may contain artifacts that will interfere with the analysis. Method blanks are routinely analyzed to demonstrate that materials are free from contamination. Sample bottles and reagents are assayed prior to use for suitability. Glass containers cannot be used for analyses requiring determination of Boron, Silicon or Barium.

5.5 Carryover can occur when a high concentration sample is analyzed. Additional rinse time may be required when encountering an elevated concentration sample to eliminate potential memory affects.

5.6 Physical interferences associated with dissolved solids content or matrix viscosity can cause suppression or enhancement of the signal. Internal standards will correct for these types of interference. If the internal standard signal is altered by more than 70-125% (30-120% for samples analyzed under QSM 5.0) of the calibration standard, dilution of the sample will usually eliminate the physical interference problem.

## 6.0 Apparatus and Materials

6.1 ICPMS3 - Perkin-Elmer ELAN DRC-e, Cetac ASX-520 auto sampler with SYS Systenax computer system (MS XP OS) and ELAN software – Version 3.4.

6.2 ICPMS2 – Perkin-Elmer Elan 6000 instrument, Cetac auto sampler, Dell OptiPlex1 computer system, and ELAN NT software – Version 2.2.

6.3 ICPMS3: Peristaltic pump tubing black/black - 0.75mm id, black/white – 0.125 id, red/orange – 0.19 id. ICPMS2: Peristaltic pump tubing black/black - 0.76mm id, black/white – 3.18 mm, yellow/orange – 0.51 mm.

6.4 Calibrated mechanical pipettes with metal free plastic pipette tips 10 – 100 µl, 100 – 1000 µl, 500 – 5000 µl, 1 – 10 ml.

6.5 50 ml plastic auto sample tubes with plastic caps.

6.6 Beakers – various sizes.

6.7 Volumetric flasks, Class A – various volumes.

6.8 0.45 µm Metricell membrane filter – Pall Corporation.

## 7.0 Reagents

7.1 High purity reagents, acid and water must be used at all times. Trace metals grade purity acids must be used for this method. Nitric acid is preferred in order to minimize polyatomic interferences. Hydrochloric acid is used to maintain stability in solutions containing antimony and silver but corrections for polyatomic ion interferences must be used.

7.2 Tuning solution stock: 10 µg/ml Ba, Be, Cd, Ce, Co, Cu, In, Pb, Mg, Rh, Tl, U. Tuning solution is prepared by pipetting 1 mL of tuning stock solution into a 1 liter flask containing 200 mL deionized water, and adding 10 mL of conc. nitric then diluting to the mark with deionized water.

7.3 2% (vol/vol) nitric acid. Prepare by adding 400 ml of nitric acid to a 20 L container Expiration date for this solution is 3 month

7.4 Internal Standard. Stock: A-100 µg/ml Li6, Sc, Y, In, Tb, Bi and B- 1000 ppm Ge.

7.4.1 Working standard: Add 0.2 ml of internal standard A and 0.1 ml of B and dilute to 500 ml with deionized water. All samples and solution must contain internal standards. Prepare fresh daily.

7.5 Single element standards at ICP-MS grade.

7.6 Standard stock solutions:

7.6.1 AAC-STD-2: 1000 µg/ml – Al, Sb, As, B, Mo, P, Sb, Se, Si, Sn, Ti, Zr (3% v/v $HNO_3$/4.9% HFv/v)

7.6.2 AAC-STD-4A: 1000 µg/ml – Ba, Be, Bi, Cd, $Cr_3$, Co, Cu, Pb, Mn, Ni, Ag, Sr, Tl, Th, V, Zn (7% absolute $HNO_3$).

7.6.3 AAC-STD-3A: 10000 µg/ml – Ca, Mg, K, Na, Fe. (7% absolute $HNO_3$).

7.6.4 Calibration Stock:

A1 – 2ml of AAC-STD-4 diluted 100 ml final volume in 2% nitric acid. Standard concentration is 20 µg/ml.

A3 – 2ml of AAC-STD-2 diluted 100 ml final volume in 2% nitric acid.. Standard concentration is 20 µg/ml.

III – 1ml of AAC-STD-3 diluted 100 ml final volume in 2% nitric acid.. Standard concentration is 100 µg/ml.

B – 1000 µg/ml Boron Standard

Si – 1000 µg/ml Silicon Standard

7.6.5 Second source single element standards – Lithium 1000µg/ml, Boron 1000 µg/ml and Silicon 1000 µg/ml

7.7 Independent Calibration Verification (ICV) - This solution must be from a different stock than the calibration standards and when available from a separate vendor. ICV stock 1 – 50 µg /mL Ag, As, Al, B, Ba, Be, Cd, Cr, Co, Cu, Mn, Mo, Ni, P, Pb, Sb, Se, Si, Sn, Sr,Ti, Tl, V, Zn (22 components). ICV stock 2 – 5000 µg/mL Na, Ca, Mg, K, Fe.

7.8 Calibration Standards: These standards are prepared fresh daily.

7.8.1 Calibration Blank: 2% nitric acid into a 50 ml auto sampler tube.

7.8.2 Cal Std: Add 250 ul of calibration stock standards A1 and A3, 4000 µl of calibration stock III and 50 µl of the B and Si standards to a final volume of 50 ml in 2% nitric acid in an auto sampler tube. The standard concentration is 100 µg/L for all elements (Al, Sb, As, Mo, P, Se, Sn, Ti, Ba, Be, Bi, Cd, Cr, Co, Cu, Pb, Mn, Ni, Ag, Sr, Tl, Th, V, Zn) except:

Na, Ca, Mg, K – 8000 µg/L
B, Si – 1100 µg/L
Fe – 8000 µg/L

7.9 ICV Standard: This standard must be prepared fresh daily.

7.9.1 Add 50 µl of ICV Stock 1, 50 µl of ICV Stock 2, 25 µl each of the boron and silicon standard and dilute 50 ml final volume in 2% nitric acid in an auto sampler tube. This solution contains the following concentrations: 50 µg/L As, Sb, Al, Ba, Be, Cd, Cr, Co, Cu, Pb, Mn, Mo, Ni, Se, Ag, Sr, Tl, V, Zn. Ti, B and Sn. 5000µg/L Na, Ca, Mg, K, Fe. 500 µg/L B, Si.

7.10 Dual Detector Cross – Calibration Solution: Add 0.125 ml of AAC-STD-2, 0.125 ml of AAC-STD-1, 0.1 ml AAC-STD-3, 1ml of each individual standard of Se, Ag, and Li, 1.25 ml Ge and 2.5 ml of the 100 µg/ml internal standard solution. Dilute to 1000 ml final volume with DI water. This solution contains the following concentrations: 125µg/L Al, Sb, As, B, Ba, Be, Bi, Cd, Cr, Co, Cu, In, Pb, P, Mn, Mo, Ni, Sc, Si, Sn, Sr, Tb, Ti, Tl, Th, V, Y, Zn: 1000 µg/L Na, Ca, Mg, Fe and K: 1.25 µg/ml Se, Ag, Li.

7.11 Interference Check Solution Stock OA: Contains 1000 mg/L Al, Ca, Fe, Mg, Na, P, K, and S; 2000 mg/L of C; 10000 mg/L Cl, and 20 mg/L Mo and Ti. To prepare interference check solution A (ICSA) perform a 100-fold dilution on the stock. This result in a solution containing the following concentrations: 10mg/L Al, Ca, Fe, Mg, Na, P, K, and S; 20 mg/L of C; 0.2 mg/L Mo and Ti

7.12 Interference Check Solution Stock OB: Contains 2 mg/L of As, Cd, Cr, Co, Cu, Mn, Ni, Ag, and Zn. To prepare interference check solution AB (ICSAB) add 0.5 ml of ICS stock OA to a 50 ml volumetric flask. Add 0.5 ml of ICS stock OB and dilute to the mark with deionized water.

7.13 Continuing Calibration Verification (CCV) standard: Add 125 ul of Calibration Standards A1 and A3, 2000 ul of calibration stock III and 25 µl each of the boron and silicon standards (Section 7.6.5) to a final volume 50ml in 2% nitric acid. This solution contains 50 µg/L of Al, Sb, As, Mo, P, Se, Sn, Ti, Zr, Ba, Be, Bi, Cd, Cr, Co, Cu, Pb, Mn, Ni, Ag, Sr, Tl, Th, V, Zn and B – 4000 µg/L of Na, Ca, Mg, K, Fe – 550 µg/L of B and Si.

7.14 All prepared standards and reagents are labeled with an identification number, the concentration of the standard (if not referenced to the preparation log), contents where appropriate, the expiration date and the initials of the preparer. Standard logs and reagent logs are maintained for recording the receipt, lot number and preparation information of all standards and reagents.

## 8.0 Preparation of Standards and Calibration Procedure

8.1 Prior to each use of the instrument the tuning solution is analyzed and a mass calibration and resolution check is performed. If the mass calibration differs by more than 0.065 amu (ICPMS3) or 0.06 (ICMPS2) from the true value the mass calibration must be adjusted to the correct value. The resolution must be verified to be less than 0.70±0.1 (ICPMS3) or 0.7±0.1 amu full width at 10% peak height.

8.2 Prior to each use of the instrument five replicates of the tuning solution are analyzed. The RSD must be <5% for each element in the solution and meet the criteria in Sec. 11.5.

8.3 The ELAN 6000 must be calibrated before analysis with at least 1 blank and at least 1 standard. For specified projects, clients or programs the calibration protocol will require a blank and 3 non-zero standards with the lowest at the RL and the highest below the linear dynamic range. Sample concentrations above the highest standard used require dilution until the result is within the calibration range or a high-level check standard is analyzed with concentrations exceeding the sample concentration. Percent recovery for the check standard must be within 10% of the expected value.

8.4 Standards are prepared as specified in section 7.

8.5 All continuing calibration standards and blanks must pass criteria specified in section 13.

8.6 Initial calibration is performed using a calibration blank and calibration standard prepared at concentrations listed in Sec. 7.8. When calibration is performed using multi-level standards the cc of the calibration curve must be >0.998.

8.7 Calibration is verified with a second source standard (ICV) prepared at the concentrations listed in Sec 7.9. Element concentrations must be within 10% of the expected value.

8.8 A continuing calibration blank is analyzed following initial calibration and after every 10 samples. Results must be less that the LOD.

8.9 A reporting limit verification sample (CRQL) is analyzed following initial calibration or prior to sample analysis and at the end of each analytical sequence. The results of the CRQL may be evaluated by data reviewers for compliance with specific method program requirements.

8.9.1 Method 200.8 requires no CRQL
8.9.2 DoD QSM Version 5.0: 20% prior to sample analysis, no subsequent CRQL samples required.
8.9.3 SW_6020: 30% prior to sample analysis and at the end of each analytical sequence

8.10 A continuing calibration standard (CCV) prepared according to Sec. 7.11 is analyzed before sample analysis, after every 10 analyses, and at the end of the analytical sequence. Element concentrations must be within 10% of the expected value.

8.11 Interference check solutions must be analyzed prior to sample analysis (and after 12 hr. of use, if applicable).

## 9.0 Sample Preparation

9.1 Allow samples to warm to ambient temperature prior to analyzing.

9.2 Check the pH of aqueous samples prior to beginning digestion.

9.3 Prepare samples according to the appropriate SOP for the particular matrix (3020A, 3050B or 3052).

## 10.0 Diagram/Table

10.1 Reserved.

## 11.0 Analytical Procedure

11.1 Initiate the plasma and allow 30 minutes for a warm up time.

11.2 Open the auto-lens workspace. Using the tuning solution clear the old calibration, click on get analytes and click on optimize. Ensure the mass calibration and resolution check meets the criteria in Sec. 13.6. Save the file.

11.3 Monthly or as needed open the dual detector workspace. Aspirate the dual detector solution. Clear the old calibration and click on get analytes. Click on optimize and save file when complete.

11.4 Open the workspace Tuning 1 and optimize the following parameters using the tuning solution: set RF power level, optimize the nebulizer argon flow, optimize the static lens voltage and save the optimization file.

11.5 Open the Daily Performance workspace. Using the tuning solution click on analyze sample button.

11.5.1 For the ICPMS3 instrument the following conditions must be observed to proceed with analysis: BKG = <25 cps In >250,000 cps Mg > 50,000 cps U > 200,000 cps Ce/CeO </= 0.03 Ba++/Ba </= 0.03. %RSD must be <5.

11.6 Instrument operating conditions:

11.6.1 Nebulizer Gas Flow: 0.9 +/-0.1
11.6.2 Lens Voltage: 8.6 +/-2
11.6.3 ICP RF Power: 1300.0 +/-100
11.6.4 Analog Storage Voltage: -2700.0 +/-1500
11.6.5 Pulse Stage Voltage: 1650.0 +/-1000
11.6.6 Detector: dual
11.6.7 Dual Detector Mode: Pulse
11.6.8 Replicates: 3

11.7 Open EPA6020 method. Calibrate the instrument and insert all QC samples in their proper location. Start the run.

11.8 For instances of sample matrix interference the Method of Standard Additions (Internal Calibration Quantification) may be required for sample quantification.

11.8.1 Four identical aliquots of the extract are taken.

11.8.2 Three of the aliquots are spiked with calibration standard solution at various concentrations that would approximate 50%, 100% and 150% of the expected analyte concentration.

11.8.3 The four aliquots are analyzed and the instrument signal is plotted versus the added concentration. This may be performed directly by the instrument or by using a linear regression plot (i.e. Excel spreadsheet). The y-intercept is determined which corresponds to the concentration of the analyte in the sample.

## 12.0 Details of Calibration and Calculations

12.1 The instrument will note if excessive curvature of the calibration curve occurs. A Correlation Coefficient of 0.998 is programmed into the software for multi-standard calibration protocols when used. Deviations from this will result in the run being stopped until a successful calibration is achieved.

12.2 Continuing calibration standards are evaluated by:

% Recovery = actual conc. / expected conc. * 100

12.3 Percent recovery - matrix spikes, post digestion spikes and LCS

% Recovery = conc. recovered-sample conc. (MS/PDS)/conc. expected * 100

12.4 Relative Percent Difference

RPD = [result 1 - result 2]/average result1..result2) * 100

12.5 Serial Dilutions

% D = (original result - Dilution result)/original result * 100

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 An initial demonstration of proficiency must be performed on instrument set-up, by all analysts performing the method or engaged in sample preparation or whenever substantial changes are made to the instrument or procedure. This is accomplished by preparing and analyzing four laboratory control samples. The

average recovery must be within 20% of the expected concentration and the %RSD must be less than 15%.

13.2 Instrument Detection Limits (IDL) must be performed initially and after significant changes to instrumentation, personnel, test method or sample matrix by the analysis of 10 calibration blanks on three non-consecutive days.

13.3 Method Detection Limit studies (MDL) are performed initially, on failure to achieve successful LOD/LOQ results, after significant changes to instrumentation, personnel, test method or sample matrix.

13.4 LOD/LOQ determinations are performed quarterly as specified in Sec. 4.

13.5 The upper limit or the linear dynamic range must be determined initially, when a new detector is installed, detector volts change, or if a new sample introduction unit is installed and verified every six months. The upper linear limit is defined as the highest concentration where the measured value is within 10 % of the actual prepared value as quantified by the calibration. Calibrate the instrument and run a series of 3-5 increasing concentration standards close to the upper linear range of the instrument.

13.6 Prior to each use of the instrument the tuning solution is analyzed and must meet the criteria specified in Sec. 8.1 and 8.2.

13.7 ICV- must be run after a calibration. The results must be +/- 10% of the stated value. If the ICV is not within limits the analysis must be terminated.

13.8 CCV - continuing calibration verifications. This standard must be run after every 10 samples. The limits are +/- 10% of the true value. If this standard fails the problem must be corrected and the previous samples repeated.

13.9 CRQL – reporting limit verification standard, prepared at the reporting limit concentration and analyzed according requiermets:8.9.1;8.9.2;8.9.3 . If the CRQL standard exhibits results beyond the acceptance limits sample results cannot be reported. Investigate, reanalyze, correct and recalibrate if necessary until acceptable CRQL results are obtained.

13.10 CCB- continuing calibration blank analyzed following every 10 samples. The result must be less than the LOD for each element. If this standard fails, correct the problem and reanalyze the samples affected.

13.11 ICSA and ICSAB: Analyze every 12 hours per analytical event. Spiked results should be within 20% of the expected value. For the ICSA solution the non-spiked elements must be less than the CRQL. If acceptable results are not obtained terminate the analytical process and correct the problem before proceeding with sample analyses.

13.12 Correction equations for isotope interferences are incorporated in the instrument software. These equations are reviewed at least annually; whenever a potential

interference is identified or when acceptable ICSA/ICSAB results cannot be obtained.

13.13 Internal Standards: The samples must recover the internal standards at 70 – 125 %. If these standards fail on a sample, attempt a five - fold dilution to correct the problem. If, after a second dilution, the problem persists place a notation in the comments section of the Analytical Sequence and report the concentration from the highest dilution. Internal standards may be evaluated by data reviewers for compliance with specific method program requirements.

13.13.1 Method 200.8 requirement: 60 – 125%.
13.13.2 DoD QSM Version 5.0 Appendix B Table 9: 30 – 120%
13.13.3 SW 6020A: >70%

13.15 A serial dilution (1:5) must be preformed when MS/MSD results exceed control limits and the sample concentration is sufficiently high - >50 times the CRQL. The serial dilution must agree within +/- 10% of the original reading.

13.16 A post digestion spike must be prepared when MS/MSD results exceed control limits and the sample result does not exceed 50 times the CRQL. The recovery should be within 80 – 120 % of the spiked value. If the MS/MSD and PDS do not produce acceptable results matrix effects are confirmed.

13.18 LCS- laboratory control sample. One LCS is required per batch. The LCS recovery must fall within the control limits listed in DoD QSM Version 5.0, Appendix C, Tables 5 and 6. For Method 200.8 the LCS control limits are 85-115%. If the LCS results exceed control limits all batch associated sample must be re-analyzed and if results are not with control limits the batch must be re-digested.

13.19 One duplicate sample may be run per every 20 samples. A control limit of 20 % RPD should not be exceeded.

13.20 Matrix Spike (MS) at a frequency of 10% (when analyzing samples for EPA 200.8) or 5% (when analyzing samples under SW 6020A) - Matrix Spike Duplicate (MSD) at a frequency of 5%. For each batch of samples a MS and MSD and a second MS are prepared. The recovery and relative percent difference (RPD) are determined.

13.19.1 Acceptance Criteria Recovery **85 - 115 %** - EPA Method 200.8.

Acceptance Criteria Recovery EPA Method 6020A – within control limits listed in DoD QSM Version 5.0, Appendix C, Tables 5 and 6.

13.19.2 Acceptance Criteria RPD **<20 %**

13.21 Method Blank is prepared for each batch of sample. The results for each analyte must be < ½ the RL. If unacceptable results are obtained re-analyze method blank once and if unacceptable results persist terminate the analysis and correct

the problem. Re-prepare sample batch if necessary.

**Table 2 -** Quality Control Criteria

| CONTROL ITEM | FREQUENCY | CRITERIA | CORRECTIVE ACTION |
|---|---|---|---|
| Initial Calibration Std. (ICV) | Daily | 90 – 110 % | Repeat Calibration |
| ICB | After ICV | < LOD | Stop, repeat - determine cause and correct |
| CCV | After ICSAB and every 10 samples | 90 – 110 % of True Value | Repeat CCV and all samples preceding a CCV failure – recalibrate if problem persists |
| CCB | After CCV and every 10 samples | <LOD | Stop, repeat - determine cause and correct |
| CRQL | After ICB and at the end of the sample set | 80-120 % - Initial<br>70-130% - Subsequent | Investigate, determine cause and correct. Repeat samples analyzed prior to unacceptable CRQL |
| Method Blank | At the beginning of each batch analyses. | <1/2RL | 1) Repeat once and if unacceptable terminate analysis, correct problem and repeat.<br>2) evaluate system<br>3) repeat batch digestion if necessary |
| ICS A & AB | Every 12 hours . | 80 - 120 %<br>Non Spiked Elements <LOD | Terminate analysis and correct the problem prior to sample analysis. |
| LCS | 1 per batch | 85 – 115 % - Method 200.8. DoD QSM 5.0 – Method 6020A | Analytes with unacceptable results cannot be reported. Investigate, repeat batch as necessary |
| MS/MSD | 5% - 1 per batch | 85 – 115 % - Method 200.8. DoD QSM 5.0 – Method 6020A | 1) Flag Data |
| Duplicate | 5% - 1 per | RPD < 20% | Investigate and |

| | | | |
|---|---|---|---|
| Samples | batch | | repeat as necessary |

## 14.0 Data Reporting Requirements

14.1 Sample results are reported as ug/L (aqueous samples) and ug/kg (solid samples).

**NOTE:** TCLP extracts may require analysis by the method of Standard Additions and are processed according to the instrument protocol for analysis by Standard Addition (Refer to Sec. 11.8).

14.2 Raw results are entered into Omega. Prep factors are automatically imported from sample prep logs. Dilutions are entered in the analytical sequence.

14.3 Sample results are reported as ug/L for water and ug/kg for soil as dry weight.

14.4 If the concentrations of secondary isotopes are less than 20% of the primary or most abundant isotope interference is suspected, the lower result is reported.

14.5 Raw instrument results are entered directly into the Omega LIMS direct instrument interface. All calculations to derive final result (including dry weight conversions) are performed automatically by the LIMS. Sample preparation information and percent moisture results are entered into the appropriate section of the LIMS prior to instrument data and are automatically factored into the final results.

14.6 Observe and evaluate QC flags or qualifiers in the sequence. If present, investigate and repeat or reanalyze as necessary.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 Sample waste container must be checked daily.

15.2 Visually check the torch condition and measure for alignment daily.

15.3 Visually check for acceptable roller pressure and condition of the sample introduction tubing. Correct pump rotation and the condition of the drain tubing daily.

15.4 Visually check the condition and levels of the rough pump oil daily.

15.5 Visually check the condition of each cone for cleanliness and proper orifice size weekly.

15.6 Check and replace filters as needed or monthly at a minimum.

15.7 Change pump oil every 3 months.

15.8 Check and adjust detector to proper voltage as needed.

15.9 Check argon pressure daily.

## 16.0 Waste Management and Pollution Prevention

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner that minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Acidic materials (pH<2) are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Soil samples are composited in a drum designated for incineration.

16.2.3 Disposal of materials is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, Method 6020A, Revision 1, February 2007.

17.2.1 EPA Methods for Chemical Analysis of Water and Wastewater. Method 200.8, Revision 5.4 (1994).

17.3 RTI Laboratories, Inc. SOP 3020A – Acid Digestion of Aqueous Samples.

17.4 RTI Laboratories, Inc. SOP 3050A – Acid Digestion of Solid Sample.

17.5 RTI Laboratories, Inc. Quality Assurance Plan.

17.6 RTI Laboratories, Inc. SOP SRC001-A_R3, Sample Receipt and Custody.

17.7 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.8 RTI Laboratories, Inc. Employee Handbook.

## 18.0 Revisions

18.1 Standards updated in Sections 7.6 and 7.7.

18.2 Removed Section 11.5.1 – ICPMS2 no longer in service. Section 11.5.2 changed to 11.5.1.

## Appendix A

**TABLE 3**

| Element | Isotopes monitored | Correction equations |
|---|---|---|
| Al | 27 | |
| Sb | 121,123 | Sb 123 = Sb 123 - 0.127189* Te 125 |
| As | 75 | As 75 = as 75 - 3.127*[ArCl 77 - (0.815*Se 82)] |
| Ba | 135,137 | Ba 137=-0.000901*La13g-0.002838*Ce |
| Be | 9 | |
| Cd | 106,108,111,114 | Cd111 = Cd111-1.073*[MoO108-(0.712*Pd106)]<br>Cd114=Cd114-0.026826*Sn118 |
| Cr | 52,53 | |
| Co | 59 | |
| Cu | 63,65 | |
| Pb | 206,207,208 | Pb208 = Pb208 + 1*Pb206+1*Pb207 |
| Mn | 55 | |
| Ni | 60,62 | |
| Ag | 107,109 | |
| Tl | 203,205 | |
| Zn | 66,67,68 | |
| Mo | 95,97,98 | Mo98 = Mo98 - 0.110588*Ru101 |
| Se | 77,82 | Se82 = Se82 - 1.008696 * Kr83 |
| Th | 232 | |
| V | 51 | V51 = V51 - 3.127*[ClO53 - (0.113*Cr52)] |
| Ca | 44 | |
| Mg | 24 | |
| Na | 23 | |
| K | 39 | |
| Fe | 54 | Fe54 = Fe54 - 0.028226*Cr52 |
| Internal standards | | |
| Li | 6 | |
| Sc | 45 | |
| Y | 89 | |
| Rh | 103 | |
| In | 115 | |
| Bi | 209 | |
| Ge | 72 | |

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# STANDARD OPERATING PROCEDURE

# ANALYSIS FOR MERCURY

| | |
|---|---|
| **Analyte:** | **Mercury** |
| **SOP #:** | **7470A_ 7471B_032015_R8** |
| **Method Reference:** | **SW-846 7470A, 7471B** |
| **Issue Date:** | **January 22, 2006** |
| **Revision No.:** | **8** |
| **Revision Date:** | **March 20, 2015** |
| **Reviewed Date:** | **March 20, 2015** |

Reviewed and Approved: **March 20, 2015**

Director, Quality Management: Charles O'Bryan

Director, Environmental Services: Yemane Yohannes

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**ANALYSIS FOR MERCURY**
**SOP#: 7470A_ 7471B_032015_R8**

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## 1.0 Scope and Application

1.1 Introduction

RTI Laboratories, Inc, has prepared this document to detail the Standard Operating Procedure (SOP) for the analysis of drinking, surface, and saline waters, domestic and industrial wastes and solid materials. In addition to inorganic forms of mercury, organic mercurial compounds may be present. These compounds do not respond to the cold vapor atomic absorption technique unless they are first broken down and converted to mercuric ions. Potassium permanganate oxidizes many of these compounds, Potassium persulfate has been found to give approximately 100% recovery when used as the oxidant with these compounds.

1.2 Summary of Method

The flameless AA procedure is a physical method based on the absorption of radiation at 253.7 nm by mercury vapor. The mercury is reduced to the elemental state and aerated from solution in a closed system. The mercury vapor passes through a cell positioned in the light path of an atomic absorption spectrometer. Absorbance (peak height) is measured as a function of mercury concentration and recorded. For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

## 2.0 Safety Precautions

2.1 This method involves working with hazardous substances. Some of the toxicological properties of these substances are not known. Always wear gloves, eye protection and clothing protection.

2.2 Potassium permanganate is a strong oxidizer. Contact with other materials may cause fire. Exposure to potassium permanganate may cause severe eye, skin, and respiratory and digestive tract irritation. May cause kidney damage.

2.3 Hydroxylamine sulfate is corrosive. May cause burns to any area of contact. Harmful if swallowed or inhaled. Affects the blood and is a powerful reducing agent.

2.4 Sodium persulfate causes severe irritation. Harmful if swallowed or inhaled. Strong oxidizer. Contact with other materials may cause fire.

2.5 Stannous chloride is corrosive. May cause severe skin and eye irritation. May cause liver damage, severe respiratory tract irritation and digestive tract irritation with nausea, vomiting and diarrhea

## 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with RTI's Standard Operating Procedure for Sample Receipt and Custody (SRC001-A). Appropriate U.S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed.

3.1.1 Soil, sludge and solid samples are collected in pre cleaned wide mouth glass jars.

3.1.2 Samples can be collected in glass or plastic bottles. Aqueous samples should be preserved with nitric acid to a pH of less than 2 and refrigerated at 4°C. Aqueous samples should have zero headspace and the bottle should not be opened until mercury is ready to be analyzed.

3.1.3 Sample volume minimum requirements: solids - 10 grams, aqueous - 100 ml.

3.1.4 Maximum sample holding time is 28 days.

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 The method detection limit (MDL) is statistically defined at the 99% confidence level according to 40 CFR Part 136 App. B. Seven replicates containing all of the analytes of interest at a concentration level of 1-5 times the estimated D.L. are analyzed and the standard deviation is calculated. The Student's T Value for the 7 replicates (3.143) is multiplied by the standard deviation of the analyte to calculate the MDL. MDLs are updated annually (or as needed) and are kept on file in the Laboratory. MDLs and reporting limits are incorporated into the applicable test code in the Omega LIMS.

4.2 The LOD (limit of detection) is determined by spiking reagent water at 1-4 times the MDL and prepared using the same procedure as samples. Analytes must be present at levels 3 times or greater than the blank response (greater than 3 times the signal to noise ratio). The concentration used is the LOD for that analyte. LOD determinations must be performed quarterly.

4.3 The LOQ (limit of quantification) is determined by spiking reagent water at the reporting limit (RL/CRQL) and prepared in the same manner as samples. Analyte recovery must be within 20% of the expected concentration. The concentration used and successfully recovered is the LOQ for that analyte. LOQ determinations must be performed quarterly.

4.4 Initially accuracy and precision at the LOQ is determined by spiking 4 aliquots of reagent water at the reporting limit (RL/CRQL) and prepared using the same procedure used for samples. The average recovery must be within 20% of the expected value and the %RSD must be less than 15%.

4.5 LOD/LOQ determinations that do not meet the specifications above require repeat analysis, adjustment to the spiking levels and/or reporting limits, repeating the MDL determination at adjusted concentrations if required and repeat LOD/LOQ determinations.

4.6 The accuracy and precision for this method are determined by analyzing four aliquots from a Laboratory Control Sample containing the element(s) of interest at the mid-level of the calculated range (diluted if above this range). Percent recovery, standard deviation, and the relative standard deviation are calculated for each analyte and documents are kept on file in the laboratory.

## 5.0 Interferences

5.1 Possible interference from sulfide is eliminated by addition of potassium permanganate. Concentrations as high as 20 mg/L of sulfide as sodium sulfide do not interfere with the recovery of added inorganic mercury from distilled waster.

5.2 Sea waters, Brines and industrial effluents high in chlorides require additional permanganate (as much as 25 mL) Care must be taken to assure that free chlorine is absent before the mercury is reduced and swept into the cell. Adding excess of hydroxylamine sulfate (25 mL) can eliminate this interference.

5.3 Copper is a reported interference. However copper concentrations up to 10 mg/L have shown no affect on recovery of mercury from spiked samples.

5.4 Volatile organic compounds that absorb at the wavelength used may interfere.

## 6.0 Apparatus and Materials

6.1 Mercury Analyzer: Cetac Quick Trace M6100 with ASX-260 Auto sampler.

6.2 Digestion cups – plastic cups for digesting the samples with marking at 10, 25 and 50ml from Environmental Express

6.3 Water bath, capable of maintaining 95 °C

6.4 Compressed Nitrogen 99.9999%.

6.5 Volumetric glassware - Class A

6.6 Variable volume pipettes – calibrated

6.7 PC with Microsoft Windows XP, Quick Trace Software and Omega LIMS.

## 7.0 Reagents

7.1 Hydrochloric acid concentrated, trace metals grade: JT Baker.

7.2 10% Stannous chloride, reagent grade: Dissolve 10g of stannous chloride in 100ml of 7% HCL. Store at room temperature for up to 5 days.

7.3 Sodium chloride - hydroxylamine hydrochloride, reagent grade: Dissolve 120 g of sodium chloride and 120 g of hydroxylamine hydrochloride in distilled water and dilute to 1000 ml with DI water. Stored at room temperature. Expiration date – 6 mos.

7.4 5% Potassium Permanganate (Alfa Aesar) (%w/v): Dissolve 5 g of potassium permanganate in 100 ml distilled water. Stored at room temperature. Expiration date – 6 mos. Stored at room temperature. Expiration date – 6 mos.

7.5 5% Potassium persulfate (JT Baker) (%w/v): Dissolve 5 g of potassium persulfate in 100 ml of distilled water. Stored at room temperature. Expiration date – 6 mos.

7.6 Primary stock mercury standard 1000mg/L - Absolute. Store at room temperature until manufacturer's expiration date.

7.7 Secondary stock mercury 1000mg/L – Inorganic Ventures. Store at room temperature until manufacturer's expiration date.

7.8 Concentrated Sulfuric acid. – Trace metals grade

7.9 Concentrated nitric acid – Trace metals grade

7.10 Aqua regia – Combine 300 ml concentrated hydrochloric acid with 100 ml of nitric acid. Prepare for each use.

7.11 Reagent Water - Deionized Water – Crossbow DI Express, mixed bed. – Type II

7.12 All reagents and standards prepared must be logged in the appropriate standards/reagents log labeled with a minimum:

7.12.1 Identity of the material.
7.12.2 Concentration of the solution.
7.12.3 Date prepared.
7.12.4 Initials of analyst preparing the solution.
7.12.5 Expiration date.

## 8.0 Preparation of Standards and Calibration Procedure

8.1 Working Mercury Solution: 1 mg/L - prepared fresh daily. Acidity of the working standard should be maintained at 0.15% HCL. Measure 100 µL of 1000 mg/L stock standard (6) and dilute to 100 ml in a volumetric flask containing 1.5 ml nitric acid.

8.2 Water calibration standards are prepared as described below in the same manner as the samples according to Section 9.0. The correlation coefficient of the calibration curve must be >0.995 to continue with the analysis of samples. If this criterion is not met the calibration standards must be re-analyzed or new standards prepared and analyzed until an acceptable correlation coefficient is obtained.

8.2.1 1.0 ppb: (µg/L): Pipette 100 µL of 1 ppm (8.1) working standard into a 100ml volumetric flask that is half full of DI water and 1.5ml of concentrated $HNO_3$ and dilute to mark.

8.2.2 2.0 ppb: (µg/L): Pipette 200 µL of 1ppm(8.1) working standard into a 100ml volumetric flask that is half full of DI water and 1.5ml of concentrated $HNO_3$ and dilute to mark. For reference purposes, the absorbance should be 8000 – 12000 for this standard.

8.2.3 5.0 ppb: (µg/L): Pipette 500 µL of 1ppm(8.1) working standard into a 100ml volumetric flask that is half full of DI water and 1.5ml of concentrated $HNO_3$ and dilute to mark.

8.2.4 10.0 ppb: (µg/L): Pipette 1000 µL of 1ppm (8.1) working standard into a 100ml volumetric flask that is half full of DI water and 1.5ml of concentrated $HNO_3$ and dilute to mark.

8.2.5 0.2 ppb: (µg/L): Pipette 20 µL of 1 ppm (8.1) calibration standard into a 100ml volumetric flask that is half full of DI water and 1.5ml of concentrated $HNO_3$ and dilute to mark.

8.2.6 0.5 ppb: (µg/L): Pipette 50 µL of 1 ppm (8.1) calibration standard into a 100ml volumetric flask that is half full of DI water and 1.5ml of concentrated $HNO_3$ and dilute to mark

8.3 A calibration blank is prepared using 25 ml of DI water and is processed according to the procedure in Section 9.0.

8.4 An intermediate calibration verification standard is prepared from the second source by diluting 100 µl of the 1000 µg/ml standard to a final volume 100 ml DI water containing 1.5 ml of $HNO_3$. Prepare fresh each use.

8.4.1 The daily working CCV is prepared by dilution 200 µl of the intermediate standard (section 8.4) to 100 ml final volume DI water containing 1.5 ml $HNO_3$.

8.5 LCS and Matrix spikes are prepared from the intermediate second source standard (section 8.4).

8.5.1 The LCS is prepared by adding 25 µof the standard to 25 ml DI water. The final concentration of this standard 1 µg/L..

8.5.2 MS/MSD samples are prepared by adding 25 µL of standard to 25 ml of a sample. The final concentration of the MS/MSD are 100 µg/Kg.

8.6 Soil calibration standards are prepared as below in the same manner as the samples according to Section 9.0. The correlation coefficient of the calibration curve must be >0.995 to continue with the analysis of samples. If this criterion is not met the calibration standards must be re-analyzed or new standards prepared and analyzed until an acceptable cc is obtained.

8.6.1 1.0 ppb: (µg/L): Pipette 30 µL of 1 ppm (8.1) working standard into a digestion cup containing 5 ml of reagent water and 5 ml of aqua regia and proceed with Sec. 9.3.3.

8.6.2 2.0 ppb: (µg/L): Pipette 60 µL of 1 ppm (8.1) working standard into a digestion cup containing 5 ml of reagent water and 5 ml of aqua regia and proceed with Sec. 9.3.3.

8.6.3 5.0 ppb: (µg/L): Pipette 150 µL of 1 ppm (8.1) working standard into a digestion cup containing 5 ml of reagent water and 5 ml of aqua regia and proceed with Sec. 9.3.3.

8.6.4 8.0 ppb: (µg/L): Pipette 240 µL of 1 ppm (8.1) working standard into a digestion cup containing 5 ml of reagent water and 5 ml of aqua regia and proceed with Sec. 9.3.3.

8.6.5 0.2 ppb: (µg/L): Pipette 6 µL of 1 ppm (8.1) intermediate standard into a digestion cup containing 5 ml of reagent water and 5 ml of aqua regia and proceed with Sec. 9.3.3.

8.6.6 0.5 ppb: (µg/L): Pipette 15 µL of 1ppm (8.1) intermediate standard into a digestion cup containing 5 ml of reagent water and 5 ml of aqua regia and proceed with Sec. 9.3.3.

8.7 A calibration blank is prepared using 5 ml of DI water and 5 ml of aqua regia and is processed according to the procedure in Section 9.0.

8.8 An intermediate calibration verification standard is prepared from the second source by diluting 100 µl of the 1000 µg/ml standard to a final volume 100 ml DI water containing 1.5 ml of $HNO_3$. Prepare fresh each use.

8.8.1 The daily working CCV is prepared by dilution 60 µl of the intermediate standard (section 8.8) to a digestion cup containing 5 ml DI water and 5 ml aqua regia and continue with section 9.3.3.

8.9 LCS and Matrix spikes are prepared from the intermediate second source standard (section 8.8).

8.9.1 The LCS is prepared by adding 30 µL of the standard (Sec 8.8) to 5 ml DI water and 5ml aqua regia. The final concentration of this standard is 50 µg/Kg.

8.9.2 MS/MSD samples are prepared by adding 30 µL of the standard to 0.6 g of a sample. The final concentrations of the MS/MSD are 50 µg/Kg.

## 9.0 Sample Preparation

9.1 Allow samples to warm to ambient temperature.

9.2. Method 7470 sample preparation

9.2.1 Transfer 25ml of sample or an aliquot diluted to 25ml in the 50ml digestion cups.

9.2.2 Add 0.75 ml of concentrated $HNO_3$ and 1.25 ml concentrated sulfuric acid to each sample, standard and QC samples.

9.2.3 Add 3.75 ml of potassium permanganate solution (see 7.4) to each bottle and mix. Alternatively add enough crystals of potassium permanganate for the sample to turn purple and hold color for at least 15 minutes

Note: For sewage samples, additional permanganate may be required. Add potassium permanganate crystals until the purple color persists for 15 minutes.

9.2.4 Add 2.0 ml of potassium persulfate (see 7.5) to each bottle.

9.2.5 Heat for 2 hours in a water bath at 95°C.

9.2.6 Add 2.0ml hydroxylamine hydrochloride (see 7.3) to the cups.

9.3 Method 7471 sample preparation.

9.3.1 Transfer 0.5 – 0.6g of solid sample taken as ~0.2g portions from the container.

9.3.2 Add 5 ml of reagent water and 5 ml aqua regia to each sample.

9.3.3 Heat for 2 minutes at 95 +/- 3 degrees C in a water bath.

9.3.4 Allow to cool: then add 25 ml of reagent water and 7.5 ml of potassium permanganate solution.

9.3.5 Mix thoroughly and place in the water bath at 95 degrees C for 30 minutes.

9.3.6 Cool and add 2.0ml hydroxylamine hydrochloride (see 7.3).

## 10.0 Diagram/Table

10.1 Reserved.

## 11.0 Analytical Procedure

11.1 Prepared samples are analyzed within 48 hours of sample preparation.

11.2 Turn the instrument on. (Let it warm up for at least 1 hour)

11.3 Turn the mercury lamp on (Let it warm for 10 minutes)

11.4 Connect the tensioners on the auto sampler over the rinse tubes (located behind the left corner of the auto sampler.

11.5 Connect the tubes on the peristaltic pump and engage the tensioner (also turn pump ~30° so that sample line doesn't get tangled).

11.6 Align the tensioner fingers over the tubing.

11.7 Fill reagent bottle (10% $SnCl_2$). Fill rinse bottle (2%$HNO_3$).

11.8 Reagent bottle: in a 1L plastic add 100g Stannous Chloride dehydrate. Add about 200ml DIW. Shake. Add 70ml conc. HCL. Shake to dissolve completely. Fill up to the 1L mark with DIW. Shake. Solution is ready for use. Solution can be stored in refrigerator for up to 5 days.

11.9 Rinse solution: 2.0% Nitric acid/5% HCl (20ml conc. HNO3 and 50ml conc. HCl diluted to 1000ml)

11.10 Check waste container and empty if needed.

11.11 Turn peristaltic pump on.

11.12 Wet the GLS (gas liquid separator) as in the following steps

11.13 Pinch the drain tubing (coming out of the GLS) to fill the GLS with liquid (DIW or rinse solution) without allowing the liquid to reach the dryer (Nafion).

11.14 Turn on the rinse pump and put the auto sampler tube down using the software controls (go to Auto Sampler, click “Down” for sample probe to go down to rinse).

11.15 Turn the Gas flow on from the tank. (N2, valve is behind peristaltic pump and set at 40 PSI).

11.16 Set up Worksheet for mercury analysis.

11.17 Load a new Worksheet from a template

11.18 Make label file (date, analyst, comment, sample type-QC std., QC blk., Sample ID-MB, LCS, etc.)

11.19 Final sample preparation steps immediately before analysis.

11.20 Add 1.5 ml of hydroxylamine hydrochloride to 10ml of sample (1.5ml/ 10ml)

11.21 Decant the clear portion of the sample into the culture tubes.

11.22 Filter samples through Whatman #41 filter paper if samples contain significant particulates, these will clog the sampling tube, so must be removed.

11.23 Then place the culture tubes in the sample rack.

11.24 Zero the instrument.

11.25 Calibrate the instrument following manufacturer’s manual and instructions. Place calibration standards, QC check std. and QC check blank in the calibration rack (be sure to remove the caps).

11.26 After the calibration is done, make sure correlation coefficient is 0.995 or greater. The calibration must be based on at least five data points.

11.27 Run samples that are in the worksheet.
(Note: SnCl2 is added on line)

11.28 After all analyses are complete put instrument into standby mode.

11.29 Use a bottle of DI water to rinse all lines starting with the reagent lines.

11.30 Remove the tubing from the reagent bottle and put it in the DIW bottle, and allow the pump to run for several minutes, and then turn off the pump.

11.31 Remove the two tubes from the Rinse bottle and allow DI water to pump for several minutes, and then use the software to raise the auto sampler sipper up and stop the auto sampler pump. Then release the tension on the auto sampler rinse lines.

## 12.0 Details of Calibration and Calculations

12.1 Final results are calculated as specified in section 14.

12.2 The CCV must be analyzed at the frequency specified in Section 13 and the concentration must be within 10% of the known value for confirmation of instrument calibration.

12.3 Continuing calibration standards are evaluated by:

% Recovery = actual conc./expected conc. * 100

12.4 Percent recovery - LCS

% Recovery = conc. recovered/conc. expected * 100

12.5 Relative Percent Difference – Duplicate samples

RPD = [result 1 - result 2]/average result1.result2) * 100

12.6 Initial Calibration Equation.

y = mx + b
y = sample absorbance
m = slope
x = sample concentration
b = intercept

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 A calibration verification standard (CCV) is analyzed following initial instrument calibration, after every 10 samples and at the end of the analytical sequence.

13.1.1 Acceptance Criteria **90 - 110 %**

13.1.2 Corrective Action: Repeat CCV and all samples preceding a CCV failure. Recalibrate if the problem persists.

13.2 A calibration verification blank (CCB) is analyzed following initial instrument calibration, after every 10 samples and at the end of the analytical sequence.

13.2.1 Acceptance Criteria **< LOD**

13.2.2 Corrective Action: Repeat CCB and all samples preceding a CCB failure. Evaluate system for sources of contamination and correct the problem before proceeding with sample analysis.

13.3 A Method Blank is processed with each batch of samples.

13.3.1 Acceptance Criteria **< ½ LOQ (RL)**

13.3.2 Corrective Action: Repeat analysis. Evaluate the systems for contamination sources and repeat the batch as necessary.

13.4 Laboratory Control Sample (LCS) – Prepared according to Section 8.5.

13.4.1 A LCS is processed with each batch of samples

13.4.2 Acceptance Criteria **82 – 119 %-Aqueous, 80 – 124%-Solid**

13.4.3 Corrective Action: Repeat LCS and sample batch as necessary.

13.5 Matrix Spike (MS) - Matrix Spike Duplicate (MSD) – Prepare as in Section 8.5.

13.5.1 For each batch of samples a MS/MSD is prepared. The recovery and relative percent difference (RPD) are determined. Statistical control limits are calculated in the LIMS.

13.5.2 Acceptance Criteria (% recovery) **82 – 119 %-Aqueous, 80 – 124%-Solid** or within laboratory established statistical control limits.

13.5.3 Corrective Action: Dilute and re-spike/re-analyze to determine if interferences can be overcome by sample dilution. If unsuccessful or if sample volume precludes re-analysis, flag data as possible matrix interference.

13.5.4 Acceptance Criteria (RPD) **<20 %** or within laboratory established statistical control limits.

13.5.5 Corrective Action: Evaluate sample homogeneity and flag data if necessary.

13.6 Duplicate Sample (DUP) prepared with each of samples

13.6.1 Acceptance Criteria (RPD) **<20%** or within laboratory established statistical control limits.

13.6.2 Corrective Action: Evaluate sample homogeneity and flag data if necessary.

13.7 One serial dilution must be preformed for every batch of samples prepared provided one of the samples has a concentration of >50 times the MDL .The dilution test is performed by making a five fold dilution of the sample. The result of the serial dilution must agree within +/- 10% of the original reading.

13.8 One post digestion spike (PDS) must be preformed for every batch of samples prepared that exhibits MS/MSD results exceeding control limits, provided one of the samples has a concentration of <50 times the MDL. The digestion solution is spiked at a concentration of 1 ug/L. The recovery of the PSD must be within 80 - 120%.

13.9 Reporting limit verification is assessed by analyzing the 0,2 calibration standard at the end of the analytical sequence. Recovery of this standard must be within 70 – 130 %. If the recovery falls outside of this range the analytical sequence must be repeated.

13.10 Method of Standard Additions (Internal Calibration Quantification) – performed for cases of matrix interference.

13.10.1 Four identical aliquots of the sample are taken.

13.10.2 Three of the aliquots are spiked with calibration standard solution at various concentrations that would approximate 50%, 100% and 150% of the expected analyte concentration.

13.10.3 The four aliquots are analyzed and the instrument signal is plotted versus the added concentration. This may be performed directly by the instrument or by using a linear regression plot (i.e. Excel spreadsheet). The y-intercept is determined which corresponds to the concentration of the analyte in the sample.

## 14.0 Data Reporting Requirements

14.1 Sample results are reported as µg/L (aqueous samples) and µg/kg (solid samples).

14.2 Raw results are entered into Omega. Prep factors are automatically imported from sample prep logs. Dilutions are entered in the analytical sequence.

14.3 Sample results are reported as ug/L for water and ug/kg for soil as dry weight.

µg/kg dry wt. = µg/kg wet wt.*100/percent solids

14.4 Raw instruments results are entered directly into the Omega LIMS system using excel spreadsheets, direct instrument interface or manually. All calculations to derive final result (including dry weight conversions) are performed automatically by the LIMS. Sample preparation information and percent moisture results are entered into the appropriate section of the LIMS prior to instrument data and are automatically factored into the final results.

14.5 Confirm that there is no QC flags or qualifiers in this sequence. If present, investigate and repeat or reanalyze as necessary. See section 9.2 of the QAP for more detail on qualifiers.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 Examine all tubing and replace as needed.

15.2 Clean GLS as needed.

15.3 Replace Nafion drying cartridge as needed.

## 16.0 Pollution Prevention and Waste Management

16.1 Pollution Prevention

16.1.1 All hazardous waste produced by this method is stored in a waste drum until that drum can be processed and disposed of properly by a professional waste management company

.

16.1.2 All samples are processed with the minimum quantity of reagents possible. This is to reduce the amount of waste generated by the test method, and, consequently, the amount of pollution generated by RTI.

16.2 Waste Management

16.2.1 Acidic materials (pH<2) are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Disposal of materials is addressed in the laboratory QAP.

## 17.0 References

17.1 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, Method 7471B (Update IVA).

17.2 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, November 1986, Revision 1 September 1994 Method 7470A.

17.3 Standard Methods for the Examination of Water and Wastewater, 20th Edition, Method 3112 B.

17.4 USEPA Methods for Chemical Analysis of Water and Wastewater, 600/4/70/200 (Rev.3/1983), Method 245.1.

17.5 RTI Laboratories, Inc. Quality Assurance Plan.

17.6 RTI Laboratories, Inc. SOP SRC001-A, Sample Receipt and Custody.

17.7 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.8 RTI Laboratories, Inc. Employee Handbook.

## 18.0 Revisions

18.1 Sections 8.2.5, 8.2.6, 8.6.5 and 8.6.6 revised for use of 1ppm standard - previously used individual ppb standards.

18.2 Rinse solution (Section 11.9) modified to incorporate 5% HCl.

18.3 Sections 13.7 and 13.8: Criteria of 25 changed to 50.

RTI Laboratories, Inc.
31628 Glendale
Livonia, Michigan 48150

# STANDARD OPERATING PROCEDURE

## ANALYSIS OF DEISEL AND OIL (RESIDUAL/LUBE) RANGE ORGANIC COMPOUNDS

| | |
|---|---|
| **Analyte:** | **Petroleum Organic Compounds** |
| **SOP #:** | **8015BDRO_ORO_040815_R3.1** |
| **Method Reference:** | **EPA SW846 – 8015B, AK102, AK103, MDEQ, WI DNR** |
| **Issue Date:** | **July 18, 2009** |
| **Revision No.:** | **3.1** |
| **Revision Date** | **May 18, 2015** |
| **Reviewed Date:** | **May 18, 2015** |

Director, Quality Management: Charles O'Bryan

Director, Environmental Services: Yemane Yohannes

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**ANALYSIS OF DEISEL AND OIL (RESIDUAL/LUBE) RANGE ORGANIC COMPOUNDS**

**SOP#: 8015BDRO_ORO_040815_R3.1**

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# 1.0 Scope and Application

## 1.1 Introduction

RTI Laboratories, Inc., has prepared this document to detail the Standard Operating Procedure (SOP) for the preparation and analysis of water and soil samples for diesel range compounds (DRO) and oil range organic compounds (ORO, RRO and LRO) by gas chromatography. For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

A detailed description of the instrumentation, calibration, run parameters and quality control procedures where applicable is included in this SOP.

## 1.2 Summary of Method

1.2.1 DRO samples are prepared for analysis using either liquid: liquid extraction for aqueous samples, sonication or hot block extraction (solids/soils). Sample cleanup procedures are employed when necessary. Compounds are introduced into the GC by injecting an aliquot of the sample extract. The GC column is temperature programmed to separate the analytes, which are then detected with a flame ionization detector (FID). Identification of the target analytes is accomplished by comparing GC pattern with diesel and motor oil standards. Quantification is accomplished by comparing the response to a five-point standard calibration curve.

# 2.0 Safety Precautions

2.1 Compounds applicable to this method may be known or suspected carcinogens. Standard preparation is conducted in fume hoods designated for organic use.

2.2 Extraction solvents are flammable and/or toxic and must be handled with caution. All extractions are performed in a manner designed to minimize exposure to these chemicals using appropriate hoods and personal protection.

# 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with RTI's Standard Operating Procedure for Sample Log-in. Appropriate U. S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed. Water samples are collected in 1L pre-cleaned amber bottles with Teflon lined screw caps. No preservative is added to the sample containers. Soil samples are collected in pre-cleaned wide mouth jars with Teflon lined lids ranging from 2 oz. to 9 oz. in size.

3.1.1 The holding time for water samples is 7 days from collection to extraction and 40 days from extraction to analysis.

3.1.2 The holding time for solid samples is 14 days from collection to extraction and 40 days from extraction to analysis.

3.1.3 All samples and extracts are stored at 4° C.

3.1.4 Sampling procedures for Wisconsin DRO.

3.1.4.1 Aqueous samples collected in 1 L amber containers must be preserved with 5 ml of 50% HCl.

3.1.4.2 Soil samples are collected in pre-weighed 60 ml VOA vials. Samples should be collected by weighing (or estimating from the soil density) 25 grams of soil directly into the vial.

3.1.4.3 Samples must be shipped to be received within 72 hours of collection.

3.1.4.4 Vials are weighed on receipt at the laboratory to determine the amount of soil added. Methylene chloride is added to each sample vial as follows:

3.1.4.1 Samples containing <25 grams: Add 25 ml of solvent and flag. Limits will be automatically adjusted by the LIMS.

3.1.4.2 Samples containing >35 grams are rejected.

3.1.4.3 Vials containing between 25 and 35 grams of sample, additional methylene chloride is added to the vial to bring the solvent/soil ratio to 1:1.

3.1.4.5 Samples must be stored on ice or at 4°C. Sample holding time is 3 days from collection to addition of solvent and 47 days to extraction and analysis.

3.1.4.6 A separate bulk soil sample must be collected for percent solids determination.

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 The method detection limit (MDL) is statistically defined at the 99% confidence level according to 40 CFR Part 136 App. B. Seven replicates containing all of the analytes of interest at a concentration level of 1-5 times the estimated D.L. are analyzed and the standard deviation is calculated. The Student's T Value for the 7 replicates (3.143) is multiplied by the standard deviation of the analyte to calculate the MDL. MDLs are performed on instrument set up and following

significant changes to the instrument, method or personnel. MDLs are kept on file in the Laboratory. MDLs and reporting limits are incorporated into the applicable test code in the Omega LIMS.

4.2 The LOD (limit of detection) is determined by spiking reagent water at 1-4 times the MDL and prepared using the same procedure as samples. Analytes must be present at levels 3 times or greater than the blank response (greater than 3 times the signal to noise ratio). The concentration used is the LOD for that analyte. LOD determinations must be performed quarterly.

4.3 The LOQ (limit of quantification) is determined by spiking reagent water at the reporting limit (RL/CRQL) and prepared in the same manner as samples. Analyte recovery must be within 20% of the expected concentration. The concentration used and successfully recovered is the LOQ for that analyte. LOQ determinations must be performed quarterly.

4.4 Initially accuracy and precision at the LOQ is determined by spiking 4 aliquots of reagent water at the reporting limit (RL/CRQL) and prepared using the same procedure used for samples. The average recovery must be within 20% of the expected value and the %RSD must be less than 15%.

4.5 LOD/LOQ determinations that do not meet the specifications above require repeat analysis, adjustment to the spiking levels and/or reporting limits, repeating the MDL determination at adjusted concentrations if required and repeat LOD/LOQ determinations.

4.6 The accuracy and precision for this method are determined by analyzing four aliquots from a Laboratory Control Sample containing the element(s) of interest at the mid-level of the calibration range. Percent recovery, standard deviation, and the relative standard deviation are calculated for each analyte and documents are kept on file in the laboratory.

## 5.0 Interferences

5.1 Interferences can arise from carryover due to high sample concentrations or contamination from reagents and/or glassware. Blanks are injected to ensure system cleanliness in both instances. All glassware must be scrupulously cleaned before use.

5.2 Samples containing high concentrations of non-target analytes or extremely high levels of select target analytes can result in elevated detection limits for other target analytes. Dilution of the extract may improve the resolution and quantification but will generally cause an elevation in the RDL. Interferences from high molecular weight organics such as oils will cause an elevated baseline. If this background is at a high concentration it will interfere with analyte identification as well as quantification.

## 6.0 Apparatus and Materials

6.1 Glass Funnels or HDPE if glass in unavailable.

6.2 pH indicator paper

6.3 Graduated cylinders. 1000ml and 100ml

6.4 Glass beakers, 250 ml size.

6.5 Microliter syringes, 50ul, 10 ul, 25ul.

6.6 Volumetric glassware

6.7 Glass vials – 2ml with Teflon lined screw caps.

6.8 Pyrex glass wool

6.9 Pasteur pipettes

6.10 HP 6890 GC with FID and 7673 auto sampler

6.11 GC column - RTX-5 30m, 0.53mm, 1um, cat# 10255

6.12 PC with Microsoft Windows NT, Agilent Chem Station data system software Version B and Omega LIMS.

**Table - GC Instrument Settings**

| Typical GC Parameters: | Settings DRO |
|---|---|
| Initial column temperature | 50 degrees C |
| Initial hold time | 1 minutes |
| 1st ramp rate/temp. | 25 degrees/min to 300 degrees C. |
| Hold time – to temp 2 | 9 minutes |
| Injector Temperature | 250 degrees C. |
| Detector Temperature | 300 degrees C. |
| Run Time (min) | 20 |

## 7.0 Reagents

7.1 Anhydrous Sodium sulfate

7.2 Methylene chloride – pesticide grade, Methanol – pesticide grade and Acetone – reagent grade

7.3 C8-C40 Retention Time Standard, 500ug/mL, Ultra, cat# SFL-601. Store refrigerated to manufacturer expiration date. 1 year after opening

7.4 SAE 30 Motor Oil, 20mg/ml, Absolute Standards, cat# 51030. Store refrigerated to manufacturer expiration date. 1 year after opening.

7.5 #2 Fuel Oil Diesel, 20mg/ml, Absolute Standards, cat# 51006. Store refrigerated to manufacturer expiration date. 1 year after opening.

7.6 SAE 30W Motor Oil, 20mg/ml, Accustandard, cat# FU-018-D-40X. Store refrigerated to manufacturer expiration date. 1 year after opening.

7.7 #2 Fuel Oil Diesel, 20mg/ml, AccuStandard. Store refrigerated to manufacturer expiration date. 1 year after opening.

7.8 DRO Mix (EPA/Wisconsin), Ultra 2000 µg/ml.

7.9 n-Eicosane-surrogate, Ultra 1000 µg/ml.

7.10 Squalene-surrogate, Ultra 1000 µg/ml.

7.11 ASTM Type II DI.

7.12 Helium – UHP.

7.13 Hydrogen –UHP

7.14 Zero Air – ultra zero grade

7.15 All reagents and standards prepared must be logged in the appropriate standards/reagents log labeled with a minimum:

7.15.1 Identity of the material
7.15.2 Concentration of the solution
7.15.3 Date prepared
7.15.4 Initials of analyst preparing the solution
7.15.5 Expiration date.

## 8.0 Preparation of Standards and Calibration Procedure

8.1 Preparation of initial calibration standards:

8.1.1 The initial calibration standards are prepared directly from the stock standards listed in section 7.3, 7.4 and 7.9. Five standards are prepared by diluting the stock standard in methylene chloride. Standards are prepared to encompass the calibration range of 200 to 10000 mg/l ORO and 50 to 10000 mg/l DRO.

ORO Calibration Curve

| Level (ug/ml) | Volume (ul) SAE 30 Motor Oil, 20mg/ml, Absolute Standards, cat# 51030/100 ul surr. | Final Volume (ml) methylene chloride |
|---|---|---|
| 10000 | 500 | 1 |
| 5000 | 250 | 1 |
| 2000 | 100 | 1 |
| 1000 | 50 | 1 |
| 500 | 25 | 1 |
| 200 | 10 | 1 |

DRO Calibration Curve

| Level (ug/ml) DRO/Surr* | Volume (µl) WI DRO (7.8) or #2 Fuel Oil Diesel (7.5) | Volume (ul) n-Eicosane*/ Squalene 1000 µg/ml | Final Volume (ml) methylene chloride |
|---|---|---|---|
| 10000 | 500 | - | 1 |
| 5000/30 | 250 | 30 | 1 |
| 1000/20 | 50 | 20 | 1 |
| 500/15 | 25 | 15 | 1 |
| 200/10 | 10 | 10 | 1 |
| 100/5 | 5 | 5 | 1 |
| 50 | 2.5 | - | |

* N-Eicosane must not be added for Wisconsin DRO calibrations

8.1.2 The ICV/CCV are made from the second source standards listed in section 7.5, 7.6 and 7.3.

1000 ug/ml DRO/ORO ICV/CCV Standard

| Volume (µl) SAE 30W Motor Oil, 20mg/ml, Accustandard, cat# FU-018-D-40X | Volume (µl) #2 Fuel Oil, 20mg/mL, Accustandard, cat# FU-002-D-40X | Volume (µl) n-Eicosane *, 1000 ug/ml | Final Volume (ml) methylene chloride |
|---|---|---|---|
| 50 | 50 | 20 | 1 |

1000 ug/ml DRO/ ICV/CCV Standard – Wisconsin DRO

| Volume (µl) WI DRO Standard | Volume (µl) Squalene, 1000 ug/ml | Final Volume (ml) methylene chloride |
|---|---|---|
| 20 | 20 | 1 |

8.2 The average RSD of the calibration curve must be <20% or the $r^2$ >0.99 for linear regression.

8.3 The CCV standard must be within 80 –120% of the expected value.

## 9.0 Sample Preparation

9.1 Allow samples to warm to ambient temperature and prepare according to SOPs for liquid or solid extraction as applicable for DRO analysis.

## 10.0 Diagram/Table

10.1 Reserved.

## 11.0 Analytical Procedure

11.1 Set up run sequence according to the data system software protocol using the following template.

11.1.1 C8-C40 Retention Time Standard
11.1.2 CCV (following initial calibration if applicable).
11.1.3 LCS
11.1.4 Method Blank
11.1.5 10 samples
11.1.6 MS/MSD
11.1.7 Continue with sample analyses up to 12 hours from time of initial CCV.
11.1.8 Repeat CCV at 12 hours and proceed from 11.1.2.

11.2 Set GC conditions according to table 3 in section 6.

11.3 Activate applicable method in the Varian Star data system.

11.4 Activate sequence in the data system.

11.5 Compound identification and quantification

11.5.1 Compound identification is based on ranges of organic compounds by analyzing a Retention Time Standard (Sec 7.3). The DRO window should include C10 and just end prior to C20. The ORO window should begin just after C20 and include C34. This procedure conforms to the protocol specified by the State of Michigan DEQ. Other States (i.e. Alaska, Ohio) or programs define DRO/ORO based on alternate hydrocarbon ranges. Quantification over the specified ranges will be performed in accordance with program specified carbon ranges.

11.5.2 Verify that the integrator is drawing a horizontal baseline from a consistent point across the summed area. The entire signal in the analyte range is to be used for calibration. Valley to valley integration shall not be used. For samples analyzed for the State of Alaska the DRO range is from the peak start of C10 to the peak start of C25 and for RRO the range is from the peak start of C25 to the peak end of C36.

11.5.2.1 For State of Wisconsin samples the carbon range is from the start of the n-Decane (C10) peak to the end of the n-Octacosane (C28) peak.

11.5.2.1.1 Integration of standards and samples is performed by baseline placement of a horizontal line parallel to the x-axis of the chromatogram through the lowest point in the chromatogram before the end of the window.

11.5.2.1.2 Integration is baseline to baseline and includes all responses within the retention time window.

11.5.2.1.3 The area response for samples as determined above is compared to the calibration curve (area responses for standards are determined in the same manner as above) for quantification of GRO in the sample.

11.5.2.1.4 No area can be subtracted from the RT window in the calculation of sample concentrations.

11.5.2.1.5 Report the presence of significant peaks outside the RT window when observed.

11.5.3 Analyst experience in evaluating chromatograms and identifying compounds in the presence of interfering components is important in final compound identification.

11.5.4 Identified compounds are quantified from the average response factor of the initial calibration or other calibration model employed when required.

11.5.5 Compounds exhibiting concentrations above the upper calibration level are diluted into the calibration range. If insufficient sample is available for dilution (i.e. both water sample vials already used) the concentration is flagged as estimated ("E").

11.5.6 Compound concentrations that are below the laboratory reporting limit or lowest calibration point but positively identified above the MDL are flagged as estimated ("J").

11.6 Manual integration guidelines and procedures

11.6.1 Situation may arise whereby the quantification provided by the data system is inappropriate. This can occur due to co-elution, baseline noise or matrix interference.

11.6.2 When manual integration of a compound is necessary the following guidelines must be followed.

11.6.2.1 Manual quantification is performed by integrating the area of the compound peak.

11.6.2.2 The integration will only include the area attributable to the compound of interest.

11.6.2.3 The area integrated shall not include baseline background noise.

11.6.2.4 The area integrated shall not extend beyond the point where the sides of the peak intersect with the baseline.

11.6.2.5 Manual integration must not be used solely to meet quality control criteria.

11.6.2.6 Manual integration must not be used as a substitute for corrective action on the GC system.

11.6.3 Instances of manual integration are flagged with an "U" by the data system. This is sufficient for routine integrations in obvious cases of peak interference and when not required to be reported as part of the contracted laboratory report. Other cases of manual integrations are documented in the LIMS analytical sequence sample comments.

## 12.0 Details of Calibration and Calculations

12.1 Response Factor:

Rf = Peak Area/Std. Conc.

12.2 % RSD:

Average Rf = (Rf1+Rf2+Rf3+Rf4+Rf5)/5

Std. Dev. = SQRT [($sumx^2$ - $sum(x)^2$/n)/(n-1)]

%RSD = Std. Dev./Average Rf x 100

12.3 Percent Difference:

$$\% \text{ Diff} = \frac{C_e - C_f}{C_e} \times 100$$

Where: $C_e$ = Expected concentration
$C_f$ = Concentration found

12.4 Surrogate compound recovery adjusted for DRO/ORO – Surrogate recovery is adjusted by analyte concentration. Each of the analyte ranges has an additive effect on the n-eicosane surrogate. Calculate the concentration of the surrogate in all samples, blanks, LCS, MS/MSD as follows:

$$\%\text{recovery} = \frac{((\text{Surr Conc}-(\text{DRO Conc} \times 0.01)-(\text{ORO Conc} \times 0.0022)) \times 100}{20\text{ug/mL}}$$

12.5 Linear Regression: y = ax + b

Where: y = Instrument response (peak area)
a = Slope of the line
x = Concentration of the calibration standard
b = Intercept

12.6 Relative Percent Difference (RPD)

RPD = (| R1 – R2 | / ((R1 + R2)/2)) * 100

Where: R1 = First result

R2 = Second result

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 Daily Setup of Blanks and Standards.

13.1.1 A continuing calibration verification standard (CCV) must be analyzed to assure the working curve is still valid. The % Difference or (% drift) must be less than 15%.

13.1.2 If the check standard is found to exceed 15% difference then an additional check standard may be analyzed and compared to the curve as above. If this second check standard is still out of control, initial calibration must be performed and a new 5-point curve generated. If the second check standard is within the allowable 15% difference samples may be analyzed using the average Cf from the curve for quantification. The daily continuing calibration verification standard should be run after every 10 samples but is considered valid for 12 hours.

13.1.3 A method blank must be run at the beginning of each day to guarantee the system is free of contamination. If any compounds are found in the blank at levels greater than ½ the LOQ (RL) the source of contamination must be identified and corrective action taken before sample analysis can proceed. Corrective actions include reanalysis of the method blank, analysis of reagent blanks, baking systems components (column, detector) and checks on sample preparation procedure. Contamination which does not interfere with the GRP or DRO range of compounds may be ignored.

13.2 LCS, Matrix Spike/Matrix Spike Duplicate

13.2.1 In each batch of samples a Laboratory Control Sample (LCS), matrix spike, and matrix spike duplicate (MSD) must be analyzed.

Note: for sample sets collected for the State of Alaska and State of Wisconsin a LCSD is required.

For water samples, preparation of batch MS/MSD is dependent upon the availability of extra sample provided by the client. In the absence of sufficient sample volume a LCS duplicate should be prepared. Statistical control limits are calculated for the recoveries and duplicate percent differences to determine warning and control limits. If a sample falls outside of these limits action will be taken to determine if the cause was due to matrix interference or method deficiencies including re-preparation of these QC samples when appropriate.

13.2.1.1 Acceptance Criteria MS/MSD – within laboratory statistical limits. Default limits - 70-130% recovery.

13.2.1.2 Acceptance Criteria RPD – within laboratory statistical limits. Default limit - 20%.

13.2.1.3 Acceptance Criteria LCS - 70 - 130 %.

13.2.1.4 LCS/LCSD limits for AK102 – 75 – 125%, RPD <20%

13.2.1.5 LCS/LCSD limits for AK103 – 60 – 120%, RPD <20%

13.3 Surrogate Control Limits

13.3.1 For each sample matrix the first 30 surrogate recoveries are used to establish control limits based on the Mean recovery +/- 3 times the standard deviation. This procedure is performed annually.

13.3.2 Surrogate Recovery Limits – AK102/AK103

13.3.2.1 CCV: 60 – 120%

13.3.2.2 LCS/LCSD: 60 – 120%

13.3.2.3 Sample: 50 – 150%

13.3.2 For samples (including QC samples) in which the surrogate recovery falls outside the established control limits, the following is required.

13.3.2.1 Check calculations for errors

13.3.2.2 Check instrument performance

13.3.2.3 Re-extract and re-analyzed the samples if the above show no problems or flag the data if sample matrix interference is present.

## 14.0 Data Reporting Requirements

14.1 If the concentration found in a sample is greater than that of the highest standard the sample must be re-analyzed after dilution. The sample should be diluted until the level is within the working range of the standard curve.

14.2 Sample concentrations are reported in ug/ml from the Star data system.

14.3 Raw results are entered into Omega. Prep factors are automatically imported from sample prep logs. Dilutions are entered in the analytical sequence.

14.4 Sample results are reported as ug/L for water and ug/kg for soil as dry weight.

ug/kg dry wt. = ug/kg wet wt.*100/percent solids

14.4 Raw instruments results are entered directly into the Omega LIMS system using excel spreadsheets, direct instrument interface or manually. All calculations to derive final result (including dry weight conversions) are performed automatically by the LIMS. Sample preparation information and percent moisture results are entered into the appropriate section of the LIMS prior to instrument data and are automatically factored into the final results.

14.5 Confirm that there are no QC flags or qualifiers in this sequence. If present, investigate and repeat or reanalyze as necessary.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 Change septum weekly or as needed. (100 injections max.)

15.2 Check carrier gas daily

15.3 Change carrier and make up gas traps every 6 months or sooner as needed.

15.4 Bake out column as needed (350 $^{0}$C for 1 hour by running the “BAKE” program in STAR).

15.5 Clean FID as needed.

## 16.0 Waste Management and Pollution Prevention

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner, which minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Organic solvents are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Soil samples are composited in a drum designated for incineration.

16.2.3 Disposal of materials is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, December 1996, Revision 2. Method 8015B

17.2 Alaska Series Laboratory Methods for the Analysis of Gasoline Range Organics. Alaska Department of Environmental Conservation (ADEC) Method AK102, AK103, Version 04/08/02.

17.3 Gasoline Range Organics (GRO by Gas Chromatography/Mass Spectrometry (GC/MS). Michigan Department of Environmental Quality, SOP#507, Revision# 0, Jan. 2007.

17.4 Modified DRO. Method for Determining Diesel Range Organics. Wisconsin DNR, September 1995 – PUBL-SW-141.

17.5 RTI SOP#'s 3510C_052506_R3 and 3550B_052506_R4.

17.5 Laboratories, Inc. Quality Assurance Plan.

17.6 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.7 RTI Laboratories, Inc. SOP: SRC001-A, Sample Receipt and Custody SOP.

17.8 RTI Laboratories, Inc. Employee Handbook.

## 18.0 Revisions

18.1 Revisions to this version incorporate procedures for Wisconsin GRO analyses.

18.1.1 Added Wisconsin calibration standards (Section 7.9).

18.1.2 Added tables to Section 8 for preparation of standard for Wisconsin method.

18.1.3 Section 11.5.2.1.

18.1.4 Added Section 3.1.4

18.1.5 Revised Instrument Table in Section 6.

18.2 Revision 3.1: Added AK control limits to Section 13.

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# STANDARD OPERATING PROCEDURE

# ANALYSIS OF GASOLINE RANGE ORGANIC COMPOUNDS

| | |
|---|---|
| **Analyte:** | **Petroleum Organic Compounds** |
| **SOP #:** | **8015DGRO_040815_R4** |
| **Method Reference:** | **EPA SW846 – 8015D, AK101, MDEQ 505, WI DNR** |
| **Issue Date:** | **July 18, 2009** |
| **Revision No.:** | **3** |
| **Revision Date:** | **April 8, 2015** |

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**ANALYSIS OF GASOLINE RANGE ORGANIC COMPOUNDS**

**SOP#: 8015DGRO_040815_R4**

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# 1.0 Scope and Application

## 1.1 Introduction

RTI Laboratories, Inc., has prepared this document to detail the Standard Operating Procedure (SOP) for the preparation and analysis of water and soil samples for gasoline range compounds (GRO) by purge and trap gas chromatography. This method is applicable to the determination of hydrocarbons in the aqueous samples from C5 (n-Pentane or as specified) to C10 (n-Decane or as specified) range, and methanol preserved soil samples from C6 (n-Hexane or as specified) to C10 (n-Decane as specified) or for non-specified Gasoline Range Organics from 2-Methyl pentane to 1,2,4-Trimethylbenzene (Refer to Sec. 11.5.3). For some applications based on specific State requirements the range can be extended to C12. For definition of terms not specifically defined in this document, refer to RTI QAP Section 16.

A detailed description of the instrumentation, calibration, run parameters and quality control procedures where applicable is included in this SOP.

## 1.2 Summary of Method

1.2.1 GRO aqueous and soil samples introduced into the GC/FID by a purge and trap system. Soil samples are prepared in 1:1 methanol. An aliquot of the methanol extract is prepared in laboratory grade water and analyzed by purge and trap/GC/FID. The GC column is temperature programmed to separate the analytes, which are then detected with a flame ionization detector (FID). Identification of the target analytes is accomplished by comparing GC pattern standards prepared from a commercial gasoline source. Quantification is accomplished by comparing the response to a six-point standard calibration curve for water samples and a seven-point calibration curve for soil samples.

# 2.0 Safety Precautions

2.1 Compounds applicable to this method may be known or suspected carcinogens. All standard preparations are performed in a manner designed to minimize exposure to these chemicals using appropriate hoods and personal protection.

2.2 Extraction solvents are flammable and/or toxic and must be handled with caution. All extractions are performed in a manner designed to minimize exposure to these chemicals using appropriate hoods and personal protection.

# 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with the RTI Standard Operating Procedure for Sample Receipt and Custody (SRC001-A). Appropriate U. S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed.

3.2 Water samples are collected in commercially obtained 40 ml pre-cleaned vials containing HCl preservative with Teflon lined screw caps. All samples are stored at 4 degrees C and have a maximum 14-day holding time. Samples collected in unpreserved vials have a maximum holding time of 7 days. The pH of each water sample is checked following analysis to ensure the presence of preservative. Samples should be received with no overt bubbles or headspace in the vial. If a problem occurs with the sample, the sampler is contacted and noted in the LIMS.

3.3 Soil sample collection using methanol preservation:

3.3.1 RTI supplies 40 ml weighed vials containing 10ml of methanol. Samples should be collected by weighing (or estimating from the soil density) 10 grams of soil directly into the vial containing methanol.

3.3.1.1 For programs where surrogate is required to be added to the methanol prior to collection (i.e. Alaska ADEC projects) 50 ul of the surrogate standard (Sec. 7.12.1) is added to each vial containing 10 ml of methanol.

3.3.2 Vials are weighed prior to analysis at the laboratory to determine the amount of soil added. Samples containing <9 grams are flagged and samples containing >20 grams are rejected. Samples are additionally flagged if the soil is not completely submerged in the methanol. Vials containing between 10 and 20 grams of sample, additional purge-and-trap grade methanol is added to the vial to bring the methanol/soil ratio to 1:1. The vial should not be opened; rather the methanol is added through the septum using a 1mL gas tight syringe.

3.3.3 Samples must be stored on ice or at 4°C. Sample holding time is 14 days from collection to analysis.

3.3.4 A separate bulk soil sample must be collected for percent solids determination.

3.5 Soil sample collection – Encore devices.

3.5.1 Samples collected in these devices have a 48 hr holding time from collection to receipt at the laboratory and transfer to methanol.

3.5.2 Upon arrival at the laboratory, 10 grams of sample will be transferred from the device to a vial containing 10 ml of methanol (if a 10 g Encore is used for collection the entire volume of soil will be transferred to the vial). The date and time of transfer is noted on the chain of custody. The weight is then recorded in the sample logbook in the VOA lab.

3.6 Soil sample collection – State of Alaska. Procedure is required for the collection of GRO sample in Alaska

3.6.1 RTI supplies 4 oz. weighed jars containing 25 ml methanol. Samples should be collected by weighing (or estimating from the soil density) 25 grams of soil directly into the jar containing methanol.

3.6.1.1 For programs where surrogate is required to be added to the methanol prior to collection (i.e. Alaska ADEC projects) 125 ul of the surrogate standard (Sec. 7.12.1) is added to each vial containing 25 ml of methanol.

3.6.2 Vials are weighed prior to analysis at the laboratory to determine the amount of soil added. Samples containing <22.5 grams are flagged and samples containing >50 grams are rejected (Refer to section 11.6). Samples are additionally flagged if the soil is not completely submerged in the methanol.

3.6.3 Samples must be stored on ice or at 4°C. Sample holding time is 14 days from collection to analysis.

3.6.4 A separate bulk soil sample must be collected for percent solids determination.

3.7 Sample collection – State of Wisconsin.

3.7.1 Samples are collected as in Sections 3.2 and 3.3. Methanol preservation is required mandatory for collection of soil samples.

3.7.2 Soil samples must be received within 4 days of collection and have a 21 day holding time to analysis.

3.7.3 Water samples from carbonate aquifers must be analyzed within 2 days or preserved with sodium azide. Preserved samples have a 14 day holding time.

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 The method detection limit (MDL) is statistically defined at the 99% confidence level according to 40 CFR Part 136 App. B. Seven replicates containing all of the analytes of interest at a concentration level of 1-5 times the estimated D.L. are analyzed and the standard deviation is calculated. The Student's T Value for the 7 replicates (3.143) is multiplied by the standard deviation of the analyte to calculate the MDL. MDLs are updated on major instrument changes and are kept on file in the Laboratory. MDLs and reporting limits are incorporated into the applicable test code in the Omega LIMS.

4.2 The LOD (limit of detection) is determined by spiking reagent water at 1-4 times the MDL and prepared using the same procedure as samples. Analytes must be present at levels 3 times or greater than the blank response (greater than 3 times the signal to noise ratio). The concentration used is the LOD for that analyte. LOD determinations must be performed quarterly.

4.3 The LOQ (limit of quantification) is determined by spiking reagent water at the reporting limit (RL/CRQL) and prepared in the same manner as samples. Analyte recovery must be within 20% of the expected concentration. The concentration used and successfully recovered is the LOQ for that analyte. LOQ determinations must be performed quarterly.

4.4 Initially, accuracy and precision at the LOQ is determined by spiking 4 aliquots of reagent water at the reporting limit (RL/CRQL) and prepared using the same procedure used for samples. The average recovery must be within 20% of the expected value and the %RSD must be less than 15%. This determination must be performed within the first quarter of every calendar year.

4.5 LOD/LOQ determinations that do not meet the specifications above require repeat analysis, adjustment to the spiking levels and/or reporting limits, repeating the MDL determination at adjusted concentrations if required and repeat LOD/LOQ determinations.

4.6 The range used by RTI is 100 to 10000 ug/L (5000 to 500000ug/KG for soils) for most of the compounds designated above. If an analyte concentration is above the linear range, a dilution of that sample that results in a concentration in the linear range will be analyzed.

4.7 The accuracy and precision for this method are determined by analyzing four LCS samples at a concentration of 1000 ug/L of each compound. The average percent recovery, standard deviation, and the relative standard deviation are calculated for each analyte. Quality control limits, mean recovery values and RPD results are incorporated in the Omega LIMS.

## 5.0 Interferences

5.1 Interferences can arise from carryover due to high sample concentrations or contamination from reagents and/or glassware. Blanks are injected to ensure system cleanliness in both instances. All glassware must be scrupulously cleaned before use.

5.2 Samples containing high concentrations of non-target analytes or extremely high levels of select target analytes can result in elevated detection limits for other target analytes. Dilution of the extract may improve the resolution and quantification but will generally cause an elevation in the RDL. Interferences from high molecular weight organics such as oils will cause an elevated baseline. If this background is at a high concentration it will interfere with analyte identification as well as quantification.

## 6.0 Apparatus and Materials

6.1 Hewlett Packard 5890 II gas chromatographs in split injection mode with FID detector

6.2 Restek Rtx-624 (75m, 0.53mm, 3 DF) capillary column, cat#10974

6.3 Centurion WS Auto sampler and CDS 7000 purge and trap with external sparge unit and Supelco Vocarb 3000 thermal trap. The heated transfer line is connected directly to the inlet on the GC.

6.4 Pentium Windows based computer workstation with HP ChemPC and Enviroquant software.

6.5 Top Loading Balance capable of weighing to 0.1g.

6.6 EPA Protocol B cleaned 40mL VOA vials with Teflon Septa.

6.7 Hamilton gas tight micro syringes – 1.0, 10-, 25-, 50-, 100-, 250-, 1000 uL.

6.8 Wheaton target vial crimper and de-capper.

6.9 National Scientific 11mm Teflon lined aluminum caps.

6.10 National Scientific 2mL amber target vials.

6.11 Class A volumetric flasks– 10-, 50-, 100-mL.

6.12 Disposable Pasteur pipettes.

## 7.0 Reagents

7.1 ASTM type II DI water.

7.2 Methanol, CH3OH – Purge and Trap quality or equivalent, demonstrated to be free of analytes. Store apart from other solvents. Record reagents in the Omega Chemical Inventory. Methanol expires 1 year after opening.

7.3 Helium - Ultra pure

7.4 Hydrogen - Ultra pure

7.5 Zero Air-Ultra pure

7.6 Gasoline Composite Mix, 5000ug/mL, AccuStandard, cat# GRO-AK-101-GCS. Store in freezer to manufacturer expiration date.

7.7 AK101 GRO C6-C10, 5000ug/mL, Absolute. Store in freezer to manufacturer expiration date.

7.8 GRO Mix C6-C10, 2000ug/ml, Ultra, cat# SAK-100-1. Store in freezer to manufacturer expiration date.

7.9 n-Pentane, 1000ug/ml, Absolute Standards. Store in freezer to manufacturer expiration date.

7.10 2-Methyl pentane, 1000 ug/ml, Absolute Standards. Store in freezer to manufacturer expiration date.

7.11 1,2,4-Trimethylbenzene, 200 ug/ml, Absolute Standards. Store in freezer to manufacturer expiration date.

7.12 Dodecane, 1000ug/ml, Absolute Standards. Store in freezer to manufacturer expiration date.

7.13 n-Undecane, 1000ug/ml, Absolute Standards. Store in freezer to manufacturer expiration date.

7.14 4-Bromofluorobenzene, surrogate – neat, Sigma. Store at ambient temperature for 1 year.

7.14.1 Prepare 500ug/mL working standard by weight 0.5g and diluting to 10mL with methanol in a volumetric flask.

7.15 1,2-Dichlorobenzene-d4, 2000ug/mL, Ultra, cat# STS-210. Store in freezer to manufacturer expiration date.

7.15.2 Prepare a 50 ug/ml working standard by adding 125 µl and diluting to volume in a 5mL volumetric flask.

7.16 PVOC GRO Mix Wisconsin – 1000 ppm Restek 30095 – second source.

7.17 Wisconsin DNR GRO standard – 1000 ppm Absolute 90379.

7.18 All reagents and standards prepared must be logged in the appropriate standards/reagents log labeled with a minimum:

7.18.1 Identity of the material
7.18.2 Concentration of the solution
7.18.3 Date prepared
7.18.4 Initials of analyst preparing the solution
7.18.5 Expiration date.

## 8.0 Preparation of Standards and Calibration Procedure

8.1 Preparation of standards: All standards are prepared fresh for each use.

8.1.1 The initial calibration standards are prepared directly from the primary standard listed in section 7.6. Standards are prepared to encompass the calibration range of 100 to 10000ug/L GRO. The CCV and MS/MSD/LCS are made from the second source standard listed in section 7.7. Store in freezer (-10 to –20 degrees C) for six months or to manufacturer expiration date, whichever is sooner.

| Level (ug/L) | µL of Gasoline Composite Mix, 5000ug/ml or GRO-AK-101-GCS 5000 ug/ml | µl of working surrogate standard | ml of MeOH for soil calibrations | Final Volume (ml) ASTM type II DI 5000water |
|---|---|---|---|---|
| 40 (soil only) | .4 | 2 | 1 | 50 |
| 100 | 1 | 5 | 1 | 50 |
| 500 | 5 | 10 | 1 | 50 |
| 1000 | 10 | 25 | 0.99 | 50 |
| 2000 | 20 | 50 | 0.98 | 50 |
| 5000 | 50 | 100 | 0.95 | 50 |
| 10000 | 100 | 200 | 0.9 | 50 |

Standard preparation for Wisconsin GRO

| Level (ug/L) | µL of Wisconsin DNR GRO Std. 1000 ug/ml | µl of working surrogate standard | ml of MeOH for soil calibrations | Final Volume (ml) ASTM type II DI 5000water |
|---|---|---|---|---|
| 100 | 5 | 5 | 1 | 50 |
| 500 | 25 | 10 | 0.975 | 50 |
| 1000 | 50 | 25 | 0.95 | 50 |
| 2000 | 100 | 50 | 0.9 | 50 |
| 5000 | 250 | 100 | 0.75 | 50 |
| 10000 | 500 | 200 | 0.5 | 50 |

8.1.1 ICV/CCV and MS/MSD/LCS are made from the second source standard listed in section 7.7. Add 50 µL of surrogate (Sec. 7.13.1) to the QC samples before transferring to the 40 ml vial (when required).

| Level (ug/L) | Working CCV standard (µL), sec. 7.7.1 | µl of working surrogate standard | ml of MeOH (sample) for soil calibrations | Final Volume (ml) ASTM type II DI water |
|---|---|---|---|---|
| 2000ug/L ICV/CCV | 20 | 50 | 0.93 | 50 |
| 1000ug/L LCS/MS/MSD | 10 | 50 | 0.94 | 50 |

Standard Preparation for Wisconsin GRO

| Level (ug/L) | Working CCV standard (µL), sec. 7.7.1 | µl of working surrogate standard | ml of MeOH (sample) for soil calibrations | Final Volume (ml) ASTM type II DI water |
|---|---|---|---|---|
| 2000ug/L ICV/CCV | 80 | 50 | 0.87 | 50 |
| 1000ug/L LCS/MS/MSD | 40 | 50 | 0.91 | 50 |

8.1.2 2000ug/mL GRO C5-C12 Retention Time Standard

| Standard | ml |
|---|---|
| GRO Mix C6-C10, 2000µg/ml, Ultra | 0.125 |
| n-Pentane, 1000µg/ml, Absolute Standards | 0.250 |
| 2-Methyl Pentane 1000µg/ml, Absolute Standards | 0.250 |
| 1,2,4-Trimethyl benzene 200µg/ml, Absolute Standards | 1.25 |
| n-Dodecane, 1000µg/ml, Absolute Standards | 0.250 |
| n-Undecane, 1000µg/ml, Absolute Standards | 0.250 |
| Methanol | 7.625 |

8.1.3 A working 100µg/l GRO C5-C12 Retention Time Window is made by taking 100µl of the 50µg/ml GRO C5-C12 Retention Time Standard and diluting to 50 ml deionized water in a volumetric flask.

8.2 The average RSD of the calibration curve must be <15% (cc >0.995 linear regression, cc>0.990 quadratic regression).

8.3 The CCV standard must be within 85 –115% of the expected value.

## 9.0 Sample Preparation

9.1 Methanol preserved soil sample: Weigh the vial and record the weight of the sample collected (weigh to 0.1 g) in the sample logbook. Methanol preserved soils are generally collected in standard 40 ml pre-cleaned glass screw-cap VOA vials with Teflon lined septa (refer also to Sec 3.7 for samples collected for the State of Alaska – volumes below are adjusted proportionally). Verify the 10g sample/10ml methanol ratio in the Methanol Preserved Sample Logbook. Add additional methanol by injecting with a syringe through the septa if the sample weight exceeds 10 grams and is less than 20 grams. (reject sample if sample weight exceeds 20 grams). Flag the sample if the weight is less than 9 grams as <10% Methanol:Soil Ratio.

Sonicate for 20 minutes. After sonication, allow sample sediment to settle. Using a 1ml syringe, transfer a 1ml aliquot of sample to a 50 ml volumetric flask. Add 5 µl of surrogate (Sec, 7.12.1) if not using the Alaska method. Bring to volume with de-ionized water. Invert the flask 2-3 times, then transfer sample to a 40ml VOA vial. Rinse the syringe 3 times with fresh methanol before transferring the next sample. **Note**: this is a 50 times dilution when compared to the initial calibration curve.

9.2 Water sample: Allow water samples to equilibrate to room temperature. Make sure any paper labels are properly affixed to the vial. Hanging labels can interfere with gripper arm's ability to transfer vials to different positions. No other preparatory steps are necessary. Add 40 µl of surrogate to the sample (Sec. 7.12.2). NOTE: Samples for MDEQ do not require surrogate and are not recommended per the DEQ SOP#505. Post analysis, the analyst checks and records sample pH in the Aqueous Preservation Logbook to ensure proper sample preservation.

## 10.0 Diagram/Table

10.1 Reserved.

## 11.0 Analytical Procedure

11.1 Set up run sequence according to the data system software protocol using following template.

11.1.1 Retention Time Window Check Standard
11.1.2 CCB
11.1.3 Initial Calibration (if applicable)
11.1.4 ICV/CCV
11.1.5 LCS
11.1.6 Method Blank
11.1.7 10 samples

11.1.8 MS/MSD

11.1.9 Continue with sample analyses up to 12 hours from time of initial CCV.

11.1.10 Repeat CCV at 12 hours or the end of the sequence (whichever comes first) and proceed from 11.1.2.

11.2 Instrument conditions

| Parameter | CDS Model 7000 |
|---|---|
| Purge gas | He |
| Purge time (min) | 11 |
| Purge temperature (°C) | Ambient |
| Dry purge time (°C) | 1 |
| Desorb temperature (°C) | 260 |
| Desorb time (min) | 2 |
| Bake temperature (°C) | 270 |
| Bake time (min) | 8 |
| Transfer line temperature (°C) | 130 |
| Valve temperature (°C) | 130 |
| Cycle timer (min) | NA |

| HP 5890 II GC Parameters | |
|---|---|
| Injector temperature (oC) | 200 |
| Detector temperature (oC) | 240 |
| Detector Flow (ml/min) Air/H2 | 400/40 |
| Carrier gas (He) flow rate (ml/min) | 9 |
| Split flow (ml/min) | 85 |
| Initial oven temperature (oC) | 40 for 9 min |
| Temperature program, | 10$^{O}$C/min to 210 $^{O}$C, hold for 14 min |
| Run time (min) | |
| Oven equlibrium time (min) | 0.5 |

11.3 Activate applicable method in the HP Chemstation data system.

11.4 Activate sequence in the data system.

11.5 Compound identification and quantification

11.5.1 Summed peak target ranges – Identified target analytes should be calculated by the external calibration method.

11.5.2 The working 100ug/L GRO C5-C12 Retention Time Window Standard or Wisconsin GRO standard is analyzed to give the appropriate carbon ranges.

11.5.3 The area-summing feature of the software integrator is used to sum peak areas within the appropriate carbon ranges.

11.5.3.1 For State of Alaska samples the carbon range is from peak start of C6 (n-Hexane) to the peak start of C10 (n-Decane).

11.5.3.2 For State of Michigan samples the carbon range is from peak start of C6 (n-Hexane) to the peak end of C10 (n-Decane).

11.5.3.3 For State of Wisconsin samples the carbon range is from the start of MTBE peak to the end of the Naphthalene peak.

11.5.3.3.1 Integration of standards and samples is performed by baseline placement of a horizontal line parallel to the x-axis of the chromatogram through the lowest point in the chromatogram before the end of the window.

11.5.3.3.2 Integration is baseline to baseline and includes all responses within the retention time window.

11.5.3.3.3 The area response for samples as determined above is compared to the calibration curve (area responses for standards are determined in the same manner as above) for quantification of GRO in the sample.

11.5.3.3.4 No area can be subtracted from the RT window in the calculation of sample concentrations.

11.5.3.3.5 Report the presence of significant peaks outside the RT window when observed.

11.5.3.4 Samples reported according to Method 8015D are quantified from the lower limit of the RT window of 2-Methyl pentane to the upper limit of the RT window for 1,2,4-Trimethylbenzene.

11.5.3.5 Other States or programs have various carbon ranges defining GRO. Quantification of samples will be performed based on the specifications or methods provided

11.5.4 The software will not automatically integrate the peaks. The analyst must use the Qedit function in the software to perform integration. Samples are integrated in the same manner as the calibration standards. The analyst should draw a horizontal baseline from a consistent point across the summed area. The entire signal in the range is to be used for calibration. Valley to valley integration shall not be used.

11.5.5 Analyst experience in evaluating chromatograms and identifying compounds in the presence of interfering components is important in final compound identification.

11.5.6 Identified compounds are quantified from the average response factor of the initial calibration or other calibration model employed when required.

11.5.7 Compounds exhibiting concentrations above the upper calibration level are diluted into the calibration range. If insufficient sample is available for dilution (e.g. both water sample vials have already been used) the concentration is flagged as estimated ("E").

11.5.8 Compound concentrations that are below the laboratory reporting limit or lowest calibration point but positively identified above the MDL are flagged as estimated ("J").

11.6 Manual integration guidelines and procedures

11.6.1 Situations may arise whereby the quantification provided by the data system is inappropriate. This can occur due to co-elution, baseline noise or matrix interference.

11.6.2 When manual integration of a compound is necessary the following guidelines must be followed.

11.6.2.1 Manual quantification is performed by integrating the area of the compound peak.

11.6.2.2 The integration will only include the area attributable to the compound of interest.

11.6.2.3 The area integrated shall not include baseline background noise.

11.6.2.4 The area integrated shall not extend beyond the point where the sides of the peak intersect with the baseline.

11.6.2.5 Manual integration must not be used solely to meet quality control criteria.

11.6.2.6 Manual integration must not be used as a substitute for corrective action on the GC system.

11.6.3 Instances of manual integration are flagged with an "m" by the data system. This is sufficient for routine integrations in obvious cases of peak interference and when not required to be reported as part of the contracted laboratory report. Other cases of manual integrations are documented in the LIMS analytical sequence sample comments.

## 12.0 Details of Calibration and Calculations

12.1 Response Factor:

Rf = Peak Area/Std. Conc.

12.2 % RSD:

Average Rf = (Rf1+Rf2+Rf3+Rf4+Rf5)/5
Std. Dev. = SQRT [(sum$x^2$ - sum$(x)^2$/n)/(n-1)]
%RSD = Std. Dev./Average Rf x 100

12.3 Percent Difference:

$$\% \text{ Diff} = \frac{C_e - C_f}{C_e} \times 100$$

Where: $C_e$ = Expected concentration
$C_f$ = Concentration found

12.4 Linear Regression: y = ax + b

Where: y = Instrument response (peak area)
a = Slope of the line
x = Concentration of the calibration standard
b = Intercept

12.5 Relative Percent Difference (RPD)

RPD = (| R1 – R2 | / ((R1 + R2)/2)) * 100

Where: R1 = First result

R2 = Second result

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 Daily Setup of Blanks and Standards.

13.1.1 A continuing calibration blank standard (CCB) must be analyzed to determine instrument cleanliness before standards run.

13.1.2 A continuing calibration verification standard (CCV) must be analyzed to assure the working curve is still valid. The % Difference or (% drift) must be less than 15%.

13.1.3 If the check standard is found to exceed 15% difference then an additional check standard may be analyzed and compared to the curve as above. If this second check standard is still out of control, initial calibration must be performed and a new 5-point curve generated. If the second check standard is within the allowable 15% difference samples may be analyzed using the average Cf from the curve for quantification. The daily continuing calibration verification standard should be run after every 10 samples but is considered valid for 12 hours.

13.1.4 A method blank must be run at the beginning of each day to guarantee the system is free of contamination. If any compounds are found in the blank at levels greater than the reporting limits, then the source of contamination must be identified and corrective action taken before sample analysis can proceed. Corrective actions include reanalysis of the method blank, analysis of reagent blanks, baking systems components (column, detector) and checks on sample preparation procedure.

Contamination that does not interfere with the GRO range of compounds may be ignored.

13.2 LCS, Matrix Spike/Matrix Spike Duplicate

13.2.1 In each batch of samples a Laboratory Control Sample (LCS), matrix spike (MS), and matrix spike duplicate (MSD) must be analyzed. For GRO water samples, preparation of batch MS/MSD is dependent upon the availability of extra sample provided by the client. In the absence of sufficient sample volume a LCS duplicate should be prepared but is not required. Statistical control limits are calculated for the recoveries and duplicate percent differences to determine warning and control limits. If a sample falls outside of these limits action will be taken to determine if the cause was due to matrix interference or method deficiencies including re-preparation of these QC samples when appropriate.

13.2.1.1 Acceptance Criteria MS/MSD – within laboratory statistical limits. Default limits - 75-125% recovery.

13.2.1.2 Acceptance Criteria RPD – within laboratory statistical limits. Default limits -80-120%.

13.2.1.3 Acceptance Criteria LCS - within laboratory statistical limits. Default limits - 70 - 130 %.

13.3 Surrogate Control Limits

13.3.1 For each sample matrix the first 30 surrogate recoveries are used to establish control limits based on the Mean recovery +/- 3 times the standard deviation. This procedure is performed annually.

13.3.2 For samples (including QC samples) in which the surrogate recovery falls outside the established control limits, the following is required.

13.3.2.1 Check calculations for errors

13.3.2.2 Check instrument performance

13.3.2.3 Re-extract and re-analyze the samples if the above show no problems or flag the data if sample matrix interference is present.

13.4 Retention Time Windows

13.4.1 Retention time windows will be established and maintained for all components. For Aroclors, at least 3-5 characteristic peaks should be used to determine the RT window.

13.4.2 RT windows are determined by analyzing three control samples over a 72-hour time frame.

13.4.3 The average and standard deviation of the three determinations are calculated and the window is defined as the Mean (average) +/- 3 times the standard deviation.

13.4.4 The retention time windows are re-calculated whenever a new column is installed.

## 14.0 Data Reporting Requirements

14.1 If the concentration found in a sample is greater than that of the highest standard the sample must be re-analyzed after dilution. The sample should be diluted until the level is within the working range of the standard curve.

14.2 Sample concentrations are reported in ug/ml from the data system.

14.3 Raw results are entered into Omega. Prep factors are automatically imported from sample prep logs. Dilutions are entered in the analytical sequence.

14.4 Sample results are reported as ug/L for water and ug/kg for soil as dry weight.

ug/kg dry wt. = ug/kg wet wt.*100/percent solids

Methanol extracted (preserved) soils:
ug/kg = ug/L x DF x MD x MC

DF = (ml DI water/amt. MeOH added) x ratio of MeOH to soil
MD = (ml of methanol in sample + (sample wt. g x percent moisture))/10

MC = 100/%solids

DF is the dilution factor determined by both the factor for the amount of methanol added to an amount of DI water (typically 1 ml methanol in 50 ml DI water) and the amount of methanol divided by the weight in g of soil sampled (target 10 g of soil to 10 ml of methanol = 1).

MD is the dilution of the water miscible solvent by the water content of the sample for samples with greater than 10% moisture.

MC is the dry weight conversion.

14.5 Standard laboratory reporting for GRO is to report as Gasoline Range Organics CX to CX where X denotes the carbon number for the range and is defined and the n-alkane corresponding to the carbon number (ex. C6 = n-Hexane). Quantification is based on State specific protocol for the corresponding range (Sec. 11.5.3). When reporting Gasoline Range Organics without specifying a carbon range the procedure in Method 8015D (Sec. 11.5.3.3) is used to quantify sample results.

14.6 Raw instruments results are entered directly into the Omega LIMS system using excel spreadsheets, direct instrument interface or manually. All calculations to derive final result (including dry weight conversions) are performed automatically by the LIMS. Sample preparation information and percent moisture results are entered into the appropriate section of the LIMS prior to instrument data and are automatically factored into the final results.

14.7 Confirm there are no QC flags or qualifiers in this sequence. If present, investigate and repeat or reanalyze as necessary.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 Change septum as needed.

15.2 Check carrier gas daily.

15.3 Bake out column as needed.

15.4 Clean FID as needed.

## 16.0 Waste Management and Pollution Prevention

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner which minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Organic solvents are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Soil samples are composited in a drum designated for incineration.

16.2.3 Disposal of materials is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, June 2003, Revision 4. Method 8015D

17.2 Alaska Series - Laboratory Methods for the Analysis of Gasoline Range Organics. Alaska Department of Environmental Conservation (ADEC) Method AK101, Version 04/08/02.

17.3 Gasoline Range Organics (GRO by Gas Chromatography/Mass Spectrometry (GC/MS). Michigan Department of Environmental Quality, SOP#505, Revision# 0, Nov. 2007.

17.4 Modified GRO. Method for Determining Gasoline Range Organics, Wisconsin DNR, September 1995. PUBL-SW-140.

17.5 Laboratories, Inc. Quality Assurance Plan.

17.6 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.7 RTI Laboratories, Inc. SOP: SRC001-A, Sample Receipt and Custody SOP.

17.8 RTI Laboratories, Inc. Employee Handbook.

## 18.0 Revisions

18.1 **8015DGRO_081514_R3 -** Additions and modifications to this SOP revision address GRO as defined in Method 8015D.

18.1.1 Text added to Section 1.1: or for non-specified Gasoline Range Organics from 2-Methyl pentane to 1,2,4-Trimethylbenzene (Refer to Sec. 11.5.3).

18.1.2 Section 7 renumbered: 7.10 and 7.11 newly added.

18.1.3 2-Methyl pentane and 1,2,4-Trimethyl added to table in Section 8.1.2.

18.1.4 Sections 11.5.3.2, 11.5.3.3 and 11.5.3.4 added.

18.1.5 Section 14 renumbered: 14.5 newly added.

18.1.6 Section 17.1 revised for 8015D

18.2 **8015DGRO_081514_R3.1**

18.2.1 Section 14.4: Procedure for methanol preserved samples added.

18.3 **8015D_040815_R4:** Revisions to this version incorporate procedures for Wisconsin GRO analyses.

18.3.1 Added - … or as specified – to carbon range designations in Section 1.1.

18.3.2 Added Wisconsin calibration standards (Sections 7.16 and 7.17).

18.3.3 Added tables to Section 8 for preparation of standard for Wisconsin method.

18.3.4 Sections 11.5.3.3 and 11.5.3.4 renamed 11.5.3.4 and 11.5.3.4.

18.3.5 Replaced section 11.5.3.3 to include procedures specified in Wisconsin method.

18.3.6 Added Section 3.7.

18.3.7 Added Sections 12.4 and 12.5.

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# STANDARD OPERATING PROCEDURE

# ANALYSIS OF PESTICIDES AND POLYCHLORINATED BIPHENYLS (PCBs)

| | |
|---|---|
| **Analyte:** | **Pesticides and PCBs** |
| **SOP #:** | **8081_8082_030314_R10** |
| **Method Reference:** | **EPA SW846/8081B/8082A**<br>**40 CFR Part 136 App. A Meth. 608** |
| **Issue Date:** | **December 7, 2005** |
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**Reviewed and Approved by: April 6, 2015**

Director, Quality Management: Charles O'Bryan

Director, Environmental Services: Yemane Yohannes

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**ANALYSIS OF PESTICIDES AND PCBs**

**SOP#: 8081_8082_030314_R10**

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## 1.0 Scope and Application:

1.1 Introduction

RTI Laboratories, Inc, has prepared this document to detail the Standard Operating Procedure (SOP) for the analysis of PCB and pesticide compounds by gas chromatography/ECD. This SOP applies to analytical procedures according to EPA Methods 8081B, 8082A & 608. Modifications to these methods are specified throughout this SOP.

A detailed description of the instrumentation, calibration, run parameters and quality control procedures where applicable is included in this SOP. For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

1.2 Summary of Method

1.2.1 A measured volume of sample is extracted according to the applicable preparation method (SOPs – 3510, 3545, 3546, 3550). The prepared extract is separated by gas chromatography using split dual capillary columns. Analytes are then measured with dual electron capture detectors. If the extract requires further cleanup to eliminate interferences, this method provides for a florisil column cleanup procedure, an acid cleanup procedure and an elemental sulfur removal procedure (3610B, 3611A, 3620B, 3630C, 3650B, 3660B).

## 2.0 Safety Precautions

2.1 Compounds applicable to this method are known or suspected carcinogens. Standard preparation is conducted in fume hoods designated for organic use.

2.2 Extraction solvents are flammable and/or toxic and must be handled with caution. All extractions are performed in a manner designed to minimize exposure to these chemicals using appropriate hoods and personal protection.

## 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with RTI Laboratories, Inc Standard Operating Procedure for sample login. Appropriate U. S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed. Water samples are collected in 1L pre-cleaned amber bottles with Teflon lined screw caps. Soil samples are received in pre-cleaned wide mouth jars with Teflon lined lids ranging from 2 oz. to 9 oz. in size.

3.1.1 The holding time for pesticide water samples is 7 days from collection to extraction and 40 days from extraction to analysis. The holding time for PCB water samples is 1 yr. from collection to extraction and 1 yr. from extraction to analysis.

3.1.2 The holding time for solid samples for pesticides is 14 days from collection to extraction and 40 days from extraction to analysis. The holding time for PCBs is 1 year from collection to extraction and 1 year from extraction to analysis.

3.1.3 All samples are stored at 4° C.

3.1.4 All extracts are stored refrigerated at <6° C.

3.1.5 For other sample handling protocols, see sample receiving SOP.

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 The method detection limit (MDL) is statistically defined at the 99% confidence level according to 40 CFR Part 136 App. B. Seven replicates containing all of the analytes of interest at a concentration level of 1-5 times the estimated D.L. are analyzed and the standard deviation is calculated. The Student's T Value for the 7 replicates (3.143) is multiplied by the standard deviation of the analyte to calculate the MDL. MDLs are updated annually (or as needed) and are kept on file in the Laboratory. MDLs and reporting limits are incorporated into the applicable test code in the Omega LIMS.

4.2 The LOD (limit of detection) is determined by spiking reagent water at 1-4 times the MDL and prepared using the same procedure as samples. Analytes must be present at levels 3 times or greater than the blank response (greater than 3 times the signal to noise ratio). The concentration used is the LOD for that analyte. LOD determinations must be performed quarterly.

4.3 The LOQ (limit of quantification) is determined by spiking reagent water at the reporting limit (RL/CRQL) and prepared in the same manner as samples. Analyte recovery must be within 30% of the expected concentration. The concentration used and successfully recovered is the LOQ for that analyte. LOQ determinations must be performed quarterly.

4.4 Initially accuracy and precision at the LOQ is determined by spiking 4 aliquots of reagent water at the reporting limit (RL/CRQL) and prepared using the same procedure used for samples. The average recovery must be within 30% of the expected value and the %RSD must be less than 15%.

4.5 LOD/LOQ determinations that do not meet the specifications above require repeat analysis, adjustment to the spiking levels and/or reporting limits, repeating the MDL determination at adjusted concentrations if required and repeat LOD/LOQ determinations.

4.6 The accuracy and precision for this method are determined by analyzing four aliquots from a Laboratory Control Sample containing the element(s) of interest at the mid-level of the calculated range (diluted if above this range). Percent recovery, standard deviation, and the relative standard deviation are calculated for each analyte and documents are kept on file in the laboratory.

4.7 The range used by RTI Laboratories, Inc is 5 to 80ng/ml for most of the pesticides and 50 to 2000ng/ml for the PCB's. The linear range for some of compounds may be established at a lower upper limit, see Section 8 for details. If an analyte concentration is above the linear range, a dilution of that sample that results in a concentration in the linear range will be analyzed.

## 5.0 Interferences

5.1 Interferences can arise from carry over due to high sample concentrations or contamination from reagents and/or glassware. Blanks are analyzed to ensure system cleanliness in both instances. All glassware must be scrupulously cleaned before use. Glassware-cleaning procedures are specified in the QAP. Glassware should be heated in a muffle furnace at 400 degrees C for 15 to 30 minutes, or solvent rinsed prior to use. High purity solvents are used for preparation and analysis.

5.2 Samples containing high concentrations of non-target analytes or extremely high levels of select target analytes can result in elevated detection limits for other target analytes. Dilution of the extract may improve the resolution and quantification of some analytes but will generally cause an elevation in the RDL.

5.3 Interferences caused by phthalate esters result in non-target interfering peaks on the chromatogram. Common flexible plastics contain varying amounts of these phthalates. Take caution not to use soft plastic funnels, separatory funnels, bottles, pipettes or syringes in any of the preparation or sample cleanup steps.

5.4 Interferences caused by co-extracted non-target peaks such as oils, chlorinated solvents and other petroleum-based products can either mask or intensify the peaks from the PCB congeners. Many of these interfering compounds can be eliminated using sample cleanup techniques such as mercury cleanup, acid washing, florisil cleanup, silica gel cleanup or GPC cleanup.

5.5 Compounds that have the same retention time under the conditions employed can cause a positive interference. Analysis on a second dissimilar column is necessary when analytes of interest are detected.

5.6 MS/MSD recoveries often are affected by samples containing PCBs other than the spiked 1016/1260 Aroclors.

## 6.0 Apparatus and Materials

6.1 Glass Funnels

6.2 pH indicator paper

6.3 Glass beakers

6.4 Class A Microliter syringes, 50ul, 10 ul, 25ul, 100µl and 500µl.

6.5 Volumetric glassware Class A, 1.0,2.0,5.0,10.0,25.0,50.0, and 100.0 ml volumes

6.6 Glass vials – 2ml with Teflon lined screw caps, 10ml with Teflon lined screw caps.

6.7 Pyrex glass wool

6.8 Pasteur pipettes

6.9 GC-ECD 1 - Varian 3400 with dual ECD and dual columns. Equipped with a Varian 8100 auto sampler

6.10 GC-ECD 3 - Hewlett Packard 5890 GC with two electron capture detectors, HP 7673 auto sampler and HP Data System.

6.11 GC-ECD 4 - Hewlett Packard 6890 GC with two electron capture detectors, HP auto sampler and HP Data System.

6.12 GC-ECD 5 - Hewlett Packard 6890N GC with two electron capture detectors, HP auto sampler and HP Data System.

6.13 RTX CLP Pesticides I - 30m x 0.53 mm primary column (or equivalent)

6.14 RTX CLP Pesticides II - 30m x 0.53 mm – confirmatory column (or equivalent)

6.15 Carrier gas- He 99.999% purity with a flow near 5.0ml/min.

6.16 Make up gas- $N_2$ 99.999% purity with a flow near 60ml/min.

6.17 PC with Microsoft Windows, Varian Star Data System 5.3, EnviroQuant Chemstation G1701BA Version B 01.00 and Omega LIMS.

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## 7.0 Reagents

7.1 MTBE – pesticide grade

7.3 Surrogate solution – refer to section 8.0

7.4 LCS/MS/MSD spike mix (PCB's) – refer to 3550, 3545, 3546 and 3510 SOPs

7.5 LCS/MS/MSD spike mix (Pesticides) – refer to 3550, 3545, 3546 and 3510 SOPs

7.6 Degradation check standard mix- refer to section 8.0

7.7 Acetone – pesticide grade.

7.8 Sulfuric acid – conc.

7.9 Reagent water, ASTM Type II

7.10 Hexane – pesticide grade.

7.11 Calibration standard mixes – refer to section 8.0.

7.12 All reagents and standards prepared must be labeled with a minimum:

7.12.1 Identity of the material
7.12.2 Concentration of the solution
7.12.3 Date prepared
7.12.4 Initials of analyst preparing the solution
7.12.5 Expiration date determined by:
Manufacturer expiration date for stock standards
Standards: 6 months or the date of the soonest expiring standard
Reagents: Vendor expiration date or 1 yr. not to exceed any vendor expiration date

## 8.0 Preparation of Standards and Calibration Procedure

8.1 A five to six point calibration curve is prepared by diluting stock standards as below.

8.1.1 Standards are stored in a refrigerator/freezer dedicated to standards. The manufacture's expiration date is to be followed for all unopened standards. All stock standard solutions must be replaced after expiration date or sooner if routine QC tests indicate a problem. All other standard solutions must be replaced after six months or sooner if routine QC indicates a problem.

8.1.2 Refer QAP Section 6 for general calibration procedures.

8.1.3 Stock Standard Mixes

8.1.3.1 PCB - Ultra EPA-1282 –Aroclor 1016, 1000ppm
8.1.3.2 PCB - Ultra EPA-1362 –Aroclor 1260, 1000ppm.
8.1.3.3 Ultra PPM 8082 - Aroclor 1016/1260, 1000ppm each.
8.1.3.4 Aroclor 1016, 1000ppm, Absolute Standards, 90123.
8.1.3.5 Aroclor 1221, 1000ppm, Absolute Standards, 79403
8.1.3.6 Aroclor 1232, 1000ppm, Absolute Standards, 79097
8.1.3.7 Aroclor 1242, 1000ppm Absolute Standards, 79098
8.1.3.8 Aroclor 1248, 1000ppm, Absolute Standards, 79099
8.1.3.9 Aroclor 1254, 1000ppm Absolute Standards, 79100
8.1.3.10 Aroclor 1260, 1000ppm, Absolute Standards, 90129
8.1.3.11 Aroclor 1262, 1000ppm, Absolute Standards, 79102
8.1.3.12 Aroclor 1268, 1000ppm Absolute Standards, 90166
8.1.3.13 Aroclor 1016, 1000ppm Ultra, EPA-1282
8.1.3.14 Aroclor 1221, 1000ppm Ultra, EPA-1292
8.1.3.15 Aroclor 1232, 1000ppm Ultra, EPA-1302
8.1.3.16 Aroclor 1242, 1000ppm Ultra, EPA-1312
8.1.3.17 Aroclor 1248, 1000ppm Ultra, EPA-1342
8.1.3.18 Aroclor 1254, 1000ppm Ultra, EPA-1352
8.1.3.19 Aroclor 1260, 1000ppm Ultra, EPA-1362
8.1.3.20 Aroclor 1262, 1000ppm Ultra, EPA-1372
8.1.3.21 Aroclor 1268, 1000ppm Ultra, EPA-1382
8.1.3.22 Pesticide – Ultra PPM 8008C - each pesticide, 1000ppm
8.1.3.23 Pesticide – AccuStandard Z-014C-R- each pesticide, 2000ppm
8.1.3.23.1 Alternate Second source Cerilliant ERS-013, 2000ppm
8.1.3.24 Toxaphene – Absolute - Toxaphene, 1000ppm
8.1.3.25 Toxaphene- Ultra-PP-271-Toxaphene, 100ppm.
8.1.3.25.1 Alternate Second source AccuStandard p-093s-h, 1000ppm
8.1.3.26 Chlordane- Absolute -Chlordane, 1000ppm
8.1.3.27 Chlordane-Ultra –PP-151 – Chlordane, 100ppm.
8.1.3.27.1 Alternate Second source AccuStandard p-017s-10x, 1000ppm
8.1.3.28 Surrogate- Ultra ISM-320-1 - TCMX/DCB each, 200ppm.
8.1.3.29 Degradation check mix- Supelco-4-8282- DDT/Endrin each, 500ppm.

8.1.2 Intermediate working standards:

8.1.2.1 Surrogate 20ppm std.- prepared by adding 0.1ml of Ultra ISM 320-1 (200ppm) to 900ul of pesticide grade Hexane.

8.1.2.2 PCB calibration std. 10ppm PCB/ 0.5ppm Surrogate- prepared by adding 100µl of Ultra PPM 8082 (1000ppm) and 25µl of Surrogate 200ppm std. to a 10ml class A volumetric flask and dilute to 10ml with pest grade Hexane.

8.1.2.3 PCB ICCV/CCV std 10ppm- prepared by adding 100µl of PCB - Ultra EPA-1282 and 100µl of Ultra EPA-1362 and 25µl of Surrogate 200ppm std to a 10ml class A volumetric flask and dilute to 10ml with pest grade Hexane.

8.1.2.4 PCB ICV/CCV std 1.0ppm- prepared by adding 1000µl of PCB ICV/CCV std 10ppm to a 10ml class A volumetric flask and dilute to 10ml with pest grade Hexane.

8.1.2.5 Pesticides calibration std 10ppm– prepared by adding 250µl of Surrogate 200ppm std and 50µl of Ultra PPM 808C to a 5ml class A volumetric flask and dilute to 5ml with pesticide grade Hexane.

8.1.2.6 Pesticide ICV/CCV/Spike intermediate standard 10ppm- prepared by adding 50µl of AccuStandard Z-014C-R to a 10 ml class A volumetric flask and dilute to 5 ml with pest grade Hexane.

8.1.2.7 Pesticide ICV/CCV 40 ppb – Prepared by adding 40µl of 8.1.2.6 and 20µl of 8.1.2.1 to 10 ml final volume with hexane in a volumetric flask.

8.1.2.8 Toxaphene calibration standard 10ppm-prepared by adding 100µl of the Absolute standard to a 10ml class A volumetric flask and dilute to 10ml with pest grade Hexane.

8.1.2.9 Toxaphene ICV/CCV std 1.0 ppm- prepared by adding 100µl of the Ultra PP271 a 10ml class A volumetric flask and dilute to 10ml with pest grade Hexane. Add 20 µl of the 20-ppm surrogate (Sec. 8.1.2.1).

8.1.2.10 Chlordane calibration standard 1.0 ppm- prepared by adding 10 µl of the Absolute standard to a 10ml class A volumetric flask and dilute to 10ml with pest grade Hexane. Add 5 µl of the Ultra ISM 320-1 standard.

8.1.2.11 Chlordane ICV/CCV standard 0.5 ppm- - prepared by adding 50 µl of Ultra PP-151 standard to a 10ml class A volumetric flask and dilute to 10ml with pest grade Hexane. Add 20 µl of the 20-ppm surrogate (Sec. 8.1.2.1).

8.1.2.12 Pesticide 0.1 ppm calibration standard – Prepared by diluting 100µl of 8.1.2.5 to 10ml final volume with hexane in a volumetric flask.

8.1.2.13 Degradation check mix 5ppm- prepared by adding 10µl of Supelco-4-8282 to 990µl of pesticide grade hexane.

8.1.2.14 Expiration dates of the diluted standards are the same as the expiration dates of the stock standards

8.1.3 Calibration standards: PCB's and Toxaphene/chlordane - Six Calibration standards are prepared according to Table 3. Calibration standards: Pesticides mix calibration standards are prepared according to Table 3.

**Table 3**

| Calibration Standard | Source | Source Conc. | | Amount added | | Final volume | | Final Conc. | |
|---|---|---|---|---|---|---|---|---|---|
| C6 | Chlordane calibration std 1.0ppm | 10 | ng/µl | 1000 | µl | 1.0 | ml | 1000 | ng/ml |
| C5 | Chlordane calibration std 1.0ppm | 10 | ng/µl | 800 | µl | 1.0 | ml | 800 | ng/ml |
| C4 | Chlordane calibration std 1.0ppm | 10 | ng/µl | 600 | µl | 1.0 | ml | 600 | ng/ml |
| C3 | Chlordane calibration std 1.0ppm | 10 | ng/µl | 400 | µl | 1.0 | ml | 400 | ng/ml |
| C2 | Chlordane calibration std 1.0ppm | 10 | ng/µl | 200 | µl | 1.0 | ml | 200 | ng/ml |
| C1 | Chlordane calibration std 1.0ppm | 10 | ng/µl | 100 | µl | 1.0 | ml | 100 | ng/ml |
| ICV/CCV | Chlordane ICV/CCV std 0.5ppm | | | | | | | | |
| | | | | | | | | | |
| C6 | Toxaphene calibration std 10ppm | 10 | ng/µl | 500 | µl | 1.0 | ml | 5000 | ng/ml |
| C5 | Toxaphene calibration std 10ppm | 10 | ng/µl | 200 | µl | 1.0 | ml | 2000 | ng/ml |
| C4 | Toxaphene calibration std 10ppm | 10 | ng/µl | 100 | µl | 1.0 | ml | 1000 | ng/ml |
| C4 | Toxaphene calibration std 10ppm | 10 | ng/µl | 50 | µl | 1.0 | ml | 500 | ng/ml |
| C2 | Toxaphene calibration std 10ppm | 10 | ng/µl | 20 | µl | 1.0 | ml | 200 | ng/ml |
| C1 | Toxaphene calibration std 10ppm | 10 | ng/µl | 10 | µl | 1.0 | ml | 100 | ng/ml |
| ICV/CCV | Toxaphene ICV/CCV std 1.0 ppm | | | | | | | | |
| | | | | | | | | | |
| C7 | Pesticides calibration std 0.1ppm | 0.1 | ng/µl | 1000 | µl | 1.0 | ml | 100 | ng/ml |
| C6 | Pesticides calibration std 0.1ppm | 0.1 | ng/µl | 800 | µl | 1.0 | ml | 80 | ng/ml |
| C3 | Pesticides calibration std 0.1ppm | 0.1 | ng/µl | 600 | µl | 1.0 | ml | 60 | ng/ml |
| C4 | Pesticides calibration std 0.1ppm | 0.1 | ng/µl | 400 | µl | 1.0 | ml | 40 | ng/ml |
| C3 | Pesticides calibration std 0.1ppm | 0.1 | ng/µl | 200 | µl | 1.0 | ml | 20 | ng/ml |
| C2 | Pesticides calibration std 0.1ppm | 0.1 | ng/µl | 100 | µl | 1.0 | ml | 10 | ng/ml |
| C1 | Pesticides calibration std 0.1ppm | 0.1 | ng/µl | 50 | µl | 1.0 | ml | 5 | ng/ml |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| ICV/CCV | Pesticide ICV/CCV std 40ppb | | | | | | | | |
| | + 20µl surrogate | | | | | | | | |
| C1 | PCB calibration std 10ppm | 10 | ng/µl | 400 | µl | 1.0 | ml | 4000 | ng/ml |
| C2 | PCB calibration std 10ppm | 10 | ng/µl | 200 | µl | 1.0 | ml | 2000 | ng/ml |
| C3 | PCB calibration std 10ppm | 10 | ng/µl | 100 | µl | 1.0 | ml | 1000 | ng/ml |
| C4 | PCB calibration std 10ppm | 10 | ng/µl | 50 | µl | 1.0 | ml | 500 | ng/ml |
| C5 | PCB calibration std 10ppm | 10 | ng/µl | 20 | µl | 1.0 | ml | 200 | ng/ml |
| C6 | PCB calibration std 10ppm | 10 | ng/µl | 10 | µl | 1.0 | ml | 100 | ng/ml |
| C7 | PCB calibration std 10ppm | 10 | ng/µl | 5 | µl | 1.0 | ml | 50 | ng/ml |
| ICV/CCV | PCB ICV/CCV std 1.0ppm | 1.0 | ng/µl | 1000 | µl | 1.0 | ml | 1000 | ng/ml |

8.1.4 Degradation check standard 40 ppb: prepared by adding 12µl of Sec. 8.1.2.13 to 1.5ml final volume with pesticide grade hexane.

8.1.5 PCB analyses are calibrated using Aroclors 1016 and 1260 for initial and continuing calibration. At least five peaks from each Aroclor are calibrated using at least five levels preferably six. For Aroclors other than 1016 and 1260 identified in samples a minimum five-point calibration (DoD QSM specification) or one-point calibration (SW-846 non-QSM samples) for the individual Aroclor is performed. For single point calibrations the level will correspond to the mid-point of the calibration range.

8.1.6 Five peaks are chosen for each Aroclor. The peaks chosen will be representative of the Aroclor and each of the 5 peaks will be at least 25% of the height of the largest Aroclor (with the exception of 1260). At least one of the five peaks for the individual Aroclor should be unique to that Aroclor where possible.

8.2. Calibration Verification Standards (CCV) standards are prepared according to Table 3.

8.3. Initial calibration is performed by analyzing at least five calibration standards (the lowest calibration standard used for the curve must be at or below the LOQ/RL). All compounds must meet one of the three options (8.3.1, 8.3.2 or 8.3.3).

8.3.1 The linear regression function of the data system can be used for analyte quantification provided the correlation coefficient is greater than 0.995, $r^2$>0.99.

8.3.2 The average response factor (RF) can be used for quantification and/or verifying linear calibration. Acceptable use of linear calibration using average RF is determined if the RSD for all compounds is < 20%. For Method 608 the % RSD must by <10%.

8.3.3 The quadratic function of the data system can be used for analyte quantification provided the correlation coefficient is greater than 0.995, $r^2$>0.99.

8.3.4 Initial calibration is performed at method start up and upon failure of a continuing calibration standard (CCV). The criteria noted in Sec. 8.3.1 and 8.3.2 must be met for both columns.

8.3.5 If the initial calibration curve fails the calibration criteria above, the following corrective action must take place, Repeat the calibration curve, if the curve still fails, replace the curve standards. Repeat the calibration curve, if the curve still fails, clean or replace the injection port liner, remove a portion of the inlet end of the column or troubleshoot the detector as necessary.

8.3.6 Immediately following initial calibration an ICV prepared from a second source standard is analyzed. All compounds must be within 15% (DoD QSM criteria allows 20% difference/drift for the ICV) of the expected concentration. Sample analysis cannon commence until initial calibration and ICV criteria are met.

8.4 Continuing Calibration.

8.4.1 The degradation check standard and CCV are analyzed at the start of each analytical batch. If the degradation is greater than 15% then the following corrective action must be performed. Clean or replace the injection port liner, and remove the first 12-18 inches of the column. Repeat the degradation check, if the check still fails, replace the column.

8.4.2 A CCV is analyzed after every 10 field samples. An ending CCV must be analyzed at the end of each analytical run or 12-hour time period. All compounds must be within 15% of the expected concentration (Method 608) or within 20% difference/drift (SW-846 or DoD QSM 5.0) The CCV standards bracketing the samples must both be acceptable before reporting the samples analyzed in between the two CCV standards. Acceptance criteria must be demonstrated on both columns.

8.4.3 If the CCV standard fails the 15% (or 20%) criteria then the following corrective action must be taken. Replace and reanalyze the CCV standard, if this still fails, generate a new initial calibration curve.

8.4.4 For quantifying PCB Aroclors the approach specified in Method 8082 is preferred (quantifying individual peaks instead of the entire Aroclor pattern). However, Method 608 requires quantification based on the total response for the Aroclor. Calibration is performed to satisfy both Method 608 and 8082 requirements.

## 9.0 Sample Preparation

9.1 Allow samples to warm to ambient temperature and proceed with extraction procedures as specified in SOPs for methods 3510C, 3545, 3546 or 3550B.

9.2 All samples extracts are stored in a refrigerator/freezer dedicated to samples only.

9.3 Pesticide sample extract cleanup procedures – used based on observed response.

9.3.1 Allow the 2mL extracts to warm to ambient temperature.

9.3.2 For SW-8081 extracts (low level pesticides).

9.3.2.1 Place a a Phenomenex STRATA FLPR Florasil column onto a 10mL vial. Wet with 1-2mL of a 9:1 Hexane/Acetone.

9.3.2.2 Using a 1mL syringe, transfer 1mL of the hexane extract to the column.

9.3.2.3 Wash the column with 2mL aliquots of the 9:1 Hexane/Acetone. Repeat until approximately 10mL of wash has been collected.

9.3.2.4 Transfer the washed extract to a TurboVap concentrator tube and re-concentrate to 1mL.

9.3.4 PCBs – used for every sample and QC sample.

9.3.4.1 Add 5mL concentrated Sulfuric Acid to the 1 or 2mL hexane extract. Shake for 1 minute.

9.3.4.2 Let the sample rest for 5 minutes to allow the phases to completely separate. Using a Pasteur pipette, transfer the hexane layer to a 2mL auto sampler vial. Add approximately 0.05 - 0.10g of florisil and 0.25 - 0.50g of copper.

## 10.0 Diagram/Table

10.1 Reserved.

## 11.0 Analytical Procedure

11.1 Recommended GC conditions:

11.1.1 Injector Temp. - 250 $^{o}$C
11.1.2 Detector Temp. - 300 $^{o}$C
11.1.3 Initial Oven Temp/Time - 150 $^{o}$C for 1 min

11.1.4 Rate 10°/min to 280° C

11.1.5 Oven Temp/Time final - 280 °C for 8 min (Total Time – 20 minutes)

11.1.5.1 Oven programs vary on instruments due to differing types of flow controls. ECD#1 (Method 2012gc1pcb - 20minute run time), ECD#2 (Method 2012gc2-20min - 20minute run time), ECD#3 (Method PESTPCB – 35minute runtime), ECD#4 (Method 2012ecd – 25minute runtime), ECD#5 (Method ECD5 20 minute runtime)

11.1.6 Auto sampler – inject 1 or 2 ul of sample extract/standards using solvent flush technique (Star method 2010gc1).

11.2 Activate current method file.

11.3 Activate Sample List File (File/New Sample List) and enter samples according to LIMS type LCS, MS, MSD, MBLK, CCV, CCB and SAMP with the corresponding batch or Omega sample ID. Enter initials of the analyst. Analytical date and time will be set by the computer data system.

11.3.1 The sample list is the run log and a typical run sequence should follow as below:

11.3.1.1 Primer (usually 5x highest calibration standard)
11.3.1.2 Reagent Blank
11.3.1.3 Degradation check standard (for pesticide analysis only)
11.3.1.4 Initial calibration curve when required.
11.3.1.5 Calibration Verification Standard
11.3.1.6 LCS (for each target list)
11.3.1.7 Method Blank
11.3.1.8 10 samples
11.3.1.9 Reagent Blank
11.3.1.10 Degradation check standard (optional)
11.3.1.11 CCV (must be analyzed once every 10 samples.)
11.3.1.12 Repeat 11.3.1.5 and 11.3.1.10 for the remainder of the samples including any additional QC samples (MS, MSD, LCS).

**NOTE:** Method blank, MS, MSD, LCS should be analyzed at or near the beginning of the sequence.

11.4 Load samples on the auto sampler tray in order with the run log above.

11.5 Begin sample list.

11.6 If the response of any compound or Aroclor exceeds the working range of the system, dilute/cleanup the extract and reanalyze.

11.7 Compound identification and quantification

11.7.1 For pesticides compound identification is based on the retention time (RT) of the eluting peak in comparison to calibration standard.

11.7.2 Initial identification is a compound that elutes within 0.04 min. of the RT of the standard compound. The 0.04 criteria is programmed into the data system method.

11.7.3 All compound identification must be confirmed by the results for the second column. The compound must be within the RT window on both compounds for positive identification

11.7.4 Co-eluting compounds must be resolved on one of the columns.

11.7.5 Aroclor identification is performed by overlaying standard Aroclor chromatographic response patterns on the sample chromatogram.

11.7.6 Analyst experience in evaluating chromatographic data and identifying compounds in the presence of interfering components is important in final compound identification.

11.7.7 Identified compounds are quantified from the linear regression curve generated by the data system during initial calibration.

11.7.8 Sample results are reported from the primary analytical column (CLP I, Sec. 6.13) unless the RPD result from values obtained on each column exceeds 40% in the absence of overlapping peaks causing an erroneously high result on one column. In these instances the higher result is reported and the disparity is noted in the comments field in the LIMS analytical sequence table for inclusion on the report case narrative.

11.7.8.1 DoD QSM protocol specifies using project specific requirements when available, method requirements when available otherwise report from the primary column.

11.7.9 Compounds exhibiting concentrations above the upper calibration level are diluted into the calibration range. If insufficient sample is available for dilution (i.e. both water sample vials already used) the concentration is flagged as estimated (“E”).

11.7.10 Compound concentrations that are below the laboratory reporting limit or lowest calibration point but positively identified above the MDL are flagged as estimated (“J”).

11.8 Manual integration guidelines and procedures

11.8.1 Situation may arise whereby the quantification provided by the data system is inappropriate. This can occur due to co-elution, baseline noise or matrix interference.

11.8.2 When manual integration of a compound is necessary the following guidelines must be followed.

11.8.2.1 Manual quantification is performed by integrating the area of the peak for the compound.

11.8.2.2 The integration will only include the area attributable to the compound of interest.

11.8.2.3 The area integrated shall not include baseline background noise.

11.8.2.4 The area integrated shall not extend beyond the point where the sides of the peak intersect with the baseline.

11.8.2.5 Manual integration must not be used solely to meet quality control criteria.

11.8.2.6 Manual integration must not be used as a substitute for corrective action on the GC system.

11.8.3 Instances of manual integration are flagged with a “U or m” by the data system. Cases of manual integrations require review and approval by the Laboratory Manager or QA Director and are documented in the corresponding instrument Excel file or in the LIMS analytical sequence Linked Files.

## 12.0 Details of Calibration and Calculations

12.1 Analyze the degradation check standard before the calibration standards. Match the retention times of the peaks in the standards with the sample peaks. For PCB quantification using Method 608 quantify every identifiable peak unless interference with non-target peaks occurs. Add peak area of each identifiable peak and calculate as total response in sample versus total response in the standard. When using Method 8082 compare and quantify at least 5 PCB peaks and average the individual results. Record results in Omega as µg/ml in extract. Omega will combine prep data, dilutions and instrument results and perform final calculations including dry weight calculations for reporting soil results.

12.2 Response Factor:

Rf = Peak Area/Std. Conc.

12.3 Degradation check:

$$\% \text{ Breakdown of DDT} = \frac{\text{sum of degradation peak areas (DDD + DDE)}}{\text{sum of all peak areas (DDT + DDD + DDE)}} \times 100$$

$$\% \text{ Breakdown of Endrin} = \frac{\text{sum of degradation peak areas ( Aldehyde + Ketone)}}{\text{sum of all peak areas (Endrin + Aldehyde + Ketone)}} \times 100$$

12.4 % RSD:

Average Rf = (Rf1+Rf2+Rf3+Rf4+Rf5)/5

Std. Dev. = SQRT [(sum$x^2$ - sum$(x)^2$/n)/(n-1)]

%RSD = Std. Dev./Average Rf x 100

12.5 Percent Difference:

$$\% \text{ Diff} = \frac{C_e - C_f}{C_e} \times 100$$

Where: $C_e$ = Expected concentration
$C_f$ = Concentration found

12.6 Relative Percent Difference (RPD)

RPD = (| R1 – R2 | / ((R1 + R2)/2)) * 100

Where: R1 = First result
R2 = Second result

12.7 Linear Regression: y = ax + b

Where: y = Instrument response (peak area)
a = Slope of the line
x = Concentration of the calibration standard
b = Intercept

12.8 Quadratic Regression: y = $ax^2$ + bx + c

$$y = ax^2 + bx + c$$

Where: y = Instrument response (peak area)
a = Slope of the line
x = Concentration of the calibration standard
b = Intercept

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 Daily Setup of Blanks, Standards and Degradation check standard:

13.1.1 A continuing calibration verification standard (CCV) must be analyzed for all applicable analytes to assure the working curve is still valid. The % Difference or (% drift) must be less than 15%.

13.1.2 This value is calculated for each compound and can be no greater than 15% in order to continue. If the check standard is found to exceed 15% difference for any of the components then an additional check standard may be analyzed and compared to the curve as above. If this second check standard is still out of control, initial calibration must be performed and a new 5-point curve generated. If the second check standard is within the allowable 15% difference samples may be analyzed using the average Cf from the curve to quantify detected compounds. The daily continuing calibration verification standard must be run after every 10 samples.

13.1.3 A reagent/method blank must be run at the beginning of each day to guarantee the system is free of contamination. If any target compound or interfering non target compounds are found in the blank at levels greater than one half the LOQ (reporting limit), then the source of contamination must be identified and corrective action taken before sample analysis can proceed. Corrective actions include reanalysis of the method blank, analysis of reagent blanks, baking systems components (column, detector) and checks on sample preparation procedure. Contamination that does not interfere with target compounds may be ignored.

13.1.4 An injection port degradation check sample must be run prior to analyzing pesticide samples. This is separate standard containing DDT and Endrin and involves checking for Endrin aldehyde/Endrin ketone and DDD/DDE as breakdown products. The breakdown products cannot exceed 15% of the total for DDT or Endrin.

13.2 LCS, Matrix Spike/Matrix Spike Duplicate

13.2.1 In each batch of samples a Laboratory Control Sample (LCS), matrix spike (MS frequency of 10% is required for Method 608 samples), and matrix spike duplicate (MSD) must be analyzed. For water samples, preparation of batch MS/MSD is dependent upon the availability of extra sample provided by the client. Rotation among client samples is required when amount of sample volume is available. In the absence of sufficient sample volume a LCS duplicate is prepared. Statistical control limits are calculated for the recoveries and duplicate percent differences to determine warning and control limits. These limits will be compared to the applicable project limits (i.e. QSM Tables) and the narrower of the limits will

be used to establish control limits provide the data sets are reasonably comparable. In cases where the calculated control limits are significantly greater than the QSM (or other) limits corrective actions will be instituted to achieve control limits consistent with the requirements of the project. If a sample falls outside of these limits action will be taken to determine if the cause was due to matrix interference or method deficiencies including re-preparation of these QC samples when appropriate. In the absence of statistical limits due to the lack of sufficient data points (i.e. water MS/MSD due to lack of sufficient volumes) interim limits based on the four LCS samples from the IDMP will be used to evaluate the batch QC data.

13.2.1.1 Acceptance Criteria MS/MSD – within laboratory statistical limits. For QSM compliance these limits are set to the LCS control limits.

13.2.1.2 Acceptance Criteria RPD – within laboratory statistical limits.

13.2.1.3 Acceptance Criteria LCS – within laboratory statistical limits or project limits as described above.

13.3 Retention Time Windows

13.3.1 Retention time windows will be established and maintained for all components. For Aroclors, at least 3-5 characteristic peaks should be used to determine the RT window.

13.3.2 RT windows are determined by analyzing three control samples over a 72-hour time frame.

13.3.3 The average and standard deviation of the three determinations are calculated and the window is defined as the Mean (average) +/- 3 times the standard deviation.

13.3.4 The retention time windows are re-calculated whenever a new column is installed.

13.3.5 The GC data system does not allow for compound specific RT windows. The widest window (0.04 min.) is programmed into the applicable method and applied to all compounds.

13.4 Surrogate Control Limits

13.4.1 For each sample matrix the first 30 surrogate recoveries are used to establish control limits based on the Mean recovery +/- 3 times the standard deviation. These limits are updated annually or sooner if the control chart reveals a bias trend.

13.4.2 For samples and QC samples in which the surrogate recovery falls outside the established control limits, the following is required.

13.4.3 Check calculations for errors

13.4.4 Check instrument performance

13.4.5 Re-analyze extract- if acceptable than no other actions are required

13.4.6 Re-extract and re-analyze the samples if the above show no problems or flag the data as estimated concentration if sample cannot be re-analyzed or if matrix interferences are obvious and cannot be cleaned up using the methods defined in the appropriate cleanup SOP's.

## 14.0 Data Reporting Requirements

14.1 If any compound is detected at a level above the MDL it must be confirmed on a second column before reporting the data with the results agreeing within 40%. If the conformation is positive, report the higher of the two calculated values. If the difference exceeds 40% then the data is qualified. If a compound is found to co-elute with another compound on one column and not the confirmation column, results are reported from the column that does not co-elute the compound of interest.

14.2 If any compound is found in a sample at a concentration greater than that of the highest standard the sample must be re-analyzed after dilution. No data shall be reported with concentrations greater than the highest calibration standard. The sample should be diluted until all compounds of interest are within the working range of the standard curve.

14.3 The instrument data files produced by this method include the laboratory sample id, the date and time of analysis, the analysis type and the analyst's initials.

14.4 Sample concentrations are reported in µg/ml from the Star data system.

14.5 Raw results are entered into Omega. Prep factors are automatically imported from sample prep logs. Dilutions are entered in the analytical sequence.

14.6 Sample results are reported as ug/L for water and ug/kg for soil as dry weight.

14.7 Raw instruments results are entered directly into the Omega LIMS system using excel spreadsheets, direct instrument interface (routinely used for this procedure) or manually. All calculations to derive final result (including dry weight conversions) are performed automatically by the LIMS. Sample preparation information and percent moisture results are entered into the appropriate section of the LIMS prior to instrument data and are automatically factored into the final results.

14.8 Confirm that there are no QC flags or qualifiers in this sequence. If present, investigate and repeat or reanalyze as necessary.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1. Change septum weekly or as needed. (100 injections max.)

15.2. Check carrier gas and make up gas daily

15.3. Bake out column as needed at 270 $^{0}$C for 1 hour.

15.4. Clean ECD as needed thermally at 330-350$^{0}$C.

## 16.0 Waste Management and Pollution Prevention

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner, which minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Organic solvents are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Soil samples are composited in a drum designated for incineration.

16.2.3 Disposal of materials is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 SW-846-EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, November 1986, Revision 1 Sept, 1994, Method 3510C, 3545, 3550B, 3610B, 3611A, 3620B, 3630C, 3650B, 3660B, 8081B, and 8082A.

17.2 40 CFR Part 136, App. A Method 608.

17.3 RTI Laboratories, Inc SOPs for methods 3510C, 3545, 3546 and 3550B.

17.4 RTI Laboratories, Inc. Quality Assurance Plan.

17.5 RTI Laboratories, Inc. SOP SRC001-A, Sample Receipt and Custody.

17.6 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.7 RTI Laboratories, Inc. Employee Handbook.

## 18.0 Revisions

18.1 Previous Section 6.10 deleted. Instrument GC-ECD 2 removed from service.

Table 4 Target Analytes

| | | |
|---|---|---|
| 4,4´-DDD | Aroclor (unspecified) | AROCLOR-1242-1 |
| 4,4´-DDE | Aroclor 1016 | AROCLOR-1242-2 |
| 4,4´-DDT | Aroclor 1221 | AROCLOR-1242-3 |
| Aldrin | Aroclor 1232 | AROCLOR-1242-4 |
| alpha-BHC | Aroclor 1242 | AROCLOR-1242-5 |
| alpha-Chlordane | Aroclor 1248 | AROCLOR-1248-1 |
| beta-BHC | Aroclor 1254 | AROCLOR-1248-2 |
| Chlordane, total | Aroclor 1260 | AROCLOR-1248-3 |
| delta-BHC | Aroclor 1262 | AROCLOR-1248-4 |
| Dieldrin | Total PCBs | AROCLOR-1248-5 |
| Endosulfan I | AROCLOR-1016-1 | AROCLOR-1254-1 |
| Endosulfan II | AROCLOR-1016-2 | AROCLOR-1254-2 |
| Endosulfan sulfate | AROCLOR-1016-3 | AROCLOR-1254-3 |
| Endrin | AROCLOR-1016-4 | AROCLOR-1254-4 |
| Endrin aldehyde | AROCLOR-1016-5 | AROCLOR-1254-5 |
| Endrin ketone | AROCLOR-1221-1 | AROCLOR-1260-1 |
| gamma-BHC | AROCLOR-1221-2 | AROCLOR-1260-2 |
| gamma-Chlordane | AROCLOR-1221-3 | AROCLOR-1260-3 |
| Heptachlor | AROCLOR-1221-4 | AROCLOR-1260-4 |
| Heptachlor epoxide | AROCLOR-1221-5 | AROCLOR-1260-5 |
| Methoxychlor | AROCLOR-1232-1 | AROCLOR-1262-1 |
| Toxaphene | AROCLOR-1232-2 | AROCLOR-1262-2 |
| Hexachlorobenzene | AROCLOR-1232-3 | AROCLOR-1262-3 |
| Decachlorobiphenyl | AROCLOR-1232-4 | AROCLOR-1262-4 |
| Tetrachloro-m-xylene | AROCLOR-1232-5 | AROCLOR-1262-5 |

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# STANDARD OPERATING PROCEDURE

# SAMPLE PREPARATION AND ANALYSIS FOR CHLORINATED HERBICIDES

| | |
|---|---|
| **Analyte:** | **Chlorinated Herbicides** |
| **SOP #:** | **8151A_040615_R7** |
| **Method Reference:** | **EPA SW-846/8151** |
| **Issue Date:** | **January 7, 2006** |
| **Revision No.:** | **7** |
| **Revision Date:** | **April 6, 2015** |

**Reviewed and Approved: April 6, 2015**

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Director, Environmental Services: Yemane Yohannes

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**SAMPLE PREPARATION FOR THE ANALYSIS OF CHLORINATED HERBICIDES BY GC/MS**

**SOP#: 8151A_040615_R7**

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## 1.0 Scope and Application

1.1 Introduction

1.1.1 RTI Labs, Inc, has prepared this document to detail the Standard Operating Procedure (SOP) for the preparation and analysis of water and soil samples for chlorinated herbicides by esterification with a diazomethane solution and analysis using GC/ECD detector. This procedure is used to measure compounds listed in EPA Method 8151.

1.1.2 A detailed description of the instrumentation, calibration, run parameters and quality control procedures where applicable is included in this SOP.

1.2 Summary of Method

1.2.1 The samples are prepared for analysis using a micro liquid-liquid extraction technique for waters and a sonication extraction for soils/solids. All samples must be subjected to a hydrolysis step using KOH, extraction with MTBE, esterification with diazomethane solution and concentration of the extract. The esterified herbicide extract is analyzed by injecting an aliquot into a dual ECD GC equipped with a RTX CLP Pesticides I - 30m x 0.53 mm primary column (or equivalent) and RTX CLP Pesticides II - 30m x 0.53 mm – confirmatory column (or equivalent) The GC column is temperature programmed to separate the analytes, which are then detected with an electron capture detector. Identification of the target analytes is accomplished by comparing the retention times of sample peaks to that of standards and confirmation by second column evaluation. Quantification is accomplished by linear regression using a five-point calibration curve. GC/MS qualitative/quantitative confirmations of high levels can be made. This procedure utilizes dual column electron capture gas chromatography for detection and quantification.

## 2.0 Safety Precautions

2.1 Compounds applicable to this method are known or suspected carcinogens. Standard preparation is conducted in fume hoods designated for organic use.

2.2 Extraction solvents are flammable and/or toxic and must be handled with caution. All extractions are performed in a manner designed to minimize exposure to these chemicals using appropriate hoods and personal protection.

## 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with RTI Standard Operating Procedure for Sample Log-in. Appropriate U. S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed. Water samples are collected in 1L pre-cleaned amber bottles with Teflon lined screw caps. No preservative is added to the sample containers. Soil samples are received in pre-cleaned wide mouth jars with Teflon lined lids ranging from 2 oz. to 9 oz. in size.

3.2 The holding time for water samples is 7 days from collection to extraction and 40 days from extraction to analysis.

3.3 The holding time for solid samples is 14 days from collection to extraction and 40 days from extraction to analysis.

3.4 All samples and extracts are stored at 4$^{o}$ C.

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 The method detection limit (MDL) is statistically defined at the 99% confidence level according to 40 CFR Part 136 App. B. Seven replicates containing all of the analytes of interest at a concentration level of 1-5 times the estimated D.L. are analyzed and the standard deviation is calculated. The Student's T Value for the 7 replicates (3.143) is multiplied by the standard deviation of the analyte to calculate the MDL. MDLs are updated on major instrument changes and are kept on file in the Laboratory. MDLs and reporting limits are incorporated into the applicable test code in the Omega LIMS.

4.2 The LOD (limit of detection) is determined by spiking reagent water at 1-4 times the MDL and prepared using the same procedure as samples. Analytes must be present at levels 3 times or greater than the blank response (greater than 3 times the signal to noise ratio). The concentration used is the LOD for that analyte. LOD determinations must be performed quarterly.

4.3 The LOQ (limit of quantification) is determined by spiking reagent water at the reporting limit (RL/CRQL) and prepared in the same manner as samples. Analyte recovery must be within LCS control limits of the expected concentration. The concentration used and successfully recovered is the LOQ for that analyte. LOQ determinations must be performed quarterly.

4.4 Initially accuracy and precision at the LCS is determined by spiking 4 aliquots of reagent water and prepared using the same procedure used for samples. The average recovery must be within LCS control limits of the expected value and the %RSD must be less than 25%.

4.5 LOD/LOQ determinations that do not meet the specifications above require repeat analysis, adjustment to the spiking levels and/or reporting limits, repeating the MDL determination at adjusted concentrations if required and repeat LOD/LOQ determinations.

4.6 The range used by RTI Labs is 0.03 µg/ml to 0.5 µg/ml which results in concentration ranges for both water and soil sample of 1.0 µg/L(Kg) to 16.7 µg/L(Kg). The RTI reporting limit is 1 µg/L for most compounds (2,4-D, 2,4-DB and Dalapon have a 10 ppb RL). If an analyte concentration is above the linear range, a dilution of that sample that results in a concentration in the linear range will be analyzed.

4.7 The accuracy and precision for this method are determined by analyzing four LCS samples at a concentration of 0.25 µg/L of each compound. The average percent recovery, standard deviation, and the relative standard deviation are calculated for each analyte. Quality control limits, mean recovery values and RPD results are incorporated in the Omega LIMS.

## 5.0 Interferences

5.1 Interferences can arise from carry over due to high sample concentrations or contamination from reagents and/or glassware. Blanks are injected to ensure system cleanliness in both instances. All glassware must be scrupulously cleaned before use. Phthalates are notorious lab contaminants and will leach from any soft plastic material used during sampling or during prep.

5.2 Samples containing high concentrations of non-target analytes or extremely high levels of select target analytes can result in elevated detection limits for other target analytes. Dilution of the extract may improve the resolution and quantification of some analytes but will generally cause an elevation in the RDL. Interferences from high molecular weight organics such as oils will cause an elevated baseline. If this background is at a high concentration it will interfere with analyte identification as well as quantification. The preferred method of reducing this high molecular weight interference is with GPC cleanup (see GPC method for specifics).

5.3 Interferences caused by phthalate esters result in non-target interfering peaks on the chromatogram. Common flexible plastics contain varying amounts of these phthalates. Take caution not to use soft plastic funnels, bottles, pipettes or syringes in any of the preparation or sample cleanup steps.

5.4 Sodium sulfate must be acidified or acid washed prior to use. Herbicides react readily with alkaline substances and may be lost during analysis. Sample extracts should be dried (using acidified sodium sulfate) prior to esterification to prevent poor recoveries.

## 6.0 Apparatus and Materials

6.1 GC-ECD #3. Hewlett Packard GC with dual electron capture detectors, HP 7673 auto sampler and HP Data System. Chemstation version B.01.00, Widows OS and PC.

6.2 RTX CLP Pesticides I - 30m x 0.53 mm primary column (or equivalent).
RTX CLP Pesticides II - 30m x 0.53 mm – confirmatory column (or equivalent).

6.3 Sonicator – Ultrasonic Processor XL or Heat Systems Virsonic 300.

6.4 TurboVap II evaporator – Zymark.

6.5 40 ml VOA vials, acid rinsed.

6.6 Glass beakers, 250 ml size.

6.7 Glass Funnels or HDPE if glass in unavailable.

6.8 Micro liter syringes, 10µL, 25 µL, 50µL, 100µL, and 1000µL.

6.9 Volumetric glassware.

6.10 Glass vials – 2mL with Teflon lined screw caps, and 12 ml with Teflon lined screw caps.

6.11 Pyrex glass wool (acidified).

6.12 Pasteur pipettes.

6.13 pH indicator paper.

6.14 Oven capable of achieving 60 degrees C.

6.15 Omega LIMS system.

## 7.0 Reagents

7.1 Calibration Standards – Absolute: herbicide methyl derivatives 100ppm mixture. Separate standards for MCPA and MCPP at 2000 ppm. Dilute to the concentrations listed below (section 8).

7.2 Initial Calibration Verification and Continuing Calibration Verification standard (ICV and CCV) second source – Restek Herbicide mix 1 and 4 at 200 ppm, mix 2 (Dalapon) at 2000 ppm.

7.3 Stock surrogate – 2,4-Dichlorophenyl acetic acid methyl derivative 100ppm in MTBE from Ultra Scientific.

7.4 Surrogate spiking solution – 100 µg/ml – 2,4-Dichlorophenyl acetic acid (DCPAA) Ultra Scientific, spike all samples/QC with 50 µl of a 5ppm surrogate spike mix prepared by diluting 50µl into 950µl of methanol. (Final extract concentration will be 0.25 µg/sample).

7.5 Herbicide spike mix – Absolute: Herbicide underivatized 16-analyte mixture, all compounds at 100 ppm in MTBE. Spike all MS/MSD/LCS with 50 µL of a 5ppm spiking solution prepared by diluting 50µl into 950µl of methanol. (Final extract concentration will be 0.25µg/sample).

7.6 Pesticide Grade Solvents: Methylene Chloride, Methanol and MTBE.

7.7 Concentrated sulfuric acid, place in freezer prior to use to chill.

7.8 ASTM Type II DI.

7.9 Ultra High Purity Helium and Nitrogen

7.10 Potassium hydroxide – 37 % – add 74 grams of KOH to 250 ml of DI water.

7.11 Trimethylsilyl-diazomethane – 2M – in hexane. This derivatizing agent is a modification of the SW-8151 method and is based on the use of this compound in EPA Method 515.1.

7.12 Anhydrous Sodium sulfate- purify by heating at 450 degrees C for 4 hours and drying in a desiccator. Acidify using sulfuric acid and ether.

7.13 Silicic acid – Aldrich 100mesh

7.14 0.1M phosphate buffer pH - 2.5 – Dissolve 2.4 grams sodium phosphate ($NaH_2PO_4$) in DI water and dilute to 200 ml adjust to pH 2.5 using phosphoric acid.

7.15 All reagents and standards prepared must be labeled with a minimum:

7.15.1 Identity of the material
7.15.2 Concentration of the solution
7.15.3 Date prepared
7.15.4 Initials of analyst preparing the solution
7.15.5 Expiration date.

## 8.0 Preparation of Standards and Calibration Procedure

8.1 All stock and prepared standards are stored refrigerated. Certificate of analysis for all stock standards are maintained in the laboratory. Prepared standards and solutions are recorded in the logbook, labeled as below and stored refrigerated.

8.1.1 Prepared solution are labeled with the solution type, concentration, expiration date and initials of the analyst.

8.2 The initial calibration is prepared from a 1ppm intermediate standard prepared from stock 7.1 and 7.3 listed above. This intermediate is prepared by adding 100µl of each 2,4-Dichlorophenyl acetic acid methyl derivative 100ppm (7.3) and herbicide methyl derivatives 100ppm mixture (7.1) to a final volume of 10mL using Hexane. A minimum 5-point curve is required for initial calibration.

8.3 Calibration standards are prepared at 0.5, 0.3, 0.2, 0.1, 0.05, and 0.02 ppm from the 1ppm intermediate following the dilution scheme below.

| Concentration | 0.5ppm | 0.3ppm | 0.2ppm | 0.1ppm | 0.05ppm | 0.02ppm |
|---|---|---|---|---|---|---|
| 1ppmIntermediate | 500µl | 300 µl | 200 µl | 100 µl | 50 µl | 20 µl |
| Hexane | 500 µl | 700 µl | 800 µl | 900 µl | 950 µl | 980 µl |

8.4 Initial calibration is evaluated every day samples are being analyzed by the analysis of the calibration verification standard. Initial calibration is required whenever there is a failure of the calibration verification standard (CCV).

8.5 The %RSD of the calibration curve must be <20%RSD for all compounds or exhibit an $r^2$ >0.99 for linear or quadratic regression.

8.6 Daily continuing and initial calibration verification (CCV) and (ICV) standards.

8.7 The ICV and CCV are prepared by analyzing a midpoint calibration standard of 0.25µg/ml. All compounds must be within 20 % difference/drift of the expected value for the initial calibration to be valid. If the criterion is not met for any compound corrective action must be taken prior to the analysis of samples.

8.8 The CCV and ICV are made from the second source standard listed in 7.2 above. Prepare the 0.25ppm Continuing Calibration Verification and Initial Calibration Verification standard (CCV and ICV) by adding 25µl of Absolute cat# 83596 herbicide methyl derivatives 100ppm mixture and 25µL of Calibration surrogate – 2,4-Dichlorophenyl acetic acid methyl derivative 100ppm Absolute cat# 30022 (7.3above) into a 10ml volumetric flask containing Hexane. QS to 10ml using Hexane.

8.9 Preparation of surrogates and spikes:

8.9.1 Surrogate spiking solution – 100 µg/ml – 2,4-Dichlorophenyl acetic acid (DCPAA) Absolute cat# 30122, spike all samples/QC with 50 µl of a 5ppm surrogate spike mix prepared by diluting 500µL into 10ml of methanol. (Final extract concentration will be 0.25 µg/sample).

8.10 Herbicide spike mix – Absolute: Herbicide underivatized 16-analyte mixture, all compounds at 100 ppm in MTBE. Spike all MS/MSD/LCS with 50 µl of a 5ppm spiking solution prepared by diluting 500µl into 10ml of methanol. (Final extract concentration will be 0.25µg/sample).

## 9.0 Sample Preparation

9.1 Aqueous samples- hydrolysis, esterification and extraction:

9.1.1 Measure 30 ml of sample using a graduated cylinder into a 40-ml VOA vial.

9.1.2 Add 50 µl of the surrogate mix.

9.1.3 Add 1 ml of the 37% potassium hydroxide solution. Confirm that the pH is >12. Let the sample stand for 1 hour, shaking periodically.

9.1.4 Add 1.5ml cold concentrated sulfuric acid. Verify that the pH is <2 using pH paper.

9.1.5 If the sample is suspected of having organic interferences, add 5mL methylene chloride and shake for 1 minute. Allow the phases to separate and quantitatively transfer the aqueous portion to a clean 40mL vial. If this clean up step is employed, all QA/QC samples (LCS, method blank, sample, MS/MSD or sample duplicate) in the batch must be subjected to the same procedure.

9.1.6 Add 4-6 ml of MTBE and shake for 3 minutes. Allow fractions to separate – MTBE layer will be on the top.

9.1.7 Allow the organic layer to separate for at least three minutes. If an emulsion forms that is greater than one third the size of the solvent layer mechanical means must be employed to achieve phase separation including stirring, filtration through glass wool, centrifugation or other physical techniques.

9.1.8 Pipette off the top MTBE layer and transfer to 40ml vial containing approximately 2 g of acidified sodium sulfate.

9.1.9 Repeat steps 9.16 – 9.17 two additional times combining the extract in the 40ml vial (Sec 9.1.8).

9.1.10 Vigorously shake the extract and drying agent and allow to stand for at least 2 hours (extracts may remain with the sodium sulfate overnight) with periodic swirling. Sufficient sodium sulfate is evident if, when swirling, free flowing crystals are observed. If the entire sodium sulfate solidifies in a cake add additional acidified sodium sulfate until free flowing crystals are visible.

9.1.11 After the drying is completed decant the solvent into a new 20ml vial.

9.1.12 Add 50 µl of 2M (Trimethylsilyl) diazomethane and shake to mix. Adding 1ml of methanol to the extract helps derivatization efficiency.

9.1.13 Heat at 50 to 60 degrees C for 1 in a drying oven. Record temperature for each use.

9.1.14 Allow to cool.

9.1.15 Transfer the contents of the 12ml vial to a TurboVap vessel rinsing with 3 10ml portions of hexane. Concentrate extract to 1 ml in the TurboVap at 40 degrees C.

9.1.16 Add about 0.01 gm of silicic acid to quench excess diazomethane.

9.1.17 Transfer the concentrate to a 2 ml vial and analyze per analytical procedure specified in Section 11.

9.2 Solid/Soil samples

9.2.1 Measure 30 gm of well-mixed soil discarding any water layer and eliminating foreign objects such as sticks, rocks, etc. using a balance and place in a 250 ml beaker.

9.2.2 Add 2ml of pH 2.5 phosphate buffer and mix. Add 10 to 20 grams of sodium sulfate and mix (sample should be free flowing).

9.2.3 Add 50 µl of the surrogate mix then immediately add 60 ml of methylene chloride/acetone 1:1 mix. Additional solvent may be required to completely cover sample.

9.2.4 Place the sonicator horn approximately 1/2 inch below the surface of the solvent and sonicate for 2 min.

9.2.5 Decant the extract through a funnel containing a acidified glass wool plug and acidified sodium sulfate and collect in a TurboVap vessel.

9.2.6 Repeat 9.2.4 and 9.2.5 two additional times combining the extracts.

9.2.7 Concentrate the extract using the TurboVap at 40 degrees C and exchange the methylene chloride mix solvent for a final solvent of 30 ml water and add 2 ml of the 37% KOH solution.

9.2.8 Proceed according to the steps listed in Section 9.1 above omitting the addition of surrogate (9.1.2).

## 10.0 Diagram/Table

10.1 Reserved.

## 11.0 Analytical Procedure

11.1 Method, run, and integration parameters are stored in the respective instrumentation according to manufacturers' procedures.

11.2 A new sample list is created for each analytical batch of samples.

11.3 Data interpretation, qualitative identification is made when sample peak falls within the established RT window. Qualitative identifications must meet the method criteria before positive identification can be realized.

11.4 All positive hits must be manually evaluated and all integrations confirmed. Baseline adjustments are often necessary due to sample matrix interferences.

11.5 A typical run sequence follows as below:

11.5.1 Reagent Blank
11.5.2 Initial calibration*
11.5.3 CCV or ICV
11.5.4 LCS
11.5.5 Method Blank
11.5.6 10 samples
11.5.7 CCV
11.5.8 10 samples
11.5.9 MS and MSD
11.5.10 Reagent Blank (CCB)
11.5.11 CCV

*Note initial calibration is only required following CCV failure.

11.6 Set instrument parameters according to Table 3.

11.7 Compounds exhibiting concentrations above the upper calibration level are diluted into the calibration range. If insufficient sample is available for dilution (i.e. both water sample vials already used) the concentration is flagged as estimated ("E").

11.8 Compound concentrations that are below the laboratory reporting limit or lowest calibration point but positively identified above the MDL are flagged as estimated ("J").

**Table 3**
**Gas Chromatograph Parameters**

| **GC Parameters:** | **Settings: Hewlett Packard dual ECD system** |
|---|---|
| Flow/Initial column temperature | Flow UHP Helium – 5.0ml/min. Split less injection<br><br>70 degrees C. |
| Initial hold time | 1 minutes |
| 1st ramp rate/temp. | 8 degrees/min. to 120 degrees C. Hold 0 min. |
| 2nd ramp rate/temp. | 4 degrees/min. to 180 degrees C. Hold 0 min. |
| 3rd ramp rate/temp. | 10 degrees/min. to 270 degrees C. Hold 3.75 min. |
| Injector Temperature | 225 degrees C. |
| Detector Temperature | 300 degrees C. |

11.9 Compound identification and quantification

Compound identification is based on the retention time (RT) of the eluting peak in comparison to calibration standard.

11.9.1 Initial identification is a compound that elutes within 0.04 min. of the RT of the standard compound. The 0.04 criteria are programmed into the data system method.

11.9.2 All compound identification must be confirmed by the results for the second column. The compound must be within the RT window on both compounds for positive identification.

11.9.3 Co-eluting compounds must be resolved on one of the columns.

11.9.4 Analyst experience in evaluating chromatographic data and identifying compounds in the presence of interfering components is important in final compound identification.

11.9.5 Identified compounds are quantified from the linear regression curve generated by the data system during initial calibration.

11.9.6 Sample results are reported from the primary analytical column unless the RPD result from values obtained on each column exceeds 40% in the absence of overlapping peaks causing an erroneously high result on one column. In these instances the higher result is reported and the disparity is note in the comments field in the LIMS analytical sequence table for inclusion on the report case narrative.

11.9.7 Compounds exhibiting concentrations above the upper calibration level are diluted into the calibration range. If insufficient sample is available for dilution (i.e. both water sample vials already used) the concentration is flagged as estimated (“E”).

11.9.8 Compound concentrations that are below the laboratory reporting limit or lowest calibration point but positively identified above the MDL are flagged as estimated (“J”).

11.10 Manual integration guidelines and procedures

11.10.1 Situation may arise whereby the quantification provided by the data system is inappropriate. This can occur due to co-elution, baseline noise or matrix interference.

11.10.2 When manual integration of a compound is necessary the following guidelines must be followed.

11.10.3 Manual quantification is performed by integrating the area of the peak for the compound.

11.10.4 The integration will only include the area attributable to the compound of interest.

11.10.5 The area integrated shall not include baseline background noise.

11.10.6 The area integrated shall not extend beyond the point where the sides of the peak intersect with the baseline.

11.10.7 Manual integration must not be used solely to meet quality control criteria.

11.10.8 Manual integration must not be used as a substitute for corrective action on the LC system.

11.10.9 Instances of manual integration are flagged with an "m" by the data system. The m flag appears in the UQUAL field of the Omega analytical sequence and on the final report. Before and after screen displays of the manual integrations are printed as pdf files and linked to the analytical sequence for review. The rationale for the manual integration is included the analytical sequence. All manual integrations and reasons are reviewed and approved by Data Reviewers or Management level staff with date and initials entered in the corresponding LIMS analytical sequence.

## 12.0 Details of Calibration and Calculations

12.1 External standard calibration using average response factor method where:
RF (response factor)=concentration/area
Avg. RF = mean of the RFs (minimum 5 points)

12.2 Linearity of the curve is assessed using the %RSD of the RF for each analyte where:
%RSD=Std. Deviation/Mean * 100
%RSD ≤ 20% for each analyte

12.3 Linear Regression: $y = ax + b$

Where: y = Instrument response (peak area)
a = Slope of the line
x = Concentration of the calibration standard
b = Intercept

12.4 Quadratic Regression: $y = ax^2 + bx + c$

$$y = ax^2 + bx + c$$

Where: y = Instrument response (peak area)
a = Slope of the line
x = Concentration of the calibration standard
b = Intercept

12.5 Daily, Initial, and Continuing calibration verification is determined by the response of the standard where: %D(percent difference)=(Mean RF – Std RF) / Mean RF *100 or %Drift = Conc. Measured/Expected conc. *100.
%D or %Drift ≤ 20% for each analyte

12.6 Soil Samples are reported as µg/Kg on a dry weight basis where:
µg/Kg = [(C · Ve · DF) / Vi] · [100 / %solid]

C = concentration found in sample
Ve = volume of extract
DF = dilution factor
Vi = initial volume of sample

Sample concentration is directly imported into the Omega LIMS, which then performs calculation using sample preparation data and percent solids data.

12.7 Water calculations are reported as µg/L where:
µg/L = (C · Ve · DF) / Vi
C = concentration found in sample
Ve = volume of extract
DF = dilution factor
Vi = initial volume of sample

Sample concentrations are directly imported into the Omega LIMS, which performs final calculations.

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 Retention Time Windows will be established and maintained for each analyte.

13.1.1 Determined by analyzing three control samples over a 72-hour period.
13.1.2 Defined as the Mean +/– (3 times the standard deviation)
13.1.3 Re-calculated whenever a new column is installed or instrument conditions are changed.
13.1.4 Retention time and tolerances are programmed into data analysis method and all standards are checked to ensure analytes fall within RT window.
13.1.5 Standard RT fall outside window a new window is calculated using the standards run over the past 72 hours.

13.2 Prepare a method blank for each batch of twenty or less samples using DI water for aqueous samples and cleaned sand (or reagents only if necessary) for solid samples.

13.2.1 Acceptance Criteria: Result less than one half the reporting limit for all target analytes.

13.2.2 Corrective Action: Clean system and check for sources of contamination.

13.3 Prepare a laboratory control sample (LCS) for each batch of twenty or less samples by adding 50µl of the spike mix (section 7.5) and 50µL of the surrogate mix (section 7.4) to 30ml of DI water for aqueous samples or 30 gm of cleaned sand (or reagents only if necessary) for solid samples.

13.3.1 Acceptance Criteria: 70 – 130 % recovery, or statistically calculated or according to project (i.e. QSM) guidelines. Current LCS control limits are set to values cited in the DoD QSM version 5.0.

13.3.2 Corrective Action: Any target analyte exceeding control limits determine the source of the problem and correct. Repeat LCS, re-prepare and re-analyze batch and repeat calibration procedure if necessary.

13.4 Prepare a matrix spike (MS) and a matrix spike duplicate (MSD) for each batch of twenty or less samples by adding 50µL of the spike mix (section 7.5) and 50µl of the surrogate mix (section 7.4) to a representative sample.

13.4.1 Acceptance Criteria: Set to LCS control limits. MSD RDP not to exceed 25%.

13.4.2 Corrective Action – Evaluate the sample spiked for matrix interference and flag the data as necessary.

13.5 An initial demonstration of capabilities is performed by analyzing 4 laboratory prepared samples at a concentration approximately 5 times the PQL. This is performed at method initiation or whenever major changes in instrumentation or methodology occur.

13.6 All CCV results must be within method specified limits (%D <20%). Failures will necessitate reanalysis of the CCV and re-calibration if necessary. Samples associated with an unacceptable CCV must be re-analyzed with acceptable CCV data. Analysis cannot proceed until acceptable CCV results are obtained.

13.7 Surrogate Control Limits:

13.7.1 Surrogate control limits are set to the values listed in the DoD QSM. If required surrogate limits may be calculated for a sample matrix using at least 20 data points and the Mean recovery +/- 3 times the standard deviation.

13.7.2 For samples (including QC samples) in which the surrogate recovery falls outside the established control limits, the following is required.

13.7.2.1 Check calculations for errors
13.7.2.2 Check instrument performance
13.7.2.3 Re-analyze extract- if acceptable than no other actions are required.
13.7.2.4 Re-extract and re-analyze the samples if the above show no problems or flag the data as estimated concentration if sample cannot be re-analyzed or if matrix interferences are obvious and cannot be cleaned up using the methods defined in the appropriate cleanup SOP’s.

## 14.0 Data Reporting Requirements

14.1 If any compound is found in a sample at a concentration greater than that of the highest standard the sample must be re-analyzed after dilution. The sample should be diluted until all compounds of interest are within the working range of the standard curve. The surrogate recoveries must fall within the statistical ranges (section 13.7).

14.2 Sample concentrations are reported in µg/mL from the data system.

14.3 Raw results are imported directly from the data system into Omega. Prep factors are automatically imported from sample prep logs. Dilutions are entered in the analytical sequence.

14.4 Sample results are reported as µg/L for water and µg/kg for soil as dry weight.

µg/kg dry wt. = µg/kg wet wt.*100/percent solids

14.5 Raw instruments results are entered directly into the Omega LIMS system using excel spreadsheets, direct instrument interface or manually. All calculations to derive final result (including dry weight conversions) are performed automatically by the LIMS. Sample preparation information and percent moisture results are entered into the appropriate section of the LIMS prior to instrument data and are automatically factored into the final results.

14.6 Confirm that there are no QC flags or qualifiers in this sequence. If present, investigate and repeat or reanalyze as necessary.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 Weekly: Change septa approximately every 100 injections, perform injection port maintenance as needed and prepare new CCV standard.

15.2 Bake out column as needed @270 $^{0}$C for 1 hour.

15.3 Clean ECD as needed thermally at 330-350$^{0}$C.

## 16.0 Waste Management and Pollution Prevention

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner, which minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Organic solvents are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Soil samples are composited in a drum designated for incineration.

16.2.3 Disposal of materials is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 SW-846-EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, Revision 1 December 1996. Method 8151A.

17.2 Standard Methods for the Examination of Water and Wastewater, 19th edition. Method 6640 parts A and B.

17.4 RTI Laboratories, Inc. Quality Assurance Plan.

17.5 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.6 RTI Laboratories, Inc. SOP: SRC001-A, Sample Receipt and Custody SOP.

17.7 RTI Laboratories, Inc. Employee Handbook.

## 18.0 Revisions

18.1 Sections 9.1.8 and 9.1.9 revised.

18.2 Sections 9.1.10 and 9.1.11 added – previous retained and follow beginning 9.1.12.

18.3 Initial calibration RSD acceptance changed from 15% to 20%.

18.4 ICV and CCV criteria changed from 15% to 20%.

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# STANDARD OPERATING PROCEDURE

# ANALYSIS OF VOLATILE ORGANIC COMPOUNDS BY GC/MS

| | |
|---|---|
| **Analyte:** | **Volatile Organic Compounds (Various)** |
| **SOP #:** | **8260C_010815_R9** |
| **Method Reference:** | **EPA SW846/5030B/5035/8260C**<br>**EPA 624** |
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**Reviewed and Approved January 8, 2015 by:**

Director, Environmental Services: Yemane Yohannes

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# STANDARD OPERATING PROCEDURE
# ANALYSIS OF VOLATILE ORGANIC COMPOUNDS
# BY GC/MS

## SOP#: 8260C_010815_R9

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# 1.0 Scope and Application

## 1.1 Introduction

RTI Laboratories, Inc. has prepared this document to detail the Standard Operating Procedure (SOP) for the analysis of soil and water samples by Purge and Trap/Gas Chromatography/Mass Spectrometry. Analytes targeted for this method are listed in Appendix B and include Purgable Hydrocarbons listed in EPA SW-846 Method 8260. Specific compound lists are contained in the test codes resident in the Omega LIMS.

A detailed description of the instrumentation, calibration, run parameters and quality control procedures is included in this SOP. For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

## 1.2 Summary of Method

Volatile analytes present in water or soil samples are analyzed by the purge and trap method of sample introduction followed by gas chromatography/mass spectrometry. The mass spectrometer is tuned to meet method requirements, calibration curves are established, and system performance and continuing calibration standards verify acceptable instrument operation prior to sample analysis. Once all calibration and quality control parameters have been successfully analyzed, samples are placed in appropriate purge and trap vessels where an inert gas purges the volatile components from the sample and delivers the analytes to a solid sorbent trap. The trap is heated to release the analytes and swept into a gas chromatograph where compound separation occurs. Compounds eluting from the GC column are introduced into a mass spectrometer where compounds are identified by the characteristic mass spectra and quantified using the primary characteristic ion.

# 2.0 Safety Precautions

2.1 Compounds applicable to this method are known or suspected carcinogens. Proper personal protective procedures should be employed when handling standard materials and samples that may contain potentially toxic compounds.

# 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with the RTI Standard Operating Procedure for Sample Receipt and Custody (SRC001-A). Appropriate U. S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed.

3.2 Water samples and TCLP ZHE extracts are collected in commercially obtained 40 ml pre-cleaned vials containing HCl preservative with Teflon lined screw caps. All samples are stored at 4 degrees C and have a maximum 14-day holding time. Samples collected in unpreserved vials have a maximum holding time of 7 days. The pH of each preserved water sample is checked following analysis to ensure the presence of preservative. Samples should be received with no overt bubbles or headspace in the vial. If a problem occurs with the sample the sampler is contacted and the problem noted in the LIMS.

3.3 Soil sample collection using methanol preservation - High level Method 5035.

3.3.1 RTI supplies 40 ml weighed vials containing 10ml methanol. Samples should be collected by weighing (or estimating from the soil density) 10 gm of soil directly into the vial containing methanol.

3.3.2 Vials are weighed prior to analysis at the laboratory to determine the amount of soil added. Samples containing <9 gm are flagged and samples containing >20 gm are rejected (Refer to section 11.6). Samples are additionally flagged if the soil is not completely submerged in the methanol.

3.3.3 Samples must be stored on ice or at 4$^{o}$C and delivered to the laboratory within 4 days. Sample holding time is 14 days from collection to analysis.

3.3.4 A separate bulk soil sample must be collected for percent solids determination.

3.4 Soil sample collection - Low level using Method 5035.

3.4.1 RTI supplies 40 ml weighed vials containing 5ml sodium bisulfate and (if required) 5ml DI water. Samples should be collected by weighing (or estimating from the soil density) 5 gm of soil directly into the vials.

3.4.2 Vials are weighed prior to analysis at the laboratory to determine the amount of soil added.

3.4.3 Samples must be stored on ice or at 4$^{o}$C and delivered to the laboratory within 4 days. Sample holding time is 14 days from collection to analysis.

3.5 Soil sample collection – Encore devices.

3.5.1 Samples collected in these devices have a 48 hr holding time from collection to receipt at the laboratory and transfer to methanol.

3.5.2 Upon arrival at the laboratory, 10 grams of sample will be transferred from the device to a vial containing 10 ml of methanol (if a 10 g Encore is used for collection the entire volume of soil will be transferred to the vial). The date and time of transfer is noted on the chain of custody. Record the weight in the sample logbook.

3.5.3 Encore samples may also be processed using the low level method with aqueous sodium bisulfate. RTI maintains 40 ml weighed vials containing 5ml sodium bisulfate. Upon arrival at the laboratory, 5 grams of sample will be transferred from the device to a 40 ml weighed vial containing 5ml sodium bisulfate and (if required) 5ml DI water. The date and time of transfer is noted on the chain of custody. Record the weight in the sample logbook.

3.6 Bulk soil sample collection – Method 5035.

3.6.1 Samples should be collected in a pre-cleaned, wide mouth 4 or 8 oz jar filled completely with minimal headspace. It is recommended that a separate container be used for the sampling of volatile organic compounds (VOC's). In the case of a single container submitted with other requests in conjunction with VOC analysis, two five gram samples will be removed from the container and placed in separate VOC vials immediately following sample login.

3.7 Soil Sample Collection – State of Alaska. Volatile organic compounds (i.e. BTEX) collected in conjunction with GRO analysis will follow the sample collection procedures specified in the GRO SOP (25 g soil preserved with 25 ml methanol collected in 4 oz containers).

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 The method detection limit (MDL) is statistically defined at the 99% confidence level according to 40 CFR Part 136 App. B. Seven replicates containing all of the analytes of interest at a concentration level of 1-5 times the estimated D.L. are analyzed and the standard deviation is calculated. The Student's T Value for the 7 replicates (3.143) is multiplied by the standard deviation of the analyte to calculate the MDL. MDLs are updated on major instrument changes and are kept on file in the Laboratory. MDLs and reporting limits are incorporated into the applicable test code in the Omega LIMS.

4.2 The LOD (limit of detection) is determined by spiking reagent water at 1-4 times the MDL and prepared using the same procedure as samples. Analytes must be present at levels 3 times or greater than the blank response (greater than 3 times the signal to noise ratio). The concentration used is the LOD for that analyte. LOD determinations must be performed quarterly.

4.3 The LOQ (limit of quantification) is determined by spiking reagent water at the reporting limit (RL/CRQL) and prepared in the same manner as samples. Analyte recovery must be within 30% of the expected concentration or within established limits. The concentration used and successfully recovered is the LOQ for that analyte. LOQ determinations must be performed quarterly.

4.4 Initially accuracy and precision at the LOQ is determined by spiking 4 aliquots of reagent water at the reporting limit (RL/CRQL) and prepared using the same procedure used for samples. The average recovery must be within 30% of the expected value or within established limits and the %RSD must be less than 15%.

4.5 LOD/LOQ determinations that do not meet the specifications above require repeat analysis, adjustment to the spiking levels and/or reporting limits, repeating the MDL determination at adjusted concentrations if required and repeat LOD/LOQ determinations.

4.6 The range used by RTI for methanol extracted samples is 30 ug/Kg to 10000 ug/Kg for most compounds. For aqueous samples the linear range is 1 ug/L to 200 ug/L for most compounds. Low level soils the linear range is 1ug/Kg to 200 ug/Kg for most compounds. The linear range for some of compounds may be established at a lower upper limit. If an analyte concentration is above the linear range, a dilution of that sample that results in a concentration in the linear range will be analyzed.

4.7 The accuracy and precision for this method are determined by analyzing four LCS samples at a concentration of 10 ug/L of each compound (m/p-Xylenes – 20ug/L). The average percent recovery, standard deviation, and the relative standard deviation are calculated for each analyte. Quality control limits, mean recovery values and RPD results are incorporated in the Omega LIMS.

## 5.0 Interferences

5.1 The major source of interference is associated with contamination. Specific areas of concern are discussed below.

5.1.1 Impurities in the purge gas and sorbent trap may introduce volatile compounds into the system. Using high purity purge gas and baking of the trap minimizes this problem. Routine analysis of method/reagent blanks is performed to ensure the system is free from contamination.

5.1.2 Contamination may arise when a low level or target analyte free sample is analyzed immediately following a sample containing high concentration of compounds. These situations should be investigated and suspect samples repeated following a blank analysis.

5.1.3 Samples containing high concentrations of non-target compounds or high levels of target analytes will require dilutions and will raise the minimum detectable limits for some or all compounds. Little can be done to avoid this problem other than to attempt to use the lowest possible dilution volume.

5.2 Methylene chloride as a common laboratory solvent can present potential contamination problems. Samples must be stored and processed in areas where methylene chloride is not used since this compound will diffuse through the septa and caps of sample vials. Attention to trip blanks, method blanks and storage blanks will identify possible problems with methylene chloride contamination. All steps to clean the system and prevent system and/or sample exposure must be undertaken when contamination is identified.

5.3 Trip blanks are prepared for each sampling event to accompany the samples through the entire process. These will assist in identifying potential sources of contamination resulting from diffusion of volatile organics through the septa of sample vials.

5.3.1 RTI supplies 40 ml weighed vials containing 5ml sodium bisulfate or 5ml DI water for low level soil samples. No other preparatory steps are required.

5.3.2 RTI supplies 40 ml weighed vials containing 10ml methanol for high level soil samples. No other preparatory steps are required.

5.3.3 Trip blanks for water samples are prepared by filling a 40 ml pre-cleaned vial with Teflon lined screw cap containing HCl preservative (or unpreserved when required) with ASTM type II DI water from the volatile laboratory.

5.4 For samples containing large amounts of water-soluble materials, suspended solids, high boiling compounds, or high concentrations of compounds being determined, it may be necessary to wash the purging device with a soap solution, rinse it with organic-free reagent water, and then dry the purging device in an oven at 105 $^{o}$C. In extreme situations where contamination occurs, the entire purge-and-trap device may require dismantling and cleaning.

## 6.0 Apparatus and Materials

6.1 Agilent 6890 GC gas chromatograph in split injection mode, Agilent 5972 Quadrapole MS, Windows based computer workstation with HP ChemPC and Enviroquant software – Version B (VOA 9).

6.2 Agilent 6890 GC gas chromatograph in split injection mode, Agilent 5973 Quadrapole MS, Windows based computer workstation with HP ChemPC and Enviroquant software – Version D (VOA 11).

6.3 Agilent 6890 GC gas chromatograph in split injection mode, Agilent 5973 Quadrapole MS, Windows based computer workstation with HP ChemPC and Enviroquant software – Version D (VOA 12).

6.4 Agilent 6890 GC gas chromatograph in split injection mode, Agilent 5973 Quadrapole MS, Windows based computer workstation with HP ChemPC and Enviroquant software – Version E (VOA 10).

6.5 Restek Rtx-624 (30m, 0.25mm, 1.4μm plate) capillary column and JW DB-624 (60m, 0.25mm, 1.4μm plate) capillary column.

6.6 EST Centurion Auto sampler (2) with external heated soil cup for low level soil analysis, and EST ENCON purge and trap with external sparge unit and Supelco Vocarb 3000 thermal trap. The heated transfer line is connected directly to the Electronic Pressure Control (EPC) inlet on the GC.

6.7 EST Centurion Auto sampler and EST ENCON purge and trap with external sparge unit and Supelco Vocarb 3000 thermal trap. The heated transfer line is connected directly to the Electronic Pressure Control (EPC) inlet on the GC.

6.8 Encon Purge and Trap (6).

6.9 Top Loading Balance capable of weighing to 0.1g.

6.10 EPA Protocol B cleaned 40mL VOA vials with Teflon Septa.

6.11 Hamilton gas tight micro syringes – 1.0, 10-, 25-, 50-, 100-, 250-, 1000µL.

6.12 Wheaton target vial crimper and de-capper.

6.13 National Scientific 11mm Teflon lined aluminum caps.

6.14 National Scientific 2mL amber target vials.

6.15 Class A volumetric flasks with stoppers – 10-, 50-, 100-mL.

6.16 Disposable Pasteur pipettes.

6.17 Branson Sonicator 3510.

6.18 Micro vials – 1 ml with 13 mm Mininert Screw Cap.

## 7.0 Reagents

7.1 ASTM type II DI water.

7.2 Methanol, $CH_3OH$ – Purge and Trap quality or equivalent, demonstrated to be free of analytes. Store apart from other solvents. Record reagent in Omega Chemical Inventory. Methanol expires 1 year after opening.

7.3 Stock Standards: NOTE: Standards from two different vendors are maintained or if not available two separate lot numbers from the same vendor are obtained. One for preparing the calibration standards and the second for preparing Calibration Check Standards (ICV/CCV), Laboratory Control Samples (LCS) and Matrix Spikes (MS)/Matrix Spike Duplicates (MSD). Standards must be obtained from vendors certified to ISO Guide 34. Store with minimal headspace and protect from light at -10°C or less in Freezer 01 located in the VOA Lab. Prior to initial use, the analyst should review the Certificate of Analysis for statement of conformance, traceability of the standard, and uncertainty of certified values. All certificates are maintained in the volatiles laboratory and electronically in the LIMS standards section linked to the appropriate standard. Stock Standards are to be recorded in OMEGA Spike/Standard Inventory Unopened standards should be replaced as recommended by the manufacturer or sooner if standard degradation is apparent. Opened Stock Standards expire 6 months after opening. Table 1 lists the standards currently in use for this method.

7.4 Intermediate Standard Solutions - Using Stock standards prepare solutions in methanol containing the compounds of interest, either singly or mixed together. Store with minimal headspace and protect from light at -10°C or less in Freezer 01 in the VOA Lab. Standards should be checked frequently for signs of degradation or evaporation, especially just prior to preparing calibration standards. Replace after 14 days. Calibration standard preparation procedures are listed in Section 8, Table 2.

7.5 All Stock and Intermediate Standards are to be recorded in OMEGA Spike/Standard Inventory. The analyst will include the source, part number, lot number, description, and initial volume of all standards and solvents used to make the standard. Each standard will be given a unique identification number. This number begins with the department abbreviation followed by a six-digit date and a letter (e.g. VOA122100A, VOA122100B, etc…). Affix a label to each stock standard vial. Write the identification number, standard description, and expiration date on the label.

7.6 Surrogate and internal standards - The surrogates are Toluene-$d_8$, 4-Bromofluorobenzene, and Dibromofluoromethane. The internal standards are Chlorobenzene-$d_5$, 1,4 - Dichlorobenzene-$d_4$, Pentafluorobenzene, and 1,4-Difluorobenzene. A 50 µg/mL surrogate/internal standard solution is prepared as described in Section 8. Each sample undergoing analysis must be spiked with the surrogate/internal standard stock solution prior to analysis (including calibration and QC samples). The Centurion will automatically deliver 5 µL of the 50 µg/mL intermediate IS/SS resulting in a 50 µg/L spike.

7.7 Helium - Ultra pure - Cryogenic Gases

7.8 40mL vials containing sodium bisulfate (1:5 solution) - Reagent Grade

7.9 40ml vials containing hydrochloric acid (1:1 v/v)

**Table 1**
**Stock Standard Solutions**

| Source | Part # | Description |
|---|---|---|
| Absolute Standards | 33003 | 2000 µg/ml Method 8260B 78 Analyte Volatiles Mixtu |
| Absolute Standards | 30058 | 2000 µg/ml Method 8260B 6 Analyte VOC Gas Mixtu |
| Restek | 30462 | 2000 µg/ml Freon 113 |
| Absolute Standards | 70074 | 1000 µg/ml 2-Chloroethyl vinyl ether |
| Absolute Standards | 70214 | 1000 µg/ml 2-Methylnaphthalene |
| Absolute Standards | 70944 | 1000 µg/ml 1,2,3-Trimethylbenzene |
| Absolute Standards | 92746 | Various Concentrations Oxygenates |
| Absolute Standards | 70409 | 1000 µg/ml 1,3.5- Trichlorobenzene |
| Absolute Standards | 71627 | 1000 µg/ml Methylcyclohexane |
| Absolute Standards | 71023 | 1000 µg/ml Cyclohexane |
| Absolute Standards | 71031 | 1000 µg/ml Methyl Acetate |
| Ultra Scientific | DWM-544 | 2000 µg/ml Method 8260B 6 Analyte VOC Gas Mixtu |
| Ultra Scientific | DWM-589N-1 | 2000 µg/ml Method 8260B 54 Analyte Volatiles Mixtu |

| | | |
|---|---|---|
| Ultra Scientific | DWM-592-1 | 2000 µg/ml Method 524.2 24 Analyte Volatiles Mixtur |
| Ultra Scientific | EPA-1016 | 5000 µg/ml 2-Chloroethyl vinyl ether |
| Restek | 30619 | 2000 µg/ml Oxygenates |
| Ultra Scientific | CUS-3598 | 1000 µg/ml 2-Methynaphtalene |
| AccuStandard | MREF1410X | 2000 µg/ml Freon 113 |
| Ultra Scientific | STM-341N-1 | 2000 µg/ml 4 Component Internal Standard |
| Ultra Scientific | STM-330N-1 | 2000 µg/ml 3 Component Surrogate Standard |
| AccuStandard | TK10208510 | 2000 µg/ml Cyclohexane |
| Restek | 20216 | 2000 µg/ml Vinyl Acetate |

**1000 µg/ml Acrolein Stock Solution**

| Volume (µL | Part # | Part Description |
|---|---|---|
| 6 | RCC-150 | 97.2% Acrolein – Ultra Scientific |
| 5000 FV | 232-1 | Purge and Trap Grade Methanol |

**1000 µg/ml 1,2,3-Trimethylbenzene Stock Solution**

| Volume (µL | Part # | Part Description |
|---|---|---|
| 6.2 | T73202-5m | 90% 1,2,3-Trimethylbenzene |
| 5000 FV | 232-1 | Purge and Trap Grade Methanol |

**2000 µg/ml 1,3,5-Trichlorobenzene Stock Solution**

| Amount | Part # | Part Description |
|---|---|---|
| 0.02g | T54607-5G | 99% 1,3,5-Trichlorobenzene |
| 10ml FV | 232-1 | Purge and Trap Grade Methanol |

**1000 µg/ml 2 Additional Analytes**

| Volume (µL) | Part # | Part Description |
|---|---|---|
| 11 | FLSA-016 | Ethanoic Acid Methyl Ester, neat 99.9% pure |
| 13 | 66294 | Methylcyclohexane, 99.5% pure |
| 10ml FV | 232-1 | Purge and Trap Grade Methanol |

**1000 µg/ml Vinyl Acetate Stock Solution**

| Volume (µL | Part # | Part Description |
|---|---|---|
| 11 | A16247 | 99% Vinyl Acetate – neat |
| 10000 FV | 232-1 | Purge and Trap Grade Methanol |

**50 µg/mL VOA Internal Standard and Surrogate Intermediate f Centurion**

| Volume (µL | Part # | Part Description |
|---|---|---|
| 250 | STM-341N | 2000 µg/mL 4 Analyte Internal Standard Mix |
| 250 | STM-330N | 2000 µg/mL 3 Analyte Surrogate Standard Mix |
| 10000 FV | 232-1 | Purge-&-Trap Grade Methanol |

FV – Final Volume.

## 8.0 Preparation of Standards and Calibration Procedure

8.1 Instrument tune check – 50 ng of BFB is injected into the GC/MS and evaluated against the criteria specified in Method 8260. These parameters are incorporated into the data system and appear on the tune report.

8.1.1 The BFB tune check must be performed prior to analyzing samples and every 12 hours of continuous instrument run time. The resultant mass spectra for the BFB must meet the criteria given below before sample analysis begins.

| m/z | Required Intensity (relative abundance) |
|---|---|
| 50 | 15 to 40% of m/z 95 |
| 75 | 30 to 60% of m/z 95 |
| 95 Base peak | 100% relative abundance |
| 95 | 5 to 9% of m/z 95 |
| 173 | Less than 2% of m/z 174 |
| 174 | Greater than 50% of m/z 95 |
| 175 | 5 to 9% of m/z 174 |
| 176 | Greater than 95% but less than 101% of m/z 174 |
| 177 | 5 to 9% of m/z 176 |

8.1.2 Preparation of BFB solution.

| Preparation of 50 µg/ml BFB Stock Solution | | |
|---|---|---|
| **Volume (µL)** | **Part #** | **Part Description** |
| 125 | STS-110N | 2000 µg/mL 4-Bromofluorobenzene Solution |
| 4875 | 232-1 | Purge and Trap Grade Methanol |
| 5000 total | | |

8.1.3 For aqueous and methanol preserved soil samples the working 12 hour solution is prepared by adding 10 ul of the of the 50 ug/ml BFB stock (Section 8.1.2) to a final volume of 50 ml DI water. When analyzing low level soil samples the BFB solution is prepared by adding 1 ul of the stock to a final volume of 5 ml DI water.

8.2 Initial and continuing calibration intermediate standards are prepared from the stock standards (Section 7, Table 1) and neat materials for Acrolein, 1,2,3-Trimethylbenzene, 1,3,5-Trichlorobenzene, 1000µg/mL 2 additional compounds and Vinyl Acetate according to the tables below and labeled with a 14 day expiration date from the date of preparation.

| 50 mg/ml VOA Initial Calibration Intermediate Standard | | |
|---|---|---|
| **Volume (mL)** | **Part #** | **Part Description** |
| 40 | STM330N1 | 2000 µg/ml Surrogates |
| 80 | Various | 1000 µg/ml Acrolein |
| 40 | 70474 | 2000 µg/ml Freon 113 |
| 80 | 70944 | 1000 µg/ml 1,2,3-Trimethylbenzene |
| 40 | 92746 | Various Concentration Oxygenates |
| 40 | 33003 | 2000 µg/ml Method 8260B 78 Analyte Volatile Mixture |
| 40 | 30058 | 2000 µg/ml Method 8260B 6 Analyte VOC Ga Mixture |
| 80 | 70074 | 1000 µg/ml 2-Chloroethyl vinyl ether |
| 80 | 70409 | 1000 µg/ml 1,3,5-Trichlorobenzene |
| 80 | 70214 | 1000 µg/ml 2-Methylnaphthalene |
| 80 | 71627 | 1000 µg/ml Methylcyclohexane |
| 80 | 71023 | 1000 µg/ml Cyclohexane |
| 80 | 71031 | 1000 µg/ml Methyl Acetate |
| 40 | 30216 | 1000 µg/ml Vinyl Acetate |
| 720 | 232-1 | Purge-&-Trap Grade Methanol |
| 1600 total | | |

| 50 mg/ml VOA Initial/Continuing Calibration Verification Intermediate Standard | | |
|---|---|---|
| **Volume (mL** | **Part #** | **Part Description** |
| 40 | DWM-589N- | 2000 µg/ml Method 524.2 54 Analyte Volatiles M |
| 40 | DWM-544-1 | 2000 µg/ml Method 524.2 6 Analyte Gas Mixture |
| 40 | DWM-592-1 | 2000 µg/ml Method 524.2 24 Analyte Volatiles Mi |
| 16 | EPA-1016 | 5000 µg/ml 2-Chloroethyl vinyl ether |
| 40 | CUS5037 | 2000 µg/ml Freon 113 |
| 80 | CUS3598 | 1000 µg/ml 2-Methynaphtalene |
| 80 | Various | 1000 µg/ml 1,2,3-Trimethylbenzene |
| 40 | OGAD001 | Various Concentration Oxygenates |
| 40 | Various | 2000 µg/ml 1,3,5-Trichlorobenzene |
| 80 | Various | 1000 µg/ml Acrolein |
| 80 | Various | 1000 µg/ml Vinyl Acetate |
| 80 | Various | 1000 µg/ml 3 Additional Analytes |
| 40 | 1020851C | 2000 µg/ml Cyclohexane |
| 900 | 232-1 | Purge-&-Trap Grade Methanol |
| 1600 total | | |

8.2.1 Working initial calibration standards are prepared according to the table below. These standards are prepared fresh for each use. In some cases the lowest standard or the highest standard might not be used to construct the calibration curve (e.g. the 0.6ug/L standard is used for benzene, ethylene dibromide and vinyl chloride only) A minimum of 5 continuous calibration standards are required for initial calibration. The lowest calibration standard must be equal to or less than the laboratory reporting limit for that compound. Refer to Appendix B for routine quantification ranges.

**Centurion Calibration Standards (Water Method/Methanol Soils*)**

| Level (ng/mL) | Conc. of Intermed Std. | µL of Intermediate Added | Final Vol. (mL) |
|---|---|---|---|
| 0.6 | 50 µg/mL | 0.6 | 50 |
| 1.0 | 50 µg/mL | 1.0 | 50 |
| 5.0 | 50 µg/mL | 5.0 | 50 |
| 10 | 50 µg/mL | 10 | 50 |
| 25 | 50 µg/mL | 25 | 50 |
| 50 | 50 µg/mL | 50 | 50 |
| 100 | 50 µg/mL | 100 | 50 |
| 200 | 50 µg/mL | 200 | 50 |

**Centurion Calibration Standards (Low level soil Method)**

| Level (ng/mL) | Conc. of Intermed Std. | µL of Intermediate Added | Final Vol. (mL) |
|---|---|---|---|
| 1.0 | 50 µg/mL | 0.1 | 5 |
| 5.0 | 50 µg/mL | 0.5 | 5 |
| 10 | 50 µg/mL | 1.0 | 5 |
| 25 | 50 µg/mL | 2.5 | 5 |
| 50 | 50 µg/mL | 5.0 | 5 |
| 100 | 50 µg/mL | 10 | 5 |
| 200 | 50 µg/mL | 20 | 5 |

*Calibration standards for quantifying methanol preserved soils samples will contain 1 ml of purge and trap grade methanol (Section 7.2) per 50 ml of standard to simulate sample conditions.

8.2.2 Working continuing calibration standards are prepared by adding 50 ul of the of the 50 ug/ml intermediate standard to a final volume of 50 ml DI water. Calibration standards for quantifying methanol preserved soils samples will contain 1 ml of purge and trap grade methanol (Section 7.2) per 50 ml of standard to simulate sample conditions. When analyzing low-level soil samples the CCV solution is prepared by

adding 5 ul of the intermediate to a final volume of 5 ml DI water. This standard is prepared for a single use and re-prepared as needed.

8.3 A minimum of 5 continuous calibration standards is required for initial calibration. The lowest calibration standard must be equal to or less than the laboratory reporting limit for that compound. The initial calibration must meet the criteria below.

8.3.1 The %RSD of the response factor for each project target compound must be <15% or the $r^2$ value of linear least squares regression or non-linear lest squares regression (quadratic) correlation coefficient must be >0.99 for successful calibration.

8.3.1.1 With the number and nature of the compounds included in this analysis the potential exists that not all compounds will meet the criteria above. If more than 10% of the compounds exceed 15% RSD or do not meet the minimum correlation coefficient the initial calibration is not considered acceptable. The system must be evaluated for leaks or active sites (Refer also to Section 13.2 for guidelines in isolating potential problems) and a new initial calibration performed. Decisions and evaluation of compounds will rely on the experience of the analyst.

8.3.1.2 Projects subject to requirements specified in the DoD QSM must meet the calibration criteria in 8.3.1 for all designated target or critical compounds designated in the project QAPP. Any exceptions must be approved by the client project manager.

8.3.2 For compounds that exceed 15% RSD the linear regression function of the data system can be used for analyte quantification. For proper use of the linear regression function, the $r^2$ value must be greater than 0.99 with at least 5 standards used in the calibration. The force through zero option may be used based on the response of the curve relative to the intercept (intercept not significantly different than zero) or with evaluation of the impact on results at the lower end of the calibration curve. Quantification of results at or slightly above the lowest standard may be more accurate when using the force through zero option of the data system. Since the data system does not include zero in the calculation of the regression equation and merely pivots the line through zero, this procedure is consistent with the guidelines in Method 8000C.

8.3.3 If the %RSD of an analyte is >15% and the linear regression correlation is <0.99 a non-linear model can be used for calibration/quantification. This applies only to situations where the analyst has experience with a compound that does not respond according to a linear model over a sufficiently wide working range or when other approaches have not met the acceptance criteria. When using quadratic regression for the calibration model there must be at least 3 statistical degrees of freedom. Therefore, a minimum of 6 standards must be included in the calibration. The minimum $r^2$ value must be >0.99. Analyst experience specific to the analyte in question is critical in selecting this option. Non-linear calibration cannot be used to compensate for detector saturation or to avoid proper instrument maintenance. In addition quadratic fitting cannot be used for calibration of more than 10% of the target compounds.

8.3.4 When linear regression is used for calibration the lowest calibration standard must be evaluated by quantifying the standard against the established calibration curve. The low standard is re-calculated using the established calibration curve - the standard does not have to be re-analyzed. The resulting calculated concentration must be within 30% of the standard concentration. If the concentration exceeds 30% the result is compared to the LCS control limits. If the concentration falls within the control limits the calibration is considered acceptable. If the result does not meet either of the criteria above the reporting limit for the compound must be modified to a level that yields acceptable quantification for that level or results at or within 30% of the lowest calibration standard must be reported as estimated.

8.3.5 All reported compounds must have an acceptable calibration using one of the options above or narrated accordingly.

8.3.6 The response factors for the average RRF and the lowest calibration standard are compared to the minimum RRF in the table in Appendix B. In addition each calibration standard may be compared to the minimum RRF to ensure compounds are responding as expected. If the minimum response factor for the average or low standard is not met the system must be assessed to determine the cause for the decrease in sensitivity for the affected compounds and corrected prior to sample analysis. NOTE: Bromomethane and Chloroethane demonstrate poor chromatographic behavior in analyses requiring methanol for high level soils and difficulty in meeting the RRF criteria due to solvent interference. Decisions for reporting data for these compounds are based on analyst experience and consultation with the Laboratory Director or QA Director.

8.3.7 For identification of a compound all of the spectral ions evaluated for each compound must have a signal to noise ratio of at least 3:1 at the lowest calibration standard. This is based on visual estimation by the analyst during data review. Compounds that contain spectral evaluation ions where the signal to noise ratio is less than 3:1 will require the reporting limit to be set at a concentration where all ions can be adequately identified. The signal to noise ratio for the primary quantification ions should be at least 5:1 and preferably 10:1.

8.3.8 The RRT of each target analyte in each calibration standard should agree within +/- 0.06 RRT units.

8.4 GC/MS calibration verification – Initial calibration verification (ICV) is performed immediately after calibration by analysis of the second source standard. Continuing calibration verification (CCV) is performed at the beginning of each 12-hour analytical shift. The second source standard is used for both the ICC and CCV

8.4.1 The BFB tune check must be performed prior to analyzing samples and every 12 hours of continuous instrument run time (See 8.1).

8.4.2 The initial calibration curve (Sec. 8.2) for each compound of interest should be verified immediately after initial calibration and once every 12 hours prior to sample analysis. The results from the calibration verification (Sec. 8.2.2) analysis must meet the following criteria.

8.4.2.1 Each compound must meet the minimum RRF in the table in Appendix B before reporting sample results. If the minimum RRF is not achieved corrective action is required prior to reporting the affected compounds in samples. Individual compounds that do not meet the minimum RRF must be re-analyzed with acceptable RRF results. Compounds meeting the minimum RRF can be reported. In cases where several compounds fail to meet the minimum RRF criteria the analyst in conjunction with the Laboratory Director or QA Director will determine the suitability of reporting any data.

8.4.2.2 The percent difference for compounds calibrated using average response factors or percent drift for other calibration methods must be <20% for each target compound.

8.4.2.2.1 If more that 20% of the target compounds exceed the 20% criteria corrective action must be taken prior to sample analyses. In cases of less than 20% unacceptable results the compounds that exceed 20% D or drift can be reported under the following guidelines.

8.4.2.2.1.1 Non-detect compounds may be reported without qualification if the calibration verification result exhibits elevated non-compliant results and adequate sensitivity for the compound.

8.4.2.2.1.2 If the calibration verification result is low or the compound is detected in the sample analyte data is qualified as estimated.

8.4.2.2.2 For or samples requiring compliance with DoD QSM criteria all target compounds must meet the 20% criteria. In instances where an analyte(s) exceeds 20% and sample re-analysis cannot be performed the compound(s) is noted in the case narrative and sample results are qualified.

8.4.3 The retention times of the internal standards in the calibration verification standard must be within 10 seconds of the retention time of the internal standards in the mid-point standard for the associated initial calibration.

8.4.4 The responses of the internal standards in the calibration verification standard must

be with 50% - 100% of the mid-point standard for associated initial calibration.

8.4.5 A method blank or calibration blank must be analyzed and demonstrate the analytical system is free of contamination that would impact sample results. Non-target compounds that do not interfere with target compounds or target compound results less than the LOD may be ignored.

8.4.6 An ending CCV must be analyzed at the end of the analytical sequence. Results for all target compounds must be within 50% D or drift. The evaluation criteria in Sec. 8.4.2.2 are applied to this CCV.

## 9.0 Sample Preparation

9.1 Allow samples to warm to ambient temperature prior to analyzing.

## 10.0 Diagram/Table

10.1 Reserved

## 11.0 Analytical Procedure

11.1 Recommended purge and trap and GC/MS conditions. Individual settings for each instrument configuration are maintained in the instrument methods and may vary from the table parameters listed below.

| Parameter | Encon |
|---|---|
| Purge gas | He |
| Purge time (min) | 11 |
| Purge temperature (°C) | Ambient |
| Dry purge time (°C) | 1 |
| Desorb temperature (°C) | 260 |
| Desorb time (min) | 2 |
| Bake temperature (°C) | 270 |
| Bake time (min) | 8 |
| Transfer line temperature (°C) | 130 |
| Valve temperature (°C) | 130 |
| Cycle timer (min) | NA |

| HP GC Parameters | |
|---|---|
| | With Encon |
| Injector temperature (°C) | 150 |
| Detector temperature (°C) | 280 |
| Carrier gas (He) flow rate (mL/min) | 1.0 |
| Velocity (cm/sec) | 35.9 |
| Split flow (mL/min) | 20 |

| | |
|---|---|
| Split ratio | 20:1 |
| Initial oven temperature (°C) | 40 for 2 min |
| Temperature program | 13°C/min to 220°C, hold for 1.5 min. |
| Run time (min) | 17 |
| Oven equlibrium time (min) | 0.5 |

| HP Quadrapole MS Parameters | |
|---|---|
| Start time (min) | Varies |
| Low mass | 35 |
| High mass | 260 |
| Threshold | 200 |
| Sampling | 3 |
| Scans/sec | 2.01 |
| EM voltage | 200+ relative |

11.2 Sample Preparation

11.2.1 Centurion unpreserved soil sample: Verify and record the calibration of the VOA laboratory top loading balance in the balance log. Transfer 5.0 g of sample to a 40 ml VOA vial. Record the sample weight. Add approximately 10 ml de-ionized water. **DO NOT** add the IS/SS stock standard. The Centurion unit will dispense 5 µL of the 50 µg/ml IS/SS stock automatically. Seal the vial. **Note**: this is not a dilution when compared to the initial calibration.

11.2.2 Centurion methanol preserved soil sample: Weigh the vial and record the weight of the sample collected (weigh to 0.1 g). Methanol preserved soils are generally collected in standard 40 ml pre-cleaned glass screw-cap VOA vials with Teflon lined silicone septa. Verify the 10gsample/10mL methanol ratio in the Methanol Preserved Sample Logbook. Add additional methanol by injecting with a syringe through the septa if the sample weight exceeds 10 gm and is less than 20 gm. (REJECT SAMPLE IF SAMPLE WEIGHT EXCEEDS 20 gm). Flag the sample if the weight is less than 9 gm as <10% Methanol:Soil Ratio. Sonicate for 20 minutes. After sonication, allow sample sediment to settle. Using a 1000 µL syringe, transfer a 1mL aliquot sample to a 50 ml volumetric flask. Bring to volume with de-ionized water. Invert the volumetric 2-3 times, then transfer sample to a 40mL VOA vial. Rinse the syringe 3 times with fresh methanol before transferring the next sample. **Note**: this is a 50 times dilution when compared to the initial calibration curve.

11.2.3 Centurion low-level soil sample: Weigh the vial and record the weight of the sample collected. Make sure any paper labels are properly affixed to the vial. Hanging labels can interfere with gripper arm's ability to transfer vials to different positions. Place the unopened vial in the Centurion and set up instrument in the soil mode.

11.2.4 Centurion water sample: Allow water samples to equilibrate to room temperature. No other preparatory steps are necessary. Post analysis, the analyst is to check and record in the Aqueous Preservation Logbook, sample pH to ensure proper sample

preservation. Flag the sample if the pH >2.

11.3 Run sequence set up using Chemstation software. Methods are set up within the system according to the manufacturers' instructions and applicable method reference.

11.3.1 From the Top View, select **Sequence/Edit Sample Log Table**. Each line in the table contains information for the analysis of one sample.

11.3.2 Click on a blank line in the table. Then click the arrow under the box labeled Type and select the type of sample to be run.

11.3.3 Use the tab key or mouse to move to the Vial box and enter the vial number.

11.3.4 Move to Method and enter the name of the method to be used for the current sample (For a list of methods, type ? in this field).

11.3.5 Supply the Data File name, Sample Name, and any Miscellaneous Information. Sample name will contain the laboratory sample ID and must correspond exactly with the LIMS designation. The miscellaneous information will contain the LIMS sample type (SAMP, MBLK, LCS, CCV, MS, etc) and the test code.

11.3.6 Use the **Repeat, Cut, Copy,** and **Paste** buttons as appropriate to add sample to the table. **Repeat** copies the highlighted line, increments the vial number, and places the new line immediately after the highlighted one. **Copy** copies the highlighted line without change. Use **Paste** to position that line where you wish. When finished, click **OK**.

11.3.7 To download the sequence to the GC/MS, select **Sequence/Run** from the Top View. Enter the date of analysis for Sequence Comment (e.g. 01/17/01). Enter the analyst's name for Operator Name. Use the analysis date for Data File Directory (e.g. D:\DATA\011701\). When ready click **Run Sequence**.

11.4 Centurion auto sampler setup.

11.4.1 Use the Centurion software to program the auto sampler. For more instruction on how to utilize the program, refer to the Centurion Operation Manual, Chapter 3.

11.5 Compound identification and quantification

11.5.1 Compound identification is based on relative retention time (RRT) and characteristic mass spectrum.

11.5.2 Initial identification is a compound that elutes with +/- 0.06 RRT units of the RRT of the standard compound. The 0.06 criteria is programmed into the data system method.

11.5.3 The mass spectrum of compounds within the RRT range is compared to the spectrum of the standard compound. Relative intensities of the characteristic ions

should be within 30% of the expected relative intensities for the reference spectrum.

11.5.4 Co-eluting structural isomers that cannot be resolved by retention time and that have similar mass spectra are reported as the sum of the isomers (i.e. m,p-xylenes).

11.5.5 Analyst experience in evaluating mass spectra and identifying compounds in the presence of interfering components is important in final compound identification.

11.5.6 Identified compounds are quantified from the average response factor of the initial calibration or other calibration model employed when required.

11.5.7 Compounds exhibiting concentrations above the upper calibration level are diluted into the calibration range. If insufficient sample is available for dilution (i.e. both water sample vials already used) the concentration is flagged as estimated (E).

11.5.8 Compound concentrations that are below the laboratory reporting limit or lowest calibration point but positively identified above the MDL are flagged as estimated (J).

11.6 Manual integration guidelines and procedures

11.6.1 Situation may arise whereby the quantification provided by the data system is inappropriate. This can occur due to co-elution, baseline noise or matrix interference.

11.6.2 When manual integration of a compound is necessary the following guidelines must be followed.

11.6.2.1 Manual quantification is performed by integrating the area of the quant ion for the compound.

11.6.2.2 The integration will only include the area attributable to the compound of interest.

11.6.2.3 The area integrated shall not include baseline background noise.

11.6.2.4 The area integrated shall not extend beyond the point where the sides of the peak intersect with the baseline.

11.6.2.5 Manual integration must not be used solely to meet quality control criteria.

11.6.2.6 Manual integration must not be used as a substitute for corrective action on the GC/MS system.

11.6.3 Instances of manual integration are flagged with a “m” by the data system. Cases of

manual integrations require review and approval by the Laboratory Manager or QA Director and are documented in the corresponding instrument Excel file or in the LIMS analytical sequence Linked Files.

## 12.0 Details of Calibration and Calculations

12.1 Response Factor: $Rf = (Ax * Cis)/(Ais * Cx)$

Where: Ax = Area of the characteristic ion for the compound being measured.
Ais = Area of the characteristic ion for the specific internal standard.
Cis = Amount of the specific internal standard (ng).
Cx = Concentration amount of the compound being measured (ng).

12.2 Concentration: $$(ug/L \text{ or } ug/kg) = \frac{(Ax)(Is)}{(Ais)(Rf)(Vo)} * Df$$

Where: Ax = Area of characteristic ion for compound being measured.
Is = Amount of internal standard injected (ng).
Ais = Area of characteristic ion for the internal standard.
R.F = Response factor for compound being measured.
Df = Dilution factor (where applicable)
Vo = Sample volume in gm or ml.

12.3 Percent Relative Standard Deviation: $$\%RSD = \frac{SD}{X} * 100$$

Where: RSD = Relative Standard Deviation.
X = Mean of the 3-5 initial R.F for a compound.
SD = Standard Deviation of average R.F for a compound.

12.4 Percent Drift: $$\% \text{ Drift} = \frac{Ce - Ca}{Ce} * 100$$

Where: Ce = Expected concentration.
Ca = Actual concentration.

12.5 Percent difference: $$\% D = \frac{RF - Avg.\ RF}{Avg.\ RF} * 100$$

Where: RF = Relative response factor.
Avg. RF = Average RRF from the ICAL.

12.6 Linear Regression: $y = ax + b$

Where: y = Instrument response (peak area)
a = Slope of the line

x = Concentration of the calibration standard
b = The intercept

12.7 Quadratic Regression: $y = ax^2 + bx + c$

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 Tune Check – 50 ng of BFB is injected into the GC/MS and evaluated against the criteria specified in Method 8260. These parameters are incorporated into the data system and appear on the tune report.

13.1.1 The BFB tune check must be performed prior to analyzing samples and every 12 hours of continuous instrument run time. Tune parameters must be within established limits.

13.1.2 Corrective Action – Repeat tune check. If problem persists re-tune the instrument using either manual or auto-tune procedures. If this fails to correct the problem clean the source.

13.2 Following successful tuning the ICV/CCV sample must be analyzed and must pass the method criteria (Section 8.4). This sample must be analyzed every 12 hours of continuous instrument run time and at the end of each analytical sequence.

13.2.1 Corrective Action – Repeat ICV/CCV sample. If acceptable results are not obtained, check the standard for degradation, assess the system for leaks, ensure that the injection port and column inlet are free from contamination and that active sites within the system are not causing the problem. Repeat the initial calibration procedure once the problem has been identified and corrected.

13.2.2 Check to be sure that there are no errors in integration of internal standards and target compounds. Examine chromatograms for interfering peaks and integrated peak areas. If errors are found, recalculate the data accordingly.

13.2.3 Make sure certified solutions and calibration standards are not expired. Expired solutions and standards may exhibit analyte degradation. Replace all expired standards and remake all calibration standards. Recalibrate the instrument.

13.2.4 Check the purge flow. Chloromethane is the most likely compound to be lost if the purge flow is too fast. Bromoform is one of the compounds most likely to be purged very poorly if the purge flow is too slow. The purge flow should be 40 mL/min. Adjust flow accordingly and recalibrate.

13.2.5 Cold spots and active sites may adversely affect response. Tetrachloroethene and 1,1-dichloroethane are degraded by contaminated transfer lines. Check all heated zones. Bake the trap for 20 minutes to remove any contamination. If response does not improve, the analyst may wish purge methanol at 70$^{O}$C for 20 minutes to try to remove contamination. Replacement of trap, transfer line, and nickel tubing may be

necessary. The instrument must be recalibrated after performing any of these steps.

13.2.6 High variability may indicate a system leak or reactive sites on the column. Leaks are noted if base line levels are high and atmospheric masses are predominant in the tune (18, 28,32, and 44). Check connections for leaks. A column that has developed active sites may need to be replaced. Typical column life expectancy is 2 years. The instrument must be recalibrated after performing these checks.

13.3 The CCV is evaluated for all target analytes in the batch. Percent D or drift for each should be within 80 – 120 % (+/-20%) beginning and 50 – 150% (+/-50%) ending. All compounds must meet the minimum RRF criteria.

13.3.1 Corrective Action – Repeat CCV and steps above (section 13.1 & 13.2) if necessary bake the trap and check for sources of contamination. All samples associated with an unacceptable CCV must be re-analyzed for the affected compounds. The analytical sequence must be re-analyzed in cases where more than 20% of the compounds do not meet the acceptance criteria.

13.3.2 Corrective Action – Immediately analyze two consecutive CCVs (within one hour of the last instrument injection). If both CCV samples meet the acceptance criteria associated samples may be reported – re-analysis is not required. If either CCV does not meet the criteria corrective actions and sample re-analysis are required.

13.4 For each 12 hour or less analytical event a Method Blank is analyzed. This is prepared for water samples by filling a 40 ml vial with deionized water containing HCl preservative, for soils 10 g (methanol preserved) or 5 g (low level) of clean sand is added to a 40 ml VOA vial containing 10 ml of methanol or 5 ml of sodium bisulfite and process as a soil sample. Surrogates and internal standards are added to each method blank.

13.4.1 Acceptance Criteria: Result less than one half the reporting limit for all target analytes

13.4.2 Corrective Action: Clean system, bake the trap and check for sources of contamination.

13.5 For each batch of samples a Laboratory Control Sample (LCS) is prepared by adding 10 µl of CCV standard to 50 ml DI water in a volumetric flask and then transferring to a 40ml vial. The concentration of the LSC is 10µg/L. Methanol soil LCS samples are prepared by spiking 100 ul of the CCV standard to 10 g of clean sand in a 40 ml VOA vial and adding 10 ml of methanol. The LCS is then sonicated of 20 min and analyzed as a soil sample. For low-level soil analysis 1 ul of the CCV solution is added to 5 g of clean sand in a 40 ml VOA vial and adding 5 ml sodium bisulfite.

13.5.1 Acceptance Criteria: 70 – 130 % recovery, or statistically calculated or according to

project (i.e. QSM) guidelines. Current LCS control limits are set to values cited in the DoD QSM version 5.0.

13.5.2 Corrective Action: Repeat LCS, re-prepare CCV solution and repeat LSC and repeat calibration procedure if necessary. See also Sec. 14.6.

13.6 For each matrix batch of 20 or less samples a MS/MSD is included that contains all of the components of interest. Control limits for each compound are statistically derived and the batch MS/MSD is evaluated against these limits. Spikes for water samples are prepared by adding 8.0 ul of the CCV solution to an undiluted sample, or by performing an appropriate dilution in a 50mL volumetric flask and introducing 10.0 ul of CCV standard to the sample. Methanol preserved soil sample spikes are prepared in the same manner as water samples with the exception that 1000 ul of methanol is added to each and 10uL of the CCV solution is added. Low level soil sample spikes are prepared by adding 1 ul of the CCV standard and to a 5 g sample.

13.6.1 Acceptance Criteria: Within statistically derived control limits (default limits - 70 130%). MSD RDP - 25%. For some projects and all projects submitted under the DoD QSM the MS/MSD recovery limits are set to the LCS control limits. The current LIMS test codes specify MS/MSD recovery limits set to the LCS control limits

13.6.2 Corrective Action –Evaluate the sample spiked for matrix interference and flag the data as necessary.

13.7 Surrogate Control Limits

13.7.1 For each sample matrix the first 30 surrogate recoveries are used to establish control limits based on the Mean recovery +/- 3 times the standard deviation. This procedure is performed annually.

13.7.2 For samples (including QC samples) in which the surrogate recovery falls outside the established control limits, the following is required.

13.7.2.1 Check calculations for errors

13.7.2.2 Check instrument performance

13.7.2.3 Re-prep and re-analyze the samples if the above show no problems or flag the data if sample matrix interference is present.

13.8 Internal standard responses.

13.8.1 The response for each internal standard must be within –50% to +100% of the mid-level calibration standard.

13.8.2 Failure to achieve the above criteria requires inspection of system operation and any necessary corrective actions. Any sample associated with the CCV must be re-analyzed.

13.9 The retention times of the internal standards in the calibration verification standard must be evaluated immediately after or during data acquisition. If the retention time for any internal standard changes by more than 30 seconds from the that in the mid-point standard level of the most recent initial calibration sequence, then the chromatographic system must be inspected for malfunctions and corrections must be made, as required. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is required.

13.10 Initial demonstrations of proficiency are performed by all analysts for all instruments and methods. IDP records are kept on file in the laboratory and referenced in analyst training files. Demonstrations of proficiency are re-performed in instances of new staff or major changes in methodology or equipment.

13.11 Storage Blanks.

13.11.1 Several VOC vials (3-5) are filled with DI water, capped with no headspace and stored in the VOC sample refrigerator.

13.11.2 At a frequency of every 14 days or less one of the storage blanks is removed and included in a sample analytical sequence. Analysis will proceed by the same procedures used for sample analysis and storage blank data will be imported into the associated LIMS analytical sequence.

13.11.3 Storage blanks exhibiting results less than the LOD for all target compounds and absence of non-target compounds are considered acceptable.

13.11.4 Presence of methylene chloride or other known laboratory artifacts consistent with levels found in method blanks and samples will be considered as laboratory contamination unrelated to storage conditions. Narration of the occurrence will follow standard laboratory practice for these instances.

13.11.5 If target or non-target compounds are detected in a storage blank proceed as follows:

13.11.5.1 Assess the associated method blank, QC samples and field samples in the analytical sequence for presence and levels of the compounds identified in the storage blank.

13.11.5.2 Evaluate previous analytical events for presence and levels of the compounds detected in the storage blanks.

13.11.5.3 Evaluate sample chromatography data for anomalies associated with the compounds detected (presence of compounds in otherwise clean

samples or inconsistencies with expected sample data).

13.11.5.4 Immediately analyze a second storage blank and assess for presence and levels of contaminating compounds.

13.11.5.5 Investigate the storage refrigerator for broken, leaking or loosely capped samples and attempt to identify the source of contamination.

13.11.5.6 Clean the storage refrigerator when necessary and analyze storage blanks daily until the blank results are acceptable.

13.11.5.7 Qualify and narrate data for all impacted samples with regard to the nature and extent of the contamination.

## 14.0 Data Reporting Requirements

14.1 Sample concentrations are read directly from the DATA SYSTEM.

14.2 Aqueous sample are routinely reported as ug/L (mg/L for TCLP extracts and when requested).

14.3 Soil samples are reported as ug/kg on a dry weight basis where:

µg/kg = concentration x 100/percent solids.

Methanol extracted (preserved) soils:
µg/kg = ug/L x DF x MD x MC

DF = (ml DI water/amt. MeOH added) x ratio of MeOH to soil
MD = (ml of methanol in sample + (sample wt. g x percent moisture))/10
MC = 100/%solids

DF is the dilution factor determined by both the factor for the amount of methanol added to an amount of DI water (typically 1 ml methanol in 50 ml DI water) and the amount of methanol divided by the weight in g of soil sampled (target 10 g of soil to 10 ml of methanol = 1).

MD is the dilution of the water miscible solvent by the water content of the sample for samples with greater than 10% moisture.

MC is the dry weight conversion.

14.4 Raw instrument results, laboratory sample identification, date and time of analysis, analyte type and test code are entered directly into the Omega LIMS by direct importing of the data system files into Omega. All calculations to derive final result (including dry weight conversions) are performed automatically by the LIMS. Sample weights, preparation information and percent moisture results are entered into the appropriate section of the LIMS prior to instrument data

and are automatically factored into the final results.

14.5 After calculation of the imported sequence verify that there are no QC flags or qualifier requiring additional actions. If present investigate and repeat or re-analyze as needed.

14.6 Due to the large number of compounds that may be included in some target compound lists all analytes may not meet all of the QC criteria specified in Sections 8 and 13. In addition there is generally limited sample volume for multiple repeat analyses. The following guidelines are used for data reporting.

14.6.1 Compound data cannot be reported without an acceptable initial calibration using average response factors, linear regression or quadratic (non-linear least squares regression).

14.6.2 Compounds that do meet all of the ICV/CCV criteria are evaluated according to the protocol in Sec. 8. In addition assess whether the affected compound is a critical project analyte. Compounds that are not critical to the objectives of the project may be reported with adequate qualification, narration and data qualifiers.

14.6.3 Compounds in the LCS that exceed control limits may be reported with adequate qualification, narration and data qualifiers. LCS data is deemed acceptable if no more than 4 compounds exceed control limits. Elevated LCS data for non-detected analytes may be reported with adequate qualifiers and narration.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 To ensure the system is kept free of any contamination, steps must be taken to keep the system clean.

15.2 All routine maintenance and trouble shooting to the Analytical System will be recorded in the Maintenance Log for that instrument in Omega.

15.3 Source cleaning will be performed whenever the tune criteria for BFB cannot be met or when instrument performance warrants source cleaning

15.4 Check helium purge flows as needed (typically during troubleshooting activities). Flow should be within 39-41 ml/min.

15.5 Gradually declining response factors for all parameters is evidence for trap replacement. Follow the manufacturer's instructions on how to disassemble the trap. The new trap should be conditioned at 280°C for 1 hour. A typical Supelco Vocarb 3000 trap will last from 3 to 6 months, depending on frequency of use and sample VOC concentration.

15.6 If trap replacement does not result in improved response factors, the soil and or water probe assemblies should be disassembled and cleaned. Follow the manufacturer's instructions on how to disassemble the soil and water probe. Sonicate the probe in methanol and dry with a high velocity air purge. Probes should be cleaned routinely every 6

months.

15.7 If trap replacement and probe cleanings do not improve repose factors, all nickel heated transfer lines should be replaced

15.8 Depending on the frequency of direct injections, every 2 to 3 months replace the injector septum and liner. Bring all heated zones (oven, detector, and injector) to ambient temperature and vent the MS via the software prior to all GC maintenance.

15.9 Approximately every two years the column will need replacement due to residual oxidation of the polysiloxane stationary phase. If poor chromatographic resolution is noted before this time, cut off 1 meter of the column at the injection port and reinstall. Bring all heated zones (oven, detector, and injector) to ambient temperature and vent the MS via the software prior to all GC maintenance.

15.10 Leaks are very common in the MSD interface and should be checked with the procedure given by Hewlett Packard in the hardware reference manual. Leaks are noted if base line levels are high and atmospheric masses are predominant in the tune (18, 28,32, and 44).

15.11 Common MSD maintenance tasks are listed in Table 2. Performing these tasks on a regular basis can reduce operating problems and prolong system life.

15.12 Replace fore line pump fluid every six months.

15.13 Replace diffusion pump fluid annually.

## 16.0 Waste Management and Pollution Prevention

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner that minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Organic materials are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Soil samples are composited in a drum designated for disposal.

16.2.3 Disposal of materials is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, Method 8260C, Revision 2, 1996.

17.2 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, Method 5030B, Revision 2, 1996.

17.3 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, Method 5035, Revision 0, 1996.

17.4 40 CFR Part 136 – App. A Meth.624: Purgeables. App. B: Appendix B to Part 136-Definition and Procedure for the Determination of the Method Detection Limit-Revision 1.11.

17.5 RTI Laboratories, Inc. Quality Assurance Plan.

17.6 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.7 RTI Laboratories, Inc. SOP: SRC001-A, Sample Receipt and Custody SOP.

17.8 RTI Laboratories, Inc. Employee Handbook.

17.9 Centurion Operation Manual

## 18.0 Revisions

**SOP# 8260C_121613_R8.1**

18.1 Section 13.11 Storage Blanks added to SOP.

**SOP# 8260C_010815_R9**

18.2 Section 6.1 Replace VOA 7 with VOA 9.

18.3 Added Section 16.18

18.4 Section 7.0 Updated Stock Standard Tables

18.5 Section 8.2 Revised standard expiration date from 7 days to 14 days.

18.6 Section 8.0 Updated standard preparation tables.

18.7 Section 8.3 Revised RSD criteria from <20% to <15%

## Appendix A - Instructions for the Analysis Using Selective Ion Monitoring (SIM)

The MDEQ RRD Operational Memorandum No. 2 and other programs require reporting limits for specific analytes at levels below those routinely assayed. For example the MDEQ analytical target detection limit for 1,2-dibromoethane (EDB) has been established at 0.05ug/L for waters and 20ug/Kg for soils. Single/selected ion monitoring (SIM) will increase instrument sensitivity in order meet the required reporting limit for EDB and other compounds. Prior to running a SIM analysis, it may be required to run a full scan using low-level methods (e.g. as done for the EPA Contract Laboratory Program).

Operation in the SIM mode requires preparation of standards at lower concentration levels than specified in Sec. 8.

Working initial calibration standards are prepared from the stock standard referenced in Sec. 8 according to the table below. These standards are prepared fresh for each use.

**Centurion Calibration Standards (Water Method/Methanol Soils*)**

| Level (ug/L) | Conc. Of Stock Std | UL of Stock Added | Final Vol (mL) |
|---|---|---|---|
| 0.05 | 50 | 0.1 | 100 |
| 0.4 | 50 | 0.2 | 100 |
| 1 | 50 | 1 | 50 |
| 5 | 50 | 5 | 50 |
| 10 | 50 | 10 | 50 |
| 25 | 50 | 25 | 50 |

*Calibration standards for quantifying methanol preserved soils samples will contain 1 ml of purge and trap grade methanol (Section 7.2) per 50 ml of standard to simulate sample conditions.

Working continuing calibration standards are prepared by adding 10 □l of the of the 50 □g/ml intermediate standard (Sec. 8) to a final volume of 50 ml DI water. This standard is prepared for a single use and re-prepared as needed.

Internal standardization is employed in this technique and are the same as that used for a full scan (Section 8.5). The %RSD of the response factors for compounds should be <15 % or evaluated according to the guidelines in Section 8.

Continuing calibration standards must have %D values <20%. SPCC/CCC compounds are not utilized in this technique.

The instrument is set up to operate in the SIM mode according to the manufacturer's instructions. The applicable ions for the compound of interest are selected by choosing the three ions with the highest abundance from the spectra of the scan mode analysis. The following table represents the settings for the analysis of EDB.

5972 Quadropole MS Parameters SIM

| | |
|---|---|
| Ion 1 m/z | 107 |

| | |
|---|---|
| Ion 2 m/z | 109 |
| Ion 3 m/z | 188 |
| Dwell | 50 |
| Resolution | Low |

## Appendix B - 8260 Analytes, Internal Standards, Surrogates

| | Target Ion | Q1 | Q2 | Expected Retention Time (min) | Min. RRF | Routine Quant Range Aqueous | Routine Quant Range Soils |
|---|---|---|---|---|---|---|---|
| Pentafluorobenzene (Internal Std) | 168 | 169 | | 4.57 | | | |
| Dichlorodifluoromethane | 85 | 87 | 100 | 1.27 | 0.100 | 1-200 | 1-200 |
| Chloromethane | 50 | 52 | 49 | 1.42 | 0.100 | 1-200 | 1-200 |
| Vinyl chloride | 62 | 64 | 47 | 1.5 | 0.100 | 1-200 | 0.6-200 |
| Bromomethane | 94 | 96 | 79 | 1.74 | 0.100 | 1-100 | 15200 |
| Chloroethane | 64 | 66 | 49 | 1.83 | 0.100 | 5-200 | 1-200 |
| Trichlorofluoromethane | 101 | 103 | 66 | 2.01 | 0.100 | 1-200 | 1-200 |
| Diethyl ether | 59 | 74 | 45 | 2.28 | | 5-200 | 5-200 |
| 1,1-Dichloroethene | 61 | 63 | 96 | 2.48 | 0.100 | 1-200 | 1-200 |
| Freon113 | 101 | 151 | 85 | 2.45 | 0.100 | 1-200 | 1-200 |
| Acrolein | 56 | 55 | 53 | 2.45 | | 10-200 | 10-200 |
| Acetone | 43 | 58 | 39 | 2.59 | 0.100 | 10-200 | 10-200 |
| Iodomethane | 142 | 127 | 141 | 2.62 | | 5-200 | 5-200 |
| Carbon disulfide | 76 | 78 | 64 | 2.65 | 0.100 | 5-200 | 5-200 |
| Allyl chloride | 41 | 76 | | 2.81 | 0.100 | 1-200 | 1-200 |
| Methylene Chloride | 49 | 84 | 86 | 2.95 | 0.100 | 5-200 | 5-200 |
| 2-Methyl-2-propanol | 59 | 41 | 43 | 3.08 | | 1-200 | 1-200 |
| Acrylonitrile | 53 | 52 | 50 | 3.23 | | 5-200 | 1-200 |
| trans-1,2-Dichloroethene | 61 | 96 | 98 | 3.14 | 0.100 | 1-200 | 1-200 |
| tert-Butyl Methyl Ether | 73 | 57 | 41 | 3.14 | 0.100 | 5-200 | 5-200 |
| Methyl Acetate | 43 | 74 | 59 | 3.30 | 0.100 | 1-200 | 1-200 |
| Isopropyl ether | 45 | 63 | 87 | 3.57 | | 5-200 | 5-200 |
| 1,1-Dichloroethane | 63 | 65 | 83 | 3.56 | 0.200 | 1-200 | 1-200 |
| tert-Butyl Ethyl Ether | 59 | 87 | 57 | 3.89 | | 5-200 | 5-200 |
| Vinyl Acetate | 43 | 86 | 42 | 3.57 | | 1-200 | 1-200 |
| 2-butanone | 43 | 72 | 57 | 4.13 | 0.100 | 5-200 | 5-200 |
| cis-1,2-Dichloroethene | 61 | 96 | 63 | 4.08 | 0.100 | 1-200 | 1-200 |
| 2,2-Dichloropropane | 77 | 79 | 97 | 4.05 | | 1-200 | 1-200 |
| Vinyl Acetate | 43 | 86 | 42 | 4.09 | | 1-200 | 1-200 |
| Propionitrile | 54 | 53 | | 4.24 | | 5-200 | 10-200 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Methyl acrylate | 55 | 85 | 58 | 4.18 | | 1-200 | 1-200 |
| Methacrylonitrile | 41 | 67 | 52 | 4.34 | | 1-200 | 1-200 |
| Bromochloromethane | 130 | 128 | 93 | 4.3 | | 1-200 | 1-200 |
| Tetrahydrofuran | 42 | 72 | 71 | 4.32 | | 10-200 | 10-200 |
| Chloroform | 83 | 85 | 87 | 4.37 | 0.200 | 1-200 | 1-200 |
| Dibromofluoromethane (Surrogate) | 113 | 111 | | 4.52 | | 1-50 | 1-50 |
| 1,1,1-Trichloroethane | 97 | 101 | 61 | 4.49 | 0.100 | 1-200 | 1-200 |
| 1-Chlorobutane | 56 | 41 | 43 | 4.6 | | 1-200 | 1-200 |
| 1,1-Dichloropropene | 75 | 110 | 39 | 4.64 | | 1-200 | 1-200 |
| Carbon tetrachloride | 119 | 117 | 121 | 4.6 | 0.100 | 1-200 | 1-200 |
| tert-Amyl Methyl Ether | 73 | 87 | 55 | 4.92 | | 1-200 | 1-200 |
| 1,2-Dichloroethane | 62 | 64 | 63 | 4.91 | 0.100 | 1-200 | 1-200 |
| Benzene | 78 | 52 | 77 | 4.82 | 0.500 | 1-200 | 0.3-200 |
| Cyclohexane | 56 | 84 | 41 | 5.01 | 0.100 | 1-200 | 1-200 |
| | | | | | | | |
| 1,4-Difluorobenzene (Internal Std) | 114 | 88 | 63 | 5.22 | | | |
| Trichloroethene | 130 | 132 | 97 | 5.42 | 0.200 | 1-200 | 1-200 |
| 1,2-Dichloropropane | 63 | 65 | 76 | 5.68 | 0.100 | 1-200 | 1-200 |
| Methyl methacrylate | 41 | 69 | 100 | 5.78 | | 1-200 | 1-200 |
| Dibromomethane | 174 | 172 | 176 | 5.79 | | 1-200 | 1-200 |
| Bromodichloromethane | 83 | 85 | 129 | 5.93 | 0.200 | 1-200 | 1-200 |
| Methyl Cyclohexane | 83 | 55 | 98 | 6.11 | 0.100 | 1-200 | 1-200 |
| 2-Nitropropane | 41 | 39 | | 6.23 | | 5-200 | 1-200 |
| 2-Chloroethyl vinyl ether | 63 | 65 | 107 | 6.24 | | 10-200 | 1-200 |
| cis-1,3-Dichloropropene | 75 | 77 | 110 | 6.37 | 0.200 | 1-200 | 1-200 |
| 4-Methyl-2-pentanone | 43 | 58 | 100 | 6.53 | 0.100 | 10-200 | 10-200 |
| Toluene-d8 (Surrogate) | 98 | 100 | 99 | 6.58 | | 1-50 | 1-50 |
| Toluene | 91 | 92 | 65 | 6.65 | 0.400 | 1-200 | 1-200 |
| trans-1,3-Dichloropropene | 75 | 110 | 77 | 6.94 | 0.100 | 1-200 | 1-200 |
| Ethyl methacrylate | 69 | 41 | 99 | 6.99 | | 1-200 | 1-200 |
| 1,1,2-Trichloroethane | 97 | 83 | 99 | 7.12 | 0.100 | 1-200 | 1-200 |
| 1,3-Dichloropropane | 76 | 78 | 41 | 7.29 | | 1-200 | 1-200 |
| Tetrachloroethene | 166 | 164 | 168 | 7.16 | 0.200 | 1-200 | 1-200 |
| 2-Hexanone | 43 | 58 | 57 | 7.36 | 0.100 | 10-200 | 10-200 |
| Chlorodibromomethane | 129 | 127 | 131 | 7.48 | 0.100 | 1-200 | 1-200 |
| 1,2-Dibromoethane | 107 | 109 | 188 | 7.6 | 0.100 | 1-200 | 1-200 |
| | | | | | | | |
| Chlorobenzene-d5 (Internal Std) | 117 | 82 | 52 | 8.06 | | | |
| Chlorobenzene | 112 | 114 | 77 | 8.08 | 0.500 | 1-200 | 1-200 |
| 1,1,1,2-Tetrachloroethane | 131 | 133 | | 8.18 | | 1-200 | 1-200 |
| Ethylbenzene | 91 | 106 | 51 | 8.17 | 0.100 | 1-200 | 1-200 |
| m,p-xylene | 91 | 106 | 51 | 8.3 | 0.100 | 1-200 | 1-200 |
| OXYL (o-Xylene) | 91 | 106 | 51 | 8.72 | 0.300 | 1-200 | 1-200 |
| Styrene | 104 | 78 | 103 | 8.76 | 0.300 | 1-200 | 1-200 |
| Bromoform | 173 | 171 | 252 | 8.96 | 0.100 | 1-200 | 1-200 |
| Cumene (Isopropyl benzene) | 105 | 120 | 77 | 9.11 | 0.100 | 1-200 | 1-200 |
| 4-Bromofluorobenzene (Surrogate) | 95 | 174 | 176 | 9.31 | | 1-50 | 1-200 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1,1,2,2-Tetrachloroethane | 83 | 85 | 168 | 9.52 | 0.300 | 1-200 | 1-200 |
| TDCB | 53 | 88 | | 9.59 | | 1-200 | 1-200 |
| 1,2,3-Trichloropropane | 75 | 110 | 112 | 9.56 | | 1-200 | 1-200 |
| Bromobenzene | 77 | 156 | 158 | 9.46 | | 1-200 | 1-200 |
| n-Propylbenzene | 91 | 120 | 105 | 9.55 | | 1-200 | 1-200 |
| 2-Chlorotoluene | 91 | 126 | 128 | 9.66 | | 1-200 | 1-200 |
| 1,3,5-Trimethylbenzene | 105 | 120 | 91 | 9.76 | | 1-200 | 1-200 |
| 4-Chlorotoluene | 91 | 126 | 128 | 9.79 | | 1-200 | 1-200 |
| 4-Isopropyltoluene | 119 | 134 | | 10.51 | | 1-200 | 1-200 |
| tert-Butylbenzene | 119 | 91 | 134 | 10.1 | | 1-200 | 1-200 |
| 1,2,4-Trimethylbenzene | 105 | 120 | 91 | 10.17 | | 1-200 | 1-200 |
| sec-Butylbenzene | 105 | 134 | 91 | 10.34 | | 1-200 | 1-200 |
| 1,3-Dichlorobenzene | 146 | 148 | 111 | 10.49 | 0.600 | 1-200 | 1-200 |
| | | | | | | | |
| 1,4-Dichlorobenzene-d4 (Internal Std) | 152 | 115 | | 10.57 | | | |
| 1,4-Dichlorobenzene | 146 | 148 | 75 | 10.6 | 0.500 | 1-200 | 1-200 |
| 123TMB (Trimethylbenzene) | 105 | 120 | 91 | 10.63 | | 1-200 | 1-200 |
| Benzyl Chloride | 91 | 126 | 65 | 10.63 | | 1-200 | |
| n-Butylbenzene | 91 | 92 | 134 | 10.97 | | 1-200 | 1-200 |
| 1,2-Dichlorobenzene | 146 | 148 | 75 | 11.01 | 0.400 | 1-200 | 1-200 |
| Hexachloroethane | 117 | 201 | 166 | 11.23 | | 1-200 | 1-200 |
| DBCP | 75 | 155 | 157 | 11.9 | 0.050 | 5-200 | 5-200 |
| 1,2,4-Trichlorobenzene | 180 | 182 | 109 | 12.8 | 0.200 | 1-200 | 1-200 |
| 1,2,3-Trichlorobenzene | 180 | 182 | 145 | 13.36 | | 1-200 | 1-200 |
| Hexachlorobutadiene | 225 | 223 | 227 | 12.95 | | 5-200 | 5-200 |
| Naphthalene | 128 | 129 | 102 | 13.08 | | 5-200 | 5-200 |
| 2MN (2-Methylnaphthalene) | 142 | 141 | 115 | 14.36 | | 5-200 | 5-200 |

RTI Laboratories, Inc.
31628 Glendale St.
Livonia, Michigan 48150

# STANDARD OPERATING PROCEDURE

# ANALYSIS OF SEMI-VOLATILE ORGANIC COMPOUNDS

| | |
|---|---|
| **Analyte:** | **Base Neutral & Acid Extractable (BNA's)**<br>**Semi Volatile Organics** |
| **SOP #:** | **8270D_041015_R14.1** |
| **Method Reference:** | **EPA SW-846 8270D, EPA 625** |
| **Issue Date:** | **June 1, 1996** |
| **Revision No.:** | **14.1** |
| **Revision Date:** | **March 15, 2016** |

**Reviewed and Approved:** **March 15, 2016**

Director, Quality Management: Charles O'Bryan

Director, Environmental Services: Yemane Yohannes

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**ANALYSIS OF SEMI-VOLATILE ORGANIC COMPOUNDS**

**SOP#: 8270D_041015_R14.1**

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# 1.0 Scope and Application

## 1.1 Introduction

RTI Lab, Inc, has prepared this document to detail the Standard Operating Procedure (SOP) for the analysis of water and soil samples for semi-volatile compounds by gas chromatography/mass spectrometry. Method 8270D can be used to quantify most neutral, acidic, and basic semi - volatile organic compounds that are soluble in methylene chloride and capable of being eluted, without requiring formation of derivatives, as sharp peaks from a GC fused-silica cap column coated with a slightly polar silicone. Such compounds include PNA's, chlorinated hydrocarbons and pesticides, phthalate esters, organophosphate esters and pesticides, nitrosamines, haloethers, aldehydes, ethers, ketones, anilines, pyridines, quinolines, aromatic nitro compounds, phenols and nitrophenols. Specific compound lists are contained in the test codes resident in the Omega LIMS.

A detailed description of the instrumentation, calibration, run parameters and quality control procedures where applicable is included in this SOP. This SOP is to be used in conjunction with the RTI QAP quality control procedures. Please review the QAP to fully implement this SOP. For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

## 1.2 Summary of Method

The samples are prepared for analysis using either liquid: liquid extraction (aqueous) or sonication (solids/soils). Sample cleanup procedures are employed when necessary (See 3550B and 3510C SOPs for cleanup procedures). The semi - volatile compounds are introduced into the GC/MS by injecting an aliquot of the sample extract. The GC column is temperature programmed to separate the analytes, which are then detected with a mass spectrometer (MS). Identification of the target analytes is accomplished by comparing their mass spectra with the electron impact spectra of standard compounds. Quantification is accomplished by comparing the response of the primary quant ion relative to an internal standard using at least a five-point calibration curve.

# 2.0 Safety Precautions

2.1 Compounds applicable to this method are known or suspected carcinogens. Standard preparation is conducted in fume hoods designated for organic use.

2.2 Extraction solvents are flammable and/or toxic and must be handled with caution. All extractions are performed in a manner designed to minimize exposure to these chemicals using appropriate hoods and personal protection.

## 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with the RTI Lab Standard Operating Procedure for Sample Receipt and Custody (SRC001-A). Appropriate U. S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed. Water samples are collected in 1L amber bottles with Teflon lined screw caps. Soil samples are received in wide mouth jars with Teflon lined lids ranging from 2 oz. to 9 oz. in size. Refer to Sample Receipt and Custody SOP (SRC001-A) and QAP section 5 for sample preservation requirements and checks.

3.2 The holding time for water samples is 7 days from collection to extraction and 40 days from extraction to analysis.

3.3 The holding time for solid samples is 14 days from collection to extraction and 40 days from extraction to analysis.

3.4 All samples are stored at 4° C. Extracts are stored in a designated freezer at <0° C

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 The method detection limit (MDL) is statistically defined at the 99% confidence level according to 40 CFR Part 136 App. B. Seven replicates containing all of the analytes of interest at a concentration level of 1-5 times the estimated D.L. are analyzed and the standard deviation is calculated. The Student's T Value for the 7 replicates (3.143) is multiplied by the standard deviation of the analyte to calculate the MDL. MDLs are updated annually (or as needed) and are kept on file in the Laboratory. MDLs and reporting limits are incorporated into the applicable test code in the Omega LIMS.

4.2 The LOD (limit of detection) is determined by spiking reagent water at 1-4 times the MDL and prepared using the same procedure as samples. Analytes must be present at levels 3 times or greater than the blank response (greater than 3 times the signal to noise ratio). The concentration used is the LOD for that analyte. LOD determinations must be performed quarterly.

4.3 The LOQ (limit of quantification) is determined by spiking reagent water at the reporting limit (RL/CRQL) and prepared in the same manner as samples. Analyte recovery must be within 20% of the expected concentration. The concentration used and successfully recovered is the LOQ for that analyte. LOQ determinations must be performed quarterly.

4.4 Initially accuracy and precision at the LOQ is determined by spiking 4 aliquots of reagent water at the reporting limit (RL/CRQL) and prepared using the same procedure used for samples. The average recovery must be within 50-130% of the expected value or LCS control limits. The %RSD must be less than 15%. This procedure is performed annually.

4.5 LOD/LOQ determinations that do not meet the specifications above require repeat analysis, adjustment to the spiking levels and/or reporting limits, repeating the MDL determination at adjusted concentrations if required and repeat LOD/LOQ determinations.

4.6 The accuracy and precision for this method are determined by analyzing four aliquots from a Laboratory Control Sample containing the element(s) of interest at the mid-level of the calculated range (diluted if above this range). Percent recovery, standard deviation, and the relative standard deviation are calculated for each analyte and documents are kept on file in the laboratory.

4.7 The analytical range used by RTI Lab, Inc is from 1.0 µg/L to 50 µg/L for most of the compounds determined by this method. If an analyte concentration is beyond its established calibration range, a dilution of that sample is required. Quantification of all reportable analytes must originate from a response within the established linear range.

4.8 Preparation of initial LOD, LOQ and MDL:

4.81. An LOD/LOD/MDL of various concentrations is prepared according to the table below in a 25 ml volumetric flask and diluting to volume with pesticide grade acetone. Spike 1mL of this standard for every LOQ/MDL sample. Spike 0.5mL of full list spike and 0.75 ml of the PNA spike for every LOD sample.

Table 1 - Full list LOD/LOQ/MDL Spike

| Standard | Volume (µl) | Final Concentration (µg/ml) |
|---|---|---|
| Hydrocarbon Std 2-comp (n-Decane/N-Octadecane), 2000 ug/ml, Absolute, 94376 | 62.5 | 5 |
| Pyridine 1000µg/ml, Absolute Standards, 79091 | 125 | 5 |
| Benzoic Acid 2000µg/ml, Restek, 31879 | 250 | 20 |
| Benzidine Mix 2000µg/ml, Restek, 31834 | 250 | 20 |
| 1,4-Dioxane, 2000 ug/ml, Restek | 62.5 | 5 |
| 8270 SVOA 64-comp, AccuStandard, M-8270-AG01-ASL | 125 | 5 |
| 8270 SVOA 39-comp, AccuStandard, M-8270-AG02-ASL | 125 | 5 |

| | | |
|---|---|---|
| 4-Nitrophenol 1000µg/ml, Absolute Standards, 70231 | 375 | 15 |
| Hexachlorocyclopentadiene 1000µg/ml, Absolute Standards, 70198 | 375 | 15 |
| 2,4-Dinitrophenol 1000µg/ml, Absolute Standards, 70159 | 375 | 15 |
| 2,3,4,6-Tetrachlorophenol 1000µg/ml, Absolute Standards, 70477 | 375 | 15 |
| Acetophenone 5000 µg/ml | 75 | 5 |
| Biphenyl, 2000 ug/ml, Absolute, 90495 | 250 | 5 |
| Additions Std (Benaldehyde/Caprolactam/Atrazine), 1000 ug/ml each, Restek, 31902 | 125 | 5 |
| 1-Methylnaphthalene, 1000 µg/ml, Ultra, EPA-1225 | 125 | 5 |

Table 2 - PNA LOD/LOQ/MDL Spike

| Standard | Volume (µl) | Final Concentration (µg/ml) |
|---|---|---|
| 8270 SVOA 64-comp, AccuStandard, M-8270-AG01-ASL | 2 | 0.2 |
| 1-Methylnaphthalene, 1000 µg/ml, Ultra, EPA-1225 | 2 | 0.2 |

## 5.0 Interferences

5.1 Interferences can arise from carryover due to high sample concentrations or contamination from reagents and/or glassware. Blanks are injected to ensure system cleanliness in both instances. All glassware must be scrupulously cleaned before use. Phthalates are notorious lab contaminants and will leach from any soft plastic material used during sampling or sample preparation.

5.2 Samples containing high concentrations of non-target analytes or extremely high levels of select target analytes can result in elevated detection limits for other target analytes. Dilution of the extract may improve the resolution and quantification of some analytes but will generally cause an elevation in the RDL. Interferences from high molecular weight organics such as oils will cause an elevated baseline. If this background is at a high concentration it will interfere with analyte identification as well as quantification. While RTI does not currently employ this method of clean up, GPC clean up (refer to GPC reference method for specifics) is a method available to reduce high molecular weight interference.

5.3 Benzidine may be subject of oxidative loss during solvent concentration and exhibits poor chromatographic behavior.

5.4 Hexachlorocyclopentadiene will thermally decompose in the GC inlet, chemically react in acetone solutions and is subject to photochemical decomposition.

5.5 N-Nitrosodimethylamine does not separate well from the solvent.

5.6 N-Nitrosodiphenylamine decomposes in the GC inlet and cannot be distinguished from diphenylamine. These compounds are reported as a combined concentration.

5.7 1,2-Diphenylhydrazine is unstable even at room temperature and converts to Azobenzene. These compounds are reported as a combined concentration.

5.8 Pentachlorophenol, 2,4-Dinitrophenol, 4-Nitrophenol, Benzoic acid, 4,6-Dinitro-2-methylphenol, 4-Chloro-3-methylphenol, Nitroanilines and Benzyl alcohol are subject to erratic chromatographic behavior especially if the GC system becomes contaminated with oils or other high boiling point materials.

5.9 Pyridine performs poorly with the injection temperature used for analysis. If this compound is critical to the program objectives a separate analysis may be required.

## 6.0 Apparatus and Materials

6.1 Glass Funnels or HDPE if glass is unavailable

6.2 pH indicator paper

6.3 Graduated cylinders. 1000ml and 100ml

6.4 Glass beakers, 250 ml size.

6.5 Microliter syringes, 10ul, 25 ul, 50ul, 100µl, 500µl, and 1000µl.

6.6 Volumetric glassware, class A

6.7 Glass vials – 2ml with Teflon lined crimp caps.

6.8 Pyrex glass wool

6.9 Pasteur pipettes

6.10 HP6890 GC/5973 MS with 7673 auto sampler – SVOC 5, Chemstation version B.

6.11 HP7890A GC/5975C MS with 7693 auto sampler – SVOC 7, Chemstation version E.

6.12 HP6890N GC/5973 MS with 7693 auto sampler – SVOC 8, Chemstation version E.

6.13 GC column – RXI-5 Sil MS 20m x 0.18mmID, 0.36 film thickness.

6.14 Restek Gooseneck Splitless Liner IP Deact., SV Wool 4mm ID (Restek #20799-231.5)

6.15 2ml amber autosampler vials

6.16 250µl vial inserts

6.17 11mm aluminum auto sampler caps with Teflon lined septa

6.18 11mm crimper tool

6.19 Pasteur pipettes.

6.20 1/16”x0.5mm ID Compact Vespel/Graphite Inlet Ferrules (Restek 20248).

6.21 1/16”x0.4mm ID Vespel/Graphite GC/MS Interface Ferrules (Restek 20211).

6.22 Gold-plated Inlet Seals, 0.8mm ID (Restek 21241).

6.23 PC with Microsoft Windows, Agilent EnviroQuant Chemstation-G1701BA Ver. B.01.00, E.02.02 and Omega LIMS.

## 7.0 Reagents

7.1 Anhydrous Sodium sulfate, muffled at 450° C for 4 hours

7.2 Methylene chloride – pesticide grade

7.3 Acetone – pesticide grade

7.4 8270 LCS Spike, 200µg/mL (Cerriliant ERS-077)- Add 100µL to each LCS, MS, and MSD samples (20ug/extract).

7.5 Working surrogate solution 250 ppm: prepared by adding 1.56mL of 6 Component BNA Surrogate Standard (Absolute Standards, catalog # 25015) to a 25ml class A volumetric flask and dilute to the mark with pesticide grade acetone. Add 100µl to each sample, method blank, MS/MSD and LCS (25ug/extract).

7.6 Internal standard mix – 4000 µg/mL (10009 from Absolute Standards), add 10 ul per 1 ml extract (40 ug/extract).

7.7 Internal standard solutions are prepared, stored and handled in a manner designed to minimize the deviation in response from the time a vial is opened

until the next new vial is opened for use. Changes to the internal standard solution may occur due to evaporation of solvent into the headspace of the vial storing the solution. The repeated opening and closing of this solution over a period of several days could lead to a concentrating of the compounds with a concomitant change in response.

7.7.1 Transfer internal standard solution into a 2ml amber autosampler vial.

7.7.2 Store the vials at room temperature protected from exposure to light.

7.8 Sulfuric acid – 1:1 in DI water

7.9 ASTM Type II DI water

7.10 Helium – UHP

7.11 Tune Standard – DFTPP Tuning Standard, 500 ug/mL, Absolute, 43030

7.12 Internal Standard – CLP Semi-VOC Internal Standard, 4000 ug/mL, Absolute, 10009

7.13 LCS/MS Spike Standard - 8270 LCS Spike, 200µg/mL, Cerilliant, ERS-077

7.14 Calibration standards –

7.14.1 8270 SVOA 64-comp, AccuStandard, M-8270-AG01-ASL
7.14.2 1,4-Dioxane, 2000ppm, Restek, 31853
7.14.3 Benzidine Mix, 2000ppm, Restek, 31834
7.14.4 Hydrocarbon 2 components, 2000ppm, Absolute, 94376
7.14.5 Benzoic Acid, 2000ppm, Restek, 31879
7.14.6 8270 BNA working Surrogates, 4000ppm, Absolute, 25015
7.14.7 1,4-Dioxane-d8, 2000ppm, Restek, 30614
7.14.8 8270 SVOA 35-comp, Ultra, SVM8271-1
7.14.9 1-Methylnaphthalene, 2000ppm, Ultra, EPA-1225
7.14.10 4-Nitrophenol, Absolute, 70231, 1000ppm
7.14.11 2,4-Dinitrophenol, Absolute, 70159, 1000ppm
7.14.12 Pyridine, Absolute,1000ppm, 79091
7.14.13 Additional Compounds, Individual standards 1000ppm-Benzaldehyde, Caprolactum, Atrazine and Acetophenone – 2000ppm Biphenyl/

7.15 Calibration check standard –

7.15.1 Benzidine Mix, 2000ug/mL, Cerilliant, ERS-018
7.15.2 8270 BNA surrogate, 4000 ug/ml, AccuStandard, M-8270-SS

7.15.3 1,4-Dioxane, 1000 ug/ml, Absolute
7.15.4 1,4-Dioxane-d8, 1000 ug/ml, Absolute
7.15.5 8270 Custom Mix, 1000ug/mL, AccuStandard, S-24053
7.15.6 Mega Mix, 1000ppm, Restek, 31850
7.15.7 Pentachloronitrobenzene, 5000ppm, PPS-133-1
7.15.8 N-Nitrosodiethylamine, 2000ppm, AccuStandard, APP-0-148-20X
7.15.9 2,6-Dichlorophenol, ABSOLUTE, 1000ppm, 70143
7.15.10 Pentachlorobenzene, absolute, 1000ppm, 70321
7.15.11 1,2,4,5-Tetrachlorobenzene, absolute, 2000ppm, 93004
7.15.12 p-Cresol (4-methylphenol), Absolute, 1000ppm, 70216
7.15.13 m-Cresol (3-methylphenol), Absolute, 1000ppm, 70215
7.15.14 Benzaldehyde, Caprolactum and Atrazine, Restek 1000ppm
7.15.15 Acetophenone, 5000ppm
7.15.16 Biphenyl, 2000ppm

7.16 Standards are stored according to the manufacturer's recommendations.

7.17 All reagents and standards prepared must be logged in the appropriate standards/reagents log labeled with a minimum:

7.17.1 Identity of the material.
7.17.2 Concentration of the solution.
7.17.3 Date prepared.
7.17.4 Initials of analyst preparing the solution.
7.17.5 Expiration date.

## 8.0 Preparation of Standards and Calibration Procedure

8.1 Storage conditions of standards are found with the manufacturer instructions and must be followed. The expiration date of all prepared standards and spikes in this method is 6 months or the shortest expiration date of any stock standard used that is less than 6 months.

8.2 Tune check standard 50ng/µl- Prepare by adding 1000µl of the Tuning Standard (Sec. 7.8) to a 10ml class A volumetric flask and diluting to the mark with pesticide grade methylene chloride.

8.3 Tune verification – A solution containing 50 ng of DFTPP, DDT, benzidine, and pentachlorophenol is injected into the GC/MS and evaluated against the criteria specified in Method 8270D. These parameters are incorporated into the data system and appear on the tune report. The tune verification must be performed prior to analyzing samples and every 12 hours of continuous instrument run time. See section 13 of this document for more information.

8.4 A pentachlorophenol, benzidine peak tailing check is performed along with the tune check on a daily basis. Peak tailing factors must be <2. DDT degradation must not exceed 20%. If results exceed the criteria, injection port maintenance must be performed. This check must be done using Enviroquant. See section 13 for more

information. Peak tailing factors and DDT degradation results are captured as PDF files and stored in the data folder for the each individual sequence.

8.5 RLVS Preparation: The RLVS is prepared according to Table 1 below.

**Table 3**
**RLVS Preparation - Full List RLVS**

| Standard | Volume (µl) | Final Concentration (µg/ml) |
|---|---|---|
| Hydrocarbon Std 2-comp (n-Decane/N-Octadecane), 2000 ug/ml, Absolute, 94376 | 62.5 | 5 |
| Pyridine 1000µg/mL, Absolute Standards, 79091 | 125 | 5 |
| Benzoic Acid 2000µg/mL, Restek | 250 | 20 |
| Benzidine Mix 2000µg/mL, Restek, 31834 | 250 | 20 |
| Base/Neutral and Acid Surrogate, 4000 ug/ml, Absolute, 25015 | 156 | 25 |
| 1,4-Dioxane, 2000 ug/ml, Restek, 31853 | 62.5 | 5 |
| 1,4-Dioxane-d8, 2000 ug/ml, Restek, 30614 | 312.5 | 25 |
| 8270 SVOA 64-comp, AccuStandard, M-8270-AG01-ASL | 125 | 5 |
| 8270 SVOA 39-comp, AccuStandard, M-8270-AG02-ASL | 125 | 5 |
| 4-Nitrophenol 1000µg/mL, Absolute Standards, 70231 | 375 | 15 |
| 2,4-Dinitrophenol 1000µg/mL, Absolute Standards, 70159 | 375 | 15 |
| Acetophenone, 5000ppm | 25 | 5 |
| Biphenyl, 2000 ug/ml, Absolute, 90495 | 62.5 | 5 |
| Additions Std (Benaldehyde/Caprolactam/Atrazine), 1000 ug/ml each, Restek, 31902 | 125 | 5 |
| 2,3,4,6-Tetrachlorophenol 1000µg/mL, Absolute Standards, 70477 | 125 | 5 |

**Table 4 - PNA RLVS**

| Standard | Volume (µl) | Final Concentration (µg/ml) |
|---|---|---|
| 8270 SVOA 64-comp, AccuStandard, M-8270-AG01-ASL | 5 | 0.2 |
| 1-Methylnaphthalene, 1000ppm, Ultra, | 5 | 0.2 |

8.6 Initial Calibration Stock Standard Preparation: The ICAL Stock Standard is prepared at 50 ug/mL according to Table 1 below.

**Table 5**
**Initial Calibration Stock Standard Preparation**

| Standard | Volume (µL) |
|---|---|
| 8270 SVOA 64-comp, AccuStandard, M-8270-AG01-ASL | 250 |
| 8270 SVOA 35-comp, Ultra, SVM8271-1 | 250 |
| Benzoic Acid, Restek, 2000ppm, 31879 | 125 |
| 4-Nitrophenol, Absolute, 70231, 1000ppm | 250 |
| Benzidine Mix, 2000 ug/ml, Restek, 31834 | 125 |
| 2,4-Dinitrophenol, Absolute, 70159, 1000ppm | 250 |
| 1-Methylnaphthalene, Absolute, 2000ppm | 125 |
| 1,4-Dioxane-d8, 2000 ug/ml, Restek, 30614 | 125 |
| 1,4-Dioxane, Restek, 2000ppm, 31853 | 125 |
| Hydrocarbon Standard, Absolute, 2000ppm, 94376 | 125 |
| Pyridine, Absolute, 1000ppm, 79091 | 250 |
| 8270 BNA working Surrogates, 4000ppm, Absolute, 25015 | 62.5 |
| Benzaldehyde, Caprolactum, Acetophenone and Atrazine 1000ppm | 62.5 ea. |

| | |
|---|---|
| Biphenyl 2000ppm | 125 |

8.6.1 The calibration curve is made through a series of dilutions of the 50 µg/ml calibration standard (Sec 8.6) to encompass the range from 1.0 – 50 ug/mL. The levels of calibration are designed to incorporate the linear range of all compounds of interest. However, all levels may not actually be used to calibrate all compounds. The lowest level used for each analyte is a reflection of the lowest limit that will allow adequate identification of all compounds ions above the instrument noise level. Therefore, some compounds may have linear ranges that include 5-6 of

the most concentrated standards. Some compounds become non-linear at the higher concentration range and 5-6 of the least concentrated standards may be used as the linear range. Standards chosen for the calibration will be continuous. Standards are prepared according to the table below.

**Table 6**
**Calibration Standard Preparation**

| Level Concentration (µg/ml) | Volume (㎖) of 50µg/mL | Volume (㎖) Internal Standard | Volume (㎖) Methylene Chloride |
|---|---|---|---|
| 1 | 20 | 10 | 980 |
| 2.5 | 50 | 10 | 950 |
| 5 | 100 | 10 | 900 |
| 10 | 200 | 10 | 800 |
| 15 | 300 | 10 | 700 |
| 20 | 400 | 10 | 600 |
| 25 | 500 | 10 | 500 |
| 50 | 1000 | 10 | 0 |

8.7 Calibration Check Standard (CCV) Preparation: The CCV is prepared according to Table 1 below.

**Table 7**
**CCV Preparation**

| Standard | Volume (µl) |
|---|---|
| Benzidine Mix, 2000ug/mL, Cerilliant, ERS-018 | 62.5 |
| 8270 BNA surrogate, 4000 ug/ml, AccuStandard, M-8270-SS | 31.25 |
| 1,4-Dioxane-d8, 1000 ug/ml, Absolute | 125 |

| | |
|---|---|
| 1,4-Dioxane, 1000 ug/ml, Absolute | 125 |
| 8270 Custom Mix, 1000ug/ml, AccuStandard, S-24053 | 125 |
| Mega Mix, 1000ppm, Restek, 31850 | 125 |
| Pentachloronitrobenzene, 5000ppm, PPS-133-1 | 25 |
| N-Nitrosodiethylamine, 2000ppm, AccuStandard, APP-0-148-20X | 62.5 |
| 2,6-Dichlorophenol, ABSOLUTE, 1000ppm, 70143 | 125 |
| Pentachlorobenzene, absolute,, 1000ppm, 70321 | 125 |
| 1,2,4,5-Tetrachlorobenzene, absolute, 2000ppm, 93004 | 62.5 |
| Benzaldehyde, Atrazine and Caprolactum 1000ppm | 125 |
| Acetophenone 5000ppm | 25 |
| Biphenyl 2000ppm | 62.5 |
| p-Cresol (4-methylphenol), Absolute, 1000ppm, 70216 | 62.5 |
| m-Cresol (3-methylphenol), absolute, 1000ppm, 70215 | 62.5 |

8.8 All ICAL compounds must pass using one of three types of criteria: <20% RSD of the RRF, a linear regression model, which must include at least 5 data points, where the correlation coefficient is >0.99, or a non-linear (quadratic) regression, which must include at least 6 data points and have a correlation coefficient >0.99. For compounds that exceed the 20% RSD the linear or non-linear regression function of the data system will be used for analyte quantification provided the correlation coefficient is greater than 0.99. The equations for these regressions can be found in the HP Chemstation software. The average RRF for each compound will be evaluated and must be greater than the minimum RRF for the SPCC compounds included in Sec. 8.9.3.1. The RRF for the standard corresponding to the LOQ for each compound must meet the minimum RRF criteria. If necessary the RRF for each compound in each ICAL standard may be evaluated to ensure compounds are responding as expected.

8.8.1 The method of linear regression analysis has the potential for a significant bias to the lower portion of a calibration curve, while the relative percent difference and quadratic methods of calibration do not have this potential bias. When calculating the calibration curves using the linear regression model, a minimum quantification check on the viability of the lowest calibration point should be performed by re-fitting the response from the low concentration calibration standard back into the curve (see Method 8000 for additional details). It is not necessary to re-analyze a low concentration standard rather the data system can recalculate the concentrations as if it were an unknown sample. The recalculated concentration of the low calibration point should be within ± 30% of standard's true concentration. Other recovery criteria may be applicable depending on the
project data quality objectives and for those situations the minimum quantification check criteria should be outlined in a laboratory standard operating procedure, or a project-specific Quality Assurance Project Plan. Analytes that do not meet the minimum quantification calibration re-fitting criteria should be considered out of control and corrective action such as redefining the lower limit of quantification and/or reporting those out of control target analytes as estimated when the concentration is at or near the lowest calibration point may be appropriate.

8.8.2 Quantification of results at or slightly above the lowest standard may be more accurate when using the force through zero option of the data system. Since the data system does not include zero in the calculation of the regression equation and merely pivots the line through zero, this procedure is consistent with the guidelines in Method 8000C.

8.8.3 In situations where a sample is analyzed on an initial calibration where one or more compounds could not be calibrated to these specifications, then both non-detections and detections must be qualified as estimated if the sample cannot be re-analyzed.

8.8.4 Immediately following initial calibration a second source standard (Sec. 7.10) must be analyzed. The concentration of all compounds must be within 20% of the expected value and compound must meet the minimum RRF values in Sec. 8.9.3.1. This standard is prepared at 25 µg/L corresponding to the mid point of the calibration range.

8.9 Twelve (12) hour continuing calibration verification (CCV with evaluation of the SPCC compounds) standards. SPCC – system performance check compounds. See section 13 for more information.

8.9.1 The SPCC must be evaluated every 12 hours whenever samples are being analyzed or on failure of a SPCC.

8.9.2 The CCV is prepared by making a midpoint calibration standard, 25ug/ml according to the table in Sec. 87 from the second source standards.

### 8.9.3 SPCC criteria – minimum RRF

#### 8.9.3.1 SPCC Compounds:

| SPCC Compound | Minimum RFF |
|---|---|
| Phenol | 0.800 |
| bis(2-Chloroethyl)ether | 0.700 |
| 2-Chlorophenol | 0.800 |
| 2-Methylphenol | 0.700 |
| 2,2'-Oxybis-(1-chloropropane) | 0.010 |
| Acetophenone | 0.010 |
| 4-Methylphenol | 0.600 |
| N-Nitroso-di-n-propylamine | 0.500 |
| Hexachloroethane | 0.300 |
| Nitrobenzene | 0.200 |
| Isophorone | 0.400 |
| 2-Nitrophenol | 0.100 |
| 2,4-Dimethylphenol | 0.200 |
| bis(2-Chloroethoxy)methane | 0.300 |
| 2,4-Dichlorophenol | 0.200 |
| Naphthalene | 0.700 |
| 4-Chloroaniline | 0.010 |
| Hexachlorobutadiene | 0.010 |
| 4-Chloro-3-methylphenol | 0.200 |
| 2-Methylnaphthalene | 0.400 |
| Hexachlorocyclopentadiene | 0.050 |
| 2,4,6-Trichlorophenol | 0.200 |
| 2,4,5-Trichlorophenol | 0.200 |
| 2-Chloronaphthalene | 0.800 |
| 2-Nitroaniline | 0.010 |
| Dimethyl phthalate | 0.010 |
| 2,6-Dinitrotoluene | 0.200 |
| Acenaphthylene | 0.900 |
| 3-Nitroaniline | 0.010 |
| Acenaphthene | 0.900 |
| 2,4-Dinitrophenol | 0.010 |
| 4-Nitrophenol | 0.010 |
| Dibenzofuran | 0.800 |
| 2,4-Dinitrotoluene | 0.200 |
| Diethyl phthalate | 0.010 |
| 1,2,4,5-Tetrachlorobenzene | 0.010 |

| SPCC Compound | Minimum RFF |
|---|---|
| 4-Chlorophenyl-phenyl ether | 0.400 |
| Fluorene | 0.900 |
| 4-Nitroaniline | 0.010 |
| 4,6-Dinitro-2-methylphenol | 0.010 |
| 4-Bromophenyl-phenyl ether | 0.100 |
| N-Nitrosodiphenylamine | 0.010 |
| Hexachlorobenzene | 0.100 |
| Pentachlorophenol | 0.050 |
| Phenanthrene | 0.700 |
| Anthracene | 0.700 |
| Carbazole | 0.010 |
| Di-n-butyl phthalate | 0.010 |
| Fluoranthene | 0.600 |
| Pyrene | 0.600 |
| Butyl benzyl phthalate | 0.010 |
| 3,3'-Dichlorobenzidine | 0.010 |
| Benzo(a)anthracene | 0.800 |
| Chrysene | 0.700 |
| Bis-(2-Ethylhexyl)phthalate | 0.010 |
| Di-n-octyl phthalate | 0.010 |
| Benzo(b)fluoranthene | 0.700 |
| Benzo(k)fluoranthene | 0.700 |
| Benzo(a)pyrene | 0.700 |
| Indeno (1,2,3-cd) pyrene | 0.500 |
| Dibenzo (a,h)anthracene | 0.400 |
| Benzo (g,h,i)perylene | 0.500 |
| 2,3,4,6-Tetrachlorophenol | 0.010 |
| Benzaldehyde | 0.010 |
| Acetophenone | 0.010 |
| Caprolactam | 0.010 |
| 1,1'-Biphenyl | 0.010 |
| Atrazine | 0.010 |

8.9.4 Target compounds calibrated using relative response factors must exhibit less than 20% difference and those calibrated using linear or quadratic models must exhibit less than 20% drift. 80% of all compounds must meet the criteria above for analysis to proceed. If more than 20% of the compounds exceed the criteria corrective action must be taken prior to analysis.

8.9.5 Compounds present in samples that exceed the 20% criteria are noted in the case narrative or flagged as estimated.

8.10 An ending CCV must be analyzed following sample analysis within the 12-hour analytical sequence for samples requiring adherence to DoD QSM 5.0 protocol. The percent drift or percent difference must be within 50% of the expected value for all target compounds.

8.11 Initial calibration procedure - SIM analysis for PAH compounds: ICAL standards are prepared by adding 2.5 µl of 4000ppm BNA Surrogate standard, 5 µl of the 2000ppm 1-Methylenenaphthalene standard and 10 µl of the 1000ppm 8270 SVOA 64 compound standard to 10 ml Methylene chloride (1000 µg/L final concentration). From this solution standards are prepared at 20, 50, 100, 200, 500 and 1000 µg/L. Calibration curve is evaluated as above for the PAH compounds.

8.12 ICV – SIM analysis PAH compounds: Add 1.25 µl of the 4000 BNA Surrogate standard and 5 µl of the 1000ppm 8270 Mega mix standard to a final volume of 10 ml Methylene chloride (500 µg/L final concentration). Evaluate ICV standard as above.

## 9.0 Sample Preparation

9.1 Allow samples to warm to ambient temperature and prepare according to SOPs 3510C and 3550B. Oily, viscous or samples suspected of containing high concentrations of matrix interference are diluted with methylene chloride prior to instrument introduction. Clean up procedures, other than dilution, are not currently performed.

## 10.0 Diagram/Table

10.1 Reserved.

## 11.0 Analytical Procedure

11.1 Set up run sequence according to the data system software protocol using the following template after a successful tune check (Note: the below list is a guide and samples and QC samples may be loaded in any sequence within the 12 hour time frame). Run sequence follows successful ICAL and ICV results.

11.1.1 CCV
11.1.2 RLVS
11.1.3 Method Blank or Reagent Blank
11.1.4 LCS
11.1.5 QC sample and MS/MSD
11.1.6 Continue with sample analyses up to 12 hours from time of initial CCV
11.1.7 Ending CCB within the 12-hour analytical sequence
11.1.8 Repeat tune check and CCV at 12 hours and proceed from 11.1.2

11.2 Set GC conditions according to the table below.

| **Typical GCMS Parameters:** | **Settings: Instrument SVOC 7** | **Settings: Instruments SVOC 5 and 8** |
|---|---|---|
| Flow/Initial column temperature | Flow UHP Helium – 1.6 ml/min Splitless, constant flow EPC injection at 35 degrees C | Flow UHP Helium – 1.0 ml/min Splitless, constant flow EPC injection at 50 degrees C |
| Initial hold time | 1.0 minutes | 1.0 minutes |
| 1st ramp rate/temp. | 15 degrees/min to 110 degrees C. | 15 degrees/min to 110 degrees C. |
| Hold time – temp 1 | 0 minutes | 0 minutes |
| 2nd ramp rate/temp | 25 degrees/min to 330 degrees C. | 30 degrees/min to 280 degrees C. |
| Hold time – temp 2 | 2 minutes | 0 minutes |
| 3nd ramp rate/temp | NA | 15 degrees/min to 330 degrees C. |
| Hold time – temp 3 | NA | 2.5 minutes |
| Injector Temperature | 280 degrees C. | 280 degrees C. |
| Detector Temperature | 280 degrees C. | 280 degrees C. |
| MS Quad Temperature | 150 degrees C. | 150 degrees C. |
| MS Source Temperature | 230 degrees C. | 230 degrees C. |

11.3 Set transfer line to 280 degrees C, and filament delay to a setting after the solvent peak has been identified.

11.4 Data interpretation, qualitative identifications and MS software specific protocol are addressed in method 8270D of SW-846, the HP GC/MS operator's and Enviroquant manual. Qualitative identifications must meet the method criteria before positive identification can be made.

11.5 Compound identification and quantification

11.5.1 Compound identification is based on retention time and characteristic mass spectrum.

11.5.2 Initial identification is a compound that elutes with the compound specified retention time (RT) window (0.25 min. for most compounds) or within a relative retention time of +/- 0.06 RRT units of the RRT of the standard compound. A minimum retention time deviation is programmed into the data system method for each compound.

11.5.3 The mass spectrum of compounds within the RRT range is compared to the spectrum of the standard compound. Relative intensities of the characteristic ions should be within 30% of the expected relative intensities for the reference spectrum.

11.5.4 Co-eluting structural isomers whose resolution is less than 50% of the average peak heights and that have similar mass spectra are to be reported as the sum of the isomers (i.e. m,p-cresols).

11.5.5 Analyst experience in evaluating mass spectra and identifying compounds in the presence of interfering components is important in final compound identification.

11.5.6 Identified compounds are quantified from the average response factor of the initial calibration or other calibration models employed when required.

11.5.7 Compounds exhibiting concentrations above the upper calibration level are diluted into the calibration range. If insufficient sample is available for dilution the concentration is flagged as estimated (“E”). Data from all dilutions are evaluated and compound results will be reported from the lowest dilution that exhibits lack of interference.

11.5.8 Compound concentrations that are below the laboratory reporting limit or lowest calibration point but positively identified above the MDL are flagged as estimated (“J”).

11.6 Manual integration guidelines and procedures

11.6.1 Situations may arise whereby the quantification provided by the data system is inappropriate. This can occur due to co-elution, baseline noise or matrix interference.

11.6.2 When manual integration of a compound is necessary the following guidelines must be followed.

11.6.2.1 Manual quantification is performed by integrating the area of the quant ion for the compound.

11.6.2.2 The integration will only include the area attributable to the compound of interest.

11.6.2.3 The area integrated shall not include baseline background noise.

11.6.2.4 The area integrated shall not extend beyond the point where the sides of the peak intersect with the baseline.

11.6.2.5 Manual integration must not be used solely to meet quality control criteria.

11.6.2.6 Manual integration must not be used as a substitute for corrective action on the GC/MS system.

11.6.2.7 Instances of manual integration are flagged with a “m” by the data system. Cases of manual integrations require review and approval by the Laboratory Manager or QA Director and are documented in the corresponding instrument Excel file or in the LIMS analytical sequence Linked Files.

11.7 SIM Analysis.

11.7.1 Set up run sequence according to the data system software protocol using the following template after a successful tune check (Note: the below list is a guide and samples and QC samples may be loaded in any sequence within the 12 hour time frame):

11.7.1.1 CCV
11.7.1.2 RLVS
11.7.1.3 Method Blank
11.7.1.4 LCS
11.7.1.5 QC sample and MS/MSD
11.7.1.6 Continue with sample analyses up to 12 hours from time of initial CCV.
11.7.1.7 CCV
11.7.1.8 Repeat tune check and CCV at 12 hours and proceed from

11.7.2 Set GC conditions according to the table below.

| **Typical GC Parameters:** | **Settings: Instrument** |
|---|---|
| Flow/Initial column temperature | Flow UHP Helium – 1.0 ml/min Splitless, constant flow EPC injection at 50 degrees C |
| Initial hold time | 1.0 minutes |
| 1st ramp rate/temp. | 15 degrees/min to 110 degrees C. |
| Hold time – temp 1 | 0 minutes |
| 2nd ramp rate/temp | 30 degrees/min to 280 degrees C. |
| Hold time – temp 2 | 0 minutes |
| 3nd ramp rate/temp | 15 degrees/min to 330 degrees C. |
| Hold time – temp 3 | 3 minutes |
| Injector Temperature | 280 degrees C. |
| Detector Temperature | 280 degrees C. |

11.7.3 Data interpretation, qualitative identifications and MS software specific protocol are addressed in method 8270D of SW-846, the HP GC/MS operator's and Enviroquant manual. Qualitative identifications must meet the method criteria before positive identification can be made.

11.7.4 For SIM analysis, internal standard calibration is used.

11.7.5 A SIM method containing the analytes of interest is created. The retention time of each analyte is determined by running the standard in the full scan mode. The primary (Quantification), secondary and tertiary ions from section 13.12 are used to create an ion-monitoring window that incorporates the retention time of the analyte of interest.

11.7.6 The resolution is set to high and the dwell time to 50ms.

11.7.7 Sections 11.5 and 11.6 of this document are used for data analysis.

## 12.0 Details of Calibration and Calculations

12.1 Response Factor:

$$RF = \frac{(A_x)(C_{is})}{(A_{is})(C_x)}$$

Where: $A_x$ = Area of the characteristic ion for the compound being measured.
$A_{is}$ = Area of the characteristic ion for the specific internal standard.
$C_{is}$ = Amount of the specific internal standard (ng).
$C_x$ = Concentration amount of the compound being measured (ng).

12.2 Concentration:

$$\frac{ug}{l} or \frac{ug}{Kg} = \frac{(A_x)(IS)}{(A_{is})(RF)(V_o)} DF$$

Where: $A_x$ = Area of characteristic ion for compound being measured.
IS = Amount of internal standard injected (ng).
$A_{is}$ = Area of characteristic ion for the internal standard.
RF = Response factor for compound being measured.
DF = Dilution factor (where applicable)
$V_o$ = Sample volume in gm or ml.

12.2 Percent Relative Standard Deviation:

$$\%RSD = \frac{s}{x} 100$$

Where: RSD = Relative Standard Deviation.
X = Mean of the 3-5 initial R.F for a compound.
σ = Standard Deviation of average R.F for a compound.

12.4 Percent Difference:

$$\%Dif = \frac{|RF - RFc|}{RF} 100$$

Where: RF = Average response factor from initial calibration.
RFc = Response factor from current verification check standard.

12.5 Percent Drift:

$$\%Drift = \frac{C_m}{C_e} 100$$

Where: $C_m$ = Concentration measured
$C_e$ = Concentration expected

12.6 Tailing Factor :

$$TailingFactor = \frac{AC}{AB}$$

Where: AC = distance from the point at peak midpoint to the trailing edge (measured at 10% of peak height)
AB = distance from the leading edge of of peak to the midpoint (measured at 10% of peak height)

12.5 Linear Regression:

$$y = ax + b$$

Where: y = Instrument response (peak area)
a = Slope of the line
x = Concentration of the calibration standard
b = The intercept

12.6 Quadratic Regression: $y = ax^2 + bx + c$

$$y = ax^2 + bx + c$$

Where: y = Instrument response (peak area)
a = Slope of the line
x = Concentration of the calibration standard
b = The intercept

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 Initial tune verification – 50 ng of tuning standard is injected into the GC/MS and evaluated against the criteria specified in Method 8270D. These parameters are incorporated into the data system and appear on the tune report.

13.1.1 The DFTPP tune evaluation must be performed prior to analyzing samples and every 12 hours of continuous instrument run time. Tune parameters must be within established limits.

13.1.1.1 Possible Corrective Actions

13.1.1.1.1 Retune the instrument.
13.1.1.1.2 Adjust the target values for the tuning procedure, retune and re-inject the tune solution.
13.1.1.1.3 Clean source.

13.1.2 Evaluate pentachlorophenol and benzidine tailing factors. If factors exceed 2 investigate and perform any necessary corrective actions.

13.1.2.1 Possible Corrective Actions.

13.1.2.1.1 Replace injection port liner.
13.1.2.1.2 Trim or replace guard column.
13.1.2.1.3 Trim or replace analytical column.

13.1.3 Evaluate DDT breakdown. Breakdown must be less than 20%. If breakdown exceeds 20% corrective actions must be performed.

13.1.3.1 Possible Corrective Actions.

13.1.3.1.1 Replace injection port liner.

13.1.3.1.2 Trim or replace guard column.

13.1.3.1.3 Trim or replace analytical column.

13.2 Refer to Section 8.6 for initial calibration evaluation criteria.

13.3 Following successful tuning, and valid initial calibration, the CCV/SPCC sample must be analyzed and must pass the method criteria (Section 8.7). This sample must be analyzed every 12 hours of continuous instrument run time.

13.3.1 Possible Corrective Action

13.3.1.1 Repeat CCV/SPCC sample.

13.3.1.2 Re-prepare the CCV standard and repeat.

13.3.1.3 Replace injection port liner.

13.3.1.4 Trim or replace guard column.

13.3.1.5 Trim or replace analytical column.

13.3.1.6 Clean the source.

13.3.1.7 Once the problem has been identified and corrected, repeat the initial calibration procedure.

13.3.1.8 Check to be sure that there are no errors in integration of internal standards and SPCC and CCC compounds. Examine chromatograms for interfering peaks and integrated peak areas. If errors are found, recalculate the data accordingly.

13.3.1.9 Make sure certified solutions and calibration standards are not expired. Expired solutions and standards may exhibit analyte degradation. Replace all expired standards and remake all calibration standards. Recalibrate the instrument.

13.3.1.10 High variability of phenol compounds may indicate a system leak or reactive sites on the column. Leaks are noted if base line levels are high and atmospheric masses are predominant in the tune (18, 28,32, and 44). Check connections for leaks. A column that has developed active sites may need to be replaced. Typical column life expectancy is 6 months or less.

13.3.2 The CCV is further evaluated for all target analytes in the batch. Percent recovery for each should be within 80 – 120 %. Refer to Sec. 8.7.4 and 8.7.5.

13.4 For each 12-hour or less analytical event a Method Blank or CCB is analyzed prior to analysis of samples to ensure the system is free of contamination that may impact sample results. Prepare the method blank for each matrix for each batch of twenty or less samples using DI water for aqueous samples and cleaned sand (or reagents only if necessary) for solid samples.

13.4.1 Acceptance Criteria: All analytes <1/2 RL

13.4.2 Corrective Action: Clean system and check for sources of contamination.

13.5 For each batch of samples a Laboratory Control Sample (LCS) at 20 ug/ml (aqueous, 666.67 ug/Kg solid concentration) is evaluated. Prepare the laboratory control sample (LCS) for each matrix for each batch of twenty or less samples by adding 0.1 ml of the spike mix (section 7.4) to one liter of DI water for aqueous samples or 30 gm of cleaned sand (or reagents only if necessary) for solid samples.

13.5.1 Acceptance Criteria: Control limits as specified in the DoD QSM. If not listed default limits of 50 – 130 % recovery or statistically derived control limits.

13.5.2 Corrective Action: Repeat LCS, re-prepare solution and repeat LSC and repeat calibration procedure if necessary.

13.6 For each matrix batch of 20 or less samples a MS/MSD is included that contains all of the components of interest. Prepare a matrix spike (MS) for each matrix for each batch of twenty or less samples by adding 0.1 ml of the spike mix (section 7.4) to a representative sample. Prepare a matrix spike duplicate (MSD) for each batch of twenty or less samples by adding 0.1 ml of the spike mix (section 7.4) to the same sample used for the MS. MS/MSD for aqueous sample require additional material to be supplied by the client.

13.6.1 Acceptance Criteria: Set to LCS control limits. MSD RDP not to exceed 25%. Spike concentration is 20 ug/ml (aqueous (based on a 1000ml sample size and a 1ml extract final volume), 666.67 ug/Kg solid concentration (based on a 30g sample size and a 1ml extract final volume)).

13.6.2 Corrective Action – Evaluate the sample spiked for matrix interference and flag the data as necessary.

13.7 Surrogate Control Limits

13.7.1 Surrogate control limits are set to the values listed in the DoD QSM. If required surrogate limits may be calculated for a sample matrix using at least 20 data points and the Mean recovery +/- 3 times the standard deviation.

13.7.2 For samples (including QC samples) in which the surrogate recovery falls outside the established control limits check the following:

13.7.2.1 Check integrations for errors.
13.7.2.2 Check calculations for errors.
13.7.2.3 Check instrument performance.
13.7.2.4 Re-extract and re-analyzed the samples if the above show no problems or flag the data if sample matrix interference is present.

13.8 Internal standard responses.

13.8.1 The response for each internal standard in the CCV must be within –50% to +100% of the mid-level calibration standard.

13.8.2 Failure to achieve the above criteria requires inspection of system operation and any necessary corrective actions. Any sample associated with the CCV having internal standard failures must be re-analyzed.

13.9 The retention times of the internal standards in the calibration verification standard must be evaluated immediately after or during data acquisition. If the retention time for any internal standard changes by more than 30 seconds from the that in the mid-point standard level of the most recent initial calibration sequence, then the chromatographic system must be inspected for malfunctions and corrections must be made, as required. When corrections are made, reanalysis of samples analyzed while the system was malfunctioning is required.

13.10 Initial demonstrations of proficiency are performed by all analysts for all instruments and methods. IDP records are kept on file in the laboratory and referenced in analyst training files. Demonstrations of proficiency are re-performed in instances of new staff or major changes in methodology or equipment. Continuing demonstration of proficiency is performed annually in conjunction with Sec. 4.4.

13.11 Refer also to the RTI QAP sections 3.0, 8.0, 9.0, 12.0 and 13.0.

13.12 Table of analytes (internal standards, surrogates and target compounds), including primary (quantification), and confirmation ions.

| Type | Compound | Primary Ion | Secondary Ion | Tertiary Ion | Quaternary Ion | Internal Standard Use |
|---|---|---|---|---|---|---|
| Internal | 1,4-Dichlorobenzene-$d_4$ | 152 | 150 | 115 | 78 | 1,4-Dichlorobenzene-d |
| Target | *N*-Nitrosodimethylamine | 74 | 42 | 43 | 59 | 1,4-Dichlorobenzene-d |
| Target | Pyridine | 79 | 52 | 51 | 50 | 1,4-Dichlorobenzene-d |
| Target | 1,4-Dioxane | 88.1 | 57.1 | 45.1 | | 1,4-Dichlorobenzene-d |
| Surrogate | 1,4-Dioxane-$d_8$ | 96.2 | 64.2 | 46.0 | | 1,4-Dichlorobenzene-d |
| Surrogate | 2-Fluorophenol | 112 | 64 | 92 | 57 | 1,4-Dichlorobenzene-d |
| Target | *N*-Nitrosodiethylamine | 102 | 56 | 42 | 71 | 1,4-Dichlorobenzene-d |
| Surrogate | Phenol-$d_5$ | 99 | 71 | 100 | 42 | 1,4-Dichlorobenzene-d |
| Target | Acetophenone | 105 | 77 | 120 | | 1,4-Dichlorobenzene-d |
| Target | Phenol | 94 | 66 | 65 | 55 | 1,4-Dichlorobenzene-d |
| Target | Benzaldehyde | 77 | 106 | 51 | | 1,4-Dichlorobenzene-d |
| Target | Aniline | 93 | 66 | 65 | | 1,4-Dichlorobenzene-d |
| Target | bis(2-Chloroethyl) ether | 93 | 63 | 95 | | 1,4-Dichlorobenzene-d |
| Target | n-Decane | 57 | 43 | 71 | 142 | 1,4-Dichlorobenzene-d |
| Target | 2-Chlorophenol | 128 | 64 | 130 | 92 | 1,4-Dichlorobenzene-d |
| Target | 1,3-Dichlorobenzene | 146 | 148 | 111 | | 1,4-Dichlorobenzene-d |
| Target | 1,4-Dichlorobenzene | 146 | 148 | 111 | | 1,4-Dichlorobenzene-d |
| Target | Benzyl alcohol | 108 | 79 | 77 | 51 | 1,4-Dichlorobenzene-d |
| Target | 1,2-Dichlorobenzene | 146 | 148 | 111 | | 1,4-Dichlorobenzene-d |
| Target | 2-Methylphenol | 107 | 108 | 79 | 90 | 1,4-Dichlorobenzene-d |
| Target | *bis*(2-Chloroisopropyl) ether | 45 | 77 | 121 | | 1,4-Dichlorobenzene-d |
| Target | 4-Methylphenol | 108 | 107 | 79 | 90 | 1,4-Dichlorobenzene-d |

| | | | | | | |
|---|---|---|---|---|---|---|
| Target | *N*-Nitrosodipropylamine | 70 | 42 | 130 | 101 | 1,4-Dichlorobenzene-d |
| Target | o-Toluidine | 106 | 107 | 79 | 77 | 1,4-Dichlorobenzene-d |
| Target | Hexachloroethane | 117 | 201 | 199 | 166 | 1,4-Dichlorobenzene-d |
| Target | Benzaldehyde | 106 | 105 | 77 | 51 | 1,4-Dichlorobenzene-d |
| Target | Acetophenone | 105 | 77 | 51 | 120 | 1,4-Dichlorobenzene-d |
| Internal | Naphthalene-$d_8$ | 136 | 68 | 108 | 54 | Naphthalene-$d_8$ |
| Surrogate | Nitrobenzene-$d_5$ | 82 | 54 | 128 | | Naphthalene-$d_8$ |
| Target | Nitrobenzene | 77 | 123 | 65 | 51 | Naphthalene-$d_8$ |
| Target | Isophorone | 82 | 138 | 95 | 54 | Naphthalene-$d_8$ |
| Target | 2-Nitrophenol | 139 | 109 | 65 | 81 | Naphthalene-$d_8$ |
| Target | 2,4-Dimethylphenol | 122 | 107 | 121 | 77 | Naphthalene-$d_8$ |
| Target | Benzoic acid | 122 | 105 | 77 | 51 | Naphthalene-$d_8$ |
| Target | *bis*(2-Chloroethoxy)methane | 93 | 95 | 123 | | Naphthalene-$d_8$ |
| Target | 2,4-Dichlorophenol | 162 | 164 | 98 | 63 | Naphthalene-$d_8$ |
| Target | 1,2,4-Trichlorobenzene | 180 | 182 | 145 | 109 | Naphthalene-$d_8$ |
| Target | 4-Chlorophenol | 128 | 130 | 65 | 73 | Naphthalene-$d_8$ |
| Target | Naphthalene | 128 | 129 | 127 | 63 | Naphthalene-$d_8$ |
| Target | 4-Chloroaniline | 127 | 129 | 65 | 92 | Naphthalene-$d_8$ |
| Target | 2,6-Dichlorophenol | 162 | 164 | 98 | 63 | Naphthalene-$d_8$ |
| Target | Hexachlorobutadiene | 225 | 223 | 227 | 118 | Naphthalene-$d_8$ |
| Target | Caprolactam | 55 | 113 | 85 | | Naphthalene-$d_8$ |
| Target | 4-Chloro-3-methylphenol | 107 | 142 | 144 | | Naphthalene-$d_8$ |
| Target | 2-Methylnaphthalene | 142 | 141 | 115 | 71 | Naphthalene-$d_8$ |
| Target | Caprolactum | 55 | 85 | 67 | 42 | Naphthalene-$d_8$ |
| Target | Biphenyl | 154 | 163 | 152 | 155 | Naphthalene-$d_8$ |
| Internal | Acenaphthene-$d_{10}$ | 164 | 162 | 160 | | Acenaphthene-$d_{10}$ |
| Target | Hexachlorocyclopentadiene | 237 | 95 | 272 | 235 | Acenaphthene-$d_{10}$ |
| Target | 1,2,4,5-Tetrachlorobenzene | 216 | 108 | 214 | 179 | Acenaphthene-$d_{10}$ |
| Target | 2,4,6-Trichlorophenol | 196 | 198 | 97 | 200 | Acenaphthene-$d_{10}$ |
| Target | 2,4,5-Trichlorophenol | 196 | 198 | 97 | 132 | Acenaphthene-$d_{10}$ |
| Surrogate | 2-Fluorobiphenyl | 172 | 85 | 75 | 171 | Acenaphthene-$d_{10}$ |
| Target | Biphenyl | 154 | 153 | 152 | | Acenaphthene-$d_{10}$ |
| Target | 2-Chloronaphthalene | 162 | 164 | 127 | 63 | Acenaphthene-$d_{10}$ |
| Target | 1-Chloronaphthalene | 162 | 164 | 127 | 63 | Acenaphthene-$d_{10}$ |
| Target | 2-Nitroaniline | 138 | 65 | 92 | 77 | Acenaphthene-$d_{10}$ |

| | | | | | | |
|---|---|---|---|---|---|---|
| Target | Dimethyl phthalate | 163 | 77 | 194 | 164 | Acenaphthene-$d_{10}$ |
| Target | 2,6-Dinitrotoluene | 165 | 89 | 63 | 121 | Acenaphthene-$d_{10}$ |
| Target | Acenaphthylene | 152 | 151 | 76 | 153 | Acenaphthene-$d_{10}$ |
| Target | 3-Nitroaniline | 65 | 138 | 92 | | Acenaphthene-$d_{10}$ |
| Target | Acenaphthene | 153 | 154 | 76 | 152 | Acenaphthene-$d_{10}$ |
| Target | 2,4-Dinitrophenol | 184 | 107 | 63 | 154 | Acenaphthene-$d_{10}$ |
| Target | 4-Nitrophenol | 65 | 109 | 81 | 139 | Acenaphthene-$d_{10}$ |
| Target | Pentachlorobenzene | 250 | 215 | 143 | 129 | Acenaphthene-$d_{10}$ |
| Target | 2,4-Dinitrotoluene | 165 | 63 | 89 | 182 | Acenaphthene-$d_{10}$ |
| Target | Dibenzofuran | 168 | 139 | 169 | 84 | Acenaphthene-$d_{10}$ |
| Target | 2,3,4,6-Tetrachlorophenol | 232 | 131 | 166 | 230 | Acenaphthene-$d_{10}$ |
| Target | Diethyl phthalate | 149 | 177 | 105 | 150 | Acenaphthene-$d_{10}$ |
| Target | 4-Chlorophenyl phenyl ether | 204 | 141 | 206 | | Acenaphthene-$d_{10}$ |
| Target | Fluorene | 166 | 165 | 167 | 139 | Acenaphthene-$d_{10}$ |
| Target | 4-Nitroaniline | 138 | 65 | 92 | 108 | Acenaphthene-$d_{10}$ |
| Target | Atrazine | 200 | 58 | 215 | 68 | Acenaphthene-$d_{10}$ |
| Surrogate | 2,4,6-Tribromophenol | 330 | 332 | 61 | 141 | Acenaphthene-$d_{10}$ |
| Internal | Phenanthrene-$d_{10}$ | 188 | 80 | 94 | | Phenanthrene-$d_{10}$ |
| Target | 4,6-Dinitro-2-methylphenol | 198 | 105 | 121 | 51 | Phenanthrene-$d_{10}$ |
| Target | *N*-Nitrosodiphenylamine | 169 | 168 | 167 | | Phenanthrene-$d_{10}$ |
| Target | Azobenzene | 77 | 182 | 105 | 152 | Phenanthrene-$d_{10}$ |
| Target | 4-Bromophenyl phenyl ether | 248 | 250 | 141 | | Phenanthrene-$d_{10}$ |
| Target | Hexachlorobenzene | 284 | 142 | 249 | | Phenanthrene-$d_{10}$ |
| Target | Atrazine | 200 | 215 | 58 | 43 | Phenanthrene-$d_{10}$ |
| Target | Pentachlorophenol | 266 | 165 | 264 | 268 | Phenanthrene-$d_{10}$ |
| Target | Pentachloronitrobenzene | 237 | 297 | 179 | 265 | Phenanthrene-$d_{10}$ |
| Target | n-Octadecane | 57 | 71 | 85 | 254 | Phenanthrene-$d_{10}$ |
| Target | Phenanthrene | 178 | 152 | 179 | 176 | Phenanthrene-$d_{10}$ |
| Target | Anthracene | 178 | 76 | 176 | 179 | Phenanthrene-$d_{10}$ |
| Target | Carbazole | 167 | 139 | 84 | 166 | Phenanthrene-$d_{10}$ |
| Target | Di-n-butyl phthalate | 149 | 150 | 104 | 278 | Phenanthrene-$d_{10}$ |
| Target | Fluoranthene | 202 | 101 | 203 | 88 | Phenanthrene-$d_{10}$ |
| Target | Benzidine | 184 | 92 | 185 | 156 | Phenanthrene-$d_{10}$ |
| Internal | Chrysene-$d_{12}$ | 240 | 236 | 120 | | Chrysene-$d_{12}$ |
| Target | Pyrene | 202 | 200 | 203 | 101 | Chrysene-$d_{12}$ |

| | | | | | | |
|---|---|---|---|---|---|---|
| Internal | Terphenyl-$d_{14}$ | 244 | 122 | 245 | 212 | Chrysene-$d_{12}$ |
| Target | Butyl benzyl phthalate | 149 | 91 | 206 | 312 | Chrysene-$d_{12}$ |
| Target | 3,3'-Dichlorobenzidine | 252 | 154 | 126 | 254 | Chrysene-$d_{12}$ |
| Target | *bis*(2-Ethylhexyl) phthalate | 149 | 167 | 279 | 113 | Chrysene-$d_{12}$ |
| Target | Benz(a)anthracene | 228 | 226 | 114 | 229 | Chrysene-$d_{12}$ |
| Target | Chrysene | 228 | 226 | 114 | 229 | Chrysene-$d_{12}$ |
| Target | Di-n-octyl phthalate | 149 | 167 | 43 | 279 | Chrysene-$d_{12}$ |
| Internal | Perylene-$d_{12}$ | 264 | 132 | 260 | 265 | Perylene-$d_{12}$ |
| Target | Benzo(b)fluoranthene | 252 | 253 | 126 | 125 | Perylene-$d_{12}$ |
| Target | Benzo(k)fluoranthene | 252 | 253 | 126 | 125 | Perylene-$d_{12}$ |
| Target | Benzo(a)pyrene | 252 | 126 | 113 | 125 | Perylene-$d_{12}$ |
| Target | Indeno(1,2,3-cd)pyrene | 276 | 138 | 124 | 277 | Perylene-$d_{12}$ |
| Target | Dibenz(a,h)anthracene | 278 | 139 | 125 | 279 | Perylene-$d_{12}$ |
| Target | Benzo(g,h,i)perylene | 276 | 138 | 124 | 277 | Perylene-$d_{12}$ |

## 14.0 Data Reporting Requirements

14.1 If any compound is found in a sample at a concentration greater than that of the highest standard the sample must be re-analyzed after dilution. The sample should be diluted until all compounds of interest are within the working range of the standard curve. Data from all dilutions are evaluated and compound results will be reported from the lowest dilution that exhibits lack of interference. The LIMS is capable on accepting multiple dilutions on a sample and reporting only the applicable compounds for each dilution. The surrogate recoveries must fall within the statistical ranges (section 13.4).

14.2 Blank results are not to be subtracted from sample values.

14.3 Sample concentrations are reported in ug/ml from the Enviroquant data system.

14.4 Raw results are entered into Omega. Prep factors are automatically imported from sample prep logs. Dilutions are entered in the analytical sequence.

14.5 Sample results are reported as ug/L for water and ug/kg for soil as dry weight.

14.6 Raw instruments results are entered directly into the Omega LIMS system using excel spreadsheets, direct instrument interface or manually. All calculations to derive final result (including dry weight conversions) are performed automatically by the LIMS. Sample preparation information and percent moisture results are entered into the appropriate section of the LIMS prior to instrument data and are automatically factored into the final results.

14.7 Confirm that there are no QC flags or qualifiers in this sequence. If present, investigate and repeat or reanalyze as necessary. See section 9.2 of the QAP for more detail on qualifiers.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 Daily: Perform air and water check, tune check, monitor tank pressures, check for RT shifts by monitoring compound RTs, and perform injection port maintenance.

15.2 Annual: Change pump oil.

15.3 All maintenance is recorded in the Omega LIMS for the applicable instrument.

## 16.0 Waste Management and Pollution Prevention

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner, which minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Organic solvents are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Soil samples are composited in a drum designated for incineration.

16.2.3 Disposal of materials is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, Method 8270D Revision 4.

17.2 RTI Lab SOPs 3510C and 3550B.

17.3 RTI Laboratories, Inc. Quality Assurance Plan.

17.4 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.5 RTI Laboratories, Inc. SOP: SRC001-A, Sample Receipt and Custody SOP.

17.6 RTI Laboratories, Inc. Employee Handbook.

## 18.0 Revisions

18.1 Additional compounds – Benzaldehyde, Acetophenone, Caprolactum. Biphenyl and Atrazine add to Tables in Sections 4, 8 and 13.

18.2 Additional compounds added to Sections 7.14 and 7.15.

18.3 1,4-Dioxane and 1,4-Dioxane-$d_8$ added to table in Section 13.

18.4 Revision 14.1 – Added SIM standard preparation Sections 8.11 and 8.12

**RTI Laboratories, Inc.**
**31628 Glendale**
**Livonia, Michigan 48150**

# STANDARD OPERATING PROCEDURE

# ANALYSIS OF EXPLOSIVES BY HPLC

| | |
|---|---|
| **Analyte:** | **Explosives** |
| **SOP#:** | **8330B_030615_R5** |
| **Method Reference:** | **SW-8330B** |
| **Issue Date:** | **March 9, 2009** |
| **Revision No.:** | **5** |
| **Revision Date:** | **March 6, 2015** |

**Reviewed and Approved: March 6, 2015**

| | |
|---|---|
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| Director, Environmental Services: | Yemane Yohannes |

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**STANDARD OPERATING PROCEDURE**

**ANALYSIS OF EXPLOSIVES**

**SOP#: 8330B_030615_R5**

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## 1.0 Scope and Application:

1.1 Introduction

RTI Laboratories, Inc. has prepared this document to detail the Standard Operating Procedure (SOP) for the analysis of explosives in aqueous and solid samples. Compounds applicable to the method are listed in Table 3. Soil extraction procedures according to method versions 8330B and 8330A are included in this SOP.

A detailed description of the instrumentation, calibration, run parameters and quality control procedures is included in this SOP. For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

1.2 Summary of Method

1.2.1 To determine content of various explosives, an extract is injected into an HPLC system and separated on a determinative column. The separated components are analyzed via UV detection. Compounds are identified by comparison of the peak retention time (RT) to the RT standards. Quantification is performed by comparison of the compound response to an established calibration curve

## 2.0 Safety Precautions

2.1 Waste materials submitted for analyses may contain hazardous components. Uncharacterized waste samples should be handled in a manner that minimizes exposure and personal contact.

2.2 Chemicals used should be regarded as a potential health risk. Sample preparation and analysis is performed in a manner designed to minimize exposure using routine good laboratory practices.

2.3 Acetonitrile may be fatal if swallowed, inhaled or absorbed through the skin. Affects the cardiovascular system, central nervous system, liver and kidneys. Flammable liquid and vapor. May cause irritation to skin, eyes and respiratory tract.

## 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with RTI Laboratories, Inc. Standard Operating Procedure for Sample Receipt and Custody (SRC001-A). Appropriate U. S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed.

3.1.1 Aqueous samples are collected in clean 1L amber bottles and maintained on ice at 4 degrees C following collection. Holding time is 7 days from the time of collection.

3.1.2 Soil, sludge and solid samples are collected in pre cleaned wide mouth glass jars and stored at 4 degree C. Holding time is 14 days from the time of collection.

3.1.3 Sample volume minimum requirements: 800 mL, aqueous – 40 g, solids.

3.1.4 All samples and sample extracts are stored at 4 degrees C in the dark.

3.1.5 Extracts have a holding time of 40 days from preparation.

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 The method detection limit (MDL) is statistically defined at the 99% confidence level according to 40 CFR Part 136 App. B. Seven replicates containing all of the analytes of interest at a concentration level of 1-5 times the estimated D.L. are analyzed and the standard deviation is calculated. The Student's T Value for the 7 replicates (3.143) is multiplied by the standard deviation of the analyte to calculate the MDL. MDLs are updated on major instrument changes and are kept on file in the Laboratory. MDLs and reporting limits are incorporated into the applicable test code in the Omega LIMS.

4.2 The LOD (limit of detection) is determined by spiking reagent water at 1-4 times the MDL and prepared using the same procedure as samples. Analytes must be present at levels 3 times or greater than the blank response (greater than 3 times the signal to noise ratio). The concentration used is the LOD for that analyte. LOD determinations must be performed quarterly.

4.3 The LOQ (limit of quantification) is determined by spiking reagent water at the reporting limit (RL/CRQL) and prepared in the same manner as samples. Analyte recovery must be within 20% of the expected concentration. The concentration used and successfully recovered is the LOQ for that analyte. LOQ determinations must be performed quarterly.

4.4 Initially accuracy and precision at the LOQ is determined by spiking 4 aliquots of reagent water at the reporting limit (RL/CRQL) and prepared using the same procedure used for samples. The average recovery must be within 20% of the expected value and the %RSD must be less than 15%.

4.5 LOD/LOQ determinations that do not meet the specifications above require repeat analysis, adjustment to the spiking levels and/or reporting limits, repeating the MDL determination at adjusted concentrations if required and repeat LOD/LOQ determinations.

4.6 The accuracy and precision for this method are determined by analyzing four laboratory control samples (LCS). The average percent recovery, standard deviation, and the relative standard deviation are calculated for each analyte. Quality control limits, mean recovery values and RPD results are incorporated in the Omega LIMS.

## 5.0 Interferences

5.1 Tetryl decomposes rapidly in water/methanol solutions and with heat.

5.2 Interferences can arise from carry over due to high sample concentrations or contamination from reagents and/or glassware. Blanks are analyzed to ensure system cleanliness in both instances. All glassware must be scrupulously cleaned before use. Glassware-cleaning procedures are specified in the QAP. Glassware should be heated in a muffle furnace at 400 degrees C for 15 to 30 minutes, or solvent rinsed prior to use. High purity solvents are used for preparation and analysis.

## 6.0 Apparatus and Materials

6.1 HPLC system (LC-5): Agilent 1100 Series Degasser G1322A, Agilent 1100 Series ALS G1311A, Agilent 1100 Series Column Compartment G1316A, Agilent 1100 Series DAD G1315A, PC with Chemstation for LC 3D Rev.B.01.03, Windows XP Professional and Omega LIMS.

6.2 HPLC system (LC-7): Waters Acquity uPLC with a TUV Detector, Sample Manager Auto Sampler and Binary Solvent Manager pump, PC with Empower Rev. 5.00, Windows 2000, Chromeleon 6.80 Build 2212

6.3 Backup Instrument: HPLC system (LC-6): Agilent 1100 Series BinPump G1312A, Agilent 1100 Series ALS G1313A, Agilent 1100 Series Column Compartment G1316A, Agilent 1100 Series DAD G1315A, PC with Chemstation for LC 3D Rev.B.01.03, Windows XP Professional and Omega LIMS.

6.4 Volumetric Flasks, 5mL; 10mL; 25mL; and 1 Liter – Class A.

6.5 Column 1: Waters Acquity uPLC BEH C18 1.7u, 2.1 x 100mm (part #186002352) with guard cartridge. This is a primary column.

6.6 Column 2: Dionex Acclaim E2 Explosives Column (part # 064309) with guard cartridge. This is a secondary column to Column 1 (Sec. 6.5) or a primary to column 3.

6.7 Backup Column: Column 3 - Dionex Acclaim E1 Explosive Column (Part # 064305) with guard cartridge. This is a secondary column to Column 2 (Sec. 6.6).

6.8 Micro syringes – 10uL, 50uL, 100uL, 500uL, 1000uL

6.9 Balance capable of weight +/-0.0001g

6.10 Vortex mixer

6.11 8 ml amber vials with Teflon lined caps

6.12 PTFE magnetic stir bars

6.13 Disposable 0.45µm PTFE cartridge filters

6.14 Pasteur pipettes

6.15 2mL amber auto sampler vials

6.16 11mm Teflon/Silicon aluminum crimp seal caps

6.17 40 ml vials with PTFE-lined cap

6.18 10 and 200 mesh sieves

6.19 Graduated cylinders – 10 ml, 25 ml and 1L

6.20 Ultrasonic water bath.

6.21 2oz. wide-mouthed jars.

6.22 5 - 10 ml disposable syringes.

6.23 Centrifuge.

6.24 Puck and ring grinder. - Essa

6.25 Top-loading balance.

6.26 Platform shaker

## 7.0 Reagents and Standards

7.1 Acetonitrile, HPLC-grade

7.2 Methanol, HPLC-grade

7.3 Organic-free reagent water

7.4 Formic acid 88%, ACS Reagent grade

7.5 Ottawa sand.

7.6 LCS – Solid reference material obtained from Absolute Standards - 100 g.

7.7 1% Formic Acid Solution – Prepare by adding 10 ml of Formic Acid, 88% to a 100 ml volumetric containing approximately 80 ml of deionized water. The solution is brought to a final volume of 100 ml with deionized water.

7.8 All standards, surrogates and spikes are stored in the dark at 4 degrees C.

7.9 Primary Standards:

7.9.1 Method 8330 Explosives Mix, 1000 µg/ml (AccuStandard: M-8330-R)
7.9.2 PETN, 1000 µg/ml (Absolute: 79250)
7.9.3 Nitroglycerine, 1000 µg/l (AccuStandard: M-8330-ADD-1-10X)
7.9.4 3,5-Dinitroaniline, 1000 µg/ml (Absolute – 71772).

7.10 Secondary Standards:

7.10.1 Method 8330 Explosives Mix, 1000 µg/ml (Ultra Scientific: NAIM-833E)
7.10.2 PETN, 100 µg/ml (AccuStandard: M-8330-ADD-2)
7.10.3 Nitroglycerin, 1000 µg/ml (Restek: 31498)
7.10.4 3,5-Dinitroaniline, 1000 µg/ml (Restek – 31661)

7.11 Surrogate Standard:
7.11.1 4-Nitroaniline, 1000 µg/ml (Absolute Standards: 70227)

7.12 All reagents and standards prepared must be logged in the appropriate standards/reagents log labeled with a minimum:

7.12.1 Identity of the material
7.12.2 Concentration of the solution
7.12.3 Date prepared
7.12.4 Initials of analyst preparing the solution
7.12.5 Expiration date.

## 8.0 Preparation of Standards and Spikes

8.1 Instrument Blank Intermediate Preparation - 4-Nitroaniline (0.2 µg/ml) - Dilute 2 µl 4-nitroaniline (7.11.1) to 10ml with acetonitrile. Store at 4 degrees C in the dark.

8.2 Working Instrument Blank Preparation - Dilute 0.5 ml of Instrument Blank Intermediate with 0.5 ml 1% Formic Acid Solution (Sec. 7.7).

8.3 Initial Calibration Stock Intermediate Standard – Store at 4 degrees C in the dark.

| Standard | Volume added | Final volume | Concentration |
|---|---|---|---|
| Nitroglycerin 1000 mg/l (Section 7.9.3) (AccuStandard: M-8330-ADD-1-10X) | 40µl | 10mL with acetonitrile | 4.0 µg/ml |
| PETN 1000 µg/ml(Section 7.9.2) (Absolute: 79250) | 100µl | | 10 µg/ml |
| 8330 Mix 1000 µg/ml (Section 7.9.1) (AccuStandard: M-8330-R) | 20µl | | 2.0 µg/ml |
| 4-Nitroaniline 1000 ug/ml (Section 7.11.1) (Absolute Standards: 70227) | 20µl | | 2.0 µg/ml |
| 3,5-Dinitroaniline 1000 µg/ml (Section 7.9.4) | 20µl | | 2.0 µg/ml |

8.4 Initial Calibration Standards– Store at 4 degrees C in the dark.

| Standard Conc. | Initial Cal Stock (Section 8.3) (µl) | Acetonitrile (µl | 1% Formic Acid Solution (Section 7.7) (µl) |
|---|---|---|---|
| 0.020µg/ml | 10 | 490 | 500 |
| 0.050µg/ml | 25 | 475 | 500 |
| 0.100µg/ml | 50 | 450 | 500 |
| 0.500µg/ml | 250 | 250 | 500 |
| 1.0µg/ml | 500 | 0 | 500 |

8.5 Initial Calibration Verification/Continuing Calibration Verification Intermediate Standard – Store at 4 degrees C in the dark.

| Standard | Volume added (µl) | Final Volume (ml) | Concentration (µg/ml) |
|---|---|---|---|
| Nitroglycerin 1000 µg/ml (Section 7.10.3) (Restek: 31498) | 20 | 10 ml with acetonitrile | 2.0 |
| PETN 100 µg/ml (Section 7.10.2) (AccuStandard: M-8330-ADD-2) | 200 | | 2.0 |
| 8330 Mix 1000 µg/ml (Section 7.10.1) (Ultra Scientific: NAIM-833E) | 10 | | 1.0 |
| 4-Nitroaniline 1000 µg/ml (Section 7.11.1) (Absolute Standards: 70227) | 10 | | 1.0 |
| 3,5-Dinitroaniline, 1000 µg/ml (Section 7.10.4) | 10 | | 1.0 |

8.6 Initial Calibration Verification/Continuing Calibration Verification Working Standard-ICV/CCV standards are prepared fresh before use.

| Standard Conc. | ICV/CCV Intermediate (Section 8.5) (µl) | Acetonitrile (µl) | 1% Formic Acid Solution (Section 7.7) (µl) |
|---|---|---|---|
| 0.5 µg/ml | 500 | 0 | 500 |

8.7 Matrix Spike Solution for Aqueous Samples – Store at 4 degrees C in the dark.

| Standard | Volume added (µl) | Final Volume (ml) | Concentration (µg/ml) |
|---|---|---|---|
| Nitroglycerin 1000 µg/ml (Section 7.10.3) (Restek: 31498) | 100 | 50 ml with acetonitrile | 2.0 |
| PETN 1000 µg/ml (Section 7.9.2) (Absolute: 79250) | 100 | | 2.0 |
| 8330 Mix 1000 µg/ml (Section 7.10.1) (Ultra Scientific: NAIM-833E) | 100 | | 2.0 |
| 3,5-Dinitroaniline, 1000 µg/ml (Section 7.10.4) | 100 | | 2.0 |

8.8 Matrix Spike Solution for Solid Samples – Store at 4 degrees C in the dark.

| Standard | Volume added (µl) | Final Volume (ml) | Concentration (µg/ml) |
|---|---|---|---|
| Nitroglycerin 1000 µg/ml (Section 7.10.3) (Restek: 31498) | 200 | 25 ml with acetonitrile | 8.0 |
| PETN 1000 µg/ml(Section 7.9.2) (Absolute: 79250) | 100 | | 4.0 |
| 8330 Mix 1000 µg/ml (Section 7.10.1) (Ultra Scientific: NAIM-833E) | 200 | | 8.0 |
| 3,5-Dinitroaniline, 1000 µg/ml (Section 7.10.4) | 200 | | 8.0 |

8.9 Surrogate Spiking Solution for Aqueous Samples (2.0µg/ml) - Dilute 200µLl4-nitroaniline (7.11.1) to 100mL with acetonitrile. Store at 4 degrees C in the dark.

8.10 Surrogate Spiking Solution for Solid Samples (8.0µg/ml) - Dilute 800µl 4-nitroaniline (7.11.1) to 100mL with acetonitrile. Store at 4 degrees C in the dark.

8.11 LOD/LOD Spike Solution for Aqueous Samples

8.11.1 LOD - Add 0.5 ml of the spike solution to 1 liter of DI water in an amber bottle.

8.11.2 LOQ - Add 1.0 ml of the spike solution to 1 liter of DI water in an amber bottle.

| Standard | Volume added (µl) | Final Volume (ml) |
|---|---|---|
| Nitroglycerin 1000 ug/ml (Section 7.10.3) (Restek: 31498) | 4 | 10 ml with acetonitrile |
| PETN 0.1 mg/ml (Section 7.10.2) (AccuStandard: M-8330-ADD-2) | 100 | |
| 8330 Mix 1.0 mg/ml (Section 7.10.1) (Ultra Scientific: NAIM-833E) | 2 | |
| 3,5-Dinitroaniline, 1000 µg/ml (Section 7.10.4) | 2 | |

8.12 LOD/LOQ Spike Solution for Soil Samples

8.12.1 LOD - Add 0.5 ml of the spike solution to 10 g Ottawa sand.

8.12.2 LOQ - Add 1.0 ml of the spike solution to 10 g Ottawa sand.

| Standard | Volume added (µl) | Final Volume (ml) |
|---|---|---|
| Nitroglycerin 1000 ug/ml (Section 7.10.3) (Restek: 31498) | 16 | 10 ml with acetonitrile |
| PETN 0.1 mg/ml (Section 7.10.2) (AccuStandard: M-8330-ADD-2) | 400 | |
| 8330 Mix 1.0 mg/ml (Section 7.10.1) (Ultra Scientific: NAIM-833E) | 8 | |
| 3,5-Dinitroaniline, 1000 µg/ml (Section 7.10.4) | 8 | |

8.13 The correlation coefficient of the calibration curve (at least 5 points) must be >0.995 for each compound to continue with the analysis of samples. If this criterion is not met the calibration standards must be re-analyzed or new standards prepared and analyzed until an acceptable cc is obtained.

8.14 Initial calibration verification standard must be run immediately after calibration. The standard is prepared from a different source than the calibration standards at a concentration corresponding to the mid-point of the curve. The ICV standard must be within ±20% of the expected concentration.

8.15 Continuing calibration verification standards are analyzed at the mid-point of the calibration at the beginning of each analytical sequence, after every 10 samples and at the end of the analytical sequence. The measured concentration of each compound in the standard must be within ±20% of the expected value.

## 9.0 Sample Preparation

9.1 Preparation of solid samples – Prior to processing samples the grinding procedure must be evaluated to ensure that particle size is being reduced to <75um by passing representative portions of a ground sample through a 200 mesh sieve.

9.1.1 Place entire solid sample on a tray, spread and air dry at room temperature (<25 degrees C). Do not expose the samples to direct sunlight.

9.1.1.1 Allow samples to dry 1-3 days depending on matrix – sand samples will dry in 1 day while clay samples will take up to 3 days to dry.

9.1.1.2 Record date time and ambient temperature daily while samples are drying.

9.1.1.3 When sample appears dry place tray on scale and record weight.

9.1.1.4 Re-weigh samples after 1 hour. If weight change is less than 4% samples are considered at constant weight.

9.1.1.5 If weight change exceeds 4% allow sample to dry overnight and re-weigh.

9.1.1.6 Repeat steps 9.1.1.4 and 9.1.1.5 until constant weight is obtained (<4% change).

9.1.1.7 Dried samples can be stored at room temperature (<25 degrees C)

9.1.2 The entire dried sample less large pebbles, rocks and sticks must be sieved through a 10-mesh sieve. Agglomerates (especially clay) must be broken up with a gloved hand or forced through the sieve by pressing the material on the sieve with a gloved hand. Vegetation is physically shredded while sieving.

9.1.3 Pulverize the entire sieved sample in quantities of 200 – 500g for 60 seconds in the ring puck mill (Sec. 6.24). NOTE: For NC based propellant based residues five 60-second grinding intervals are required with two minute cool down periods between grind cycles.

9.1.4 For samples requiring 8330B - Spread the entire sample out onto a clean pan so that it is 1-2cm thick. Randomly chose 30 increments from the entire depth to obtain a 10 g sub sample. Place the 10g sample into a pre-cleaned 40 ml VOA vial.

9.1.5 For Samples requiring 8330A – Place a 2 g sub sample in a pre-cleaned 40 ml VOA vial.

9.1.6 Grinding blank prep – Prior to sample grinding, after every 10 samples and at the end of the batch process a grinding blank using Ottawa Sand according to the procedure in Sec. 9.1.3. Each Grinding Blank must be collected separately and cataloged. A composite is made from the batch grinding blanks by adding equal parts of each blank to make a 10 g sample.

9.1.7 Grinding LCS – Process a grinding LCS using the nitroaromatic reference material (Sec. 7.6) with each batch of samples according to the procedure in Sec. 9.1.3 - 9.1.5.

9.1.8 MS/MSD prep – Prepare a MS/MSD (if sufficient sample is available for water samples) with each batch of samples. Soil MS/MSD samples are prepared on post ground material.

9.1.9 DUP and DUP-DUP sample prep – Process one sample in triplicate according to the procedure in Sec 9.1.1 – 9.1.5.

9.1.10 Extraction LCS/LCSD – DO NOT GRIND. Prepare a LCS/LCSD by adding 10 g (8330B) or 2 g (8330A) of Ottawa Sand (Sec. 7.5) into a pre-cleaned 40 ml VOA vial. An LCSD is only required if there is insufficient sample available for a MS/MSD.

9.1.11 Extraction Method Blank – DO NOT GRIND. Prepare an Extraction Method Blank by adding 10 g (8330B) or 2 g (8330A) of Ottawa Sand (Sec. 7.5) into a pre-cleaned 40 ml VOA vial.

9.1.12 LOD/LOQ prep – DO NOT GRIND. Prepare a LOD and LOQ by adding 10g of Ottawa Sand (Sec. 7.5) into a pre-cleaned 40 ml VOA vial.

9.1.13 Add surrogate (Sec. 8.10), spike (Sec 8.8) and acetonitrile according to Table 1 below.

9.1.14 For Samples that require 8330B, place sample on a on a platform shaker for 18 hours. For samples that require 8330A, place samples in a cooled ultrasonic bath for 18 hours.

9.1.15 After the sample has extracted, settle for 30 minutes.

9.1.16 Transfer 6 ml of the supernatant liquid to a disposable syringe equipped with a 0.45 µm syringe filter. Pass the extract through the filter, discarding the first milliliter.

9.1.17 Prior to analysis all sample and QC extracts are diluted 1:1 by adding 0.5 ml of 1% Formic Acid Solution (Sec. 7.7) to 0.5 ml extract in a 2 ml amber auto sampler vial.

**Table 1**
**Surrogate and Spike Procedure**

| Sample Type | Surrogate (ml) | Spike (ml) | LOD/LOQ Spike (ml) | 8330B ACN (ml) |
|---|---|---|---|---|
| Sample | 1 | 0 | 0 | 19 |
| MS/MSD | 1 | 1 | 0 | 18 |
| DUP/DUPDUP | 1 | 0 | 0 | 19 |
| Grinding Blank | 1 | 0 | 0 | 19 |
| Grinding LCS | 1 | 0 | 0 | 19 |
| Extraction Blank | 1 | 0 | 0 | 19 |
| Extraction LCS/LCSD | 1 | 1 | 0 | 18 |
| LOD | 1 | 0 | 0.5 | 18.5 |
| LOQ | 1 | 0 | 1 | 18 |

9.2 Preparation of aqueous samples: Refer to SOP 3535A_ . . .

## 10.0 Diagram/Table

10.1 Reserved.

## 11.0 Analytical Procedure

11.1 Method, run, and integration parameters are stored in the respective instrumentation according to manufacturers' procedures.

11.2 A new sample list is created for each batch of samples.

11.3 A typical analytical sequence should proceed as below.

11.3.1 ICB
11.3.2 Initial calibration *
11.3.3 CCV (±20%)or ICV (±20%)
11.3.4 CRQL
11.3.5 LCS
11.3.6 Method Blank
11.3.7 10 samples
11.3.8 CCV
11.3.9 10 samples
11.3.10 MS and MSD
11.3.11 Reagent Blank (CCB)
11.3.12 CCV

*NOTE: Initial calibration is required on method initiation and subsequently on failure of the CCV acceptance criteria.

11.4 Set instrument parameters according to the Tables below.

**TABLE 1**
**Liquid Chromatograph Parameters Primary Column Instrument**

| **Typical LC-7Parameters:** | **Settings:** |
|---|---|
| Flow Rate (Injection Loop) | 0.5 ml/min (5 µl) |
| UV wavelength | 254 nm and 210 nm, BW 4, peak width >0.05 min (0.5s) |
| Gradient: A: 5%/95% v/v Methanol/Water; B: 100% Methanol @ 55.4°C. Prepared each use. | Primary Column: Waters BEH-C18 (section6.5) |

**TABLE 2**
**Liquid Chromatograph Parameters Confirmation Column Instrument**

| **Typical LC-5 Parameters:** | **Settings:** |
|---|---|
| Flow Rate(Injection Loop) | 1.0 ml/min (100 µl) |
| UV wavelength | 254 nm and 210 nm, BW 4, peak width >0.05 min (1s), Slit width 4nm |
| Isocratic 45%/55% v/v Methanol/Water @ 25-35°C. Prepared each use. | Secondary Column: Acclaim Explosives E2 (section6.6) |

**TABLE 3**
**Liquid Chromatograph Parameters Backup Instrument**

| **Typical LC-6 Parameters:** | **Settings:** |
|---|---|
| Flow Rate(Injection Loop) | 1.0 ml/min(100 µl) |
| UV wavelength | 254 nm and 210 nm, BW 4, peak width >0.05 min (1s), Slit width 4nm |
| Isocratic 37%/63% v/v Methanol/Water @ 10-40°C. Prepared each use. | Secondary Column: Acclaim Explosives E1 (section6.7) |

11.5 Compound identification and quantification

11.5.1 Compound identification must be confirmed by the results for the second column. The compound must be within the RT window on both columns for positive identification. Batch QC must also be analyzed on the secondary column as below.

11.5.1.1 Batch Method Blank (Grinding and/or Extracted) must be analyzed.
11.5.1.2 Batch LCS.
11.5.1.3 Include the parent, MS and MSD if the parent sample requires confirmation analysis.
11.5.1.4 Omit the parent, MS and MSD if the parent sample is non-detect for all compounds on the primary column.

11.5.2 Positive sample results are reported from both columns. The results are qualified (P-flagged) if the RPD result from values obtained on each column exceeds 40% in the absence of overlapping peaks causing an erroneously high result on one column. The disparity is noted in the comments field in the LIMS analytical sequence table for inclusion on the report case narrative.

11.5.3 Compound identification is based on the retention time (RT) of the eluting peak in comparison to calibration standard.

11.5.4 Initial identification is a compound that elutes within 0.05 min. of the RT of the standard compound. The 0.05 criteria is programmed into the data system method.

11.5.5 All compound identification must be confirmed by the results for the second column. The compound must be within the RT window on both compounds for positive identification.

11.5.6 Co-eluting compounds must be resolved on one of the columns.

11.5.7 Analyst experience in evaluating chromatographic data and identifying compounds in the presence of interfering components is important in final compound identification.

11.5.8 Identified compounds are quantified from the linear regression curve generated by the data system during initial calibration.

11.5.9 Compounds exhibiting concentrations above the upper calibration level are diluted into the calibration range. If insufficient sample is available for dilution (i.e. both water sample vials already used) the concentration is flagged as estimated ("E").

11.5.10 Compound concentrations that are below the laboratory reporting limit or lowest calibration point but positively identified above the MDL are flagged as estimated ("J").

11.6 Manual integration guidelines and procedures

11.6.1.1 Situations may arise whereby the quantification provided by the data system is inappropriate. This can occur due to co-elution, baseline noise or matrix interference.

11.6.2 When manual integration of a compound is necessary the following guidelines must be followed.

11.6.2.1 Manual quantification is performed by integrating the area of the peak for the compound.

11.6.2.2 The integration will only include the area attributable to the compound of interest.

11.6.2.3 The area integrated shall not include baseline background noise.

11.6.2.4 The area integrated shall not extend beyond the point where the sides of the peak intersect with the baseline.

11.6.2.5 Manual integration must not be used solely to meet quality control criteria.

11.6.2.6 Manual integration must not be used as a substitute for corrective action on the HPLC system.

11.6.3 Instances of manual integration are flagged with an “M” by the data system. Manual integrations require reason and initials of the analyst performing the manual integration and are documented in the corresponding Excel file and incorporated in the LIMS analytical sequence.

## 12.0 Details of Calibration and Calculations

12.1 Final results are calculated as specified in section 14.

12.2 The CCV must be analyzed at the frequency specified in Section 13 and the concentration must be within 20% of the known value for confirmation of instrument calibration.

12.3 Linear Regression: y = ax + b

Where: y = Instrument response (peak area)
a = Slope of the line
x = Concentration of the calibration standard
b = The intercept

12.4 % RSD

$$\overline{Rf} = \frac{\sum_{i=1}^{n} Rf_i}{n}$$

$$s = \sqrt{\frac{\sum_{i=1}^{n} (Rf_i - \overline{Rf})^2}{n-1}}$$

$$\%RSD = \frac{s}{\overline{Rf}} 100$$

12.5 Percent Drift

$$\% \text{ Drift} = \frac{C_e - C_f}{C_e} \times 100$$

Where: Ce = Expected concentration
Cf = Concentration found

12.6 Relative Percent Difference (RPD)

RPD = (| R1 – R2 | / ((R1 + R2)/2)) * 100

Where: R1 = First result, R2 = Second result

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 Aqueous Samples - Prepare a method blank for each batch of samples using DI water.

13.1.1 Acceptance Criteria: < ½ **LOQ (RL)**

13.1.2 Corrective Action: Determine the source and eliminate (see interferences) - re-analyze samples as necessary.

13.2 Aqueous Samples - Prepare a laboratory control sample (LCS) and LCS duplicate (LCSD – when insufficient volume is supplied for MS/MSD analyses) for each batch of twenty or less samples by adding the specified amount of the Matrix Spiking Solution to 1L of DI water in a 1L amber bottle for each.

13.2.1 Acceptance Criteria: **QSM 5.0 percent recovery limits. LCSD PRD <20%**

13.2.2 Corrective Action: For results outside of acceptance limits determine source of the problem. Re-analyze LCS and samples if sufficient volume is supplied. Flag and narrate data if re-analysis is not possible.

13.3 Aqueous Samples - Prepare a matrix spike (MS) and matrix spike duplicate (MSD) for each batch of twenty or less samples by adding the specified amount of the Matrix Spiking Solution to the QC sample bottle when sufficient sample volume is supplied.

13.3.1 Acceptance Criteria: **Percent recovery acceptance ranges are set to LCS limits. MSD RPD <20%**

13.3.2 Corrective Action: For results outside of lab established control limits attempt to determine source of the problem (matrix interferences/poor injection/instrument problems). Re-analyze and/or flag data.

13.4 Aqueous Samples - Duplicate Sample (DUP) – Prepared if sufficient volume is supplied with each batch of samples. Not required if MSD is prepared.

13.4.1 Acceptance Criteria (RPD) **<20 %** or within laboratory established statistical control limits.

13.4.2 Corrective Action: Evaluate sample homogeneity and flag data if necessary.

13.5 Soil Samples – A grinding blank is processed through the grinding and sub-sampling steps using clean Ottawa sand (Sec. 7.5). Batch grinding blanks are prepared prior to analysis, after every 10 samples and at the end of the batch. The grinding blanks in each batch may be composited.

13.5.1 Acceptance Criteria: < ½ **LOQ (RL)**

13.5.2 Corrective Action: If the acceptance criteria is exceeded all samples in the batch are flagged with a B qualifier..

13.6 Soil Samples, Extraction blank – A method extraction blank is processed through the sample extraction procedure using clean Ottawa sand (Sec. 7.5).

13.6.1 Acceptance Criteria: < ½ **LOQ (RL)**

13.6.2 Corrective Action: If the acceptance criteria is exceeded all samples in the batch are flagged with a B qualifier..

13.7 Soil Samples -A grinding LCS from the standard reference material (Sec. 7.6) is processed through the entire grinding and sub-sampling procedure for each batch of samples.

13.7.1 Acceptance Criteria: **Within Specified Control Limits**

13.7.2 Corrective Action: Investigate and correct problem and flag data. Repeat instrument analysis if appropriate.

13.8 Soil Samples –An extraction LCS is prepared by spiking clean Ottawa sand and process through the extraction procedure for each batch of samples.

13.8.1 Acceptance Criteria: **QSM 5.0 percent recovery limits.**

13.8.2 Corrective Action: Investigate and correct problem and flag data. Repeat instrument analysis if appropriate.

13.9 Soil Samples - A MS and MSD is prepared by spiking a sample post grinding for each batch of samples.

13.9.1 Acceptance Criteria: **Percent recovery acceptance ranges are set to LCS limits. MSD RPD <20%**

13.9.2 Corrective Action: Evaluate, investigate and flag data. Repeat instrument analysis if appropriate.

13.10 Soil Samples – Sample Triplicate: From a sample expected to contain the highest concentrations of analytes three 10g aliquots are taken from the ground sample and analyzed individually.

13.10.1 Acceptance Criteria: **%RSD <20% for results >RL.**

13.10.2 Corrective Action: Investigate the grinding process to ensure sufficient sample particle size reduction is occurring. Flag and Narrate data.

13.11 Retention Time Windows

13.11.1 Retention time windows will be established and maintained for all components.

13.11.2 RT windows are determined by analyzing three control samples over a 72-hour time frame.

13.11.3 The average and standard deviation of the three determinations are calculated and the window is defined as the Mean (average) +/- 3 times the standard deviation.

13.11.4 The retention time windows are re-calculated whenever a new column is installed.

13.11.5 The GC data system does not allow for compound specific RT windows. The widest window (0.05 min.) is programmed into the applicable method and applied to all compounds.

13.12 Surrogate Control Limits

13.12.1 Acceptance Criteria: **70 – 130%**

13.12.2 For samples and QC samples in which the surrogate recovery falls outside the established control limits, the following is required.

13.12.3 Check calculations for errors.

13.12.4 Check instrument performance

13.12.5 Re-analyze extract- if acceptable no other actions are required.

13.12.6 Re-extract and re-analyze the samples or flag the data as estimated concentration if sample cannot be re-analyzed or if matrix interferences are obvious and cannot be cleaned up using the methods defined in the appropriate cleanup SOP’s.

13.13 Recovery limits for compounds not included in the QSM tables for LCS, LCSD, MS and MSD samples will be set at 70-130%.

## 14.0 Data Reporting Requirements

14.1 Sample results are reported as µg/L (aqueous samples) and µg/kg (solid samples).

14.2 Sample results are reported as µg/L for water and µg/kg for soil as dry weight.

µg/kg dry wt. = µg/kg wet wt.*100/percent solids

14.3 Raw instruments results are entered directly into the Omega LIMS system using excel spreadsheets, direct instrument interface or manually. All calculations to derive final result (including dry weight conversions) are performed automatically by the LIMS. Sample preparation information and percent moisture results are entered into the appropriate section of the LIMS prior to instrument data and are automatically factored into the final results.

14.4 Confirm that there are no QC flags or qualifiers in this sequence. If present, investigate and repeat or reanalyze as necessary. See section 9.2 of the QAP for more detail on qualifiers.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 At the beginning of each instrument start up monitor the system for large fluctuations in pressure. Pressure should be 900 – 1600 psi. The system is checked for leaks if low pressures are observed. High pressure situations require back flushing the system with methanol for 1 hour.

15.2 All maintenance is recorded in the Omega LIMS for the applicable instrument.

## 16.0 Waste Management and Pollution Prevention

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner that minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Acidic materials (pH<2) are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Disposal of materials is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 EPA Test Methods for Evaluating Solid Waste. Laboratory Manual Physical/Chemical Methods, Method 8330B, Revision 2 October 2006.

17.2 RTI Laboratories, Inc. Quality Assurance Plan.

17.3 RTI Laboratories, Inc. SOP SRC001-A, Sample Receipt and Custody.

17.4 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.5 RTI Laboratories, Inc. Employee Handbook.

## 18.0 Revisions

18.1 Section 6.0 – Deleted unused equipment.

18.2 Section 7.0 – Deleted NaCl. Added 3.5-Dinitroaniline to sections 7.9 and 7.10.

18.3 Revised standards in Sections 8.0 and added 3,5-Dinitroaniline.

18.4 Section 9.0 – Revised grinding blank frequency in Section 9.1.6 to QSM 5.0 guidelines. Clarified MS/MSD procedure. Modified Table 1. Added Section 9.2.

## 19.0 Target Analyte List With Example Retention Times

| Analyte | Retention Time (min.) on Column E1 | Retention Time (min.) on Column E2 | Retention Time (min.) on Column BEH-C18 | Quantification Range (µg/L) |
|---|---|---|---|---|
| HMX | 5.75 | 8.060 | 1.633 | 20 – 1000 |
| 4-Nitroaniline | 8.78 | 10.396 | 2.292 | 20 – 1000 |
| RDX | 9.60 | 13.089 | 2.625 | 20 – 1000 |
| 1,3,5-Trinitrobenzene | 13.13 | 13.519 | 3.983 | 20 – 1000 |
| 1,3-Dinotrobenzene | 17.37 | 17.290 | 5.033 | 20 – 1000 |
| Nitrobenzene | 19.39 | 18.940 | 5.883 | 20 – 1000 |
| Nitroglycerine | 20.21 | 25.451 | 6.733 | 40 – 2000 |
| Tetryl | 21.79 | 25.811 | 6.917 | 20 – 1000 |
| 2,4,6-Trinitrobenzene | 24.05 | 24.012 | 7.067 | 20 – 1000 |
| 4-Amino-2,6-dinitrotoluene | 28.38 | 42.670 | 7.367 | 20 – 1000 |
| 2-Amino-4,6-dinitrotoluene | 29.56 | 44.868 | 7.225 | 20 – 1000 |
| 2,6-Dinitrotoluene | 30.69 | 28.942 | 7.625 | 20 – 1000 |
| 2,4-Dinitrotoluene | 31.76 | 30.068 | 7.525 | 20 – 1000 |
| 2-Nitrotoluene | 37.57 | 33.429 | 8.208 | 20 – 1000 |
| 3-Nitrotoluene | 45.51 | 39.327 | 8.575 | 20 – 1000 |
| 4-Nitrotoluene | 42.08 | 36.579 | 8.358 | 20 – 1000 |
| PETN | 43.97 | 55.838 | 9.292 | 100 – 5000 |

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# STANDARD OPERATING PROCEDURE

# ANALYSIS OF HEXANE EXTRACTABLE MATERIAL

| | |
|---|---|
| **Analyte:** | **HEM** |
| **SOP#:** | **9071B_031014_R2** |
| **Method Reference:** | **EPA WW 1664** |
| **Issue Date:** | **March 9, 2007** |
| **Revision No.:** | **2** |
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Director, Quality Management: Charles O'Bryan

Director, Environmental Services: Yemane Yohannes

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**ANALYSIS OF HEXANE EXTRACTABLE MATERIAL**

**SOP#: 9071B_031014_R2**

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## 1.0 Scope and Application:

1.1 Introduction

RTI Laboratories, Inc. has prepared this document to detail the Standard Operating Procedure (SOP) for analysis of soil samples for n-hexane extractable material (HEM) by extraction and weighing.

A detailed description of the instrumentation, calibration, run parameters and quality control procedures is included in this SOP. For definition of terms not specifically defined in this document refer to RTI Laboratories, Inc. QAP Section 16.

1.2 Summary of Method

1.2.1 A 30 g aliquot of sample is mixed with sodium sulfate and Soxhlet extracted at 20 cycles/hour for 4 hours. The extract is dried over sodium sulfate. The solvent is evaporated from the extract and the HEM weighed.

1.2.2 For silica gel treated HEM (SGT-HEM) determination (modification to be used on approval, this procedure is not included in the reference method) the extract or the re-dissolved HEM is filtered through silica gel. The solvent is evaporated, and the SGT-HEM is weighed.

## 2.0 Safety Precautions

2.1 Chemicals and reagents using this procedure present health and safety concerns. Refer to the RTI Laboratories, Inc. CHP for handling procedures.

2.2 Hexane is a flammable solvent and should be used under a hood with adequate ventilation. Avoid contact with skin and eyes. Avoid breathing vapors. Wear hand and eye protection when handling any solvents.

## 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with the RTI Standard Operating Procedure for Sample Receipt and Custody (SRC001-A). Appropriate U. S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed.

3.1.1 Soil, sludge and solid samples are collected in wide mouth glass jars.

3.1.2 Sample volume minimum requirements: solids – 30 g.

3.1.3 Maximum sample holding time is 28 days (assigned by RTI Laboratories, Inc. – not established in the reference method).

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 The method detection limit (MDL) is statistically defined at the 99% confidence level according to 40 CFR Part 136 App. B. Seven replicates containing all of the analytes of interest at a concentration level of 1-5 times the estimated D.L. are analyzed and the standard deviation is calculated. The Student's T Value for the 7 replicates (3.143) is multiplied by the standard deviation of the analyte to calculate the MDL. MDLs are performed on instrument set up and following significant changes to the instrument, method or personnel. MDLs are kept on file in the Laboratory. MDLs and reporting limits are incorporated into the applicable test code in the Omega LIMS.

4.2 The LOD (limit of detection) is determined by spiking reagent water at 1-4 times the MDL and prepared using the same procedure as samples. Analytes must be present at levels 3 times or greater than the blank response (greater than 3 times the signal to noise ratio). The concentration used is the LOD for that analyte. LOD determinations must be performed quarterly.

4.3 The LOQ (limit of quantification) is determined by spiking reagent water at the reporting limit (RL/CRQL) and prepared in the same manner as samples. Analyte recovery must be within 20% of the expected concentration. The concentration used and successfully recovered is the LOQ for that analyte. LOQ determinations must be performed quarterly.

4.4 Initially accuracy and precision at the LOQ is determined by spiking 4 aliquots of reagent water at the reporting limit (RL/CRQL) and prepared using the same procedure used for samples. The average recovery must be within 20% of the expected value and the %RSD must be less than 15%.

4.5 LOD/LOQ determinations that do not meet the specifications above require repeat analysis, adjustment to the spiking levels and/or reporting limits, repeating the MDL determination at adjusted concentrations if required and repeat LOD/LOQ determinations.

4.6 Reporting Limit = 100mg/kg soil

4.7 Method working range is 100mg/kg to 100% for soil/solid.

4.8 Initial precision and recovery (IPR) – To establish the ability to generate acceptable precision and accuracy, the analyst shall perform the following operations:

4.8.2 Extract and evaporate four LSC Samples (Section 8.2). Calculate the average percent recovery and the relative percent difference. Results must be within 70 – 120% recovery and the RSD <15%.

## 5.0 Interferences

5.1 This method is non-specific and measures the presence of hydrocarbons in the extract. Any compound that is extractable in the solvent will be included in the data.

5.2 Glassware, reagents and the laboratory environment should be free from any source of contamination that could interfere with the analysis. Boiling flasks that will contain the extracted residue are dried in an oven at a105-115 degrees C and stored in a desiccator.

5.3 Non-oily extractable materials (sulfur compounds, chlorophyll, organic dyes, etc) will result in elevation of the results. As specified by the reference method all materials extracted and retained by this procedures are defined as HEM.

## 6.0 Apparatus and Materials

6.1 Bottles – detergent water wash, tap water rinse, cap with aluminum foil, and bake at 200-250 degrees C for 1-hour minimum prior to use. Solvent rinse may be used in place of baking.

6.2 Oven- Drying

6.3 Analytical Balance- located in weight room. (capable of weighing to 0.1mg)

6.4 Volumetric Glassware, 100 ml.

6.5 Syringes - Hamilton 100 - 500 ul

6.6 Assorted Beakers, Glassware, Soxhlet extractors and Thimbles.

6.7 Filter paper – Whatman number 40, 11cm., with HDPE funnel and glass wool

6.8 Steam/Water bath 85 degrees C.

6.9 Boiling flask – 500 ml.

6.10 Desiccator.

6.11 PC with Balancelink software, Microsoft Excel and Omega LIMS.

## 7.0 Reagents

7.1 Type II Deionized Water

7.2 n-Hexane – 85%

7.3 Sulfuric Acid, concentrated – Reagent grade.

7.3.1 Prepare an approximate 6N solution by mixing 1 part concentrated sulfuric acid with 3 parts DI water.

7.4 Sodium Sulfate, Anhydrous

7.5 Silica Gel - 60-200 mesh Davison grade 950 or equivalent. Dry at 200-250 degrees C for 24 hours and store in a desiccator or tightly sealed container. The silica gel must contain less than 5 mg of extractable material per 30gm.

7.6 Acetone ACS

7.7 Spiking solution (LCS) – Commercially obtained 10 ml solution Hexadecane/Stearic acid 40 mg. Store in a freezer. Expiration date – manufacturer specified.

7.8 All reagents and standards prepared must be labeled with a minimum and are stored at room temperature:

7.8.1 Identity of the material
7.8.2 Concentration of the solution
7.8.3 Date prepared
7.8.4 Initials of analyst preparing the solution
7.8.5 Expiration date.

## 8.0 Preparation of Standards and Calibration Procedure

8.1 Precision and recovery standard (PAR) – Add the 10 ml spiking solution (Sec. 7.7) to 1000 ml reagent water 1L Class A graduated cylinder. Quantitatively transfer the sample to the separatory funnel. This standard is used to determine initial precision and recovery and ongoing precision and recovery.

8.2 Laboratory Control Sample (LCS) - Stock Solution

8.2.1 Use the (LCS) spike mix (Sec. 7.7) for every batch, spike at the same level as above (8.1) into 1000ml reagent water.

8.3 Calibration Verification – Verify the calibration of the balance before and after each batch of 14 or fewer measurements according to Sec. 8.5 below.

8.4 Balances are calibrated annually by an outside vendor.

8.5 The balance is checked using 2 mg and 1000 mg class–S weights, certified against NIST standards annually by outside vendor. Calibration data is maintained on file.

8.5.1 The result of the 2 mg weight must be within +/- 10%.

8.5.2 The result of the 1000 mg weight must be within +/- 0.5%.

## 9.0 Sample Preparation

9.1 Allow samples to warm to ambient temperature prior to analyzing.

9.2 Remove sticks, stones, insects and any other foreign objects from the sample.

9.3 Samples, Blank, LCS, MS and DUP - Soxhlet Extraction:

9.3.1 Tare a clean weighing flask by placing in an oven at 105 – 115 $^{o}$C for 2 hr. Remove from oven with tong and place in the desiccator to cool. Remove from desiccator with tongs, add 3-5 boiling chips, weigh and record weight.

9.3.2 Weigh 30 g of a representative portion of the sample and place in a beaker.

9.3.3 Add sodium sulfate and blend until the mixture becomes a paste.

9.3.4 Place the paste in a thimble and assemble the Soxhlet apparatus.

9.3.5 Add 250 – 300 ml of hexane to the boiling flask, turn on condenser water and adjust heating mantle to extract the sample a 20 cycles/hr.

9.3.6 Extract for 4 hours.

9.3.7 Proceed to Section 9.3.10 unless a determination for SGT-HEM is required. For SGT-HEM continue as below (Sec. 9.3.8 and 9.3.9).

9.3.8 Filter the solution through silica gel into a pre-dried, weighed boiling flask containing several boiling chips. Rinse the silica gel and filter paper with several small amounts of hexane to complete the transfer.

9.3.9 Evaporate the solution and determine the weight of SGT-HEM (steps 9.3.13 and 9.3.15).

9.3.10 Evaporate the hexane from the boiling flask using a water bath at 85 °C.

9.3.11 When the flask appears almost dry, remove the flask from the water bath and sweep out the final liquid by using either a vacuum source or a stream of air or nitrogen. Wipe the outside surface dry to remove moisture and fingerprints.

9.3.12 Inspect the residue in the flask for crystals. Crystal formation is an indication that sodium sulfate may have dissolved into the hexane. If crystals are present, re-dissolve the extract in hexane, filter into another weighed boiling flask and repeat evaporation procedure.

9.3.13 Place flask in the oven and heat at 100 ° C for 15 minutes.

9.3.15 Cool the boiling flask in a desiccator for 2 hours. Remove with tongs and weigh immediately. Record weight to nearest 0.1 ml in the logbook.

## 10.0 Diagram/Table

| |
|---|
| Measure sample, add sodium sulfate and extract with Soxhlet apparatus. |
| Treat with silica gel if SGT-HEM is required or omit if HEM only is desired. |
| Evaporate hexane in a water bath and dry in a desiccator. |
| Weigh boiling flask to nearest 0.1mg and calculate results. |
| Report results in Omega. |

## 11.0 Analytical Procedure

11.1 Refer to section 9.

## 12.0 Details of Calibration and Calculations

.

12.1 Hexane Extractable Material (HEM) mg/kg = weight of extractable material (mg)/Sample weight (Kg).

12.2 Calculation for soil samples:

mg/kg HEM or SGT-HEM = (final weight of flask with residue(mg) – initial weight of flask(mg))/ WT

WT = Weight of Soil Extracted (Kg)

12.3 Percent recovery - matrix spikes and LCS

% Recovery = conc. recovered/conc. expected * 100

12.4 Relative Percent Difference

RPD = [result 1 - result 2]/average (result1, result2) * 100

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 A Method Blank is processed with each batch of samples.

13.1.1 Acceptance Criteria **<1/2 LOQ (RL)**

13.1.2 Corrective Action: Repeat analysis. Evaluate the systems for contamination sources and repeat the batch as necessary.

13.2 Laboratory Control Sample (LCS) – Prepared as in Sec. 8.2.

13.2.1 A LCS is processed with each batch of samples if available

13.2.2 Acceptance Criteria: 70 - 120% recovery

13.2.3 Corrective Action: Repeat LCS and sample batch as necessary. If insufficient sample for repeat analysis flag data in LIMS.

13.3 Duplicate Sample (DUP) – if no MSD is prepared

13.3.1 Acceptance Criteria (RPD) <20%

13.3.1 Frequency: 1 per batch of 20 or less samples.

13.3.2 Corrective Action: Evaluate sample homogeneity and flag data if necessary.

13.4 Matrix Spike/Matrix Spike Duplicate (MS/MSD.

13.4.1 Prepare by adding 10 ml of the spiking solution (7.7) to 30 gm of a soil sample. HEM = 1333 ppm SGT-HEM = 666ppm in soil.

13.4.2 Frequency: 1 MS/MSD per batch of 20 or less samples.

13.4.3 Acceptance Criteria: 70 - 120 % Recovery <20 % RPD

13.4.4 Corrective action: Evaluate for matrix interferences and flag data.

13.5 Balances are checked daily or on each use by weighing three standard weights. The weight obtained for each must be within the posted acceptance limits on the balance log.

## 14.0 Data Reporting Requirements

14.1 Sample results are reported as: mg/kg.

14.2 Final calculated results are entered directly into the Omega LIMS system using excel spreadsheets. All calculations to derive final result (including dry weight conversions) are performed automatically by the LIMS.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 Analytical balance calibration must be checked daily.

15.2 Balances are services annually by an approved vendor.

## 16.0 Waste Management and Pollution Prevention

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner that minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Acidic materials (pH<2) are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Soil samples are composited in a drum designated for incineration.

16.2.3 Disposal of materials is addressed in the laboratory QAP (Section 5).

## 17.0 References

17.1 Test Methods for Evaluating Solid Waste. SW-846, Method 9071B. Revision 2, April 1998.

17.2 EPA Methods for Chemical Analysis of Water and Wastewater, 600/4/70/200 (Rev.3/1983) Method 1664.

17.3 Standard Methods for the Examination of Water and Wastewater. 20th Ed. 1998. Method 5520-F.

17.4 RTI Laboratories, Inc. Quality Assurance Plan.

17.5 RTI Laboratories, Inc. SOP SRC001-A, Sample Receipt and Custody.

17.6 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.7 RTI Laboratories, Inc. Employee Handbook.

RTI Laboratories, Inc.
31628 Glendale
Livonia, Michigan 48150

# STANDARD OPERATING PROCEDURE

# ANALYSIS OF PERCENT MOISTURE (PMOIST)

| | |
|---|---|
| **Analyte:** | **PMOIST** |
| **SOP#:** | **D2216_060611_R1** |
| **Method Reference:** | **ASTM Method D2216** |
| **Issue Date:** | **June 6, 2011** |
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**ANALYSIS OF PMOIST**

**SOP#: D2216_060611_R1**

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## 1.0 Scope and Application:

1.1 Introduction

This Standard Operating Procedure applies to the analysis of the amount of moisture in soil and sediment samples

This document is for the analysis of several defined solids on soil, sediment, peat and other organic solids based on the temperature to which the sample is exposed but the basic procedures for all is the similar.

A detailed description of the instrumentation, calibration, run parameters and quality control procedures is included in this SOP. For definition of terms not specifically defined in this document refer to RTI QAP Section 16.

1.2 Summary of Method

1.2.1 A well-mixed sample aliquot is placed in a weighing dish and dried to a constant weight at 105-115 $^{o}$C.

## 2.0 Safety Precautions

2.1 Chemicals and reagents using this procedure may present health and safety concerns. Disposable gloves and eye protection should be used when handling potentially hazardous chemicals.

2.2 Disease causing agents may be present in environmental samples known to contain or to have been in contact with human waste.

2.3 All sample dish transfers to and from the oven should be performed using tongs or heat-resistant gloves.

## 3.0 Sample Requirements and Sample Handling Procedures

3.1 Samples are received in accordance with RTI's Standard Operating Procedure for Sample Receipt and Custody (SRC001-A). Appropriate U. S. Environmental Protection Agency (EPA) sample handling procedures and sample preservation recommendations are followed.

3.1.1 Solids samples are collected in 4oz wide mouth glass bottles with Teflon lined lids and stored at 4 degrees C.

3.1.2 Sample volume minimum requirements: - 10.0 g

3.1.3 Maximum sample holding time is 28 days.

## 4.0 MDL, Linear Range, Accuracy and Precision

4.1 The method detection limit (MDL) is defined using a minimum weight of 0.1mg per sample. For percent moisture this would be result in a theoretical MDL of 0.001 % for a 10-gram sample size. Cited laboratory PQL concentrations for this procedure are 1%. LOD determinations are not applicable for this method.

4.2 The working range depends on the sample size necessary to filter the sample due to the loading of solids.

4.3 The accuracy and precision for this method are determined by analyzing four aliquots from a Laboratory Control Sample. Percent recovery, standard deviation, and the relative standard deviation are calculated for each analyte and documents are kept on file in the laboratory.

## 5.0 Interferences

5.1 Method procedures and temperatures must be controlled to minimize affects on the samples.

5.2 Glassware and apparatus must be properly cleaned to avoid artifacts that could cause a positive interference.

## 6.0 Apparatus and Materials

6.1 Drying oven, capable of being controlled at 105-115 $^{o}$C.

6.2 Aluminum weighing pans

6.3 Desiccator.

6.4 Analytical balance, capable of weighing to 0.1 mg.

6.5 Gateway Laptop with Windows XP and Microsoft Office 2000 (with Excel).

6.6 Mettler Toledo Balance Link data capturing software.

## 7.0 Reagents

7.1 No reagents are used in this method

## 8.0 Preparation of Standards and Calibration Procedure

8.1 Balances are calibrated annually by a contracted vendor and are checked daily using three weights

8.2 Balance class–S weights are certified against NIST standards annually by outside vendor. Calibration data is maintained on file.

8.3 Thermometers are calibrated annually against NIST standard thermometer.

8.4 Oven temperatures are recorded prior and at the end of the heating stage.

## 9.0 Sample Preparation

9.1 Allow samples to warm to ambient temperature.

## 10.0 Diagram/Table

10.1 Reserved.

## 11.0 Analytical Procedure

11.1 Create spreadsheet file in designated folder /RTI storage on Glendaless/Analytical Data/ANALYTICAL DATA OMEGA//Wet Chem/2010/TS/'Month'/'file name'. File names will correspond to the date of analysis and letter (A,B,C…) for multiple analytical batches on the same date.

11.2 Enter sample numbers into spreadsheet 'Sample ID' column corresponding to labeled beaker IDs. Enter applicable sample type (MBLK, LCS, SAMP or DUP) in 'S.Type' column.

11.3 Upon any of the below specified weigh steps place the cursor in the cell immediately below the column header for that particular weight corresponding to the first sample in the sequence. When the balance has stabilized for that sample press F10 on the keyboard and the weight will be transferred to the spreadsheet. The cursor will automatically move to the next cell. Repeat procedure above for all remaining samples.

11.4 Enter date/time at start of analysis and dates/times and temperatures for all required steps in the procedure. Enter initials of person performing the procedure.

11.5 Preparation of weighing container:

11.5.1 Dry the aluminum weighing pans at 105-115$^{o}$C for a minimum of 12 hours, preferably overnight.

11.5.2 Cool the container in a desiccator and weigh. Bring up the appropriate spreadsheet file and begin with column header 'Initial Wt 1'. Repeat drying, cooling, desiccating and weighing (using applicable spreadsheet and procedure described) to a constant weigh of <4% or 0.5 mg of the previous weight, whichever is less.

11.5.3 Store dishes in desiccator until needed.

11.6 Allow the sample to warm to room temperature.

11.7 For every 10 samples a duplicate of one of the samples must be analyzed.

11.8 Weigh 25-50 g of sample into the weighing container.

11.9 Place the container in a drying oven at 105 to 115 $^{o}$C for a minimum of 12 hours

11.10 Cool the container in a desiccator and weigh. Repeat drying, cooling, desiccating and weighing to a constant weight of <4% or 0.5mg of the previous weight, whichever is less. Capture weights in the 'Final Wt1 and Wt2' columns of the associated spreadsheet.

## 12.0 Details of Calibration and Calculations

12.1 Calculations are as follows

$$\text{Percent moisture} = 100*(W_{wet}-W_{dry})/(W_{wet}-W_{pan})$$

where:
*$W_{wet}$=weight of wet sample and weighing dish (g)*
*$W_{dry}$=weight of dry sample and weighing dish (g)*
*$W_{wet}$=weight of wet sample and weighing dish (g)*
$W_{pan}$=weight of weighing dish (g)

12.2 All equations are incorporated into the test code and Omega source code.

## 13.0 Quality Assurance/Quality Control (QA/QC) Requirements

13.1 Duplicate Sample (DUP) at a frequency of no less than 10 %.

13.1.1 Acceptance Criteria (RPD) **<10 %**

13.1.2 Corrective Action: Evaluate sample homogeneity and flag data if necessary.

13.2 Balances are checked daily or on each use by weighing three standard weights. The weight obtained for each must be within the posted acceptance limits on the balance log.

## 14.0 Data Reporting Requirements

14.1 Sample results are reported as percent moisture based on original weight of raw sample.

14.2 Completed Excel files created in Sec. 11 are saved as .pdf files. This file is linked to the associated Omega analytical sequence.

14.3 The Excel file is then saved as a .csv file. This file is used to import analytical data directly into the Omega LIMS.

14.4 All calculations to derive the final result are performed by the LIMS.

## 15.0 Preventative Maintenance and Routine Cleaning

15.1 The analytical balance must be kept clean. Any spills must be immediately cleaned.

## 16.0 Waste Management and Pollution Prevention

16.1 Pollution Prevention

16.1.1 Reagents are purchased and quantities used to reflect anticipated usage and minimize disposal of expired or unused chemicals.

16.1.2 Chemicals are handled in a manner that minimizes the potential for release or spill of the material.

16.2 Waste Management

16.2.1 Acidic materials (pH<2) are treated as hazardous waste and placed in the appropriate waste drum for disposal.

16.2.2 Soil samples are composited in a drum designated for incineration.

16.2.3 Disposal of materials is addressed in the laboratory QAP (Section 5.6).

## 17.0 References

17.1 Standard Methods Online for the Examination of Water and Wastewater. Method D2215

17.2 RTI Laboratories, Inc. Quality Assurance Plan.

17.3 RTI Laboratories, Inc. SOP SRC001-A, Sample Receipt and Custody.

17.4 RTI Laboratories, Inc. Chemical Hygiene Plan.

17.5 RTI Laboratories, Inc. Employee Handbook.

# METHOD 1030

## IGNITABILITY OF SOLIDS

SW-846 is not intended to be an analytical training manual. Therefore, method procedures are written based on the assumption that they will be performed by analysts who are formally trained in at least the basic principles of chemical analysis and in the use of the subject technology.

In addition, SW-846 methods, with the exception of required method use for the analysis of method-defined parameters, are intended to be guidance methods which contain general information on how to perform an analytical procedure or technique, which a laboratory can use as a basic starting point for generating its own detailed standard operating procedure (SOP), either for its own general use or for a specific project application. Performance data included in this method are for guidance purposes only and must not be used as absolute quality control (QC) acceptance criteria for purposes of laboratory QC or accreditation.

## 1.0 SCOPE AND APPLICATION

1.1 This method is suitable for the determination of the ignitability of solids and is appropriate for pastes, granular materials, solids that can be cut into strips, and powdery substances. Also, if it is impractical to perform this test because of the physical form of the sample, generator knowledge should be used to determine the ignitability hazard posed by the material. The test method described here is based on the test procedure adopted by the Department of Transportation (DOT) from the United Nations regulations for the international transportation of dangerous goods (see Appendix E to Part 173 of 49 CFR).

1.2 This method is not required by the Federal regulations to determine if a waste passes or fails the characteristic of ignitability according to the RCRA regulatory definition at 40 CFR 261.21. To clarify, the test results of this method cannot be used to directly classify a waste as a D001 hazardous waste, nor can the results be used by themselves to definitively classify a waste as non-hazardous. No specific test for ignitable solids is required by the RCRA regulations, and only a waste meeting the narrative regulatory definition at 40 CFR 261.21(a)(2) is an ignitable hazardous waste because it is an ignitable solid. In addition, the test in this method for a liquid may be helpful in determining whether a liquid waste has hazardous properties; however, a liquid waste is only a D001 hazardous waste if it is an oxidizer, as defined at 40 CFR 261.21(a)(4), or based on its flash point, as defined at 40 CFR 261.21(a)(1). This test method was developed to specifically illustrate the ignitability properties of materials, including wastes, and its results provide relevant and useful information that may be applied to knowledge of a waste in determining whether a waste meets the 40 CFR 261.21 criteria.

1.3 Prior to employing this method, analysts should consult the disclaimer statement at the front of the manual and the information in Chapter Two for 1) guidance on the intended flexibility in the choice of methods, apparatus, materials, reagents, and supplies; and 2) the responsibilities of the analyst for demonstrating that the techniques employed are appropriate for the analytes of interest, in the matrix of interest, and at the levels of concern.

In addition, analysts and data users are advised that, except where explicitly specified in a regulation, the use of SW-846 methods is *not* mandatory in response to Federal testing requirements. The information contained in this method is provided by the Environmental Protection Agency (EPA) as guidance to be used by the analyst and the regulated community in

making judgments necessary to generate results that meet the data quality objectives (DQOs) for the intended application.

1.4 This method is restricted to use by, or under supervision of, appropriately experienced and trained personnel. Each analyst must demonstrate the ability to generate acceptable results with this method.

## 2.0 SUMMARY OF METHOD

In a preliminary test, the test material is formed into an unbroken strip or powder train, 250 mm in length. An ignition source is applied to one end of the test material to determine whether combustion will propagate along 200 mm of the strip within a specified time period. Materials that propagate burning along a 200-mm strip within the specified time period are then subjected to a burning rate test. Materials that do not ignite or propagate combustion as described above do not require further testing. In the burning rate test, the burning time is measured over a distance of 100 mm and the rate of burning is determined. The test method described here is based on the test procedure adopted by the Department of Transportation from the United Nations regulations for the international transportation of dangerous goods and is contained in Appendix E to Part 173 of 49 CFR.

## 3.0 DEFINITIONS

Refer to Chapter One and the manufacturer's instructions for definitions that may be relevant to this procedure.

## 4.0 INTERFERENCES

4.1 In laboratory tests, the burning rate of duplicate runs is usually repeatable to within 10%. However, large differences in burning rates may occur if experimental conditions are not held constant. Variation in airflow rates, particle size, and moisture content of the test material will affect test results. Therefore, at least triplicate determinations of the burning rate should be conducted.

4.2 Particle size of test material can affect not only the burning rate, but also the ignition of the material. Therefore, the particle size of the test material should be the same for each test run. The particle size of the test material should be reported in a simple descriptive format (e.g., fine powder, sand, coarse granular).

4.3 Temperature of some test material (such as sulfur powder) affects the burning rate. For reproducible results, all tests should be performed at approximately the same initial temperature (ambient room or laboratory temperature).

4.4 All tests must be carried out inside a fume hood with the test apparatus situated perpendicular ($90^{\circ}$) to the direction of airflow. Airflow parallel ($0^{\circ}$) to the test apparatus results in non-reproducible burning rates.

4.5 The rate of airflow through the fume hood affects the burning rate. An airflow rate that is too high distorts the flame and retards its horizontal propagation. The optimum airflow rate appears to be in the range of 0.7-1 meters per second.

4.6 Materials that are moisture sensitive (i.e., readily absorb moisture from air) should be tested as quickly as possible after removal from the sample container. All materials should be tested as received by the laboratory.

## 5.0 SAFETY

5.1 This method does not address all safety issues associated with its use. The laboratory is responsible for maintaining a safe work environment and a current awareness file of OSHA regulations regarding the safe handling of the chemicals specified in this method. A reference file of material safety data sheets (MSDSs) should be available to all personnel involved in these analyses.

5.2 Prior to starting the preliminary screening test, all sample materials must be tested to determine if that material is explosive or extremely flammable (see WARNING below). Use a very small portion of material (1 g or less) for this test.

WARNING: If the sample material is explosive or extremely flammable, do not conduct this test.

5.3 This method could involve the combustion of highly flammable materials and the generation of toxic fumes. All tests must be conducted in a suitable fume hood fitted with a pull-down sash to prevent the escape of toxic fumes into working areas. The analyst should wear appropriate protective clothing, including a laboratory jacket or apron, safety glasses, and protective gloves. The laboratory should have appropriate firefighting equipment (such as a Class A fire extinguisher) readily available to extinguish small fires.

## 6.0 EQUIPMENT AND SUPPLIES

The mention of trade names or commercial products in this manual is for illustrative purposes only, and does not constitute an EPA endorsement or exclusive recommendation for use. The products and instrument settings cited in SW-846 methods represent those products and settings used during method development or subsequently evaluated by the Agency. Glassware, reagents, supplies, equipment, and settings other than those listed in this manual may be employed provided that method performance appropriate for the intended application has been demonstrated and documented.

This section does not list common laboratory glassware (e.g., beakers and flasks) that might be used.

6.1 Low-heat conducting, non-combustible, impervious ceramic tile or equivalent material, an approximate dimension of 25 cm x 25 cm x 2.5 cm (the tile must be at least 25 cm in length to support a 250-mm test sample).

6.2 High temperature marker or equivalent marking device for marking ceramic plates.

6.3 Powder train mold (see Figure 1) for molding powdered and granular materials for the burn rate test. The material of construction can be aluminum, brass, stainless steel, or plastic. The mold is 250 mm in length and has a triangular cross-section, with a width of 20 mm, and a depth of 10 mm as measured from the bottom of the triangular opening to where the sides meet. On both sides of the mold, in the longitudinal direction, two sheets are mounted as lateral limitations which extend 2 mm beyond the upper edge of the triangular cross-section.

This device can be fabricated by most machine shops. The complete burn rate apparatus is available from: Associated Design and Manufacturing Co., Lorton, Virginia, 22079.

6.4 A Bunsen (propane gas and air) burner with a minimum diameter of 5 mm capable of attaining a temperature of at least 1,000 °C.

6.5 Stop watch.

6.6 Thermocouple to measure the temperature of the gas flame.

6.7 Thermometer to measure initial temperature of material (i.e., room temperature).

6.8 Anemometer to measure airflow in the fume hood.

## 7.0 REAGENTS AND STANDARDS

No special reagents or standards are required to conduct this test.

## 8.0 SAMPLE COLLECTION, PRESERVATION, AND STORAGE

8.1 Samples should be tested on an as-received basis unless requested otherwise. No sample preservation is required, but sample containers should be completely filled and tightly sealed to preserve sample integrity.

8.2 Samples should be tested as soon as possible after removal from the sample container (i.e., samples should not be allowed to dry or absorb moisture for excessive periods or to lose volatiles). Samples that are chilled or cooled upon receipt to the laboratory should be allowed to equilibrate to the ambient laboratory temperature in the sample container.

## 9.0 QUALITY CONTROL

9.1 Refer to Chapter One for additional guidance on quality assurance (QA) and quality control (QC) protocols. When inconsistencies exist between QC guidelines, method specific QC criteria take precedence over both technique specific criteria and Chapter One criteria; technique specific QC criteria take precedence over Chapter One criteria. Any effort involving the collection of analytical data should include development of a structured and systematic planning document, such as a Quality Assurance Project Plan (QAPP) or a Sampling and Analysis Plan (SAP), which translates project objectives and specifications into directions for those implementing the project and assessing the results.

Each laboratory should maintain a formal quality assurance program. The laboratory should also maintain records to document the quality of the data generated. Development of in-house QC limits for each method is encouraged. Use of instrument specific QC limits is encouraged, provided such limits will generate data appropriate for use in the intended application. All data sheets and quality control data should be maintained for reference or inspection.

9.2 All tests must be performed on a clean ceramic plate at room temperature.

9.3 All replicate runs must be at the same initial temperature (ambient laboratory temperature).

9.4 All replicate tests must be run at approximately the same airflow through the fume hood.

9.5 Only materials of the same particle size distribution should be used for all replicate tests.

9.6 The burn rate test must be conducted in triplicate if the preliminary screening test is positive. Any burn rate for non-metallic samples that exceeds 2.2 mm/sec (or a burn time of less than 45 seconds for 100 mm) is considered to have a positive result. For metals, a burn rate of more than 0.17 mm/sec (or burn time of less than 10 minutes for 100 mm) is considered to have a positive result.

## 10.0 CALIBRATION AND STANDARDIZATION

There are no calibration or standardization steps directly associated with this procedure. See the equipment manufacturer's instructions for the calibration of certain equipment used in this method (e.g., the thermocouple).

## 11.0 PROCEDURE

WARNING: Prior to starting the preliminary screening test, all sample materials must be tested to determine if that material is explosive or extremely flammable. Use a very small portion of material (1 g or less). If the sample material is explosive or extremely flammable, do not conduct this test.

### 11.1 Preliminary screening test

11.1.1 The preliminary screening test for ignitability is conducted on all waste materials. On a clean, impervious ceramic tile (Sec. 6.1), clearly mark a 250 mm long test path. Make another mark at exactly 200 mm from the start of the sample path.

11.1.2 Prepare the test material in its "as received" form by forming an unbroken strip or powder train of sample 250 mm long by 20 mm wide by 10 mm high on the ceramic tile. Use the mold to form the material as described in Sec. 11.2.3.1, if appropriate.

11.1.3 Place the ceramic tile with the loaded sample in a fume hood about 20 cm (~8 inches) from the front of the hood and in an area of laminar airflow. Position the sample perpendicular to the airflow (See Figure 2). The airflow across the perpendicular axis of the sample should be sufficient to prevent fumes from escaping into the laboratory and should not be varied during the test. The air velocity should be approximately 0.7 meters/second. Measure the air velocity with an anemometer.

11.1.4 Light the Bunsen burner and adjust the height of the flame (6.5 to 7.5 cm) by adjusting the propane gas and air flows. Measure the temperature of the flame (tip of the flame) by a thermocouple. The temperature of the flame must be at least 1000 °C.

11.1.5 Apply the tip of the flame to one end of the sample strip. The test period will depend on the sample matrix (whether non-metallic or metallic) as described below in Sec. 11.1.5.1 and 11.1.5.2.

11.1.5.1 If the waste is non-metallic, hold the flame tip on the sample strip until the sample ignites or for a maximum of 2 minutes. If combustion occurs, begin timing with a stop watch and note whether the combustion propagates up to the 200 mm mark within the 2 minute test period.

11.1.5.2 If the waste is a metal or metal alloy powder, hold the flame tip on the sample strip until the sample ignites or for a maximum of 5 minutes. If combustion occurs, begin timing with a stop watch and note whether the combustion propagates up to the 200-mm mark within the 20 minute test period.

11.1.6 If the waste does not ignite and propagate combustion either by burning with open flame or by smoldering along the 200-mm sample strip within the 2 minute test period (or 20 minute test period for metal powders), the waste is not considered flammable and no further testing is required. If the waste propagates burning of 200 mm of the test strip within the 2 minute test period (20 minute test period for metals), the material must be evaluated by the burning rate test (proceed to Sec. 11.2).

11.2 Burning rate test

11.2.1 The preparation of the test sample for the burning rate test will depend on the physical characteristics of the waste. Wastes that exist in a powdered or granular state are molded in a powder train mold as shown in Figure 1. Pasty materials are formed into a rope that is 250 mm in length with a cross-section of 1 $cm^2$. All tests for the burn rate test are performed on clean, ambient temperature, ceramic plates.

11.2.2 On a clean, impervious ceramic tile (Sec. 6.2), clearly mark a 250-mm long test path. Make two additional timing marks at 80 mm and 180 mm from the start of the sample path. The distance between the two marks (100 mm) will be used to calculate the rate of burn in Sec. 12.0.

11.2.3 Sample preparation based on physical characteristics

11.2.3.1 Powder or granular material -- Tighten the side plates on the mold. Place the mold on the base plate. Pour the material to fill the triangular cross section of the mold loosely. Drop the unit from a height of 2 cm onto a solid surface three times to settle the powder. Remove the side supports. Lift the mold off the base plate. Place a clean ceramic test plate with the appropriate timing marks (Sec. 11.2.2) face down on top of the mold. Invert the setup and remove the mold.

11.2.3.2 Pasty wastes - Spread the waste on a marked ceramic tile (Sec. 11.2.2) in the form of a rope 250 mm in length with a cross-section of 1 $cm^2$.

11.2.4 Place the ceramic tile with the loaded sample prepared in Sec. 11.2.3 in a fume hood about 20 cm (~8 in) from the front of the hood and in an area of laminar airflow. Position the sample perpendicular to the airflow (See Figure 2). The airflow across the perpendicular axis of the sample should be sufficient to prevent fumes from escaping into the laboratory and should not be varied during the test. The air velocity should be

approximately in the range of 0.7-1 meters/second. Measure the air velocity with an anemometer.

11.2.5 Light the Bunsen burner and adjust the height of the flame (6.5 to 7.5 cm) by adjusting the propane gas and air flows. Measure the temperature of the flame (tip of the flame) by a thermocouple. The temperature of the flame must be at least 1000 °C.

11.2.6 Apply the tip of the flame to one end of the sample strip to ignite the test strip as described in Sec. 11.1.5.1 or 11.1.5.2 (based on whether the sample is non-metallic or metallic).

11.2.7 When the test strip or powder train has burned up to the 80-mm time marker, begin timing the rate of combustion with a stop watch. Stop the timer when the burned strip reaches the 180-mm time marker. Record the amount of time (in sec) required to burn the 100-mm test strip.

## 12.0 DATA ANALYSIS AND CALCULATIONS

Calculate the rate of burning by dividing the length of the burn test strip (100 mm) by the total time (sec). Results of the burn rate test should be reported in mm/sec. Wastes that have a rate of burning of more than 2.2 mm/sec (or burn time of less than 45 sec for 100 mm) are considered to have a positive result for ignitability according to DOT regulations. For metals, this time is 10 minutes or less for 100 mm (or a burn rate of more than 0.17 mm/sec). The following format may be used to document the data.

Test Material Information

Source of material (e.g., company, operation or process):
Description of material (e.g., powder or paste, metallic or non-metallic):
Particle size (e.g., fine powder, granular, sand, etc.):
Preliminary burning time (sec):

Test Conditions

Date of Test:
Temperature of test material (°C):
Air velocity through fume hood (m/s):

| Ignitability Test Data | | | | |
|---|---|---|---|---|
| Test Number | Time (sec) Elapsed Between Application of Flame and Start of Ignition | Burning Time over 100 mm (sec) | Burning Rate (mm/sec) | Comments |
| 1 | | | | |
| 2 | | | | |
| 3 | | | | |

## 13.0 METHOD PERFORMANCE

13.1 Performance data and related information are provided in SW-846 methods only as examples and guidance. The data does not represent required performance criteria for users of the methods. Instead, performance criteria should be developed on a project-specific basis, and the laboratory should establish in-house QC performance criteria for the application of this method. Performance data must not be used as absolute QC acceptance criteria for laboratory QC or accreditation.

13.2 An independent laboratory validation was conducted on the robustness of the burn rate test procedure. The materials selected for this evaluation included:

1. A 50/50 mixture of metallic silicon and lead dioxide ($PbO_2$)
2. Excelsior
3. Dextrin (yellow powder)
4. Sulfur (fine yellow powder)
5. Aluminum metal (coarse)
6. Magnesium metal (coarse)
7. Polyethylene high density (granular)
8. Polyethylene low density (fluffy white powder)
9. Scott fertilizer (32-3-10:N-P-K)
10. JP-4 contaminated soil (approximately 5000 ppm)

Of these materials, the 50/50 mixture of metallic silicon and lead dioxide ($PbO_2$), elemental sulfur, and excelsior gave a positive ignitability result under the conditions of the test. The remaining materials gave negative (nonflammable) results under the conditions of the test. Several test variables including: ignition source, ambient temperature, and apparatus orientation, were studied using these materials. Partial results of this study are summarized in Table 1. These data are provided for guidance purposes only.

13.3 In another evaluation of the DOT burn rate test, potentially ignitable finishing wastes from the furniture industry were collected and tested for burning rates. Each waste was tested in triplicate to establish a mean value for the burning rate. The results for the flammable wastes are summarized in Table 2. These data are provided for guidance purposes only.

13.4 In order to evaluate the ruggedness of the DOT burn rate test, select ignitable finishing wastes were split and tested by a state laboratory and an independent contract laboratory. The results of this comparison are summarized in Table 3. These data are provided for guidance purposes only.

## 14.0 POLLUTION PREVENTION

14.1 Pollution prevention encompasses any technique that reduces or eliminates the quantity and/or toxicity of waste at the point of generation. Numerous opportunities for pollution prevention exist in laboratory operations. The EPA has established a preferred hierarchy of environmental management techniques that places pollution prevention as the management option of first choice. Whenever feasible, laboratory personnel should use pollution prevention techniques to address their waste generation. When wastes cannot be feasibly reduced at the source, the Agency recommends recycling as the next best option.

14.2 For information about pollution prevention that may be applicable to laboratories and research institutions consult *Less is Better: Laboratory Chemical Management for Waste Reduction*, a free publication available from the American Chemical Society (ACS), Committee on Chemical Safety, http://portal.acs.org/portal/fileFetch/C/WPCP_012290/pdf/WPCP_012290.pdf.

## 15.0 WASTE MANAGEMENT

The Environmental Protection Agency requires that laboratory waste management practices be conducted consistent with all applicable rules and regulations. Laboratories are urged to protect air, water, and land by minimizing and controlling all releases from hoods and bench operations, complying with the letter and spirit of any sewer discharge permits and regulations, and by complying with all solid and hazardous waste regulations, particularly the hazardous waste identification rules and land disposal restrictions. For further information on laboratory waste management, consult *The Waste Management Manual for Laboratory Personnel* available from the American Chemical Society at the address listed in Sec. 14.2.

## 16.0 REFERENCES


1. "Test Methods for Readily Combustible Solids. Burning Rate Test." (14.2.2.5). Recommendations on the Transport of Dangerous Goods, Fifth Revised Edition, United Nations, New York, 1988.

2. 49 CFR, Appendix E to Part 173 (12-31-91 Edition), pp. 597-598.

3. "Flammability (solids). Method A.10," Official Journal of the European Communities, No. L251/63, September 19, 1984.

4. Foster Wheeler Enviresponse, Inc., Edison NJ., "Validation of Ignitability Method For Solids," submitted to the Office of Solid Waste, US EPA, February 1994.

5. Internal Report (AMFA Report), North Carolina Department of Environmental Health and Natural Resources (Bill Hamner).


## 17.0 TABLES, DIAGRAMS, FLOW CHARTS, AND VALIDATION DATA

The following pages contain the tables and figures referenced by this method. A flow diagram of the procedure is included after the figures.

TABLE 1

TEST VARIABLES FOR IGNITABILITY

| Material Tested | Test Number | Variable combination[1] | Burn Time over 100 mm (sec) | Burn Rate (mm/sec) |
|---|---|---|---|---|
| 50% Metallic Silicon and 50% Lead IV Oxide | 1 | ABC | 0.84 | 119 |
| | 2 | Abc | 0.50 | 200 |
| | 3 | aBc | 0.69 | 145 |
| | 4 | abC | 0.65 | 154 |
| Excelsior (wood shavings) | 1 | ABC | 13.45 | 7.43 |
| | 2 | Abc | 9.14 | 10.9 |
| | 3 | aBc | 13.37 | 7.47 |
| | 4 | abC | 13.59 | 7.36 |

[1]Key:

A - Flame ignition
a - Hot wire ignition source
B - Ambient temperature of 20 ° C
b - Ambient temperature of 100 ° C
C - Orientation of test apparatus of 90 ° to air flow
c - Orientation of test apparatus of 0 ° to air flow

These data are provided for guidance purposes only.

TABLE 2

EXAMPLE BURNING RATES FOR IGNITABLE WASTES

| Sample No. | Description of Waste | Burn Time over 100 mm (sec) | Burn Rate (mm/sec) |
|---|---|---|---|
| A2 | Segregated Lacquer Dust | 4.7 | 21.3 |
| J2 | Segregated Lacquer Dust | 4.6 | 21.7 |
| U | Segregated Lacquer Dust | 8.6 | 11.6 |
| K | Consolidated Lacquer Dust | 6.0 | 16.7 |
| H | Catalyzed Lacquer Dust | 6.7 | 14.9 |
| F | Water Based Lacquer Dust | 19.4 | 5.15 |
| P | Booth Coat-Stain Overspray | 12.5 | 8.0 |
| O | Pallet Covered Cardboard | 11.1 | 9.0 |
| Q | Pallet Covered Cardboard | 12.3 | 8.13 |

These data are provided for guidance purposes only.

TABLE 3

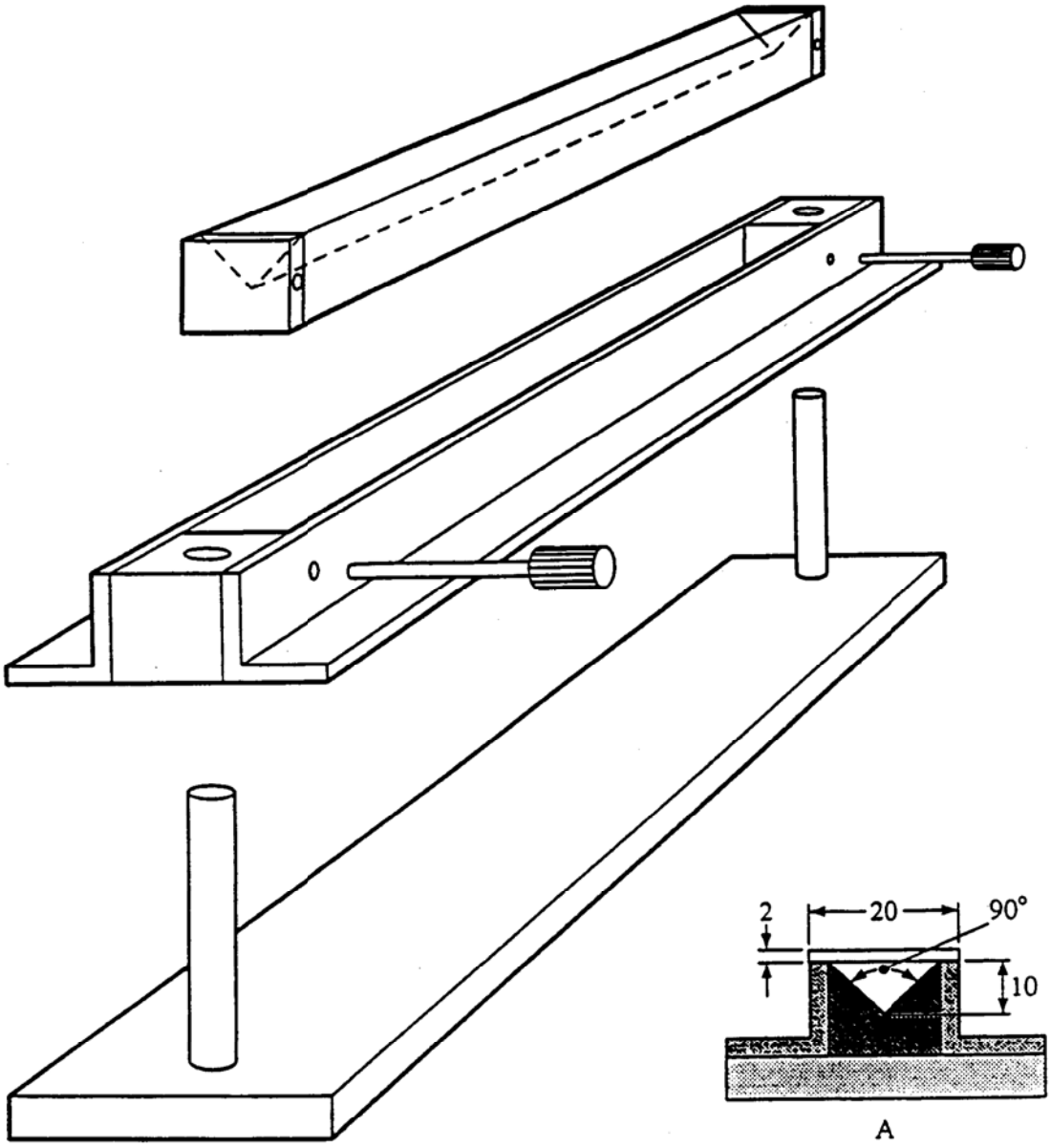
EXAMPLE COMPARISON OF BURN RATES

| Sample No. | Description of Waste | Mean Burn Time Over 100 mm (Seconds) | |
|---|---|---|---|
| | | State Laboratory | Contract Laboratory |
| A1 | Segregated Lacquer Dust | 4.7 | 5 |
| J1 | Segregated Lacquer Dust | 4.6 | 4.3 |
| 12 | Booth Coat-Glaze Overspray | 0[1] | 0[1] |

[1] Waste was found to be nonflammable under conditions of the test.
These data are provided for guidance purposes only.

FIGURE 1

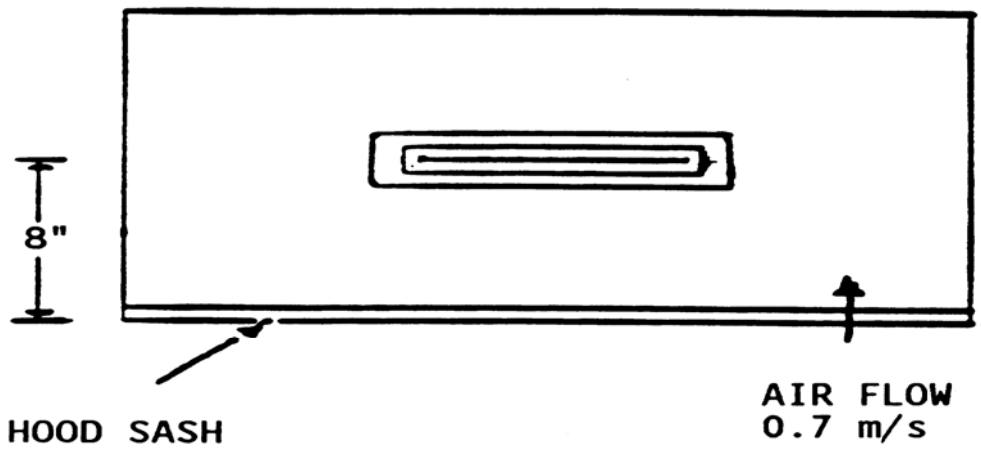
POWDER TRAIN MOLD




(A) Cross-section of 250 mm long mould

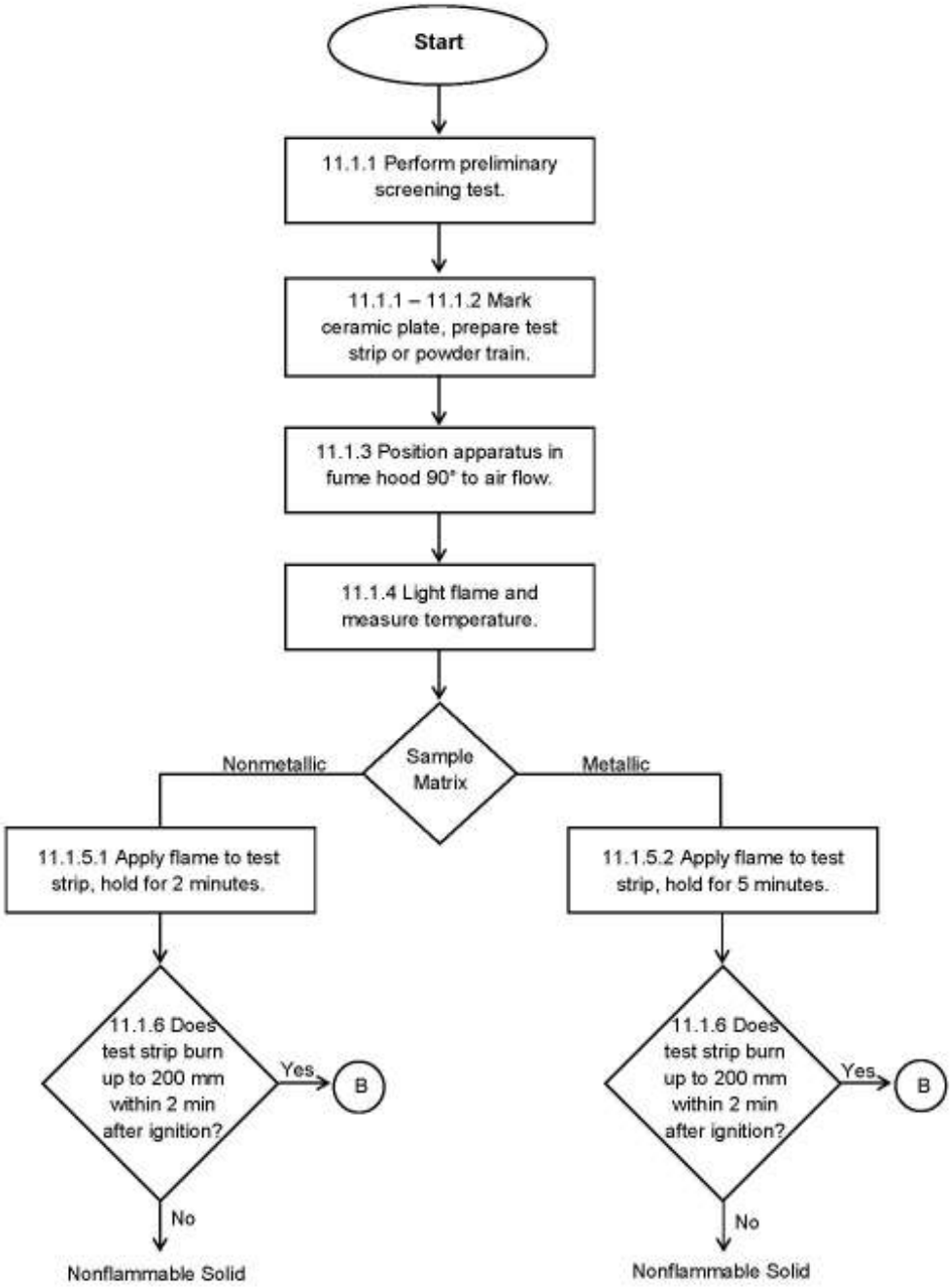
FIGURE 2

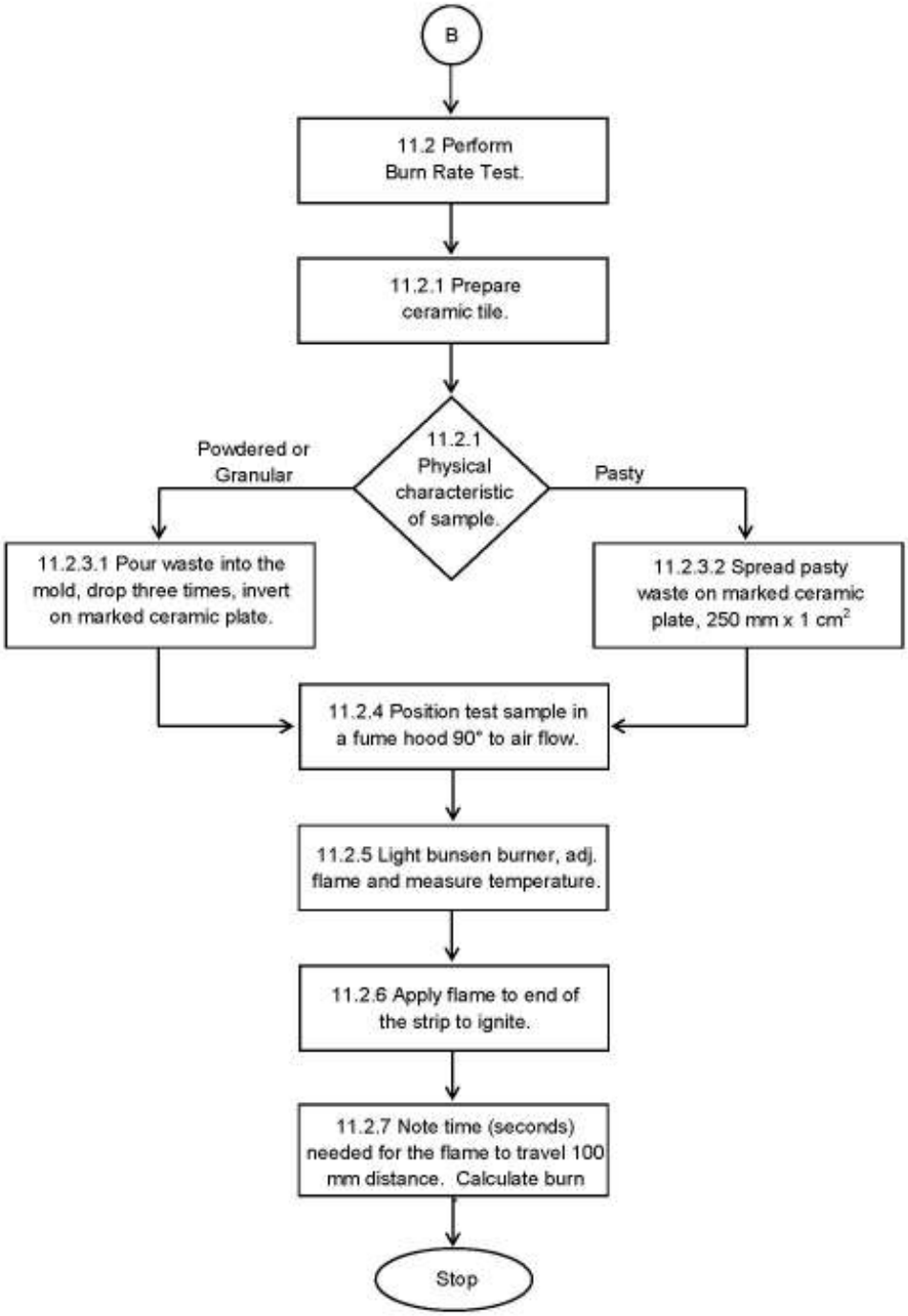
TEST APPARATUS POSITION IN FUME HOOD




SAMPLE 90° TO AIR FLOW

IGNITABILITY OF SOLIDS




B
11.2 Perform Burn Rate Test.
11.2.1 Prepare ceramic tile.
11.2.1 Physical characteristic of sample.
Powdered or Granular
Pasty
11.2.3.1 Pour waste into the mold, drop three times, invert on marked ceramic plate.
11.2.3.2 Spread pasty waste on marked ceramic plate, 250 mm x 1 cm²
11.2.4 Position test sample in a fume hood 90° to air flow.
11.2.5 Light bunsen burner, adj. flame and measure temperature.
11.2.6 Apply flame to end of the strip to ignite.
11.2.7 Note time (seconds) needed for the flame to travel 100 mm distance. Calculate burn
Stop

## Appendix A:

## Summary of Revisions to Method 1030 (From Revision 0 December 1996)

1. Improved overall method formatting for consistency with new SW-846 methods style guidance. The format was updated to Microsoft Word .docx.

2. Minor editorial and technical revisions were made throughout to improve method clarity.

3. The flowcharts on pages 14 and 15 were updated to improve visual clarity and edited for content.

4. The revision number was changed to 1 and the date published was changed to July 2014.

5. This appendix was added showing changes from the previous revision.

6. Items regarding regulatory use of this method in Sec. 1.1 and 1.2 were updated to reflect current guidance.

# Attachment C

# References

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# Appendix D

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**Photo 1: Entrance to Camp Hero North of Site H-15**



**Photo 2: Coast Guard Radar Installation and 500 gallon AST**



**Photo 3: AECOM Site Review of H-15. Note potential metal site boundary post.**



**Photo 4: Water Pump House/Reservoir at Well 4. Suspect UST G in RI Work Plan**



**Photo 5: Top of Water Pump House/Reservoir at Well 4.**



**Photo 6: Debris Near Water Pump House/Reservoir at Well 4**



**Photo 7: Chlorine Contact Chamber House Along Site Wide Sanitary Sewer**



**Photo 8: Chlorine Contact Chamber House Along Site Wide Sanitary Sewer**



**Photo 9: Chlorine Contact Chamber House Along Site Wide Sanitary Sewer**



**Photo 10: View of Chlorine Contact Chamber Access Inside of House Structure**



**Photo 11: View of Chlorine Contact Chamber Access Inside of House Structure**



**Photo 12: View of Former Sanitary Sewer Outfall Block**



**Photo 13: View West of Former Sanitary Sewer Outfall Block**



**Photo 14: View of Former Sanitary Sewer Outfall Block**



**Photo 15: View of Revetments in Drainage Ditch Near H-14**



**Photo 16: Cemented Manhole Along Site Wide Sanitary Sewer East of H-14**



**Photo 17: View of Site H-14 Looking South**



**Photo 18: View of Site H-21 Looking South. Debris noted In Upper Portion of Photo.**



**Photo 19: View of Site H-21 Looking South. Debris noted In Upper Portion of Photo.**



**Photo 20: View of Site Wide Sanitary Sewer Line East of Former Building at Site H-4**



**Photo 21: View of 55-Gallon Drum at Site H-2**



**Photo 22: View of 55-Gallon Drum at Site H-2**



**Photo 23: View of Secondary Storage for Former 200,000 Gallon AST at Site H-35**



**Photo 24: View of Former Fuel Pump House at Site H-13, Northwest of H-35**



**Photo 25: View of Secondary Storage for Former 200,000 Gallon AST at Site H-35**



**Photo 26: View Inside 50,000 Gallon Reservoir South of the Former Fire Department Building. Water Piping Runs into the Reservoir through Back Wall in Picture**



**Photo 27: Concrete Access Vault on top of 50,000 Gallon Reservoir South of the Former Fire Department Building**



**Photo 28: Concrete Access Vault on top of 50,000 Gallon Reservoir South of the Former Fire Department Building**



**Photo 29: Well House for Well Number 2 in Southeast Portion of Camp Hero**



**Photo 31: Former Heating Plant Location at H-11**



**Photo 32: Former Septic Tank South of H-11 and H-12**



**Photo 33: View South of Former Entrance to Plotting/Switchboard Room (112,113)**



**Photo 34: Vaults on North Side of Former Plotting/Switchboard Room (112,113)**



**Photo 35: Empty Vault on North Side of Former Plotting/Switchboard Room (112,113)**



**Photo 36: View of Discarded Boiler Site H-7 North of Former Plotting/Switchboard Room (112,113)**

# Appendix E

# Accident Prevention Plan

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**FINAL**

# ACCIDENT PREVENTION PLAN

## Remedial Investigation, Feasibility Study, Proposed Plan and Decision Document Former Camp Hero, Montauk, New York

**Revision: 0**

**Prepared for:**

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**June 2016**

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## PREFACE

This Accident Prevention Plan (APP) has been developed in accordance with ER 385-1-92, Safety and Occupational Health Requirements for Hazardous, Toxic, and Radioactive Waste Activities. The APP covers each of the applicable APP elements identified in Appendix A of Engineering Manual (EM) 385-1-1 (United States Army Corps of Engineers, 2008). An APP is a safety and health program and policy document.

This APP interfaces with the AECOM-Tidewater JV's overall safety and health program and policies, and is applicable site-wide for all planned investigations at Former Camp Hero. A Site Safety and Health Plan (SSHP) specific to the AECOM-Tidewater JV activities is included as Appendix G to this APP. This plan covers elements outlined in Section 28.A.02 b of EM 385-1-1.

The purpose of this APP is to establish site-specific safety and health procedures, practices, and equipment to be implemented and used to protect personnel from the potential occupational safety and health hazards associated with the field investigation activities. The APP assigns responsibilities, establishes standard operating procedures, and provides for contingencies that may arise while operations are conducted.

Project work will be performed in accordance with applicable federal, state, and local government safety and occupational health laws and regulations including Occupational Safety and Health Administration (OSHA) standards 29 Code of Federal Regulations 1910.120 and 1926.65. The content of the APP is subject to review and revision, as new information becomes available.

This APP has been developed based on known and anticipated potential hazards that may arise during performance of project tasks. At least one copy of the APP and applicable SSHP for the specific site, and the AECOM-Tidewater JV's United States Operations Safety, Health, and Environmental (SH&E) Manual, will be maintained in a readily accessible onsite location for review at all times during all field activities. The requirements established by this APP are mandatory and apply to all AECOM-Tidewater JV employees, subcontractors, and any other personnel entering designated work areas at the project sites during active field operations. Record keeping will be maintained in accordance with this APP and the applicable SH&E Program Standard Operating Procedures (SOPs). In the event of a conflict between this APP, the SSHP, the SOPs, and/or federal, state, and local regulations, workers shall follow the most stringent/protective requirements.

## CHANGES TO THE APPROVED APP

It is understood that this APP is a dynamic document and changes in the scope of work, field changes, or unanticipated site conditions may require APP modification and approval in order to retain field safety compliance with contract requirements, EM 385-1-1 (United States Army Corps of Engineers, 2008), and the OSHA regulations. All changes to the APP shall be prepared by the SH&E Manager, and approved by the Program Manager and Task Order Manager. All such modifications will be supplied to USACE for review and approval.

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Appendix E HAZWOPER Training and Medical Monitoring Documentation
Appendix F First Aid and CPR Trained Individuals
Appendix G AECOM-Tidewater JV Site Safety and Health Plan

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## List of Acronyms and Abbreviations

| | |
|---|---|
| ACGIH | American Conference of Governmental Industrial Hygienists |
| AHA | Activity Hazard Analysis |
| ANSI | American National Standards Institute |
| APP | Accident Prevention Plan |
| CFR | Code of Federal Regulations |
| CIH | Certified Industrial Hygienist |
| CPR | Cardio Pulmonary Resuscitation |
| CSP | Certified Safety Professional |
| CWM | Chemical Warfare Materiel |
| DD | Decision Document |
| DDESB | Department of Defense Explosives Safety Board |
| DOT | Department of Transportation |
| DPM | Deputy Project Manager |
| EM | Engineering Manual |
| ERP | Emergency Response Plan |
| ERT | Emergency Response Team |
| EZ | Exclusion Zone |
| FS | Feasibility Study |
| FUDS | Formerly Used Defense Site |
| HAZWOPER | Hazardous Waste Operations and Emergency Response |
| HSI | Hazardous Substance Inventory |
| JV | Joint Venture |
| MEC | Munitions and Explosives of Concern |
| NE | New England |
| NIOSH | National Institute for Occupational Safety and Health |
| NY | New York |
| NYSDEC | New York State Department of Environmental Conservation |
| OSHA | Occupational Safety and Health Administration |
| PHSP | Programmatic Health and Safety Plan |
| PM | Project Manager |
| PP | Proposed Plan |
| PPE | Personal Protective Equipment |
| RI | Remedial Investigation |
| SCBA | Self-Contained Breathing Apparatus |
| SDS | Safety Data Sheet |
| SH&E | Safety, Health and Environmental |

| | |
|---|---|
| SOP | Standard Operating Procedure |
| SS | Site Supervisor |
| SSHO | Site Safety and Health Officer |
| SSHP | Site Safety and Health Plan |
| TLV | Threshold Limit Value |
| USACE | United States Army Corp of Engineers |

## 1. SIGNATURE SHEET

This Accident Prevention Plan (APP) was prepared for employees performing field activities at Former Camp Hero, Montauk, New York. It was prepared based on the best available information regarding the physical, chemical, and biological hazards known or suspected to be present at the project sites. While it is not possible to discover, evaluate, and protect in advance against all possible hazards that may be encountered during the completion of the project, adherence to the safety and health program requirements of this APP will significantly reduce the potential for occupational injury.

By signing below, I acknowledge that I have reviewed and hereby approve this APP for the field activities at Former Camp Hero. This APP has been written for exclusive use by the AECOM-Tidewater JV employees and its subcontractors. This APP was written for specified site conditions, dates, and personnel, and must be amended if these conditions change.

Plan Preparer:



Date: January 14, 2016

1.a Amanda Martin
Safety, Health, & Environmental Representative
AECOM-Tidewater JV

Plan Review:



Date: January 14, 2016

1.b. Mark MacEwan
Project Manager
AECOM-Tidewater JV

Plan Concurrence:



Date: January 27, 2016

1.c. Bob Miller, CIH
Safety, Health, & Environmental Manager
AECOM-Tidewater JV

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# 2. BACKGROUND INFORMATION

## 2.a. Contractor

AECOM-Tidewater JV, a joint-venture between AECOM and Tidewater, is the prime contractor.

## 2.b. Contract Number

The project is being conducted under the United States Army Corps of Engineers (USACE) contract number W912DR-13-D-0016, Task Order DB01.

## 2.c. Project Name

The Project Name is Remedial Investigation (RI), Feasibility Study (FS), Proposed Plan (PP), and Decision Document (DD) for Former Camp Hero, Montauk, New York.

## 2.d. Project Description

The AECOM-Tidewater JV will conduct a RI at the former Camp Hero, a Formerly Used Defense Site (FUDS). The areas of concern (AOCs) at Camp Hero include (but are not limited to) former waste disposal areas, former coal storage areas, abandoned drum locations, and former storage tanks.
RI activities will include geophysical surveying, test pitting, surface and subsurface soil sampling, groundwater sampling, and monitoring well installation. The RI phase of the project is limited to the investigation of these sites (i.e., no remediation); however, the exception will include proposed disposal of empty containers at the Camp Hero State Park bluffs and at former drum sites.

The probability of encountering Unexploded Ordnance (UXO), munitions and explosives of concern (MEC), or Chemical Warfare Materiel (CWM), present as chemical agent identification sets (CAIS) is low at Camp Hero; however, if they are encountered, STOP WORK AUTHORITY will be used and the authorities will be notified. See Section 6.b for recognition training requirements.

A FS, PP, and DD will be prepared based on the results of the RI. Throughout the investigation of Camp Hero, the AECOM-Tidewater JV will support the client with public involvement including coordination with landowners and other stakeholders, as well as answering miscellaneous inquiries from concerned citizens, which will include the solicitation of interest in a Restoration Advisory Board (RAB) for this FUDS, and assisting in the operation of a RAB, should a RAB be formed. The AECOM-Tidewater JV will prepare a Client Draft, Draft and Final Public Information Plan fact sheets.

## 2.e. Project Location

Camp Hero State Park is located on the eastern tip of the south fork of Long Island, New York, approximately 5 miles east of the Village of Montauk in Suffolk County, NY (Figure 2-1). The Camp

is bounded by Montauk Highway (Route 27) to the north, the Atlantic Ocean to the south, Montauk Point State Park to the east, and Camp Hero State Park's undeveloped sanctuary area to the west.

### 2.f. Contractor Accident Experience

A copy of the Occupational Safety and Health Administration (OSHA) 300 form is included in Appendix A.

### 2.g. Phases of Work and Hazardous Activities Requiring an Activity Hazard Analysis

Activities planned as part of field operations that require an Activity Hazard Analysis (AHA) include:

- Mobilization/Demobilization
- Vegetation Removal
- Utility Clearance and Metal Anomaly Avoidance
- Geophysical Survey
- Drilling Oversight (Direct Push and Hollow Stem Auger)
- Direct Push Soil and Groundwater Sampling
- Monitoring Well Sampling and Development
- Mechanical Excavation (Test Pitting)
- Land surveying
- Assessment of Abandoned Buildings

AHAs for each of the investigation tasks are included as part of the Site Safety and Health Plan (SSHP) discussed in Section 9.gg. of this APP.

### 2.e. Emergency Lines of Communication

In the event of an emergency, defined as a medical/accident incident, discovery of an UXO, MEC, CWM, or CAIS, the communication channels listed in the table below should be followed.

**Table 2-1**

**Notification Channels**

| Activity / Event | Person(s) Responsible and Communication Channels |
|---|---|
| **EMERGENCY RESPONSE** | **CALL 911**<br>Site Safety and Health Officer will immediately notify:<br>1- Project Manager<br>Mark MacEwan – 703-682-9092 OR<br>Megan Donahue- 703-682-9142 (Deputy)<br>2- AECOM Project SH&E Manager<br>Bob Miller – 540-431-7908<br>Project Manager, or designee, will notify:<br>1- USACE Project Manager: Greg Goepfert- 917-790-8235<br>2- USACE Technical Lead: Megan Cullen- 978-318-8042 |
| UXO or MEC Find | **CALL 911**<br>Site Safety and Health Officer will immediately notify:<br>1- Project Manager<br>Mark MacEwan – 703-682-9092 OR<br>Megan Donahue- 703-682-9142 (Deputy)<br>2- AECOM Project SH&E Manager<br>Bob Miller – 540-431-7908<br>Project Manager, or designee, will notify:<br>1- USACE Project Manager: Greg Goepfert- 917-790-8235<br>2- USACE Technical Lead: Megan Cullen- 978-318-8042 |
| CWM or CAIS Find | **CALL 911**<br>Site Safety and Health Officer will immediately notify:<br>1- Chemical Warfare Design Center (CEHNC-OEC) at USAESCH<br>Wilson Walters- 256-895-1180<br>2- 20th Support Command- 410-322-7145<br>3- Project Manager<br>Mark MacEwan – 703-682- OR<br>Megan Donahue- 703-682-9142 (Deputy)<br>Project Manager, or designee, will notify:<br>1- USACE Project Manager: Greg Goepfert- 917-790-8235<br>2- USACE Technical Lead: Megan Cullen- 978-318-8042 |
| Cultural and Archaeological Find | Field Team Leader will notify the correct individual for technical support:<br>– Cultural: Marcos Paiva- 978-318-8796<br>– Ecological: Mike Penko- 978-318-8139 |

Note:
1. If there is an on-site USACE Representative, she or he will be notified immediately.
2. Where numbered, notify personnel in that order unless otherwise directed.

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AECOM
3101 Wilson Blvd., Suite 900
Arlington, VA 22201
T 703-682-4900 F 703-682-4901

# Site Location
# Former Camp Hero Military Base

Camp Hero Accident Prevention Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 2-1** |

5/2/2016 1:24,000 Y:\Projects\Camp_Hero\Maps\APP\Figure 2-1 Site Location.mxd

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## 3. STATEMENT OF SAFETY AND HEALTH POLICY

AECOM-Tidewater JV believes that the safety and health of our employees and the responsible stewardship of the built and natural environment are critical elements to business growth and success. AECOM-Tidewater JV demonstrates commitment to this fundamental responsibility by embracing "Safety" as one of our Core Values. AECOM-Tidewater JV has developed and implemented a Safety, Health, and Environmental (SH&E) Programmatic Health and Safety Plan (PHSP) for United States operations, which establishes the framework to maintain effective SH&E management, monitoring, measurement, documentation, communication, and methods to promote continuous improvement.

### SH&E Programmatic Health and Safety Plan Overview

The SH&E PHSP is based on proven management principles and practices. It consists of an organized framework that is continually monitored and periodically reviewed in response to changing internal and external factors. The system is designed to record SH&E actions, program performance, assist in communications, awareness, facilitates auditing, and management involvement and review. All AECOM-Tidewater JV employees are responsible for maintaining compliance with the PHSP, SH&E Policy, and Safe Operating Procedures. This SH&E Management System is based on the four-step problem solving process of "Plan-Do-Check-Act" methodology, which incorporates five major operational components:

- **Policy** — A clear SH&E Policy is the central focus of the PHSP. AECOM-Tidewater JV management and employees are fully committed to maintain compliance with this policy. AECOM-Tidewater JV's current corporate safety and health policy statement detailing the commitment to providing a safe and healthful workplace for all employees is included as Appendix B of this APP.

- **Planning** — A comprehensive plan of action supports the achievement of the SH&E Policy.

- **Implementation and Operation** — AECOM-Tidewater JV management provides the resources, including human and financial, for effective SH&E management. The PHSP includes procedures and systematic controls for the application of the resources.

- **Checking and Corrective Action** — Performance and the effectiveness of SH&E controls are continuously monitored and evaluated. Corrective actions are taken as necessary.

- **Management Review** — The PHSP is reviewed and continually improved with the aim of improving overall SH&E performance.

Through implementation of the PHSP, AECOM-Tidewater JV has established a uniform, systematic, and cost-effective approach to addressing safety, health, and environmental issues and concerns associated with AECOM-Tidewater JV personnel and services. The PHSP has been structured to align itself with the key elements of OSHA regulations.

Redacted copies or excerpts of the PHSP may be made available at the discretion of AECOM-Tidewater JV without waiving its right to maintain the confidentiality of such materials.

**SH&E Policy Overview**

It is the policy of AECOM-Tidewater JV to provide a safe and healthy work environment for all of its employees. AECOM-Tidewater JV considers no phase of operations or administration to be of greater importance than injury and illness prevention. Safety takes precedence over expediency and shortcuts. AECOM-Tidewater JV believes that every accident and every injury is avoidable and every reasonable step will be taken to reduce the possibility of injury, illness, or accident.

AECOM-Tidewater JV is fully committed to protecting the safety and health of our employees and meeting our obligations with respect to the protection of others affected by our activities. We strive to ensure that our operations do not pose unreasonable safety or environmental risks. In all of our activities, we will develop and implement appropriate systems and procedures designed to comply with applicable laws, legislation, licensing requirements, and stakeholder expectations.

In order to guide the implementation efforts required by this policy, the AECOM-Tidewater JV Management Committee, Program Management Team, and Regional Leaders collaborate to establish SH&E programs that:

- Incorporate a “ZERO injury” and “environmental sustainability” philosophy into design standards and project review processes.
- Recognize those who contribute to their improved SH&E performance.
- Comply with all applicable SH&E rules and regulations at the local, state, and national level.
- Meet client SH&E requirements and standards.
- Where no specific regulation exists, comply with AECOM-Tidewater JV standards and appropriate industry practices.

- Report on performance relative to short- and long-term SH&E metrics designed to help achieve established goals.

- Consult with, listen to, and respond to employees, customers and partners in order to continuously improve their SH&E performance.

All employees will be responsible for:

- Conducting themselves in accordance with directives, standards and procedures established by their applicable SH&E program.

- Temporarily suspending their personal work activities and requesting guidance from their supervisor before continuing a task when they identify a condition or practice that creates a serious safety, health, or environmental risk.

- Immediately reporting safety, health, and/or environmental incidents to their supervisor.

AECOM-Tidewater JV SH&E policy is formally reviewed annually. However, if substantial changes occur in legislation, organization and/or other business drivers, changes may be made on an interim basis.

**Safety Program Goals**

Consistent with the AECOM-Tidewater JV corporate SH&E policy, the safety program goals under this contract are ZERO injuries and accidents.

**SH&E Standard Operating Procedures**

AECOM-Tidewater JV SH&E SOPs establish minimum safety requirements and guidelines for AECOM-Tidewater JV United States operations and business lines. AECOM-Tidewater JV has developed individual SOPs that serve as the basis for the safe execution of specific tasks associated with field operations. These range from stop work and management authority, to the safe execution of confined space entries. Numerous SOPs are referenced throughout this APP and are included as Appendix C. A copy of the SOPs will be kept onsite at all times.

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# 4. RESPONSIBILITIES AND LINES OF AUTHORITY

## 4.a. Statement of Responsibility

AECOM-Tidewater JV has the ultimate responsibility for the successful implementation and management of AECOM-Tidewater JV's activities at Former Camp Hero in correlation to this APP.

## 4.b. Personnel Responsible for Safety

All personnel are responsible for continuous adherence to the safety and health procedures presented in this APP and attached SSHP during the performance of work. No person may work in a manner that conflicts with the intent of, or the inherent safety and environmental precautions expressed in these procedures. After due warnings, the company will dismiss from the site any person who violates safety procedures.

The AECOM-Tidewater JV organization chart for the management of safety at both the corporate and project level for this project is presented as Figure 4-1. The positions/responsibilities presented in the organization chart are discussed below.

**Program Manager [John Franz]**

The Resolution Consultants Program Manager is responsible for supporting the establishment and oversight of the overall health and safety program presented in the APP.

**SH&E Manager [Bob Miller, CIH]**

The AECOM-Tidewater JV SH&E Manager is a Certified Industrial Hygienist (CIH) with experience in managing safety and occupational health at hazardous waste site cleanup operations.

The SH&E Manager is responsible for developing, maintaining, and overseeing the implementation of the APP and SSHP. The SH&E Manager will approve the APP and SSHP prior to final submittal. Specific responsibilities of the SH&E Manager includes the following:

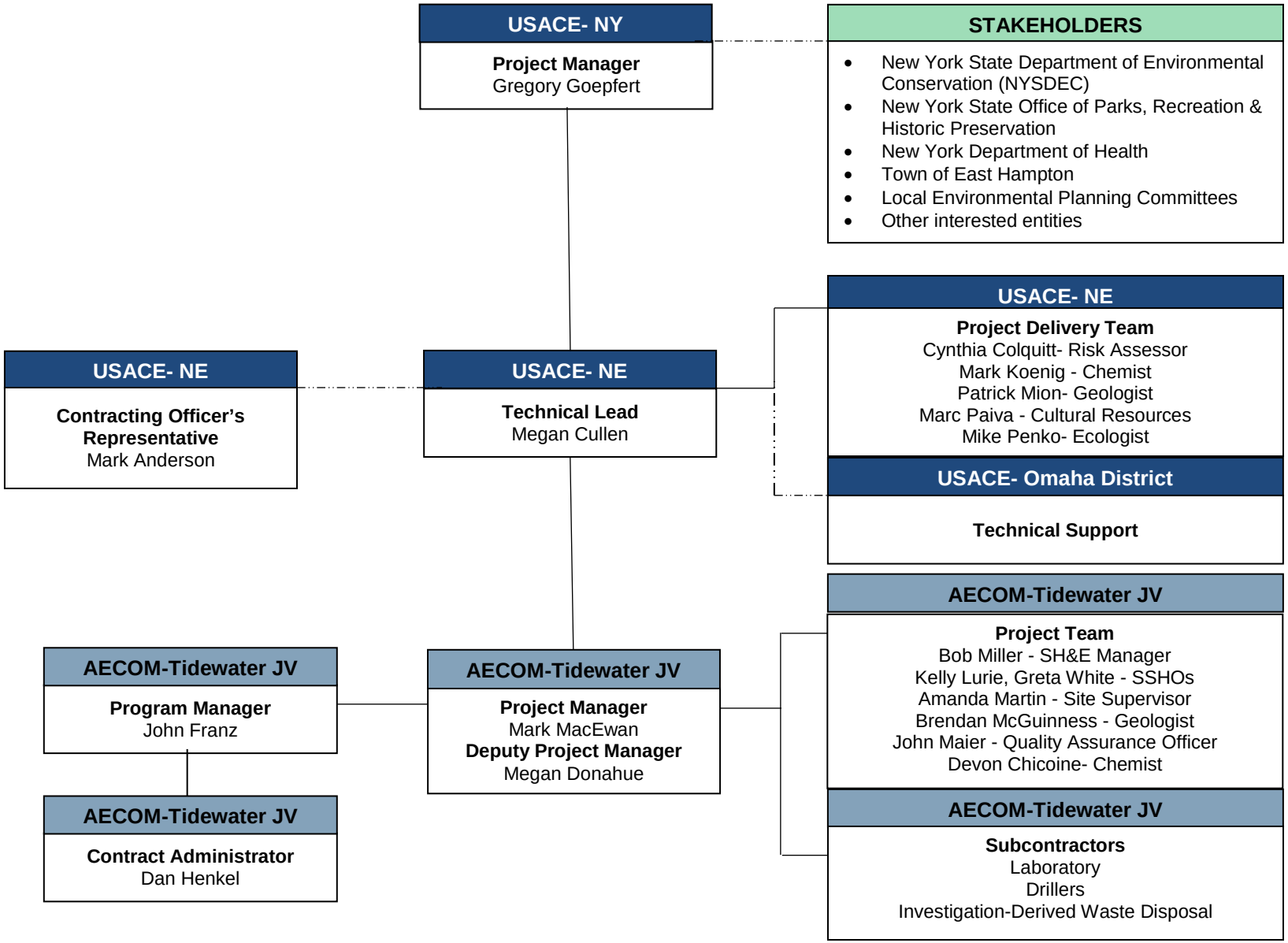
- Approve the appointment of the Site Safety and Health Officer (SSHO) and ensure that he/she has the appropriate training and competencies to perform the duties.

- Participate in quality control planning such as development of Quality Control Plans, safety and health checklists, and perform design and system safety analyses as appropriate.

- Visits the project as needed to audit the effectiveness of the safety and health program.

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## Figure 4-1 Safety Organization Chart



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- Provide safety and health expectations and flow down requirements for subcontractor statements of work.

- Be available on a 24-hour basis for consultation with SSHO during onsite emergencies or as needed.

- Coordinate any modifications to the safety plans with the SSHO and Task Order Manager (TOM), as required.

- Evaluate occupational exposure monitoring/air sampling data and adjust APP/SSHP requirements as necessary.

- Provide continued support for upgrading and/or downgrading the level of personal protective equipment (PPE).

- Participate in the investigation of unplanned events, high loss potential incidents, and accidents.

- Assist in development of onsite training, which will be provided by the SSHO.

**Project Manager [Mark MacEwan, PE, PMP]**

The AECOM-Tidewater JV PM represents the company in all aspects of the project work and is responsible for the following:

- Providing leadership by, among other things, setting an example for all site personnel through actions and words regarding the importance of proper health and safety practices and holding project staff accountable for safety performance.

- Coordinating all work performed by AECOM-Tidewater JV personnel and subcontractors for the project.

- Ensuring the APP/SSHP is approved prior to commencing field operations.

- Ensuring all required PPE, other types of equipment and instruments, safety incentives, and other safety-related items are budgeted and provided.

- Ensuring that subcontractor “Statements of Work” include appropriate safety provisions and expectations.

- Ensuring that safety and health requirements are covered during kickoff meetings.
- Participating in the investigation of, and ensuring that unplanned events, high loss potential incidents, and accidents are properly reported to USACE.
- Notifying the SH&E Manager of any changes in the scope of work or site conditions, and ensuring that the APP/SSHP is updated to address new hazards.
- Immediately stopping operations in the event of an emergency or serious hazard, in order to protect personnel and the environment.
- Preparing and submitting required work progress reports.

**Deputy Project Manager/SH&E Coordinator [Megan Donahue, PG, PMP]**

The DPM reports to PM and has overall management authority and responsibility for all site operations, including safety in PM's absence.

The DPM also acts as SH&E Coordinator reporting to the SH&E Manager and coordinates with the Site Supervisor (SS) and SSHO to ensure the fulfillment of the safety needs of the project operations. The SH&E Coordinator provides support to the SSHO with developing, maintaining, and overseeing the implementation of the APP and SSHP. Responsibilities of the SH&E Coordinator includes the following:

- Participate in quality control planning such as development of Quality Control Plans, safety and health checklists, and other routine safety systems as appropriate.
- Coordinates SH&E expectations and requirements for subcontractor statements of work.
- Coordinate any modifications to the safety plans with the SSHO and PM, as required.
- Tracks training and certification requirements and documentation for field personnel.
- Provide continued support for upgrading and/or downgrading the level of PPE.
- Assist in implementing onsite training, which will be provided by the SSHO.

**Site Safety and Health Officer [Kelly Lurie, Greta White]**

The SSHO will be on site at all times when work is being conducted. The SSHO's OSHA 30-Hour Training Certificate is provided in Appendix D. The SSHO will be responsible for managing, implementing, and enforcing AECOM-Tidewater JV's health and safety program in accordance with the accepted APP. The SSHO will be a competent person that can identify existing and predictable hazards in the working environment or working conditions that are dangerous to personnel, and who has authorization to take prompt corrective measures to eliminate them. The SSHO will have the authority and is responsible for the following actions:

- Be present during investigation operations to implement the APP/SSHP. All site personnel must be able to communicate via phone or radio to the SSHO at all times.

- Inspect site activities to identify safety and occupational health deficiencies and correct them.

- Coordinate changes/modifications to the APP/SSHP with the SH&E Manager, PM, and SS.

- Ensure all field personnel, including any subcontractor personnel, assigned to the project have satisfied requirements for training and medical surveillance as specified by 29 Code of Federal Regulation (CFR) 1910.120, and that records of training and medical approval are available and maintained for each person.

- Oversee compliance with the APP/SSHP procedures and OSHA regulations through daily inspections.

- Serve as a member of the quality control staff on matters relating to safety and health.

- Stop work if unacceptable safety and health conditions exist, and take necessary action to re-establish and maintain safe working conditions.

- Operate and maintain air monitoring equipment required at a site for airborne contaminates and prepare air monitoring reports.

- Maintain all required safety and health records (e.g., OSHA 300 Logs, incident/accident reports, training certificates and qualifications, equipment checklists, safety plans, air monitoring data and reports, etc.) throughout the life of the project.

**Site Supervisor [Amanda Martin]**

The SS will manage the onsite investigation operations in accordance with the approved Work Plan and APP/SSHP. The SS will coordinate all onsite personnel and equipment conducting investigation operations in a safe manner. The SS will coordinate all work with the SSHO to ensure that all safety concerns are adequately addressed and controlled. The SS will immediately stop work in the event of an emergency or serious hazard in order to protect personnel and the environment. The SS will work with the SH&E Manager, PM/DPM, and SSHO in coordinating changes/modifications to the APP/SSHP, as needed.

**UXO Technician II [Nina Bennerson]**

Based on a UXO probability analysis completed by USACE Baltimore District, it has been determined that the Camp Hero site activities have a low probability of encountering munitions and explosives of concern (MEC), except for areas H and K, which will not be entered at any point during RI field activities. Anomaly avoidance will be conducted in accordance with EM 385-1-97 during subsurface investigations. "Anomaly avoidance" is defined as the avoidance of surface MEC and any subsurface anomalies where the specific activity can be moved to another location. A UXO Technician II will conduct anomaly avoidance during RI field activities. The UXO Technician II will have the appropriate level of training and experience as stated in Department of Defense Explosives Safety Board Technical Paper 18.

**Field Personnel**

Field Personnel will be responsible for understanding and following the APP/SSHP and performing their work in a safe and responsible manner. Specific responsibilities will include the following:

- Act in a responsible manner at all times in order to prevent incidents, injury, and/or exposure to themselves and their co-workers, this includes exercising Stop Work Authority if needed.

- Report any and all incidents, including near misses, to the SS or SSHO.

- Attend and participate in all daily health and safety tailgate meetings.

- Participate in the development of AHAs as required, and follow the provisions as outlined in the final AHAs.

- Follow instructions and directions of the SSHO and SS.

- Utilize the prescribed PPE provided for each task.

- Following all field safety procedures for safe work practices (e.g., the buddy system, communication, site control, decontamination, evacuations, and related emergency procedures).

- Perform only those tasks they have been instructed to perform if they are trained, qualified, and capable of performing safely at the time of assignment.

- Report any personal condition that could affect their safety and/or the safety of co-workers (e.g., fatigue, drowsiness, severe illness, impairment by prescription medications, influence by drugs and alcohol, emotional stress, or other condition).

- Ensure that no work tasks are performed in deviation from the APP/SSHP and/or the initial instructions of the SSHO and SS.

- Complete ordnance recognition training prior to the start of field activities, understand anomaly avoidance procedures, and utilize stop work authority immediately if MEC or CWM is suspected.

**Site Visitors**

Site visitors will:

- Participate in a site briefing before leaving the administrative office or site entry point.

- Follow all site rules and instructions.

- Be escorted at all times by authorized personnel unless otherwise approved by the SSHO.

- Wear PPE provided.

Conformance of everyone with these responsibilities is necessary to achieve the goals of the APP/SSHP. Failure to do so could result in removal from the site.

### 4.c. Names of Competent and Qualified Personnel

Competent persons are qualified individuals that can identify existing and predictable hazards in the working environment or working conditions that are dangerous to personnel and have authorization to take prompt corrective measures to eliminate them. The only planned task requiring the designation of a competent person at Camp Hero is MEC anomaly avoidance support. Anomaly

avoidance will be conducted in accordance with EM 385-1-97 during subsurface investigations. The competent person for this task is listed below.

| Title | Inspection Role | Name | Proof of Competency |
|---|---|---|---|
| UXO Technician II | MEC Anomaly Avoidance | Nina Bennerson | See Appendix E |

### 4.d. Competent Person Work Requirements

In order to complete certain specified tasks (drill rig operation, excavation inspections, etc.), a designated subcontractor competent person must be on site to perform the required daily inspections of certain equipment and/or operations. No work may be performed on these tasks unless the subcontractor competent person is present on the job site.

### 4.e. Pre-Task Safety and Health Analysis Requirements

AHAs are used to identify hazards and hazard controls associated with a specific job function. AHAs focus on the relationship between the workers, the task, the resources required to complete the task, and the work environment. These variables must be evaluated to identify the potential hazards associated with the task. Once identified, steps can be taken to eliminate, reduce, or control the hazards to an acceptable risk level. Guidelines for developing AHAs are located in SH&E SOP 5-209-*Hazard Assessment and Project Planning*.

### 4.f. Stop Work Authority

All employees have the right and duty to stop work when conditions are unsafe, and to assist in correcting these conditions as outlined in SH&E SOP 5-002-*Stop Work Authority for Unsafe Work*. Whenever the SSHO determines that workplace conditions present an uncontrolled risk of injury or illness to employees, immediate resolution with the appropriate supervisor shall be sought. Should the SS be unable or unwilling to correct the unsafe conditions, the SSHO is authorized and required to stop work, which shall be immediately binding on all affected AECOM-Tidewater JV employees and subcontractors. **Stop work authority will be used immediately if MEC or CWM is suspected.**

Upon issuing the stop work order, the SSHO shall implement corrective actions so that operations may be safely resumed. Resumption of safe operations is the primary objective; however, operations shall not resume until the SH&E Manager and PM have concurred that workplace conditions meet acceptable safety standards. Reviewing and updating the appropriate AHA and other documentation may be necessary to document the change. All stop work actions must be documented in the field notes and immediate contact made with the AECOM-Tidewater JV PM.

### 4.g. Lines of Authority

Figure 4-1 illustrates the lines of authority for the personnel responsible for project safety.

### 4.h. Noncompliance Policies and Procedures

Employee non-compliance with safety requirements is taken very seriously by AECOM-Tidewater JV management. Personnel not following procedures are warned and counseled on the proper safety procedures and if the problem persists, are again counseled with notations made in their permanent record. Continued non-compliance can lead to termination of employment.

AECOM-Tidewater JV has developed the following progressive discipline policy for the violation of safety requirements. Extremely careless or reckless violations may results in immediate termination. All instances of progressive disciplinary action will be handled in conjunction with the sponsoring joint–venture employer (Tidewater or AECOM) Human Resource Department.

**First Violation:** An oral warning will be given for the first violation of a SH&E requirement depending on the severity of the violation. The employee will be informed by his or her supervisor of the violation and of the correct safe practice or procedure. The supervisor will review with the employee all applicable safety and health workplace requirements and guidelines. The employee must sign a statement indicating understanding of those requirements and guidelines. The supervisor should inform the employee that future violations will result in higher levels of discipline and may lead to dismissal.

**Second Violation:** The employee may be given a written warning for the second documented safety and health requirement violation. This warning will specifically identify the violation. The warning will also refer the employee to applicable safety and health requirements and guidelines for review, and also show the date the employee previously read and signed the statement of understanding of safety and health requirements and guidelines. The employee, the employee's supervisor, the department head, Human Resources, and the employee's personnel file receive copies of the warning.

**Third Violation:** The employee may be given a final warning for the third documented violation of safety and health requirements or guidelines. This warning will specifically identify the violation. It will also state that any further violation of safety and health requirements and guidelines will result in dismissal. All persons who receive a copy of the previously written warning will receive a copy of the final warning.

**Any Subsequent Violation:** The employee may be dismissed for a subsequent violation. If dismissed, the employee will receive a letter specifically identifying the violation of the safety and health requirement or guideline, as well as rights of appeal through the grievance process.

**Immediate Termination:** On occasion, an employee can commit a violation of a safety and health requirement or guideline that is so careless and reckless, or that so endangers life or property, that it can be considered imminently dangerous. When this occurs, an employee can be dismissed immediately, without benefit of any warnings. An employee dismissed in this fashion will receive a letter specifically identifying the violation and setting out his/her right of appeal within the grievance process.

**Discipline for Subcontractor Personnel:** If noncompliance actions are committed by subcontractor personnel, AECOM-Tidewater JV will recommend that the employer discipline the employee. If the action continues, AECOM-Tidewater JV will have the employer remove the employee from the site. If the employer refuses to adhere to our requirements, they may be dismissed from the project.

**Documentation:** Employee warnings and disciplinary actions will be documented using AECOM-Tidewater JV's Corporate Memorandum format in a manner consistent with the requirements of this policy and the sponsoring joint–venture employer (Tidewater or AECOM) Human Resource Department.

### 4.i Manager and Supervisor Accountability

Managers and supervisors are responsible for enforcing safety and health as part of their job descriptions. They are ultimately responsible for protecting the welfare of the employees, as well as minimizing the potential liability associated with on-the-job accidents. Annual performance reviews and incentive plans for managers and supervisors include the assessment of both the individual's safety performance as well as their project safety performance.

# 5. SUBCONTRACTORS AND SUPPLIERS

## 5.a. Subcontractor and Supplier Identification

The following types of subcontractors and suppliers may be utilized for field activities at Former Camp Hero, if the tasks are not self-performed by the AECOM-Tidewater JV:

- Utility Clearance;
- Driller (Direct Push) for concrete coring/soil boring/sampling/well installation;
- Driller (Hollow Stem Auger) for soil boring;
- Geophysical Surveyor to locate potential leach fields/underground storage tanks/utilities;
- Land Surveyor to locate newly-installed permanent monitoring wells;
- Mechanical Excavation contractor to excavate test pits using heavy equipment;
- Waste transportation and disposal subcontractor for removal and disposal of investigation-derived waste (IDW); and
- Various suppliers for field sampling equipment and health and safety supplies.

## 5.b. Subcontractor Safety Responsibilities

Each AECOM-Tidewater JV subcontractor is responsible for assigning specific work tasks to their employees. Each subcontractor's management will provide qualified employees and allocate sufficient time, materials, and equipment to safely complete assigned tasks. In particular, each subcontractor is responsible for equipping its personnel with any required PPE and adherence to all applicable SH&E performance or regulatory standards.

AECOM-Tidewater JV's SSHO will be responsible for ensuring subcontractor compliance with the APP/SSHP. Specific responsibilities of subcontractor employees include:

- Compliance with the requirements of their Scope of Work.
- Participate in development of a SSHP with THAs for their work activities.
- Maintain a safe and healthy work environment.

- Compliance with the APP, contract requirements, laws, regulations, and Engineering Manual (EM) 385-1-1.
- Review the APP to ensure that the health and safety requirements of their specific tasks are satisfied.
- Provide trained and experienced workers for the specific work activities.
- Participate in the Daily Safety Tailgate Meetings.
- Identify additional training needs for unique tasks.
- Enforce company- and project-specific rules and procedures during work activities.
- Report all incidents and participate in the investigations.
- Participate in routine site inspection activities.
- Ensure all equipment brought to the site is in proper working order, is routinely inspected and maintained in safe working order.

### 5.c. Supplier Safety Responsibilities

All suppliers of safety-related items are required to provide approved and/or appropriate materials for the project, and meet applicable specifications, testing criteria or third party certifications. These items will be inspected upon receipt by the SSHO.

Each hazardous material supplied for site use will be accompanied by a Material Safety Data Sheet (MSDS) and will be added to the site list of hazardous materials. These materials must be pre-approved for use by the PM and SSHO prior to being brought onto the jobsite. MSDSs and the list will be maintained by the SSHO.

# 6. TRAINING

## 6.a. New Hire Safety Orientation Training

Employees will be provided with safety and health orientation prior to the start of work. All orientation training will be documented in writing by data, name, content, and trainer. The training will, at a minimum, include:

- Requirements and responsibilities for accident prevention and the maintenance of safe and healthful work environments.
- General safety and health policies and procedures and pertinent provisions of EM 385-1-1.
- Employee and supervisor responsibilities for reporting all accidents.
- Provisions for medical facilities and emergency response and procedures for obtaining medical treatment or emergency assistance.
- Procedures for reporting and correcting unsafe conditions or practices.
- Job hazards and the means to control/eliminate those hazards, including applicable THAs.

## 6.b. Mandatory Training and Certifications

The following training and certificates are mandatory for the RI field work at Camp Hero.

**Hazardous Waste Operations and Emergency Response Training**.

Personnel who participate in field activities associated with this project must be qualified Hazardous Waste Operations and Emergency Response (HAZWOPER) workers (unless otherwise noted in specific AHA or by the SSHO), and must meet the training and medical monitoring requirements. Personnel must have successfully completed training, meeting the provisions established in 29 CFR 1910.120 for 40-hour training and 8-hour annual refresher training. Additionally, onsite management and supervisors directly responsible for, or who supervise employees engaged in, hazardous waste operations shall receive at least eight additional hours of specialized hazardous waste operations management training. Appendix E contains project personnel HAZWOPER training and medical monitoring documentation.

**Site Supervisor Training.**

In addition to HAZWOPER training, onsite management and supervisors directly responsible for, or who supervise employees engaged in, hazardous waste operations shall receive at least eight

additional hours of specialized hazardous waste operations management training. Appendix E contains project Site Supervisor 8-hour HAZWOPER training and medical monitoring documentation.

**Site Safety and Health Officer Training.**

In addition to HAZWOPER training, onsite management and supervisors who act as the SSHO shall receive the OSHA 30-hour General Industry or Construction Industry Procedures Training. The SSHO's OSHA 30-Hour Training Certificate is provided in Appendix D.

**Medical Monitoring.**

AECOM-Tidewater JV personnel performing onsite work that may result in exposure to contaminant-related health and safety hazards are enrolled in the medical surveillance program that complies with OSHA standard 29 CFR 1910.120 (f)/29 CFR 1926.62 (f).

They will have successfully completed a pre-placement occupational physical examination and annually thereafter. The medical surveillance program meets the following requirements:

- The physician's opinion concerning the employees' abilities to perform the assigned work shall be provided to the SH&E Manager or designated company HR representative.
- The required written physician's opinion shall be made available upon request.
- All medical records are maintained in accordance with 29 CFR 1910.1020.
- Examinations are given at least once every 12 months unless the attending physician believes a longer interval (not greater than biennially) is appropriate.
- Examinations are administered by a licensed physician who is certified by the American Board of Preventive Medicine.

Medical examinations must meet the requirements specified by the licensed physician. The physician takes into account site-specific contaminant issues during the examinations. This examination has been designed to meet the requirements of 29 CFR 1910.120 (f) requirements for hazardous waste site operations. The employee will be informed of any medical conditions that would result in work restriction or that would prevent them from working at hazardous waste sites.

AECOM-Tidewater JV will certify that all employees have successfully completed a physical examination by a qualified occupational health physician and will supply certification of

medical clearance for each onsite employee. Certification of medical surveillance program participation is provided as Appendix E. The certifications include employee name, date of last examination, and name of examining physician.

**Ordnance Recognition Training.**

Prior to beginning field operations, all field personnel, including AECOM-Tidewater JV employees and subcontractors, will complete Ordnance Recognition Training in order to identify potential explosive hazards and react appropriately. **Stop work authority will be used immediately if MEC is suspected.**

**UXO Technician II Training.**

The UXO Technician II will have the appropriate level of training and experience as stated in DDESB Technical Paper 18.

**Chemical Warfare Materiel Recognition Training.**

Prior to beginning field operations, all field personnel, including AECOM-Tidewater JV employees and subcontractors, will complete CWM and CAIS Recognition Training in order to identify potential explosive hazards and react appropriately. **Stop work authority will be used immediately if CWM is suspected.**

### 6.c. Procedures for Periodic Safety and Health Training

The SSHO will maintain training/certification records on site for all personnel as well as track training expiration dates. Prior to expiration, the SSHO will coordinate training of all site personnel with the PM to maintain valid training/certification requirements.

### 6.d. Emergency Response Training

AECOM-Tidewater JV will provide training in the handling of emergency situations that may arise from project activities or equipment operation. Prior to commencement of project activities, all site personnel will be trained on the posted emergency telephone numbers, location and use of spill kit materials, directions to the hospital, location and use of fire extinguishers, location of first aid kits, and the persons who are certified in first aid and CPR. Additional details on applicable emergency response training and procedures are provided in Section 9.b, Emergency Response Plans.

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# 7. SAFETY AND HEALTH INSPECTIONS

## 7.a. Daily Job Site Safety and Health Inspection

The SSHO will conduct daily jobsite health and safety inspections/audits to identify new or previously unidentified hazards, verify the effectiveness of hazard control measures, observe workers performing tasks, and provide feedback to workers. Deficiencies that pose a significant safety hazard will be corrected immediately, or work will be stopped in the affected area until the deficiency is corrected. The daily jobsite health and safety inspection will be documented in the SSHO logbook.

Safety and health issues and deficiencies identified during the "weekly" level inspections, and the actions, timetable, and responsibility for correcting the deficiencies, will be recorded on an inspection form. Follow-up inspections to ensure correction of any identified deficiencies will also be conducted and documented on an inspection form. If safety and health issues or deficiencies are documented during the inspection, the weekly inspection report will be submitted to NAE.

AECOM-Tidewater JV will establish a safety and occupational health deficiency tracking log that lists and monitors the status of safety and health deficiencies. The log will be available, be updated daily, and will provide the following information:

- Data of deficiency.
- Description of deficiency.
- Name of person responsible for correcting deficiency.
- Projected resolution date.
- Date actually resolved.

Table 7-1 lists the safety and health inspection requirements for field operations at Former Camp Hero.

**Table 7-1**
**Safety and Health Inspection Requirements**

| What | Who | When | Documentation |
|---|---|---|---|
| General Site Conditions | SSHO | Daily | Log Book |
| | SSHO | Weekly | Safety Inspection Form |
| | Task Order Manager | Monthly | Safety Inspection Form |
| | SH&E Manager | Quarterly | Safety Inspection Form |
| Tools and Equipment | Users | Daily | Tag and Remove Defective Items from Service |
| PPE | Users | Upon issue and daily thereafter | Reported to SSHO for log book entry |

### 7.b. External Inspections and Certifications

External inspections are not expected for this project. In the event that an OSHA or other regulatory agency inspection, AECOM-Tidewater JV will immediately notify and provide USACE the opportunity to accompany AECOM-Tidewater JV on the inspection. AECOM-Tidewater JV will provide USACE a copy of any citations or reports issued by the inspector and any corrective action responses to the citation(s) or report(s).

## 8. ACCIDENT REPORTING

All accidents and incidents that occur on site during any field activity will be promptly reported to the SSHO and the immediate supervisor in accordance with SH&E SOP 5-004-*Incident Reporting*. If any AECOM-Tidewater JV employee is injured and requires medical treatment, the SS will contact the AECOM-Tidewater JV **SH&E Manager and the PM immediately**. The SS will initiate a written report, using the ***Supervisor's Report of Incident*** form (or equivalent). The report will then be provided to the Regional SH&E Manager before the end of the following shift.

All accidents and incidents that occur on site will comply with the USACE Accident Reporting requirement that all work-related recordable injuries, illnesses and property damage accidents (excluding on-the-road vehicle accidents), in which the property damage exceeds $5,000.00, shall be verbally reported to USACE within 4 hours of the incident. Serious accidents as described in EM 385-1-1 Section 01.D.02 shall be immediately reported to USACE. ENG Form 3394 shall be completed and submitted to USACE within five working days of the incident.

If any employee of a subcontractor is injured, documentation of the incident will be accomplished in accordance with the subcontractor's procedures; however, copies of all documentation (which at a minimum must include the OSHA Form 301 or equivalent) must be provided to the SSHO within 24 hours after the accident has occurred.

All accidents/incidents will be investigated in accordance with SH&E SOP 5-603-*Incident Investigation and Review*. Copies of all subcontractor accident investigations, whether accomplished in accordance with their own procedures or SH&E SOP 5-004-*Incident Reporting*, will be provided to the SSHO within five (5) days of the accident/incident.

All personnel at the work site shall use the buddy system, staying within sight of their partner. If a partner becomes incapacitated or severely ill, an ambulance shall be called. In the event that a cessation of work is ordered, all personnel should:

- Assist the SSHO and/or SS, if required, in decontaminating the victim and/or administering first aid.
- Leave the contaminated area and undergo decontamination prior to entering the worker rest area.
- Assist emergency response personnel when requested.

All workers receiving medical treatment by a physician will obtain a release from the physician on the date of treatment stating one of the following: (1) the employee is not fit for duty, (2) the employee is fit for restricted duty, or (3) the employee is fit for duty.

### 8.a. Exposure Data

AECOM-Tidewater JV will maintain records of all exposure and accident experience incidental to the project work including AECOM-Tidewater JV personnel and subcontractors. These records will include exposure work hours and a log of occupational injuries and illnesses (OSHA Form 300 or equivalent). The monthly exposure hours, which captures hours expended for on-site work, will be submitted to the NAE Safety Manager Shelia Harvey, electronically to sheila.harvey@usace.army.mil.

### 8.b. Accident Investigations, Reports, and Logs

USACE requires that all injuries be reported as soon as reasonably possible, but no later than 24 hours. Notification of accidents, injuries, and illnesses will be evaluated and reported in accordance with applicable USACE requirements. The SH&E Manager will report the incident to USACE by completing a Contractor Significant Incident Report. The SH&E Manager will review all documentation associated with the incident, and will assist in the performance of any necessary accident investigation or other follow-up. The PM will ensure that the recommendations resulting from any investigation are implemented without delay.

Daily records of all first aid treatments not otherwise reportable will be recorded on a first aid treatment form and furnished to USACE upon request.

### 8.c. Immediate Accident Notification

An accident that has, or appears to have, any of the consequences listed below will be immediately reported by AECOM-Tidewater JV to USACE. The following accidents will be investigated in depth to identify all causes and to recommend hazard control measures:

- A fatal injury/illness.
- A permanent totally disabling injury/illness.
- A permanent partial disabling injury/illness.
- The hospitalization of three or more people as inpatients resulting from a single occurrence.
- Accidental property damage of $200,000 or more.

AECOM-Tidewater JV will also notify OSHA when any employees are hospitalized or if a fatality occurs relating to work activities within eight hours of said incident. All work in-patient hospitalizations amputations and loss of an eye are to be reported to OSHA within 24 hours.

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# 9. PLANS (PROGRAMS, PROCEDURES) REQURIED BY THE SAFETY MANUAL

Based on the scope of site investigation activities, all applicable safety plans, programs, and procedures to address risk and compliance requirements were identified and are described below.

## 9.a. Layout Plans

Locations where drilling will be conducted are shown on Figure 9-1. An existing general location maps for the AOCs are provided as Figures 9-2 through 9-10, including locations where geophysical surveys and test pitting will occur. Prior to drilling and sampling activities, more detailed layout plans will be generated and included in the site-specific Work Plan.

## 9.b. Emergency Response Plans

The AECOM-Tidewater JV site team will hold an emergency response plan meeting during mobilization and prior to fieldwork to discuss and define the following:

- Personnel roles and line of authority
- Safe distances from emergency location
- Evacuation/Hospital route, procedures, and pre-determined meeting place
- Medical emergency and communication procedures
- Emergency alert and response procedures
- Emergency equipment and location onsite

The Emergency Response Plan (ERP) will be discussed during initial site training and discussed regularly during the Daily Tailgate Safety Meetings. Annually, or as needed, the SSHO and the PM will review the ERP and make any changes necessary to keep the ERP current with new or changing site conditions and information. The SSHO will conduct drills monthly or more frequently if conditions change to evaluate the response and testing the effectiveness of the ERP. Conditions that may lead to an emergency situation during field activities will be addressed in specific AHAs as tasks are identified. These conditions include:

- Fire
- Vehicle collisions or rollovers
- Environmental release
- Unintended detonation
- Severe weather
- Medical emergency due to heat/cold stress, physical/physiological incident, allergic reactions

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AGC
Site 4

Background

WDS

H-19

H-20

H-9

H-3

Hill 83

Hill 72

H-15

Plotting
Room 113

H-22

Background

H-6

WDS

H-4

Motor
Pool

Tank G

Background

WDS

WDS

WDS

H-16

WDS

Engineering
Field office

WDS

WDS

H-14

Battery
216

H-21

H-7

Pump
House/
Tank F

Bldg
104R

Bldg 22

WDS

H-17

Bldg 2

WDS

Bldg
3001

H-11,
WDS H-12

Bldg
2010

H-8

WDS

WDS

WDS

WDS

WDS

WDS

WDS

WDS

Bldg 20

AST-35
Distribution
Line

WDS

AGC
Site 2

AST-35

Bldg 201

Bldg 203

Bldg
F100C

H-2

H-1

AGC
Site 1

Background

**Area H**

**Area K**

Drilling Areas
Existing Building
Bunker or Battery
Former Building
Waste Disposal System
Streams

NY CT RI MA NJ Camp Hero

MAP LOCATION

Surface water features obtained from National Hydrography Dataset (NHD) Dates of publication vary.

2013 NAIP Aerial Imagery obtained from the USDA Geospatial Data Gateway, a service of the US Department of Agriculture.

Wetlands shapes from U. S. Fish and Wildlife Service. 2015. National Wetlands Inventory website. http://www.fws.gov/wetlands/

NAD 1983 StatePlane Long Island FIPS 3104

N W E S

0 175 350 700 Feet

1 inch = 400 feet

[redacted]

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# Drilling Locations

Camp Hero Accident Prevention Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 9-1** |

5/18/2016 1:4,800 Y:\Projects\Camp_Hero\Maps\APP\Figure 9-1 Drill_Locs.mxd

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MAP LOCATION

Surface water features obtained from National Hydrography Dataset (NHD) Dates of publication vary.

2013 NAIP Aerial Imagery obtained from the USDA Geospatial Data Gateway, a service of the US Department of Agriculture.

Wetlands shapes from U. S. Fish and Wildlife Service. 2015. National Wetlands Inventory website. http://www.fws.gov/wetlands/

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# Key to Detail Maps

Camp Hero Accident Prevention Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 9-2** |

5/3/2016 1:9,600 Y:\Projects\Camp_Hero\Maps\APP\Figure 9-2 Key to Detail Maps.mxd

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**FWS Wetlands 2014**

- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond; Lake

22 - Office, Kitchen

B

Bldg 206

Northern tilefield extent is estimated. It extends off historic drawings.

Bldg 2

C

Barracks

27

Kitchen/ Exchange Store

3 - Gym/ Recreation

7

Bldg 4

6 - Mess

8

B

Bldg 5

H-11

29

28

Heating Plant

10

H-12

Sewage Ejector Station

Bldg 11

12

A

Force Main

13

14

C

22

21

15

20 - Fire Dept.

16

19 - Barracks

17

- Geoprobe Soil/GW Sample Location
- Water Well
- Proposed Background Soil Samples
- AOCs from Cashin Report
- Hills

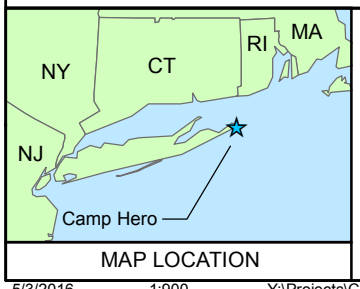
**Buildings**

- Existing Building
- Bunker or Battery
- Former Building

**Storage Tanks**

- AST (closed)
- AST to be Investigated
- UST (closed)
- UST to be Investigated

- Geophysics Area
- Sanitary Sewer Lines A - J
- Force Main
- Secondary Sewer Line
- Septic Lines
- Drain Tilefields
- Septic Tank
- Other
- Manhole
- Box (cleanout or other)
- Cesspool




MAP LOCATION

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community Surface water features obtained from National Hydrography Dataset (NHD) Dates of publication vary.

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Wetlands shapes from U. S. Fish and Wildlife Service. 2015. National Wetlands Inventory website. http://www.fws.gov/wetlands/

NAD 1983 StatePlane Long Island FIPS 3104

N W E S

0 37.5 75 Feet

1 inch = 75 feet

[redacted]

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# Site Detail 1

Camp Hero Accident Prevention Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 9-3** |

5/3/2016 1:900 Y:\Projects\Camp_Hero\Maps\APP\Figure 9-3 SiteDetail1.mxd

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**FWS Wetlands 2014**

- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond; Lake

39

BG-01

H-7

38

Plotting/Switchboard
Room (112, 113)

Bldg
206

Commisary

D

46

H-17

A

Bldg 4

E

26

Bldg
3001

49

- Geoprobe Soil/GW Sample Location
- Water Well
- Proposed Background Soil Samples
- AOCs from Cashin Report
- Hills

**Buildings**

- Existing Building
- Bunker or Battery
- Former Building

**Storage Tanks**

- AST (closed)
- AST to be Investigated
- UST (closed)
- UST to be Investigated

- Geophysics Area
- Sanitary Sewer Lines A - J
- Force Main
- Secondary Sewer Line
- Septic Lines
- Drain Tilefields
- Septic Tank
- Other
- Manhole
- Box (cleanout or other)
- Cesspool




MAP LOCATION

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community Surface water features obtained from National Hydrography Dataset (NHD) Dates of publication vary.

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Wetlands shapes from U. S. Fish and Wildlife Service. 2015. National Wetlands Inventory website. http://www.fws.gov/wetlands/

NAD 1983 StatePlane Long Island FIPS 3104

N W E S

0 50 100 Feet

1 inch = 100 feet

[redacted]

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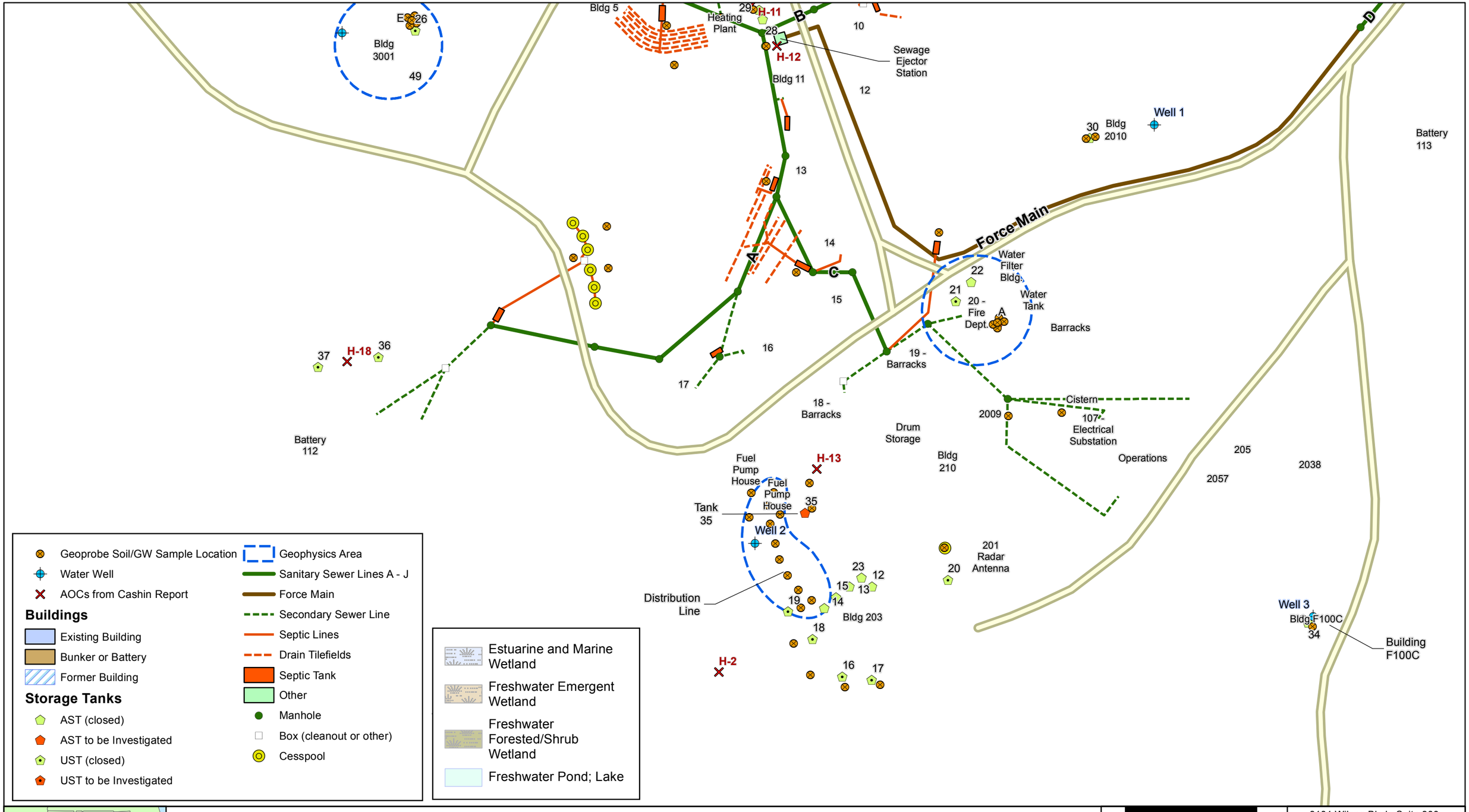
# Site Detail 2

Camp Hero Accident Prevention Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 9-4** |

5/3/2016 1:1,200 Y:\Projects\Camp_Hero\Maps\APP\Figure 9-4 SiteDetail2.mxd

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- Geoprobe Soil/GW Sample Location
- Water Well
- AOCs from Cashin Report

**Buildings**

- Existing Building
- Bunker or Battery
- Former Building

**Storage Tanks**

- AST (closed)
- AST to be Investigated
- UST (closed)
- UST to be Investigated

- Geophysics Area
- Sanitary Sewer Lines A - J
- Force Main
- Secondary Sewer Line
- Septic Lines
- Drain Tilefields
- Septic Tank
- Other
- Manhole
- Box (cleanout or other)
- Cesspool

- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond; Lake




MAP LOCATION

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community Surface water features obtained from National Hydrography Dataset (NHD) Dates of publication vary.

2013 NAIP Aerial Imagery obtained from the USDA Geospatial Data Gateway, a service of the US Department of Agriculture.

Wetlands shapes from U. S. Fish and Wildlife Service. 2015. National Wetlands Inventory website.

N W E S

0 65 130 260 Feet

1 inch = 130 feet

[redacted]

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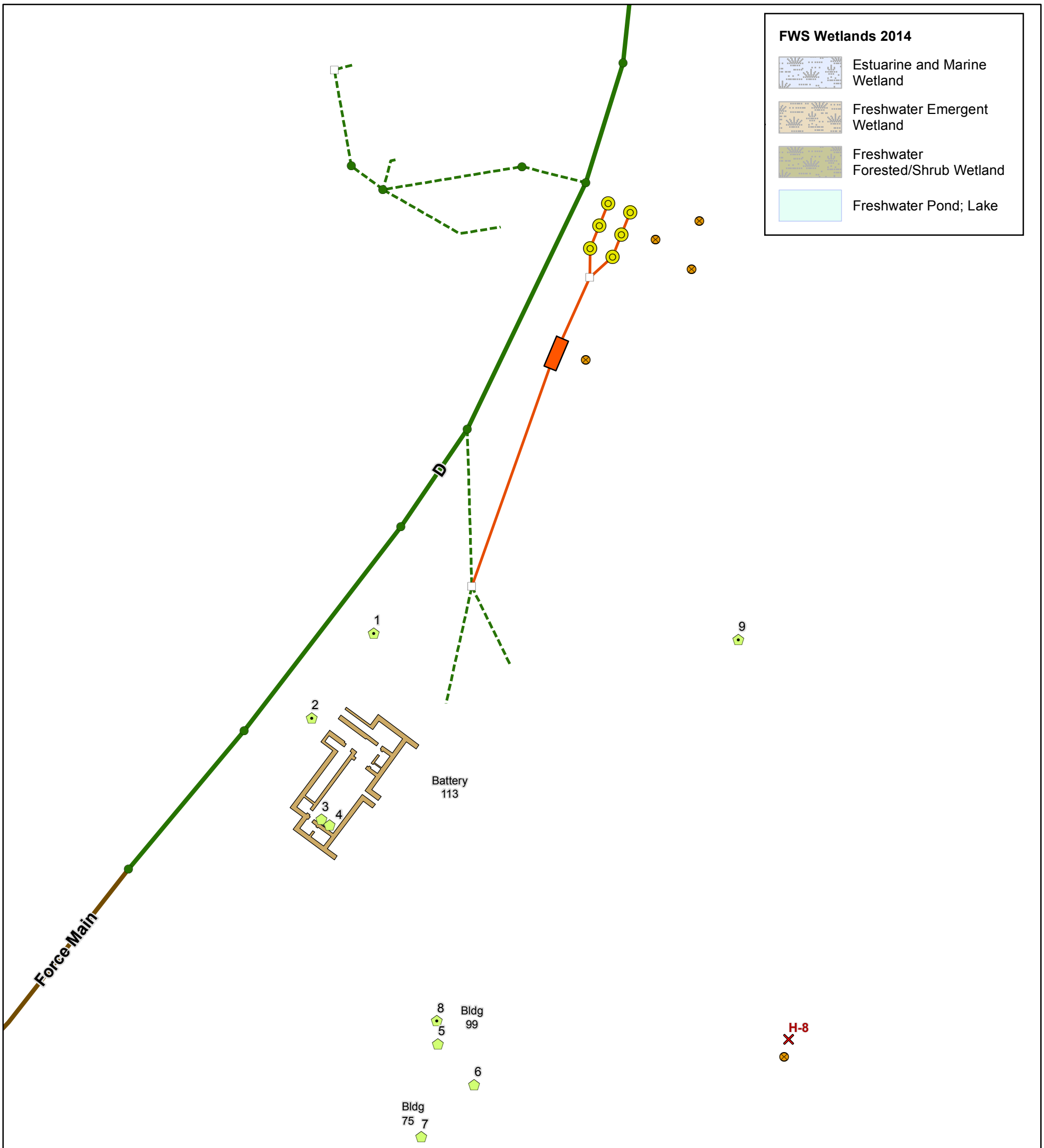
# Site Detail 3

Camp Hero Accident Prevention Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 9-5** |

5/3/2016 1:1,560 Y:\Projects\Camp_Hero\Maps\APP\Figure 9-5 SiteDetail3.mxd

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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community Surface water features obtained from National Hydrography Dataset (NHD) Dates of publication vary.

2013 NAIP Aerial Imagery obtained from the USDA Geospatial Data Gateway, a service of the US Department of Agriculture.

Wetlands shapes from U. S. Fish and Wildlife Service. 2015. National Wetlands Inventory website. http://www.fws.gov/wetlands/

NAD 1983 StatePlane Long Island FIPS 3104

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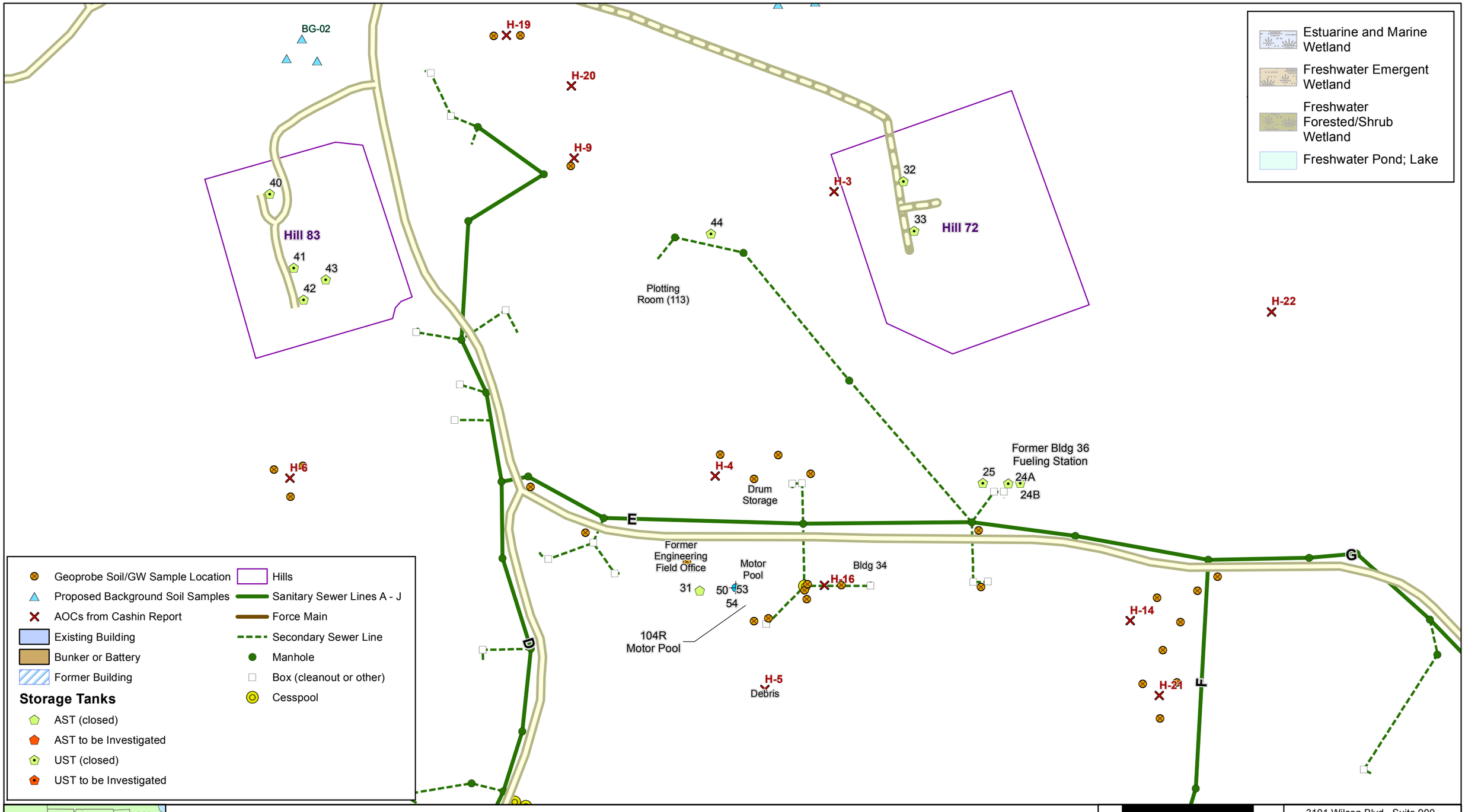
# Site Detail 4

Camp Hero Accident Prevention Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | Mary 2016 | **Figure 9-6** |

5/3/2016 1:1,020 Y:\Projects\Camp_Hero\Maps\APP\Figure 9-6 SiteDetail4.mxd

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Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community Surface water features obtained from National Hydrography Dataset (NHD) Dates of publication vary.

2013 NAIP Aerial Imagery obtained from the USDA Geospatial Data Gateway, a service of the US Department of Agriculture.

Wetlands shapes from U. S. Fish and Wildlife Service. 2015. National Wetlands Inventory website.

[redacted]

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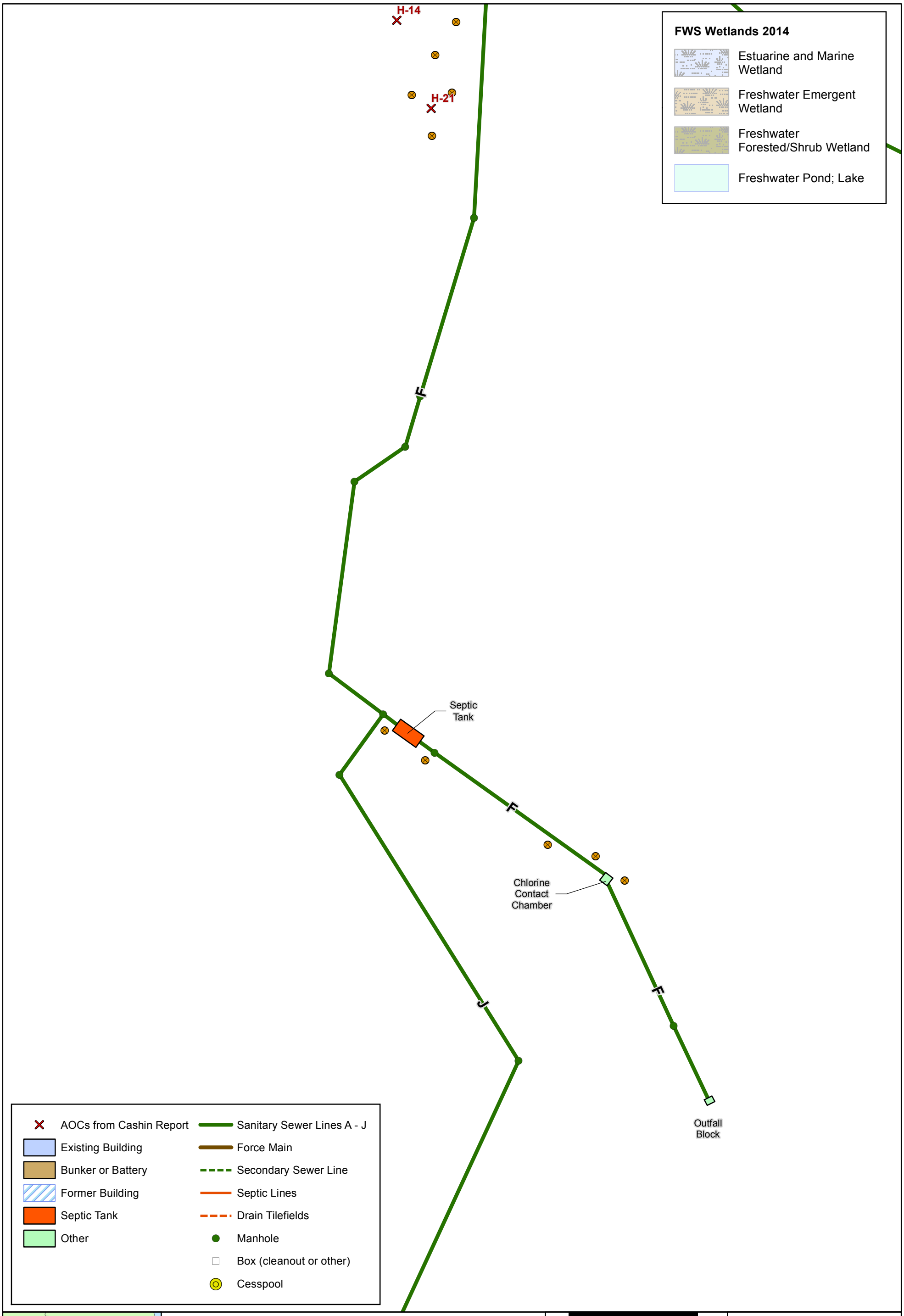
# Site Detail 5

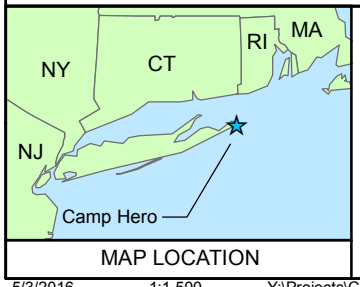
Camp Hero Accident Prevention Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 9-7** |

5/3/2016 1:1,800 Y:\Projects\Camp_Hero\Maps\APP\Figure 9-7 SiteDetail5.mxd

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MAP LOCATION

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community Surface water features obtained from National Hydrography Dataset (NHD) Dates of publication vary.

2013 NAIP Aerial Imagery obtained from the USDA Geospatial Data Gateway, a service of the US Department of Agriculture.

Wetlands shapes from U. S. Fish and Wildlife Service. 2015. National Wetlands Inventory website. http://www.fws.gov/wetlands/

NAD 1983 StatePlane Long Island FIPS 3104

N W E S

0 62.5 125 Feet

1 inch = 125 feet

[redacted]

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# Site Detail 6

Camp Hero Accident Prevention Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 9-8** |

5/3/2016 1:1,500 Y:\Projects\Camp_Hero\Maps\APP\Figure 9-8 SiteDetail6.mxd

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**FWS Wetlands 2014**

- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond; Lake

H-15

Pump House

G

Well 4

45

Battery 216

46

Original Well

F

H

G

Camp Hero State Park Bluffs

Forward Control Station (manhole)

- Geoprobe Soil/GW Sample Location
- Water Well
- AOCs from Cashin Report

**Buildings**

- Existing Building
- Bunker or Battery
- Former Building
- Geophysics Area

**Storage Tanks**

- AST (closed)
- AST to be Investigated
- UST (closed)
- UST to be Investigated

- Sanitary Sewer Lines A - J
- Force Main
- Secondary Sewer Line
- Septic Lines
- Manhole
- Box (cleanout or other)
- Cesspool




MAP LOCATION

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community Surface water features obtained from National Hydrography Dataset (NHD) Dates of publication vary.

2013 NAIP Aerial Imagery obtained from the USDA Geospatial Data Gateway, a service of the US Department of Agriculture.

Wetlands shapes from U. S. Fish and Wildlife Service. 2015. National Wetlands Inventory website. http://www.fws.gov/wetlands/

NAD 1983 StatePlane Long Island FIPS 3104

N W E S

0 65 130 Feet

1 inch = 130 feet

[redacted]

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Arlington, VA 22201
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# Site Detail 7

Camp Hero Accident Prevention Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 9-9** |

5/3/2016 1:1,560 Y:\Projects\Camp_Hero\Maps\APP\Figure 9-9 SiteDetail7.mxd

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Estuarine and Marine Wetland
Freshwater Emergent Wetland
Freshwater Forested/Shrub Wetland
Freshwater Pond; Lake

**Area H**

11
103 - Transmitter
10

**Area K**

**Buildings**
Existing Building
**Storage Tanks**
AST (closed)
UST (closed)
Sanitary Sewer Lines A - J
Force Main
Secondary Sewer Line
Manhole
Box (cleanout or other)



MAP LOCATION

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community Surface water features obtained from National Hydrography Dataset (NHD) Dates of publication vary.

2013 NAIP Aerial Imagery obtained from the USDA Geospatial Data Gateway, a service of the US Department of Agriculture.

Wetlands shapes from U. S. Fish and Wildlife Service. 2015. National Wetlands Inventory website. http://www.fws.gov/wetlands/

NAD 1983 StatePlane Long Island FIPS 3104

N W E S

0 65 130 260 Feet

1 inch = 125 feet

[redacted]

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# Site Detail 8

Camp Hero Accident Prevention Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 9-10** |

5/3/2016 1:1,500 Y:\Projects\Camp_Hero\Maps\APP\Figure 9-10 SiteDetail8.mxd

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### 9.b.(1) Procedures and Tests

In accordance with the above, a test drill will be conducted on an as needed basis to evaluate the effectiveness of the ERP and to ensure all employees on site are adequately accounted for. The drills will consist of mock simulations of differing events requiring emergency response and will be applicable to the type of work being conducted on the site.

Drills will consist of responding to a medical emergency, striking utility lines, environmental releases (i.e., spills), fires, and other typical onsite emergencies as determined applicable to the SSHO. Using the protocols outlined in the subsections below, personnel will be required to perform emergency shutdown operations of equipment/tasks, follow proper evacuation and emergency procedures, and assemble at the pre-determined safe places of refuge where the SSHO will take head-counts of onsite personnel using the Site Control log for the project site. Based on the parameters established for the drill (e.g., medical emergency versus spill response), the list of contact numbers for the appropriate local and company specific emergency notifications will be reviewed with all site personnel as a part of the drill.

A post-drill analysis will be performed by the SSHO to analyze the response actions of site personnel and determine their effectiveness (evacuation times, routes, muster points, accountability, contacts, etc.). If any deficiencies are noted, adjustments to the ERP will be made by the SSHO and site personnel re-trained on the appropriate course of action for the type of emergency.

The SSHO will be responsible for the overall direction and implementation of the ERP, and for overall coordination of any emergency response actions. Specific ERP responsibilities of the SSHO include, but are not limited to, the following:

- Notifying facility police, fire department, and other offsite emergency units, as required
- Notifying the PM and providing updates as conditions change
- Directing offsite emergency response personnel to the scene and providing assistance
- Site control
- Completing any follow-up reports
- Rescuing personnel

- Accounting for all site personnel and visitors
- Providing emergency first aid
- Preventing further injury of personnel
- Providing current status of the incident to the SH&E Manager
- Ensuring that onsite emergency response personnel don the proper PPE if needed
- Assisting onsite emergency response personnel with treatment and transport of sick/injured
- Providing medical background information of the sick/injured and applicable site health and safety information to the offsite emergency medical responders
- Accompanying sick/injured personnel to hospital
- Accounting for all site personnel using the Site Control Log (Sign-in Log)

AECOM-Tidewater JV personnel, subcontractors, and visitors will be responsible for:

- Reporting any site emergencies to the SSHO or SS
- Knowing the exit location and evacuation route(s) within the exclusion zone
- Knowing the pre-planned evacuation assembly point and going there in the event of an emergency
- Assisting emergency response personnel as requested

**Emergency Recognition and Prevention**

An emergency is an unplanned event that threatens the safety of site personnel. Compliance with this APP can assist in the prevention of anticipated site emergencies. These emergency situations can easily be recognized by visual observations, worker complaints, safety audits, and/or monitoring instruments.

### Safe Distances and Places of Refuge

The SSHO will determine safe distances and places of refuge. Prior to the start of each workday, the SSHO will hold a safety meeting with all personnel and discuss the following, as applicable:

- Evacuation routes from work areas
- The assembly point (both primary and secondary) to be used in the event of an emergency
- Locations of the nearest fire extinguishers and spill containment equipment
- Discussion on specific safety and health concerns of personnel

### Evacuation Procedures

The SSHO will establish site evacuation routes. Evacuation notification will be three long blasts on an air horn, vehicle horn, or direct verbal communication. If evacuation is necessary, all personnel are to:

- Gather equipment to the extent safely possible
- Evacuate to the vehicle(s) location, and prepare to move out

### Emergency Procedures

Upon discovering an emergency, the following series of events will occur:

- Notify personnel
- Establish communication
- Stop work activities, if necessary
- Lower background noises (shut down equipment)
- Begin emergency procedures (order is dependent on the situation)
- Survey casualties
- Assess “Airway, Breathing, Circulation” of each patient
- Request aid, if necessary
- Assess existing and potential hazards to site personnel and offsite populations

- Allocate resources
- If a certified Emergency Medical Technician is in attendance, help extricate and stabilize victims
- Evacuate all non-essential personnel

**Alerting and Communications**

An employee alarm system will consist of the use of air horns or verbal instructions, either directly or via radio. Air horn signals, (and hand signals if necessary) will be established and employees will be trained in the signals and appropriate response. Telephones will be used to contact offsite emergency responders. Contact lists included in the SSHP will be posted in the site offices, and a copy will be kept in site vehicles. The following information will be communicated:

- Name of the person reporting the emergency
- Telephone number at the location of the person making the call
- Name of the injured person, if known
- Description of the emergency
- Exact location of the emergency
- Actions already taken
- Assistance required

**Coordination with Local Emergency Agencies**

Local or base authorities and emergency services will be contacted prior to initiation of work. The work objectives and onsite capabilities will be explained, as well as the most likely emergencies.

Preferred contact procedures will be established and the response capabilities of local or base responders will be determined. AECOM-Tidewater JV will ensure there is good coordination between our emergency plan and base requirements. Contact agencies, points of contact, and phone numbers will be provided in the SSHP.

**Emergency Response Team**

During emergency response operations, safety and health requirements put in place to protect site workers must be maintained. The SSHO will be alerted of the accident or incident that happened, which requires the Emergency Response Team (ERT) response and/or recovery operations.

Response to hazardous substances release will be limited to immediate action available due to equipment and training, (i.e., oil or fuel spills of small quantities). Responding facility emergency response personnel have authority for the site upon arrival. Project ERT personnel will assist local facility emergency response personnel, as needed.

The project ERT will notify base emergency response personnel, project personnel, and USACE in the event of a hazardous substance release. Team response is limited to the confining or recovery of small spills using a spill containment kit, shovel, and approved container with lid. Training of personnel is in accordance with 29 CFR 1910.120(q)(6)(ii).

A first aid kit must be maintained on site and checked weekly (EM 385-1-1 section 03.B.02). A log of items used will be maintained.

Project personnel will rely on base emergency response personnel through the use of the 911 emergency notification system and/or base emergency notification system.

If an injury or illness requires more than first aid, but is not an emergency, the employee will be taken to a pre-determined clinic for examination or observation. If the injury or illness is considered an emergency, emergency services will be contacted to transport the victim to the local hospital or emergency care facility.

### 9.b.(2) Spill Plans

Potential hazardous spills control measures:

- Provide for secondary containment where required by regulation or contract, and where a spill could result in significant hazard or economic loss

- Provide other appropriate engineering controls to prevent environmental releases to the ground, water, or air. These will be identified in AHAs or environmental permits (or equivalent)

- Provide equipment and personnel to perform emergency measures to mitigate spills and control their spread

- Dispose of contaminated materials
- Provide a decontamination program to clean previously uncontaminated areas.

**Spill Contingency Plan**

In the event of a spill or release, AECOM-Tidewater JV will:

- Take immediate measures to control and contain the release, including contacting local emergency service providers, if necessary
- Isolate and contain hazardous release areas
- Deny entry to the spill area to unauthorized personnel
- Stay upwind, keep out of low areas
- Keep combustible materials away from the spilled material
- Collect samples for analysis to determine that cleanup is adequate
- If liquid, prevent the discharge from traveling beyond site boundaries
- Prevent spilled materials from reaching storm water receptacle, ditches, creeks and drainage canals
- Take caution when handling drums and containers
- Notify Camp Hero personnel and USACE

**Notification of Spills and Discharges**

All environmental spills or releases of hazardous materials (e.g., fuels, solvents, etc.), whether in excess of the Reportable Quantity or not, will be reported according to the sequence identified for the site.

AECOM-Tidewater JV will notify Camp Hero personnel and USACE immediately of any spill or discharge. AECOM-Tidewater JV will make all regulatory notifications for AECOM-Tidewater JV generate spills.

In determining whether a spill or release must be reported to a regulatory agency, the SS will assess the quantity of the spill or release and evaluate the reporting criteria against the state-specific reporting requirements, the applicable regulatory permit, and/or client-specific reporting procedures. **If reporting to a state or federal regulatory agency is required, AECOM-Tidewater JV has 15 minutes from the time of the spill/release to officially report it.**

### 9.b.(3) Fire Fighting Plan

In any fire situation, it is important to act quickly and decisively in order to contain the spread of the fire. Regardless of the size and nature of the fire, and AECOM-Tidewater JV's ability to respond, all fires will be reported immediately to the local fire department. The SSHO will:

- Sound the fire alarm (local or auxiliary);
- Determine the extent of the fire;
- Notify Fire Department — 911 (Fire Department is to be notified of any fires larger in size than a wastebasket); Provide the following information:
  - Name of Facility
  - Address, including nearest cross street(s)
  - Exact location of the fire within the site
  - Provide name and phone number
- Coordinate and manage fire suppression efforts until the additional personnel arrive
- Coordinate the evacuation of injured or non-essential personnel from the site upwind following the evacuation procedure
- Check attendance
- Provide emergency first aid as required
- If the SSHO has determined that it is safe to do so, site personnel may use available onsite fire extinguishers on incipient stage fires only
- Remove or isolate flammable or other hazardous materials, which may contribute to the fire

- Clear access routes for emergency vehicles

Fire Department officials will determine when it is safe for re-entry.

**Documentation and Review**

After the response, AECOM-Tidewater JV will prepare an Incident Report. It will include such things as a chronological history of the emergency, facts, action, personnel present, sample results (if collected), summary of injuries, and possible exposures. For spills and releases, it will also include:

- Description of material spilled, including identity, quantity, and a copy of the waste disposal manifest
- Exact time and location of the spill and the description of the area involved
- Containment procedures utilized
- Description of the cleanup procedure employed at the site, including disposal of spill residue
- Summary of the communications AECOM-Tidewater JV had with other agencies

This report will be given to USACE within two (2) days of the incident along with immediate verbal notification. The report will also contain a critique of the response and modifications to this APP will be made if necessary to adequately address subsequent emergencies.

### 9.b.(4) Posting of Emergency Telephone Numbers

Emergency phone numbers, call signs, and detailed instruction for obtaining emergency response and medical assistance will be posted in the SSHP Section H.14.4, Table H-6. This includes a detailed hospital route map and approximate times and distances. All personnel will be trained on the emergency alert systems in place at the work site.

**Safety and Health Information**

The AECOM-Tidewater JV SSHO will have the appropriate safety and health information available in an area commonly accessed by workers. The information will be maintained current, readily available to affected workers, and protected against the elements and unauthorized removal. Required postings and general safety awareness reminder posters will be used to communicate information to site participants. The required postings will include copies of the current:

- APP
- AHAs
- OSHA Form 300 (if injury has occurred)
- Safety and Health promotional posters
- Date of last lost workday injury (if injury has occurred)
- OSHA Safety and Health Poster
- A highly visible map showing the route to the nearest emergency room
- Emergency contact numbers

Each office/project site where AECOM-Tidewater JV has established a presence will have the appropriate labor posters. Ensure local and state posting are included. At a minimum, ensure OSHA's Occupational Safety and Health Act Poster (OSHA 3165) is available onsite and communicated to all affected employees. It is anticipated that all postings will be maintained in the site vehicle in the absence of a dedicated site office.

### 9.b.(5) Man Overboard/Abandon Ship

This section is not applicable to this project.

### 9.b.(6) Medical Support

Onsite medical support during project execution will be available from two or more individuals who are trained in First Aid and CPR and bloodborne pathogens. A list of individuals and dates of First Aid and CPR training is depicted in the table below and copies of the certifications provided in Appendix F. Onsite first aid kits will meet the requirements of EM 385-1-1. First aid kits are Type III, 16 unit kits, including one pocket mouthpiece or CPR barrier. Kits will be checked prior to use, and at least weekly when work is in progress to ensure that contents are replaced as used. If a unit is available, personnel will be trained in the use of the Automated External Defibrillator.

| AECOM-Tidewater JV Personnel | First Aid (Date of Expiration) | CPR (Date of Expiration) |
|---|---|---|
| Amanda Martin, SS | 19 November 2015 | 19 November 2017 |
| Kelly Lurie, SSHO | 21 October 2017 | 21 October 2017 |
| Greta White, SSHO | 21 October 2017 | 21 October 2017 |
| Kathryn Priess, Env Scientist | 24 September 2014 | 24 September 2016 |

Emergency medical support contact information is contained in the SSHP. Employees can contact emergency personnel by dialing 911 or the appropriate Camp Hero emergency services contact number. The dispatcher will contact fire and/or emergency medical services. The emergency reference sheet attached to the SSHP provides the numbers of the nearest medical center and AECOM-Tidewater JV safety personnel. Emergency phone numbers can be found in the SSHP Table H-8 for all jobsites.

### 9.c. Plan for Prevention of Alcohol and Drug Abuse

AECOM-Tidewater JV is committed to providing a safe and healthy workplace for all employees. Consistent with this commitment and in keeping with the federal Drug-Free Workplace Act of 1988, it is the policy of AECOM-Tidewater JV to maintain a drug-free workplace.

**Key Provisions**

AECOM-Tidewater JV policy prohibits employees from being under the influence of alcohol or drugs or improperly using medication in any way that could diminish, or raise questions concerning, an employee's ability to perform at his or her best while performing services for or on behalf of AECOM-Tidewater JV. While on duty, employees will not use or be under the influence of alcohol, narcotics, intoxicants, or similar mind-altering substances.

This policy also prohibits the sale, possession, manufacturing, and/or distribution of illegal drugs, and/or other controlled substances in the workplace or while on company business off premises. Compliance with this policy is considered a condition of employment.

Violations of this policy will be considered to be gross and willful misconduct and will result in disciplinary action, up to and including termination. Any illegal substances discovered in the workplace will be turned over to the appropriate law enforcement agency and may result in criminal prosecution.

**Employee Responsibilities**

When a worker is impaired by the use of drugs or alcohol, he or she threatens the safety and well-being of everyone at a worksite. As a AECOM-Tidewater JV employee, you must do the following to protect workplace safety:

- Understand AECOM-Tidewater JV's drug-free workplace policy
- Follow it and set a good example for others by working drug and alcohol free
- Seek help if you or your co-worker(s) need it

- Notify management if you observe use of or impairment from drugs or alcohol that could threaten the health and safety of co-workers

Confidential help is available, at no cost to employees. If you and/or a co-worker are struggling with drug or alcohol problems, turn to services such as:

- Those provided through the AECOM-Tidewater JV sponsoring employer HR department.
- The ***Substance Abuse Treatment Locator:*** (800) 662-HELP or www.findtreatment.samhsa.gov.

If an employee observes drug-free workplace policy violations or obvious, on-the-job impairment you believe poses an immediate danger to any worker on the job:

- DO NOT DELAY or ignore the situation
- ACT to prevent the worker from committing the unsafe practice, if at all possible
- NOTIFY your supervisor (and/or SSHO) *immediately*

**Supervisors Responsibilities**

When a worker is impaired by the use of drugs or alcohol, he or she threatens the safety and well-being of everyone at a worksite. While it is the responsibility of every employee to work drug free, supervisors can be the first line of defense by taking appropriate action when a worker may be impaired.

Supervisors must familiarize themselves with AECOM-Tidewater JV's drug-free workplace policy and be able to explain it to others. In addition, you must ensure that your workers understand their responsibility to:

- Know the AECOM-Tidewater JV drug-free workplace policy
- Follow it and set a good example for others
- Seek help if they or their co-workers need it
- Notify you/management if they observe drug or alcohol use or impairment that threatens safety

Supervisors can play a powerful role in improving workplace safety by intervening and encouraging workers with alcohol or drug problems to seek help. Both on and off the job, symptoms of alcohol or drug use may be **physical** (chills, smell of alcohol, sweating, weight loss, physical deterioration); **emotional** (increased aggression, anxiety, burnout, denial, depression, paranoia); and/or **behavioral** (excessive talking, impaired coordination, irritability, lack of energy, limited attention span, poor motivation).

While different types of drugs produce different physical symptoms or behaviors, there are numerous ways that misuse affects work behavior — and ultimately job performance and safety. It could be a sign of a drug or alcohol problem if a worker is:

- Arriving late, leaving early, and/or often absent
- Unreliable and often away from assigned job
- Careless and repeatedly making mistakes
- Argumentative and uncooperative
- Unwilling or unable to follow directions
- Avoiding responsibilities
- Making excuses that are unbelievable or placing blame elsewhere
- Taking unnecessary risks by ignoring safety and health procedures
- Frequently involved in mishaps and accidents or responsible for damage to equipment or property

Supervisors are not expected to perform the role of police officer or counselor. Since part of the supervisors job is to assess employees' job performance to ensure that all necessary tasks are completed in accordance with specifications and deadlines, supervisors primary role in enforcing the policy is to be observant. When an employee begins to show a consistent pattern of problem behavior, supervisors should take action. Focusing on job performance, even when the problem may be caused by drugs or alcohol, allows the supervisor to balance both the rights of the individual employee to privacy and fair treatment and the rights of the work group to a safe, secure, and productive environment.

Do not wait until someone gets hurt to address a worker's drug or alcohol misuse. If you suspect a worker has a problem, follow company guidelines, which include these steps:

- Start documenting evidence of declining job performance
- List specific incidents (include date and time) and be concrete about what job functions/responsibilities were affected
- Share this documentation with the appropriate company official who is qualified to advise you on how to handle the situation (human resources manager)
- Meet with the employee and tell him/her that you are concerned about his/her job performance. Describe specific incidents and problems using your documentation as a guide
- Ask the employee if he/she has any explanation for the problem. Offer the opportunity to make the connection between alcohol/drug use and performance, but don't accuse the employee unless you have “reasonable suspicion” and are going to require a drug test
- Define what must be done to correct the performance problem and specify the consequences for the employee if the problem is not corrected
- Refer the employee for professional assistance if he/she has admitted that drug or alcohol use is the root cause of the performance problem. Even if the employee has not admitted he/she has a problem, reconfirm your concern and suggest he/she seek assistance since personal problems-including, but not limited to, alcohol and drug use — are often the root causes of these types of job performance issues
- Set a timeframe for improvement and be willing and able to follow through on your promises about consequences

When a worker has a problem with alcohol or drugs, AECOM-Tidewater JV employee assistance programs provided through AECOM-Tidewater JV sponsoring employer healthcare benefits are generally the best places to turn for help since they are confidential. Some additional free and confidential resources include:

- **Substance Abuse Treatment Locator**
  1-800-662-HELP
  www.findtreatment.samhsa.gov

- **Alcoholics Anonymous (AA)**
  (212) 870-3400
  www.aa.org

- **Narcotics Anonymous**
  (818) 773-9999
  www.na.org

- **Al-Anon**
  1-888-4AL-ANON
  www.al-anon.alateen.org

- **National Council on Alcoholism and Drug Dependence Hopeline**
  1-800-NCA-CALL
  www.ncadd.org

**Testing for Drugs and Alcohol**

Employees who are under the influence of alcohol or any controlled substance have the potential for interfering with their own and their coworkers' safe and efficient job performance. Drug and/or alcohol screening may be required:

- Of any applicant to whom a job offer has been made

- Of any employee where there is reason to believe that he or she may be using illegal or non-prescribed drugs or may be under the influence of drugs and alcohol. "Reason to believe" includes an injury or accident at work where there is reason to believe that employee impairment may have been a factor. "Reason to believe" may be based on objective symptoms such as the employee's appearance, behavior or speech

- As part of occasional follow-up testing if the employee is found to have breached these policies but has been permitted to remain employed

- As required by client contract, project, or if an employee is employed in a safety-sensitive position. Under these limited circumstances, employees may also be subjected to pre-employment and random drug screening

An employee's cooperation with such drug or alcohol screening tests is required as a condition of employment. The employee's refusal to cooperate with such a request and to provide a specimen

may result in termination where there is reason to believe that the employee has violated this policy and the employee's refusal to cooperate has prevented a medical determination of his or her condition. Any violation of this policy may result in immediate termination.

Employees found to be under the influence of or consuming such substances will be immediately removed from the job site. Contractors shall enforce the drug-free workplace requirements.

Any employee under a physician's treatment and taking prescribed narcotics or any medication that may prevent one being ready, willing, and able to safely perform position duties, shall provide a medical clearance statement to his/her supervisor.

### 9.d. Site Sanitation Plan

**Smoking, Eating, and Drinking**

Eating and drinking will be permitted only in designated areas at AECOM-Tidewater JV project sites. Smoking will be permitted only in areas designated by SSHO and situated in locations that are not in the immediate vicinity of activities associated with work site activities. Additionally, the SSHO will designate each smoking area giving primary consideration to those personnel who do not smoke.

Personnel actively involved in the performance of certain activities will not be permitted to smoke, eat, drink, or use smokeless tobacco, except during breaks (e.g., HAZWOPER Controlled work areas).

**Water Supply**

Water supplies will be available for use onsite and will comply with the following requirements.

**Potable Water**

**Drinking Water:** An adequate supply of cool water will be supplied and will be kept in water coolers in the support zone onsite. The water cooler will be kept closed and appropriately sealed to protect the drinking water integrity. Personnel will be instructed to wash their face and hands prior to drinking.

Potable water can be provided in the form of approved well or city water, bottled, or drinking fountains. Where drinking fountains are not available, individual use cups will be provided as well as adequate disposal containers. Potable water containers will be properly identified in order to distinguish them from non-potable water sources.

**Non-Potable Water**

Non-potable water maintained at the project site and all outlets dispensing non-potable water should have posted the following: "CAUTION – WATER UNSAFE FOR DRINKING, WASHING, OR COOKING." Non-potable water may be used for hand washing and cleaning activities. Non-potable water will not be used for drinking purposes. All containers/supplies of non-potable water used will be properly identified/labeled as such.

**Toilet Facilities**

Chemical toilet(s) will be available for site personnel and visitors. A minimum of one toilet will be provided for every 20-site personnel, with separate toilets maintained for each sex, except where there are less than five total personnel onsite. The toilet will be equipped with toilet paper, toilet paper holder, locking door, and adequate ventilation.

For mobile crews where work activities and locations permit transportation to nearby toilet facilities (e.g., gas station, or rest stop), onsite facilities are not required.

**Washing Facilities**

Site personnel will wash hands and face after completing work activities and prior to breaks, lunch, or completion of workday.

**Personal Cleaning Supplies**

Cleaning supplies at project sites will consist of soap, water, and disposable paper towels or items of equal use/application (e.g., anti-bacterial gels, wipes, etc.).

**Clothing and PPE**

All PPE will be kept clean at all times and maintained in accordance with the manufacturer's requirements.

**Sanitation - General Work Areas**

At all times, work areas will be kept free of dirt and debris that may impact the safety of site personnel and visitors. All trash receptacles will be regularly emptied.

**Sanitation - Break Areas and Lunchrooms**

Site personnel will observe the following requirements when using break areas and lunchrooms at project sites:

- All food and drink items will be properly stored when not in use

- Food items will not be stored in personal lockers for extended periods in order to prevent the potential for vermin infestation

- Perishable foods will be refrigerated whenever possible

- All waste food containers will be discarded in trash receptacles

- All tables, chairs, counters, sinks, and similar surfaces will be kept clean and free of dirt, waste food, and food containers at all times

- Refrigerators used to store food items will be maintained at 45 degrees Fahrenheit and emptied of all unclaimed food items weekly

- Routine cleaning of refrigerators will also be performed on a regular basis

**Housekeeping**

Site personnel will observe the following general housekeeping requirements:

- All work areas shall be kept clean to the extent that the nature of the work allows;

- Every work area shall be maintained, so far as practicable, in a dry condition; where wet processes are used, drainage shall be maintained and platforms, mats, or other dry standing places shall be provided, where practicable, or appropriate waterproof footgear shall be provided;

- Protruding objects or placement of materials on paths or foot traffic areas present a problem with regard to slips, trips, falls, and puncture wounds. Personnel will use a reasonable amount of effort to keep slip, trip, and fall hazards to a minimum;

- Excess debris and trash will be collected and stored in an appropriate container (e.g., plastic trash bags, garbage can, roll-off bin) prior to disposal; and

- At no time will debris or trash be intermingled with waste PPE or contaminated materials.

### 9.e. Access and Haul Road Plan

This section is not applicable to this project.

### 9.f. Respiratory Protection Program

Level D PPE with no respiratory protection will be worn during majority of general work activities. However, respiratory protection associated with Modified Level D PPE may be required at some AOCs, as determined in the field by the SSHO. A half mask or full-face respirator equipped with a P100/organic vapor cartridges will be used when collecting samples of suspect PCBs. A half mask or full-face respirator equipped with a P100 cartridge will be used if working in old or abandoned buildings with potential mold, avian or rodent droppings, or other biological hazards.

Personnel will receive training in the use and care of respirators, in accordance with 29 CFR 1920.134. Personnel will be assigned personal respirators and fit-tested with their assigned respirator prior to the start of field activities.

Based on the scope of work and work methods, dust is not expected to be of concern. Exposure to dust in excess of the OSHA PEL of 15 $mg/m^3$ is not expected. The OSHA PEL would be protective of workers' potential exposure to lead and PCBs. Nevertheless, dust concentrations will monitored using a dust monitor device, and work will temporarily be stopped and dust control measures shall be implemented if the OSHA PEL is exceeded. Specific measures will be determined by the SSHO and PM based on the activities and site conditions.

### 9.g. Health Hazard Control Program

All operations, materials, and equipment associated with this project will be evaluated/assessed to determine the presence of hazardous environments or if hazardous or toxic agents could be released into the work environment. Additional hazard assessment will be conducted if a change in conditions occurs.

The AHA procedures will be used to identify all substances, agents, and environments that present a hazard and recommend hazard control measures. Engineering and administrative controls will be used to control hazard and in cases where engineering or administrative controls are not feasible, PPE use will be mandated. These controls are detailed in the AHAs applicable to the project site and have been included in Attachment 3 of the SSHP.

The analyses will identify the workplace and activity evaluated; the name of the person certifying that the evaluation has been performed; and the date of the evaluation.

Operations, materials, and equipment involving potential exposure to hazardous or toxic agents or environments shall be evaluated by an AECOM-Tidewater JV certified industrial hygienist (CIH), CSP, or other competent person. Exposure, through inhalation, ingestion, skin absorption, or physical contact, to any chemical, biological, or physical agent in excess of the acceptable limits

specified in the most recently published American Conference of Governmental Industrial Hygienists (ACGIH) guideline, "*Threshold Limit Values and Biological Exposure Indices,*" or by OSHA, whichever is more stringent, shall be prohibited.

### Identification of Principal Hazards

The following are the principal hazards that can be anticipated while conducting field investigations:

- Chemical hazards
- Biological hazards
- Physical hazards

### Hazard/Risk Management

AECOM-Tidewater JV has adopted and implemented the composite risk management process, which includes the following steps:

- Identification of the hazard
- Assessment of the hazard
- Development of controls and risk decision
- Implementation of controls
- Supervision and evaluation during task performance

### Hazard Identification

A concise statement is prepared identifying the conditions that reflect actual or potential conditions that can cause injury, illness, or death of personnel, damage to the environment, damage or loss of equipment, or degradation of the production goals.

### Exposure Control

The following methods will be utilized for the control of exposure to hazardous or toxic agents and environments:

- Substitution, if the substitute process or product is determined to provide the same outcome and to be less of a hazard
- Engineering controls (such as local/general ventilation), to limit exposure to hazardous or toxic agents and environments within acceptable limits

- Work practice controls, when engineering controls are not feasible or are not sufficient to limit exposure to hazardous or toxic agents and environments within acceptable limits

- Appropriate PPE (i.e., respirators, gloves, etc.) and associated programs shall be instituted when engineering, work practice controls or material substitution are not feasible or are not sufficient to limit exposure to hazardous or toxic agents

**Personal Protective Equipment**

The purpose of PPE and clothing is to protect individuals from chemical and physical hazards. Specific work tasks with unique hazards and/or PPE requirements will be evaluated or reevaluated prior to beginning work. This task review will be led by the SSHO, and will include knowledgeable individuals such as the worker(s) and the supervisor. PPE requirements, based on this assessment are found in the SSHP and in the AHA for the specific task. All workers must be trained in the requirements of the APP, SSHP, and the applicable AHAs prior to beginning work.

Requirements for task and activity-specific levels of protective clothing are presented on the AHAs. Personnel performing site tasks shall use the appropriate level and type of PPE specified in this APP for each individual task. This APP makes provisions for use of the following levels of PPE, in accordance with the hazards and contamination level anticipated for each task or operation.

**Level D Protection**

**Level D** protection is the minimum protection required for project personnel and visitors at the site. Level D protection may be sufficient when no contaminants are present or work operations preclude splashes, immersion, or the potential for unexpected inhalation or contact with hazardous levels of chemicals.

The following equipment will be used for Level D protection:

- Coveralls or other suitable fieldwork clothing

- Persons exposed to vehicular or equipment traffic, including signalpersons, spotters, or inspectors, shall wear high visibility apparel meeting American National Standards Institute/Safety Equipment Association (ANSI/SEA) 107 Class 3 requirements

- Work boots with either steel or composite safety toe meeting the ANSI Z41 standard (steel-toe boots should not be utilized during use of geophysical instruments during anomaly avoidance and related activities)

- Safety glasses or goggles as needed
- Hardhat if overhead hazard or heavy equipment is encountered or operated (hard hats should not be worn avoided during anomaly avoidance unless overhead hazards are present and, if worn, should be secured with chinstraps)
- Leather work gloves
- Hearing protection, earplugs, and/or earmuffs as needed
- Raingear and Rubber Boots (if required)

Should personnel encounter an unusual odor, discolored soil, or an unknown item, they will immediately notify their supervisor and will evacuate the site upwind of the suspected item. The SSHO will notify the PM of the actions taken.

**Modified Level D** protection will incorporate all of the above with the addition of chemical protective gloves (nitrile), tyvek coveralls, and rubber over booties for biological hazard avoidance if necessary.

**Level C Protection**

**Level C** protection is the next higher level of PPE that encompasses Level D and incorporates additional safety equipment. Level C will be upgraded to if the need for respiratory protection is found by the SSHO. The main components of Level C are as follows:

- Full-face or half-face, air purifying respirators [National Institute for Occupational Safety and Health (NIOSH) approved]
- Hooded chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls)
- Gloves, outer, chemical-resistant
- Gloves, inner, chemical-resistant

**Level B Protection**

**Level B** protection is the next higher level of PPE that encompasses Level C and incorporates additional safety equipment. Level B will be upgraded to if the need for respiratory protection is found by the SSHO. The main components of Level B are as follows:

- Positive pressure, full-facepiece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA (NIOSH approved)
- Hooded chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls)
- Gloves, outer, chemical-resistant
- Gloves, inner, chemical-resistant
- Boots, outer, chemical-resistant steel toe and shank

**Level A Protection**

**Level A** protection is the next higher level of PPE that encompasses Level B and incorporates additional safety equipment. Level A will be upgraded to when directed by the SSHO. The main components of Level A are as follows:

- Positive pressure, full face-piece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA, approved by the NIOSH
- Totally-encapsulating chemical-protective suit
- Gloves, outer, chemical-resistant
- Gloves, inner, chemical-resistant
- Boots, chemical-resistant, steel toe and shank

Disposable protective suit, gloves, and boots (depending on suit construction, may be worn over totally-encapsulating suit).

### Proper PPE Selection

The selection of the PPE will be done after a thorough evaluation of the hazards involved at the site during each phase of the operation. All persons entering the site area will put on the required PPE according to established procedures in this APP.

Hazard and risk assessment is a continuing process to be conducted by the SSHO, throughout the duration of the project. Changes in specific PPE or levels of PPE may be required in accordance with information obtained from implementation of site activities and data derived from the other sources. As a general rule, levels of PPE will need to be reassessed if any of the following occur:

- Appearance of previously unidentified or anticipated chemicals, conditions, or task hazards
- Airborne concentrations of known chemicals exceed action levels
- Ambient weather conditions changes impacting the use of assigned PPE
- A new task is introduced or a previously assigned and evaluated task is expanded in scope

Specific levels of protection will be modified when onsite conditions warrant, and based upon the revisions presented in the SSHP for a specific location. The decision to change levels of protection will be made by the SSHO with concurrence from the PM and the SH&E Manager. Levels of protection will not be downgraded without prior approval from the SH&E Manager.

### Head Protection

AECOM-Tidewater JV employees and visitors will wear hard hats that meet the requirements of ANSI Z89.1 (as indicated by the manufacturer's label) if there is a potential of exposure to flying/falling objects or overhead hazards. Hard hats can be removed in break areas or where their use presents potential safety hazards. Ear protection and face shields may be attached to hard hats. The following criteria will be followed:

- No modification to the shell or suspension is allowed except when such changes are approved by the manufacturer.
- Hard hats shall be worn with the bill facing forward unless the SSHO has determined exceptions for certain trades in order to accommodate appropriate mission accomplishments.

- No ball caps, knit caps, or other headdress shall be worn under the hard hat that could interfere with the fit or stability of the hard hat.

- Protective headgear and components shall be visually inspected on a daily basis for signs of damage (dents, cracks, etc.) that might reduce the degree of safety integrity originally provided.

- Headgear will be periodically inspected for ultraviolet degradation as evidenced by cracking or flaking of the helmet.

- Drilling holes or in any way changing the integrity of the hard hat is prohibited. Alterations that will reduce the dielectric or impact strength will not be made.

- Chin straps will be worn when wearers are subject to high wind conditions, working on elevated structures, and/or during surface metal anomaly avoidance activities.

**Eye Protection**

Eye and face protection equipment shall meet the requirements of ANSI Z87.1, and bear a legible and permanent "Z87" logo to indicate compliance with the standard providing side protection. When required to wear eye protection, persons whose vision requires the use of corrective lenses in eyeglasses shall be protected by one of the following:

- Prescription safety glasses providing optical correction and equivalent protection.

- Protective glasses with side shields designed to fit over corrective lenses without disturbing the adjustment of the glasses.

- Goggles that can be worn over corrective lenses without disturbing the adjustment of the glasses or goggles that incorporate corrective lenses mounted behind the protective lenses.

The SSHO will ensure that suitable eye protection is available and provided to all onsite personnel. The use of eye protection by all personnel will meet the requirements of the following minimum requirements:

- Provide adequate protection against the particular hazards for which they are designed

- Be reasonably comfortable when worn under the designated conditions

- Fit snugly and not unduly interfere with the wearer's movements

- Be durable

- Be easily cleaned and sanitized

Contact lenses do not provide adequate eye protection. Contact lens wearers must use the same additional eye protection as non-lens wearers. Persons whose vision requires correction and who are required to wear eye protection may wear goggles or spectacles of one of the following types:

- Spectacles whose protective lenses provide optical correction (prescription)

- Goggles that can be worn over corrective (prescription) spectacles without disturbing the adjustment of the spectacles

- Goggles that incorporate corrective (prescription) lenses mounted behind the protective lenses

**Hearing Protection**

Hearing protection will be worn, as appropriate, whenever sound-pressure levels exceed 85-decibel A-weighted sound level (dBA) steady-state expressed as a time-weighted average or 140 dBA impulse, or as desired by individual workers when working around noise-producing equipment. Hearing protection worn by personnel will comply with the requirements of 29 CFR Part 1910.95(j), and will provide a minimum noise reduction rating of at least 21.

Hearing protection will be worn at all times when normal conversation becomes difficult at distances of 3 feet or less, such as during the operation of heavy equipment. The use of hearing protection and its necessity will be detailed in the applicable AHAs for the individual tasks.

**Foot Protection**

All workers entering designated fieldwork areas will wear sturdy leather or leather/synthetic combination work boots with safety toes that provides adequate ankle support and provide adequate protection for the task being performed. Sandals and other open-top footwear are not acceptable in designated fieldwork areas.

**Hand Protection**

Employees will use appropriate hand protection when exposed to hazards that could cause injury to the hands. Gloves must resist puncturing and tearing, as well as provide any necessary chemical resistance. Generally, leather or Kevlar gloves will be worn during material and equipment handling

activities and Nitrile gloves will be used for chemical protection as indicated in the AHA developed for the specific task and during biological hazard avoidance.

**Traffic Safety Vests**

When working on or near public roads and when working around moving vehicles at designated field work areas, all personnel will wear traffic safety vests, shirts, or similar colored garment so as to provide high visibility to drivers/operators (e.g., Class I, II or III as required).

**PPE Use**

All site personnel will be given initial PPE-specific training. This training will be given by the SSHO prior to personnel participating in site operations where PPE is required. All personnel receiving PPE training will be required to demonstrate an understanding of the training topics and the ability to correctly use the PPE. This will be accomplished through the SSHO supervising and visually inspecting each individual's ability to properly don and use the PPE during its initial use. Upon completion of the training and after each employee has successfully demonstrated the requisite understanding, the SSHO will complete any applicable training completion form.

**PPE Program Effectiveness**

The jobsite shall be evaluated to determine if the incorporated PPE levels are adequate based upon the site conditions and contaminants detected. If additional work tasks, are added to the Statement of Work, after approval of this APP, the PM and SSHO shall identify and assess the task hazards, and relay that information to the SH&E Manager. The SSHO, in conjunction with the SH&E Manager, will prepare an amendment to the APP/SSHP and submit the amendment for approval to USACE. The amendment will be added to the APP/SSHP upon approval.

The SSHO will ensure PPE use complies with all applicable OSHA, USACE, and AECOM-Tidewater JV requirements.

**PPE Inspection and Care**

Maintenance of PPE can vary greatly, based upon the complexity of the PPE and the intricacy of the repair involved. The SSHO will become familiar with the manufacturer's recommended maintenance, and when possible, repair defective PPE. If unable or unauthorized to conduct the repair, the SSHO will return the item to the manufacturer for repair, or to procure a replacement.

The SSHO will be responsible for ensuring that PPE is in good, clean, working order prior to the initial issuing of the PPE. Once issued, site personnel will ensure that re-usable articles of PPE are maintained in a clean, sanitary fashion. During the work task, co-workers should periodically inspect each other for the proper use of PPE. For items used inside an exclusion zone,

site personnel will follow the requirements of the Site-Specific Decontamination Plan, and ensure that the PPE is properly decontaminated in the Contaminate Reduction Zone before removing the item from the exclusion zone.

### 9.h. Hazard Communication Program

The AECOM-Tidewater JV will implement a hazard communication program on field projects managed by the SSHO responsible for maintaining a list of hazardous materials used on the site, as well as a Safety Data Sheet (SDS) for each hazardous material. Details of the program are contained in SH&E SOP 5-507- *Hazardous Materials Communication WHMIS* which includes the development of a site-specific Hazard Communication Plan, complete with inventory log, which will be developed for the project site.

The program establishes procedures for AECOM-Tidewater JV employees and subcontractors who handle and store chemical products at project sites. It ensures that hazards of all chemicals purchased are evaluated and the information concerning their hazards is transmitted to employees. The delivery of information is to be accomplished by employee training, container labeling, and other forms of warning and MSDSs. All SDSs are requested from the suppliers at the time of order. If not available, then a recent SDS will be downloaded off the Internet.

The requirements defined in this program apply to all AECOM-Tidewater JV facilities, projects, employees, and subcontractors, which receive, use, handle, store, transport, or distribute hazardous substances.

All hazardous substances found in a particular workplace shall be listed on a Hazardous Substance Inventory (HSI). The HSI will be reviewed at least annually. New hazardous substances entering a workplace (e.g., project-specific materials) shall be added to the HSI upon receiving and reviewing the SDS. The HSI includes the following information:

- Product name
- Chemical name (if different from product name)
- Manufacturer's name
- Approximate typical quantity
- Location of substance (i.e., work area)
- Description of use

A copy of the most current HSI, along with the corresponding SDS and a copy of this program (or site-specific program), will be available onsite for review by all employees. The name of the material (product or chemical) on the HSI must be consistent with the SDS for that material. A site map will be attached to the inventory showing where inventoried substances are stored. The inventory and site map will be updated as frequently as necessary to ensure accuracy.

**Safety Data Sheets**

AECOM-Tidewater JV does not manufacture, package, or distribute hazardous commodities. However, as an end user, AECOM-Tidewater JV must maintain hazard documentation for each hazardous substance used on each job site. This documentation will take the form of a listing of all onsite hazardous substances, and copies of manufacturer developed SDSs for each listed item.

A SDS shall be available for every hazardous substance used or stored on each job site. Copies of all SDSs will be maintained onsite as an Appendix to the site-specific SSHP. All site personnel will be briefed as to the location of the SDSs, and will have immediate access to examine any SDS at any time during their work shift.

SDSs received for consumer products, articles and other materials not covered by this procedure will be maintained and made available to employees.

For on-going projects, each SDS associated with a material no longer in use will be marked as obsolete and the date it was obsolete. At the completion of any project, the accumulated SDSs will be maintained as part of the project records. NO SDS ASSOCIATED WITH ANY PROJECT WILL BE DESTROYED.

Employees are required to report any hazardous substance found at the project site that is not on the list of hazardous substances. The report is to be made to the PM and SS. If no SDS accompanies a hazardous substance, the manufacturer, distributor, or importer will be immediately notified and requested to provide one as soon as possible. The request will be documented in a letter or telephone log. If this request is not honored, the SH&E Department will be notified.

When purchasing hazardous substances, the verbal or written purchase order will request an SDS be sent with the shipment. For each facility and/or project, the SDS will be kept along with the HSI in a location that is readily accessible to all employees at all times during their work periods. Additionally, the SDSs and HSI will be available to employees for review in such a way so that the assistance of a supervisor is not necessary.

**Labels**

All hazardous substances received from outside suppliers will conform to legal requirements and display on each container, as a minimum, the following:

- Identification of the hazardous substance(s)
- Appropriate hazard warnings such as an Hazardous Materials Identification System and/or National Fire Protection Association-type label
- Name and address of the manufacturer, importer, or other responsible party

Any failure to have a label on the container at the time of receipt will be cause to refuse delivery of the product in addition to the following guidance:

- Stationary process containers may have signs, placards, process sheets, batch tickets, operating procedures, or other written material in lieu of fixed labels on the containers, as long as the alternative method conveys hazard information. The written materials will be readily accessible to the employees in the work area.
- Although the practice is not recommended, if an employee will use the hazardous substance in a portable container immediately, the portable container need not be labeled when the substance is transferred from the labeled container. The term "immediate use" is intended to mean that the hazardous chemical will be exclusively under the control of and used by the person performing the transfer at all times and work will be completed within the current work shift.
- Containers of hazardous substances transferred from labeled containers and not intended for the immediate use of the employee performing the transfer must be labeled in accordance with a hazardous materials identification system or an equivalent commercial system
- Labels on incoming containers will not be removed or defaced
- Labels or other forms of warning will be legible, in English, and prominently displayed on the containers, or readily available throughout each work shift
- Container size is not the determining factor in deciding if a label is required; ALL containers of hazardous chemicals must be labeled

**Hazard Communication Training**

Due to the nature of our business, the information and training provided to AECOM-Tidewater JV employees with regard to hazard communication will take two forms: general and specific. General training and information will include the following:

- The elements and requirements of the OSHA Hazard Communication standard (29 CRF 1910.1200) and applicable state regulation
- Tasks and operations where hazardous substances are present
- The location and availability of the written Hazard Communication Program, including the list(s) of hazardous substances and SDS's and how employees can obtain and use hazard information
- The methods and observations that may be used to detect the presence or release of a hazardous substance, such as personal and area monitoring, continuous monitoring devices, visual appearance or odor of hazardous substances when being released, etc.
- The physical and health hazards of the substances in the work area
- The measures they can take to protect themselves from these hazards, including specific procedures implemented for the project or shop to protect employees from exposure to hazardous substances, such as appropriate work practices, emergency procedures, and PPE to be used
- The project- or shop-specific details of the Hazard Communication Program, including an explanation of the labeling system and the SDS's, and how employees can obtain and use the appropriate hazard information
- Information for their physician to receive, regarding hazardous substances to which the employee may be exposed according to provisions of this section
- Freedom from discharge or other discrimination due to the employee's exercise of the rights afforded pursuant to the provisions of the Hazardous Substances Information and Training Act

Site-Specific Hazard Communication Training regarding safe handling and use of hazardous materials found on the HSI will be presented during site-specific training programs. This training may be for specific hazardous materials or for groups of hazardous substances, including flammable/combustible liquids, compressed gases, organic solvents, corrosives, and toxic metals. Additional specific training will be provided to the affected employees any time a new hazardous substance is introduced into the workplace (e.g., project specific substances) and/or when an employee is reassigned. All training conducted will be documented and copies of the documentation included in the permanent project files.

The SSHO must ensure that project personnel can immediately obtain the required information about chemicals of concern during an emergency.

**Handling Controls and PPE**

When engineering and work practice controls or substitution are either infeasible or insufficient, appropriate PPE and chemical hygiene facilities will be provided and used for the transportation, use, and storage of hazardous or toxic agents.

When irritants or hazardous substances may contact skin or clothing, chemical hygiene facilities and PPE will be provided. PPE may include suitable gloves, face/eye protection, and chemical protective suits. Required task-specific PPE are identified in the AHAs.

The CIH, CSP, or other competent personnel will determine the scope and type of protective equipment. Special attention shall be given to selecting proper chemical protection when working with materials designated with a "skin" notation by Occupational Exposure Limits. Such materials may produce systemic toxic effects through absorption through broken or unbroken skin.

When eyes or body of any person may be exposed to hazardous or toxic agents, suitable facilities for quick drenching or flushing of the eyes and body will be provided in the work area for immediate emergency use and shall be no more than 10 seconds from the hazardous material.

Emergency eyewash equipment must be provided where there is the potential for an employee's eyes to be exposed to corrosives, strong irritants, or toxic chemicals. The emergency eyewash equipment must irrigate and flush both eyes simultaneously while the operator holds the eyes open.

Storage prior to transportation of hazardous chemicals, materials, substances, and wastes will be under the supervision of a qualified person. Transportation, use, and storage of hazardous or

toxic agents will be planned and controlled to prevent contamination of people, animals, food, water, equipment, materials, and environment.

All storage of hazardous or toxic agents shall be in accordance with the recommendations of the manufacturer, OSHA, and National Fire Protection Association requirements and accessible only to authorized personnel.

Disposal of surplus or excess hazardous or toxic agents will occur in a manner that will not contaminate or pollute any water supply, ground water, or streams; and will comply with federal, state, and local regulations and guidelines.

Containers used to hold hazardous or toxic agents should not be used to hold other materials unless they have been managed or cleaned under hazardous waste and Department of Transportation (DOT) regulatory requirements. Every hazardous or toxic agent being transported for disposal shall be transported with a copy of the substance's SDS whenever applicable.

Persons who prepare shipments of hazardous chemicals, materials, substances, and/or wastes that are defined as hazardous material under DOT regulations, are required to be DOT trained, certified, and issued an appointment letter in accordance with Defense Transportation Regulation 4500.9-R, Chapter 204.

### 9.i. Process Safety Management Plan

This section is not applicable to this project.

### 9.j. Lead Abatement Plan

This section is not applicable to this project.

### 9.k. Asbestos Abatement Plan

This section is not applicable to this project.

### 9.l. Radiation Safety Program

This section is not applicable to this project.

### 9.m. Abrasive Blasting

This section is not applicable to this project.

## 9.n. Heat/Cold Stress Monitoring Plan

### Heat Stress

Heat stress is one of the most common (and potentially serious) illnesses that affect site workers. When site personnel are engaged in operations involving hot environments, a number of physiological responses can occur, which may seriously affect the health and safety of the workers. These affects can be eliminated or controlled through the use of a comprehensive heat stress prevention and monitoring program.

It is the responsibility of the SSHO and each employee to ensure that temperature stress controls are adequate for the site conditions and tasks. All employees, and specifically the SSHO, are empowered and expected to stop or modify work and take any precautionary measures to prevent temperature related illnesses.

Individuals vary in their susceptibility and degree of response to stress induced by increased body heat. Heat stress can result in health effects ranging from transient heat fatigue to serious illness or death. Heat stress is caused by a number of interacting factors including environmental condition, clothing, workload, and the individual characteristics of the worker. Because heat stress is probably one of the most common (and potentially serious) illnesses at work sites, regular physiological or area monitoring (as appropriate) and other preventive precautions are vital. Factors that may predispose a worker to heat stress include:

- Lack of physical fitness
- Lack of acclimatization to hot environments
- Degree of hydration
- Level of obesity
- Current health (i.e., having an infection, chronic disease, diarrhea, etc.)
- Alcohol or drug use
- The worker's age and sex
- Prior history of heat stress

### Effects of PPE

The amount, and type of PPE worn, directly influences reduced work tolerance and the increased risk of excessive heat stress. PPE adds weight and bulk, severely reduces the body's access to

normal heat exchange mechanisms (evaporation, convection, and radiation), and increases energy expenditure. Therefore, when selecting PPE, each item's benefit should be carefully evaluated in relation to its potential for increasing the risk of heat stress. Once PPE is selected, the safe duration of work/rest periods should be determined based on the following criteria and that of the recommendations of the ACGIH Threshold Limit Value (TLV) handbook:

- Anticipated work rate
- Ambient temperature and other environmental factors
- Type of protective ensemble
- Individual worker characteristics and fitness

Sweating does not cool the body unless moisture is removed from the body. The use of PPE reduces the body's ability to eliminate large quantities of heat because the evaporation of sweat is decreased. The body's effort to maintain an acceptable temperature may become impaired and this may cause heat stress. Increased body temperature and physical discomfort also promote irritability and a decreased attention to the performance of hazardous tasks.

**Early Symptoms of Heat Related Illness**

The following are the early symptoms of heat related problems that may be experienced by the field teams:

- Decline in task performance
- Lack of coordination
- Decline in alertness
- Unsteady walk
- Excessive fatigue
- Muscle cramps
- Dizziness

**Heat Stress Disorders**

This section outlines the major heat related illness that may result from exposure to high heat environments, which include heat rash, fainting, heat cramps, heat exhaustion, and heat stroke. For the purpose of this program, reference to "liquids" will indicate the use of water or an

electrolyte replacement solution, and not tea or coffee (unless it is decaffeinated) or carbonated soft drinks.

### *Heat Rash*

Heat rash is caused by continuous exposure to heat and humid air and is aggravated by wet chafing clothing. This condition can decrease a worker's ability to tolerate hot environments.

- **Symptoms:** Mild red rash, especially in areas of the body that sweat heavily.

- **Treatment:** Decrease amount of time in protective gear and provide powder such as cornstarch or baby powder to help absorb moisture and decrease chafing. Maintain good personal hygiene standards and change into dry clothes if needed.

### *Heat Cramps*

Heat cramps are caused by a profuse rate of perspiration that is not balanced by adequate fluid and electrolyte intake. The occurrence of heat related cramps are often an indication that excessive water and electrolyte loss has occurred, which can further develop into heat exhaustion or heat stroke.

- **Symptoms:** Acute, painful spasms of voluntary muscles such as the back, abdomen, and extremities.

- **Treatment:** Remove victim to a cool area and loosen restrictive clothing. Stretch and massage affected muscles to increase blood flow to the area. Have patient drink one to two cups of liquids immediately, and every twenty minutes thereafter. Consult with physician if condition does not improve. If available, an electrolyte replacement solution should be taken along with liquids.

### *Heat Exhaustion*

Heat exhaustion occurs due to the large fluid and salt loss from profuse sweating. It is a state of very definite weakness or exhaustion caused by increased stress on various organs to meet increased demands to cool the body due to excessive loss of fluids from the body. This condition leads to inadequate blood supply and cardiac insufficiency. Heat exhaustion is less dangerous than heat stroke, but nonetheless must be treated. If allowed to go untreated, heat exhaustion can quickly develop into heat stroke.

- **Symptoms:** Pale or flushed, clammy, moist skin, profuse perspiration, and extreme weakness. Body temperature is basically normal or slightly elevated, the pulse is weak and

rapid, and breathing is shallow. The individual may have a headache, be dizzy or nauseated.

- **Treatment:** Remove the individual to a cool, air-conditioned place, loosen clothing, elevate feet, and allow individual to rest. Consult physician, especially in severe cases. Have patient drink one to two cups of liquids slowly and immediately, and every twenty minutes thereafter. Total liquid consumption should be about one to two gallons per day. If the signs and symptoms of heat exhaustion do not subside, or become more severe, immediate medical attention will be required.

### *Heat Stroke*

Heat stroke is an acute and dangerous reaction to heat stress caused by failure of the heat regulating mechanisms of the body. Heat stroke occurs when the body's system of temperature regulation fails and the body temperature rises to critical levels. When this occurs, the body core temperature rises very rapidly to a point (>105.8°F) where brain damage and death may result if the person is not cooled quickly.

- **Symptoms:** The victim's skin is hot, and may or may not be red, dry, and/or spotted, due to the fact that the individual may still be wet from having sweat while wearing protective clothing earlier; nausea; dizziness; confusion; extremely high body temperature; rapid respiratory and pulse rate; delirium; convulsions; unconsciousness or coma.

- **Treatment:** Cool the victim immediately. If the body temperature is not brought down quickly, permanent brain damage or death may result. The victim should be moved to a shady area; he should lie down and keep feet elevated. Cool the victim by either sponging or immersing the victim in very cool (not cold) water to reduce the core temperature to a safe level (<102°F). If conscious, give the victim cool liquids to drink. Observe the victim and obtain immediate medical help. Do not give the victim energy, caffeinated or alcoholic beverages. Heat stroke is considered a medical emergency. Medical help should be summoned immediately. EARLY RECOGNITION AND TREATMENT OF HEAT STROKE ARE THE ONLY MEANS OF PREVENTING BRAIN DAMAGE OR DEATH.

### Preventive Measures

Proper training and preventive measures will help avert serious illness and loss of work productivity. Preventing heat stress is particularly important because once someone suffers from heat exhaustion, that person may become predisposed to additional heat injuries. In order to avoid heat related illnesses, proper preventive measures will be implemented whenever environmental conditions dictate the need, normally whenever the temperature reaches at least 70°F.

These preventive measures represent the minimal steps to be taken and will include the following procedures.

The SSHO or other authorized person will observe each site worker prior to the start of daily operations, and periodically throughout the day, to determine the individuals susceptible to heat induced stress. Evidence of extreme dehydration, illness, or drug or alcohol use may require the SSHO to restrict the worker's activities until such time as the worker is fit for duty. Personnel identified as being at high risk for heat stress who are allowed to participate in site operations will be monitored frequently by the SSHO.

Site workers will be trained to recognize and treat heat-related illnesses. This training will include the signs, symptoms, and treatment of heat stress disorders. In order to maintain workers' body fluids at normal levels, workers will be encouraged to drink, as a minimum, approximately sixteen ounces of liquids prior to start of work in the morning, after lunch, and prior to leaving the site at the conclusion of the day's activities. Disposable four to twelve ounce cups and liquids will be provided onsite. Liquids to be provided will be water. Liquids containing caffeine should be avoided.

When ambient conditions and site workload requirements dictate, as determined by the SSHO, workers will be required to drink a minimum of 16 to 32 ounces of liquids during each rest cycle. The normal thirst mechanism is not sensitive enough to ensure that enough water will be consumed to replace lost sweat. When heavy sweating occurs, workers shall be encouraged to drink even though they may not be thirsty. A shelter or shaded area may be provided where workers can be protected from direct sunlight during rest periods.

Monitoring of ambient or physiological heat stress indices will be conducted to allow prevention and/or early detection of heat-induced stress. Monitoring will be conducted in accordance with applicable paragraphs of this APP.

Site workers will be given time to acclimatize to site work conditions, temperature, protective equipment, and workload. Acclimatization is the adaptive process that usually takes two to six days of continued work in hot environments, resulting in a decrease of the physiological strain and allowing the worker's body to become adjusted to the level and type of work required by the application of a constant environmental stress. This process involves a gradual increase in the individual's workload over the required period, the length of which depends upon the nature of the work performed, ambient temperatures, and the individual's susceptibility to heat stress.

Work schedules will be adjusted as follows:

- Modify work/rest schedules according to monitoring requirements
- Mandate work slowdowns as needed
- Rotate personnel: alternate job functions to minimize over-stress or overexertion at one task
- Add additional personnel to work teams
- Perform work during cooler hours of the day if possible

Workers will be encouraged to achieve and maintain an optimum level of physical fitness. Increased physical fitness will allow workers to better tolerate and respond to hot environments and heavy workloads. In comparison to an unfit person, a fit person will have less physiological strain, a lower heart rate and body temperature, and a more efficient sweating mechanism.

Alcohol should not be consumed in a hot environment because the loss of body fluids increases the risk of heat stress.

### Heat Stress Monitoring

Because the incidence of heat stress depends on a variety of factors, all workers shall be monitored. Initially, the frequency of physiological monitoring depends on the air temperature adjusted for solar radiation and the level of physical work. The length of the work cycle will be governed by the frequency of the required physiological monitoring.

Monitoring of personnel wearing PPE should begin when the ambient temperature is 72°F or above. Table 9-1 presents the suggested frequency for such monitoring. Monitoring frequency should increase as the ambient temperature increases or as slow recovery rates are observed.

A person with a current first aid certification who is trained to recognize heat stress symptoms should perform heat stress monitoring. Other methods for determining heat stress monitoring, such as the wet bulb globe temperature (WBGT) index from ACGIH TLV booklet or portable heat stress monitoring instrumentation can be used.

**Table 9-1**
**Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers**

| Adjusted Temperature[1,2] | Normal Work Ensemble[3] | Impermeable Ensemble |
|---|---|---|
| 90°F (32.2°C) or above | After each 45 min. of work | After each 15 min. of work |
| 87.5°-90°F(30.8°-32.2°C) | After each 60 min. of work | After each 30 min. of work |

**Table 9-1**
**Suggested Frequency of Physiological Monitoring for Fit and Acclimatized Workers**

| Adjusted Temperature[1,2] | Normal Work Ensemble[3] | Impermeable Ensemble |
|---|---|---|
| 82.5°-87.5°F (28.1°-28.1°C) | After each 90 min. of work | After each 60 min. of work |
| 77.5°-82.5°F (25.3°-28.1°C) | After each 120 min. of work | After each 90 min. of work |
| 72.5°-77.5°F (22.5°-25.3°C) | After each 150 min. of work | After each 120 min. of work |

**Notes:**
1 For work levels of 250 kilocalories/hour
2 Calculate the adjusted air temperature (ta adj) by using this equation: ta adj °F = ta °F + (13 x % sunshine). Measure air temperature (ta) with a standard mercury-in-glass thermometer, with the bulb shielded from radiant heat. Estimate percent sunshine by judging what percent time the sun is not covered by clouds that are thick enough to produce a shadow. (100 percent sunshine = no cloud cover and a sharp, distinct shadow; 0 percent sunshine = no shadows.)
3 A normal work ensemble consists of cotton coveralls or other cotton clothing with long sleeves and pants.

When workers are wearing permeable clothing (i.e., standard cotton work clothes), follow recommendations for monitoring requirements, and suggested work/rest schedules in the current ACGIH TLVs for Heat Stress.

When monitoring the worker physically, measure:

- Heart rate:
  - Count the radial pulse during a 30-second period as early as possible in the rest period
  - If the working heart rate (while in PPE and performing tasks) exceeds 180 beats per minute minus the workers age, the work cycle should be discontinued and an appropriate rest/recovery period should begin
  - If the heart rate exceeds 110 beats per minute at the beginning of the rest period (after 1 minute of rest), shorten the next work cycle by one-third and keep the rest period the same
  - If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third
- Oral temperature:
  - Use a clinical thermometer (three minutes under the tongue) or similar device to measure the oral temperature at the end of the work period (before drinking)
  - If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period

- If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following cycle by one-third
- Do not permit a worker to wear a semi-impermeable or impermeable garment when oral temperature exceeds 100.6°F (38.1°C)

For site conditions where personnel are working in Level D PPE, and the ambient temperature is greater than 72°F, the SSHO may conduct WBGT monitoring to assist in controlling the potential for site workers experiencing heat related adverse health effects. The SSHO may take readings on a WBGT monitor throughout the day to determine the work/rest schedule to be implemented (see Table 9-2).

**Table 9-2**
**Permissible WBGT Heat Exposure Threshold Limit Values (TLV)**

| | Work Load | | |
|---|---|---|---|
| **Work — Rest Regimen** | **Light** | **Moderate** | **Heavy** |
| Continuous work | 86 (30.0) | 80 (26.7) | 77 (25.0) |
| 75% Work — 25% Rest, each hour | 87 (30.6) | 82 (28.0) | 78 (25.9) |
| 50% Work — 50% Rest, each hour | 89 (31.4) | 85 (29.4) | 82 (27.9) |
| 25% Work — 75% Rest, each hour | 90 (32.2) | 88 (31.1) | 86 (30.0) |

**Note:**
* Consult the ACGIH TLV booklet for definitions of Light, Moderate, and Heavy workloads. Values are given in F and (C) WBGT, and are intended for workers wearing single layer summer type clothing. Use of semi or totally impermeable clothing requires monitoring in accordance with the Heat Stress Prevention Program. As workload increases, the heat stress impact on a non-acclimated worker is exacerbated. For non-acclimated workers performing a moderate level of work, the permissible heat exposure TLV should be reduced by approximately 2.5°C.

The values outlined in Tables 9-1 and 9-2 are designed such that nearly all acclimatized, fully clothed workers with adequate water and electrolyte replacement liquids intake will be able to function without the body temperature exceeding 100.4°F (38°C).

### Heat Stress Documentation

The SSHO will be responsible for recording all heat stress related information. This will include training sessions and monitoring data. Training sessions will be documented on the Safety Meeting and Training Form, and WBGT data and other information will be recorded on a heat stress monitor log.

### Cold Stress

If work is conducted in the winter months, thermal injury due to cold exposure can become a problem for field personnel. Work will cease under unusually hazardous conditions (e.g., wind-chill less than 0°F, or wind-chill less than 10°F with precipitation). Systemic cold exposure is referred to as hypothermia. Localized cold exposure is generally labeled frostbite. Recognition of the symptoms of cold related illness will be discussed during the health and safety briefing conducted

prior to the onset of site activities. Refer to the 2003 ACGIH TLV for Chemical Substances and Physical Agents for additional information on cold stress prevention, monitoring, and work-warming regimens.

### *Hypothermia*

Hypothermia is a life-threatening condition in which the core body temperature falls below 95°F. Hypothermia can occur at temperatures above freezing particularly, when the skin or clothing becomes wet. During exposure to cold, maximum shivering occurs when the core temperature falls to 95°F. As hypothermia progresses, depression of the central nervous system becomes increasingly more severe. This accounts for the progressive signs and symptoms ranging from sluggishness and slurred speech to disorientation and eventually unconsciousness (see Table 9-3).

**Table 9-3**
**Progressive Clinical Symptoms of Hypothermia**

| Core Temperature (°F) | Clinical Signs |
|---|---|
| 95° | Maximum shivering |
| 87° - 89° | Consciousness clouded; blood pressure becomes difficult to obtain; pupils dilated |
| 84° - 86° | Progressive loss of consciousness; muscular rigidity; respiratory rate decreases |
| 79° | Victim rarely conscious |
| 70° - 72° | Maximum risk of ventricular fibrillation |

The ability to sustain metabolic rate and to reduce skin blood flow is diminished by fatigue. Thus, fatigue increases the risk of severe hypothermia by decreasing metabolic heat. Additionally, because blood flow through the skin is reduced to conserve heat, the skin and underlying tissues become more susceptible to frostbite.

### *Frostbite*

Frostbite is both the general and medical term given to areas of cold injury. Unlike hypothermia, frostbite rarely occurs unless environmental temperatures are less than freezing and usually less than 20°F. Frostbite injuries occur most commonly on the distal parts of the body (nose, earlobes, hands, and feet) that are subject to intense vasoconstriction. The three general categories of frostbite are:

- Frostnip — A whitened area of the skin, which is slightly burning or painful
- Superficial frostbite — Waxy, white skin with a firm sensation but with some resiliency. Symptomatically feels “warm” to the victim with a notable cessation of pain
- Deep frostbite — Tissue damage deeper than the skin, at times, down to the bone. The skin is cold, numb, and hard

### Prevention of Cold Related Illness

The following are precautions that will be taken to prevent illness relating to cold stress:

- Educate worker to recognize the symptoms of frostbite and hypothermia
- Ensure the availability of an enclosed, heated environment within the vehicles. The nearest heated environment will be the interior of the vehicles at the site
- Ensure the availability of dry changes of clothes
- Record temperature readings
- Ensure the availability of warm beverages, preferably non-caffeinated

### Monitoring for Cold Exposure

Cold stress monitoring will be conducted in accordance with the ACGIH cold stress TLV. The TLV objective is to prevent the deep body core temperature from falling below 96.8°F and to prevent cold injury to body extremities. Temperature monitoring and recording will be initiated in the following situations:

- At the SSHO discretion when suspicion is based on changes in worker's performance or mental status
- At worker's request
- As a screening measure whenever a worker on the site develops hypothermia
- Any person developing moderate hypothermia (a core temperature of 92°F) cannot return to work for 48 hours

## 9.o. Crystalline Silica Monitoring Plan

This section is not applicable to this project.

## 9.p. Night Operations Lighting Plan

This section is not applicable to this project.

### 9.q. Fire Prevention Plan

All project personnel will be responsible for observing and reporting fires and conditions that could lead to fires. During all onsite activities, the following practices will be used for fire prevention and protection:

- Smoking on site is prohibited in designated work areas, contamination reduction zones, and other areas where smoking may create a fire hazard (e.g., dry fields or forested areas)
- A designated smoking area will be established (if allowed by base regulations) as necessary by the SSHO or SSs when operations on site begin
- Accumulations of combustible scrap and debris onsite will be promptly removed and properly disposed
- Care will be taken with all equipment to reduce the possibility of sparks or open flames
- Inspect all electrical cords and plugs prior to use; keep cords away from water and moisture
- Fire extinguishers (minimum 2 A:B:C, 10-lb) will be available at the work area and support area
- A fire extinguisher will be available on all pieces of heavy equipment

Requirements for storage of flammable and combustible liquids will include:

- A suitable portable fire extinguisher will be available at the location where flammable or combustible liquids are stored
- "No Smoking" signs will be posted in the storage area
- Flammable liquids will be stored in closed containers. Type I or Type II metal safety cans (not greater than 5 gallons capacity) will be used for small quantities. Plastic storage containers are not allowed
- Not more than 60 gallons of Class I or Class II liquids, nor more than 120 gallons of Class III liquids may be stored in a storage cabinet
- Containers of flammable and combustible liquids shall be stored properly when not in use

- The grounds around the storage area will be kept free of weeds, trash, and other unnecessary combustible materials

- Spills will be cleaned up promptly

- Proper bonding and grounding principles will be observed when transferring flammable liquids from one container to another

**Fire Extinguishers**

Fire extinguishers are divided into categories, based on different types of fires. Each fire extinguisher also has a numerical rating that serves as a guide for the size of fire the extinguisher can handle. The higher the number rating, the more firefighting power of the extinguisher. The following is a quick guide to project management to help choose the right type of extinguisher:

- Class A extinguishers are for ordinary combustible materials such as paper, wood, cardboard, and most plastics. The numerical rating on these types of extinguishers indicates the amount of water it holds and the amount of fire it can extinguish.

- Class B fires involve flammable or combustible liquids such as gasoline, kerosene, grease and oil. The numerical rating for class B extinguishers indicates the approximate number of square feet of fire it can extinguish.

Class C fires involve electrical equipment, such as appliances, wiring, circuit breakers, and outlets. Never use water to extinguish class C fires – the risk of electrical shock is far too great! Class C extinguishers do not have a numerical rating. The C classification means the extinguishing agent is non-conductive.

### 9.r. Wild Land Fire Management Plan

This section is not applicable to this project.

### 9.s. Hazardous Energy Control Plan

This section is not applicable to this project.

### 9.t. Critical Lift Plan

This section is not applicable to this project.

### 9.u. Contingency Plan for Severe Weather

Daily weather conditions will be a part of the daily briefing. During severe weather, project personnel will seek shelter in an appropriate location (i.e., building or vehicle). The individual is ultimately responsible for his/her personal safety and has the right to take appropriate action when threatened by severe weather.

**Safe Locations during Severe Weather and Locations to Avoid**

No place is absolutely safe from severe weather; however, some places are safer than others:

- Large enclosed structures (substantially constructed buildings) tend to be much safer than smaller or open structures
- The risk for lightning injury depends on whether the structure incorporates lightning protection, construction materials used, and the size of the structure
- In general, fully enclosed metal vehicles such as cars, trucks, buses, vans, etc. with the windows rolled up provide good shelter from many weather conditions

*AVOID being in or near*: High places and open fields, isolated trees, rain or picnic shelters, communications towers, flagpoles, light poles, bleachers (metal or wood), metal fences, water (lakes, streams, rivers, etc.).

*When inside a building AVOID*: Use of the telephone, washing your hands, or any contact with conductive surfaces with exposure to the outside such as metal door or window frames, electrical wiring, telephone wiring, cable TV wiring, plumbing, etc., if lightning is a factor. Generally speaking, identify and seek shelter that is appropriate for the type of severe weather you are encountering. Proper shelter will always include sound structure and remove you from the elements. When available, pay attention to weather warning devices such as National Oceanic and Atmospheric Administration weather radio and/or credible weather detection systems, however, do not let this information override good common sense.

Weather-related hazards will directly correlate to the type of weather involved. Hot, dry weather may cause greater dust emissions, particularly during intrusive activities. Rain may increase slip/trip hazards, particularly for ground workers. Additionally, lightning strikes during electrical storms could also be a potential hazard. The following procedures will be implemented once thunder is heard or lightning spotted:

- If thunder is heard, all site personnel are to be alert of any visible lightning flashes. The SSHO will observe the storm front and track the direction it is moving. The SSHO will continue to observe the storm front until it passes or until the prevailing direction is determined to be away from the site.

- If lightning is observed, the Site Supervisor or SSHO are to be notified. When the next lightning flash is observed, a "second" count shall be initiated from the time the lightning is observed until the thunder from the strike is heard.

- The following action guidelines shall be implemented once the "second" count is ≤ 30 seconds:

  — "second" count > 30, the Site Supervisor or SSHO will continually observe the storm front. If the front is moving away, work will continue. If the front is moving towards the site, the Site Supervisor will initially place workers on alert for potential evacuation.

  — "second" count ≤ 30, the Site Supervisor will issue the evacuation command and all workers are to report to the break/lunch trailer. Work can be re-initiated once the front has passed by and thunder has not been heard for 30 minutes.

- If lightning is observed and the storm front is moving away from or around the site and is > 20 miles away, work will be permitted to continue. The location of the storm can be confirmed via internet access to a local weather website that has a Doppler radar tracking system.

### 9.v. Float Plan

This section is not applicable to this project.

### 9.w. Site-Specific Fall Protection & Prevention Plan

This section is not applicable to this project.

### 9.x. Demolition Plan

This section is not applicable to this project.

### 9.y. Excavation/Trenching Plan

Geophysical surveys will be completed at some Camp Hero AOCs where underground anomalies are suspected to exist. Based on results of the geophysical survey, test pits may be required to

determine the presence or absence of underground tanks or other anomalies. At AOCs discrete anomalies cannot be safely identified and hand excavated, the test pits will be excavated using an excavator. The test pits will be shallow, narrow exploratory trenches and no employee would be entering the trenched area at any time.

The need for test pitting will be assessed after the initial phase of field work. If test pits are deemed necessary, an APP Addendum will be prepared to address the Excavation/Trenching Plan for the test pits in accordance with EM 385-1-1, Section 25.A.01. An Excavation/Trenching Plan and/or AHA will be required for excavations or trenches expected to be greater than 5 ft (1.5 m) in depth. The Excavation/Trenching Plan and/or AHA should prepared by the Competent Person for Excavation or a Registered Professional Engineer, and submitted and accepted by the USACE prior to beginning operations.

Excavated material will be deposited onto impermeable plastic sheeting the ground surface in an adjacent dry area of the AOC. No employee will be entering the trenched area at any time.

Excavated sediment will be placed a minimum of three feet from the edge of the excavation. Erosion control measures will be utilized to prevent erosion where necessary when excavations cease in each area.

**Underground and Overhead Utility Avoidance**

Test pitting operations will be conducted in a manner that avoids any potential for inadvertent contact with underground and overhead utilities. Utility clearance and/or dig permits will be obtained from the facility prior to excavation.

**Heavy Equipment Operation**

Experienced, proficient equipment operators will operate the backhoe. Equipment operation will also be done under the supervision of the SSHO. During mechanical excavation, all non-essential personnel will be removed from the exclusion zone (EZ). Essential site personnel will maintain a safe distance and remain clear of the swing of operating equipment. All site personnel working in the vicinity of heavy equipment will wear required PPE. Swamp mats may be utilized beneath the heavy equipment if extremely wet conditions exist at the time of operations.

**Exposure to Vehicular Traffic**

Employees exposed to vehicular traffic will wear high-visibility safety vests. Traffic control barricades will be established for roadways impacted by excavation activities.

**Exposure to Falling Loads**

No employee will be permitted under loads handled by lifting, digging, or dumping equipment. Employees are required to maintain clearance from vehicles being loaded or unloaded to avoid being struck by spillage or falling objects.

### 9.z. Emergency Rescue

This section is not applicable to this project.

### 9.aa. Underground Construction Fire Prevention and Protection Plan

This section is not applicable to this project.

### 9.bb. Compressed Air Plan

This section is not applicable to this project.

### 9.cc. Formwork and Shoring Erection and Removal Plans

This section is not applicable to this project.

### 9.dd. Precast Concrete Plan

This section is not applicable to this project.

### 9.ee. Lift Slab Plans

This section is not applicable to this project.

### 9.ff. Steel Erection Plan

This section is not applicable to this project.

### 9.gg. Site Safety and Health Plan for Hazardous Toxic Radiological Waste Work

This section is not applicable to this project.

### 9.hh. Blasting Safety Plan

This section is not applicable to this project.

### 9.ii. Diving Plan

This section is not applicable to this project.

### 9.jj. Confined Space Program

This section is not applicable to this project.

## 10. RISK MANAGEMENT PROCESSES

Risk management processes are implemented to insure all project hazards have been identified by the management team and safety professionals, and that procedures are in place to control the exposure to these hazards.

The following are the major types of hazards that are anticipated for tasks at the Camp Hero AOCs:

- Physical
- Chemical
- Biological

Each task or activity will have an AHA developed to define the activity to be performed. The AHA will reflect the work sequences, site conditions, anticipated hazards, control methods, equipment requirements, and training to be implemented to eliminate or reduce the hazards.

Operations at the site may require additional tasks not identified or addressed in the SSHP. Before performing any task not covered in this APP or associated SSHP, an AHA must be prepared, and approved by the Project SH&E Manager.

The specific AHAs identifying the project-specific task hazards and controls are presented in the SSHP, Appendix G to this APP. The following text discusses the major types of hazards.

### 10.a. Chemical Hazards

Chemical hazards include the materials that are found on site during field tasks and those chemicals brought on the site to support the project. AECOM-Tidewater JV has effective Hazard Communication, Personal Protective Equipment, and Environmental Monitoring Programs to control chemical hazards. The areas of concern (AOCs) at Camp Hero identified for inclusion in the Remedial Investigation included former waste disposal areas, sewage treatment systems, former coal storage areas, abandoned drum locations, former petroleum storage tanks, areas of possible DoD-related disposal, former boilers, a motor pool, and a former power plant. Underground storage tank (UST) closure reports indicated elevated levels of lead at the location of two former UST locations. s; Additionally, a previous investigation of transformers indicated elevated levels of Polychlorinated biphenyls in concrete staining in three buildings included in the investigation.

Otherwise, no previous investigations have been conducted to identify contaminants of potential concern (COPCs). This investigation will include soil and groundwater sample collection for analysis

of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), PCBs, herbicides, pesticides, and metals.

PCBs may be present at some Camp Hero AOCs. Routes of exposure to PCBs include inhalation, absorption, ingestion, and skin/eye contact. Symptoms of exposure are: irritation of eyes; chloracne; liver damage; and reproductive effects. OSHA has established a Permissible Exposure Limit (PEL) of 0.5 milligrams per cubic meter ($mg/m^3$) of air as an 8-hour time-weighted average (TWA) for PCBs containing 54% chlorine and 1 $mg/m^3$ as an 8-hour TWA for PCBs containing 42% chlorine. The National Institute for Occupational Safety and Health (NIOSH) has established a Recommended Exposure Limit (REL) of 0.001 $mg/m^3$ for both forms, and an Immediately Dangerous to Life or Health (IDLH) concentration of 5 $mg/m^3$. NIOSH considers PCBs an occupational carcinogen.

PCBs and lead in dust only comprise a small percentage of the total dust composition, which depends on the concentration of lead and PCBs in the soil/dust. Exposure to dust in excess of the general OSHA PEL of 15 $mg/m^3$ for dust is not expected. The OSHA PEL would be protective of workers' potential exposure to lead and PCBs.

Hexane is used as a solvent when collecting wipe samples of PCB-containing materials. Routes of exposure to hexane include inhalation, ingestion, and skin/eye contact. Symptoms of exposure are: irritated eyes, nose; nausea, headache, dizziness; peripheral neuropathy, numbness of the extremities, muscle weakness; and dermatitis. OSHA has established a PEL of 500 ppm of air as an 8-hour time-weighted average (TWA). NIOSH has established a REL of 50 ppm, and an Immediately Dangerous to Life or Health (IDLH) concentration of 1100 ppm.

Other contaminants may be present in soil and groundwater, including VOCs, SVOCs, metals, petroleum-based compounds, pesticides, and herbicides.

Exposure to chemical hazards may have adverse effects on organs or systems of the body, and can occur through four routes of exposure:

- ingestion
- inhalation
- skin/eye absorption
- skin/eye contact

Potential hazards for all possible routes of entry may be minimized by protecting against exposures through use of good work practices, engineering controls, and appropriate PPE.

**General Rules and Procedures**

Occupational Exposure Limits: The Permissible Exposure Limits of OSHA and the TLVs of the ACGIH will be monitored and appropriate controls will be implemented to maintain our personnel exposure below these limits. Occupational exposure limits for the chemicals in use or anticipated at this project are listed in the SDS's for each chemical. To avoid incidental exposure to hazardous chemicals please follow these criteria:

- Develop and practice safe chemical hazard recognition habits
- Avoid unnecessary exposure to chemicals by any route
- Do not smell or taste chemicals
- Wear and inspect gloves before handling chemical containers or contaminated debris

Eating, smoking, etc.:

- Do not eat, drink, smoke, chew gum, or apply cosmetics in areas where chemicals are present
- Wash hands, face, arms and neck before conducting these activities
- Storage, handling, or consumption of food or beverages from refrigerators used for samples holding is prohibited

Personal housekeeping:

- Keep the work area clean and uncluttered
- Properly label and store chemicals and equipment
- Clean up the work area on completion of an operation or at the end of each shift

Personal protection:

- Ensure that appropriate eye protection (ANSI approved Safety Glasses with side shields) is worn by all persons, including visitors, where chemicals are stored or handled

- Wear appropriate gloves when the potential for contact with toxic materials exists, inspecting them before each use, washing them before removal, and replacing them periodically

- Use any other protective and emergency apparel and equipment as appropriate

- Use of contact lenses in areas where chemicals may be encountered is not permitted

- Remove PPE immediately on discovering significant contamination

### 10.b. Biological Hazards

Biological hazards, which may be found on jobsites, include insects, arachnids, such as spiders, ticks, mites, and plants. Several varieties of snakes and other wildlife are also common hazards on jobsites. Employee awareness and the safe work practices outlined in the following paragraphs should reduce the risk associated with these hazards to acceptable levels.

The common biological hazards and controls that may be applicable to this project are indigenous hazards that will be discussed during the site orientation training and daily briefings, and where necessary, PPE and first aid treatment protocols will be established during site operations.

Generally speaking, employee exposure to biological hazards is anticipated to be low, however; specific tasks may increase the likelihood of exposure to biological hazards. In an effort to mitigate any potential hazards to employees, the SSHO will assess the work areas during site activities in an effort to delineate the presence of poisonous plants (poison ivy/oak) or other biological hazards. These areas will be adequately delineated and the location of material fully disclosed to all onsite personnel.

**Biological Hazard Injury and Illness Prevention**

Contact with bodies of water, animals, insects, and plants can cause injury and illness to personnel. Care must be taken to ensure that these types of injuries are avoided. Some examples of biological hazards include:

1. Natural and artificial bodies of water (e.g., lakes, rivers, ponds, lagoons, etc.), may contain a variety of microorganisms. Microorganisms, in particular, present a significant hazard to personnel who may come into contact with water bodies. Contact with microorganisms in

water may result in dermatitis, infection (i.e., in cuts/lacerations), digestive distress, and other diseases.

Always be aware of areas that may contain excessive amounts of microorganisms. Such areas may include areas of standing water, areas of warm water (i.e., cooling tower effluents, etc.), and areas downstream of municipal wastewater treatment. To prevent exposure to microorganisms in water, always adhere to the following:

- Wear protective gloves (i.e., nitrile, etc.) and other appropriate PPE to prevent skin contact with water

- Never drink from natural or artificial bodies of water; such water is considered non-potable and is not safe for drinking

2. Wild animals, such as snakes, raccoons, squirrels, and rats. These animals not only can bite and scratch, but can carry transmittable diseases (e.g., rabies). Snakes may inflict a venomous bite. Avoid animals whenever possible. If bitten, go to the nearest medical facility. Examples of common venomous snakes in New York are shown in Figure 10-1.

3. Insects and spiders such as mosquitoes, ants, ticks, scorpions, bees, wasps, and widow and recluse spiders. Mosquitoes can potentially carry and transmit the West Nile Virus. Fire ants respond quickly and aggressively by biting and inflicting a venom sting. Ticks can transmit Lyme disease or Rocky Mountain Spotted Fever. Scorpions, bees, and wasps can sting by injecting venom, which causes some individuals to experience anaphylactic shock (extreme allergic reaction). Widow and recluse spiders bite and inject venom which will usually require medical attention. Whenever entering areas that provide a habitat for insects (e.g., grass areas, woods), wear light-colored clothing, long pants and shirt, and spray exposed skin areas with a DEET-containing repellent. Keep away from high grass wherever possible. Keep your eyes and ears open for bee and wasp nests. If bitten by insects, see a doctor if there is any question of an allergic reaction. Examples of common hazardous insects and spiders in New York are shown in Figure 10-2.

4. Plants such as poison ivy and poison oak can cause severe rashes on exposed skin. Be careful where you walk, wear long pants, and minimize touching exposed skin with your hands after walking through thickly vegetated areas until after you have thoroughly washed your hands with soap and water. Remember, poisonous vegetation is poisonous year round, not just during the foliage seasons. Examples of common poisonous or irritating plant species in New York are shown in Figure 10-3.

5. Avian Droppings. Avian droppings may be present when assessing or working in old, abandoned buildings. The contaminants of concern are *Cryptococcus neoformans* and *Histoplasma capsulatum*, the causative fungi of cryptococcosis and histoplasmosis, respectively. These fungi are natural inhabitants of the soil and become aerosolized when the soil is disturbed, as occurs during construction, demolition, and other earth-moving activities. They have a predilection for growth in soils contaminated with bird droppings and are often found in the vicinity of bird-roosting areas. These fungi may cause occupational mycoses and are transmitted by the respiratory route.

   *C. neoformans* – Inhalation of fungal spores is the major route of entry. The most common clinical manifestation of cryptococcosis is infections of the cerebral cortex, brain stem, cerebellum or meninges. Symptoms onset may include headache, dizziness, irritability, subtly altered mental status, personality change, and visual symptoms. Pulmonary cryptococcosis has a variety of clinical manifestations and an unpredictable course. Symptoms include dry cough and chest pain, with little or no fever. The disease mainly affects immunocompromised hosts (including patients with AIDS, sarcoidosis, or lymphoma, and those requiring chronic steroids); occupational cases are rare.

   *H. capsulatum* – Acute pneumonia may result from exposures to inhaled particulates containing high concentrations of this fungus. Cleanup, construction, or demolition in urban areas may be associated with inhalation of airborne infectious spores; this is the major route of exposure.

   Acute pulmonary histoplasmosis typically presents with symptoms of cough, pleuritic chest pain, fever, chills, myalgias, nausea, anorexia, and weight loss. Chronic pulmonary histoplasmosis occurs most commonly in middle-aged men with underlying emphysema or chronic bronchitis. Symptoms include cough and sputum production, chest pain, dypsnea, malaise, weakness, fever, weight loss and fatigue. An exposure should be suspected when several individuals develop respiratory illness two weeks following a common outdoor exposure. The prevention of inhalation exposures is recommended; the use of negative pressure respirators equipped with P100 filters decreases the risk when conducting activities that increase the number of airborne spores. Personnel will wear Level C protection when in the vicinity of operations that disturb these areas of droppings.

6. Rodents. Rodent droppings may be present when assessing or working in old, abandoned buildings. Hantaviruses may be associated with infected rodent secretions, urine, and feces or by inhalation of airborne infected dust particles. Exposure may result in hantavirus

pulmonary syndrome (HPS); symptoms include fever, myalgias, headache, and cough. The prevention of inhalation exposures is recommended; personnel should avoid coming into contact with nesting areas. If these areas are expected to be disturbed, the use of negative pressure respirators equipped with P100 filters decreases the inhalation risk. Personnel will wear Level C protection when in the vicinity of operations that disturb areas suspected to be contaminated.

7. Fungal growth. Fungal growth may be present when assessing or working in old, abandoned buildings; personnel will not enter areas of excessive growth, or will also don modified level D PPE protection when disturbance of these areas cannot be avoided. Modified level D protection may include a half mask or full-face respirator equipped with a P100 filter will be required when collecting samples and disposable coveralls/boot covers.

**Response Measures for Contact with Hazardous Plants**

If you have been exposed to poison ivy, oak, or sumac, act quickly because the toxin in the plants penetrates the skin within minutes. If possible, stay outdoors until you complete the first two steps:

1. Cleanse the exposed skin with generous amounts of a surfactant/emulsifying agent and wipe the area clean (Tecnu, Ivy-X wipes, etc.)

2. Wash the skin with water

3. Take a regular shower with soap and cool water. Do not use soap until this point because it will pick up the toxin from the surface and move it around.

4. Wash clothes, tools, and anything else that may have been in contact with the toxin, with alcohol and water. Be sure to wear hand protection during that process.

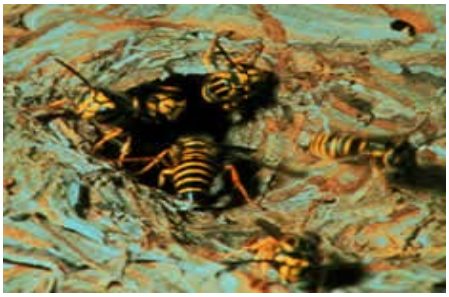
Signs and symptoms of exposure include redness and swelling that appears 12 to 48 hours after exposure. Blistering and itching will follow. If you have had a severe reaction in the past, you should see an occupational physician right away. Otherwise, according to the Federal Drug Administration, there are quite a few effective over-the-counter products to help with symptoms, including Cortaid and Lanacort, baking soda, Aveeno oatmeal bath, and calamine lotion. Additional information on the avoidance and protective measures to be implemented from field biological hazards can be found in SH&E SOP *5-313 Wildlife, Plants and Insects*.

## Figure 10-1 Hazardous Snakes Identification Guide

| | |
|---|---|
| **Rattlesnakes**<br>• Rattle snakes are pit vipers with triangle-shaped heads broader than their body<br>• Two different types in New York varying in size and color (see additional references to distinguish): the timber rattlesnake and the massasauga rattlesnake<br>• Have rattle on end of tail to serve as warning signal when threatened, however, may strike without warning<br>• Adults average 2 to 4 feet long |  |
| **Copperheads**<br>• They prefer woodlands, but may occur in semi-open habitats.<br>• Color is pale tan to reddish tan, and darker toward the midline.<br>• There are 10 to18 reddish-brown, hourglass-shaped markings.<br>• The top of the head is plain except for a small, dark spot near each eye.<br>• Most adults are 18 to 24 inches long; few are more than 38 inches. |  |

****If bitten by either of these snakes, call the Poison Center (800-222-2221) for instructions.**

## Figure 10-2 Hazardous Insects and Spiders Identification Guide

| | |
|---|---|
| **Bees**<br>• Bees typically establish new hives in the spring and fall. This is when they are most active.<br>• Honey bees are the only bees with a barbed stinger that can sting only once.<br>• Bee stings are intense and immediate.<br>• If possible, remove the stinger and the attached poison sac by scraping it from the skin with a dull edge or fingernail. Do not pinch the stinger to remove it.<br>• Honey Bees (shown in photo) are about ½ inch long. Their color varies from light brown to black mixed with yellow. Africanized honey bees are a strain of this species and difficult to distinguish from managed honey bees. |  |
| **Wasps**<br>• Wasps stingers are not barbed which allows for multiple stings.<br>• The pain is sharp and intense and may cause local swelling. Reactions should subside in a few hours.<br>• Yellow Jackets (shown in photo), sometimes called "hornets" are about ½ inch long. They are typically black with yellow markings on the head, thorax and abdomen. The body is smooth and wings are clear.<br>• Wasps may be aggressive when looking for food, especially in the fall. |  |
| **Sac Spiders**<br>• Spider bites in New York blamed on brown recluses are more probable to be bites attributable to the much more common yellow sac spiders.<br>• These spiders are pale yellow, with a body length of less than 1/2 inch.<br>• They hunt at night and hide during the day. Their hiding places are likely to be under rocks or inside rolled-up leaves, in which they build silken tubes in which to hide.<br>• A sac spider bite is usually painful initially, and in some individuals it may cause cramping, nausea and other symptoms similar to those of a black widow bite. Eventually, an open sore or tissue death similar to, but less severe than, that caused by a brown recluse bite may occur at the site of the bite. Usually, the bite doesn't cause serious harm. |  |

## Figure 10-2 Hazardous Insects and Spiders Identification Guide (Continued)

### Recluse Spiders

- The Brown Recluse does not occur naturally in New York, but introduced species may be able to survive for some time.
- The brown recluse spider is commonly known as a "fiddle-back" because of the violin-shaped marking on the top of the head portion. The shape and intensity of the fiddle design may vary.
- The body size is 1/4 to 3/4 inch with the leg span about the size of a quarter or half dollar.
- It lives in dark secluded places where there is little activity.
- Effects from a bite vary. It may be immediate or delayed; vary from no pain, to a stinging sensation, to intense pain. Within 24-36 hours fever, chills, weakness and pain may or may not occur. Within 2-3 days, the bite site may or may not erupt into an ulcerating lesion.



### Widow Spiders

- The Northern Black Widow spider can be found in New York, but is extremely rare.
- The female is about 1.5 inches long with a red marking on the underside of her spherical abdomen. The marking typically is a red hourglass shaped, but not always. The color may vary from white, red, orange, pink, or other colors.
- The male is about half her size and along with juveniles tend to have more markings.
- Females bite when threatened or protecting an egg sac.
- The neurotoxin causes intense pain in 1 - 3 hours and may cause medical difficulties. Bites may be problematic, especially for infants and elderly.



****If bitten by any of these spiders, call the Poison Center (800-222-2221) for instructions.**

## Figure 10-3 Hazardous Plant Identification Guide

### Poison Ivy

- Grows in East, West, Midwest
- Several forms — vine, trailing shrub, or shrub
- Three leaflets (can vary 3-9)
- Leaves green in summer, red in fall
- Yellow or green flowers
- White berries




### Poison Sumac

- Grows in boggy areas, especially in the Southwest and Northern states
- Shrub up to 15 feet tall
- Seven to 13 smooth-edged leaflets
- Glossy pale yellow or cream-colored berries




### Cow Parsnip

- Widespread throughout North America except Southeastern United States
- Grows in a variety of habitats including woodlands, forest openings, grasslands, stream and river edges, along roadsides
- Large, grows from 3-10 feet tall
- Leaves are 12"-18," rough and hairy, divided into 3 segments, with coarsely toothed leaflets and a broad wing at the base of each leaf stalk
- Stems are rough, hairy, hollow and grooved
- White- or cream-colored flowers with a sweet fragrance . Flowers have 5 petals of different sizes and are arranged in broad, flat-topped clusters at the top of short stalks. Blooms in mid-summer
- Sap contains a phototoxin that reacts with ultraviolet light to cause skin irritation ranging from a mild rash to severe blistering




## Figure 10-3 Hazardous Plant Identification Guide (Continued)

### Stinging Nettle

- Perennial, erect herb with stinging hairs
- Opposite heart-shaped leaves, small greenish flowers
- Present throughout the United States, in forests and natural areas at the edges of woods. It is also found in disturbed areas such as waste places and roadsides
- Stinging hairs on stems and leaves produce an intense burning and itching sensation that can last up to thirty minutes





### Wild Parsnip

- Large plant, stands erect at 2-5 feet tall
- Leaves have saw-toothed edges, stems are hollow and deeply grooved
- small, 5-petaled, yellow flowers arranged in a flat-topped broad umbel; flowers June-September
- Flowers produce a round, smooth, straw-colored seed pod that is approximately 0.25 inches in size.
- Those sensitive to the plant develop a rash if skin contacts the leaves or plant sap in the presence of sunlight. Very painful rash can develop, which in some people leaves scars, that can persist for several months or longer
- Most irritating during flowering





### 10.c. Physical Hazards

AECOM-Tidewater JV has published safe work practice procedures that will provide general guidelines that are to implement when executing work in the field. These procedures apply to all activities, and personnel working on field projects and operations.

**General Housekeeping**

During site activities, work areas will be continuously policed for identification of excess trash and unnecessary debris. Excess debris and trash will be collected and stored in an appropriate container (e.g., plastic trash bags, garbage can, roll-off bin) prior to disposal. At no time will debris or trash be intermingled with waste PPE or contaminated materials. Additional information on the requirements of housekeeping can be found in SH&E SOP 5-307-*Housekeeping Worksite* and Section 9.d. Site Sanitation Plan.

**Manual Lifting**

Most materials associated with investigation and remedial activities are moved by hand. The human body is subject to severe damage in the forms of back injury, muscle strains, and hernia if caution is not observed in the handling process. Whenever possible, use mechanical assistance to lift or move materials and at a minimum, use at least two people to lift, or roll/lift with your arms as close to the body as possible. For additional requirements, refer to SH&E SOP 5-308-*Manual Lifting Field.*

**Slips/Trips/Falls**

Physical hazards such as slips, trips, and falls may occur. Workers must walk cautiously at the site to avoid tripping, especially when physical obstructions are present and illumination is poor. Falls are more serious when they occur from heights. Extra precautions must be taken if guardrails or railings are absent.

Ladders shall be maintained free of oil, grease and other slipping hazards. They shall not be loaded beyond the maximum intended load for which they were built, or beyond the manufacturer's rated capacity. Ladders shall only be used for the purpose for which they were designed. Areas around the bottom of the ladder or stairway shall be kept clear. When ascending or descending a ladder, the user shall face forward and use at least one hand to grasp the ladder. A worker shall not carry any object or load that could cause him/her to lose balance and fall. Workers shall be trained, as necessary, in the hazards related to ladders, including the nature of fall hazards in the work area.

**Heat and Cold Stress**

Heat and cold stress can result when working in hot or cold environments, particularly when protective clothing decreases natural body ventilation. Section 9.n. contains additional information on Heat Stress.

**Noise**

Hearing protection (ear plugs and/or muffs) must be used when working in areas where noise levels could reasonably be expected to exceed 85 dBA. Hearing protection will be worn in the vicinity of heavy equipment, generators, concrete cutters, and any other high noise emitting equipment.

**Hand Tools**

Hand tools should be kept in good repair and used only for their designed purposes. Proper protective eyewear should be worn when using hand tools and portable power tools. Unguarded sharp-edged or pointed tools will not be carried in employees' pockets. The use of tools with mushroomed heads, split or defective handles, worn parts, or other defects will not be permitted. Inspect all tools prior to start-up or use to identify any defects. Tools that have become unsafe will be reconditioned before reissue or discarded. Throwing or dropping of tools from one level to another will not be permitted; rather, containers and hand lines should be used for transporting tools from one level to another.

Non-sparking tools will be used in atmospheres where sources of ignition may cause fire or explosion. Electric-powered shop and hand tools will be of the double-insulated, shockproof type or be effectively grounded. Only designated employees who are familiar with their use should operate power tools. When not in use, tools will not be left on scaffolds, ladders, or overhead working surfaces. URS SMS 16 addresses the use of hand tools and portable equipment.

The use of sampling equipment and hand tools presents the potential for hand injuries. Site personnel must be aware of hand hazards (pinch points, cutting tools) and take proper precautions to avoid injury, including the use of proper tools, good work practices, and protective gloves.

**Appendix A**
**AECOM-Tidewater JV OSHA 300 Form**

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**Attention:** This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health programs.

Form approved OMB no. 1218-0176

OSHA's Form 300

# Log of Work Related Injuries and Illnesses

Year: 20XX

You must record information about every work-related death and about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR Part 1904.8 through 1904.12. Feel free to use two lines for a single case if you need to. You must complete an Injury and Illness Incident Report (OSHA Form 301) or equivalent form for each injury or illness recorded on this form. If you're not sure if a case is recordable, call your local OSHA office for help.

**Establishment name**

**City/State**

| Identify the person | | | Describe the case | | | Classify the case | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Using these four categories, check ONLY the most serious result for each case: | | | | Enter the number of days the injured or ill worker was: | | Check the "injury" column or choose one type of illness (M) | | | | |
| (A) Case # | (B) Employee's Name | (C) Job Title (e.g. welder) | (D) Date of injury or onset of illness (month/day) | (E) Where the event occurred (e.g. Loading dock north end) | (F) Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill. (e.g. Second degree burns on right forearm from acetylene torch) | (G) Death | (H) Days away from work | (I) Remained at work: Job transfer or restriction | (J) Remained at work: Other recordable cases | (K) On the job transfer or restriction | (L) Away from work | (1) Injury | (2) Skin Disorder | (3) Repiratory condition | (4) Poisoning | (5) All other illnesses |
| 1 | | | | | | | | | | days | days | | | | | |
| 2 | | | | | | | | | | days | days | | | | | |
| 3 | | | | | | | | | | days | days | | | | | |
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| 24 | | | | | | | | | | days | days | | | | | |
| 25 | | | | | | | | | | days | days | | | | | |
| | | | | | Totals | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

**Attention:** This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health programs.

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OSHA's Form 300

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**Establishment name**

**City/State**

| Identify the person | | Describe the case | | | | Classify the case | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Using these four categories, check ONLY the most serious result for each case: | | | | Enter the number of days the injured or ill worker was: | | Check the "injury" column or choose one type of illness (M) | | | | | |
| (A) | (B) | (C) | (D) | (E) | (F) | | | | | | | | | | | | |
| Case # | Employee's Name | Job Title (e.g. welder) | Date of injury or onset of illness (month/day) | Where the event occurred (e.g. Loading dock north end) | Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill. (e.g. Second degree burns on right forearm from acetylene torch) | Death (G) | Days away from work (H) | Remained at work: Job transfer or restiction (I) | Remained at work: Other recordable cases (J) | On the job transfer or restriction (K) | Away from work (L) | Injury (1) | Skin Disorder (2) | Repiratory condition (3) | Poisoning (4) | All other illnesses (5) |
| | | | | | | | | | | | | | | | | | |
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## Appendix B
## AECOM-Tidewater JV Safety and Health Policy Statement

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# Safety, Health, and Environmental Policy Statement

**PURPOSE**

The purpose of this policy is to:

- Establish and maintain a framework for a safe and healthy workplace for all AECOM-Tidewater JV and partners' employees and minimize our impact on the environment.
- Outline expectations relative to compliance with governing occupational safety, health and environmental legislation.

**COMMITMENT**

AECOM-Tidewater JV is committed to protecting the safety and health of our employees and meeting our obligations with respect to the protection of others affected by our activities. We are also committed to protecting and preserving the natural environment and communities in which we operate. We will actively seek to conserve energy, water and natural resources and to recycle and reduce waste where appropriate during the execution of our business activities. We and our partners will be good corporate citizens by striving to ensure that our facilities and operations do not pose unreasonable safety or environmental risks, and by participating in community-related activities that promote excellence in safety, health and environmental practices. In all of our activities we will develop and implement appropriate systems and procedures designed to comply with applicable laws, legislation, licensing requirements and stakeholder expectations. AECOM-Tidewater JV will plan and design its processes, facilities and projects in a manner that reduces risks and impacts during their entire life cycle, consistent with the direction and objectives of our clients.

**OBJECTIVES**

Our ultimate goals are simple:

- Prevent work-related injuries or illnesses
- Prevent damage to property and/or equipment from our activities
- Prevent adverse impacts to the environment from our ongoing projects or operations

**IMPLEMENTATION**

To guide the implementation efforts required by this policy, the Management Committee will collaborate to establish Safety, Health and Environmental (SH&E) programs that reflect the following expectations and beliefs:

- SH&E performance will not be compromised for the sake of other business or client demands.
- All accidents are preventable.
- Compliance with all applicable safety, health and environmental rules and regulations at the local, state, provincial and national level is a minimal expectation; we will not be satisfied to simply meet SH&E compliance standards. Where no specific regulation exists, we will comply with our standards and appropriate industry practices.
- We will meet client requirements.
- Concern for employee health and safety will be evident and embedded into all phases of our work by design and through the business decisions that we make.
- We will report on performance using SH&E metrics designed to help achieve established goals.
- We will communicate to all affected employees their individual SH&E obligations.
- We will incorporate input from employees, customers and partners to continuously improve our SH&E performance. We will periodically review and continually improve our processes to reflect feedback and experience, and ensure they remain relevant and appropriate to the organization.
- We will recognize those who contribute to their improved SH&E performance.

**EMPLOYEE RESPONSIBILITIES**

All employees will be responsible for:

- Conducting themselves in accordance with directives, standards and procedures established by the applicable SH&E program.
- Helping ensure their fellow employees and stakeholders have the knowledge, skills, and equipment necessary to protect themselves and others.
- Temporarily suspending their personal work activities and requesting guidance from their supervisor before continuing a task when they identify a condition or practice that creates a serious safety, health or environmental risk.
- Immediately reporting safety, health and/or environmental incidents to their supervisor.

AECOM-Tidewater JV Management Committee:

Mark MacEwan
Project Manager

Amanda Martin
Safety, Health & Environmental Representative

Bob Miller, CIH
Safety, Health, & Environmental Manager

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## Appendix C
## AECOM-Tidewater JV SH&E Standard Operating Procedures

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**Americas**

# Safe Work Standards and Rules

**S3NA-001-PR1**

## 1.0 Purpose and Scope

1.1 Demonstrates AECOM's commitment to the establishment and maintenance of workplaces free from recognized hazards.

1.2 This procedure applies to all AECOM North America based employees and operations.

## 2.0 Terms and Definitions

2.1 **Safety Violation –** Not following verbal or written safety policies, rules and procedures (e.g., guidelines, rules, horse play, failure to wear selected PPE, abuse of selected PPE, etc.).

2.2 **Safe Work Practices** – The do's and don'ts about carrying out a task or use of equipment, informing the worker about the hazards present and providing direction on how to safeguard against the hazard. Safe Work Practices are generally guidelines only.

2.3 **Safe Job Procedures** – Written step-by-step set of instructions about completing a specific task safely including control measures and responding to emergency situations.

## 3.0 References

3.1 AECOM Employee Handbook

## 4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Managers and Supervisors –** Responsible for compliance with all SOP's and governmental requirements, and will be held responsible to prevent or bring any violations to the attention of the appropriate level of Management for corrective actions as per AECOM HR policies.

4.1.2 **District, Office, and Project Managers** (Including field task managers, supervisors – Responsible for implementation of, and compliance with, this procedure.

4.1.3 **Region and District SH&E Managers –** Provide guidance as to safe work standards, rules, requirements and guidelines.

4.1.4 **Human Resource Managers –** Provide guidance and direction to managers and supervisors implementing the disciplinary process for safety violations (as defined in the Employee Handbook).

4.1.5 **Employees –** Responsible for adhering to all AECOM safe work standards, rules, requirements and instructions and to provide input as appropriate.

4.2 Standard Operating Procedures (SOPs)

4.2.1 Safe Work Practices and Safe Job Procedures are embodied in the SH&E Standard Operating Procedures and are available on AECOM's Americas SH&E website.

4.2.2 Specific Safe Work Practices and Safe Job Procedures have been developed in conjunction with employees and with particular input from those who have significant experience.

4.2.3 Standard Operating Procedures have been developed to provide clear instruction regarding the safety and reporting requirements of staff and operations.

4.3 Inspections and Audits

4.3.1 **Project Managers**, **Supervisors** and **Office Managers** shall conduct project audits and office inspections to identify safe work practices and potential safety violations.

4.4 Any employee who willfully disregards AECOM or client safety standards, rules or requirements is subject to disciplinary action.

## 5.0 Records

None

## 6.0 Attachments

6.1 S3NA-001-ST Safety Rules

**Americas**

# Safety Rules

**S3NA-001-ST**

## 1.0 Rules for all Employees

1.1 Work in a manner that will not put oneself, other personnel or equipment or facilities at risk.

1.2 Identify hazardous conditions and activities in the work environment consistent with the job and training.

1.3 If a hazard cannot be eliminated, report it to the manager or supervisor promptly.

1.4 Implement established control methods consistent with project procedures and/or training.

1.5 Cooperate and comply with all AECOM Policies and Standard Operating Procedures.

1.6 Immediately report all acts of aggression, verbal or physical threats, assaults, sexual or other harassment to your supervisor, manager or the AECOM Hotline 1 888-299-9602.

1.7 Complete a Training Needs Assessment and take any safety training required for your job function or tasks.

1.8 Use or wear all personal protective equipment, devices or clothing required in accordance with manufacturers' instructions and AECOM training and/or procedures.

1.9 Do not perform any work task or activity which you believe is unsafe. Inform your supervisor immediately.

1.10 Immediately report all incidents (including near misses), injuries, property damage, spills, hazards, safety concerns and safety violations to your supervisor.

1.11 Report all observed unsafe acts, conditions, or behaviors that compromise the safety of AECOM employees, its clients, sub consultants, general contractors, or the public to your supervisor.

1.12 Keep all personal work areas clean from debris and tripping hazards.

1.13 Complete AECOM Vehicle and Driver Safety Program before operating any vehicle on AECOM business.

1.14 Operate all vehicles and mobile equipment in accordance with applicable regulations.

1.15 Do not use or operate any equipment, machine or device that may endanger you or another worker.

1.16 Do not remove damage, disable or make ineffective any protective safety, fire-fighting or first aid equipment or devices.

1.17 Use only vehicles, equipment and tools that are in safe operating condition and maintained in accordance with manufacturer's specifications. Report, remove from service, or have repaired, any tool or equipment that is damaged, not working properly or may otherwise be hazardous if used.

1.18 Do not use any hand-held wireless device while driving a vehicle or performing other safety critical tasks like working near traffic or working with power tools.

1.19 When travelling, working alone or working away from the AECOM office, particularly in remote areas, follow applicable call-in procedures.

1.20 Do not bring firearms onto AECOM property or allow them on AECOM projects unless expressed permission is provided by management for the use in wildlife protection.

1.21 Do not smoke in areas designated as "NO SMOKING" or in any AECOM facility.

1.22 Do not use, sell or distribute, be under the influence, or have in their possession any controlled substances, drugs, or alcohol while performing work duties.

## 2.0 Rules for Project or Field Work

2.1 Always report to site supervisor before performing work on site to determine specific requirements for the site or project. Follow all safety requirements, including AECOM's, or that of a client or prime contractor, as applicable.

2.2 Use only designated project entrances, parking areas and facilities.

2.3 Show or produce evidence of identification or required training if requested to gain entry to or while on a project.

2.4 Obey all warning signs (e.g., "Do Not Enter," "Eye, Hearing or Respiratory Protection Required," "Permit Required Confined Space," "Authorized Personnel Only").

2.5 Do not block, deface or remove any signage, barricade or fencing without approval.

2.6 Keep passageways clean and clear of debris, materials, hoses, cords, and tripping obstructions. Items should be moved to low activity areas or storage.

2.7 Verify with the **Project Manager** that all required Permits are in place prior to commencing work.

2.8 Be aware of work going on, around or above you including contractor activities and public motor vehicles.

2.9 Do not work alone when performing high risk or remote work. Examples of high risk work activities include, but are not limited to:

- 2.9.1 Entering trenches/excavations
- 2.9.2 Entering permit-required confined spaces
- 2.9.3 Working at-height (i.e., donning a full-body harness)
- 2.9.4 Operating an aerial lift
- 2.9.5 Working over water
- 2.9.6 Boating
- 2.9.7 Working in atmospheres that have the potential to contain highly hazardous chemicals (e.g. hydrogen sulphide, explosive atmospheres, etc.)
- 2.9.8 Working near operating mobile and heavy equipment
- 2.9.9 Working in or adjacent to work zones containing vehicular activity

2.10 Personal cameras, video recorders, and other photographic equipment shall not be permitted on site without the **Project Manager** and client's approval.

2.11 Plan work tasks before beginning work and consider any hazards that may exist and how to avoid them through safe work practices or safe work procedures.

**Americas**

# Stop Work Authority for Unsafe Work

**S3NA-002-PR1**

## 1.0 Purpose and Scope

1.1 This procedure establishes the requirements for AECOM personnel to stop any task or company operation if they believe there is an imminent safety, health, or environmental risk as described within this document.

1.2 The AECOM Safety Red Card is a key component in the Stop Work Authority for Unsafe Work procedure. The Safety Red Card is derived from its use in football (soccer), where circumstances are such that a referee has to stop the play, similar to an imminently dangerous situation on a project site. The Safety Red Card is a physical tool that reinforces the Stop Work Authority Procedure.

1.3 This procedure applies to all Americas-based employees and operations.

## 2.0 Terms and Definitions

2.1 **Contractor** – For the purposes of this procedure, a person or business whose contract to provide work or services is not with AECOM. AECOM may have the responsibility of safety oversight for Contractor-controlled work on a particular project or construction site if specified in the associated contract.

2.2 **Direct Subcontractor** – For the purposes of this procedure, a person or business which has a contract directly with AECOM to provide work or services.

2.3 **Imminent Danger –** For the purposes of this procedure, an immediately dangerous situation that, if left uncorrected, is likely to result in serious injury, loss of life, or environmental impairment.

2.4 **Project Management / Construction Management (PM-CM)** – AECOM has contractually agreed with the client to the specified roles and responsibilities of oversight of Contractor-controlled work for the given project.

2.5 **Safety Red Card** - A tangible reminder of stop work authority for all AECOM employees that can be presented when stopping work. The intent is for every employee to have or have access to their own Safety Red Card.

2.6 **Stop Work Order – AECOM and Direct Subcontractors -** A directive to cease AECOM-directed work, issued for failure to follow procedures, Imminent Danger situations/conditions, accumulation of safety violations, etc. The Stop Work Order will also be completed when there is disagreement between those affected or involved regarding the validity of the stop work issue or adequacy of the resolution actions. The Stop Work Order will apply to AECOM employees and AECOM Direct Subcontractors placed at risk by the identified situations or conditions. Refer to *S3NA-002-FM1 Stop Work Order – AECOM Employees and Direct Subcontractors*.

2.7 **Stop Work Order – Project Management / Construction Management** – Applies to Contractor-controlled work for which AECOM Project Management / Construction Management (PM-CM) has contractually agreed to the responsibility of safety oversight of Contractors for the given project. A directive served to the Contractor to cease Contractor-controlled work, issued for failure to follow procedures, Imminent Danger situations / conditions, accumulation of safety violations, etc. Refer to *S3NA-002-FM2 Stop Work Order-Project Management / Construction Management.* Note: If PM-CM has not contractually agreed specifically to oversight of safety, this form does not apply.

## 3.0 References

None

# 4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Employees**

- Any time an employee identifies a condition or act that is likely to cause an Imminent Danger situation:
- Responsible for stopping associated AECOM-directed work and that of Direct Subcontractors, and for bringing it to the attention of the appropriate supervisor, manager, **SH&E Representative**, and/or Contractor representative.
- Where **Employees** are working alongside Contractors for which AECOM has contractual **Project Management / Construction Management (PM-CM)** safety oversight of the Contractor, employees shall be responsible for stopping associated Contractor-controlled work and for bringing it to the attention of the appropriate supervisor, manager, SH&E representative, and/or Contractor representative.
- Where employees are working alongside Contractors for which AECOM PM-CM has not contractually agreed to the responsibility of safety oversight of Contractors for the given project, employees can, as applicable, report unsafe conditions/acts to the Contractor's site representative (supervisor, foreman, etc.) for resolution. **Employees** shall promptly report the situation to AECOM management.
- Where no contract exists between AECOM and the party presenting the situation, employees can, as applicable, and report unsafe conditions/acts to the parties' site representative (supervisor, foreman, etc.) for resolution. **Employees** shall promptly report the situation to AECOM management.
- Where **Employees** are working under the direction of client / customer supervisors and/or working on a task with a client / customer employee, **Employees** shall be trained, as is applicable, to communicate directly with the worker involved, report the unsafe conditions/acts to their client / customer supervisor and/or point-of-contact for resolution and subsequently report it to AECOM management.
- Decline to participate in client / customer-directed work under unsafe conditions or acts and immediately report the situation to AECOM management.
- **Employees** shall retain their individual Safety Red Card. An **Employee** may or may not physically present a Safety Red Card when stopping work.

4.1.2 **SH&E Manager**

- Review all Stop Work Orders applicable to their scope.
- Provide technical guidance for the development and implementation of corrective actions.
- Training of AECOM **Employees** should include how to exercise stop work authority and the measures AECOM management will take as a result of the work stoppage.
- Honor any worker refusals of unsafe work. Assist in resolving issues before operations resume, and that all stop work actions are properly resolved with required follow-up completed.

4.1.3 **Manager**

- Establish a safety culture where the stop work authority is embraced by the workforce as a tool so that all AECOM employees share the responsibility for safe working conditions.
- Training of AECOM **Employees** should include how to exercise stop work authority and the measures AECOM management will take as a result of the work stoppage.
- AECOM **Employees** have or have access to their own Safety Red Card and understand its meaning.

- Contractors for which AECOM PM-CM has contractual safety oversight, and Direct Subcontractors are informed of the stop work authority of AECOM and its **Employees** as a regulatory and Company requirement, as well as the intent of the program, which is to empower employees to work safe and prevent injuries.
- Clients / customers understand stop work authority of **Employees** is a regulatory and Company requirement, as well as the intent of the program, which is to empower **Employees** to work safe and prevent injuries.
- Honor any worker refusals of unsafe work, Resolve issues before operations resume, and that all stop work actions are properly resolved with required follow-up completed.
- Confirm reporting is completed any time an **Employee** exercises stop work authority
- Review so that Reporting is appropriate to the stop work situation, using inspection and observations programs (e.g. LifeGuard, Office Inspections, etc.) and IndustrySafe. Refer to *S3NA-004-PR1 Incident Reporting* for additional direction.
- Maintain and track reports associated with the stop work situation until resolved/closed.
- Stop work interventions that include a near miss or incident shall be reported as such.
- Review for Stop Work Orders completed when AECOM **Employees** or Direct Subcontractors completing AECOM-directed work fail to provide resolution to the stop work situation, or if at any time the actions or failure to act of those involved in the Stop Work Order cause Imminent Danger to the health and safety of Employees, any other person at the place of employment, or the environment. Refer to *S3NA-002-FM1 Stop Work Order – AECOM Employees and Direct Subcontractors*.
- Review Stop Work Orders – Project Management / Construction Management are completed when Contractors performing Contractor-controlled work, subject to AECOM contractual safety oversight, fail to provide resolution to the stop work situation, or if at any time the actions or failure to act of those involved in the Stop Work Order cause Imminent Danger to the health and safety of **Employees**, any other person at the place of employment, or the environment. Refer to *S3NA-002-FM2 Stop Work Order – Project Management / Construction Management*.
- When an unsafe condition or act has been reported by an AECOM **Employee** of a Contractor for which AECOM does not have specific contractual safety oversight, communicate promptly with client representative(s).
- Review corrective actions have appropriately addressed the conditions leading to the stoppage of work or the Stop Work Order.
- If AECOM has control over the circumstance that led to the condition, initiate additional corrective actions necessary to correct the conditions leading to the Stop Work Order. Otherwise, remain in communication with the persons or entities that are taking the corrective measures.
- Communicate such corrective actions and the effects of such corrective actions on the project / location / office to the client and/or next level of AECOM Management.
- Work activities of AECOM-directed work should not resume until the stop work situation has been resolved to the satisfaction of all involved and/or the appropriate approvals received to resume work.
- Monitor that work activities of Contractors subject to AECOM contractual safety oversight do not resume work until the unsafe situation has been resolved.
- Documentation related to the Stop Work Order and corrective actions is placed in the project / location / office file.

4.2 Requirements

4.2.1 **Employees** shall be trained in how to exercise stop work authority, the use of the Safety Red Card and in the measures AECOM management will take as a result of the work stoppage.

4.2.2 **Employees** will each be provided a Safety Red Card for their own use.

4.2.3 It is AECOM's policy and firm commitment that **Employees** are expected to stop their work to prevent unacceptable exposure to workplace hazards, including unsafe conditions or worker behaviors, without fear of reprimand or reprisal.

- "Stopping work" for AECOM-directed work may include stabilizing an Imminent Danger situation, as is safely possible, to the extent that it can be left unattended for a prolonged period of time until the issue is resolved.
- Stop work interventions to correct some unsafe situations that do not present an Imminent Danger (e.g., to remind workers to put on their hard hats, safety glasses, etc.) may not require formal stop work notification but should be appropriately reported (e.g. LifeGuard, Inspection Report).

4.2.4 There will be no retribution or any form of intimidation directed against an employee for good faith reporting of SH&E issues or the good faith stopping of work due to unsafe conditions.

4.2.5 Where **Employees** identify an unsafe act or condition related to a Contractor or worker for which AECOM does not have specific contractual safety oversight , as applicable, **Employees** should report the situation to the Contractor or worker's site representative (supervisor, foreman). **Employees** shall immediately report the situation to AECOM management who, in turn, shall promptly communicate with the client representative(s).

- While **Employees** may not be authorized to stop client / customer-directed work, **Employees** shall decline to participate in work under the Imminently Dangerous situation and immediately report the situation to the client / customer representative and AECOM management.

4.2.6 AECOM's stop work authority applies to all work AECOM-directed work and to Contractor-controlled work for which AECOM PM-CM has contractually agreed to the responsibility of safety oversight of Contractors for the given project.

- When an **Employee** identifies an Imminent Danger situation, the **Employee** shall immediately stop work and notify the affected co-worker(s) and supervisor, manager, SH&E representative and/or Contractor representative.
- If the supervisor / manager / representative is not readily available and/or the affected person(s) are in an Imminent Danger situation, the stop work intervention should be initiated directly with the **Employee(s)** at risk. The supervisor / manager / representative shall be informed as soon as possible.
- The supervisor / manager / representative shall communicate the stop work situation with any other affected personnel and the applicable client / customer representative(s).
- **Managers**, and/or **SH&E Managers** may issue a formal Stop Work Order for AECOM-directed work in the following situations:
    - Imminent Danger exists involving an employee's safety and health, that of any other person at the place of employment or damage to the environment, facilities, or property.
    - A project, or any segment of the project, is executed improperly or is out of compliance with applicable regulations or standards.

4.2.7 Stop Work Order – Project Management / Construction Management

Applies to Contractor-controlled work for which AECOM Project Management / Construction Management (PM-CM) has contractually agreed to the responsibility of safety oversight of Contractors for the given project. Refer to *S3NA-002-FM2 Stop Work Order- Project Management / Construction Management.*

- With a stop work situation related to Contractor- controlled work for which AECOM has contractually specified safety oversight, the Contractor is expected to immediately resolve the stop work situation. A Stop Work Order – Project Management / Construction Management form must be completed if:

- Imminent Danger exists involving the **Employees'** safety & health, the environment, facilities, or property.
- There is a discrepancy, deficiency, or potentially dangerous condition or act that is likely to cause an unsafe or unhealthy situation or an Imminent Danger situation.

- When a Stop Work Order – Project Management / Construction Management is issued by AECOM, the Contractor is expected to establish and document corrective actions and provide items (e.g. pictures, documents, etc.) related to the stop work situation and related corrective actions. AECOM will monitor the Contractor's corrective actions.

4.2.8 Stop Work Order – AECOM Employees and Direct Subcontractors

With a stop work situation related to AECOM-directed work, the appropriate parties (e.g. affected personnel, supervision, SH&E representative, management, client / customer representative, etc.) shall discuss and gain agreement on the stop work issue.

- If determined and agreed by all involved that the task or operation is cleared to safely proceed, the affected persons shall immediately resume work.
- If determined and agreed that the stop work issue is valid, then every attempt must be made to resolve the issue for the safety of **Employees**, Contractors, any other person at the place of employment, and the environment.
- If the stop work issue cannot be resolved immediately, work shall be suspended until proper resolution can be achieved to the satisfaction of all involved.
- If all affected by the stop work issue cannot agree that work can be resumed safely (opinions differ regarding the validity of the stop work issue or adequacy of the resolution actions), a Stop Work Order must be completed. Refer to *S3NA-002-FM1 Stop Work Order – AECOM Employees and Direct Subcontractors*.
  - In order for work to resume, the completed Stop Work Order must be reviewed by the **Manager**, the applicable **SH&E Manager** and any other parties necessary (this may include the Employee who initiated the stoppage of work) to determine whether work can be resumed safely.
- If it is determined work can be resumed safely but the disagreement remains, work will only commence with the written approval to return to work by the Vice President of the applicable business group and, as applicable, the client representative. Refer to *S3NA-002-FM1 Stop Work Order – AECOM Employees and Direct Subcontractors.*
- If the responsible organization fails to provide resolution, or if at any time the responsible organization's acts or failure to act cause Imminent Danger to the health and safety of **Employees**, that of any other person at the place of employment, or the environment, AECOM may issue a Stop Work Order. Refer to *S3NA-002-FM1 Stop Work Order – AECOM Employees and Direct Subcontractors*.

4.2.9 In most cases, a Stop Work Order affects only those areas immediately involved in the hazardous situation. The Stop Work Order will apply to AECOM – directed work, its **Employees** and its Direct Subcontractors placed at risk by the situations or conditions. The Stop Work Order – Project Management / Construction Management will apply to Contractor-controlled work and its employees for which AECOM PM-CM has contractually agreed to the responsibility of safety monitoring of Contractors for the given project.

4.2.10 AECOM may issue a Stop Work Order for a portion of the work area(s) or for an entire work area when unacceptable risks exist.

4.2.11 The Stop Work Order will remain in effect until the responsible organization resolves the problem(s) and brings the work area(s) to satisfactory conformance with established AECOM SH&E requirements. Corrective actions taken and preventative measures put in place must be communicated to all affected by the Stop Work Order.

4.2.12 Work will not resume until appropriate corrective actions have been completed. The “Return to Work” portion of the Stop Work Order must be completed.

4.2.13 An AECOM **Employee’s** failure to comply with any Stop Work Order in whole or in part may result in disciplinary action, and/or termination of employment. An AECOM Direct Subcontractor **Employee’s** failure to comply with any Stop Work Order may result in immediate removal from the project, location and/or office.

## 5.0 Records

5.1 The completed Stop Work Order and any corrective action reports generated will be maintained at the project site for the duration of the project and placed in the closed project file.

## 6.0 Attachments

6.1 S3NA-002-FM1 Stop Work Order – AECOM Employees and Direct Subcontractors

6.2 S3NA-002-FM2 Stop Work Order – Project Management / Construction Management

6.3 S3NA-002 ATT1 Stop Work Order – Authority Table

**Americas**

# SH&E Training

**S3NA-003-PR1**

## 1.0 Purpose and Scope

1.1 AECOM's Safety For Life (SFL) Training Program is designed to provide job specific training to all Employees.

1.2 Establish procedures and standards to develop, deliver, and record training activities.

1.3 This procedure applies to all AECOM Americas-based employees and operations.

1.4 Major objectives of the SFL Training Program include:

- Identify accountability, responsibility, and authority pertaining to the SFL training program requirements.
- Establish minimum training course and/or instructor criteria to support compliance with applicable regulatory requirements as well as AECOM's SFL requirements.
- Provide a framework to assess participant competency and understanding.
- Define recordkeeping requirements for the training program.
- Maintain consistency in SH&E training content throughout the Americas Geography.

## 2.0 Terms and Definitions

2.1 **Awareness Training –** Training designed to make an employee aware of a particular hazard, but does not authorize the employee to engage with the hazard.

2.2 **Compliance Training –** Training meant to provide a safe and healthy workplace for AECOM employees and others through adherence to legislative and regulatory mandates (e.g. Federal, State, Provincial, Territorial, local/municipal governments and agencies thereof), AECOM's SH&E policy and procedure, and client-specified requirements as defined in project specifications and contracts.

2.3 **Conformance Training –** Training developed by AECOM intended to further develop the AECOM SH&E culture, but is not required by legislative or regulatory requirements, SH&E policy and procedure, or client requirements.

2.4 **Competent Person –** One who is capable of identifying existing and predictable hazards in surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has authorization and resources to take prompt corrective measures to eliminate them.

2.5 **Learning Management System (LMS) –** An electronic data management system for recording the requirements of the TNA and the successful completion of assigned SH&E training.

2.6 **Performance Training –** Training designed to make an employee aware of a particular hazard, and provides training to prepare the employee to engage with the hazard.

2.7 **Training Needs Assessment (TNA) –** A tool in which a selection process identifies an employees' SH&E training requirements based on their job role(s), responsibility(s) and associated hazards, and reviews the selected course(s) with his/her supervisor for approval and provision.

## 3.0 References

3.1 S3NA-202-PR1 Competent Person Designation

3.2 S3NA-509-PR1 Hazardous Waste Operations and Emergency Response Activities Procedure

# 4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Region Executives** and **District Managers**

Responsible for establishing adequate resources (budget, training staff, etc.) to implement this procedure.

4.1.2 **Office Managers (Operations)**

Responsible for identifying and providing resources to support local administration in implementing this procedure, including:

- Assignment of database management duties
- Development of training schedules

4.1.3 **Supervisors** and **Project Managers**

Responsible for the following:

- Assisting the employee in completing the TNA
- Identify supplemental employee training courses based on local/client requirements.
- Identify additional employee SH&E training requirements based upon prudent risk management considerations and local performance issues.
- Provide time and resources to allow employee to complete training identified in the TNA.
- Implement corrective actions when employees fail to meet training requirements.
- Confirm that the appropriate level of training is being assigned to the employee with regard to their specific job and task assignments and client needs.
- Determine who is defined as competent person(s) per the *S3NA-202-PR1 Competent Person Designation*.
- Determine what is required for training per the *S3NA-509-PR1 Hazardous Waste Operations and Emergency Response Activities.*

4.1.4 **Americas SH&E Director**

Responsible for the following:

- Establishing and maintaining this procedure.
- Providing the necessary tools, support, and staff for on-going development and support of the training program.
- Reporting/communicating training status to senior management.

4.1.5 **Region SH&E Manager**

Responsible for the following:

- Ensuring Region and Business Line management understand the function of the LMS and provide training, access and resources.
- Working with office managers and project managers to develop schedules, develop skills of local employees assigned with training and recordkeeping duties, and providing training classes as requested.
- Reviewing and approving qualifications of safety training providers.
- Approving training lesson plans and course agendas for training courses.
- Offering all training participants the opportunity to evaluate training events.
- Reporting compliance with training program requirements to line management.

4.1.6 **Employees**

Responsible for the following:

- Completing a TNA.
- Coordinating with their supervisor to complete training identified in the TNA.
- Monitoring their own training expiration dates and coordinating refresher training to prevent expiration of any required training certifications.
- Maintaining a personal record of all training certifications.
- Supplying copies of training completion certificates for inclusion in the LMS.
- Providing feedback on training through the evaluation process.

4.2 Training Needs Assessment

4.2.1 The purpose of the TNA is to aid employees in identifying applicable training.

4.2.2 **Employees** shall complete the TNA:

- Upon employment;
- When an employee is assigned a significantly different job with new hazards;
- When an employee is assigned to a new project or work location; and/or
- For employee's whose job duties do not frequently change, the TNA may be updated on an annual basis.

4.2.3 The employee's **supervisor** will review, modify and/or confirm training assignments in the TNA, and support enrolment into the required training programs. Details for completing a TNA may be found in *S3NA-003-WI1 Training Needs Assessment Process.* Refer to the TNA required training, *S3NA-003-FM2 Training Needs Assessment.*

4.2.4 An electronic training record will be maintained in LMS by the employee and supervisor.

4.3 Training Delivery

4.3.1 SFL Training may be delivered in several methods to meet AECOM's wide diversity of staff, office, and project locations.

4.3.2 Standards for developing and delivering training courses, as well as certification criteria are provided in Work Instruction *S3NA-003-WI2 Training Delivery*.

4.4 Internal Training

4.4.1 Internal training is performed by AECOM's internal resources and may include intranet and classroom-based training.

Courses taught by an AECOM instructor in a classroom format will be delivered by trainers that are SH&E Department-approved personnel using materials developed specifically to train AECOM employees. Refer to *S3NA-003-TP1 SH&E Training Syllabus Template* and *S3NA-003-TP2 SH&E Training Certificate Template*. All training course curricula is reviewed and approved by the **SH&E Department** prior to provision of training.

4.5 External Training

4.5.1 External vendors conduct training that is not available through internal training sources. All external vendors are to be selected and pre-approved by the **SH&E Department** prior to any employee attending a training class.

4.5.2 AECOM will use Internet training to supplement internal training courses. All Internet-based safety training courses and providers should be approved by the **SH&E Department** prior to any employee participating in training.

4.6 Project-Specific Training

4.6.1 In the course of employment with AECOM, employees may be asked to participate in project work incorporating activities new to them or activities for which they have let their SH&E training expire. Should this occur, they must immediately inform their supervisor and not participate in any tasks with hazards for which they do not have current training.

4.6.2 **Project Managers** must review all employees scheduled to work on their projects for compliance with SH&E training for hazards present or anticipated on their particular project. **Project Managers** must not let any employee that does not have current training for the identified hazards work on their projects.

4.6.3 **Employees** must complete training identified in the TNA prior to conducting the associated work activity. Completion is determined by the instructor and may include: active participation, passing quizzes, examinations or other form of assessment.

4.7 Training Evaluation

4.7.1 At the conclusion of a training event, participants will be provided with the opportunity to anonymously evaluate the training session with through the use of *S3NA-003-FM8 SH&E Training Course and Instructor Evaluation* or the online version of the form.

4.7.2 Training instructors will review evaluations at the conclusion of training and to request assistance addressing consistently noted deficiencies when appropriate.

4.8 Training Tracking

4.8.1 Records documenting employee participation safety training will be maintained in accordance with applicable regulatory requirements and according to the following:

- Each employee is responsible for maintaining a personal file that contains their history of training certifications.
- Sign In Sheets can be used to record attendance of training, *S3NA-003-FM1 SH&E Training Sign In* Sheet.
- Records shall be retained in accordance with *S3NA-003-WI3 Training Documentation.*

4.8.2 Each region/district is responsible for maintaining documentation of course completion by each individual employee in AECOM's LMS.

4.8.3 Training Expiration

- Training will expire in accordance with requirements specified on syllabus.
- Expiration of training will be tracked electronically using the AECOM LMS.
- Employees tracking training outside of the AECOM LMS are responsible for tracking their individual training expiration dates.
- If training expires for an employee, they will be disqualified from performing tasks associated with the training when training is required by AECOM defined requirements or legislation/regulation to perform the tasks. Once training has been renewed, the employee will be qualified to perform associated tasks.

## 5.0 Records

None

## 6.0 Attachments

6.1 S3NA-003-WI1 Training Needs Assessment Process

6.2 S3NA-003-WI2 Training Delivery

6.3 S3NA-003-WI3 Training Documentation

| | | |
|---|---|---|
| 6.4 | S3NA-003-FM1 | SH&E Training Sign In Sheet |
| 6.5 | S3NA-003-FM2 | Training Needs Assessment |
| 6.6 | S3NA-003-FM3 | Training Needs Assessment – Administrative Employees |
| 6.7 | S3NA-003-FM4 | Training Needs Assessment – Technical Employees |
| 6.8 | S3NA-003-FM5 | Training Needs Assessment – Employee Supervisors & Project Managers |
| 6.9 | S3NA-003-FM6 | Training Needs Assessment – On-site Project Supervisors |
| 6.10 | S3NA-003-FM7 | Training Needs Assessment – Line Managers |
| 6.11 | S3NA-003-FM8 | SH&E Training Course and Instructor Evaluation |
| 6.12 | S3NA-003-TP1 | SH&E Training Syllabus Template |
| 6.13 | S3NA-003-TP2 | SH&E Training Certificate Template |

**Americas**

# Training Needs Assessment Process

**S3NA-003-WI1**

## 1.0 Requirements

1.1 This work instruction applies to all AECOM Americas Geography employees and provides options through which an employee can complete a Safety Health & Environment (SH&E) Training Needs Assessment (TNA).

## 2.0 References

None

## 3.0 Process

3.1 Employees will complete a SH&E TNA:

- Upon employment
- When an employee is assigned a significantly different job with new hazards
- When an employee is assigned to a new project or work location

3.2 Supervisors will verify that their direct reports have completed a TNA through one of the processes defined below. It is the responsibility of the supervisor and/or project manager to confirm that the appropriate level of training is being assigned to the employee with regard to their specific job task assignments and client needs.

3.3 Employs will complete a SH&E TNA through one of three processes:

- Through completion of the employee-specific SH&E TNA:
  - Electronic version – SH&E TNA
  - Paper version – *S3NA-003-FM2 Training Needs Assessment*
- Through adoption of the list of compliance training as specified in *S3NA-003-FM3– FM 7 Training Needs Assessments* and required by the **SH&E Department** or,
- Through development of process that provides a comparable level of assessment as the SH&E TNA.

## 4.0 Records

None

## 5.0 Attachments

5.1 S3NA-003-FM2 Training Needs Assessment

5.2 S3NA-003-FM3 Training Needs Assessment – Administrative Employees

5.3 S3NA-003-FM4 Training Needs Assessment – Technical Employees

5.4 S3NA-003-FM5 Training Needs Assessment – Employee Supervisors & Project Managers

5.5 S3NA-003-FM6 Training Needs Assessment – On-Site Project Supervisors

5.6 S3NA-003-FM7 Training Needs Assessment – Line Managers

## 1.0 Training Courses & Content

1.1 Course Content

1.1.1 AECOM developed and delivered training will be designed to meet the organizational needs and goals of AECOM.

1.1.2 Training may be provided through external resources and in such cases training content will be evaluated for applicability and acceptability.

1.1.3 The structure of the course content will generally be consistent with the following:

- Introduction to the training topic
- Standards applicable to the training, i.e. regulatory/legislative, AECOM SOP, etc.
- Training objectives
- Primary course content
  - Significance of topic as it relates to AECOM
  - Expectations to apply the skills and knowledge provided
  - Examples of the training being applied on specific AECOM projects
- Training summary
- Comprehension assessment

1.1.4 The specific content of the course will vary depending on the number of topics covered during the course, the complexity of the course content, and the level of certification being offered.

1.1.5 A syllabus will be developed for AECOM developed training consistent with the syllabus template, *S3NA-003-TP1 SH&E Training Syllabus Template*.

1.1.6 The level of certification being offered will determine the level of comprehension assessment being performed.

1.2 Course Content Reviews

1.2.1 Course content shall be periodically reviewed, with no greater than three years between reviews.

1.2.2 The **Region SH&E Manager**, or their designee, shall conduct course content reviews. Reviews will be made to determine if training materials are still relevant to AECOM and the need to modify content accordingly.

1.2.3 Results from training evaluations will also be incorporated into course content reviews and modifications.

1.2.4 For courses where training is provided on an annual basis, course content will be updated annually, or multiple versions of training may be developed for rotating use, to provide participants with new learning materials and avoid stagnation.

1.2.5 All modifications made to SH&E training will be performed to maintain compliance with this SOP, and additional applicable SOP and regulatory/legislative standards.

1.2.6 When modifications to course syllabus and training materials are made, revisions will be approved by the **Region SH&E Manager**, or their designee, and communicated to all Authorized Instructors for use and application.

## 2.0 Authorized Instructors

2.1 The **Region SH&E Managers**, or their designee, will authorize personnel to deliver SH&E training.

2.2 The **Region SH&E Managers** will assess instructor capabilities and provide feedback in order to promote the consistent delivery of training materials in alignment with known adult learning principles.

2.3 Instructor assessments will be performed through live observation of training delivery as well as the use of *S3NA-003-FM8 SH&E Training Course and Instructor Evaluation* or the Training Course & Instructor Evaluation Survey found on the Americas SH&E Training Calendar.

Training instructors will review evaluations at the conclusion of training and to request assistance addressing consistently noted deficiencies when appropriate.

## 3.0 Comprehension Assessment & Certification

3.1 The level of certification being sought will determine the level of comprehension assessment that participants must successfully complete in order to receive credit for completing the training module.

3.2 Comprehension assessments may take the form of structured tests and quizzes, proficiently demonstrating the performance of related skills, discussion of training materials, or other forms that demonstrate to the instructor that the participant has retained and can perform the objectives of the training.

3.3 The different levels of certification are detailed with recommended comprehension assessment techniques. Comprehension assessment techniques for each training course will be specified within the training syllabus.

3.4 The training instructor will validate the attendance form and provide certificates, where appropriate, to participants.

3.5 Results of training and certificates will be stored in the LMS.

## 4.0 Certification Levels

4.1 **Information Dissemination**

- Information is provided to employees through verbal or written communication. This type of training may be used in scenarios where the goal is to provide information to employees with no expectation of implementation or executing a regulatory requirement or AECOM SOP.
- The communication is mostly one way and there is no confirmation or knowledge assessment (i.e. test, interactive discussion, etc.) that the employee must pass to demonstrate understanding and meet a training goal.
- Examples of this type of communication would be newsletters, safety alerts, webinar presentations, video only presentations, etc.

4.2 **Awareness Level Certification**

- Awareness-level certifications are applicable to training where the primary goal is to transfer knowledge from the organization to participants.
- Training will typically take the form of instructor-lead discussions, presentation of related video content, and/or self-directed e-learning modules.
- In most cases comprehension assessment will be performed through discussion of the training topic with the participants and/or a simple quiz.
- When quizzes are provided employees will successfully complete at least 75% of the questions.

4.3 **Performance Level Certification**

- Performance-level certifications will build upon the Awareness level.
- The goal of Performance Training is to have an employee successfully demonstrate that they can apply the knowledge discussed during training and perform the desired skills necessary to perform their job.

- Training materials are provided and discussed, and will incorporate a demonstration of the skills to be completed.
- The instructor will gauge the level of understanding through interactive discussion with participants and a pass/fail designation of demonstrated skills by the employee.
- A test or quiz of moderate difficulty will be provided, with participants scoring 80% or better, followed by the successful demonstration of the desired skill to receive certification.

4.4 **Competent Person Level Certification**

- Competent Person-level certifications may be applicable to, and dictated by, specific regulatory standards.
- When Competent Person-level certifications are offered, comprehension assessments will build upon Performance-level certification.
- Competent Person certifications will incorporate classroom training along with on-the-job mentoring provided by employees previously certified to the Competent Person-level in the area of competency being sought.
- Candidates for Competent Person certification will be required to score 85% or better on administered written exams. Additionally, candidates must be capable of repeatedly demonstrating the desired skills both in a classroom setting as well as in an actual work setting to the Instructor, Project Manager for the project the employee is seeking to gain and apply the certification to, and/or the mentoring Competent Person.
- Competent Person(s) will be designated on a project-by-project basis, in accordance with *S3NA-202-PR1 Competent Person Designation.* Forms to document certification and designation of a Competent Person are provided with the SOP and a record of the designation will be maintained within the project files and LMS.

## 5.0 Expiration of Training

5.1 Training expirations will be defined for each course offered in the course syllabus.

5.2 Employees with expired compliance training will not engage in activities associated with the training until training and certifications have been updated.

5.3 Supervisors will work with employees to determine when training is set to expire and develop individual training plans in order to maintain compliance.

5.4 AECOM will use its LMS to track completion of compliance and conformance training and report back to operations on overall training performance.

# Training Documentation

S3NA-003-WI3

## 1.0 Employee Training File

1.1 Minimum Requirements

1.1.1 Supervisor-approved personal training requirements is defined in a Training Needs Assessment (TNA).

1.1.2 Certificates will be offered for all classes offered and completed, and must indicate:

- Employee name
- Course name, and applicable reference to specific regulatory requirement
- Instructor's printed name and signature
- Date(s) of class
- Company name
- Number of Continuing Education Units (CEU) or Professional Development Hours (PDH) credits, if eligible
- Course attendance or sign-in sheets shall have the signature and ID number of all employees

1.2 Data Formats

1.2.1 Electronic Records (Learning Management System) – An electronic database tracking system that maintains employee safety training information (dates, course name, certificates, etc.), including training certificates. Data will be entered by local SH&E Administrators, and each supervisor is responsible to see that the database is current for personnel under their responsibility.

1.2.2 Hardcopy Records (Paper) – Each employee is required to maintain a personal file with hardcopies of their certification(s) from all (internal, external, intranet, Internet) training providers.

## 2.0 Training Courses

2.1 Records

2.1.1 An individual training summary will be maintained for each course which must include:

- For each AECOM-delivered training call the sign-in sheet (*S3NA-003-FM1 SH&E Training Sign In Sheet*) will indicate:
  - Course Name
  - Training location information
  - Date(s)
  - Class start and stop time
  - Employee name, signature, location and employee identification number
  - Course outline (list of topics discussed) corresponding to the approved training syllabus
  - Instructors' name(s) and signature(s)
- For external vendor classes equivalent documentation is required.

2.1.2 Expiration of training will be tracked in the AECOM LMS with SH&E Department updating training expiration dates when entering/updating training certificates.

Americas

# SH&E Training Sign-In Sheet

S3NA-003-FM1

| | | | | | |
|---|---|---|---|---|---|
| **Course Name:** | | | | | |
| **Region:** | | **District:** | | | |
| **Business Line:** | | **Dept #:** | | | |
| **Office:** | | **Address:** | | | |
| **Date:** | | **Start Time:** | | **Stop Time:** | |

**Certification Level (Check One):** **Awareness** ☐ **Performance** ☐ **Competent Person** ☐

| **Lead Instructor:** | **Instructor 1:** | **Instructor 2:** |
|---|---|---|
| | | |

| | **Employee Name: (PRINT LEGIBLY)** | **Employee Signature** | **Region/Office Company (if not AECOM)** | **Employee ID #:** | **Instructor Initials verifying completion** |
|---|---|---|---|---|---|
| **1.** | | | | | |
| **2.** | | | | | |
| **3.** | | | | | |
| **4.** | | | | | |
| **5.** | | | | | |
| **6.** | | | | | |
| **7.** | | | | | |
| **8.** | | | | | |
| **9.** | | | | | |
| **10.** | | | | | |
| **11.** | | | | | |
| **12.** | | | | | |
| **13.** | | | | | |
| **14.** | | | | | |
| **15.** | | | | | |
| **16.** | | | | | |

# Course Agenda

| Course Name/ Module | Approximate Duration | Learning Objectives | Comprehension Assessment | Certification |
|---|---|---|---|---|
| | | • | • | • |
| | | • | • | • |
| | | • | • | • |

Lead Instructor's Signature _____ Date _____

Instructor 1 Signature _____ Date _____

Instructor 2 Signature _____ Date _____

Americas

# Training Needs Assessment

S3NA-003-FM2

| | | | |
|---|---|---|---|
| **First Name:** | **Last Name:** | **Employee Number:** | **Department Number:** |
| **Home Office:** | **Date Completed:** | **Supervisor:** | |
| **Region:** | **Business Line:** | **District:** | |

**Instructions**

- Answer each question as it pertains to your job now and for the coming year.
- Consider any potential changes to your job, new roles that you may be performing, and your business goals for the coming year.
- If you are uncertain if a job role or function applies to you now, or in the coming year, contact your Supervisor for assistance in making this determination.
- During completion of the Trainnig Needs Assessment (TNA) similar and/or duplicate training may be identified. When this occurs contact your Region SH&E Manager to discuss opportunities where training may be consolidated to avoid redundant training.

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **BASIC EMPLOYEE SH&E TRAINING** | | | | | | |
| | Are you an employee of Canada? | SH&E Fundamentals - Awareness Training | Annual | 003, 209 | Canada | 2 |
| | Are you an employee of the US? | SH&E Fundamentals - Awareness Training | 3 | 003, 209 | US | 2 |
| | Do you work in the State of California | Injury Ilness Prevention Plan | 3 | 108 | California | 0.5 |
| | Are you in the Environment Business Line? | Behavior Based Safety (all three modules) | Initial - Training does not require renewal | | US, Canada | 2.0 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **OFFICE SAFETY** | | | | | | |
| | Do you spend at least 1 full day, or at least 10 total hours per week, working in an office setting? NOTE: This can be your assigned AECOM office, a client site office, a home office, or a job-site trailer or similar field office location | Office Ergonomics - Awareness Training | 3 | 102 | US | 0.5 |
| | Does your work ever involve using a computer for at least 2 hours continuously, a total of 4 hours in any work day, or at least half of your time in the office? | Office Ergonomics - Awareness Training | 3 | 102 | US | 0.5 |
| | Does your work ever involve using a computer for at least 2 hours continuously, a total of 4 hours in any work day, or at least half of your time in the office? | Office Ergonomics - Awareness Training* | 3 | 102 | Canada | 0.5 |
| | Are you assigned to an AECOM Office? | Emergency Evacuation | 1 | 101 | US, Canada | 0.5 |
| | Is your office equipped with portable fire extinguisher for use on small, initial-stage fires (no larger than an office trash receptacle)? | MANDATORY TRAINING - Fire Extinguisher - Awareness Training; AECOM will not require you to operate a fire extinguisher in the office, only evacuate the office safely. | Annual | 106 | US, Canada | 0.5 |
| | Are you designated as a First Aid certified employee in the office? | First Aid - Performance Training* | 2 | 101, 207 | US | 2.5 |
| | Are you designated as a CPR certified employee in the office? | CPR - Performance Training* | 2 | 101, 207 | US | 2.5 |
| | Are you designated as an AED trained employee within the office? | AED - Performance Training | 2 | 101, 203, 207 | US | 0.5 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **OFFICE SAFETY** | | | | | | |
| | Do you receive and process shipments for your office (by FedEx, UPS, etc.) and/or are you the person who signs for incoming shipments and packages? NOTE: Regardless of shipment contents. | HzM(US)/TDG(CAN) Shipping - Awareness Training* | 3 | 508 | US, Canada | 0.75 |
| | Do you receive shipments of hazardous materials or dangerous goods? NOTE: This can include analytical laboratory samples, waste materials, calibration gases, other compressed-gas items, or any hazardous materials/wastes. | Level 1 Shipper - HzM(US)/TDG(CDN) - Performance Training* | 3 | 508 | US, Canada | 5.0 |
| | Do you co-chair an office Occupational Health & Safety (OHS) committee? | Workplace Safety & Health Committee - Performance Training (as per local jurisdictions)* | Initial - Training does not require renewal | | Canada | 16 |
| | Do you perform office-based work for Shell (an AECOM Client), i.e. project oversight, planning, design, any billed labor, etc.? | Shell 12 Life Saving Rules | Initial - Training does not require renewal | 201, Shell | US, Canada | 1 |
| | Are you a Fire Warden for your office and/or are you responsible for the inspection and maintenance of fire extinguishers? | Fire Extinguisher - Awareness Training* | 1 | 106, 206 | US, Canada | 0.5 |
| | Are you listed in an Office Safety Plan as a provider of First Aid, CPR, AED and other advanced life saving skills? | Standard First Aid, with CPR & AED Performance Training* | 3 | 101 | Canada | 16 |
| | Do you routinely (i.e. daily or more frequently) perform activities involving lifting heavy objects, repetitive motions and/or awkward postures? | Industrial Ergonomics - Awareness Training | 3 | 308 | US, Canada | 0.75 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **VEHICLE OPERATIONS AND MOBILE EQUIPMENT** | | | | | | |
| | Do you regularly drive for work AND your supervisor has identified the need for expanded driver safety training; example: you have been assigned an AECOM owned or leased vehicle? | Complete AECOM Driver's Acknowledgement Form | 2 | 5 | US, Canada | 0 |
| | | Driver & Vehicle Safety - Awareness Training | 2 | 5 | US, Canada | 0.5 |
| | Has AECOM provided you with a company owned or leased vehicle for long-term use, i.e. >30 days/year? | Def. Driver NSC(U.S.)/CMA(CAN) - Awareness Training | Initial - Training does not require renewal | 005, 404 | US, Canada | 4 |
| | Do you drive an ATV? | ATV Safety Performance Training | 2 | 402 | US, Canada | 6 |
| | Do you drive a Commercial Motor Vehicle (>10,001 GVWR U.S.) for business purposes? | Commercial Motor Vehicle (CMV) - Performance Training* | Initial - Training does not require renewal | 404 | US | 4 |
| | | Def. Driver NSC(U.S.)/CMA(CAN) - Awareness Training | Initial - Training does not require renewal | 005, 404 | US, Canada | 4 |
| | Do you work for a client that requires you complete Smith System Defensive Driver training? | Smith System Driver - Performance Training | Initial - Training does not require renewal | 201 | US, Canada | 8 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **EMPLOYEE MANAGEMENT** | | | | | | |
| | Do you Manage or Supervise AECOM Employees, or do you work unsupervised? | Canadian Due Diligence - OH&S Training* | Initial - Training does not require renewal | C45 | Canada | 3 |
| | | Incident Investigation - Awareness Training* | Initial - Training does not require renewal | Varied depending upon province | Canada | 2 |

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **HAZWOPER AND EMERGENCY RESPONSE** | | | | | | |
| | Are you a HAZWOPER worker, are you Project Manger for HAZWOPER projects, or are you required to visit any designated HAZWOPER site AND enter into any Exclusion Zone areas? | HazCom(US)/WHMIS(CDN) - Awareness Training* | Annual | 507 | US, Canada | 0.5 |
| | | HAZWOPER 40-Hour - Performance Training*. Consult your RSH&EM about the need for Medical Surveillance. | Initial - Training does not require renewal | 509 | US, Canada | 40 |
| | | HAZWOPER 8-Hour Refresher - Awareness Training*. Consult your RSH&EM about the need for Medical Surveillance. | Annual | 509 | US, Canada | 8 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **HAZWOPER AND EMERGENCY RESPONSE** | | | | | | |
| | Do you perform field management of HAZWOPER work (including supervising a work/investigation team) or people on a HAZWOPER site, and/or serve as a Site Safety Officer for any HAZWOPER site/activity? | HAZWOPER 8-Hour Supervisor - Awareness Training* | Initial - Training does not require renewal | 509 | US, Canada | 8 |
| | Do you perform HAZWOPER emergency response work, have you been issued respiratory protection PPE, have you been required to wear respiratory protection PPE by AECOM, and/or do you wear a respirator inside an Exclusion Zone for more than 30 days in any yea | Hearing Protection - Awareness Training*. Consult your RSH&EM about the need for Medical Surveillance. | Annual | 207 | US, Canada | 0.75 |
| | | Respiratory Protection - Awareness Training*. Consult your RSH&EM about the need for Medical Surveillance. | Annual | 519 | US, Canada | 0.75 |
| | Do you perform HAZWOPER Emergency Response services as defined in 29 CFR 1910.120(q)(3)? | HAZWOPER Emergency Response Performance Training in accordance with assigned role, i.e. First Responder Operations Level, Hazardous Materials Technician, Hazardous Materials Specialist, and/or On Scene Incident Comander.* Consult your RSH&EM about the ne | Annual | 509 | US | 8 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **FIELD WORK** | | | | | | |
| | Do you perform any Field work NOT associated with Environmental Clean-up? | Field Safety - Awareness Training. Consult your RSH&EM about the need for Medical Surveillance. | 2 | 209 | US, Canada | 4 |
| | | Natural Biological Hazards - Awareness Training | 2 | 503 | US, Canada | 1 |
| | Do you work in a location where First Aid and CPR skills were needed wherein emergency services were either unavailable or remote as defined in SH&E SOP 208, and/or have you been identified as the First Aid/CPR Responder in a project Safe Work Plan? | CPR - Performance Training* | 2 | 101, 207 | US | 2 |
| | | First Aid - Performance Training* | 2 | 101, 207 | US | 2 |
| | Do you routinely (i.e. daily or more frequently) perform field activities involving lifting heavy objects, repetitive motions and/or awkward postures? | Industrial Ergonomics - Awareness Training | 3 | 308 | US, Canada | 0.75 |
| | Do you work in close proximity to heavy equipment (i.e. skid steers, back hoes, excavators, bulldozers and other yellow iron)? | Mobile and Heavy Equipment Operations Safety Awareness Training* | 3 | 309 | US, Canada | 0.5 |
| | Do you work on a project equipped with an AED where you are designated as an AED trained employee for the project? | AED - Performance Training | 2 | 101, 203, 207 | US | 0.5 |
| | Do you wear hearing protection (ear plugs, ear muffs, etc.) for a total of 2 hours or more in a single work shift on average at least two times per month, have you been issued hearing protection by AECOM, have you been required to wear hearing protection | Hearing Protection - Awareness Training*. Consult your RSH&EM about the need for Medical Surveillance. | Annual | 207 | US, Canada | 0.75 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **FIELD WORK** | | | | | | |
| | Do you perform a task where a fire extinguisher is a required piece of equipment for the job (e.g., fire watch)? NOTE: The presence of fire extinguishers in the workplace does not indicate that you are required to use one. | Fire Extinguisher - Awareness Training* | 1 | 106, 206 | US, Canada | 0.5 |
| | Do you regularly work in remote and isolated locations where you have the potential to be isolated overnight? | Wilderness Survival - Awareness Training | Initial - Training does not require renewal | 313, 503 | Canada | 16 |
| | Do you work in locations where bears may be encountered? | Bear Safety - Awareness Training | 2 | 313, 503 | Canada | 1 |
| | Do you conduct or supervise permitted fish sampling/salvaging with the use of an electro-fisher? | AED - Performance Training | 2 | 203, 207 | Canada | 0.5 |
| | | Electrofishing Certification* | Initial - Training does not require renewal | 407 | US, Canada | 16 |
| | Do you work on or adjacent to a roadway that has live traffic? | Traffic Safety - Awareness Training | 3 | 306 | US, Canada | 0.75 |
| | Do you prepare Traffic Control Plans for the direction of traffic on an AECOM controlled project? | Traffic Control Planner, contact your RSH&EM to obtain training.* | Varied | 306 | Canada | |
| | Are you listed in a project Safe Work Plan as a provider of First Aid, CPR, AED and other advanced life saving skills? | Standard First Aid, with CPR & AED Performance Training* | 3 | 101 | Canada | 16 |
| | Do you use power tools, extension cords and other electrically powered devices on the job? | Electrical Safety - Awareness Training* | 2 | 302, 410 | US, Canada | 0.75 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **FIELD WORK** | | | | | | |
| | Do you work in a location with exposure to a fall of 6ft/2m or greater? | Fall Protection - Awareness Training* | 3 | 304 | US, Canada | 0.75 |
| | Do you wear a Personal Fall Arrest System (PFAS) while working at heights in excess of 6ft/2m, or on an elevated working platform or access way with an unprotected edge in excess of 1.2m/4ft and exposure to water, heavy equipment, chemicals, or other reco | Fall Protection - Performance Training* | 3 | 304 | US, Canada | 4 |
| | Do you work near open excavations and/or trenches, or do you enter an open excavation/trench >1.5m/5ft in depth? | Trenching & Excavation Safety - Awareness Training* | 3 | 303 | US, Canada | 0.75 |
| | Will you work outside for longer than one (1) hour exposed to temperatures at or below 40 F/4.5 C? | Cold Stress Prevention Awareness Training | 3 | 505 | US, Canada | 0.5 |
| | Do you perform activities involving high air temperatures, radiant heat sources, high humidity, direct physical contact with hot objects, or strenuous physical activities when the corresponding Heat Index is >91 F/33 C? | Heat Stress Prevention - Awareness Training | 3 | 511 | US, Canada | 0.5 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **HAZARDOUS MATERIALS (HZM), HAZARDOUS WASTE (HZW) & DANGEROUS GOODS HANDLING, TRANSPORT AND SHIPMENT** | | | | | | |
| | Individually or on behalf of your office, do you offer for shipment, potentially package for shipment, or receive shipments (by FedEx, UPS, etc.)? NOTE: Regardless of shipment contents. | HzM(US)/TDG(CAN) Shipping - Awareness Training* | 3 | 508 | US, Canada | 0.75 |
| | Do you handle or work with any type of controlled materials, hazardous materials or chemicals? NOTE: Consider only materials procured or brought to the work site by AECOM, NOT environmental contaminants, asbestos, lead, commonly available consumer prod | HazCom(US)/WHMIS(CDN) - Awareness Training* | Annual | 508 | US, Canada | 0.5 |
| | Do you request that someone ship on your behalf, receive shipments of, or are you required to personally package, prepare for shipment, or fill out/complete shipping documents or paperwork (by FedEx, UPS, etc.) for any types of hazardous materials or dang | Level 1 Shipper - HzM(US)/TDG(CDN) - Performance Training* | 3 | 508 | US, Canada | 5 |
| | Are you required to develop, oversee, or direct the process for packaging/shipping any hazardous, dangerous, or radioactive materials, devices or items? NOTE: Checking YES here will require that you complete HAZMAT Level 2 shipper training. This traini | Level 2 Shipper - HzM(US)/TDG(CDN) - Performance Training* | 3 | 508 | US, Canada | 24 |
| | Are you required to personally package or prepare for shipment (by FedEx, UPS, etc.) any meters that contain radioactive materials? This includes transport within an AECOM owned or leased vehicle, or personal vehicle used for AECOM business purposes NOT | Level 1 - Nuclear Density Gauge Shipping- Performance Training* | 2 | 508 | US, Canada | 6 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **HAZARDOUS MATERIALS (HZM), HAZARDOUS WASTE (HZW) & DANGEROUS GOODS HANDLING, TRANSPORT AND SHIPMENT** | | | | | | |
| | Do you sign HzM/HzW manifests or bills of lading while acting as an Authorized Agent on Behalf of a Client? | Level 1 Shipper - HzM(US)/TDG(CDN) - Performance Training* | 3 | 508 | US, Canada | 5 |
| | | RCRA Part B Annual Training - Awareness Training* | Annual | 415 | US | 2 |
| | Do you ship HzM(US)/TDG(CAN) by Air Transportation/Courier Methods? | IATA - International Air Transportation Association HzM(US)/TDG(CAN) Training | 2 | 508 | US, Canada | 6 |
| | CA Title 22 - Performance Training | Are you involved with the shipment of HzM/HzW in California, or do you provide HzW waste management services on a project site in California? | Annual | 415, 508 | US | 0.5 |

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **CONSTRUCTION, ENGINEERING & INSPECTION OVERSIGHT, MANAGEMENT AND PERFORMANCE** | | | | | | |
| | Do you perform work on active or inactive Construction, Engineering & Inspection projects? | Petroleum Safety Training Systems (PSTS) and/or Construction Safety Training System (CSTS) as required by the Client.* | PSTS/ CSTS - Initial | | Canada | |
| | Do you work on active construction projects in MA or RI? | OSHA 10-Hour Construction - Awareness Training* | Initial - Training does not require renewal | State/Project Requirement | US | 10 |
| | Do you work on active construction projects in NV? | OSHA 10-Hour Construction - Awareness Training* | 5 | State/Project Requirement | US | 10 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **CONSTRUCTION, ENGINEERING & INSPECTION OVERSIGHT, MANAGEMENT AND PERFORMANCE** | | | | | | |
| | Do you work on PUBLICLY FUNDED projects in NH, CT, NY, MO? | OSHA 10-Hour Construction - Awareness Training* | Initial - Training does not require renewal | State/Project Requirement | US | 10 |
| | Are you the Site Safety Officer on an Army Corps of Engineers Project? | OSHA 30-Hour Construction - Awareness Training* | Initial - Training does not require renewal | State/Project Requirement | US | 30 |
| | Are you a site manager, foreman, or Site Safety Officer for job sites involving construction or demolition activities? NOTE: This can include HAZWOPER/environmental sites where significant construction/demolition is required. | Construction Awareness; consult your RSHE&M and Supervisor to determine specific training topics. | Initial - Training does not require renewal | Varied depending on job tasks | US | 4 |
| | Do you spend at least one day a week, or one-third of your total overall work time, on construction/demolition sites? NOTE: In this case, check YES whether you manage/perform the work, or provide inspector, engineering, or other support functions, as lo | Construction Awareness; consult your RSHE&M and Supervisor to determine specific training topics. | Initial - Training does not require renewal | Varied depending on job tasks | US | 4 |
| | Does your work have the potential to be affected by Lockout/Tagout? | Lockout/Tagout - Awareness Training* | 3 | 302, 410 | US, Canada | 0.75 |
| | Do you perform Lockout/Tagout Operations on systems (i.e. electrical, pressurized, equipment maintenance, etc.)? | Lockout/Tagout - Performance Training* | 2 | 302, 410 | US, Canada | 4 |
| | Do you ever work on electrically-energized (live) systems/circuits? Testing of potentially live electrical equipment is considered live electrical work. | Arc-FLASH (NFPA 70E) Training* | Initial - Training does not require renewal | 302, 410 | US | 1 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **CONSTRUCTION, ENGINEERING & INSPECTION OVERSIGHT, MANAGEMENT AND PERFORMANCE** | | | | | | |
| | | Electrical Safety - Awareness Training* | 2 | 302, 410 | US | 0.75 |
| | Do you have the potential to access scaffolding? | Scaffolding Safety - Awareness Training* | 3 | 311 | US, Canada | 0.75 |
| | Do you work near open excavations and/or trenches, or do you enter an open excavation/trench >1.5m/5ft in depth? | Trenching & Excavation Safety - Awareness Training* | 3 | 303 | US, Canada | 0.75 |
| | Do you wear a Personal Fall Arrest System (PFAS) while working at heights in excess of 6ft/2m, or on an elevated working platform or access way with an unprotected edge in excess of 1.2m/4ft and exposure to water, heavy equipment, chemicals, or other reco | Fall Protection - Performance Training* | 3 | 304 | US, Canada | 4 |
| | Do you perform or manage Quality Control (QC) oversight on U.S. Army Corps of Engineer (USACE) projects? | USACE CQC - Performance Training* | 5 | 201 | US | 8 |
| | Do you work in a location with exposure to a fall of 6ft/2m or greater? | Fall Protection - Awareness Training* | 3 | 304 | US, Canada | 0.8 |

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **CHEMICAL EXPOSURE** | | | | | | |
| | Do you have potential to be exposed to Chemical Hazards? | HazCom(US)/WHMIS(CDN) - Awareness Training* | Annual | 507 | US, Canada | 0.5 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **CHEMICAL EXPOSURE** | | | | | | |
| | Do you handle or work with any type of controlled materials, hazardous materials or chemicals? NOTE: Consider only materials procured or brought to the work site by AECOM, NOT environmental contaminants, asbestos, lead, commonly available consumer products, etc. | HazCom(US)/WHMIS(CDN) - Awareness Training* | Annual | 507 | US, Canada | 0.5 |
| | Do you have potential to be exposed to Lead? | Lead Safety - Awareness Training* | Annual | 513 | US, Canada | 0.75 |
| | Do you have potential to be exposed to Asbestos? | Asbestos - Awareness Training* | Annual | 501 | US, Canada | 0.75 |
| | Do you perform Asbestos inspections of buildings or other facilities? | Asbestos Inspector (State Specific) - Performance Training*. Consult your RSH&EM about the need for Medical Surveillance. | Annual | 501 | US, Canada | 8 |
| | Do you write Asbestos Management Plans? | Asbestos Planner (State Specific) - Performance Training*. Consult your RSH&EM about the need for Medical Surveillance. | Annual | 501 | US, Canada | 8 |
| | Do you perform Lead inspections of buildings or other facilities? | Lead Based Paint Inspector/Assessor (State Specific) - Performance Training*. Consult your RSH&EM about the need for Medical Surveillance. | Annual | 513 | US, Canada | 8 |
| | Do you write Lead Management Plans? | Lead Based Planner (State Specific) - Performance Training*. Consult your RSH&EM about the need for Medical Surveillance. | Annual | 513 | US, Canada | 8 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **CHEMICAL EXPOSURE** | | | | | | |
| | Do you have the potential to be exposed to Hydrogen Sulfide (H2S), (i.e. Oil & Gas support services, WWTP, Landfills, etc.)? | H2S - Awareness Training* | Annual | 507 | US | 0.8 |
| | Do you work in an analytical laboratory space? | Laboratory Safety – Awareness Training* | Annual | 209, 512 | US, Canada | 1.0 |

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **CONFINED SPACE ENTRY** | | | | | | |
| | Do you have a responsibility to identify and characterize Confined Spaces? | Confined Space - Awareness Training* | 3 | 301 | US, Canada | 1 |
| | Do you perform any of the following roles during a Confined Space Entry operation: Entrant, Attendant, Entry Supervisor? | Confined Space Entry – Entrant & Attendant Performance Training*. Consult your project Safety Plan and Region SH&E Manager to determine training required per your job role and function. | 3 | 301 | US | 8 |
| | Do you perform any of the following roles during a Confined Space Entry operation: Entrant, Attendant, Supervisor? | Confined Space - Performance Training* | 3 | 301 | Canada | 8 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **MSHA** | | | | | | |
| | Do you work on any sites regulated by the Mine Safety and Health Administration (MSHA) that require miner training in accordance with 30 CFR 46? | MSHA Initial Miner Safety - Performance Training*. Consult your RSH&EM about the need for Medical Surveillance. | Initial - Training does not require renewal | 30 CFR 46.5-.6 | US | 24 |
| | | MSHA Miner Safety Refresher - Awareness Training*. Consult your RSH&EM about the need for Medical Surveillance. | Annual | 30 CFR 46.8 | US | 8 |

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **WORK IN/OVER WATER** | | | | | | |
| | Do you work near, on, in or over water? | Boating Safety Course – Performance Training | Initial - Training does not require renewal | | Canada | |
| | | Working Around Water Safety Awareness Training | 3 | 315 | US, Canada | 1 |
| | Do you work on, or operate, a powered vessel? | Boating Safety Course – Performance Training. Consult your project Safety Plan and Region SH&E Manager to determine training required per your job role and function, i.e. Boater Safety, Water Rescue, etc. | Initial - Training does not require renewal | 417 | US | 8 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **WORK IN/OVER WATER** | | | | | | |
| | Do you work on frozen water bodies infrequently? | Working Around Water Safety Awareness Training | Initial - Training does not require renewal | 24 | Canada | |
| | Do you work on frozen water bodies frequently or for extended periods of time? | Ice Rescue Performance Training | Initial - Training does not require renewal | | Canada | |
| | Do you regularly work in or on large and fast-flowing creeks, rivers, streams? | Swift Water Rescue Performance Training | Initial - Training does not require renewal | | Canada | |
| | Do you perform electo-fishing sampling operations? | Electrofishing Performance Training* | Initial - Training does not require renewal | 407 | US, Canada | 16 |

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **RADIATION SAFETY** | | | | | | |
| | Does your work expose you to Ionizing Radiation (i.e. NORM, radioactive sources in manufacturing/O&G industry, etc.)? | Radiation Safety - Awareness Training* | Annual | 516 | US, Canada | 3 |
| | Do you operate a soil density/moisture gauge? | Nuclear Density Gauge Operator - Performance Training* | Annual | 516 | US, Canada | 8 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **RADIATION SAFETY** | | | | | | |
| | Do you operate any devices containing non-exempt ionizing radiation sources or are you required to wear an AECOM-supplied thermoluminescent radiation dosimeter? | Radiation Worker I Safety - PerformanceTraining* | Annual | 516 | US, Canada | 8 |
| | Are you a Radiation Safety Officer (project site or administrative RSO) for an AECOM radioactive materials (RAM) license? | Radiation Safety Officer - Performance Training * | Initial - Training does not require renewal | 516 | US, Canada | 8 |

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **HEAVY AND MOBILE EQUIPMENT OPERATIONS** | | | | | | |
| | Do you ride in or operate a manlift or other type of aerial lift during the performance of your work? | Aerial Lift (Man-lift) Operation - Performance Training* | 2 | 304, 408 | US, Canada | 4 |
| | | Fall Protection - Performance Training* | 3 | 304 | US, Canada | 4 |
| | Will you perform rescue operations if someone falls from an aerial lift? | Aerial Device Rescue - Performance Training* | 2 | 304, 408 | US, Canada | 4 |
| | | Fall Protection - Performance Training* | 3 | 304 | US, Canada | 4 |
| | Do you operate (drive) a forklift or other powered industrial truck? | Powered Industrial Truck (Forklift) Safety - Performance Training* | 3 | 409 | US, Canada | 6 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **HEAVY AND MOBILE EQUIPMENT OPERATIONS** | | | | | | |
| | Do you operate other types of mobile equipment, heavy equipment or Yellow Iron? | Mobile and Heavy Equipment Performance Training - Coordinate training with Region SH&E Manager to receive training specific to the equipment being operated. | Varied | 309 | US, Canada | |

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **RAILROAD SAFETY** | | | | | | |
| | Do you perform work within or adjacent to an active railroad right-of-way? | Client-Specific Railroad Safety Training - Awareness Training | Determined by Client | 201 | US, Canada | 2 |
| | | E-Railsafe - Awareness Training* | 2 | 201 | US | 1 |
| | | Railroad General Roadway Worker Protection (FRA) - Awareness Training (or client equivalent)* | Annual | 201 | US | 1.5 |
| | | Railroad General Roadway Worker Protection (FRA) - Awareness Training (or client equivalent)* | Annual | 201 | Canada | 1.5 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **CLIENT TRAINING** | | | | | | |
| | Do you work for Oil & Gas Sector (i.e. Petroleum) Clients? | Petroleum Safety Training Systems (PSTS) and/or Construction Safety Training System (CSTS) as required by the Client.* | PSTS/ CSTS - Initial | | Canada | |
| | Do you work for Chevron EMC? | Chevron HAZ ID Training - Awareness Training | Initial - Training does not require renewal | 201, Chevron | US, Canada | 2 |
| | | Chevron Loss Prevention System (LPS) - Performance Training | 3 | 201, Chevron | US, Canada | 8 |
| | | Smith System Driver - Performance Training | 3 | 201 | US, Canada | 8 |
| | Do you work for BP? | BP Business Unit Training (Coordinate with PM) | Varied | 201, BP | US, Canada | |
| | Do you work for Shell Oil Company? | Shell 12 Life Saving Rules | Initial - Training does not require renewal | 201, Shell | US, Canada | 1 |
| | Do you work for Anadarko? | SafeLand USA Training | Initial - Training does not require renewal | 201, Anadarko | US, Canada | 8 |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **COMPETENT PERSON TRAINING** | | | | | | |
| | Asbestos | Competent Person (Asbestos) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 501, 514 | US, Canada | |
| | Blasting & Explosives | Competent Person (Blasting and Explosives) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202 | US, Canada | |
| | Concrete & Masonry Construction | Competent Person (Concrete & Masonry) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202 | US, Canada | |
| | Confined Space Entry | Competent Person (Confined Space Entry) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 301 | US, Canada | |
| | Control of Hazardous Energy, i.e. Lockout/Tagout | Competent Person (Lockout/Tagout) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 302, 410 | US, Canada | |
| | Cranes & Derricks | Competent Person (Cranes & Derricks) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 310 | US, Canada | |
| | Demolition | Competent Person (Demolition) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202 | US, Canada | |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **COMPETENT PERSON TRAINING** | | | | | | |
| | Electrical Wiring Design & Protections | Competent Person (Electrical Wiring Design & Protection) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 302, 410 | US, Canada | |
| | Fall Protection | Competent Person (Fall Protection) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 304, 408 | US, Canada | |
| | Hearing Protection | Competent Person (Hearing Protection) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 207 | US, Canada | |
| | Heavy Equipment | Competent Person (Heavy Equipment) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 309 | US, Canada | |
| | Ionizing Radiation | Competent Person (Ionizing Radiation) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 516 | US, Canada | |
| | Lead | Competent Person (Lead) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 513 | US, Canada | |
| | Material Hoists & Personnel Hoists | Competent Person (Material Hoists & Personnel Hoists) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 310, 409 | US, Canada | |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **COMPETENT PERSON TRAINING** | | | | | | |
| | Stairways & Ladders | Competent Person (Stairways & Ladders) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 312 | US, Canada | |
| | Respiratory Protection | Competent Person (Respiratory Protection) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 519 | US, Canada | |
| | Rigging Equipment | Competent Person (Rigging Equipment) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 310 | US, Canada | |
| | Scaffolds | Competent Person (Scaffolds) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 311 | US, Canada | |
| | Steel Erection | Competent Person (Steel Erection) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202 | US, Canada | |
| | Traffic Control Planning | Competent Person (Traffic Control & Planning) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 306 | US | |
| | Trench & Excavations | Competent Person (Trench & Excavations) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 303 | US, Canada | |

* Indicates training required by legislation/regulation

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **COMPETENT PERSON TRAINING** | | | | | | |
| | Underground Construction | Competent Person (Underground Construction) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 414 | US, Canada | |
| | Welding & Cutting | Competent Person (Welding & Cutting) - Designation made by Project Manager in consultation with RSH&EM.* | 2 | 202, 416 | US, Canada | |

| X if yes | Question | Training | Frequency (years until topic expires) | SOP | Applies to | Estimated Hours to Complete |
|---|---|---|---|---|---|---|
| **OTHER –** Other training may be required based on the jurisdiction, client requirements or unique hazards. | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

| **Acknowledgement**** | | |
|---|---|---|
| Employee Name (Print) | Employee Signature | Date |
| Supervisor Name (Print) | Supervisor Signature | Date |

** When *Acknowledgements* are completed the original goes to the SH&E Administrator (for inclusion in the employee's file and upload to the LMS) and copies are provided to the employee and supervisor.

* Indicates training required by legislation/regulation

**Americas**

# Training Needs Assessment – Administrative Employees S3NA-003-FM3

## 1.0 Scope and Purpose

1.1 This form applies to all Americas AECOM employees solely performing Administrative functions.

1.2 Administrative employees will only work in an AECOM office and do not travel to project sites, client sites, or travel for any business purposes.

## 2.0 List of Compliance Training

2.1 Training listed is general in nature and will not address client-specific training requirements or specialized job functions including.

2.2 Although this list of training is provided as a guideline of training an employee needs to complete to do their job, it is the responsibility of the supervisor and/or project manager to confirm that the appropriate level of training is being assigned to the employee with regard to their specific job and task assignments and client needs.

2.3 The list of training below is not to be considered an all-inclusive list of training needs.

| Training | Hours to Complete Training | Related SOP | Training Frequency (Years) | Applies to US/Canada Employees |
|---|---|---|---|---|
| HzM(US)/TDG(CAN) Shipping - Awareness Training | 0.5 | 509 | 3 | US, Canada |
| Level 1 Shipper - HzM(US)/TDG(CDN) - Performance Training | 4.0 | 509 | 3 | US, Canada |
| Office Ergonomics - Awareness Training | 0.5 | 102 | 2 | US, Canada |
| OPTIONAL TRAINING - Fire Extinguisher - Awareness Training; AECOM will not require you to operate a fire extinguisher in the office, only evacuate the office safely. | 0.5 | 106 | Annual | US, Canada |
| HazCom(US)/WHMIS(CDN) - Awareness Training* | 0.5 | 508 | Annual | US, Canada |
| SH&E Fundamentals - Awareness Training | 2.0 | 003, 209 | Annual | Canada |
| SH&E Fundamentals - Awareness Training | 2.0 | 003, 209 | 3 | US |
| Workplace Safety & Health Committee - Performance Training* | 16.0 | | Initial - Training does not require renewal | Canada |
| **Total (Initial)** | **26.0** | **Total (Annual renewal)** | | **~5.5** |

**Acknowledgement**

| Employee Name (Print) | Employee Signature | Date |
|---|---|---|
| Supervisor Name (Print) | Supervisor Signature | Date |

**Americas**

# Training Needs Assessment –Technical Employees

**S3NA-003-FM4**

## 1.0 Scope and Purpose

1.1 This form applies to all Americas AECOM employees performing Technical functions.

1.2 These employee perform work in AECOM offices as well as active AECOM project sites.

1.3 Technical employees will not be expected to perform supervisory functions.

## 2.0 List of Compliance Training

2.1 Training listed is general in nature and will not address client-specific training requirements or specialized job functions including.

2.2 Although this list of training is provided as a guideline of training an employee needs to complete to do their job, it is the responsibility of the supervisor and/or project manager to confirm that the appropriate level of training is being assigned to the employee with regard to their specific job and task assignments and client needs.

2.3 The list of training below is not to be considered an all inclusive list of training needs.

| **Training** * Indicates training is required by applicable regulation/legislation. | **Hours to Complete Training** | **Related SOP** | **Training Frequency (Years)** | **Applies to US/Canada Employees** |
|---|---|---|---|---|
| AED - Performance Training | 0.5 | 101, 203, 207 | 2 | US |
| Asbestos - Awareness Training* | 0.8 | 501 | Annual | US, Canada |
| Bear Safety - Awareness Training | 1.0 | 313, 503 | 2 | Canada |
| Biological Hazards - Awareness Training | 1.0 | 503 | 2 | US, Canada |
| Client-Specific Railroad Safety Training - Awareness Training | 2.0 | 201 | Determined by Client | US, Canada |
| Complete AECOM Driver's Acknowledgement Form | 0.0 | 005 | 2 | US, Canada |
| Confined Space - Awareness Training* | 1.0 | 301 | Annual | US |
| Confined Space - Awareness Training* | 1.0 | 301 | 3 | Canada |
| Construction Awareness; consult your RSHE&M and Supervisor to determine specific training topics. | 4.0 | Varied depending on job tasks | Initial - Training does not require renewal | US |
| CPR - Performance Training | 2.5 | 203, 207 | 2 | US |
| Driver & Vehicle Safety - Awareness Training | 0.5 | 005 | 2 | US, Canada |
| E-Railsafe - Awareness Training* | 1.0 | 201 | 2 | US |
| Fall Protection - Awareness Training* | 0.8 | 304 | 3 | US, Canada |
| Field Safety - Awareness Training. Consult your RSH&EM about the need for Medical Surveillance. | 4.0 | 209 | 2 | US, Canada |

| **Training** * Indicates training is required by applicable regulation/legislation. | **Hours to Complete Training** | **Related SOP** | **Training Frequency (Years)** | **Applies to US/Canada Employees** |
|---|---|---|---|---|
| Fire Extinguisher - Awareness Training* | 0.5 | 106, 206 | 1 | US, Canada |
| First Aid - Performance Training* | 2.5 | 101, 207 | 2 | US |
| H2S - Awareness Training* | 0.8 | 508 | Annual | US |
| H2S - Awareness Training* | 8.0 | 508 | 3 | Canada |
| HazCom(US)/WHMIS(CDN) - Awareness Training* | 0.5 | 508 | Annual | US, Canada |
| Hearing Protection - Awareness Training*. Consult your RSH&EM about the need for Medical Surveillance. | 0.8 | 207 | Annual | US, Canada |
| Heavy Equipment Operations & Safety - Awareness Training* | 0.5 | 309 | 3 | US, Canada |
| HzM(US)/TDG(CAN) Shipping - Awareness Training* | 0.5 | 509 | 3 | US, Canada |
| Industrial Ergonomics - Awareness Training | 0.7 | 308 | 3 | US, Canada |
| Lead Safety - Awareness Training* | 0.8 | 513 | Annual | US, Canada |
| Level 1 Shipper - HzM(US)/TDG(CDN) - Performance Training* | 4.0 | 509 | 3 | US, Canada |
| Lockout/Tagout - Awareness Training* | 0.8 | 302, 410 | 3 | US, Canada |
| Office Ergonomics - Awareness Training | 0.5 | 102 | 2 | US |
| Office Ergonomics - Awareness Training* | 0.5 | 102 | 2 | Canada |
| Railroad Worker Protection - Awareness Training* | 1.5 | 201 | Annual | US, Canada |
| Respiratory Protection - Awareness Training*. Consult your RSH&EM about the need for Medical Surveillance. | 0.8 | 519 | Annual | US, Canada |
| SH&E Fundamentals - Awareness Training | 2.0 | 003, 209 | Annual | Canada |
| SH&E Fundamentals - Awareness Training | 2.0 | 003, 209 | 3 | US |
| Standard First Aid, with CPR & AED Performance Training* | 16.0 | 101, 207 | 3 | Canada |
| Traffic Safety - Awareness Training | 0.7 | 306 | 3 | US, Canada |
| Trenching & Excavation Safety - Awareness Training* | 0.8 | 303 | 3 | US, Canada |
| Workplace Safety & Health Committee - Performance Training* | 16.0 | | Initial - Training does not require renewal | Canada |
| **Estimated Initial Total (US/CAN)** | **37.8/68.5** | **Estimated Annual Renewal Total (US/CAN)** | | **19.9/24.5** |

**Acknowledgement**

| Employee Name (Print) | Employee Signature | Date |
|---|---|---|
| Supervisor Name (Print) | Supervisor Signature | Date |

**Americas**

# Training Needs Assessment – Employee Supervisors & Project Managers

**S3NA-003-FM5**

## 1.0 Scope and Purpose

1.1 This form applies to all Americas AECOM employees performing project and employee supervisory functions.

1.2 These employee perform work in AECOM offices as well as active AECOM project sites.

## 2.0 List of Compliance Training

2.1 Training listed is general in nature and will not address client-specific training requirements or specialized job functions including.

2.2 Although this list of training is provided as a guideline of training an employee needs to complete to do their job, it is the responsibility of the supervisor and/or project manager to confirm that the appropriate level of training is being assigned to the employee with regard to their specific job and task assignments and client needs.

2.3 The list of training below is not to be considered an all inclusive list of training needs.

| **Training** * Indicates training is required by applicable regulation/legislation. | **Hours to Complete Training** | **Related SOP** | **Training Frequency (Years)** | **Applies to US/Canada Employees** |
|---|---|---|---|---|
| AED - Performance Training | 0.5 | 101, 203, 207 | 2 | US |
| Asbestos - Awareness Training* | 0.8 | 501 | Annual | US, Canada |
| Bear Safety - Awareness Training | 1.0 | 313, 503 | 2 | Canada |
| Biological Hazards - Awareness Training | 1.0 | 503 | 2 | US, Canada |
| Canadian Due Diligence - OH&S Training* | 3.0 | C45 | Initial - Training does not require renewal | Canada |
| Client-Specific Railroad Safety Training - Awareness Training | 2.0 | 201 | Determined by Client | US, Canada |
| Complete AECOM Driver's Acknowledgement Form | 0.0 | 005 | 2 | US, Canada |
| Confined Space - Awareness Training* | 1.0 | 301 | Annual | US |
| Confined Space - Awareness Training* | 1.0 | 301 | 3 | Canada |
| Construction Awareness; consult your RSHE&M and Supervisor to determine specific training topics. | 4.0 | Varied depending on job tasks | Initial - Training does not require renewal | US |
| CPR - Performance Training* | 2.5 | 101, 207 | 2 | US |
| Driver & Vehicle Safety - Awareness Training | 0.5 | 005 | 2 | US, Canada |
| Electrical Safety - Awareness Training* | 0.8 | 302, 410 | 2 | US |
| E-Railsafe - Awareness Training* | 1.0 | 201 | 2 | US |
| Fall Protection - Awareness Training* | 0.8 | 304 | 3 | US, Canada |

| **Training** * Indicates training is required by applicable regulation/legislation. | **Hours to Complete Training** | **Related SOP** | **Training Frequency (Years)** | **Applies to US/Canada Employees** |
|---|---|---|---|---|
| Field Safety - Awareness Training. Consult your RSH&EM about the need for Medical Surveillance. | 4.0 | 209 | 2 | US, Canada |
| Fire Extinguisher - Awareness Training* | 0.5 | 106, 206 | 1 | US, Canada |
| First Aid - Performance Training* | 2.5 | 101, 207 | 2 | US |
| H2S - Awareness Training* | 0.8 | 508 | Annual | US |
| H2S - Awareness Training* | 8.0 | 508 | 3 | Canada |
| HazCom(US)/WHMIS(CDN) - Awareness Training* | 0.5 | 508 | Annual | US, Canada |
| Hearing Protection - Awareness Training*. Consult your RSH&EM about the need for Medical Surveillance. | 0.8 | 207 | Annual | US, Canada |
| Heavy Equipment Operations & Safety - Awareness Training* | 0.5 | 309 | 3 | US, Canada |
| HzM(US)/TDG(CAN) Shipping - Awareness Training* | 0.5 | 509 | 3 | US, Canada |
| Incident Investigation - Awareness Training* | 2.0 | Varied depending upon province | Initial - Training does not require renewal | Canada |
| Industrial Ergonomics - Awareness Training | 0.7 | 308 | 3 | US, Canada |
| Lead Safety - Awareness Training* | 0.8 | 513 | Annual | US, Canada |
| Level 1 Shipper - HzM(US)/TDG(CDN) - Performance Training* | 4.0 | 509 | 3 | US, Canada |
| Lockout/Tagout - Awareness Training* | 0.8 | 302, 410 | 3 | US, Canada |
| Office Ergonomics - Awareness Training | 0.5 | 102 | 2 | US |
| Office Ergonomics - Awareness Training* | 0.5 | 102 | 2 | Canada |
| Railroad Worker Protection - Awareness Training* | 1.5 | 201 | Annual | US, Canada |
| Respiratory Protection - Awareness Training*. Consult your RSH&EM about the need for Medical Surveillance. | 0.8 | 519 | Annual | US, Canada |
| SH&E Fundamentals - Awareness Training | 2.0 | 003, 209 | Annual | Canada |
| SH&E Fundamentals - Awareness Training | 2.0 | 003, 209 | 3 | US |
| Standard First Aid, with CPR & AED Performance Training* | 16.0 | 101, 207 | 3 | Canada |
| Traffic Safety - Awareness Training | 0.7 | 306 | 3 | US, Canada |
| Trenching & Excavation Safety - Awareness Training* | 0.8 | 303 | 3 | US, Canada |

| **Training** * Indicates training is required by applicable regulation/legislation. | **Hours to Complete Training** | **Related SOP** | **Training Frequency (Years)** | **Applies to US/Canada Employees** |
|---|---|---|---|---|
| Workplace Safety & Health Committee - Performance Training* | 16.0 | | Initial - Training does not require renewal | Canada |
| **Estimated Initial Total (US/CAN)** | **37.8/68.5** | **Estimated Annual Renewal Total (US/CAN)** | | **19.9/24.5** |

**Acknowledgement**

| Employee Name (Print) | Employee Signature | Date |
|---|---|---|
| Supervisor Name (Print) | Supervisor Signature | Date |

**Americas**

# Training Needs Assessment – On-site Project Supervisors

**S3NA-003-FM6**

## 1.0 Scope and Purpose

1.1 This form applies to all Americas AECOM employees performing on-site project supervisory functions.

1.2 These employee perform work in AECOM officesas well as active AECOM project sites.

## 2.0 List of Compliance Training

2.1 Training listed is general in nature and will not address client-specific training requirements or specialized job functions including.

2.2 Although this list of training is provided as a guideline of training an employee needs to complete to do their job, it is the responsibility of the supervisor and/or project manager to confirm that the appropriate level of training is being assigned to the employee with regard to their specific job and task assignments and client needs.

2.3 The list of training below is not to be considered an all inclusive list of training needs.

| **Training** * Indicates training is required by applicable regulation/legislation. | **Hours to Complete Training** | **Related SOP** | **Training Frequency (Years)** | **Applies to US/Canada Employees** |
|---|---|---|---|---|
| AED - Performance Training | 0.5 | 101, 203, 207 | 2 | US |
| Asbestos - Awareness Training* | 0.8 | 501 | Annual | US, Canada |
| Bear Safety - Awareness Training | 1.0 | 313, 503 | 2 | Canada |
| Biological Hazards - Awareness Training | 1.0 | 503 | 2 | US, Canada |
| Canadian Due Diligence - OH&S Training* | 3.0 | C45 | Initial - Training does not require renewal | Canada |
| Client-Specific Railroad Safety Training - Awareness Training | 2.0 | 201 | Determined by Client | US, Canada |
| Competent Person Function Specific Training - Designation made by Project Manager in consultation with RSH&EM.* | | 202 + Specific Technical SOP | 2 | US, Canada |
| Complete AECOM Driver's Acknowledgement Form | 0.0 | 005 | 2 | US, Canada |
| Confined Space - Performance Training* | 8.0 | 301 | 3 | Canada |
| Confined Space - Performance Training*. Consult your project Safety Plan and Regional SH&E Manager to determine training required per your job role and function. | 8.0 | 301 | Annual | US |

| **Training** * Indicates training is required by applicable regulation/legislation. | **Hours to Complete Training** | **Related SOP** | **Training Frequency (Years)** | **Applies to US/Canada Employees** |
|---|---|---|---|---|
| Construction Awareness; consult your RSHE&M and Supervisor to determine specific training topics. | 4.0 | Varied depending on job tasks | Initial - Training does not require renewal | US |
| CPR - Performance Training* | 2.5 | 101, 207 | 2 | US |
| Driver & Vehicle Safety - Awareness Training | 0.5 | 005 | 2 | US, Canada |
| Electrical Safety - Awareness Training* | 0.8 | 302, 410 | 2 | US |
| E-Railsafe - Awareness Training* | 1.0 | 201 | 2 | US |
| Fall Protection - Performance Training* | 4.0 | 304 | 3 | US, Canada |
| Field Safety - Awareness Training. Consult your RSH&EM about the need for Medical Surveillance. | 4.0 | 209 | 2 | US, Canada |
| Fire Extinguisher - Awareness Training* | 0.5 | 106, 206 | 1 | US, Canada |
| First Aid - Performance Training* | 2.5 | 101, 207 | 2 | US |
| H2S - Awareness Training* | 0.8 | 508 | Annual | US |
| H2S - Awareness Training* | 8.0 | 508 | 3 | Canada |
| HazCom(US)/WHMIS(CDN) - Awareness Training* | 0.5 | 508 | Annual | US, Canada |
| Hearing Protection - Awareness Training*. Consult your RSH&EM about the need for Medical Surveillance. | 0.8 | 207 | Annual | US, Canada |
| Heavy Equipment Operations & Safety - Awareness Training* | 0.5 | 309 | 3 | US, Canada |
| HzM(US)/TDG(CAN) Shipping - Awareness Training* | 0.5 | 509 | 3 | US, Canada |
| Incident Investigation - Awareness Training* | 2.0 | Varied depending upon province | Initial - Training does not require renewal | Canada |
| Industrial Ergonomics - Awareness Training | 0.7 | 308 | 3 | US, Canada |
| Lead Safety - Awareness Training* | 0.8 | 513 | Annual | US, Canada |
| Level 1 Shipper - HzM(US)/TDG(CDN) - Performance Training* | 4.0 | 509 | 3 | US, Canada |
| Lockout/Tagout - Performance Training* | 4.0 | 302, 410 | 2 | US, Canada |
| Office Ergonomics - Awareness Training | 0.5 | 102 | 2 | US |
| Office Ergonomics - Awareness Training* | 0.5 | 102 | 2 | Canada |
| OSHA 10-Hour Construction - Awareness Training* | 10.0 | State/Project Requirement | Initial with varying renewal | US |
| Radiation Safety - Awareness Training* | 1.0 | 516 | Annual | US, Canada |

| **Training** * Indicates training is required by applicable regulation/legislation. | **Hours to Complete Training** | **Related SOP** | **Training Frequency (Years)** | **Applies to US/Canada Employees** |
|---|---|---|---|---|
| Railroad Worker Protection - Awareness Training* | 1.5 | 201 | Annual | US, Canada |
| Respiratory Protection - Awareness Training*. Consult your RSH&EM about the need for Medical Surveillance. | 0.8 | 519 | Annual | US, Canada |
| Scaffolding Safety - Awareness Training* | 0.8 | 311 | 3 | US, Canada |
| SH&E Fundamentals - Awareness Training | 2.0 | 003, 209 | Annual | Canada |
| SH&E Fundamentals - Awareness Training | 2.0 | 003, 209 | 3 | US |
| Standard First Aid, with CPR & AED Performance Training* | 16.0 | 101, 207 | 3 | Canada |
| Traffic Safety - Awareness Training | 0.7 | 306 | 3 | US, Canada |
| Trenching & Excavation Safety - Awareness Training* | 0.8 | 303 | 3 | US, Canada |
| Workplace Safety & Health Committee - Performance Training* | 16.0 | | Initial - Training does not require renewal | Canada |
| **Estimated Initial Total (US/CAN)** | **59.3/86.0** | **Estimated Annual Renewal Total (US/CAN)** | | **29.8/30.0** |

**Acknowledgement**

| Employee Name (Print) | Employee Signature | Date |
|---|---|---|
| Supervisor Name (Print) | Supervisor Signature | Date |

**Americas**

# Training Needs Assessment – Line Managers

**S3NA-003-FM7**

## 1.0 Scope and Purpose

1.1 This form applies to all Americas AECOM employees performing Line (Department, District, Region, etc.) Management functions.

1.2 These employees primarly perform work in AECOM offices and may occasionally work on AECOM project sites.

## 2.0 List of Compliance Training

2.1 Training listed is general in nature and will not address client-specific training requirements or specialized job functions including.

2.2 Although this list of training is provided as a guideline of training an employee needs to complete to do their job, it is the responsibility of the supervisor and/or project manager to confirm that the appropriate level of training is being assigned to the employee with regard to their specific job and task assignments and client needs.

2.3 The list of training below is not to be considered an all inclusive list of training needs.

| **Training** * Indicates training is required by applicable regulation/legislation. | **Hours to Complete Training** | **Related SOP** | **Training Frequency (Years)** | **Applies to US/Canada Employees** |
|---|---|---|---|---|
| Canadian Due Diligence - OH&S Training* | 3.0 | C45 | Initial - Training does not require renewal | Canada |
| Complete AECOM Driver's Acknowledgement Form | 0.0 | 005 | 2 | US, Canada |
| Driver & Vehicle Safety - Awareness Training | 0.5 | 005 | 2 | US, Canada |
| Field Safety - Awareness Training. Consult your RSH&EM about the need for Medical Surveillance. | 4.0 | 209 | 2 | US, Canada |
| HazCom(US)/WHMIS(CDN) - Awareness Training* | 0.5 | 508 | Annual | US, Canada |
| HzM(US)/TDG(CAN) Shipping - Awareness Training* | 0.5 | 509 | 3 | US, Canada |
| Incident Investigation - Awareness Training* | 2.0 | Varied depending upon province | Initial - Training does not require renewal | Canada |
| Office Ergonomics - Awareness Training | 0.5 | 102 | 2 | US |
| Office Ergonomics - Awareness Training* | 0.5 | 102 | 2 | Canada |
| SH&E Fundamentals - Awareness Training | 2.0 | 003, 209 | Annual | Canada |
| SH&E Fundamentals - Awareness Training | 2.0 | 003, 209 | 3 | US |

| **Training** * Indicates training is required by applicable regulation/legislation. | **Hours to Complete Training** | **Related SOP** | **Training Frequency (Years)** | **Applies to US/Canada Employees** |
|---|---|---|---|---|
| Workplace Safety & Health Committee - Performance Training* | 16.0 | | Initial - Training does not require renewal | Canada |
| **Estimated Initial Total (US/CAN)** | **8.0/29.0** | **Estimated Annual Renewal Total (US/CAN)** | | **3.8/5.2** |

**Acknowledgement**

| Employee Name (Print) | Employee Signature | Date |
|---|---|---|
| Supervisor Name (Print) | Supervisor Signature | Date |

**Americas**

# SH&E Training Course & Instructor Evaluation

**S3NA-003-FM8**

| | | | | | |
|---|---|---|---|---|---|
| **Course Name:** | | | | | |
| **Date:** | | **Start Time:** | | **Stop Time:** | |

**Type of Training (Check One):**

☐ **AECOM Live (Classroom)** ☐ **AECOM Live (WebEx/Teleconference)** ☐ **AECOM eLearning**

☐ **External Live** ☐ **External eLearning** ☐ **OTHER:**

| **Lead Instructor:** | **Instructor 1:** | **Instructor 2:** |
|---|---|---|
| | | |

| | Excellent | Good | Average | Below Average | Poor | Not Applicable |
|---|---|---|---|---|---|---|
| 1. Please rate the quality of the training materials in the following categories: | | | | | | |
| a. The training was technically accurate. | ☐5 | ☐4 | ☐3 | ☐2 | ☐1 | ☐NA |
| b. The training and discussion aligned with the training objectives. | ☐5 | ☐4 | ☐3 | ☐2 | ☐1 | ☐NA |
| c. The training was practical and relevant to my job at AECOM. | ☐5 | ☐4 | ☐3 | ☐2 | ☐1 | ☐NA |
| 2. Please provide your assessment of the Trainer's presentation skills and abilities: | | | | | | ☐NA |
| a. Instructor was knowledgable in the subject matter. | ☐5 | ☐4 | ☐3 | ☐2 | ☐1 | ☐NA |
| b. Instructor was capable of clearly and effectively communicating and teaching. | ☐5 | ☐4 | ☐3 | ☐2 | ☐1 | ☐NA |
| c. Instructor was able to accurately answer my questions. | ☐5 | ☐4 | ☐3 | ☐2 | ☐1 | ☐NA |
| d. Instructor was able to engage the class and maintain my attention. | ☐5 | ☐4 | ☐3 | ☐2 | ☐1 | ☐NA |
| 3. Please provide your assessment of the training event as a whole in the following categories: | | | | | | ☐NA |
| a. How do you rate the quality of audio/visual materials, handouts and other training aids? | ☐5 | ☐4 | ☐3 | ☐2 | ☐1 | ☐NA |
| b. How do you rate the overall quality of the entire training event? | ☐5 | ☐4 | ☐3 | ☐2 | ☐1 | ☐NA |
| c. Was the training location comfortable and large enough to accomodate your class? | ☐5 | ☐4 | ☐3 | ☐2 | ☐1 | ☐NA |

Please list any new skills, techniques, or ideas you learned during this training session that you will apply to your job.

Please provide any additional comments on the training.

**Americas**

# Training Syllabus – [COURSE TITLE]

**S3NA-003-TP1**

| | |
|---|---|
| **Course Title** | (Insert Course Title) |
| **Duration** | # Hours |
| **Regulatory/policy applicability** | (Insert regulatory and/or SOP reference) |
| **Comprehension assessment method** | (Insert assessment method [Quiz, Test, Skill Performance] and the percentage required to pass) |
| **Certification Level** | (Insert certification level) |
| **Duration of Training Validity** | (Insert expiration, if applicable) |
| **Intended Participants** | (Use Regulatory citation or SHE SOP reference to describe who the training is applicable to, and should be or is required to participate.) |
| **Learning Objectives** | (Briefly describe learning objectives for the training and how they will be assessed.) |

## Training Prerequisites:

- Employee SH&E Orientation including SH&E Fundamentals eLearning

(Discuss any training that may need to be completed prior to attending this course. Examples may include completion of 40-Hour HAZWOPER for 8-Hour HAZWOPER Refresher, or Awareness training required to be completed prior to a Functional/Competency Certification course.)

## Course Outline:

(Detail the contents of the course that will include duration and delivery methods. Provide additional description of who the training is applicable to and how participants will be assessed to ensure adequate knowledge transfer. Complete the table below that will be used in creating the attendance sheet that will serve as the record of training.)

| Module Title | Module Duration* | Module Content (Specify eLearning provider where applicable) |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

* Indicates module is delivered as eLearning by AECOM or authorized provider.

## Expiration of Training:

Training is valid for X years. Re-fresher training may utilize local resources or hands-on training to focus on elements which are unique to the location. Some AECOM Clients may require refresher training on a more frequent basis and it is the responsibility of the project team to ensure all employees meet the training needs of their client. If an employee is unable to produce a valid training certificate where one is needed they may be required to complete a new course.

## Revision History:

| Revision | Date | Change |
|---|---|---|
| Original | (Date) | N/A |
| Revision 1 | | |

# CERTIFICATE OF COMPLETION

## [Course Name]

This is to recognize that

## [EMPLOYEE]

Has completed AECOM SH&E Training Course [Title], required by [Regulatory and/or SOP Reference] on [DATE]. Training expires on [DATE].

[Trainer Name]
[Trainer Title]

**Americas**

# Vehicle and Driver Safety Program

**S3NA-005-PR1**

## 1.0 Purpose and Scope

1.1 This procedure applies to employees who operate motor vehicles that are owned, rented, or leased by AECOM and to employees who use personal, client or government-supplied vehicles while conducting AECOM business. This Vehicle and Driver Safety Program applies to AECOM Americas operations. Policies and procedures related to the operation of commercial motor vehicles are in addition to this procedure, see *S3NA-404-PR1 Commercial Motor Vehicles.* Operational procedures related to the use of AECOM owned vehicles are addressed in the *Americas Fleet Vehicle Operations Policy*.

1.2 Vehicle and transportation related death is among the leading causes of death in the United States. In the occupational setting, motor vehicle crashes are the number one cause of death.

1.3 Vehicle damage and damage to property by vehicles are generally avoidable incidents that can result in injuries and added costs for repairs and replacements.

## 2.0 Terms and Definitions

2.1 **Americas Fleet Vehicle Managemen**t – The team of AECOM employees who oversee the operations, safety, and performance of the Americas Fleet.

2.2 **Authorized Driver** – AECOM employees who have provided proof of a current driver's license, proof of insurance and completed AECOM Driver & Vehicle Safety Training. Employees authorized to operate an AECOM Fleet Vehicle must receive additional approval by Region Fleet Vehicle Coordinators. Refer to *Americas Fleet Vehicle Operations Policy*.

2.3 **Commercial Motor Vehicle (CMV)** – For AECOM operations, a CMV is defined as a vehicle used for AECOM business that:

- ≥10,001 lbs gross vehicle weight rating (GVWR); and/or
- Carries a quantity of hazardous material (quantities ≥ 1001 lbs. combined total weight) at any time beyond the criteria in 49 CFR 173.6 (Materials of Trade).

2.4 **Company Business** – Any activity that is performed in the name of the company. This includes vehicle travel between work locations, client sites, meeting locations as well as driving performed as a part of work related travel (driving to and from airports, hotels, train stations). Company business does not include driving that is a part of a routine commute from home to an office location.

2.5 **Distracted Driving** – An activity that takes the driver's attention away from the primary task of driving.

2.6 **Driving Under the Influence (DUI)/Driving While Intoxicated (DWI)** – DUI is the operation of a vehicle on company business under the influence of alcohol, drugs, medications, or other substances capable of inducing an altered mental state and/or impairing physical and mental judgments such that the influence of said substances produces impairment in violation of governmental laws for the location of the impairment.

2.7 **Fatigue** – A general term used to describe the experience of being "sleepy", "tired" or "exhausted". The effect of fatigue is both a physiological and a psychological and can severely impair a driver's judgement. Fatigue can cause lapses in concentration which could prove fatal. Fatigue is not just a problem for drivers on long trips as a drivers can also suffer from fatigue even on short trips.

2.8 **Fleet Vehicle** – A motorized vehicle owned or leased by AECOM. These vehicles may be assigned to a specific driver or may be part of an office vehicle pool.

2.9 **IndustrySafe** – AECOM's internal database for the management of safety, health and environmental incidents. IndustrySafe is accessible to all AECOM employees, and maintains confidentiality for protected information.

2.10 **Journey Management** – A process for planning and executing necessary journeys safely.

2.11 **Local Laws** – Signs, postings, laws, regulations, ordinances and codes applicable for the jurisdiction in which the motor vehicle is being operated.

2.12 **Managers/Management** – All AECOM company personnel with supervisory responsibilities or direct reports.

2.13 **Mobile Communication Device** – A mobile electronic device that is used to receive or communicate voice, email, internet, and/or public media. The device requires user interaction (typing, dialing, reading, keying, etc.) that distracts the motor vehicle operator. Example devices include, but are not limited to:

- Mobile/Cellular phones
- Personal Data Assistant (PDA)
- iPads, iPods, or other tablet models
- Computers
- Global Positioning System receivers

2.14 **Motor Vehicle Report (MVR)** – A listing of the tickets (violations), incidents collision for an individual driver over a period of time (e.g. 3 years, 5 years) provided by a state or provincial authority such as the Department of Motor Vehicles.

2.15 **Personal Vehicle** – A motorized vehicle owned or leased by an employee.

2.16 **Spotters –** Extra personnel that may provide guidance when maneuvering in close and/or complex situations in order to avoid the occurrence of an incident.

2.17 **Task Hazard Analysis (THA)** – A process for planning and evaluating tasks, such as driving, for hazards and control measures to reduce and eliminate the risk of a harmful event.

2.18 **Vehicle Incident** – An incident, for the purposes of this procedure, is a vehicle collision or other vehicle related event where personal injury or property damage occurs. This includes theft, vandalism, and criminal mischief. Citations are considered incidents when the citation is received during the course of business and results in a restricted or suspended license, a governmental motor vehicle agency assigning points to the employee's license, or the employee provides AECOM's insurance as proof of insurance at the time of incident.

## 3.0 References

3.1 AECOM US, Canada and South America Employee Handbook (HR Department)

3.2 Americas Fleet Vehicle Operations Policy

3.3 AECOM Global Travel Policy

3.4 National Safety Council

3.5 Smith Systems

3.6 WP-001-PR Firearms Standard

3.7 S2-032-PR1 Weapons Safety

3.8 S3NA-003-PR1 SH&E Training

3.9 S3NA-004-PR1 Incident Reporting

3.10 S3NA-209-PR1 Project Hazard Assessment and Planning

3.11 S3NA-404-PR1 Commercial Motor Vehicles

3.12 S3NA-603-PR1 Incident Investigation and Review

# 4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Regional Executive**

- Supports the implementation of the *Americas Fleet Vehicle Operations Policy*, including preventative maintenance, vehicle disposition and insurance.
- Providing necessary resources to manage vehicles and drivers to the extent their operation requires.

4.1.2 **Supervisor**

- Confirming employees are informed of the provisions of this procedure and related vehicle procedures.
- Providing a copy of this procedure to an employee who will be driving an AECOM owned, leased or personal vehicle for company business.
- Verifying that each employee has completed *S3NA-005-FM1 Driver's Authorization* per the instructions on the form.
- Allowing employees to designate time to complete required driving safety training, vehicle inspections and related activities.
- Assigning driving tasks to authorized employees only.
- Selecting and providing vehicles for use by authorized employees that are appropriate for the planned working conditions and environment.
- Supporting employees in the reporting of vehicle incidents per *S3NA-004-PR1 Incident Reporting,* including the entry of the incident into IndustrySafe.

4.1.3 **Employee**

- Following this procedure and applicable laws while operating a vehicle.
- Completing required training consistent with the training needs assessment and requirements per the *S3NA-003-PR1 SH&E Training*.
- Reporting to their supervisor if the vehicle selected is not appropriate for working conditions and environment.
- Reporting to their supervisor if they are inexperienced in operating the type of vehicle they are assigned.
- Reporting to their supervisor if they are inexperienced driving in the type of working conditions and environment they are assigned.
- Review the Driving THA and prepare a Journey Management Plan by completing the *S3NA-005-TP1 Journey Management Plan.*
- Immediately reporting vehicle incidents per *S3NA-004-PR1 Incident Reporting*, including the entry of the incident into IndustrySafe.
- Notifying their Supervisor, Region SH&E Manager, and Region Counsel upon receipt of a legal summons associated with a moving violation related to the use of a company vehicle.
- Immediately reporting a change or limitation(s) to his or her Driver's License to his or her Supervisor.
- Conducting a pre-operational inspection of the vehicle for damage or deficiencies and reporting discovered deficiencies affecting the safe operation of the motor vehicle to the appropriate authority (Region Fleet Vehicle Coordinator, Rental Car Agency or other).

4.1.4 **Region SH&E Manager / SH&E Department**

- Maintaining and updating resources for Driver Safety Training
- Maintaining this procedure and updating it when regulatory or company policies dictate.
- Assisting operational leaders with determining the risk incurred by the use of motor vehicles.
- Participating in the incident investigation and review process.

4.1.5 **Region Fleet Vehicle Coordinator (in their assigned regions)**

- Escalating safety issues related to fleet vehicles for resolution through the Fleet Management Company.
- Disposing of fleet vehicles per the guidance in the *Americas Fleet Vehicle Operations Policy*.
- Refer to the Region SH&E Manager for Fleet Vehicle driver training verification and risk assessment.

4.1.6 **Region Human Resources Manager**

- Responsible for verifying license and proof of personal vehicle insurance at the time of hire and upon verification of the Driver Authorization Form.

4.2 General Procedures and Practices

- Only Authorized Drivers are to operate a motor vehicle (rental, personal, or AECOM owned/leased) while on AECOM business, refer to *S3NA-005-WI1 Authorized Driver Safety Practices*.
- Drivers must comply with *AECOM's Global Travel Policy*, *Americas Fleet Vehicle Operations Policy*, and the applicable laws. (NOTE: *Individual state, provincial, and local laws vary*.)
- AECOM Fleet Vehicles and Rentals Cars should not be operated if the age or mileage on that vehicle exceeds the following:
  - Light/Medium Duty Trucks: 72 months/150,000 miles
  - Sedans: 36 months/80,000
  - Sport Utility Vehicles/Vans: 60 months/100,000 miles
- Seat belts are to be worn by the occupants. The number of passengers shall not exceed the manufacturer's specifications for the vehicle.
- Motorcycles may not be operated on company business unless:
  - Specific approval is provided by the **Supervisor** with concurrence from the **Region SH&E Manager.**
  - A hazard analysis is completed.
  - Required training and license is in place.
  - Headlights or daytime running lights will be used when the vehicle is in operation. Class 2 or 3 safety vest worn while operating a motorcycle.
- Fire arms and weapons are not permitted in AECOM Fleet Vehicles or rental vehicles insured by AECOM. Firearms and weapons in personal vehicles are subject to the laws and regulations of the respective local, provincial, state, territory, federal and region and/or country. In accordance with the Global Safety Department standards, no firearms or weapons are allowed to be used without express permission by the **Region Executive** and **Chief Security Officer**, refer to the *WP-001-PR Global Firearms Standard*. Exceptions can be made in writing from the **Region Executive** and **Chief Security Officer** if knives or weapons are required as part of the work activity or for third party protection and planned for appropriate hazard control measures and training, refer to the *S2-032-PR1 Weapons Safety*. Vehicles are to be selected based on the nature of planned use. In some working conditions, four-wheel drive and higher clearance vehicles may be required to ensure safe travel. Vehicle requirements/specifications must be identified in the project specific safety plan or THA.

- Vehicles are to be outfitted with the appropriate support equipment based on the THA or client vehicle specifications. Support equipment may include cones, rotating waning lights, warning flags, vehicle identification (magnetic door signs or similar,), wheel chocks, cargo nets, rollover protection.
- Drivers are to operate vehicles in a manner that avoids situations where backing is necessary. Reverse parking of all vehicles while on business is required. Backing of trucks and heavy equipment requires then a spotter to assist the driver in avoiding collisions.
- Non-AECOM drivers (subcontractors, joint venture partners, clients) are prohibited from operating an AECOM leased or owned vehicle unless the activity is specifically agreed to in the applicable contract and only if the use of the vehicle is consistent with the terms of the contract.

4.3 Distracted Driving

The use of all mobile communication devices (MCDs) while driving is strictly prohibited. MCDs include all hand-held or hands-free devices, including all mobile phones and other portable electronic devices that cause driver distraction such as tablets (e.g., iPads), PDAs, pagers, iPods, MP3s, GPS, DVD players, laptops, etc. Employees shall not use a personal or company MCD while driving a company vehicle; use a company MCD while driving a personal vehicle; or use a personal MCD while driving a personal vehicle on company business. Driving includes the time spent in traffic or while stopped at red lights or stop signs.

GPS units and GPS units on smart phones may only be used if factory installed or secured to the vehicle with a bracket that allows the driver to view the image without having to take their eyes off the road. Electronic devices shall be setup for operation prior to commencing driving activities.

4.4 Impairment

- Impairment can take many forms ranging from fatigue, to the use of prescription medication or alcohol (even small amounts), to the abuse use of illegal and legal drugs and alcohol. AECOM **Employees** are not to drive in an impaired condition.
- AECOM **employees** are prohibited from being under the influence of alcohol or drugs or improperly using medication in a way that could diminish, or raise questions concerning, an employee's ability to perform at his or her best while performing services for or on behalf of AECOM.
- AECOM **Employees** are prohibited from operating a vehicle if they are experiencing signs and symptoms of fatigue. **Employees** should stop work and rest before driving. No **Employee** should operate a vehicle if they have worked 14 consecutive hours within a 24 hour period.

4.5 Task Hazard Analysis (THA)

All **Employees** are to review a Driving THA prior to driving for company business, refer to *S3NA-209-PR1 Project Hazard Assessment and Planning*.

4.6 Journey Management

Journey Management is a process for planning and executing necessary journeys safely. Journey Management includes the following steps:

- Determining if the trip is necessary;
- Evaluating alternative safer modes of transport;
- Evaluating the potential to combine journeys with others.

Trips in excess of 100 miles (160 kms) (each way), or into remote or hazardous areas, or when otherwise deemed necessary, shall have a Journey Management Plan (JMP). This plan typically includes the route, location of route hazards, timing, rest periods and locations, communications, emergency response and security arrangements.

A sample Journey Management Plan has been provided in *S3NA-005-TP1 Journey Management Plan.*

Drivers are responsible for developing the Journey Management Plan in coordination with their **Supervisor**, **Project Manage**r and **Region SH&E Manager** (as appropriate).

4.7 Driver Safety Training

- Driver safety training is to be assigned based on the risks posed with the work environment and vehicle type, using the training needs assessment process, refer to *S3NA-003-PR1 SH&E Training*. A determination of training type is at the discretion of the **Supervisor**, the following guidance will be applied:
- Driver Safety Awareness – is appropriate for Authorized Drivers who periodically use their personal vehicle, AECOM Fleet Vehicle or rental car for AECOM business. Driver Safety Awareness training is an eLearning module approximately 1 Hour in length.
- Defensive Driver (online) – is appropriate for authorized drivers who are assigned an AECOM Fleet Vehicle or rental vehicle for a significant period of time with the expectation that the **Employee** utilizes the vehicle on a regular basis for AECOM business. Defensive Driver training is provided online through one of the following AECOM-approved training resources:
  - The National Safety Council
  - Alert Driving
- Defensive Driver (hands-on) – is appropriate for Authorized Drivers who drive in remote locations, hazardous environments (such as refineries, ports, terminals etc.), at-risk drivers, and as required by clients. Defensive Driver hands-on training is provided through one of the following AECOM-approved training resources such as Smith Systems. Hands on defensive driver training may also be required as a result of an incident or negative Motor Vehicle Report.
- Driver Retraining – Drivers involved in repeated motor vehicle incidents, incidents of sufficient severity or concern, or drivers identified as at-risk through AECOM's Motor Vehicle Report/Driver Abstract process shall be subject to a driver retraining program that may include any of the above programs or other training programs appropriate for the type of driving the employees performs. Retraining programs will be implemented at the discretion of the **Supervisor** and **Region SH&E Manager** Depending on the severity of the incident, the **Employee** may be subject to disciplinary and refused the right to drive on behalf of AECOM.
- Special Vehicles and Driving Conditions – Vehicles such as All-Terrain Vehicles (ATVs), four wheel drive vehicles, motorized carts, box vans and trailers (towing) require specialized training and supervision. Use of these types of vehicles is limited to AECOM projects, therefore training and qualification programs for drivers will be project specific. The **Project Manager** shall work with the **Region SH&E Manager** to tailor training to the specific needs of the project.

4.8 AECOM Fleet Vehicles (additional requirements)

- The requirements of this procedure apply to the use of AECOM Owned or Leased Vehicle, and additional requirements are set forth in the Americas Fleet Vehicle Operations Policy.
- Fleet Vehicles are to be parked on project sites in a manner that prevents the driver from backing (reversing) upon departure. For example, the vehicle should be backed into a parking spot or drivers should select a parking spot that allows them to "pull" through" so that the vehicle is facing the direction of departure.
- Fleet Vehicles are to have a "Safety Kit" that contains a first-aid kit, portable fire extinguisher, safety triangle, and two reflective safety vests. If not available, contact the **Region Fleet Vehicle Coordinator** about how to obtain one through the procurement system.

4.9 Personal Vehicles (additional requirements)

The requirements of this procedure apply to the use of a personal vehicle for company business. Additional requirements are set forth in the *AECOM Global Travel Policy*.

4.10 Rental Vehicles (additional requirements)

The requirements of this procedure apply to the use of a rental vehicle for company business. Additional requirements are set forth in the *AECOM Global Travel Policy*.

4.11 Requirements for Authorized Drivers

- Review the *S3NA-005-WI1 Authorized Driver Safety Practices* for more specifics.
- Perform pre-operation vehicle inspections, a sample vehicle inspection checklist is provided in *S3NA-005-FM2 Vehicle Inspection Checklist*.
- Arrange for preventive maintenance services for the vehicle and maintain it in sound mechanical condition, per manufacturer's recommendations.
- Drivers are not to permit unauthorized persons to operate an AECOM owned/leased/rented vehicle.
- Do not operate the vehicle if unsafe maintenance conditions exist that would likely result in vehicle damage or personal injury. This applies to vehicles owned or leased by AECOM and to personally-owned vehicles used for company business. Escalate other maintenance issues for correction to appropriate authority (**Region Fleet Vehicle Coordinator**, Rental Car Agency, **Supervisor** etc.).
- Use AECOM owned or leased vehicles for business only. Exceptions to use the vehicle as transportation to and from work, parking at residences overnight, may be permitted only if written approval is obtained from the **Regional Executive**.
- Transport only persons on AECOM related business or those persons receiving transportation as a prescribed service. Only drive vehicles in conditions for which the driver has the appropriate training and experience.
- No smoking by the driver or passengers in the vehicle.
- Drivers are responsible for damage caused by abuse of the vehicle.
- Secure the vehicle when left unattended.
- Securing loads in the inside and outside compartments of the vehicle. Do not rely on weight/shape of load alone. Always use a cargo net, straps, containers or other mechanical device when necessary to ensure load is secure. Mark loads that extend the beyond the end of truck, trailer or similar edge with a red warning flag of at least 16 square inches.
- Refrain from modifying existing equipment (warning sounds, backing alarms etc.) and from installing aftermarket equipment including toolboxes, truck caps, specialty lights, or towing equipment) without approval from the **Regional Executive, Region Fleet Vehicle Coordinator**, and AECOM Procurement Department.
- Shut the engine off when refuelling the vehicle.

4.12 Emergency Preparedness

- The following suggested items should be kept in vehicles used for company business in remote project locations:
    - First Aid kit, appropriate to the work and crew size, or per regulations.
    - Fire extinguisher, safety triangle, and safety vest
    - Emergency equipment (e.g., flares, flashlight, blanket, drinking water, etc.) based on conditions.
    - Means of communication (cell phone, radio or satellite phone), extra batteries or a charger.
- To the extent possible, **Employees** should refrain from changing tires or making repairs to vehicles in the field. A road side assistance service should be identified for vehicles used for company business in advance travel.
- Specific emergency procedures are to be identified in the Journey Management Plan or the THA.

4.13 Vehicle Incidents

- Vehicle incidents are to be managed consistent with *S3NA-004-PR1 Incident Reporting*.
- For vehicle incidents that involve non-emergency injuries or potential injuries, **Employees** must call the Incident Reporting and Assistance Line at 1.800.348.5046 for connection with Work Care medical support. The **Employee** or **Supervisor** is responsible for making the initial notification into IndustrySafe within 4 hours of the event.
- For vehicle incidents that involve property damage greater than $2,500, **Employees** are to call the Incident Reporting and Assistance Line at 1.800.348.5046 for connection with appropriate resources within AECOM, The **Employee** or **Supervisor** is responsible for making the initial notification into IndustrySafe within 4 business hours of the event.
- Non-critical and no-injury incidents (property damage less than $2,500, near misses, etc.), the **Employee** or **Supervisor** is responsible for making the case entry into IndustrySafe by the end of the work shift (at least within 24 hours of the event).
- For Fleet Vehicles, employees must contact the AECOM Fleet Management Company (Wheels: 800-477-2211) to report the incident. Refer to the Americas Fleet Vehicle Operations Policy for further information. Vehicle incidents that result in property damage or loss greater than $2,500 or cause injuries to AECOM **Employees** that result in medical treatment are to be investigated using the AECOM Incident Investigation Process in *S3NA-603-PR1 Incident Investigation and Review*.
- The **Employee(s)** involved in the incident are advised to:
  - Provide (if requested) to police and the other driver(s) their liability insurance information.
  - Not operate a damaged vehicle if its safety is questionable, its operating condition is illegal by applicable laws or its condition is such that further damage would likely result from its operation.
  - Cooperate with **Region Counsel** if the incident results in unresolved risks or third party claims, or if the **Employee** receives a Summons, Complaint or other legal documents relating to a traffic incident.
  - NOT ADMIT LIABILITY, AGREE TO PAY FOR DAMAGE OR SIGN A DOCUMENT RELATED TO AN INCIDENT EXCEPT AS REQUIRED BY LAW. Statements made in haste or anger may be legally damaging.
  - **Employees** must report the incident to AECOM's Global Travel Department. If the incident involved a third party, the driver is responsible for obtaining a copy of the police report and providing to global travel

4.14 Drug and Alcohol Testing

- Testing for Alcohol and/or Drugs procedures are specified in the *US and Canadian Employee Handbook* and administered through the AECOM **Human Resources Department**.
- In the event that a police/regulatory officer responding to a vehicle incident administers field and/or laboratory impairment testing AECOM reserves the right to obtain copies of such testing results for inclusion in the incident report and consideration in a subsequent incident investigation.

4.15 Citations and Violations

- Citations and violations which occur while driving for company business are to be reported as a Vehicle incident, using *S3NA-004-PR1 Incident Reporting* within 24-hours.
- The **Employee** is personally responsible for payment of fines for moving violations and parking citations incurred while driving a vehicle on AECOM business and for reporting such Incidents to his/her **Supervisor**, **Region SH&E Manager**, and **Region Counsel**.
- If an Authorized Driver receives a citation for DUI/DWI/Operating Under the Influence, is suspended from driving or has his/her driver's license revoked, he/she is required to notify his/her **Supervisor** and

**Region Fleet Vehicle Coordinator** within 8 hours of the action. Failure to do this may result in disciplinary action up to and including termination.

## 5.0 Records

5.1 None

## 6.0 Attachments

6.1 S3NA-005-WI1 Authorized Driver Safety Practices

6.2 S3NA-005-FM1 Driver Authorization

6.3 S3NA-005-FM2 Vehicle Inspection Checklist

6.4 S3NA-005-TP1 Journey Management Plan

**Americas**

# Authorized Driver Safety Practices

**S3NA-005-WI1**

## 1.0 Before Vehicle Operation

1.1 Conduct a Pre-Trip *Vehicle Inspection, S3NA-005-FM2*.

1.2 Be familiar with applicable client rules and regulations when on the client's sites. The employee may, for example, be required to leave their keys in the ignition with the vehicle turned off or to display a vehicle pass. When parking, it is recommended that employees back the vehicle into the parkingspace.

1.3 Plan your travel to avoid being in a rush, traveling during peak traffic hours, and traveling through high traffic volume areas. Utilize the *S3NA-005-TP1 Journey Management Plan* as appropriate.

## 2.0 During Vehicle Operation

2.1 The Driver and all passengers must wear seatbelts at all times.

2.2 Maintain a safe distance when travelling behind other vehicles.

2.3 Confirm the area behind your vehicle is clear prior to and while reversing a vehicle.

2.4 When parking the vehicle on the edge of a roadway, turn on the four-way indicators (hazard lights) prior to leaving the vehicle. Use cones or other warning devices, and wear a high visibility traffic vest.

2.5 Observe extra caution in and around emergency and construction zones.

2.6 Avoid unattended rest areas, when possible, and especially at night.

2.7 If the vehicle breaks down, attempt to get to a secured location. Call police or roadside assistance as appropriate. Do not leave the vehicle.

2.8 Contact the police to help those with car trouble instead of stopping to assist.When possible, staff should have a car mechanic or roadside assistance change or repair a flat tire. If the Driver or passenger must change a tire, the Driver and passenger must adhere to the manufacturer's specifications and observe the proper lifting technique and safety procedures. Proper lifing is addressed in *S3NA-308-PR1 Manual Lifting, Field*.

## 3.0 24 – Hour Roadside Assistance, AECOM Fleet Vehicles only: Wheels: 800-477-2211

3.1 Authorized Drivers are to park Vehicles are to on project sites in a manner that prevents the driver from backing (reversing) upon departure. For example, the vehicle should be backed into a parking spot or the driver should select a parking spot that allows them to "pull" through" so that the vehicle is facing the direction of departure.

3.2 Authorized Drivers should use the "Get Out And Look" (GOAL) method before placing a vehicle in motion. Drivers are to make a 360-degree (360°) walk around of the vehicle immediately before placing vehicle into motionin order to determinewhether there are hazards or possible obstructions in the proposed path of travel. Drivers are to clear the area of people and objects before placing the vehicle in motion. A check will also be performed to ensure overhead and side clearances are adequate. The following are recommended best practices:

- Placement of cones on the right side of the front and rear of vehicle upon parking and retrieved during the 360° GOAL walk-around.
- In lieu of cones, place GOAL magnets on the right side of the hood and truck/tailgate of the vehicle upon parking. The GOAL magnets should then be retrieved during the 360° GOAL walk around just prior to moving the vehicle again.

- Place a GOAL sticker on the driver side door window as a reminder to get out and look.

## 4.0 If Vehicle is to be Left Unattended

4.1 Turn the ignition off, remove the key and set the emergency brake (if parked on an incline).

4.2 Lock and secure the vehicle.

4.3 Secure equipment and property in a locked trunk or tool chest.

4.4 Do not leave keys in an unattended vehicle.

## 5.0 Staff shall Drive Defensively

5.1 Look aheadtaking at least 15 seconds to visually identify if there is slowing traffic or another type of road hazard ahead or to your side. Don't drive behind vehicles that block your view.

5.2 Get the big pictureand look for hazards (other motorists, pedestrians, cyclists, road debris, etc.)

5.3 Scan your mirrorsevery 5 – 8 seconds to look for hazards. Don't stare or fix your eyes on any one item for too long.

5.4 Leave yourself an outby monitoring your space in front, behind and to each side of the vehicle, leaving enough are as a cushion so that you can take evasive action if needed.

5.5 Be seen by all other drivers, pedestrians, cyclists and others using or crossing the road. Use your headlights and avoid driving in the blind spot of other vehicles. Make sure your horn works and use it to warn others.

## 6.0 Road Rage

6.1 Road rage is a dangerous driving situation that can occur and should be avoided whenever possible, but NEVER instigated. Do not get drawn into a confrontation. Avoid any confrontational eye contact or gestures.

6.2 The driver should be aware of the vehicles around them, paying frequent attention to the vehicle's mirrors.

6.3 Get out of the way.even if the other motorist is speeding, it is safest not to make a point by staying in your lane. The other driver may be dealing with an emergency situation.

6.4 Unless it is necessary to use the horn as an alert, do so sparingly.

6.5 If someone is following you after an on-the-road encounter, drive to a public place or to the nearest police station and seek assistance.

6.6 Attempt to note the offender's license plate number and write it down as soon as it is safe to do so and the vehicle is not in motion.

6.7 Report any aggressive driving to the police immediately. This action may aid in preventing further occurrences by the same driver.

## 7.0 Work Trucks

7.1 When accessing any pickup truck box, staff will: step up into the box to avoid excess reaching and strain and; use three point contact getting in and out of the truck box (i.e., avoid jumping off the tailgate).

7.2 Be vigilant of differences between trucks and small cars related to blind spots, turning radius, and required overhead and undercarriage clearances.

## 8.0 Winter Driving

8.1 Clear snow from exterior vehicle surfaces.

8.2 Avoid using cruise control on icy roads.

8.3 Accelerate and brake gently to reduce skids or spinouts.

8.4 Wear winter clothing that does not restrict movement, vision or hearing.

8.5 Where required, have snow chains for the vehicle and be familiar with their installation.

8.6 Use extra caution while driving during hazardous winter conditions.

8.7 Avoid sudden changes of speed or direction to reduce possibility of skidding.

8.8 Drivers should leave extra distance between their vehicle and the vehicle ahead of them. Stopping on ice takes about eight times the distance that it takes on dry pavement.

8.9 Carry suitable warm clothing and emergency equipment during the winter months. Temperatures can plunge rapidly.

8.10 Be aware of icy patches on the road bridges and intersections that are especially prone to ice patches.

8.11 Be familiar with the skid control procedures for the type of vehicle being driven (i.e., front, rear or four-wheel drive).

## 9.0 Gravel Roads and Remote Locations

9.1 Prior to driving on a road with an assigned radio frequency, the passenger will test the two-way radio to confirm that the proper radio frequency is set, and that the transmission is being received clearly by other traffic. The passenger will operate the two-way radio.

9.2 Drivers will maintain appropriate speed for the road conditions.

9.3 Headlights will be used when operating the vehicle.

9.4 Drivers will respect the understood road protocol, drive defensively and respect intersections.

9.5 4WD options will be utilized at the discretion and comfort level of the driver. If road conditions are questionable even for 4WD use, the road will not be traveled and either another route found or the job postponed until road conditions improve.

## 10.0 Off-road

10.1 If inexperienced, seek supervisory advice and training.

10.2 Vehicles should only be driven off roads after other available options (e.g., use of ATV's, etc.) have been considered.

10.3 Prior to driving off-road, check to see that the vehicle is in good operating condition and your tires are properly inflated.

10.4 Realize the limitations of your vehicle and do not become over confident.

10.5 Seat belts should be kept fastened and loose objects in the vehicle securely fastened to prevent them from becoming projectiles in the event of a sudden stop.

10.6 Drive according to the ground conditions.

10.7 Speed and power are normally not required in rough off-road driving.

10.8 Learn to read the surrounding terrain. Monitor the ground conditions ahead of the vehicle -- it is essential to know what to expect in light of the road conditions.

10.9 When slowly traversing difficult areas of soft ground, try to keep the vehicle in motion. Once stopped it will be far more difficult to get the vehicle going again. If the vehicle becomes stuck, do not spin the wheels, as it will only dig in further or deeper until the vehicle chassis rests on the ground. Try to go slowly backwards in the vehicle's own tracks, as these have been previously compressed by the vehicle. In most cases this will

be successful. If not, place appropriate material (e.g., wooden planks, mats, branches, etc.) under the wheel to improve traction.

10.10 Before driving over rough terrain, the terrain should be inspected on foot first.

10.11 When climbing hills in the vehicle go straight up or down. It is also smart to know what is on the other side of the hill before going up. At the base of the hill the driver should apply more power. Ease up on the power while approaching the top and before going over the crest. If the vehicle stalls on the ascent, back straight down the hill in reverse. For downhill travel in a vehicle with manual transmission, always use the lowest appropriate gear, and do not disengage the clutch to allow the vehicle to coast. If the vehicle is equipped with an automatic transmission, use low range and the lowest drive setting. DO NOT drive a hill at an angle this increases the risk for a roll-over incident. If the hill is very steep and you do not feel confident that your vehicle can make it up, then do not attempt it.

10.12 When driving through water, consider the maximum wading depth of the vehicle. The air intake must always be kept clear of water. Driving through water should always be done slowly to keep the bow wave low. In addition, slow speed prevents a hot engine from suffering tension cracks by sudden contact with cold water. Check the brakes after leaving the water.

10.13 Prior to returning to the road, do a vehicle inspection to confirm the vehicle is road worthy.

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# Driver Authorization

**S3NA-005-FM1**

| Employee Name : | Employee Number: | Office or Project Location: | Date: |
|---|---|---|---|

**NOTE: It is not a requirement to provide copies of your driver license or proof of insurance as an attachment to this form. Supervisors are responsible for validating these documents are accurately represented in this form.**

**Employee**

| | |
|---|---|
| Driver's License Expirations Date | |
| Driver's License Number | |
| Proof of valid automobile insurance (for personal vehicle use only) | Check if Confirmed ☐ |

I acknowledge that I have read S3NA-005-Driver and Vehicle Safety and understand that it contains important information about AECOM's procedures regarding employee use of AECOM fleet, rental and personal vehicles. I agree to adhere to the requirements of the Procedure. _____ (Initial)

As a condition of driving a vehicle on AECOM business I will present my driver's license and proof of insurance (personal vehicle only) for validation by my Supervisor. _____ (Initial)

I understand as a condition to operating an AECOM fleet vehicle, AECOM may run a Motor Vehicle Driving Record report and provide this report to my Supervisor. _____ (Initial)

I understand I must notify supervisor immediately of any change to the status of my Driver's License, any citation or violation I receive driving for company business, and any incident that occurs while driving for company business. _____ (Initial)

I understand that AECOM reserves the right to terminate my driving privileges and associated benefits at any time, for any reason, in its sole discretion. _____ (Initial)

I understand that I am required to participate in a defensive driving course at AECOM's expense and may be required to participate in more advance training. _____ (Initial)

This procedure and my signed acknowledgement supplement the terms of my employment relationship with AECOM. _____ (Initial)

| Date: | Signature: |
|---|---|

**Supervisor**

I confirm that the Driver's License Number, Expiration Date and Proof of Insurance designated above are consistent with the employee's Driver's License and Proof on Insurance.

| Date: | Signature: |
|---|---|

**Distribution**

When the *Authorization* is completed email a copy to hrrecords@aecom.com (for inclusion in the employee's file). Additional copies must be provided to the following:

1) The employee
2) The supervisor (if the employee is assigned to an office location)
3) Project record (if the employee is assigned to a project location)

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# Vehicle Inspection Checklist

S3NA-005-FM2

| Vehicle Tag No : | Date: | Time: | Mileage: | Driver Name: | Location: |
|---|---|---|---|---|---|

**Inspection Checklist:** This Pre-Trip Vehicle Inspection Checklist is intended to be completed by the vehicle driver prior to departing on a trip. Checking boxes means that item is present and functioning. Deficiencies increase risk of an incident and should be repaired or corrected prior to departure. This checklist should only be used in addition to an on-going vehicle maintenance program. For AECOM Fleet Vehicles, report defiencies to: 800-477-2211 (Wheels)

| Item | Yes | No | N/A |
|---|---|---|---|
| **1. General** | | | |
| 1-1. Proof of insurance and registration available and current? | ☐ | ☐ | ☐ |
| 1-2. Is the date of the last regular maintenance known, or is the mileage/date of next scheduled maintenance known? | ☐ | ☐ | ☐ |
| 1-3. Have any safety recalls issued for this vehicle been addressed? | ☐ | ☐ | ☐ |
| 1-4. Is the overall condition of the vehicle good (no leaks , body damage, unusual sounds when started)? | ☐ | ☐ | ☐ |
| **2. Tires** | | | |
| 2-1. Do all four tires have sufficient tread for driving conditions? Legal limit: 2/32" (for rain/snow: > 4/32") | ☐ | ☐ | ☐ |
| 2-2. Are tires sufficiently inflated for driving conditions? | ☐ | ☐ | ☐ |
| 2-3. Are the lug nuts and stem capspresent and tight for each tire? | ☐ | ☐ | ☐ |
| 2-4. Is the spare tire and jack present and in good condition? | ☐ | ☐ | ☐ |
| **3. Driver's and Passenger's Seat** | | | |
| 3-1. Are the pedal pads in good condition? | ☐ | ☐ | ☐ |
| 3-2. Are the floor mats in good condition and not interfering with the pedals? | ☐ | ☐ | ☐ |
| 3-3. Is the seat properly adjusted (including the headrest)? | ☐ | ☐ | ☐ |
| 3-4. Is the seatbelt in good condition? | ☐ | ☐ | ☐ |
| 3-5. Are the mirrors is good condition (not broken, dirty)? | ☐ | ☐ | ☐ |
| 3-6. Is the dashboard free of warning lights and do the gauges appear to work when the car is started? | ☐ | ☐ | ☐ |
| 3-7. Does the horn work? | ☐ | ☐ | ☐ |
| 3-8. Are distractions such as cell phones and gps units secured so they do not encourage? | ☐ | ☐ | ☐ |
| **4. Lights and Signals** | | | |
| 4 -1. Do the headlights and high beams work? | ☐ | ☐ | ☐ |
| 4-2. Do the turn signals work (front and rear)? | ☐ | ☐ | ☐ |
| 4-3. Do the brake lights work, including the high light in the rear window? | ☐ | ☐ | ☐ |
| 4-4. Do the hazard lights (emergency flashers) work? | ☐ | ☐ | ☐ |
| 4-5. Do backing lights work? | ☐ | ☐ | ☐ |
| **5. Windows and Windshield** | | | |
| 5-1. Is the windshield clean and unbroken? | ☐ | ☐ | ☐ |
| 5-2. Are the wiper blades in good condition (front and rear)? | ☐ | ☐ | ☐ |
| 5-3. Are all the windows clean and unbroken and windshield fluid available and operational? | ☐ | ☐ | ☐ |
| **6. Emergency Equipment (as needed per conditions/project requirements)** | | | |
| 6-1. Is there a "Safety Kit" (fire extinguisher, first aid, safety triangle and 2 reflective vests)? | ☐ | ☐ | ☐ |
| 6-2. Is there a first aid kit, has it been inspected recently? | ☐ | ☐ | ☐ |
| 6-3. Is a means for emergency communication available? | ☐ | ☐ | ☐ |

| 7. Other Equipment (as needed per conditions/project requirements) | | | |
|---|---|---|---|
| 7-1. Is there a means to secured loads (cargo next, container)? | ☐ | ☐ | ☐ |
| 7-2. Are cones or other warning devices available? | ☐ | ☐ | ☐ |
| 7-3. Is weather specific equipment (snow chains, tired etc.)? | ☐ | ☐ | ☐ |

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# Journey Management Plan

**S3NA-005-TP1**

| **Journey Management Plan – required for trips > 100 miles (one way)** |
|---|
| **1. Driver and Passenger Information** |
| Driver Name: |
| Driver Training Completed: |
| Passengers: |
| |
| **2. Vehicle Information** |
| Vehicle Type/Description: |
| |
| **3. Trip Information** |
| What is the purpose of the trip? |
| Single Trip: ☐ Reoccurring Trip: ☐ / / to / / |
| Is traveling for this purpose necessary? |
| Have alternate modes of travel (telepresence, public transportation, air,) been evaluated? ☐ YES ☐ NO |
| Departure Location: |
| Departure Date: Time: |
| Arrival Location: |
| Arrival Date: Estimated Time: |
| What is the weather forecast: |
| What is the route of travel: (okay to insert map) |
| **4. Special Conditions** |
| Check all that may apply: |

| | |
|---|---|
| ☐ Night Driving | ☐ Rugged Terrain (4 x 4) |
| ☐ Weather | ☐ Large Vehicles/Farm Equipment |
| ☐ Long Driving (Over 2 hours) | ☐ Animals |
| ☐ Fatigue | ☐ Rush Hour/Heavy Traffic |
| ☐ Potential for distraction | ☐ Towing |
| ☐ Other _____ | ☐ Other _____ |
| ☐ Other _____ | ☐ Other _____ |

| **5. Site Arrival/Departure Procedure** | |
|---|---|
| 1) Notify supervisor of safe arrival. | |
| **6. Site Arrival/Departure Procedure** | |
| 1) Notify supervisor of safe arrival. | |
| **7. Emergency Planning** | |
| AECOM Supervisor (Name and Phone): | |
| AECOM Project Manager (Name and Phone): | |
| Roadside Service: | For AECOM Fleet Vehicles Use: 800-477-2211 (Wheels) |
| AECOM Incident Reporting Line: 800-348-5046 | |
| AECOM Fleet Management: 800-477-2211 | |
| **8. Approvals:** all JMPs shall be reviewed and acknowledged by the driver and the driver's supervisor. A copy of the form shall remain with the driver and the supervisor for the duration of the journey. (Electronic copies are acceptable). | |
| Driver's Signature: | |
| Project Manager or Supervisor Name and Signature: | |

**Americas**

# Competent Person Designation

**S3NA-202-PR1**

## 1.0 Purpose and Scope

1.1 Outlines the process and minimum requirements necessary for classifying an AECOM employee as a "Competent Person" in one or more activity areas.

1.2 This procedure applies to all AECOM Americas-based employees and operations where AECOM is self-performing the identified activities and where AECOM controls projects performing the activities requiring a Competent Person. Client-mandated requirements may apply on a project-specific basis and shall be addressed in supplemental documents (e.g., Task Hazard Analysis, Safe Work Plan or Health and Safety Plan).

1.3 It is recognized that regulations and legislation may contain alternate definitions for Competent Person and it will be the responsibility of the **Project Manager** to determine if conflicts exist between AECOM and applicable regulatory/legislative definitions and resolve the conflict.

1.4 When a qualified employee within AECOM is not available to be designated as the AECOM Competent Person, the **Project Manager** in coordination with their **Region SH&E Manager** may designate an appropriately qualified and trained Contractor employee as the Competent Person for the project.

## 2.0 Terms and Definitions

2.1 **Competent Person –** One who has legislation knowledge and capable of identifying existing and potential hazards in surroundings or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the knowledge, authorization and resources to take prompt corrective measures to eliminate them.

2.2 **HASP –** Project Health and Safety Plan.

## 3.0 References

3.1 None

## 4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 A **Competent Person** in AECOM is an employee who functions in a technical role when either AECOM self-performs associated field work (above) or oversees and directs the work of subcontractors. For operations where AECOM is providing oversight of subcontractors (ex. drilling services), it is the subcontractors employee who shall be designated as the Competent Person on site for that phase of operation.

Any AECOM employee considered for designation as a "Competent Person" shall:

- Complete a Training Needs Assessment (TNA) with their Supervisor under the guidance of the **Region SH&E Manager**, regarding competent person's requirements.
- Obtain approval from their supervisor prior to enrolling in any AECOM-sponsored safety competent person training program.
- Track his or her own training anniversary dates and arrange for appropriate refresher training at least 30 days prior to expiration of certification.

Contractor Competent Persons:

- Unless AECOM is self-performing, the Contractor is responsible for determining the safe means and methods of its work activities.
- The Contractor is responsible for designating its Competent Person(s) for each category of work it undertakes as required above.
- The Contractor's Competent Person is responsible for technically supporting the Contractor's site operations for the safe execution of its activities.
- The Contractor's Competent Person should be knowledgeable about the work activities, compliance with the associated safety and health regulations, identifying and removing any field hazards and the Contractor's work practices and procedures.
- For work on AECOM controlled sites, the Project Manager confirms that the Contractor designates a Competent Person(s) for its activities. *S3NA-202-FM1 Competent Person Designation* or the equivalent may be used for this purpose.

4.1.2 **Project Manager** are responsible for ensuring that all assigned personnel, including personnel utilized from other offices to support their operations, comply with the requirements of this procedure. The **Project Manager** shall:

- Designate the Competent Person based on the work activity using *S3NA-202-FM1 Competent Person Designation*.
- Implement corrective actions when employees fail to meet training requirements.
- Identify supplemental employee training needs based on local/client requirements.
- Verify competent person training requirements are reviewed with each employee, based upon current and anticipated job functions and past performance on a routine basis.
- Identify additional employees requiring competent person training based on this procedure.
- For projects controlled by AECOM, when these activities are contracted to another party, secure the identity of the Contractor's Competent Person(s), provide them with a copy of this SOP to verify the Contractor's capability to comply with the requirements within, and obtain documentation to support the designation of the Contractor employee as a Competent Person for AECOM.
- Verify the designation of the Competent Person for a specific activity is effectively communicated to field personnel on site during daily tailgate safety meetings.

4.1.3 The **Region SH&E Manager** or designee will work with the **Project Manager** to assess the competency of all designated persons based on specific requirements outlined in this procedure. **Region SH&E Manager** with the **Project Manager** is responsible for:

- Establishing competent person training/experience requirements and communicating these requirements to the supervisor.
- Monitoring the overall implementation of this Standard Operating Procedure (SOP).
- Monitoring field compliance of this procedure.
- Providing technical assistance/support as requested.
- Coordinating internal safety training classes as requested.
- Supporting the **Project Manager** in establishing minimum competent person requirements for regulated job activities based on individual job descriptions, applicable regulatory requirements, operational considerations, and management directives.
- Reviewing as requested by designated operations representatives the Competent Person's qualifications for AECOM employees.

4.2 The following activities require an individual to be designated as a competent person:

- Asbestos
- Blasting & Explosives
- Concrete & Masonry Construction
- Confined Spaces
- Control of Hazardous Energy (Lockout-Tagout)
- Cranes & Derricks
- Demolition
- Electrical Wiring Design & Protections
- Elevated Work Platforms & Aerial Lifts
- Fall Protection
- Hearing Protection
- Heavy Equipment
- Ionizing Radiation
- Lead
- Material Hoists & Personnel Hoists
- Stairways & Ladders
- Respiratory Protection
- Rigging Equipment
- Scaffolds
- Steel Erection
- Trench & Excavations
- Underground Construction
- Welding & Cutting

4.3 The AECOM competent person field functions are dependent on the project activities and AECOM's field function. Refer to each SH&E SOP for the activities listed above and the associated legislative standards to determine the details of responsibility. Generally, it is the Competent Person's responsibility to be on site at all times when AECOM staff are performing work governed by this SOP, make daily inspections of the conditions and work activities, and take actions to control any hazards associated with those activities.

4.4 The *S3NA-202-FM1 Competent Person Designation* shall be used on all projects for documenting Competent Person designations. It must be filled out completely and updated as necessary.

## 5.0 Records

5.1 AECOM Competent Person Designation forms shall be maintained in the project file.

5.2 Documentation as to daily inspections and corrective measures by the AECOM Competent Person shall be maintained in the project file.

## 6.0 Attachments

6.1 S3NA-202-FM1 Competent Person Designation

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# Competent Person Designation

**S3NA-202-FM1**

**Company:** _____ **Project Manager:** _____

**Project Location:** _____ **Project No:** _____

**Designated Competent Person:** _____ **Employee No:** _____

**Check the technical activity for which the Designation will apply:**

- ☐ Asbestos
- ☐ Blasting & Explosives
- ☐ Concrete & Masonry Construction
- ☐ Confined Space Entry
- ☐ Control of Hazardous Energy (Lockout/Tagout)
- ☐ Cranes & Derricks
- ☐ Demolition
- ☐ Electrical Wiring Design & Protections
- ☐ Elevated work platforms & aerial lifts
- ☐ Fall Protection
- ☐ Hearing Protection
- ☐ Heavy Equipment
- ☐ Ionizing Radiation
- ☐ Lead
- ☐ Material Hoists & Personnel Hoists
- ☐ Stairways & Ladders
- ☐ Respiratory Protection
- ☐ Rigging Equipment
- ☐ Scaffolds
- ☐ Steel Erection
- ☐ Trench & Excavations
- ☐ Underground Construction
- ☐ Welding & Cutting

**Other (Explain):**

The AECOM employee identified has been designated as the Competent Person in the technical area specified, and by the Project Manager identified. This designation is based on the following:

1. The Project Manager is authorizing the Competent Person to allocate whatever resources that are necessary to perform tasks associated with the area of competency to provide a safe work environment and comply with applicable regulatory and legislative requirements, and AECOM SH&E procedures and policies.
2. The Project Manager has confirmed that the individual is competent to perform the required tasks by way of:
   a. Documented training
   b. Practical experience (hands-on)
   c. Documented professional experience
   d. Legislative knowledge

**Print name and sign below**

**Designated by:** _____ **Date:** _____
(AECOM Project Manager)

**Designated by:** _____ **Date:** _____
(AECOM Office Manager)

**Designated by:** _____ **Date:** _____
(AECOM Region SH&E Manager or Designee)

**Comments:**

*Attach any related documentation of training, certifications, insurance coverages, or other related information that supports the designation of the person as Competent.*

**Americas**

# Equipment Inspections and Maintenance

**S3NA-205-PR1**

## 1.0 Purpose and Scope

1.1 This procedure establishes the AECOM requirements for the maintenance, inspection, and repair of AECOM-owned equipment used by AECOM staff for the purpose of preventing unsafe conditions from developing.

1.2 This procedure applies to all AECOM Americas-based staff and operations.

1.3 This procedure does not apply to Personal Protective Equipment.

## 2.0 Terms and Definitions

2.1 **Equipment** – Any machinery, tools, or other devices that serve a function and are used during work for AECOM business.

2.2 **Inspection** – A formal (planned, documented) or informal (ongoing observations/physical checks, not documented) review of the condition and function of the equipment, the purpose of which is to identify any damage or condition that might pose a hazard or impair the proper functioning of the equipment.

2.3 **Maintenance** – Regular care and upkeep of equipment in accordance with manufacturers' instructions, at a minimum, and with AECOM-specified schedules and requirements where applicable.

## 3.0 References

3.1 Q2-312-PR1 Monitoring and Measuring Equipment Procedure

## 4.0 Procedure

4.1 Inspections and maintenance of AECOM-owned or -leased equipment shall be completed and documented by qualified persons. If the applicable equipment is used for testing and measuring and requires calibration, refer to *Q2-312-PR1 Monitoring and Measuring Equipment Procedure*.

4.2 Supervisors and managers will confirm that staff assigned to use equipment are familiar with the specific inspection and maintenance requirements of that equipment.

4.3 Maintenance

4.3.1 All AECOM-owned or -leased equipment shall be maintained in good working order, free of defects or conditions that may pose a risk to employees, the public, or the environment.

4.3.2 All equipment, including large mobile equipment or equipment that has associated high risk exposures (e.g., electrical or radiation) shall have an established, documented, preventative maintenance program. Examples of equipment that will have documented maintenance inspections include:

- Nuclear densometers
- AECOM-leased or -owned vehicles
- AECOM-leased or -owned boats, ATVs, or snowmobiles
- Electrofishers
- Lab equipment

4.3.3 The maintenance program shall:

- Adhere to applicable regulations, standards, and manufacturers' specifications;
- Provide for service by appropriately qualified maintenance personnel; and,
- Require maintenance schedules and records of maintenance.

4.3.4 **District General Managers** and **Office Managers** (Operations) shall determine and inventory the equipment within their operation requiring scheduled maintenance. Using applicable regulations, industry standards, best practices, and manufacturer's recommendations, the operations must develop a maintenance schedule with defined responsibility, required actions, and frequency (*S3NA-205-FM1 Equipment Maintenance Inventory*).

4.3.5 **Employees** who are assigned equipment or tools that require maintenance under this program will review maintenance schedules for that equipment and will confirm that required maintenance has occurred or see that it is undertaken.

4.4 Inspections

4.4.1 **Employees** will inspect all tools and equipment before using them to identify:

- Damage
- Unsafe conditions
- Need for recertification
- Suitability of the tool or equipment for the intended work process

4.5 Repairs and Out of Service

4.5.1 All tools or equipment that an employee deems defective will immediately be repaired by a qualified person, or, if repair is not practicable, tagged "Out of Service" and sent for repairs or discarded.

4.5.2 Defects or other unsafe conditions observed during an AECOM inspection shall be recorded and tracked until the equipment is repaired and ready to return to service (*S3NA-205-FM2 Equipment Inspection Report*).

4.6 Rented or Personal Equipment

4.6.1 Any equipment that is not owned by AECOM (e.g., rental or personal equipment used for AECOM business) shall be inspected by employees prior to use.

4.6.2 Any defects or unsafe conditions shall be reported to the supervisor, rental agency, or owner of the equipment, and the equipment shall be tagged "Out of Service" until the equipment is repaired, the condition is corrected, or alternate equipment is found.

## 5.0 Records

5.1 Completed maintenance inventories (*S3NA-205-FM1 Equipment Maintenance Inventory*) and associated maintenance records will be stored in local office files.

5.2 Completed inspection reports (*S3NA-205-FM2 Equipment Inspection Report*) and associated repair records will be stored in local office files.

## 6.0 Attachments

6.1 S3NA-205-FM1 Equipment Maintenance Inventory

6.2 S3NA-205-FM2 Equipment Inspection Report

Americas

# Equipment Maintenance Inventory

S3NA-205-FM1

| Equipment (*Make, Model, Serial #*) | Equipment Owner | Equipment Status (*On Hire, Active, Decommissioned*) | Frequency of service | Service Type | Manufacturer's Standards | Industry Standards | Legislated Requirements | Location of Equipment |
|---|---|---|---|---|---|---|---|---|
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**Americas**

# Equipment Inspection Report

**S3NA-205-FM2**

| EQUIPMENT | DATE | INSPECTED BY | RESULTS | ACTION REQUIRED | ACTION COMPLETED (DATE) |
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**Americas**

# Fire Protection, Field

**S3NA-206-PR1**

## 1.0 Purpose and Scope

1.1 This procedure establishes the AECOM requirements for the selection, placement, use, and inspection of fire extinguishing and fire detection equipment.

1.2 This procedure applies to all AECOM Americas field work.

## 2.0 Terms and Definitions

2.1 **Combustible liquid** – Liquid that must be heated to a temperature of 100 degrees Fahrenheit (°F) or 37.8 degrees Celsius (°C) to emit sufficient vapors to form an ignitable mixture with the air.

2.2 **Flammable liquid** – Liquid that gives off enough vapors to form an ignitable mixture with air at ambient temperatures (less than 100°F or 37.8°C).

## 3.0 References

3.1 S3NA-004-PR1 Incident Reporting

## 4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 The **Project Manager** shall confirm that fire protection equipment is available at all field sites or in vehicles as required.

4.1.2 The **Project Manager** shall confirm that any fire extinguishing and detection equipment established at AECOM temporary worksites (and vehicles) are appropriately maintained and inspected in accordance with local fire codes.

4.1.3 The **Project Manager** shall confirm that all field staff who may have to use a portable fire extinguisher or other fire protection equipment are adequately trained in their use.

4.1.4 **Employees** shall maintain required training and familiarize themselves with the fire response and protection procedures that apply to the site on which they are working.

4.2 Planning

4.2.1 All field sites (including vehicles) will be equipped with a fire extinguisher and/or fire protection equipment appropriate to the number of staff, location of the work, and job task, as dictated by legislation or client requirements.

4.2.2 Fire protection equipment may include:

- Fire extinguishers, of the appropriate size, class, and type for the hazard; and/or
- Round-nosed shovel, as required

4.2.3 All **employees** shall be constantly on the alert for conditions that might contribute to a fire and shall remove or report the hazard.

4.2.4 All **employees** shall know the location of fire protection equipment in their work area.

4.2.5 Access to fire protection equipment must never be blocked by material, equipment, or vehicles.

4.2.6 A schedule for inspecting fire protection equipment shall be developed to confirm that it is in place, accessible, and fully charged. Inspection and maintenance shall be conducted in accordance with the manufacturer's instructions.

4.3 In the Event of a Fire

4.3.1 Activate the nearest fire alarm or call for help, if available, before attempting to extinguish a fire. If the fire is too big to control with the equipment at hand, retreat.

4.3.2 Never turn your back on a fire. Always back away until you are at a safe distance.

4.3.3 Never use water on an electrical fire.

4.3.4 All fire extinguisher contents shall be applied from upwind and shall be directed at the base or outer edge of the fire with a sweeping motion.

4.3.5 Never return a discharged fire extinguisher to its normal location. Take it out of service for recharging and replace it with a fully charged unit.

4.4 Fire Extinguishers

4.4.1 Vehicles and mobile equipment used for field work may be required to carry fire extinguishers, depending on client and/or industry standards. These fire extinguishers must be secured to the vehicle and never carried loose the cab. It is the responsibility of all field staff to confirm that these fire extinguishers are kept charged, secured, and available in good working condition.

4.4.2 Fire extinguishers shall be readily available wherever the potential for fire exists (e.g., during welding, grinding, or open flame operations).

4.4.3 Fire extinguishers shall be available in locations where flammable or combustible materials are stored, handled, or used.

4.4.4 Fire extinguishers shall be readily accessible, properly maintained, regularly inspected, and promptly refilled immediately after use.

4.4.5 Only trained personnel shall use a fire extinguisher. In the event of a fire, follow the site or project-specific emergency procedures for contacting the local fire department.

4.5 Location and Identification of Fire Extinguishers

4.5.1 Fire extinguishers shall be located and installed as follows:

- Mount fire extinguishers in compliance with local legislation.
- Located where they are readily seen. If an obstruction is unavoidable, then a sign indicating the location of the extinguisher and/or color symbol (e.g., red markings) will be used.
- Fire extinguishers shall always be positioned with the label visible.
- If extinguishers of different classes (e.g., one Class A and one Class B) are stored together, then they shall be marked using stencils or signs clearly indicating the type of fire for which each should be used.
- If an extinguisher contains an electrically conductive agent (e.g., water), it shall be clearly labeled with a sign that states “Not for Electrical Fires” with letters visible from at least 3 feet away.
- Extinguishers shall not be left on the floor, but shall be hung on a wall, column, or other appropriate support or shall be of the wheeled or cart type. Extinguishers of not more than 40 pounds shall be hung so that the top is not more than 5 feet above the floor. Extinguishers greater than 40 pounds shall be hung so that the top is not more than 3-½ feet from the floor. The bottom of the extinguisher shall not be less than 4 inches from the floor.
- Extinguishers shall be suitable for use at temperatures of 40°F to 120°F. The mounting locations shall allow the fire extinguishers to be kept within this temperature range.

4.6 Inspection of Fire Equipment

4.6.1 Inspection, Maintenance, and Testing of Portable Extinguishers

- The use or discharge of any fire extinguisher by an AECOM employee shall be immediately reported to the Supervisor. All use shall be reported in accordance with *S3NA-004-PR1 Incident Reporting.*

- Extinguishers shall be inspected monthly to ensure they are still in the proper location, have not been used or tampered with, are still properly charged, and that they have no obvious external damage. The initials of the inspector and the date of inspection shall be noted on the tag attached to the extinguisher.
- Any extinguisher showing damage shall be replaced.
- A thorough inspection shall be performed annually by personnel specifically trained in the inspection (e.g., extinguisher supplier).
- Extinguishers shall be tested and recharged by qualified contractors as required by the applicable regulations and standards.

4.7 Wildfire Fires

4.7.1 If a crew discovers an uncontrolled, wildfire, they will:

- Notify the appropriate authorities;
- If possible, use the fire protection equipment at their disposal to suppress the fire; or
- Evacuate the area; and
- Immediately notify their project manager and other AECOM personnel in the area.

4.7.2 If a crew is to be working in an area where a known wildfire is burning or a wildfire starts, they will:

- Reschedule work where practicable;
- Monitor the current status of the fire using radios and contact with the local authorities;
- Evacuate the area if an evacuation alert is given; and
- **Immediately notify their project manager and other personnel in the area if the hazard or circumstances change.** If crews must start or monitor a fire for any reason, they will:
  - Obtain the appropriate permits;
  - Monitor any fire bans in the area;
  - Design a containment area; and
  - Take every precaution to keep the fire in control.

4.8 Fire Prevention

4.8.1 During dry weather and wildfire seasons, the below steps to prevent wildfires from starting and spreading will be implemented.

- Defensible Space – A buffer zone or defensible space shall be established, around the work area of at least 50 feet. This defensible space is created by clearing flammable materials away from the work area and buildings.
- Remove flash fuels such as dead grass or vegetation that is down on the ground. (Do not remove live native plants from the natural area open space.)
- Consistently monitor defensible space for maximum fire prevention.
- Smoking – During conditions that present a high risk for fire, smoking will be limited to a fire safe area (smoking pen) established by the Safety Supervisor. The pen will contain a water-filled butt can and fire bucket. At instruction of the Safety Supervisor, smoking may be prohibited during dry weather and wildfire season.
- Hot Work – During conditions that present a high risk for fire, all outdoors field hot work (welding, cutting or use of spark producing tools) will be suspended. If hot work must be performed, it will be done in a fire safe area and only after a hot work permit has been issued by the safety officer. For 60 minutes after the completion of the hot work a fire watch will be maintained.
- Equipment – During dry weather and wildfire season, spark arrestors should be considered for use on mechanical equipment such as generators, chain saws, chop saws, string trimmers and

off road vehicles to prevent sparks form exiting trough the exhaust pipe. Spark arrestors should be in proper working order. Vehicles with under carriage exhaust/catalytic converters shall not be parked in grassy areas.

- Fires of any type are strictly prohibited, at all times.

## 5.0 Records

5.1 Fire extinguisher inspections shall be maintained in the appropriate office safety files.

## 6.0 Attachments

6.1 S3NA-206-WI1 Portable Fire Extinguishers

# Portable Fire Extinguishers



## 1.0 Portable Fire Extinguishers

1.1 Selection Requirements

Portable extinguishers will be selected based on the following classifications:

| Classification | Type of Fire |
|---|---|
| Class A | Combustible materials |
| Class B | Flammable liquid, gas, or grease |
| Class C | Electrical equipment |
| Class D | Combustible metal |

In addition, portable fire extinguisher selection, placement, and fire protection systems designed for use on a project or in an AECOM office will be made in conjunction with an AECOM Safety, Health and Environment (SH&E) representative, the local fire department, or a professional fire protection systems contractor. Unless otherwise approved by an AECOM SH&E representative, fire extinguishers selected for use will be of the Type A, B, and/or C variety, typically charged with water, carbon dioxide, nitrogen, a dry chemical, or other approved extinguishing agent.

1.2 Class A Extinguishers

The number of Class A extinguishers will be based on the following:

| | Light (low) Hazard Occupancy | Ordinary (moderate) Hazard Occupancy | Extra (high) Hazard Occupancy |
|---|---|---|---|
| **Minimum rated single extinguisher** | 2-A | 2-A | 2-A |
| **Maximum floor area per unit of A** | 3,000 square feet | 1,500 square feet | 1,000 square feet |
| **Maximum floor area for extinguisher** | 11,250 square feet | 11,250 square feet | 11,250 square feet |
| **Maximum travel distance to extinguisher** | 75 feet | 75 feet | 75 feet |

The availability of Class A extinguishers can be satisfied with the use of extinguishers with multiple ratings (e.g., Class A, B, and C). In addition, where automatic sprinkler systems are present, the maximum floor area for each extinguisher does not apply; however, the 75-foot travel distance does.

1.3 Class B Extinguishers

Class B extinguishers will be provided according to the severity of the hazard as listed below:

**Fire extinguishers labeled prior to June 1, 1969**

| Type of hazard | Basic minimum extinguisher rating |
|---|---|
| Light | 4B |
| Ordinary | 8B |
| Extra | 12B |

**Fire extinguishers labeled after June 1, 1969**

| Type of hazard | Basic minimum extinguisher rating |
|---|---|
| Light | 5B, 10B |
| Ordinary | 10B, 20B |
| Extra | 20B, 40B |

An open tank in a building having flammable liquids in depth exceeding ¼ inch will be provided with sufficient extinguishers to provide one numerical unit of Class B for each square foot of tank surface area, the minimum extinguisher being a 5B (using labels after June 1, 1969). So, for example, a tank with a surface area of 50 square feet would require two Class 20B (or one 40B) and one Class 10B extinguisher. For tanks exceeding 100 square feet in surface area, a fixed extinguisher will be provided in addition to sufficient portable extinguishers for the numerical unit of Class to equal 100 (e.g., two Class 40B and one Class 20 B).

All Class B extinguishers will be located on the same floor as the hazard, with a travel distance of no more than 50 feet. For widely separated hazards (e.g., boiler rooms, paint storage areas, kitchens), a separate extinguisher for each class of hazard will be provided if the travel distance is more than 25 feet.

1.4 Class C Extinguishers

Class C extinguishers (one 15-pound carbon dioxide or equivalent) will be provided within 25 feet of a high hazard area containing an electrical distribution source such as a generator, transformer, or main switchgear. Also, the extinguisher size and locations will be determined based on the expected type of fire (combustible-Class A, or flammable-Class B) as noted above.

1.5 Class D Extinguishers

A Class D extinguisher for the specific type of combustible metal will be kept within 25 feet of the area where the metal is machined or processed.

# Medical Services and First Aid



## 1.0 Purpose and Scope

1.1 The purpose of AECOM's Medical Services and First Aid Program is to ensure employee accessibility to medical and first aid personnel and supplies commensurate with the hazards of the workplace**.**

1.2 This procedure applies to all AECOM Americas employees and operations, except where legislation is more stringent.

## 2.0 Terms and Definitions

2.1 **Automated External Defibrillator (AED)** – A portable electronic device that automatically diagnoses the potentially life threatening cardiac arrhythmias of ventricular fibrillation and ventricular tachycardia in a patient, and is able to treat them through defibrillation, the application of electrical therapy which stops the arrhythmia, allowing the heart to re-establish an effective rhythm, are used in the resuscitation of a patient in full cardiac arrest.

2.2 **Cardiopulmonary Resuscitation (CPR) –** An emergency procedure in which the heart and lungs are made to work by manually compressing the chest overlying the heart and forcing air into the lungs. CPR is used to maintain circulation when the heart stops pumping, usually because of disease, drugs, or trauma.

2.3 **First Aid Provider –** Is a trained, volunteer, AECOM employee who provides emergency first aid or treatment to someone who is injured or suddenly ill, before emergency medical personnel arrives. A first aid provider responding to an injury or illness is protected as a "Good Samaritan". They may use a limited amount of equipment to perform initial assessment and provide immediate life support and care while awaiting arrival of emergency medical services.

2.4 **High Risk Task(s) –** For the purpose of this procedure, a work related task with the potential to cause traumatic injury/illness or immediate life threatening conditions.

2.5 **Occupational Exposure –** Reasonably anticipated skin, eye mucous membrane, or parenteral contact with blood or other potentially infectious materials that may result from the performance of an employee's duties. Employees will be considered to be potentially exposed, even though they are using the precautions specified for the project.

## 3.0 References

3.1 Title 29, Code of Federal Regulations, Sections 1910.151, 1910.266(i)(7), 1910.1030(g)(2) and 1926.50

3.2 S3NA-003-PR1 Training

3.3 S3NA-004-PR1 Incident Reporting

3.4 S3NA-208-PR1 Personal Protective Equipment Program

3.5 S3NA-503-PR1 Blood Borne Pathogen Program

3.6 CANADA OCCUPATIONAL HEALTH AND SAFETY REGULATIONS SOR/86-304

## 4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Region SH&E Manager**

- Supporting the assessment of office and field employees in the need for first aid, CPR and/or AED training and making training available to required employees.
- Assisting Office and Project Managers with the assessment of each office or project site for adequate response time and availability of Emergency Medical Services (EMS).
- Coordinating first aid/adult cardiopulmonary resuscitation (CPR) and automated external defibrillator (AED) training with the local Office Manager (Operations).

4.1.2 **Office Managers (Operations) or Project Managers**

- Coordinating monthly inspections of first aid kits and AEDs.
- Coordinating replacement supplies to re-stock first aid kits and AEDs.

4.1.3 **Site Supervisor or Site Safety Officers (SSO)**

- Coordinating weekly inspections of first aid kits and AEDs.
- Coordinating replacement supplies to re-stock first aid kits and AEDs.

4.1.4 **Employees**

- Notifying supervisors of any injuries.
- Completing entries into first aid kit log or inventory list for items used.
- Reporting all work related injuries in accordance with *S3NA-004-PR1 Incident Reporting*.

4.2 Requirements

4.2.1 An assessment shall be made by the **Office** or **Project Manager** for each office or project site, to determine if Emergency Medical Services (EMS) will likely be available within the minimum response times required by legislation.

4.2.2 In the absence of an infirmary, clinic, hospital, or physician, that is reasonably accessible in terms of time and distance to the office or worksite, the responsible **Office** or **Project Manager** shall assure an adequate number of trained First Aid Providers and first aid supplies available during hours of normal operation or while performing field site work.

4.2.3 Minimum Response Times

- High Risk Tasks: In workplaces locations (office or field) where “High Risk Tasks” are performed, emergency medical services must be available within 4 minutes if there is no employee on the site who is trained to render first aid.
- Remote Potential for Serious Injury: Somewhat longer response time of up to 15 minutes may be reasonable in workplaces, such as offices, where the possibility of such serious work-related injuries is remote.

4.2.4 The number of First Aid Providers, the type and quantity of first aid supplies, and additional requirements such as blankets will vary depending upon the number of workers, location of the office or project site, associated site hazards and legislation. As a minimum AECOM requires at least one First Aid Provider for every 50 employees. **Office** or **Project Managers** are responsible for determining these requirements with the assistance of the **Region SH&E Manager**.

4.2.5 All on-site personnel must be aware of the First Aid Room, First Aid Provider’s location and contact information.

4.3 First Aid Rooms

4.3.1 Where required by the applicable federal, provincial, or territorial legislation, every first aid room will:

- Be located in an area that is easily accessible to workers at all times;
- Be clearly identified as a first aid room;
- Be used exclusively for the purposes of administering first aid and medical examinations and to provide rest for persons who are ill or injured;
- Have adequate lighting, ventilation, and heating and be covered by a floor made of non-porous material;
- Be of an adequate size to accommodate all supplies;
- Be equipped with
- An appropriately sized First Aid Kit;
- Instructions on how ad where to access a first aider,
- A communication system capable of communicating with the medical facility to which an injured worker would be transported,
- A permanently installed sink with hot and cold potable running water,
- A cot or bed with a moisture-protected mattress and two pillows;
- A stretcher.
- During working hours, be supervised by a first aid provider, who is readily available to provide first aid; and
- Be kept clean and sanitary.

4.4 First Aid Supplies

4.4.1 It is required that all AECOM project or field sites maintain an adequate amount of first aid supplies in an easily accessible location. All field sites (including vehicles) must be equipped with a complete first aid kit appropriate to the number of staff, location of work, and site hazards, as dictated by the applicable legislation and regulation.

4.4.2 A log or inventory list to track usage and a monthly inspection form should be included with each first aid kit.

4.4.3 The **Site Supervisor** or **Site Safety Officer** identified on each individual project site will be responsible for the monthly inspection of field based kits for their assigned projects, including all vehicles.

4.4.4 Staff working away from the primary work site of a first aid kit shall carry a personal first aid kit.

4.4.5 The first aid equipment and supplies must be maintained in a clean, dry and serviceable condition, contained in a material that protects the contents from the environment, and clearly identified as first aid equipment and supplies, refer to *S3NA-208-PR1 Personal Protective Equipment Program*.

4.5 Training

4.5.1 First Aid Provider(s) shall possess a valid certificate in First Aid, CPR, and AED training from the U.S. Bureau of Mines, the Red Cross, or equivalent, that can be verified by documentary evidence.

4.5.2 First Aid, CPR, and AED training will be renewed 30 days before expiration, refer to *S3NA-003-PR1 Training.* Specific training may also be considered for such topics including wilderness survival and rescue for employees performing work in remote locations where access by EMT is limited by extreme terrain.

4.5.3 If there is potential for occupational exposure to blood borne pathogens, all requirements of *S3NA-503-PR1 Blood Borne Pathogen Program* will be followed.

4.6 Providing Assistance to Injured Employees

4.6.1 In the case of an emergency, the First Aid Provider may provide injured workers with a level of care within the scope of the their training, objectively record observed or reported signs and symptoms of injuries and exposures to contaminants, and refer workers with injuries considered to be serious or beyond the scope of the provider's training to medical personnel. In Canada, complete the *S3NA-207-FM1 First Aid Treatment Record (Canada)* record.

## 5.0 Records

5.1 Records associated with treatment will be filed.

## 6.0 Attachments

6.1 S3NA-207-FM1 First Aid Treatment Record (Canada)

Americas

# First Aid Treatment Record

S3NA-207-FM1

## First Aid Treatment Record

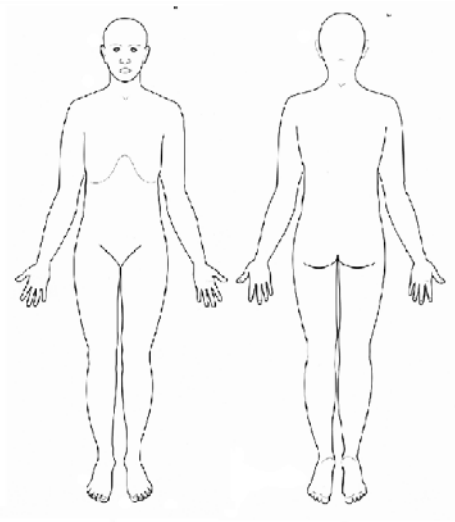
Use this form to record ANY First Aid treatment that was provided for an AECOM employee or by an AECOM First Aid Provider. This Record is confidential and shall be submitted to Shared Services for record keeping.

AECOM

| DETAILS OF PERSON RECEIVING TREATMENT | |
|---|---|
| INJURED EMPLOYEE NAME: | INJURED EMPLOYEE NUMBER: |
| HOME OFFICE: | SUPERVISOR: |
| PROJECT NAME & NUMBER: ☐ N/A | LOCATION: |
| DATE OF TREATMENT : | TIME OF TREATMENT: |
| **DETAILS OF INJURY / ILLNESS** | |
| DATE OF INJURY (IF KNOWN) : | TIME OF INJURY (IF KNOWN): |
| WITNESS(ES) TO INJURY: ☐ YES – NAME:<br>☐ NO | HISTORY OF INJURY / ILLNESS: |
| ALLERGIES: | MEDICATION: |

**DESCRIPTION OF INJURY / ILLNESS:**

- ☐ Cut / laceration
- ☐ Crush Injury
- ☐ Strain / sprain
- ☐ Loss of consciousness / fainting
- ☐ Burn / scald
- ☐ Foreign object (e.g. splinter, object in eye)
- ☐ Contusion / bruise
- ☐ Exposure to (please specify) :_____
- ☐ Other (please specify) :_____



**OBSERVATIONS:**

# First Aid Treatment Record

Use this form to record ANY First Aid treatment that was provided for an AECOM employee or by an AECOM First Aid Provider. This Record is confidential and shall be submitted to Shared Services for record keeping.

**DESCRIPTION OF TREATMENT PROVIDED:**

**REFERRED CASE TO (E.G. HOSPITAL, CLINIC ETC.):**

**WORKCARE ASSISTANCE SOUGHT?:** ☐ **YES – CASE NUMBER:**

☐ **NO**

**FIRST AID PROVIDER DETAILS**

| **FIRST AID PROVIDER NAME:** | **FIRST AID PROVIDER EMPLOYEE NUMBER:** |
|---|---|

**FORM SUBMISSION:**

| **SUBMITTED TO SHARED SERVICES:** ☐ **YES** ☐ **NO** | **SH&E MANAGEMENT ONLY:** **ATTACHED TO INCIDENT FILE?** ☐ **YES** ☐ **NO** ☐ **N/A** |
|---|---|

**Americas**

# Personal Protective Equipment Program

**S3NA-208-PR1**

## 1.0 Purpose and Scope

1.1 Provide an effective Personal Protective Equipment (PPE) Program to protect AECOM employees from potential workplace safety and health hazards.

1.2 This procedure applies to all AECOM Americas-based employees and operations.

1.3 The proper use of appropriate PPE, in combination with effective engineering and administrative controls, can provide AECOM employees with protection against potential workplace hazards and can reduce the potential for workplace injury and illness.

## 2.0 Terms and Definitions

2.1 **PPE** – Personal Protective Equipment

2.2 **CSA** – Canadian Standards Association

2.3 **ANSI** – American National Standards Institute

2.4 **SDSs** – Safety Data Sheets (previously Material SDSs)

## 3.0 References

3.1 Occupational Safety and Health Administration PPE standard (Title 29 of the Code of Federal Regulations 1910.132)

3.2 Canadian Standards Association (CSA)

3.3 Canada Labor Code, Part II

## 4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Region SH&E Manager**

- Provide guidance to **Project Managers, Supervisors**, and field staff on the assessment of hazards and the selection of PPE.
- Provide training materials to **Project Managers** and **Supervisors** for **employee** training.

4.1.2 **Project Managers** or **Supervisors**

- Conduct Hazard Assessments to identify hazards present and to specify PPE appropriate for those hazards.
- Determine which staff requires employee-issued PPE.
- Approve the purchase of company-issued PPE.
- Verify that appropriate PPE is utilized by **employees** when required or necessary.

4.1.3 **Employee**

- In accordance with training and instructions, utilize appropriate PPE that has been issued when required or necessary.
- Inspect PPE prior to use to confirm that it is functional, and maintain PPE in a clean and functional condition.
- Follow instructions and manufacturers' guidance on the care, use, and storage of PPE.
- Review all relevant site hazard assessments prior to commencing work.

- Only work with materials for which the SDS have been reviewed.
- Refrain from wearing PPE outside of the work area for which it is required if doing so would constitute a hazard.

4.2 Hazard Assessment for Office Locations

4.2.1 *S3NA-208-FM1 PPE Hazard Analysis* will serve as the certificate of hazard assessment, as defined in local legislation for office activities that require PPE. This checklist will also be used to determine the PPE requirements for nonroutine maintenance tasks that may not be evaluated during the initial hazard assessments.

4.3 Hazard Assessment for Project Site Locations

4.3.1 HAZWOPER Locations

- Each Health and Safety Plan (HASP) that is prepared for waste site investigations/remediation includes a hazard assessment for each proposed field activity. Task-specific PPE requirements are listed in the HASP. Therefore, the HASP will serve as the certificate of hazard assessment for each project that involves off-site work activities that require the use of PPE.

4.3.2 All Other Project Site Locations

- The Task Hazard Analysis will serve as the certificate of hazard assessment for projects that involves off-site work activities that require the use of PPE. The checklist will be reviewed with the entire field team prior to arriving at the site.

4.4 Training

4.4.1 Staff will receive adequate instruction on the correct use, limitations, and assigned maintenance duties for the equipment to be used. The following information, at a minimum, will be covered during PPE training:

- What PPE is required.
- When it is required.
- Why it is required.
- How to properly don, doff, adjust, and wear the PPE described.
- The limitations of the PPE, including its expected useful life.
- How to properly care for, maintain, and dispose of the PPE.

4.4.2 Field staff is responsible for confirming that they have reviewed the operation manual for the PPE before work commences.

4.4.3 All staff will receive an orientation to the hazards on the job site as well as initial Field Safety orientation that outlines appropriate PPE requirements.

4.4.4 **Employees** who have participated in the 40-hour HAZWOPER training course are considered to have met the employee training requirements for the use of basic, non-specialized PPE. The training certificates that are issued as documentation of successful completion of the 40-hour HAZWOPER course will also serve as documentation of training as required by the PPE standard for basic PPE. **Employees** who have not participated in the HAZWOPER training will be provided PPE training specific to their assignment and/or location. The PPE Facts Sheets can serve as the basis for training.

4.5 Determining the Need for PPE

4.5.1 Using the Task Hazard Assessment, Safe Work Plan (SWP) or HASP, the need for the following types of PPE will be evaluated.

4.5.2 PPE will:

- Be selected and used in accordance with recognized standards and provide effective protection.

- Not in itself create a hazard to the wearer.
- Be compatible so that one item of PPE does not make another item ineffective.
- Be maintained in good working order and in a sanitary condition.

4.5.3 Prior to entering any regulated work area, employees shall confirm that they have access to or are equipped with the following ANSI/CSA-approved PPE, appropriate to the site hazards:

- Head Protection
- Eye & Face Protection
- Foot Protection
- Hi-Visibility Vests
- Hearing Protection

4.5.4 After the hazard assessments have been completed, the **Project Manager** will select the appropriate PPE for each job category or task, as necessary. The selected equipment will be indicated on the hazard assessment. PPE will be provided to each **employee** appropriate for the hazards present. All PPE selected and purchased by AECOM will meet or exceed the ANSI standards, CSA standards, or other standards as dictated by provincial, territorial, or state legislation.

4.6 Eye and Face Protection

4.6.1 AECOM **employees** must use appropriate eye and face protection when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acid and caustic liquids, chemical gases or vapors, and injurious light radiation. Eye protection shall provide side protection when there is a hazard from flying objects.

4.7 Head Protection

4.7.1 Protective helmets (hard hats) are required when **employees** are working in areas where there is a potential for falling objects to cause injury to the head. When working near exposed electrical conductors that could contact the head, helmets designed to reduce electrical shock shall be worn.

4.8 Foot Protection

4.8.1 Protective footwear is required when **employees** are working in areas where there is a danger of foot injuries from falling and rolling objects or from objects piercing the sole and where an **employee's** feet are exposed to electrical hazards.

4.9 Hand Protection

4.9.1 Appropriate hand protection is required when **employee's** hands are exposed to hazards such as those from skin absorption of harmful substances, severe cuts and lacerations, severe abrasions, punctures, chemical burns, thermal burns, or harmful temperature extremes.

4.10 Chemically Resistant Clothing

4.10.1 Chemically resistant clothing is required when there is significant potential for the **employee** to come in direct contact with the chemicals he/she is handling. Tasks that involve chemical handling will be evaluated for the potential of splashing or spilling.

4.11 High-Visibility Apparel

4.11.1 High-visibility apparel with reflective banding (CSA/ANSI Class II and III garment) is required for all field activities in close proximity to moving traffic and other modes of transportation (transit, airlines, marine, etc.), in proximity to heavy equipment operations, or whenever otherwise specified in a project SWP or HASP. Color of apparel (orange or lime) may be client/project-specific.

4.11.2 Work conducted at night may require that the minimum level of apparel worn be, at minimum, CSA/ANSI Class III, as required by governing legislation.

4.12 Personal Clothing

4.12.1 **Employees** on a project site shall wear full length trousers and shirts that cover shoulders.

4.12.2 For personal safety on the job site, do not wear

- Loose or unsecured clothing or loose fitting cuffs;
- Greasy or oily clothing, gloves, or boots; or
- Torn or ragged clothing.

4.12.3 Neck chains shall not be worn when working with moving parts or where the risk of entanglement exists. For all other circumstances, they will be worn under clothing so that they do not hang out. Long hair will be tied back or otherwise confined.

4.12.4 Clothing made of synthetic fibres can be readily ignited and melted by electric flash or extreme heat sources. Cotton or wool fabrics are recommended for general use.

4.13 Specialized PPE

4.13.1 In addition to basic PPE, additional specialized PPE may be required to provide appropriate protection to the employee. Refer to applicable legislation and related Standard Operating Procedures for additional information on PPE requirements.

- Fall Protection – Only full-body harnesses with shock-absorbing lanyards will be used for personal fall arrest.
- Respiratory Protection – Respiratory protection shall be selected based on the contaminant and concentration to which the employee will be exposed. Refer to *S3NA-519-PR1 Respiratory Protection Program, the* task- or project-specific hazard assessments and the applicable SDSs for specific requirements.
- Fire Resistant Clothing – Approved fire-resistant outer clothing may be required at work locations with flammable or explosive materials or environments.
- Other Head Protection – Operators and passengers (if permitted) of all-terrain vehicles and snowmobiles will wear approved helmets.
- Chemical Protective Clothing – Approved chemical protection appropriate to the hazard will be worn. Review applicable SDSs for appropriate PPE.
- Protection from Drowning – **Employees** being transported by boat or exposed to any other drowning hazards are required to wear life jackets. Life jackets will have the proper regulatory approval.

4.14 PPE Supplies

4.14.1 Each AECOM office will maintain a supply of safety equipment including hard hats, high visibility vests, safety glasses, gloves, hearing protection and chemically resistant clothing based on the nature of their field activities. The **Office Manager (Operations)** or designee will be responsible for maintaining this inventory. PPE that is required for large field efforts will be ordered by the **Project Manager** or their designee.

4.14.2 At a minimum, operations will review its PPE program annually.

4.15 Obtaining Personalized Safety Gear

4.15.1 PPE for eyes, face, head, and extremities, protective clothing, and respiratory devices shall be provided to **employees** wherever necessary by reason of hazards.

4.15.2 **Employees** are not expected to provide their own general PPE. Certain personalized safety gear such as prescription safety glasses, safety-toed (capped) boots, and cotton coveralls will be ordered and sized specifically for the user.

4.15.3 Most PPE will be provided to the **employee** at no charge, with the exception of the above personalized safety equipment (prescription safety glasses, safety-toed boots, washable coveralls).

A partial cost reimbursement to the **employee** may be made based on company practice or project stipulations.

4.15.4 Prescription Safety Glasses

- Employees who are eligible will be allowed to obtain prescription safety glasses according to the specialized PPPE purchase program in their location.

4.15.5 Safety-Toed Boots/Shoes

- Employees who are eligible will be allowed to obtain safety work boots according to the specialized PPE purchase program in their location.

4.15.6 Reusable Coveralls

- Employees who are eligible will be allowed to obtain reusable coveralls according to the requirements of the project or location they are working at.

## 5.0 Records

5.1 Completed *S3NA-208-FM1 PPE Hazard Analysis* forms will be maintained in local office safety files.

## 6.0 Attachments

6.1 S3NA-208-WI1 PPE Selection

6.2 S3NA-208-WI2 Eye and Face Protection Fact Sheet

6.3 S3NA-208-WI3 Head Protection Fact Sheet

6.4 S3NA-208-WI4 Foot Protection Fact Sheet

6.5 S3NA-208-WI5 Hand Protection Fact Sheet

6.6 S3NA-208-WI6 Protective Clothing Fact Sheet

6.7 S3NA-208-FM1 PPE Hazard Analysis

## 1.0 Lists of Potential Hazards

| | POTENTIAL HAZARDS |
|---|---|
| HEAD | Falling overhead objects |
| | Spark contact |
| | Chemical contamination |
| | Cold/heat |
| | Electrical (>600 volts) |
| | |
| HANDS | Cuts, punctures, abrasions |
| | Burns |
| | Dermatitis |
| | Chemical absorption |
| | Cold |
| | |
| FEET | Falling or rolling objects |
| | Chemical absorption |
| | Dermatitis |
| | Burns |
| | Cold |
| | Slips, trips |
| | |
| FACE | Burns (chemical, spark, UV radiation) |
| | Chemical splashing |
| | Flying particulates |
| | Abrasions, cuts |
| | |
| EYES | Burns (gas, liquid, spark) |
| | Abrasions-flying particulates |
| | Absorption |
| | Retinal/corneal damage (UV/IR radiation) |
| | |
| EARS | Noise |
| | Cold |

| | |
|---|---|
| **BODY PROTECTION** | **Chemical splashing** |
| | **Burns (chemical, UV radiation)** |
| | **Absorption** |
| | **Spark contact** |
| | **Cuts/abrasions/punctures** |
| | **Heat/cold stress** |
| | **Moving vehicles/heavy equipment** |
| | |
| **MISCELLANEOUS** | **Insects (ticks, spiders, mosquitoes, bees/wasps)** |
| | **Animals (dogs, bears, wild boars, raccoons)** |
| | **Reptiles (snakes)** |
| | **Poison plants (poison ivy, poison sumac, poison oak)** |
| | **Biological (fungus, bacteria, fungus, viral)** |

## 2.0 Eye & Face Protection Selection Chart

| | | ASSESSMENT | PROTECTOR TYPE (see Table 3.0) | PROTECTOR | LIMITATIONS | NOT RECOMMENDED |
|---|---|---|---|---|---|---|
| I M P A C T | Chipping, grinding, machining, masonry work, riveting, and sanding. | Flying fragments, objects, large chips, particles, sand, dirt, etc. | B, C, D, E, F, G, H, I, J, K, L, N | Spectacles, goggles, faceshields<br><br>SEE NOTES (1) (3) (5) (6) (10)<br>For severe exposure<br>Add N | Protective devices do not provide unlimited protection.<br><br>SEE NOTE (7) | Protectors that do not provide protection from side exposure.<br>SEE NOTE (10)<br><br>Filter or tinted lenses that restrict light transmittance, unless it is determined that a glare hazard exists. Refer to OPTICAL RADIATION. |
| H E A T | Furnace operation, pouring, casting, hot dipping, gas cutting, and welding. | Hot sparks | B, C, D, E, F, G, H, I, J, K, L, *N<br><br>*N<br><br>N | Faceshields, goggles, spectacles.<br>*For severe exposure, add N<br><br>SEE NOTE (2) (3)<br><br>*Faceshields worn over goggles H, K<br><br>SEE NOTE (2) (3)<br><br>Screen faceshields.<br>Reflective faceshields.<br><br>SEE NOTE (2) (3) | Spectacles, cup and cover type goggles do not provide unlimited facial protection.<br><br>SEE NOTE (2)<br><br>SEE NOTE (3) | Protectors that do not provide protection from side exposure. |
| | | Splash from molten metals | | | | |
| | | High temperature exposure | | | | |
| C H E M I C A L | Acid and chemicals handling, degreasing, plating | Splash | G, H, K<br><br>*N | Goggle, eyecup and cover types.<br><br>*For severe exposure, add N | Ventilation should be adequate but well protected from splash entry | Spectacles, welding helmets, handshields |
| | | Irritating mists | G | Special purpose goggles | SEE NOTE (3) | |
| D U S T | Woodworking, buffing, general dusty conditions. | Nuisance dust | G, H, K | Goggles, eyecup and cover types | Atmospheric conditions and the restricted ventilation of the protector can cause lenses to fog. Frequent cleaning may be required. | |

| | ASSESSMENT | PROTECTOR TYPE | PROTECTOR | LIMITATIONS | NOT RECOMMENDED |
|---|---|---|---|---|---|
| OPTICAL RADIATION | WELDING:<br>Electric Arc | O, P, Q | **TECTORS FILTER LENS PRO-SHADE TECTORS**<br>SEE NOTE (9)<br>10-14 Welding Helmets or Welding Shields | Protection from optical radiation is directly related to filter lens density. SEE NOTE (4). Select the darkest shade that allows adequate task performance. | Protectors that do not provide protection from optical radiation.<br>SEE NOTE (4) |
| | WELDING:<br>Gas<br>CUTTING<br>TORCH BRAZING | J, K, L, M, N, O, P, Q | SEE NOTE (9)<br>4-8 Welding Goggles or Welding Faceshield 3-6<br>3-4 | SEE NOTE (3) | |
| | TORCH SOLDERING | B, C, D, E, F, N | 1.5-3 Spectacles or Welding Faceshield | | |
| | GLARE | A, B | Spectacle<br>SEE NOTE (9) (10) | Shaded or Special Purpose lenses, as suitable.<br>SEE NOTE (8) | |

NOTES

(1) Care shall be taken to recognize the possibility of multiple and simultaneous exposure to a variety of hazards. Adequate protection against the highest level of each of the hazards must be provided.
(2) Operations involving heat may also involve optical radiation. Protection from both hazards shall be provided.
(3) Faceshields shall only be worn over primary eye protection.
(4) Filter lenses shall meet the requirements for shade designations in Table 9-2.
(5) Persons whose vision requires the use of prescription (Rx) lenses shall wear either protective devices fitted with prescription (Rx) lenses or protective devices designated to be worn over regular prescription (Rx) eyewear.
(6) Wearers of contact lenses shall also be required to wear appropriate covering eye and face protection devices in a hazardous environment. It should be recognized that dusty and/or chemical environments may represent an additional hazard to contact lens wearers.
(7) Caution should be exercised in the use of metal frame protection devices in electrical hazard areas.
(8) Refer to Section 6.5, Special Purpose Lenses. (ANSI A87.1-1989)
(9) Welding helmets or handshields shall be used only over primary eye protection.
(10) Non-sideshield spectacles are available for frontal protection only.

## 3.0 Eye and Face Protector Selection Guide

A. SPECTACLE, No sideshield
B. CUP GOGGLE, Direct ventilation
C. CUP GOGGLE, Indirect ventilation
D. SPECTACLE, Headband temple
E. COVER WELDING-BURNING
F. GOGGLES, Indirect Ventilation
G. FACESHIELD
H. WELDING HELMET, Hand held
I. WELDING HELMET, Stationary window
J. WELDING HELMET, Lift front
K. COVER GOGGLE, Direct ventilation
L. SPECTACLE, Half sideshield
M. SPECTACLE, Full sideshield
N. SPECTACLE, Detachable sideshield
O. SPECTACLE, Non-removable lens
P. SPECTACLE, Lift front
Q. COVER GOGGLE, No ventilation
R. COVER GOGGLE, Indirect ventilation

## 4.0 Filter Lenses for Protection Against Radiant Energy

| OPERATIONS | ELECTRODE SIZE 1/32 INCH | ARC CURRENT | MINIMUM PROTECTIVE SHADE |
|---|---|---|---|
| Shielded metal-arc welding | Less than 3<br>More than 3-5<br>More than 5-8<br>More than 8 | Less than 60<br>60-160<br>161-250<br>251-550 | 7<br>8<br>10<br>11 |
| Gas metal arc welding and flux cored arc welding | | Less than 60<br>60-160<br>161-250<br>251-500 | 7<br>10<br>10<br>10 |
| Gas tungsten arc welding | | Less than 50<br>50-150<br>151-500 | 8<br>8<br>10 |
| Air carbon | (Light) | Less than 500 | 10 |
| Air cutting | (Heavy) | 500-1000 | 11 |
| Plasma arc welding | | Less than 20<br>20-100<br>101-400<br>401-800 | 6<br>8<br>10<br>11 |
| Torch brazing | | | 3 |
| Torch soldering | | | 2 |
| Carbon arc welding | | | 14 |
| | | | |
| **OPERATIONS** | **PLATE THICKNESS (INCHES)** | **(MM)** | **MINIMUM* PROTECTIVE SHADE** |
| Gas welding:<br>Light<br>Medium<br>Heavy | <br>Under 1/8<br>1/8 to ½<br>Over 1/2 | <br>Under 3.2<br>3.2 to 12.7<br>Over 12.7 | <br>4<br>5<br>6 |
| Oxygen cutting:<br>Light<br>Medium<br>Heavy | <br>Under 1<br>1 to 6<br>Over 6 | <br>Under 25<br>25 to 150<br>Over 151 | <br>3<br>4<br>5 |

**Americas**

# Eye and Face Protection Fact Sheet

**S3NA-208-WI2**

## 1.0 Introduction

1.1 Personal protective equipment (PPE) is designed to protect employees from health and safety hazards that cannot be removed from the work environment. PPE is designed to protect many parts of the body including eyes, face, head, hands, and feet. This fact sheet has been developed to inform employees about why eye and face protection is needed, when it should be worn, how to wear and adjust it properly, the limits of this type of PPE, and how to properly maintain and clean the eye and face protection issued.

## 2.0 Types of Eye and Face Protection

There are three major types of eye and face protection, including:

2.1 Primary Protectors

2.1.1 Safety glasses – The most widely used form of eye protection is safety glasses. To prevent lateral exposure to impact fragments, safety glasses are often equipped with side shields. Depending on the hazard, side shields can be either a cup-type or flat-folded. The cup-type provides more complete protection.

2.1.2 Safety goggles

- Vented goggles—impact only
- Indirectly vented—chemical splash and impact
- Non-vented—chemical fumes

2.1.3 Glasses offer excellent protection against impact; however, goggles form a tight-fitting seal to the skin around the entire eye and are more appropriate for chemical concerns.

2.2 Secondary Protectors

2.2.1 Faceshield

- Wear faceshields when there is a severe danger from impact or chemical splash. Faceshields are secondary protectors and must be worn over safety glasses or goggles.

2.2.2 Welding Helmet or Faceshield

- When welding, employees must use equipment with filter lenses that has a shade number appropriate for protection against injurious light radiation.

## 3.0 Cleaning and Maintaining Safety Eyewear

3.1 Clean lenses and frames regularly with soap and water. Store in a clean, dry area.

3.2 Replace scratched, pitted, cracked, or broken safety eyewear immediately.

## 4.0 Proper Fit/Adjusting Glasses

4.1 PPE that fits poorly will not afford the necessary protection. When fitting devices for eye protection against dust and chemical splashes, be sure that the devices are sealed to the face. If the temple bars of the glasses are too long, the glasses will have a tendency to fall forward and slide down your nose. Check with your SH&E coordinator if you need glasses with adjustable temple bars. Standard safety glasses are 58 millimeter; however, smaller sizes (54 millimeter) are also available.

**WHEN TO WEAR PROTECTION**

| Hazard | Concern | Glasses | Goggles | Faceshield |
|---|---|---|---|---|
| Impact | Flying fragments from front/sides. | Safety glasses with sideshields. | Vented goggles. | Severe danger from impact. Wear with glasses/goggles. |
| Chemicals | Splash. | | Indirectly vented. | Severe splash. Wear with goggles. |
| Chemicals | Fumes. | | Non-vented. | |
| Injurious Light | | | Welding goggles with appropriate shaded lens. | Welding helmet with appropriate shaded lens. |
| Dust | Dust entering the eye. | Safety glasses with sideshields. | Vented goggles. | |

## 5.0 Prescription Glasses/Contact Lenses

5.1 Prescription eyeglasses must not be substituted for safety eyeglasses. Regular eyeglasses do not offer the same impact resistance of the lens and frame assembly as safety glasses and are not Canadian Standards Association (CSA)/American National Standards Institute (ANSI) approved. Goggles can be worn over eyeglasses. If you wear corrective lenses, contact your SH&E coordinator for information about how to obtain prescription safety glasses.

5.2 Contact lenses are not recommended for any industrial job. Dust caught underneath the lens can cause painful abrasions. Some chemicals can react with your contacts to cause permanent injury.

## 6.0 Guidelines

6.1 Eye Protection – The following standards apply to eye and face protection:

| Association | Standard |
|---|---|
| **ANSI** | Z87.1-2003, Practice for Occupational and Educational Eye and Face Protection<br>Z87.1-1989, Practice for Occupational and Educational Eye and Face Protection |
| **CSA** | Z94.3-02, Eye and Face Protectors<br>Z94.3.1-02, Protective Eyewear: A User's Guide<br>Z94.3-99, Industrial Eye and Face Protectors<br>CAN/CSA-Z94.3-92, Industrial Eye and Face Protectors |

6.1.1 AECOM will offer safety glasses with permanently attached sideshields or directly vented goggles to all employees working in an area or at a process that involves flying particles.

6.1.2 Non-vented and indirectly vented goggles will be worn when employees are handling chemicals.

6.1.3 Faceshields, in combination with glasses or goggles, will be required where a severe splash or impact hazard has been identified.

6.1.4 When welding, employees must use equipment with filter lenses that have a shade number appropriate for protection against injurious light radiation.

6.1.5 **Supervisors** are responsible for ensuring that crews have access to the eye and face protection necessary to ensure their safety. This may include:

- Safety glasses with side shields,
- Safety goggles, or
- Face shield.

6.1.6 CSA/ANSI-approved eye and face protection shall be worn by all employees while engaged in activities where a risk of injury to the eyes or face may exist.

6.1.7 Face shields shall be worn when using grinding, drilling, buffing, or striking tools.

6.1.8 Eye protection shall be worn when handling liquid or powder chemicals and when draining or breaking joints on any pressure vessel, line, or equipment. In some situations, a face shield should be used in conjunction with goggles for additional eye and face protection.

6.1.9 Face shields shall be made available or installed whenever they may be required. Goggles shall be provided, as required.

6.1.10 Hardened glass prescription lenses and sport glasses are not an acceptable substitute for proper, required industrial safety eye protection.

6.1.11 Comfort and fit are very important in the selection of safety eyewear. Lens coatings, venting, or fittings may be needed to prevent fogging or to fit with regular prescription eyeglasses.

6.1.12 Sunglasses shall be worn when glare is a concern. Glare from sun and snow or water should be taken seriously as it can cause reduced vision and fatigue.

6.1.13 A combination of types of PPE may be necessary if more than one type of hazard exists. For example, where the potential hazards are chemical splashes and flying objects, chemical splash goggles used in combination with safety glasses may be required.

6.1.14 When contact lenses are worn (and where a hazard exists), extra precautions are required to reduce the potential for injury. As previously stated, contact lenses are not protective devices. PPE for contact lens wearers includes splash or dust-resistant goggles, and safety glasses. Other workers not wearing contact lenses would wear the same PPE when exposed to the same hazards.

6.1.15 Prescription eyewear may be worn if it is safety eyewear meeting CSA/ANSI standards and appropriate to the hazard or if it is worn behind equipment that meets the above requirements.

6.1.16 Personal eye and face protection is regulated for specific job tasks. For the most up-to-date information and for guidance, application or interpretation of these laws or guidelines, you should contact your local regulatory authority directly.

6.1.17 DO

- Replace pitted, scratched, bent, and poorly fitted PPE (damaged face/eye protection interferes with vision and will not provide the protection it was designed to deliver).
- Wear proper fitting eye protection (close to the face).
- Clean safety glasses daily, more often if needed.
- Store safety glasses in a safe, clean, dry place when not in use.

6.1.18 DON'T

- Modify eye/face protection.
- Use eye/face protection that does not have CSA/ANSI certification (a CSA stamp for safety glasses is usually on the frame inside the temple near the hinges of the glasses).

**Americas**

# Head Protection Fact Sheet

**S3NA-208-WI3**

## 1.0 Introduction

1.1 Personal protective equipment (PPE) is designed to protect **employees** from health and safety hazards that cannot be removed from **the** work environment. PPE is designed to protect many parts of **the** body including eyes, face, head, hands, and feet. AECOM has evaluated each of the job tasks that are performed in the office. The purpose of these evaluations was to assess the hazards associated with a specific task and to determine what type or types of PPE will adequately protect **employees** from those hazards.

1.2 Because there is no potential for injury to the head from falling objects in the office, head protection is not required. However, some nonroutine maintenance tasks or construction activities may require such equipment. The need for this type of PPE while performing such nonroutine tasks will be evaluated by your project manager.

## 2.0 Types of Head Protection

2.1 The main type of head protector is the helmet. Helmets are designed to protect you from impact and penetration caused by objects hitting your head and from limited electrical shock or burns. The shell of the helmet is designed to absorb some of the impact. The suspension, which consists of a headband and strapping, not only holds the helmet in place but is critical for absorbing and distributing impact shock loads. AECOM recommends ratchet style suspension for rapid adjustment during changing site conditions.

## 3.0 Hard Hat Impact Types

3.1 Type I Hard Hats

3.1.1 Type I hard hats are intended to reduce the force of impact resulting for a blow only to the top of the head.

3.2 Type II Hard Hats

3.2.1 Type II hard hats are intended to reduce the force of impact resulting from a blow that may be received off center or to the top of the head. A Type II hard hat typically is lined on the inside with thick, high-density foam.

3.3 Electrical Classes

3.3.1 Class G (General) – Class G hard hats are intended to reduce the danger of contact exposure to low voltage conductors. Test samples are proof-tested at 2,200 volts (phase to ground). However, this voltage is not intended as an indication of the voltage at which the hard hat protects the wearer. Please note: Class G hard hats were formerly known as Class A.

3.3.2 Class E (Electrical) – Class E hard hats are intended to reduce the danger of exposure to high voltage conductors. Test samples are proof-tested at 20,000 volts (phase to ground). However, this voltage is not intended as an indication of the voltage at which the helmet protects the wearer. Please note: Class E hard hats were formerly known as Class B.

3.3.3 Class C (Conductive) – Class C hard hats are not intended to provide protection against contact with electrical conductors.

## 4.0 Proper Fit/Maintenance

4.1 The suspension of the hard hat must be adjusted to fit the wearer and to keep the shell a minimum distance of 1-1.5 inches (3 centimetres) above the wearer's head. Periodically inspect the suspension of your hard hat. Look for loose or torn cradle straps, loose rivets, broken sewing lines, or other defects. Replace the hat after a major impact.

## 5.0 Guidelines

5.1 Head Protection – The following standards apply to PPE for the head:

| Association | Standard |
|---|---|
| **American National Standard (ANSI)** | Z89.1-2003, American National Standard for Industrial Head Protection<br>Z89.1-1997, American National Standard for Industrial Head Protection |
| **Canadian Standards Association (CSA)** | CAN/CSA-Z94.1-92 (R1998), Industrial Protective Headwear<br>CSA Standard Z94.1-05, Industrial Protective Headwear - Performance, Selection, Care and Use |

5.1.1 On all construction projects and in the event that an overhead hazard exists, a four-point suspension Type II, Class G or E hard hat will be provided to affected employees.

5.1.2 Supervisors and staff are responsible for confirming that crews have the head protection necessary for their safety. This may include, as required by the specific job task:

- Hard hat, or
- Helmet

5.1.3 CSA/ANSI-approved industrial protective headwear that is appropriate to the hazards and meets applicable legislative requirements shall be worn by all personnel while engaged in construction, operation, maintenance, or other activities where there exists a foreseeable danger of injury to a worker's head at a work site and/or a significant possibility of lateral impact to the head.

5.1.4 Visitors to areas where the above activities are being conducted shall comply with the hard hat requirement.

5.1.5 Helmets, hard hats, and hard hat accessories (as required) shall be provided by AECOM.

5.1.6 Proper care is required for headgear to perform efficiently. The service life is affected by many factors including temperature, chemicals, sunlight, and ultraviolet radiation (welding). The usual maintenance for headgear is simply washing with a mild detergent and rinsing thoroughly.

5.1.7 DO

- Replace headgear that is pitted, holed, cracked, or brittle.
- Replace headgear that has been subjected to a blow even though damage cannot be seen.
- Remove from service any headgear if its serviceability is in doubt.
- Replace headgear and components according to manufacturers' instructions.
- Consult the Safety, Health and Environment team or your supplier for information on headgear.

5.1.8 DON'T

- Drill, remove peaks, or alter the shell or suspension in any way.
- Use solvents or paints on the shells.
- Put chin straps over the brims of Class B headgear.
- Use any liner that contains metal or conductive material.
- Apply any unnaproved stickers to the hard hat.
- Carry anything in the hard hat while wearing the hard hat.

**Americas**

# Foot Protection Fact Sheet

**S3NA-208-WI4**

## 1.0 Introduction

1.1 Personal protective equipment (PPE) is designed to protect employees from health and safety hazards that cannot be removed from the work environment. PPE is designed to protect many parts of the body including the feet.

Foot injuries are most likely to occur:

- When heavy or sharp objects fall on your foot.
- When something rolls over your foot.
- When you step on an object that pierces the sole of your boot.
- When there is improper ankle support when walking on uneven surfaces.

## 2.0 Types of Foot Protection

2.1 Safety boots must meet the regulated standard. Safety boots are made with a steel-reinforced box toe to protect your foot from being pierced or crushed by a falling object. Safety boots with flexible steel insoles provide puncture resistance. They will stop or deflect nails or other objects that have penetrated the sole of the boot. Oil-resistant soles provide the added safety feature of preventing slips and trips on slippery work floors. Safety boots with tall upppers provide ankle support only when laced and tied appropriately.

## 3.0 Proper Fit

3.1 With most PPE, the more comfortable it is to use, the more likely you will be to use it. The fit of the safety boot is of the utmost importance. You must try on safety boots before purchasing them. When selecting boots, be sure that they are Canadian Standards Association (CSA)/American National Standard (ANSI) approved. Consult with your supervisor about how to obtain safety boots.

## 4.0 Guidelines

4.1 Foot Protection – The following standards apply to foot protection equipment:

| Association | Standard |
|---|---|
| **ANSI** | Z41-1991, American National Standard for Personal Protection - Protective Footwear |
| **CSA** | Z195-02, Protective Footwear<br>Z195.1-02, Guideline on Selection, Care, and Use of Protective Footwear<br>Z195-M92 (R2000), Protective Footwear |

4.1.1 Safety work boots shall have leather or rubber uppers, an oil-resistant sole, and a distinctive heel. When required by the regulations or the client, AECOM will provide affected employees with safety-toed boots that meet the requirements of the applicable ANSI or CSA standard.

4.1.2 **Supervisors** are responsible for confirming that employees have foot protection necessary to ensure their safety. This may include the following types as required by the specific job task:

- Steel-toed boots;
- Caulk boots;
- Chemical-resistant boot covers;
- Non-slip wading boots; or

- Rubber boots.

4.1.3 CSA/ANSI-approved safety-toed boots shall be worn by all **employees** while engaged in construction, operation, maintenance, or other activities where a risk of injury to the feet may exist.

4.1.4 The purchase of normal footwear for work is the responsibility of the **employee**.

4.1.5 **Employees** are responsible for confirming that the PPE they are provided with is in good working condition before work commences.

4.1.6 DO

- Choose a high-cut boot to provide ankle support.
- Choose footwear according to job hazard and CSA/ANSI standards.
- Lace up boot and tie laces securely. Boots do not protect if they are a tripping hazard or fall off.

4.1.7 DON'T

- Wear defective safety footwear (e.g., exposed steel-toe caps).
- Underprotect your feet or modify safety footwear.

**Americas**

# Hand Protection Fact Sheet

**S3NA-208-WI5**

## 1.0 Introduction

1.1 Personal protective equipment (PPE) is designed to protect employees from health and safety hazards that cannot be removed from the work environment. PPE is designed to protect many parts of the body including eyes, face, head, hands, and feet. This fact sheet will inform employees about why and when hand protection is needed, the limits of gloves, and how to properly clean and dispose of gloves.

1.2 Gloves most commonly used in the construction industry are made from:

- Leather,
- Cotton,
- Rubber,
- Synthetic rubbers and other manmade materials, or
- Combinations of materials.

## 2.0 Types of Hand Protection

2.1 Hand protection is required when there is a potential for:

- Skin absorption of harmful substances,
- Severe cuts or lacerations, abrasions, or punctures,
- Vibration, or
- Temperature extremes.

2.2 Gloves are the most common protectors for the hands. Unfortunately, no one type of glove provides adequate protection against all potential hand hazards. Leather gloves provide good protection from cuts and lacerations but offer no protection against chemicals. Nitrile or neoprene rubber gloves offers good resistance to certain chemicals but they tear and rip easily when sharp objects are handled. The chemically resistant gloves used by AECOM shall be selected based on the manufacturer's chemical compatibility data, which indicates how each glove material performed in breakthrough time tests against certain chemicals. Do not substitute another type of glove for the chemically resistant gloves that have been selected. They may not offer adequate protection for the chemicals you handle.

## 3.0 Proper Fit/Cleaning Disposal

3.1 Gloves will deteriorate over time depending on the types and amount of chemicals with which they come into contact. Remove excessive chemical residue that builds up on the glove. Replace cracked, ripped, or torn gloves or when breakthrough occurs. Breakthrough is the time between initial contact of the chemical on the glove surface and the detection of the chemical on the inside of the glove. Tight-fitting gloves can cause fatigue while loose-fitting gloves can be hazardous. Measure the circumference of your hand around the palm area. This measurement, in inches, is closest to your actual glove size. For example, 7" is equal to a size 7 glove. Always select the right size glove. Dispose of chemically resistant gloves in accordance with the established protocols at the site or office. The product Safety Data Sheet (SDS) will need to be consulted if the glove is contaminated from chemical handling.

## 4.0 Guidelines

4.1 Hand Protection – Use performance characteristics as listed by the Manufacturer.

4.1.1 Leather or Kevlar gloves should be used as appropriate to prevent cuts, lacerations, abrasions, and punctures. Chemically resistant gloves such as neoprene or nitrile rubber will be issued to employees who are likely to come into direct contact with chemicals. When selecting chemically resistant gloves, AECOM will review the manufacturer's data tables regarding degradation of the glove material when exposed to the chemicals of concern, penetration of the chemicals of concern through imperfections in the gloves, and permeation (breakthrough times) of the chemicals of concern through the glove material.

- PPE must be provided to protect a worker's skin from harmful substances that may injure the skin on contact or may adversely affect a worker's health if it is absorbed through the skin.
- Employees shall wear appropriate gloves or mitts to protect their hands from workplace hazards, including hazardous material, heat, cold, abrasion, and sharp edges.
- Vinyl coated or leather gloves are good for providing protection while handling wood or metal objects.
- Inspect and maintain hand PPE regularly. If in doubt about the selection or need for glove or hand PPE, consult your safety supplier, Material SDSs, or local Safety, Health and Environment office.

4.1.2 DO

- Inspect hand PPE for defects before use.
- Wash all chemicals and fluids off gloves before removing hand PPE.
- Use gloves that fit properly.
- Use the proper hand PPE for the job.
- Follow manufacturer's instructions on the care and use of the hand PPE you are using.
- Cover exposed skin (no gap between the sleeve and the hand).

4.1.3 DON'T

- Wear gloves when working with moving machinery (gloves can get tangled or caught).
- Wear hand PPE with metal parts near electrical equipment.

**Americas**

# Protective Clothing Fact Sheet

**S3NA-208-WI6**

## 1.0 Introduction

1.1 Some projects require job tasks where there is a recognized hazard of injury to a person if protection is not provided to the legs or body of the individual. These hazards are effectively mitigated through the use of proper personal protection equipment (PPE).

1.2 Employees will dress appropriately for the climate & weather (cold, heat, wet, dry).

1.3 Supervisors are responsible for confirming that crews have the limb and body protection necessary to ensure their safety. This may include, as required by the specific job task:

- Leg chaps;
- Gloves (leather, cotton, latex, chemical-resistant, etc.);
- Fire-retardant overalls;
- High visibility vests;
- Retro-reflective strips; and/or
- Chemically resistant suits or overalls.

## 2.0 Chemically Resistant Clothing

2.1 Whenever there is a potential for chemical splashing, chemically resistant, disposable clothing, such as a coated-Tyvek coverall or apron, will be worn. Examples of when such clothing may be required include:

- Cleaning of small spills.
- Washing and rinsing of the printing presses.
- Non-routine tasks involving the use of chemicals.
- The transfer of large quantities of chemicals from large containers to smaller ones.

The process for selecting chemically resistant clothing will be similar to that described for the selection of chemically resistant gloves. The need for chemically resistant clothing will be determined by your Project Manager. The **Project Manager** will issue the required clothing to you.

## 3.0 Types of Chemically Resistant Clothing

Like gloves, the objective of whole body protection is to separate the person from a contaminating or hazardous material. Disposable garments, such as Tyvek coveralls or aprons, provide this type of barrier. Uncoated Tyvek coveralls are made of a porous fabric and are designed to prevent contact with particulates. Coated Tyvek coveralls provide a nonporous barrier to protect the worker from chemical splash and vapors. Protective aprons are made from nitrile or neoprene rubber like that used to make chemically resistant gloves.

## 4.0 Proper Fit/Cleaning/Disposal

Before donning a protective coverall, inspect it for rips or tears. Promptly remove any protective clothing that becomes ripped or torn during a particular task. Be sure the garment fits properly. The garment-to-glove seam will be taped when there is a potential for liquids to directly contact the skin if the arm of the suit shifts upward.

Single-use garments, such as Tyvek coveralls, will be disposed of in accordance with the environmental protocols at the site. Some clothing, such as rubber aprons, is meant for repeated use. Wipe down the apron using soap and water to remove any remaining liquids or residues.

## 5.0 Guidelines

5.1 "High visibility safety apparel" means personal protective safety clothing that is intended to provide conspicuity during both daytime and nighttime usage and that meets the Performance Class II or III requirements of the American National Standards Institute (ANSI) and Canadian Standards Association (CSA) standards.

5.2 The following standards apply to visibility protection:

| Association | Standard |
|---|---|
| **CSA** | CAN/CSA-Z96-02, High-Visibility Safety Apparel |
| **ANSI** | ANSI/ISEA 107 - High-Visibility Safety Apparel |

5.3 If there is a specific need to be visible to the passing public, to machine operators, or to other crew members, high visibility vests shall be worn (and retro-reflective striping on arms and legs at night).

5.4 Chemically Resistant Protective Clothing – use performance characteristics as listed by the Manufacturer

5.4.1 Whenever there is a potential for chemical splashing, disposable, chemically resistant clothing, such as a coated Tyvek coverall or apron will be worn. Examples of when such clothing may be required include the cleaning of small spills, nonroutine tasks involving the use of chemicals, and the transfer of large quantities of chemicals from large containers to smaller ones. The process for selecting chemically resistant clothing will be similar to that described for the selection of chemically resistant gloves.

5.5 All employees shall wear suitable clothing for the existing conditions and the work being performed.If there is a danger that a worker's hand, arm, leg, or torso may be injured, an employer ensure that the worker wears properly fitting hand, arm, leg, or body protective equipment that is appropriate to the work, the work site, and the hazards identified.

5.6 In the presence of a flash fire or electrical equipment flashover hazard, staff must wear flame resistant outerwear (overalls) and use other protective equipment appropriate to the hazard.

5.7 Where there is a risk of drowning, a personal flotation device or lifejacket must be worn, as per the applicable regulations.

5.8 Electrically rated rubber gloves and rubber boots must be worn when working around electricity (waders must also be worn for electro fishing where there is an electric current passing through the water).

5.9 When wearing flame resistant outerwear (coveralls), staff must not wear against their skin clothing that is made of a fabric or material that will melt when exposed to heat (e.g., fleece).

**Americas**

# PPE Hazard Analysis

**S3NA-208-FM1**

*This form will be used for office activities that require PPE. It will also be used to determine the PPE requirements for non-routine maintenance tasks that may not be evaluated during the initial hazard assessments.*

**1.** **Job Title(s):** This hazard analysis describes the tasks and required personal protective equipment (PPE) for the following job titles:

**2.** **Description of Tasks:** The tasks performed by personnel in the above job titles include:

3. **Potential Hazards and PPE Selection** (see *S3NA-208-WI1 PPE Selection Guidelines* for assistance).

| TASK | POTENTIAL HAZARDS (1) | PPE SELECTION |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

The signature of the certifying manager below verifies that the tasks are accurately described:

Signature _____ Date _____

Print _____ Date _____

**Americas**

# Project Safety Meetings

**S3NA-210-PR1**

## 1.0 Purpose and Scope

1.1 Establishes the requirements for conducting and documenting meetings on topics that are designed to promote Safety, Health and Environmental (SH&E) awareness and facilitate discussion regarding hazards and risks.

1.2 This procedure applies to all AECOM Americas-based employees and operations in the performance of services directed and controlled by AECOM.

## 2.0 Terms and Definitions

2.1 None

## 3.0 References

3.1 Q2-251-PR1 Project Meeting Procedure

3.2 Q2-381-PR1 Construction Phase Services Procedure

3.3 S3NA-003-PR1 SH&E Training

3.4 S3NA-004-PR1 Incident Reporting Procedure

3.5 S3NA-209-PR1 Project Hazard Assessment and Planning

## 4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Project Managers** shall ensure that all employees and personnel under the control of AECOM, e.g. subcontractors, temporary agency employees, etc., assigned to projects within their areas of responsibility participate in project initiation/kick-off meetings, special situation meetings, task hazard analyses, on-site safety inspections, and supplemental training meetings.

4.1.2 **District SH&E Manager** shall provide assistance to Project Managers as required to carry out the requirements of this procedure, particularly in the area of making training materials available and providing spot- checks of proper documentation.

4.1.3 **Site Supervisor or Site Safety Officer** shall assist the Project Manager in running safety meetings, training or site inspections.

4.2 Construction Phase Initiation/Kick-off meeting for field operations

4.2.1 A construction phase initiation/kick-off safety meeting will be conducted prior to the start of field operations; refer to *Q2-381-PR1 Construction Phase Services Procedure* and *Q2-251-PR1 Project Meeting Procedure.* Discussion points for this meeting will come from the project-specific SH&E documentation (e.g., Health and Safety Plan [HASP], Safe Work Plan [SWP], Task Hazard Analysis [THA], etc.). The meeting will involve representatives from all organizations with a direct contractual relationship with AECOM on the project site. Topics for this meeting will include:

- Communication to all participants regarding on-site SH&E responsibilities and authority.
- Establishing safety points of contact for each organization and phase of work.
- Communication of organizational SH&E performance expectations.
- Identification of significant project SH&E issues, risks, and solutions.
- Coordination of organizational SH&E conflicts and interactions.

4.3 Meetings

4.3.1 Change in Scope/Activity – Conducted for all AECOM staff and site personnel with a direct contractual relationship with AECOM to discuss changes to scope or a new phase of work.

4.3.2 Periodic – Conducted at a regular, recurring frequency of not less than biweekly, but preferably once per week.

4.3.3 Daily – Daily safety discussions as part of daily routine project coordination meetings. Daily meetings are required for HAZWOPER activities and other activities as identified in the safety plan. Daily safety discussions will involve representatives from all organizations with a direct contractual relationship with AECOM on the job site.

4.3.4 Significant Personnel Turn-over – Conducted at the start of any workday where a new organization begins work on site or when more than 25 percent of the day's work force is new to the site.

4.3.5 Post-Incident – Conducted at the start of the work day following the occurrence of a serious incident as defined in *S3NA-004-PR1 Incident Reporting*. All project initiation/kick-off safety meetings will be documented using the *S3NA-210-FM1 Tailgate Safety Meeting Log*.

4.3.6 All special situation safety meetings listed above will include review of applicable THAs for the scope of services to be performed and be documented using the *S3NA-210-FM1 Tailgate Safety Meeting Log* or equivalent.

4.3.7 Daily safety discussions not otherwise required by HAZWOPER or the project safety plan will be documented.

4.4 Supplemental Training Meetings

4.4.1 The **Project Manager**, **Site Supervisor** or **Site Safety Officer** will implement worker training on general safety topics as part of routine on-site training activities. Where such training is conducted it will be documented on the *S3NA-210-FM1 Tailgate Safety Meeting Log*.

4.5 Safety Orientation

4.5.1 All project employees will attend a project-specific safety orientation and training session prior to the start of any project and/or task.

4.5.2 The **Project Manager**, **Site Supervisor**, or **Site Safety Officer** will conduct the meeting based on project specifics (e.g., location, unique hazards and risks, client requirements, etc.) and any mandatory topics required by *S3NA-003-PR1 SH&E Training*. The **Region SH&E Manager** can provide examples of project safety orientation material for reference.

4.5.3 The depth/level of training will be commensurate with the job function(s) to be performed. Site visitors will receive general orientation and task-specific training.

4.5.4 At a minimum, employee orientation and training will consist of the items listed below:

- Identification of hazards associated with the individual's job function and responsibilities.
- Specific safety procedural instruction needed to perform his or her required job function or task.
- Content of the HASP, SWP and any THA in accordance with *S3NA-209-PR1 Project Hazard Assessment and Planning*.

4.6 Periodic Safety Training Meetings

4.6.1 Safety training meetings will be scheduled and conducted throughout the duration of the project.

4.6.2 Meetings shall give project personnel an opportunity to maintain a high degree of safety awareness through timely and quality safety education. Meeting time will be used to discuss specific safety topics and obtain employee feedback.

4.6.3 Safety meetings will be conducted by the **Project Manager**, **Site Supervisor** or **Site Safety Officer** and supplemented by lead persons of the various crafts represented at the site (e.g., electrician, heavy equipment operator, foreman, inspector, resident engineer, etc.).

4.6.4 Topics for discussion will include SH&E hazards noted during routine and non-routine work situations and an explanation of job safety procedures unique to the project.

4.6.5 The **Project Manager** and **Site Safety Officer** will monitor safety meetings to ensure that subject matter is properly presented.

4.6.6 All periodic safety meetings will be documented using *S3NA-210-FM1 Tailgate Safety Meeting Log*. Sign-in of every meeting participant is required to ensure proper accountability and to meet AECOM project recordkeeping requirements.

4.6.7 SH&E considerations will be discussed at every project meeting. Once on site:

- All on-site personnel must review and acknowledge the form or plan at a “tailgate” or “toolbox” meeting.
- Any new or previously unidentified hazards must be documented on the form or plan as a revision and acknowledged with initials by all on-site staff.
- The HASP, SWP or THA must be reviewed regularly as required and documented on the plan.

## 5.0 Records

5.1 All signed copies of the field forms and project plans must be placed in the appropriate project folder.

## 6.0 Attachments

6.1 S3NA-210-FM1 Tailgate Safety Meeting Log

**Americas**

# Tailgate Safety Meeting Log

**S3NA-210-FM1**

This sign-in log documents the topics of the tailgate safety briefing and individual attendance at the briefing. Personnel who perform work operations on site are required to attend each safety briefing and acknowledge their ability to ask questions and receipt of such briefings daily. Please provide a brief narrative of the following topics as applicable to the Project.

**Name of Meeting Leader** _____ **Signature** _____

**PROJECT NAME & LOCATION**

| **PROJECT NUMBER** | **DATE/TIME** | **WEATHER CONDITIONS** |
|---|---|---|
| | | |

**TOPIC**
***Discussion – check all that apply***

| | | | | | |
|---|---|---|---|---|---|
| Today's Scope of Work (All tasks) | ☐ yes | ☐ n/a | Access / Egress / Slips, Trips, & Falls | ☐ yes | ☐ n/a |
| Schedule / New Work / Scope Changes | ☐ yes | ☐ n/a | Smoking, Eating, & Drinking | ☐ yes | ☐ n/a |
| Reviewed Procedures, Task Hazard Analysis, etc. | ☐ yes | ☐ n/a | Washroom / Facilities Location | ☐ yes | ☐ n/a |
| Emergency Action Plan & Procedures | ☐ yes | ☐ n/a | Heat/Cold Stress | ☐ yes | ☐ n/a |
| Communications Protocol | ☐ yes | ☐ n/a | Exclusion Areas Barricades / Cones | ☐ yes | ☐ n/a |
| Required Personal Protection Equipment | ☐ yes | ☐ n/a | Required Permits, Passes, Keys, etc. | ☐ yes | ☐ n/a |
| Required Monitoring / Instruments | ☐ yes | ☐ n/a | Decontamination Procedures / Investigation-Derived Waste Management | ☐ yes | ☐ n/a |
| Fitness for work / Fatigue | ☐ yes | ☐ n/a | Equipment Inspections/Safety Checklists | ☐ yes | ☐ n/a |
| Site Control / Work Zones / Security | ☐ yes | ☐ n/a | | | |

**COMMENTS / OTHER**

**Tailgate Meeting Attendees**

| **Print Name** | **Signature** |
|---|---|
| | |
| | |
| | |
| | |
| | |
| | |

**SIX QUESTIONS FOR SUCCESS** – As your final preparedness, take two minutes to think through and answer these questions**:**

1. What are we about to do?
2. What equipment are we going to use?
3. Have I/we been trained to use this equipment?
4. Have I/we been trained to do this job?
5. How can I/we be hurt?
6. How can I/we prevent this incident?

*If you and your team aren't prepared to do the assigned work, STOP WORK, and take time to properly prepare.*

**END OF DAY SIGN-OFF:**

_____

Site Safety Officer Signature

☐ No Incidents Occurred

☐ Number of Near Misses/Observations Reported

☐ All Incidents Reported the Incident Reporting Line

**LESSONS LEARNED / COMMENTS / OTHER**

## 1.0 Purpose and Scope

1.1 Provides a process through which AECOM Subcontractors are evaluated to determine if the use of that Subcontractor will pose an unacceptable risk to AECOM and/or its clients, employees, equipment, or property.

1.2 This policy applies to all AECOM North America based operations.

## 2.0 Terms and Definitions

2.1 **Subcontractor:** Any contractor or organization procured to provide direct services for, or in support of, an AECOM managed activity or operation. This is inclusive of any AECOM managed activity or operation that requires the physical presence of that contractor at the location to conduct the contracted service. Examples include, but are not limited to:

- Heavy equipment operations
- Surveying
- Construction/renovation/clean-construction operations
- Demolition
- Well abandonment
- Electrical system installation/service
- HAZWOPER Activities

2.2 **AECOM field site:** A site at which AECOM is providing field-related services.

## 3.0 References

None.

## 4.0 Procedure

4.1 **Subcontractor Selection Requirements**

4.1.1 For all subcontractors, the selection process will include consideration of the candidate firms' SH&E management and performance indicators.

4.1.2 Subcontractor bids/submittals shall include a completed Subcontractor SH&E Evaluation. Each questionnaire will be evaluated during the subcontractor selection process to identify any organizations whose past SH&E performance may disqualify them from selection.

4.1.3 Prior to the start of their on-site operations, the selected subcontractor firms are required to provide copies of any SH&E documentation (e.g., insurance carrier supplied Experience Modification Rates documents, insurance certificates, safety plan, manual of safety procedures, employee training/medical monitoring certifications) to the Project Manager and/or subcontractor selection manager.

4.1.4 Although the questionnaire is to be used as a guideline to determine whether a bidder's safety and health record is acceptable, there are no simple pass/fail criteria. The guidance outlines the standards **AECOM**'s **S**H&E Department has established to reflect performance acceptability. Marginal performance (Score is less than 3) will require evaluation for final approval of a subcontractor by the PM in coordination with the SH&E Department. Priority will be given to subcontractors who have obtained certification standards (e.g., OHSAS 18001; Certificate of Recognition).

4.2 **Procurement Phase.** Prior to starting fieldwork, each subcontractor organization shall provide the AECOM Project Manager (or AECOM representative) with at least one of the following for review and acceptance:

4.2.1 Site-specific SH&E documentation addressing specific performance requirements for the subcontractor's on-site work activities, site safety coordinator's name and responsible persons; or


**PRINTED COPIES ARE UNCONTROLLED. CONTROLLED COPY IS AVAILABLE ON COMPANY INTRANET.**

4.2.2 A written statement of adoption of the provisions in AECOM's project SH&E documentation as the subcontractor's minimum procedures while working on the job site. This documentation must be in letter format (company letterhead), and must include the following information:

- Site location
- Anticipated scope of work activities to be performed and equipment to be used by the subcontractor
- Name of the subcontractor's Site Safety Officer, with contact phone numbers
- Name of the subcontractor's Health and Safety Manager, with contact phone numbers
- In addition to the subcontractor's own SH&E requirements, a statement adopting the AECOM's project SH&E documentation as the subcontractor's minimum requirements for the project
- Statement requiring that only qualified and trained personnel (to the level of assigned responsibilities) will perform assigned work activities on the site
- Designation of required personal protective equipment anticipated for the subcontractor's assigned work activities
- Copies of supplemental or additional subcontractor-specific provisions, policies, procedures and/or protocols that will be implemented by the subcontractor during site activities

4.3 **On-Site Subcontractor SH&E Requirements**

4.3.1 Subcontractor organizations are responsible for safely performing their assigned work activities in accordance with all applicable federal and state/provincial/territorial occupational safety and health regulations, acts, and codes.

4.3.2 Subcontractors are responsible for providing AECOM with a copy of their project-specific SH&E documentation for the subject work. The specification of minimum acceptable on-site SH&E performance should be included.

4.3.3 Subcontractors are responsible for confirming that their employees are provided the appropriate equipment and training to perform the work safely.

4.3.4 All subcontractors must provide input to, and be orientated to, the hazards associated with the site and activities of the project.

4.3.5 All subcontractors must provide proof of safety training as required for the hazards identified, inclusive of any required medical surveillance documentation.

4.3.6 Subcontractors will be provided with a copy of AECOM's project-specific SH&E documentation for the specification of minimum acceptable on-site SH&E performance.

4.3.7 If at any time the subcontractor obtains the services of another subcontractor, consultant, or lower tier subcontractor for any portion of the work to be performed, a copy of the Statement of Work and the approved project-specific SH&E documentation shall be provided as part of the package submitted to each respective subcontractor, consultant, or lower-tier subcontractor. Prior to the start of work, the subcontractor shall submit in writing to the PM, subcontractor selection manager, or their designee the names of any lower-tier subcontractors that may be used in the project that have yet to be approved. The start of work is conditional upon this approval.

4.4 **Roles and Responsibilities**

4.4.1 **Regional Management** is responsible for:

- Providing the resources to implement the subcontractor evaluation process.
- Maintaining all subcontractor SH&E performance data (developing and managing a database recommended).

4.4.2 **Project Managers** are responsible for confirming that all subcontractors have been properly evaluated for SH&E performance and potential risk. This includes:


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- Communicating the requirements established in this procedure to the subcontractor and providing them with the Subcontractor SH&E Evaluation form.
- Reviewing the completed subcontractor evaluation and confirming their potential risk prior to the start of work.
- Providing a completed evaluation to the project file and the administrator or database manager in their region.
- Verifying a subcontractor's minimum level of insurance coverage as stipulated by AECOM's Legal and Procurement Departments (Workers' Compensation, Auto Insurance, General Liability, etc.).

4.4.3 **Regional SH&E Manager** is responsible for:

- Providing support to the project managers in understanding the subcontractor evaluation process and requirements.

## 5.0 Records

5.1 Business Line management will maintain subcontractor evaluations and associated documentation either in the project file, or, preferably, in a centralized database for tracking.

**Americas**

# Hand and Power Tools

**S3NA-305-PR1**

## 1.0 Purpose and Scope

1.1 Provides the AECOM requirements for all manually operated hand and power tools and equipment use, handling and storage.

1.2 This procedure applies to all AECOM Americas-based employees and operations.

## 2.0 Terms and Definitions

2.1 None

## 3.0 References

3.1 S3NA-003-PR1 SH&E Training

3.2 S3NA-205-PR1 Equipment Inspections & Maintenance

3.3 S3NA-208-PR1 Personal Protective Equipment Program

3.4 S3NA-302-PR1 Electrical, General

3.5 S3NA-410-PR1 Hazardous Energy Control

3.6 S3NA-510-PR1 Hearing Conservation Program

## 4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Project Managers/Field Task Managers/Supervisors –** Ensure that all aspects of this procedure are followed and adhered to on all AECOM projects, sites and locations. If a specific tool is not included in the attachments, appropriate guidelines shall be established prior to work associated with that equipment, including following manufacturer's recommendations.

4.1.2 **Region Safety, Health and Environment (SH&E) Manager –** Provide technical guidance and support as to this procedure.

4.1.3 **Employees** – No work with any tool that they are not familiar with without first obtaining training associated with that equipment. In addition, **employees** must following manufacturer's recommendations for its use and must not modify the equipment without first obtaining authorization from the manufacturer.

4.2 Restrictions

4.2.1 No **employee** shall use any hand tool, unless they are familiar with the use and operation of the equipment or have received specific instruction on its use and operation.

4.2.2 All tools will be used in accordance with manufacturer's specifications.

4.3 Training

4.3.1 Instruction in the proper use, safe handling, and maintenance of tools will be provided to employees unfamiliar with the tool. Refer to the attachments section for specifics and oncurrence in the employee's Training Needs Assessment (TNA) per the *S3NA-003-PR1 SH&E Training* procedure.

4.4 Personal Protective Equipment

4.4.1 Lockout devices (padlocks, multiple lock hasps, tags), gloves appropriate to the task, safety-toed boots, as required, hard hats and eye and face protection, as required and in accordance with the *S3NA-208-PR1 Personal Protective Equipment Program*.

4.5 Inspections

4.5.1 All tools must be inspected prior to each use. Any tool that is defective or has missing parts must not be used. Every broken or defective tool must be tagged 'out of service'. Tagged tools will be returned to the supervisor for repair or replacement. Tagged tools will be immediately removed from service.

4.5.2 All tools must be inspected to manufacture's specifications according to tool rests and guard adjustment tolerances. All tools will be inspected to ascertain that all safety devices are present and functioning properly in accordance with the *S3NA-205-PR1 Equipment Inspections & Maintenance* procedure.

## 5.0 Records

5.1 None

## 6.0 Attachments

| | | |
|---|---|---|
| 6.1 | S3NA-305-WI1 | Chainsaw Safety Card |
| 6.2 | S3NA-305-WI2 | Circular Saw Safety Card |
| 6.3 | S3NA-305-WI3 | Cut Off Saw Safety Card |
| 6.4 | S3NA-305-WI4 | Handheld Grinder Safety Card |
| 6.5 | S3NA-305-WI5 | Impact Wrench Safety Card |
| 6.6 | S3NA-305-WI6 | Nail Gun Safety Card |
| 6.7 | S3NA-305-WI7 | Dustless Vacuum Safety Card |
| 6.8 | S3NA-305-WI8 | Power Drill Safety Card |
| 6.9 | S3NA-305-WI9 | Pressure Washer Safety Card |
| 6.10 | S3NA-305-WI10 | Reciprocating Saw Safety Card |
| 6.11 | S3NA-305-WI11 | Sander Safety Card |
| 6.12 | S3NA-305-WI12 | Utility Knife Safety Card |
| 6.13 | S3NA-305-WI13 | Wood Chipper Safety Card |
| 6.14 | S3NA-305-WI14 | Clearing and Grubbing Equipment Safety Card |
| 6.15 | S3NA-305-WI15 | Pneumatic Tools Safety Card |
| 6.16 | S3NA-305-WI16 | Manual Hand Tools Safety Card |
| 6.17 | S3NA-305-WI17 | Small Engines Safety Card |
| 6.18 | S3NA-305-WI18 | Electric and Battery Powered Hand Tools Safety Card |
| 6.19 | S3NA-305-GL1 | Hand and Power Tools Guide |

**Americas**

# Chainsaw Safety Card

**S3NA-305-WI1**

## 1.0 Objective / Overview

1.1 Available in a variety of types and capacities, chainsaws are one of the most powerful, yet dangerous cutting tools available.

1.2 Working safely with a chain saw begins with training.

1.3 Additional safety measures include proper training, good body mechanics and felling technique, well-maintained equipment, and protective clothing.

## 2.0 Safe Operating Guidelines

2.1 A sharp chainsaw is safer than a dull one. Keep the saw clean, lubricated, and adjusted. Before starting work inspect and test the chain brake, chain catch, throttle lock, handles and guards, all nuts and bolts, spark arrestor, and muffler and air filter. The chain tension should be properly adjusted and the carburetor tuned. Never “drop start” the saw.

2.2 A chainsaw is not only dangerous to the operator but also to surrounding persons. Keep the saw close to the body. Bend from the knees, not the waist. Improper lifting techniques and poor posture contribute to injuries.

## 3.0 Potential Hazards

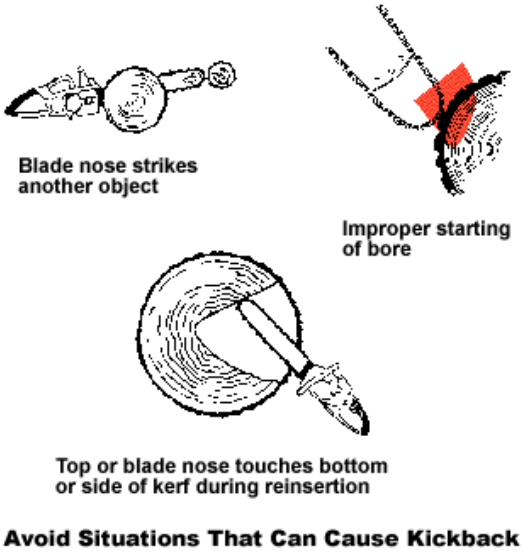
3.1 Kickback – Sudden and violent reverse movement of the saw

3.2 Hand/arm vibration

3.3 Noise

3.4 Flying/falling debris

3.5 Severe cuts




**Avoid Situations That Can Cause Kickback**

## 4.0 Training Requirements

4.1 Review of training requirements per the Training Needs Assessment (TNA).

4.2 Demonstrated knowledge on the use of a chainsaw.

4.3 Review of manufacturers operating guidelines.

## 5.0 Personal Protective Equipment (Level D PPE )

5.1 Debris Shield

5.2 Chainsaw Chaps

5.3 Leather Gloves

5.4 Hearing Protection

## 6.0 Other Safety Tips

6.1 Always avoid standing on the log and making cuts with the saw between your legs; always cut with the saw to the outside of your legs.

6.2 Determine where the tree/limb will fall prior to cutting. Always ensure that personnel and equipment are not in the path of the falling tree/log, and that you have time to move away. If necessary, flag/or fence off the area to prevent entry.

6.3 Always stand to one side of the limb you are to cut, never straddle it.

6.4 Always keep in mind where the chain will go if it breaks; never position yourself or other people in line with the chain.

6.5 Keep the chain out of the dirt, debris will fly, the teeth will be dulled and the chain life shortened.

**Americas**

# Circular Saw Safety Card

**S3NA-305-WI2**

## 1.0 Objective / Overview




1.1 The circular saw is used in cutting wood products (i.e., plywood, construction lumber, etc.).

1.2 Safe measures for use include proper training, good body mechanics and felling technique, well-maintained equipment, and protective equipment. Potential Hazards

1.3 Kickback – Sudden and violent reverse movement of the saw

1.4 Noise

1.5 Flying debris

1.6 Sharp, moving blade (severe cuts)

## 2.0 Safe Operating Guidelines

2.1 Use sharp blades. Dull blades cause binding, stalling and possible kickback.

2.2 Use the correct blade for the application and check for proper operation before each cut.

2.3 Check often to ensure that guards return to their normal position quickly. Never defeat the guard to expose the blade.

2.4 Before starting a circular saw, be sure the power cord and extension cords are out of the blade path and are long enough to freely complete the cut. A sudden jerk or pulling on the cord can cause loss of control of the saw and a serious accident.

2.5 Secure the work being cut to avoid movement.

2.6 For maximum control, hold the saw firmly with both hands after securing the work piece.

2.7 Keep the upper and retracting lower blade guard and the motor free from dust.

2.8 Do not hold or force the retracting lower guard in the open position.

2.9 Do not over tighten the blade-locking nut.




2.10 Do not twist the saw to change, cut or check alignment.

2.11 Do not use a saw that vibrates or appears unsafe in any way.

2.12 Do not force the saw during cutting.

2.13 Do not cut materials without first checking for obstructions or other objects such as nails and screws.

2.14 Check frequently to be sure clamps remain secure.

2.15 Avoid cutting small pieces that can't be properly secured and material on which the saw shoe can't properly rest.

2.16 Do not overreach. Keep proper footing and balance.

2.17 When you start the saw, allow the blade to reach full speed before contacting the work piece.

## 3.0 Training Requirements

3.1 Review of training requirements per the Training Needs Assessment (TNA).

3.2 Demonstrated knowledge on the use of a circular saw.

3.3 Review and follow manufacturer's operating guidelines.

## 4.0 Personal Protective Equipment (Level D PPE )

4.1 Leather Gloves

4.2 Safety glasses

4.3 Hearing Protection

## 5.0 Other Safety Tips

5.1 Circular saws are designed for right-hand operation; left-handed operation will demand more care to operate safely.

5.2 Disconnect power supply before adjusting or changing the blade.

5.3 Do not place hand under or in front of the shoe or guard of the saw when operating.

5.4 Cut at the proper depth (¼ inch/ 0.64 centimeter) below work surface (see picture). Set the depth of the blade prior to use, when the saw is unplugged.

5.5 Circular saw must be double-insulated or protected by a ground fault circuit interrupter.

**Americas**

# Cut off Saw Safety Card

**S3NA-305-WI3**

## 1.0 Objective / Overview

1.1 Cut-off saws are high-speed cutting tools and very dangerous to operate. Therefore, it is very important to review the general safety rules, training, Personal Protective Equipment and procedures for working with portable cut off saws.

1.2 Cut off saws are used in a variety of activities (i.e. concrete, piping, metal, etc.).

## 2.0 Potential Hazards




2.1 Noise

2.2 Flying debris

2.3 Sharp, moving blades (severe cuts)

2.4 Burns from engine

2.5 Fire hazard from sparks and gasoline

2.6 Hand/arm vibration

2.7 Kickback – Sudden and violent reverse movement of the saw

## 3.0 Safe Operating Guidelines

3.1 **Pre-start checks** - Inspect the abrasive wheel for cracks and chips. If cracked or chip replace wheel before use. Ensure guard is positioned properly prior to start-up (*S3NA-411-PR1 Machine Guarding*). Make sure the fuel cap is properly secured.

3.2 **Starting -** Start the saw on firm ground or other solid surface in an open area. Never attempt to drop-start the engine (see picture). Clear the working area. Avoid operating the saw if the terrain is wet and/or frozen.

3.3 **Handling -** Hold the saw firmly with two hands when the engine is running, and whenever the blade is rotating until it comes to a complete stop. Carry the saw with engine stopped, muffler away from your body, while protecting the cutting wheel from striking the ground or other objects.

3.4 **Cutting -** Begin cutting at full throttle and continue at full throttle until the cut is finished. Avoid standing in a direct line with the cutting wheel. Use only downward pressure on the saw, as lateral pressure may cause the blade to break and shatter. Do not change the direction of the cut once started, as this can also cause the blade to break and shatter. Do not use abrasive-type wheels for rough grinding. Do not cut above shoulder height.

3.5 **Maintenance -** Shut off the engine and remove the spark plug wire before adjusting or working on the saw.

## 4.0 Training Requirements

4.1 Review of training requirements per the Training Needs Assessment (TNA).

4.2 Demonstrated knowledge on the use of a cut off saw.

4.3 Review and follow manufacturers operating guidelines.

## 5.0 Personal Protective Equipment (Level D PPE)

5.1 Face shield

5.2 Chainsaw Chaps

5.3 Hearing protection: earplugs and/or earmuffs

5.4 Respirator if required (concrete operations)

## 6.0 Other Safety Tips

6.1 Keep flammable and combustible materials away from saw while cutting metal.

**Americas**

# Handheld Grinder Safety Card

**S3NA-305-WI4**

## 1.0 Objective / Overview



1.1 Handheld grinders are high-speed electric- or pneumatic-powered grinding tools used to shape or cut metal, and can be dangerous to operate.

1.2 Grinders are used in a variety of activities (i.e., piping installation/repair, metal, restoring, polishing, sharpening, etc.).

## 2.0 Potential Hazards





2.1 Kickback – Sudden and violent reverse movement of the grinder

2.2 Flying debris

2.3 Moving parts (severe cuts)

2.4 Fire hazard from sparks igniting nearby debris or objects

2.5 Noise

2.6 Hand/arm vibration

## 3.0 Safe Operating Guidelines

3.1 Basic safety rules can help prevent hazards associated with the use of handheld grinders:

- 3.1.1 Never carry the tool by the cord (or the hose for pneumatic tools).
- 3.1.2 Never yank the cord or the hose to disconnect the tool from the receptacle.
- 3.1.3 Keep cords and hoses away from heat, oil, and sharp edges.
- 3.1.4 Denergize tools when not in use, before servicing, and when changing accessories such as blades/bits/cutters.
- 3.1.5 All observers should be kept at a safe distance from the work area.
- 3.1.6 Always secure work with clamps or a vise, freeing both hands to operate the tool.
- 3.1.7 Avoid accidental starting; do not hold a finger on the trigger/switch while carrying a powered tool.
- 3.1.8 Tools should be maintained with care. They should be kept clean and sharp for the best performance. Follow instructions in the user's manual for lubricating and care instructions.
- 3.1.9 Be sure to keep your footing and maintain proper balance.
- 3.1.10 The proper apparel should be worn. Loose clothing or jewelry can become caught in moving parts.
- 3.1.11 Inspect the tool before every use. Damaged tools must be removed from use and tagged "DO NOT USE".

## 4.0 Training Requirements

4.1 Review of training rquirements per the Trainign Needs Assessment (TNA).

4.2 Demonstrated knowledge on the use of a handheld grinder.

4.3 Follow manufacturers operating guidelines, especially for proper grinding wheel attachment.

## 5.0 Personal Protective Equipment (PPE)

5.1 Leather gloves

5.2 Safety glasses with sideshields

5.3 Hearing protection: earplugs and/or earmuffs

5.4 Other PPE as necessary for the work site/activity

## 6.0 Other Safety Tips

6.1 Keep flammable and combustible materials away from the grinder.

6.2 Have a fire extinguisher on hand while using grinder.

6.3 Inspect the abrasive wheel for cracks and chips. If cracked or chipped, replace wheel before use.

6.4 Ensure safety guard(s) is positioned properly prior to start-up.

6.5 Never clamp a handheld grinder in a vice.

**Americas**

# Impact Wrench Safety Card

**S3NA-305-WI5**

## 1.0 Objective / Overview

1.1 Impact wrenches are mainly used for tire changing but that does not limit their use. They can be used in all applications when a certain amount of torque is needed to loosen or tighten nuts and bolts.

1.2 The danger comes in to play when employees try to use the wrong sockets with an air wrench. Employees using air wrenches must have a general understanding of how to use them.



## 2.0 Potential Hazards

2.1 Flying debris

2.2 Noise

2.3 Cuts

2.4 Hand/arm vibration

## 3.0 Safe Operating Guidelines

3.1 Drain water from air compressor tank and condensation from air lines.

3.2 Disconnect the tool from the air supply before lubricating or changing sockets. Impact wrench sockets and accessories must be used with this tool.

3.3 Do not use hand sockets and accessories. Select the required impact socket.

3.4 Connect tool to air hose of recommended size. The use of a quick connect set makes connecting easier.

3.5 Never use a wire, soft pin, or nail to hold the socket onto the square spindle of the impact wrench.

3.6 If the proper retaining device on the tool is broken, the tool should be repaired.

3.7 On applications where a low or critical level of torque is required, it is recommended that you impact each fastener lightly, and then perform the final tightening with a hand torque wrench.

## 4.0 Training Requirements

4.1 Review of training requirements per the Training Needs Assessment (TNA).

4.2 Demonstrated knowledge on the use of a electric drill.

4.3 Review and follow manufacturers operating guidelines.

## 5.0 Personal Protective Equipment (Level D PPE)

5.1 Leather gloves/anti-vibration gloves

5.2 Hearing protection

## 6.0 Other Safety Tips

6.1 Be sure no one is below when using the tool at heights.

6.2 The proper fastening torque may differ depending upon the kind or size of the bolt.

6.3 Check the torque with a torque wrench.

**Americas**

# Nail Gun Safety Card

**S3NA-305-WI6**

## 1.0 Objective / Overview

1.1 Nail guns are useful tools, but must be handled with care.

1.2 Nail guns have been shown to be the cause of unnecessary injuries when the design of the gun places emphasis on speed, rather than safety.




## 2.0 Potential Hazards

2.1 Flying debris/nails

2.2 Imbedded object

2.3 Puncture wounds

2.4 Noise

## 3.0 Safe Operating Guidelines

3.1 Watch out for other crewmembers working near you.

3.2 Never let an inexperienced crewmember use a nail gun without supervised training.

3.3 Never use bottled gas as a power source for pneumatic tools.

3.4 Disconnect a nail gun before you service it.

3.5 Hold your hand a good 12 inches back from the ends of studs or joists when you are nailing.

3.6 Keep the gun properly aligned with your work both vertically and horizontally.

3.7 Never nail with the gun pointed toward you or anyone else on the job.

3.8 Never try to nail beyond your reach.

## 4.0 Training Requirements

4.1 Review of training requirements per the Trainign Needs Assessment.

4.2 Demonstrated knowledge on the use of a coring machine.

4.3 Review and follow manufacturers operating guidelines.

## 5.0 Personal Protective Equipment (Level D PPE)

5.1 Leather gloves

5.2 Hearing protection

## 6.0 Other Safety Tips

6.1 When you are moving about the work area keep your finger off the trigger until you are ready to fire. Make sure you have only placed the nose guard against the material you are going to nail together.

6.2 Never rest the gun against any part of your body, or try to climb a ladder with the gun cradled against your body.

6.3 Be aware of what is located behind the nailing surface. Never place hands or other body parts directly behind the nailing surface.

6.4 Use only for intended work.

6.5 Avoid nailing into knots as nail can splinter wood.

6.6 Never disable safety tip on gun.

**Americas**

# Dustless Vacuum Safety Card

**S3NA-305-WI7**

## 1.0 Objective / Overview



*Worker is using the roto-peen (scabbler) attachment; VAC-PAC collection system shown with 55 gal drum.*

1.1 Dustless decontamination system (also refered to as Pentek bradn name) removes and packages surface contamination from concrete and steel structures.

1.2 The Pentek integrated suite of manually operated equipment (e.g., squirrel III, corner cutter, roto-peen, and crack chaser) is designed for the safe removal of radioactive materials, lead-based paints, polychlorinated biphenyls, pesticides, chemical residues, and other contaminated coatings.

1.3 The Pentek system incorporates a high-performance vacuum and waste packaging unit, the VAC-PAC, in conjunction with pneumatically operated equipment to remove contaminated material. Dust and debris are captured at the cutting tool surface. Supporting equipment required to operate the unit includes a 60 kilowatt generator and an air compressor (minimum 350 cubic feet capacity), as well as a drum grappler for drum handling activities.

## 2.0 Potential Hazards

2.1 Hazardous noise

2.2 Vibration

2.3 Tripping hazard from cables and hoses

2.4 Hot surfaces (vacuum unit)

2.5 Electrical (high voltage)

2.6 Pinch hazard

2.7 Back strain

2.8 High pressure air

## 3.0 Safe Operating Guidelines

3.1 Prior to use, a pre-operation inspection must be completed to determine if the unit is in safe working condition.

3.2 The vacuum unit should be placed a minimum of 50 feet (15.2 meters) away from the work area.

3.3 Once in position to begin work, apply the brake to stabilize the unit. When raising the VAC-PAC to insert/remove a drum, do not place your body or any extremity under the VAC-PAC while it is in the raised position.

3.4 Two workers should be used to maneuver the unit into place.

3.5 A minimum 10 feet (3 meters) clearance will be established around the unit while in operation.

3.6 Workers should be aware of their position in relation to the hoses and cable to minimize tripping hazards.

3.7 A competent person will train each worker in the operation of the unit.

3.8 Maintenance in excess of preventive maintenance activities (e.g., lubrication) will be performed by manufacturer personnel ONLY.

## 4.0 Personal Protective Equipment (Level D PPE ensemble)

4.1 Leather gloves (maintenance)

4.2 Tyvek suit (with hood)

4.3 Anti-vibration gloves (operation)

4.4 Hearing protection (plugs or muffs)

## 5.0 Other Safety Tips

5.1 Always know where the emergency stop is located.

5.2 Operators of a motorized drum grappler must be trained in agreement with the powered industrial truck standard.

5.3 Review *S3NA-302-PR1 Electrical, General* prior to refueling the electrical generator and/or compressor.

**Americas**

# Power Drill Safety Card

**S3NA-305-WI8**

## 1.0 Objective / Overview

1.1 Available in a variety of types and capacities, portable power drills are undoubtedly the most used power tools.

1.2 Because of their handiness and application to a wide range of jobs, drills often receive heavy use. For this reason, you will need to carefully check your drill's capacity limitations and accessory recommendations.

## 2.0 Potential Hazards




2.1 Electrical shock

2.2 Puncture wounds

2.3 Flying debris

2.4 Severe cuts

2.5 Fire

2.6 Burns (hot bits)

2.7 Manual handling (sprains/strains - wrist)

## 3.0 Safe Operating Guidelines

3.1 Check carefully for loose power cord connections and frays or damage to the cord. Keep all cords clear of the cutting area during drilling.

3.2 Replace damaged tool and extension cords immediately.

3.3 Always keep drill bits sharp.

3.4 Disconnect the power supply before changing or adjusting bit or attachments,

3.5 Do not use high speed steel (HSS) bits without cooling or using lubrication.

3.6 Be sure the chuck is tightly secured to the spindle. This is especially important on reversible-type drills. Tighten the bit securely as described by the owner/operators manual.

3.7 The chuck key must be removed from the chuck before starting the drill. A flying key can be an injury-inflicting missile.

3.8 Secure workpiece being drilled to prevent movement.

3.9 Check auxiliary handles, if part of the tool. Be sure they are securely installed.

3.10 Always use the auxiliary drill handle when provided. It gives you more control of the drill, especially if stalled conditions occur.

3.11 Grasp the drill firmly by insulated surfaces.

3.12 Always hold or brace the tool securely. Brace against stationary objects for maximum control. If drilling in a clockwise -- forward -- direction, brace the drill to prevent a counter-clockwise reaction.

3.13 Do not overreach. Always keep proper footing and balance.

3.14 Don't force a drill. Apply enough pressure to keep the drill bit cutting smoothly. If the drill slows down, relieve the pressure. Forcing the drill can cause the motor to overheat, damage the bit and reduce operator control.

## 4.0 Training Requirements

4.1 Review of training needs per the Training Needs Assessment.

4.2 Demonstrated knowledge on the use of a power drill.

4.3 Review and follow manufacturers operating guidelines.

## 5.0 Personal Protective Equipment (Level D PPE)

5.1 Safety glasses

5.2 Leather Gloves

## 6.0 Other Safety Tips

6.1 Electric drills must be double-insulated or plugged into a ground fault circuit interrupter outlet.

6.2 Never carry tool by cord or yank it to disconnect from receptacle.

6.3 Keep cord away from sharp edges.

**Americas**

# Pressure Washer Safety Card

**S3NA-305-WI9**

## 1.0 Objective / Overview

1.1 High pressure washers can operate up to pressures of 5,000 pounds per square inch and come in a variety of types ranging from gas operated to electrical. If not used correctly and safely, pressure washers can be dangerous piece of work equipment.

1.2 AECOM only allows trained, authorized personnel to operate the high pressure washers. Along with training, other safety measures include: reviewing the manufacturers instructional booklet, proper maintenance of equipment, and personal protective equipment.

## 2.0 Potential Hazards

2.1 Kickback – Sudden and violent reverse movement of the gun

2.2 Flying debris

2.3 Slips and trips on wet surfaces and hoses

2.4 Noise

2.5 Manual handling

2.6 Exhaust fumes/carbon monoxide (CO) in enclosed spaces

2.7 Severe cuts

## 3.0 Safe Operating Guidelines

3.1 The gun valve must always be pointed at the work area, NEVER point the gun valve at yourself or another person.

3.2 High pressure washers shall be used to clean or decontaminate equipment, surfaces or structures only.

3.3 High pressure washers WILL NOT be used to clean or decontaminate workers or personal protective equipment while it is being worn.

3.4 Maintain a distance from the spray contact point to reduce noise exposure and risk of being struck by flying debris. Ensure that you are not overreaching and remain stable.

3.5 Always set the tripper safety lock when the gun valve is not in use.



## 4.0 Training Requirements

4.1 Review of training requirements per the Training Needs Assessment.

4.2 Demonstrated knowledge on the use of a pressure washer.

4.3 Review of manufacturers operating guidelines.

## 5.0 Personal Protective Equipment (Level D PPE)

5.1 Hard hat with faceshield

5.2 Heavy gloves

5.3 Hearing protection

5.4 PVC (or equivalent) rain suit

## 6.0 Other Safety Tips

6.1 Never fill a pressure washer fuel tank with fuel while the engine is running or if the engine is still hot.

6.2 Non-operators must remain a minimum of 25 feet from the operator.

6.3 High-pressure washing equipment should be cleaned often to avoid dirt buildup, especially around the trigger and guard area.

6.4 Always set the trigger safety lock when the gun valve is not in use.

6.5 Relieve the pressure in the system before coupling and uncoupling hoses.

6.6 Visually inspect the full length of high pressure discharge hose and inspect other high pressure fluid-handling components for abrasions or cuts, damage caused by exposure to chemicals and for damage caused by kinks in the hose.

**Americas**

# Reciprocating Saw Safety Card

**S3NA-305-WI10**

## 1.0 Objective / Overview

1.1 The versatility of the reciprocating saw, in cutting metal, pipe, wood and other materials have made it a widely used tool.

1.2 By design, it is a simple tool to handle. Its demands for safe use, however, are very important.

## 2.0 Potential Hazards

2.1 Flying debris

2.2 Noise

2.3 Sharp, moving parts (cuts)

2.4 Hand/arm vibration

## 3.0 Safe Operating Guidelines

3.1 Use sharp blades. Dull blades can produce excessive heat, make sawing difficult, result in forcing the tool, and possibly cause an accident.

3.2 Position yourself to maintain full control of the tool, and avoid cutting above shoulder height.

3.3 To minimize blade flexing and provide a smooth cut, use the shortest blade that will do the job.

3.4 The work piece must be clamped securely, and the shoe of the saw held firmly against the work to prevent operator injury and blade breakage.

3.5 Maintain firm contact between the saw's shoe and the material being cut.

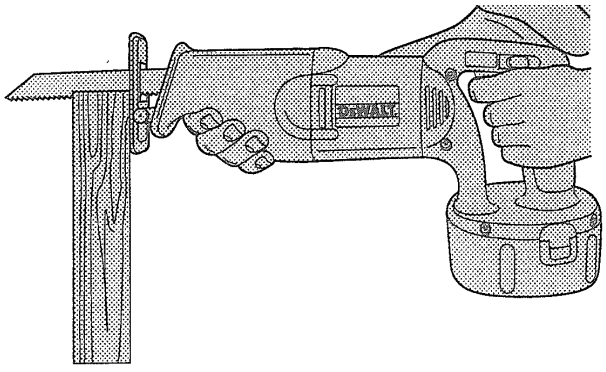
3.6 When making a "blind" cut (you can't see behind what is being cut), be sure that hidden electrical wiring, or water pipes are not in the path of the cut.

3.7 If wires are present, they must be disconnected at their power source by a qualified person or avoided, to prevent the possibility of lethal shock or fire.

3.8 Water pipes must be drained and capped.

3.9 Always hold the tool by the insulated grouping surfaces. When making anything other than a through cut, allow the tool to come to a complete stop before removing the blade from the work piece. This prevents breakage of the blade, and possible loss of tool control.

3.10 Different work surfaces demand different blades.




*The correct way to hold the reciprocating saw while operating.*

## 4.0 Training Requirements

4.1 Review of training requirement per the Training Needs Assessment (TNA).

4.2 Demonstrated knowledge on the use of a reciprocating saw.

4.3 Review and follow manufacturers operating guidelines.

## 5.0 Personal Protective Equipment (Level D PPE)

5.1 Safety glasses

5.2 Hearing protection

## 6.0 Other Safety Tips

6.1 Do not operate reciprocating saw in explosive atmospheres.

6.2 Do not overreach. Keep proper footing and balance at all times.

6.3 Do not use tool if switch is not operating correctly.

6.4 Check for misalignment or binding of moving parts, breakage or parts and any other condition that may affect the tool's operation.

6.5 Do not wear jewelry on the fingers/wrists during use.

6.6 Always use two hands to operate saw (see picture).

**Americas**

# Sander Safety Card

**S3NA-305-WI11**

## 1.0 Objective / Overview

1.1 Sanders are commonly used at project sites for a variety of tasks.

1.2 Often times the hazards associated with sanders are overlooked; they don't appear threatening because they don't have sharp blades or bits. These misconceptions can be prevented through proper training and personal protective equipment (PPE) selection.

## 2.0 Potential Hazards

2.1 Kickback – Sudden and violent reverse of the sander

2.2 Noise

2.3 Hand/arm vibration

2.4 Dust exposure

2.5 Flying debris

2.6 Severe abrasive cuts

2.7 Electrocution

2.8 Explosion/fire hazard from the dust

## 3.0 Safe Operating Guidelines

3.1 Make sure the sander is switched "OFF" before connecting the power supply.

3.2 Disconnect power supply before changing a sanding belt, making adjustments, or emptying dust collector.

3.3 Inspect sanding belts before use. Replace those belts that are worn or frayed.

3.4 Install sanding belts that are the same widths as the pulley drum.

3.5 Adjust sanding belt tension to keep the belt running true and at the same speed as pulley drum.

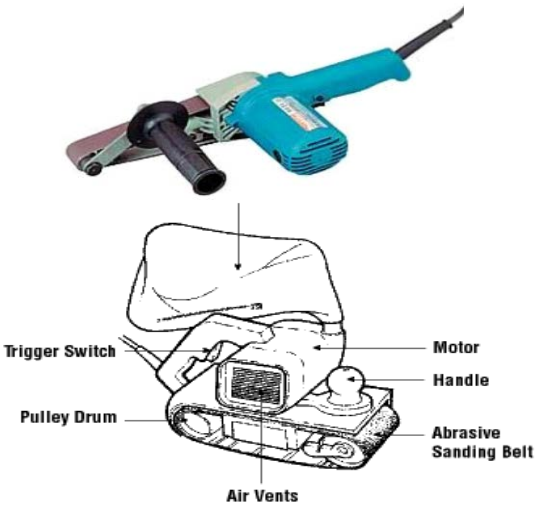
3.6 Secure the sanding belt in the direction shown on the belt and the machine. Keep hands away from the sanding belt.

3.7 Before starting a sander, be sure the power cord and extension cords are out of the belt path and are long enough to freely complete the task. The sander must be either double insulated or connected to a ground fault circuit interrupter.

3.8 Use two hands to operate sanders – one on the trigger and the other on the front handle knob.

3.9 Clean dust from the motor and vents at regular intervals.

3.10 Do not use a sander without an exhaust system or dust collector present that is in good working order. The dust created when sanding can be a fire and explosion hazard. Proper ventilation is essential.




3.11 Empty the collector when ¼ full. Minimise dust disturbance when emptying the collector.

3.12 Do not exert excessive pressure on a moving sander. The weight of the sander provides adequate pressure for the job.

3.13 Do not work on unsecured stock unless it is heavy enough to stay in place. Clamp the stop into place or use a ‘stop block’ to prevent movement.

3.14 Do not overreach. Always keep proper footing and balance.

3.15 Do not cover air vents of the sander.

3.16 Check often to ensure that guards are in their normal position.

## 4.0 Training Requirements

4.1 Review of training requirements per the Training Needs Assessment (TNA).

4.2 Review and follow manufacturers operating guidelines.

## 5.0 Personal Protective Equipment (Level D PPE)

5.1 Hearing protection

5.2 Safety Glasses

5.3 Leather gloves

**Americas**

# Utility Knife Safety Card

**S3NA-305-WI12**

## 1.0 Objective / Overview

1.1 Utility knives serve a variety of purposes at work sites, and can be a useful tool, when used safely and correctly.

1.2 Learning proper positioning and correctly using a utility knife will drastically reduce the potential of cut-related injuries.

## 2.0 Safe Operating Guidelines

2.1 Always be sure that knives are sharp and not dull. A dull blade will require more force to cut, increasing the likelihood of slipping.

2.2 Be sure the blade is seated in the frame of the knife correctly, closed, and fastened together properly.

2.3 Always keep body parts away from the cut line, (e.g., fingers), and ensure that the material being cut is on firm ground and not against a body part (e.g. cutting rope against your leg).

2.4 Always pull the knife, never push the knife (the blade may break, and momentum could cause the body to come into contact with broken blade).

2.5 Always retract the blade when not in use.

## 3.0 Potential Hazards



3.1 Lacerations from direct contact with the blade.

3.2 Lacerations from blade breaking or shattering.

3.3 Ergonomics.

## 4.0 Training Requirements

4.1 Review of Applicable Standard Operating Procedures.

4.2 Review of client-specific requirements.

4.3 Demonstrated knowledge on the safe use of a utility knives.

4.4 Review and follow manufacturers operating guidelines for specialized or unusual knives.

## 5.0 Personal Protective Equipment (Level D PPE)

5.1 Cut resistant gloves (Kevlar, thick leather, etc.).

## 6.0 Other Safety Tips

6.1 Purchase safety-equipped utility knives with guarding or automatically retracting blades.

6.2 Replace dull blades – When knife begins to tear rather than cut, it is a good indicator the blade is dull.

6.3 Always wear a cut-resistant glove on your free hand.

6.4 Always use the right tool for the job – NEVER use the blade as a screwdriver or prying tool.

6.5 When using a knife to cut thicker materials, use several passes. Increased force on the blade can cause it to stray from the intended cut path, or break the blade.

6.6 When changing blades, always handle from the non-sharp side. Cover blade with duct tape and dispose.

6.7 Use an alternate tool when possible (scissors, wire cutters, etc.).



Utility Knives with Gaurding

**Americas**

# Wood Chipper Safety Card

**S3NA-305-WI13**

## 1.0 Objective / Overview

1.1 Wood chippers should be used with extreme caution in order to prevent personal injury, as the wood chipper is open to receive tree branches and other wooden material.

1.2 AECOM only allows trained, authorized personnel to operate a wood chipper.

1.3 Along with training, other safety measures include: reviewing the manufacturers instructional booklet, proper maintenance of equipment, and personal protective equipment.

## 2.0 Safe Operating Guidelines

2.1 The operator must be completely familiar with the controls and proper use of the equipment.

2.2 Workers feeding material into self-feeding wood chippers are at risk of being fed through the chipper if they reach or fall into the infeed hopper or become entangled in branches feeding into the machine.

2.3 Prior to use, make sure all safety devices and controls, such as emergency shut-off devices, are tested and verified to be functioning properly.

2.4 Make sure two workers (buddy system) are in close contact with each other when operating the chipper.

## 3.0 Potential Hazards

3.1 Burns from contact with the hot muffler or engine.

3.2 Flying debris.

3.3 Noise exposure.

3.4 Exhaust fumes exposure.

3.5 Entanglement in limbs and contact with chipper blades.



## 4.0 Training Requirements

4.1 Review of Applicable Standard Operating Procedures.

4.2 Demonstrated knowledge on the use of a wood chipper.

4.3 Review of manufacturers operating guidelines.

## 5.0 Personal Protective Equipment (Level D PPE)

5.1 Leather gloves

5.2 Hearing protection

5.3 Debris shield

5.4 Long sleeve shirt (e.g. working near poison ivy, poison oak, etc.)

## 6.0 Other Safety Tips

6.1 Stand to the side of the chipper while inserting limbs into chipper, never stand directly in front.

6.2 Insert trunk portion of tree/limb first. This will prevent the branches from getting entangled with clothing, etc. and pulling you in with the tree/limb.

6.3 Bystanders should be kept at least 25 feet away when in operation.

6.4 Keep the area around the wood chipper free of tripping hazards.

6.5 Never wear loose clothing that may get caught on feed material or moving parts.

6.6 Always set the trigger safety lock when the gun valve is not in use.

6.7 Never fill the fuel tank while the engine is running or if the engine is still hot.

**Americas**

# Clearing and Grubbing Equipment Safety Card

**S3NA-305-WI14**

The following safety precautions will be followed during site clearing and tree falling

## 1.0 Hand Tools

1.1 All hand tools shall be in safe condition. Tools shall be inspected by the user daily.

1.2 Handles shall be sound, straight and tight-fitting.

1.3 Driven tools shall be dressed to remove any mushrooming.

1.4 Cutting tools shall be kept sharp and properly shaped.

1.5 All clearing activities shall terminate during electrical storms and periods of high winds.

1.6 Dead, broken or rotted limbs or trees (widow makers) shall be felled first.

1.7 Always wear the appropriate Personal Protective Equipment (PPE) when using hand tools, particularly eye and hand protection.

1.8 Use the right tool that is being used for the job to reduce chance of unexpected occurrences. Do not submit or use makeshift tools.

1.9 Defective tools shall not be used. They shall be taken out of service until repaired or replaced.

1.10 Check tools for damage or wear prior to each use to reduce chance of unexpected occurrences.

1.11 Replace cracked or broken handles on files, hammers, screwdrivers, or sledges.

1.12 Replace worn jaws on wrenches, pipe tools, and pliers

1.13 Redress burred or mushroomed heads on striking tools.

1.14 Sharpen cutting tools frequently to reduce chance of unexpected occurrences.

1.15 Store hand tools properly after each use.

1.16 Tools shall be clean and dry to avoid slippage when in use.

1.17 Never leave tools on ladders, scaffolds, or overhead work areas when they are not in use (a high number of injuries occur from objects/tools falling from overhead work areas in construction).

1.18 Always keep tools being used in overhead work areas in containers that will prevent them from falling.

1.19 Carry tools using a heavy belt or apron and hang tools at your sides.

1.20 Never carry tools in your pockets or hanging behind your back.

1.21 Avoid muscle strain and fatigue by doing the following:

- Avoid using hand tools with your wrist bent.
- Choose tools that allow you to keep your wrist straight when using them.
- Always PULL on wrenches and pliers. Never push unless you hold the tool with your palm open.
- Always cut away from yourself when using cutting tools.

1.22 Establish balance and stable footing when using a bar for prying. Pry bars can slip or break without warning.

1.23 Be aware of the presence of other personnel when using any tool, especially picks or axes.

## 2.0 Machete Use

2.1 A machete will only be used for its designated purpose; do not carelessly swing the machete when it is not needed.

2.2 To prevent lacerations, employees will wear Kevlar gloves and Kevlar chain saw chaps.

2.3 Machetes shall not be used when other employees are in the immediate work area.

## 3.0 Use of Weed Whips

3.1 Weed whips may be used to clear vegetation such as grass, light brush, briars and tree seedlings. The L-shaped weed whip cuts grass and weeds but is unstable for use on larger growth; the triangular-frame weed whip cuts briars and woody stems up to a half-inch in diameter. A “Suwannee” sling is a heavy duty weed whip that also has an axe blade. It does the same work as a weed whip, but can also cut through large materials. The heavier weight of this tool allows it to more easily cut off larger material than a weed whip.

3.2 When using weed whips, employees should follow these safety procedures:

3.2.1 Select the correct tool for the types and size of vegetation present across the landfill.

3.2.2 Employees will wear leather gloves when using weed whips.

3.2.3 Weed whips are meant to be swung back and forth with both hands. Avoid using a golf swing. The tool should be swung no higher than an employee’s side.

3.2.4 Strong swings should be made to prevent the blade from bouncing or glancing off springy growth.

3.2.5 Screws hold the serrated double-edge blade in place. These screws can work loose so check them before each use.

3.2.6 At the end of the day, inspect the whips for damage. Clean, sharpen, and oil as necessary and store with a sheath in place.

## 4.0 Chain Saws

4.1 Refer to *S3NA-305-WI1 Chainsaw Safety Card.*

## 5.0 Felling Trees Manually

5.1 Before cutting begins, survey the work area for dead limbs, the lean of the tree to be cut, wind conditions and the location of other trees.

5.2 Remove lodged trees (tree has not fallen to the ground after being separated from its stump) as soon as possible. Never work under a lodged tree.

5.3 The distance between workers should be maintained at twice the height of the trees being felled.

## 6.0 Chipping Operations

6.1 Access covers and doors shall not be opened until the drum or disk is at a complete stop.

6.2 Infeed and discharge ports shall be designed to prevent employee contact with disc, knives and blower blades.

## 7.0 Cutting Tools

7.1 Wear safety glasses and protective gloves when using cutters.

7.2 Choose the proper cutter for the job. Cutters are designed for a specific type, hardness, and size of material.

7.3 Inspect the tool for proper working condition.

7.4 If tool is designed to have a guard, make sure guards are in place.

7.5 Cut materials straight across - keep the material being cut at right angles to the cutting edges of jaws.

7.6 Warn those in the area to take precautionary measures to avoid possible injury from flying metal pieces.

7.7 Keep cutting tools in good repair.

7.8 Adjust and lubricate cutter and moving parts daily if heavily used.

7.9 Sharpen jaws according to manufacturer's instructions.

7.10 Do not use a cutting tool until you are trained in its proper and safe use.

7.11 Do not use cushion grip handles for jobs requiring electrically-insulated handles. Cushion grips are for comfort primarily and do not protect against electric shock.

7.12 Do not use cutters which are cracked, broken or loose.

7.13 Do not exceed the recommended capacity of a tool.

7.14 Do not cut diagonally.

7.15 Do not rock cutters from side to side when cutting wire.

7.16 Do not pry or twist with tool when cutting.

7.17 Do not hammer on cutting tools or extend the handle length to achieve greater cutting power.

7.18 Do not expose cutters to excessive heat.

## 8.0 Selection and Use

8.1 Select tools that can be used without bending the wrist. Hand tools should allow the operator to grasp, hold, and use the tool with the wrist held straight.

8.2 Select the tool with the workplace layout and job design in mind. Sometimes a tool is correct for one operation and incorrect for another.

8.3 Use the right tool for the job. Confirm it is the right size and has sufficient power to do the job safely. When there is a choice, select a tool of a low weight.

8.4 Select low-vibrating tools, or choose tools with vibration-absorbing handles, like those covered with cork, rubber, plastic or plastic bonded to steel, to reduce hand/arm vibration.

8.5 Choose hand tools that have a center of gravity within or close to the handle.

8.6 Select tools with rounded and smooth handles that you can grip easily.

8.7 If they are available, choose hand tools with double handles to permit easier holding and better manipulation of the tool.

8.8 Select tools with a trigger strip, rather than a trigger button. This strip will allow you to exert more force over a greater area of the hand that, in turn, will reduce muscle fatigue.

8.9 Confirm that the trigger works easily to reduce the effort needed to operate it.

8.10 Confirm that your tool is well maintained and in good repair.

8.11 Frequently used tools that weigh more than 1 pound should be counter-balanced.

8.12 Hold the tool close to the body. Do not overreach.

8.13 Keep good balance and proper footing at all times. This will help operators to control the tool better, especially in response to unexpected situations.

8.14 Rest your hands by putting the tool down when you are not using it.

8.15 Reduce power to the lowest setting that can complete the job safely. This action reduces tool vibration at the source.

8.16 Confirm that cutting tools, drill bits, etc., are kept sharp, clean, and well maintained.

8.17 Do not wear gloves, loose clothing or jewelry while using revolving power tools. Tie back long hair or wear appropriate hair protection to prevent hair from getting caught in moving parts of equipment (manufacturer's operating manual for recommended PPE and/or safety issues/concerns).

8.18 Do not use a tool unless you have been trained to use it safely and know its limitations and hazards.

## 9.0 Storage and Handling

9.1 All tools shall be stored in a manner to prevent damage and injury. Store tools in a dry, secure location when they are not being used.

9.2 Tools shall be properly put away after each use.

9.3 Sharp or pointed tools shall be handled only if the sharp/pointed edge is covered, carried in a tool box or other device designed for that purpose, or the sharp/pointed edge is pointed downward, away from the body.

**Americas**

# Pneumatic Tool Safety Card

**S3NA-305-WI15**

## 1.0 General Requirements

1.1 Wear safety glasses at all times and face shield if required. (Level “D” Personal Protective Equipment required).

1.2 Use hearing protection, where required.

1.3 Ensure that the compressed air supplied to the tool is clean and dry. Dust, moisture, and corrosive fumes can damage a tool. An in-line regulator filter and lubricator increases tool life.

1.4 Keep tools clean and lubricated, and maintain them according to the manufacturers' instructions.

1.5 Use only the attachments that the manufacturer recommends for the tools you are using.

1.6 Be careful to prevent hands, feet, or body from injury in case the machine slips or the tool breaks.

1.7 Reduce physical fatigue by supporting heavy tools with a counter-balance wherever possible.

1.8 Use the proper hose and fittings of the correct diameter.

1.9 Use hoses specifically designed to resist abrasion, cutting, crushing and failure from continuous flexing.

1.10 Choose air supply hoses that have a minimum working pressure rating of 150 pounds per square inch gauge or 150 percent of the maximum pressure produced in the system, whichever is higher.

1.11 Check hoses regularly for cuts, bulges and abrasions. Tag and replace, if defective.

1.12 Blow out the air line before connecting a tool. Hold hose firmly and blow away from yourself and others.

1.13 Make sure that hose connections fit properly and are equipped with a mechanical means of securing the connection (e.g., chain, wire, or positive locking device).

1.14 Install quick disconnects of a pressure-release type rather than a disengagement type. Attach the male end of the connector to the tool, NOT the hose.

1.15 Do not operate the tool at a pressure above the manufacturer's rating.

1.16 Turn off the air pressure to the hose when not in use or when changing power tools.

1.17 Do not carry a pneumatic tool by its hose.

1.18 Avoid creating trip hazards caused by hoses laid across walkways or curled underfoot.

1.19 Do not use compressed air to blow debris or to clean dirt from clothes.

## 2.0 Pneumatic Nailing and Stapling Tools

2.1 Permit only experienced and trained persons to operate pneumatic nailing and stapling tools.

2.2 Wear safety glasses or face a shield and, where necessary, use hearing protection.

2.3 Inspect a tool before connecting it to air supply:

- 2.3.1 Check tool safety mechanisms if applicable.
- 2.3.2 Tighten securely all screws and cylinder caps.

2.4 Check correct air supply and pressure before connecting a tool.

2.5 Check that the tool is correctly and securely connected to the air supply hose and that it is in good working order, with the safety mechanism operative, before using.

2.6 Always handle a tool as if it loaded with fasteners (nails, staples, etc.).

2.7 Equip tools with a work-contacting element that limits the contact area to one that is as small as practical.

2.8 Make sure that the mechanical linkage between the work-contacting element and trigger is enclosed.

2.9 Disconnect a tool from the air supply when the tool is unattended and during cleaning or adjustment. Before clearing a blockage, be sure that depressing the trigger exhausts all air from the tool.

2.10 Use only fasteners recommended by the manufacturer.

2.11 Permit only properly trained people to carry out tool maintenance.

2.12 Do not depress the trigger unless the nosepiece of tool is directed onto a safe work surface.

2.13 Do not carry a tool with the trigger depressed.

2.14 Do not load a tool with fasteners while the trigger is depressed.

2.15 Do not overreach. Keep proper footing and balance.

**Americas**

# Manual Hand Tools Safety Card

**S3NA-305-WI16**

## 1.0 Hammers

1.1 Hammers are designed according to the intended purpose. Select a hammer that is comfortable for you and that is the proper size and weight for the job. Misuse can cause the striking face to chip, possibly causing a serious injury.

1.2 Choose a hammer with a striking face diameter approximately ½ inch (1.3 centimeters) larger than the face of the tool being struck (e.g., chisels, punches, wedges, etc.).

1.3 Ensure that the head of the hammer is firmly attached to the handle.

1.4 Replace loose, cracked or splintered handles.

1.5 Discard any hammer with mushroomed or chipped face or with cracks in the claw or eye sections.

1.6 Strike a hammer blow squarely with the striking face parallel to the surface being struck. Always avoid glancing blows and over and under strikes. (Hammers with beveled faces are less likely to chip or spall).

1.7 Look behind and above you before swinging the hammer.

1.8 Watch the object you are hitting.

1.9 Hold the hammer with your wrist straight and your hand firmly wrapped around the handle.

1.10 Do not use a hammer with a loose or damaged handle.

1.11 Do not use handles that are rough, cracked, broken, splintered, sharp-edged or loosely attached to the head.

1.12 Do not use any hammer head with dents, cracks, chips, mushrooming, or excessive wear.

1.13 Do not use a hammer for any purpose for which it was not designed or intended.

1.14 Do not use one hammer to strike another hammer, other hard metal objects, stones or concrete.

1.15 Do not redress, grind, weld or reheat-treat a hammer head.

1.16 Do not strike with the side or cheek of the hammer.

## 2.0 Wrenches

2.1 Inspect pipe wrenches periodically for worn or unsafe parts and replace them (e.g., check for worn threads on the adjustment ring and movable jaw).

2.2 Keep pipe wrench teeth clean and sharp.

2.3 Face a pipe wrench forward. Turn wrench so pressure is against heel jaw.

2.4 Pull, rather than push on the pipe wrench handle. Maintain a proper stance with feet firmly placed to hold your balance.

2.5 Do not use a pipe wrench as a hammer, or strike a pipe wrench with a hammer.

2.6 Do not use pipe wrenches on nuts and bolts.

2.7 Do not use a pipe extender for extra leverage. Get a larger pipe wrench.

2.8 Replace pipe cutter wheels which are nicked or otherwise damaged.

2.9 Use a three- or four-wheeled cutter, if there is not enough space to swing the single wheel pipe cutter completely around the pipe.

2.10 Choose a cutting wheel suitable for cutting the type of pipe material required:

2.10.1 Thin wheel for cutting ordinary steel pipe.

2.10.2 Stout wheel for cutting cast iron.

2.10.3 Other wheels for cutting stainless steel, plastic and other materials.

2.11 Select the proper hole diameter and correct tap size to tap a hole. The hole should be sized so that the thread cut by the tap will be about 75 percent as deep as the thread on the tap.

2.12 Use a proper tap wrench (with a “T” handle) for turning a tap.

2.13 Use lubricant or machine cutting fluid with metals other than cast iron.

2.14 Do not permit chips to clog flutes (groves in the tap that allow metal chips to escape from the hole). The chips may prevent the tap from turning – this may result in the tap breaking if you continue to apply pressure.

2.15 Do not use a conventional adjustable wrench for turning a tap – it will cause uneven pressure on the tap that may cause it to break.

2.16 Do not attempt to thread hardened steel. This can chip or damage the die.

2.17 Do not thread any rod or other cylindrical object that is larger in diameter than the major diameter of the die thread.

2.18 Do not use a spiral reamer on a rotating pipe. The reamer may snag and cause serious injury.

## 3.0 Pliers and Wire Cutters

3.1 Pliers are made in various shapes and sizes and for many uses. Use the correct pliers or wire cutters for the job.

3.2 Choose pliers or wire cutters that have a grip span of 2½ – 3½ inches (6.4 – 8.9 centimeters) to prevent your palm or fingers from being pinched when the tools are closed.

3.3 Use adjustable pliers that allow you to grip the work piece firmly while maintaining a comfortable handgrip (i.e., hand grasp is not too wide).

3.4 Use tools only if they are in good condition.

3.5 Make sure that the cutting edges are sharp. Dull and worn-down cutting edges require many times more force for cutting.

3.6 Make sure that the toothed jaws are clean and sharp. Greasy or worn-down jaws can result in compromised safety. Such tools also require increased force to hold the work piece which, in turn, increases the risk of muscular fatigue and repetitive strain injuries.

3.7 Oil pliers and wire cutters regularly. A drop of oil on the hinge will make the tools easier to use.

3.8 Pull on the pliers; do not push away from you when applying pressure. If the tool slips unexpectedly, you may lose your balance or injure your hand.

3.9 Cut at right angles. Never rock the cutting tool from side to side or bend wire back and forth against the cutting edges.

3.10 Do not cut hardened wire unless the pliers or wire cutters are specifically manufactured for this purpose.

3.11 Do not expose pliers or wire cutters to excessive heat.

3.12 Do not bend stiff wire with light pliers. Needle-nose pliers can be damaged by using the tips to bend large wire. Use a sturdier tool.

3.13 Do not use pliers as a hammer.

3.14 Do not hammer on pliers or wire cutters to cut wires or bolts.

3.15 Do not extend the length of handles to gain greater leverage. Use a larger pair of pliers for gripping or a bolt cutter for cutting.

3.16 Do not use cushion grip handles for jobs requiring tools with electrically insulated handles. Cushion grips are for comfort primarily and do not protect against electric shock.

3.17 Do not use pliers on nuts and bolts; use a wrench.

## 4.0 Screwdrivers

4.1 Screwdrivers are made in various shapes and sizes and for many uses. Use the correct screwdriver for the job.

4.2 Choose contoured handles that fit the shank tightly, with a flange to keep the hand from slipping off the tool.

4.3 Use a slot screwdriver with a blade tip width that is the same as the width of the slotted screw head.

4.4 For cross-head screws, use the correct size and type of screwdriver; a Phillips screwdriver may slip out of a screw head designed for use with the slightly flatter-tipped Pozi-driv screwdriver.

4.5 Use a vise or clamp to hold the stock if the piece is small or moves easily.

4.6 Keep the screwdriver handle clean. A greasy handle could cause an injury or damage from unexpected slippage.

4.7 If work must be carried out on “live” electrical equipment, use screwdrivers that have insulated handles designed for electrical work and a non-conducting shaft. Remember, most plastic handles are designed for grip and comfort.

4.8 Use non-magnetic tools when working near strong magnets (e.g., in some laboratories).

4.9 Use a screw-holding screwdriver (with screw-holding clips or magnetic blades) to get screws started in awkward, hard-to-reach areas. Square-tipped screwdrivers (e.g., Robertson) that hold screws with recessed square holes are also useful in such situations.

4.10 Use an offset screwdriver in close quarters where a conventional screwdriver cannot be used.

4.11 Use a screwdriver that incorporates the following features when continuous work is needed:

- 4.11.1 Use a pistol grip to provide for a straighter wrist and better leverage.
- 4.11.2 Use a "Yankee drill" mechanism (spiral ratchet screwdriver or push screwdriver) which rotates the blade when the tool is pushed forward.
- 4.11.3 Use a ratchet device to drive hard-to-move screws efficiently, or use a powered screwdriver.

4.12 File a rounded tip square making sure the edges are straight. A dull or rounded tip can slip out of the slot and cause hand injury or damage to materials.

4.13 Store screwdrivers in a rack or partitioned pouch so that the proper screwdriver can be selected quickly.

4.14 Do not lean or push on a screwdriver with any more force than necessary to keep contact with the screw. A screw properly piloted and fitted will draw itself into the right position when turned. Keep the shank directly over the screw being driven.

4.15 Do not hold the stock in one hand while using the screwdriver with the other. If the screwdriver slips out of the slot you may cut your hand.

4.16 Do not hammer screws that cannot be turned.

4.17 Do not grind the tip to fit another size screw head.

4.18 Do not try to use screwdrivers on screw heads for which they are not designed (e.g., straight blade screwdrivers on Phillips, clutch head, Torx or multi-fluted spline screw heads).

4.19 Do not use defective screwdrivers (e.g., ones with rounded or damaged edges or tips; split or broken handles; or bent shafts).

4.20 Do not use a screwdriver for prying, punching, chiseling, scoring, scraping or stirring paint.

4.21 Do not use pliers on the handle of a screwdriver for extra turning power. A wrench should be used only on the square screwdriver shank designed for that purpose.

4.22 Do not expose a screwdriver blade to excessive heat. Heat can affect the temper of the metal and weaken the tool.

4.23 Do not use a screwdriver to check if an electrical circuit is live. Use a suitable meter or other circuit testing device.

4.24 Do not carry screwdrivers in your pockets.

## 5.0 Snips

5.1 Wear safety glasses and protective gloves when working with snips. Small pieces of metal may go flying in the air and cut edges of metal are sharp.

5.2 Snips are made in various shapes and sizes for various tasks. The handle can be like those on scissors with finger and thumb holes or like plier handles. Models are available for cutting in straight lines and in curves to the left or right.

5.3 Universal snips can cut in both straight and wide curves.

5.4 Straight snips and duckbill snips (flat blade, "perpendicular" to the handle, with pointed tips) are generally designed to cut in straight lines; some duckbill snips are designed for cutting curved lines.

5.5 Hawk's bill snips (with crescent-shaped jaws) are used for cutting tight circles.

5.6 Aviation snips have compound leverage that reduces the effort required for cutting.

5.7 Offset snips have jaws that are set at an angle from the handle.

5.8 Select the right size and type of snips for the job; check the manufacturer's specifications about the intended use of the snips (e.g., type of cut - straight, wide curve, tight curve, right or left, and maximum thickness and kind of metal or other material that can be cut).

5.9 Use only snips that are sharp and in good condition.

5.10 Use snips for cutting soft metal only. Hard or hardened metal should be cut with tools designed for that purpose.

5.11 Use ordinary hand pressure for cutting. If extra force is needed, use a larger tool.

5.12 Cut so that the waste is on the right if you are right-handed or on the left if you are left-handed.

5.13 Avoid springing the blades. This results from trying to cut metal that is too thick or heavy for the snips you are using.

5.14 Keep the nut and the pivot bolt properly adjusted at all times.

5.15 Oil the pivot bolt on the snips occasionally.

5.16 Do not try to cut sharp curves with straight cut snips.

5.17 Do not cut sheet metal thicker than the manufacturer's recommended upper limit (e.g., cuts up to 16-gauge cold, rolled steel or 18-gauge stainless steel). Do not extend the length of handles to gain greater leverage.

5.18 Do not hammer or use your foot to exert extra pressure on the cutting edges.

5.19 Do not use cushion grip handles for tasks requiring insulated handles. They are for comfort primarily and not for protection against electric shocks.

5.20 Do not attempt to re-sharpen snips in a sharpening device designed for scissors, garden tools, or cutlery.

## 6.0 Wood Chisels

6.1 Wear safety glasses.

6.2 Wood chisels are made in various shapes and sizes and for many uses. Use the correct chisel for the job.

6.3 Use the right size of chisel for the job.

6.4 Choose smooth, rectangular handles that have no sharp edges and are attached firmly to the chisel.

6.5 Ensure that the cutting edge is sharp. Dull chisels can be difficult to control and require more effort to do the job.

6.6 Check stock thoroughly for knots, staples, nails, screws, or other foreign objects before chiseling.

6.7 Clamp stock so it cannot move.

6.8 Adjust your stance so that you do not lose your balance if the tool slips.

6.9 Chip or cut away from yourself.

6.10 Keep your hands and body behind the cutting edge.

6.11 Use a wooden or plastic mallet with a large striking face on all chisels. Only heavy-duty or framing chisels are made of a solid or molded handle that can be struck with a steel hammer.

6.12 Make finishing or paring cuts with hand pressure alone.

6.13 Place chisels safely within the plastic protective caps to cover cutting edges when not in use.

6.14 Replace any chisel that is bent or shows dents, cracks, chips, or excessive wear.

6.15 Store chisels in a “storage roll,” a cloth or plastic bag with slots for each chisel, and keep them in a drawer or tray.

6.16 Replace broken or splintered handles.

6.17 Sharpen cutting edges as often as necessary.

6.18 Do not use a wood chisel as a pry or a wedge.

6.19 Do not use a wood chisel on metal.

6.20 Do not use an all-steel chisel with a mushroomed face or a chipped edge. Redress with a file or whetstone.

6.21 Do not use a grinder to redress heat-treated tools. Use a whetstone.

6.22 Do not use a dull chisel.

## 7.0 Wrenches

7.1 Use the correct wrench for the job - pipe wrenches for pipes and plumbing fittings, and general-use wrenches for nuts and bolts.

7.2 Discard any damaged wrenches (e.g., open-ended wrenches with spread jaws or box wrenches with broken or damaged points).

7.3 Select the correct jaw size to avoid slippage.

7.4 Position your body in a way that will prevent you from losing balance and hurting yourself if the wrench slips or something (e.g., a bolt) suddenly breaks.

7.5 Use a box or socket wrench with a straight handle, rather than an off-set handle, when possible.

7.6 Ensure that the jaw of an open-ended wrench is in full contact (fully seated, “flat,” not tilted) with the nut or bolt before applying pressure.

7.7 Face an adjustable wrench “forward,” adjust tightly and turn the wrench so pressure is against the permanent or fixed jaw.

7.8 Ensure that the teeth of a pipe wrench are sharp and free of oil and debris and that the pipe or fitting is clean to prevent unexpected slippage and possible injuries.

7.9 Apply a small amount of pressure to a ratchet wrench initially to ensure that the ratchet wheel (or gear) is engaged with the pawl (a catch fitting in the gear) for the direction you are applying pressure.

7.10 Support the head of the ratchet wrench when socket extensions are used.

7.11 Pull on a wrench using a slow, steady pull; do not use fast, jerky movements.

7.12 Stand aside when work is done with wrenches overhead.

7.13 Make sure adjustable wrenches do not "slide" open during use.

7.14 Keep tools well maintained (cleaned and oiled).

7.15 Clean and place tools and wrenches in a tool box, rack or tool belt after use.

7.16 Do not push on a wrench - losing your balance is more likely if the wrench slips.

7.17 Do not use a wrench that is bent or damaged.

7.18 Do not use worn adjustable wrenches. Inspect the knurl, jaw and pin for wear.

7.19 Do not pull on an adjustable wrench that is loosely adjusted.

7.20 Do not use pipe wrenches on nuts or bolts.

7.21 Do not use pipe wrenches for lifting or bending pipes.

7.22 Do not use a wrench on moving machinery.

7.23 Do not use the wrong tools for the job. For example, never use pliers instead of a wrench or a wrench as a hammer.

7.24 Do not use a makeshift wrench.

7.25 Do not insert a shim in a wrench for better fit.

7.26 Do not strike a wrench (except a "strike face" wrench) with a hammer or similar object to gain more force.

7.27 Do not increase the leverage by adding sleeved additions (e.g., a pipe) to increase tool handle length.

7.28 Do not expose a wrench to excessive heat (like from a blow torch) that could affect the temper of the metal and ruin the tool.

## 8.0 Files/Rasps

8.1 Do not use a file as a pry bar, hammer, screwdriver, or chisel.

8.2 When using a file or a rasp, grasp the handle in one hand and the toe of the file in the other.

8.3 Do not hammer on a file.

## 9.0 Chisels

9.1 Do not use a chisel that has a dull cutting edge.

9.2 Do not use chisels that have "mushroomed" striking heads.

9.3 Hold a chisel by using a tool holder if possible.

9.4 Clamp small work pieces in the vise and chip towards the stationary jaw when working with a chisel.

## 10.0 Vises

10.1 When clamping a long work piece in a vise, support the far end of the work piece by using an adjustable pipe stand, saw horse or box.

10.2 Position the work piece in the vise so that the entire face of the jaw supports the work piece.

10.3 Do not use a vise that has worn or broken jaw inserts, or has cracks or fractures in the body of the vise.

10.4 Do not slip a pipe over the handle of a vise to gain extra leverage.

## 11.0 Clamps

11.1 Do not use the C-clamp for hoisting materials.

11.2 Do not use the C-clamp as a permanent fastening device.

## 12.0 Jacks

12.1 Do not exceed the jack's rated lifting capacity as noted on the label of the jack.

12.2 Clear all tools, equipment and any other obstructions from under the vehicle before lowering the jack.

**Americas**

# Small Engine Safety Card

**S3NA-305-WI17**

## 1.0 Objective / Overview

1.1 Operate small engine machines, such as push mowers, weed trimmers, and leaf blowers, in a safe manner.

1.2 You should be trained and competent in how to operate and maintain them in a safe manner.

1.3 Read the operator's manual. It will contain detailed information on the safe operation and maintenance of the machine. If you do not have a manual, ask if one can be obtained from the manufacturer.

## 2.0 Potential Hazards

2.1 Flying debris

2.2 Noise

2.3 Moving and sharp parts (cuts)

2.4 Hot surfaces (burns)

## 3.0 Safe Operating Guidelines

3.1 Do not wear loose or baggy clothing around tools with rotating parts.

3.2 Never run the engine indoors, in poorly ventilated areas, or in a location where the exhaust could be drawn into a building through an opening.

3.3 Never store engine with fuel in fuel tank inside a building with potential sources of ignition such as hot water and space heaters, clothes dryers, electric motors, etc.

3.4 Never remove fuel cap or add fuel when engine is running.

3.5 Never start or operate the engine with the fuel fill cap removed.

3.6 Refuelling: allow engine to cool; fill in well-ventilated area; and do not smoke while re-fuelling.

3.7 Use only properly labelled, American National Standards Institute/Canadian Standards Association-approved red gasoline containers to store and dispense fuel.

3.8 Do not pour fuel from engine or siphon fuel by mouth.

3.9 Never leave the engine unattended while it is running.

3.10 Never operate the engine with an unguarded engine shaft.

3.11 Do not modify the engine or tamper with the factory setting of the engine governor.

3.12 Never operate the engine without a muffler guard in place and avoid touching hot areas of the engine.

3.13 Keep all flammable materials away from the muffler and the rest of the engine; do not idle or park the engine in dry grass or ground cover.

3.14 When working on the equipment, avoid accidental starts by removing the ignition key, turn off all engine switches, disconnect the battery and disconnect the spark plug, keeping it away from metal part.

3.15 Always wear hearing protection when operating an engine.

## 4.0 Training Requirements

4.1 Review of training requirements per the Training Needs Assessment (TNA).

4.2 Demonstrated knowledge on the use of small engine equipment.

4.3 Review and follow manufacturers operating guidelines.

## 5.0 Personal Protective Equipment (Level D PPE)

5.1 Always wear safety glasses with shields

5.2 Leather or cotton gloves

5.3 Long pants and long sleeve shirt

5.4 Safety toe work boots

5.5 Hearing protection (earmuffs or earplugs)

**Americas**

# Electrical and Battery Hand Tools Safety Card

**S3NA-305-WI18**

All electrical tools and equipment must be operated in accordance with the requirements of *S3NA-302-PR1 Electrical, General.*

## 1.0 Safe Work Practices

1.1 Maintain all electrical tools and cords in good condition and not overloaded.

1.2 Do not wear loose or baggy clothing around tools with rotating parts.

1.3 The switch on the tool must be in the OFF position before connecting it to a power source.

1.4 Verify that the power source is the same voltage and current as indicated on the nameplate of the tool. Using a higher voltage can cause serious injury to the operator as well as burn out the tool.

1.5 The tool must have an approved three-wire cord with a three-prong plug so that it can be used only in a properly grounded three-hole receptacle, unless the tool is double insulated to protect the operator from electrical shock.

1.6 All outdoor receptacles must be protected by means of a ground fault circuit interrupter (GFCI or GFI) available in portable or fixed models. Do not use any electric power tools outdoors in a receptacle that is not properly protected.

1.7 Report all shocks and/or sparks from electrical tools, no matter how minor. The tool in question should be tagged out and not be used until it has been checked for ground fault.

1.8 Maintain electrical cords and appliances in good working order.

- 1.8.1 Cords and appliances must be American National Standards Institute/Canadian Standards Association approved.
- 1.8.2 Never carry an electric tool by the cord or disconnect the plug by pulling or jerking on the cord (can damage, loosen, or separate connections).
- 1.8.3 Check cords frequently for such damage such as kinks, cuts, and cracked or broken outer jackets (any cord that feels more than comfortably warm to the touch should be checked by an electrician for overloading).

1.9 Store electrical cords in a clean, dry area off the ground to prevent damage to cord.

1.10 Equipment must have proper guards or shields and they must remain in place. If, due to damage or deterioration, the original guard provided on a piece of equipment cannot be put in place, the tool must be removed from service.

1.11 Do not modify, remove, or disable any machine guards.

1.12 Stand to one side when engaging or disengaging an electrical circuit breaker to avoid electrical flash backs.

1.13 It's strongly advisable to use GFCI with all portable electric tools at any time.

1.14 A cord should not be pulled or dragged over nails, hooks, or other sharp objects that may cause cuts in the insulation. In addition, cords should never be placed on radiators, steam pipes, walls, and windows. Particular attention should be placed on connections behind furniture, since files and bookcases may be pushed tightly against electrical outlets, severely bending the cord at the plug.

1.15 Disconnect electrical equipment before cleaning, adjusting, or applying flammable solutions. If a guard is removed to clean or repair parts, replace it before testing the equipment and returning the machine to service.

1.16 Only authorized persons are permitted to activate, de-activate or lockout electrical equipment.

1.17 Where there is or may be a danger to a worker, from the inadvertent operation of electrical equipment, then that equipment must be locked out and tagged prior to commencing work.

1.17.1 Switch off all appropriate devices (MCC, Distribution Panel, Disconnect).

1.17.2 Lock and tag Electrical Supply devices in the “OFF” position.

1.17.3 Test to be sure the equipment cannot be operated at the STOP-START switch.

1.17.4 Test to be sure electrical equipment is de-energized.

1.17.5 After completion of task, remove padlocks and destroy tags.

## 2.0 Inspection

2.1 Inspect tools for any damage prior to each use.

2.2 Ensure that the power tool has the correct guard, shield or other attachment that the manufacturer recommends.

2.3 Ensure that the tools are properly grounded using a three-prong plug, are double insulated (and are labeled as such), or are powered by a low-voltage isolation transformer; this will protect users from an electrical shock.

2.4 Check electric tools to ensure that a tool with a three-prong plug has an approved three-wire cord and is grounded. The three-prong plug should be plugged in a properly grounded three-pole outlet. If an adapter must be used to accommodate a two-hole receptacle, the adapter wire must be attached to a known, functioning ground. Never remove the third, grounding prong from a plug.

2.5 Check the handle and body casing of the tool for cracks or other damage.

2.6 If the tool has auxiliary or double handles, check to see that they installed securely.

2.7 Inspect cords for defects: check the power cord for cracking, fraying, and other signs of wear or faults in the cord insulation.

2.8 Any tool with a spring-operated trigger switch shall be fully functional.

2.9 Check for damaged switches and ones with faulty trigger locks.

2.10 Inspect the plug for cracks and for missing, loose or faulty prongs.

2.11 If a tool is defective, remove it from service, and tag it clearly “Out of service for repair.” Replace damaged equipment immediately – do not use defective tools “temporarily.” DO NOT ATTEMPT FIELD REPAIRS.

## 3.0 Battery Powered Tools

3.1 Use only the kind of battery that the tool manufacturer specifies for the battery-powered tool that you are using.

3.2 Recharge a battery-powered tool only with a charger that is specifically intended for the battery in that tool.

3.3 Remove the battery from the tool or ensure that the tool is switched off or locked off before changing accessories, making adjustments, or storing the tool.

3.4 Store a battery pack safely so that no metal parts, nails, screws, wrenches and so on can come in contact with the battery terminals; this could result in shorting out the battery and possibly cause sparks, fires or burns.

## 4.0 Using Electric Tools

4.1 Switch off the tools before connecting them to a power supply.

4.2 If a power cord feels more than comfortably warm or if a tool is sparking excessively, have it checked by an electrician or other qualified person.

4.3 Disconnect the power supply before making adjustments or changing accessories.

4.4 Remove any wrenches and adjusting tools before turning on a tool.

4.5 Inspect the cord for fraying or damage before each use. Tag defective tools clearly with an “Out of Service” tag and replace immediately with a tool in good running order.

4.6 During use, keep power cords clear of tools and the path that the tool will take.

4.7 Use clamps, a vice or other devices to hold and support the piece being worked on, when practical to do so. This will allow you to use both hands for better control of the tool and will help prevent injuries if a tool jams or binds in a work piece.

4.8 Use only approved extension cords that have the proper wire size for the length of cord and power requirements of the electric tool that you are using. This will prevent the cord from overheating.

4.9 For outdoor work, use outdoor extension cords marked “W-A” or “W.”

4.10 Suspend power cords over aisles or work areas to eliminate stumbling or tripping hazards.

4.11 Eliminate octopus connections: if more than one receptacle plug is needed, use a power bar or power distribution strip that has an integral power cord and a built-in overcurrent protection.

4.12 Pull the plug not the cord when unplugging a tool. Pulling the cord causes wear and may adversely affect the wiring to the plug - an electrical shock to the operator may result.

4.13 Keep power cords away from heat, water, oil, sharp edges and moving parts. They can damage the insulation and cause a shock.

4.14 Avoid accidental starting by ensuring the tool is turned off before you plug it in. Also do not walk around with a plugged-in tool with your finger touching the switch.

4.15 Do not bypass the ON/OFF switch and operate the tools by connecting and disconnecting the power cord.

4.16 Do not disconnect the power supply of the tool by pulling or jerking the cord from the outlet.

4.17 Do not leave a running tool unattended. Do not leave it until it has been turned off, has stopped running completely, and has been unplugged.

4.18 Do not use electric tools in wet conditions or damp locations unless tool is connected to a GFCI.

4.19 Do not expose electric power tools to rain or wet conditions; wet tools increase the likelihood for getting an electric shock.

4.20 Avoid body contact with grounded surfaces like refrigerators, pipes and radiators when using electric powered tools; this will reduce the likelihood of shock if the operator's body is grounded.

4.21 Do not plug several power cords into one outlet by using single-to-multiple outlet adapters or converters (“cube taps”).

4.22 Do not use light duty power cords.

4.23 Do not connect or splice extension cords together to make a longer connection; the resulting extension cord may not be able to provide sufficient current or power safely.

4.24 Do not carry electrical tools by the power cord.

4.25 Do not tie power cords in knots; knots can cause short circuits and shocks. Loop the cords or use a twist lock plug.

4.26 Never break off the third prong on a plug: replace broken three-prong plugs and make sure the third prong is properly grounded.

4.27 Never use extension cords as permanent wiring; use extension cords only as a temporary power supply to an area that does not have a power outlet.

4.28 Do not walk on or allow vehicles or other moving equipment to pass over unprotected power cords. Cords should be put in conduits or protected by placing planks on each side of them.

4.29 Do not brush away sawdust, shavings or turnings while the tool is running. Never use compressed air for cleaning surfaces or removing sawdust, metal turnings, etc.

4.30 Do not operate tools in an area containing explosive vapors or gases.

4.31 Do not clean tools with flammable or toxic solvents.

4.32 Do not surprise or touch anyone who is operating a tool. Startling a tool operator could end up causing an accident or injury.

## 5.0 Belt Sanders

5.1 Refer to *S3NA-305-WI11 Sander Safety Card*.

## 6.0 Drills

6.1 Refer to *S3NA-305-WI8 Power Drill Safety Card.*

## 7.0 Planers

7.1 Wear safety glasses.

7.2 Disconnect the planer from the power supply before making any adjustments to the cutter head or blades.

7.3 Use blades of the same weight and set at the same height.

7.4 Ensure that the blade-locking screws are tight.

7.5 Remove adjusting keys and wrenches before turning on power.

7.6 Support the material (stock) in a comfortable position that will allow the job to be done safely and accurately.

7.7 Check stock thoroughly for staples, nails, screws, or other foreign objects before using a planer.

7.8 Start a cut with the infeed table (front shoe) resting firmly on the stock and with the cutter head slightly behind the edge of the stock.

7.9 Use two hands to operate a planer - one hand on the trigger switch and the other on a front handle.

7.10 Do not put your finger or any object in a deflector to clean out chips while a planer is running.

7.11 Disconnect the power supply when stopping to dump out chips.

7.12 Do not set a planer down until blades have stopped turning.

7.13 Keep all cords clear of cutting area.

## 8.0 Routers

8.1 Wear safety glasses.

8.2 Disconnect the power supply before making any adjustments or changing bits.

8.3 Ensure that the bit is securely mounted in the chuck and the base is tight.

8.4 Put the base of the router on the work, template or guide. Make sure that the bit can rotate freely before switching on the motor.

8.5 Secure stock. Never rely on yourself or a second person to support or hold the material. Sudden torque or kickback from the router can cause damage and injury.

8.6 Before using a router, check stock thoroughly for staples, nails, screws or other foreign objects.

8.7 Keep all cords clear of cutting area.

8.8 Always hold both hands on router handles, until a motor has stopped. Do not set the router down until the exposed router bit has stopped turning.

8.9 Do not overreach. Keep proper footing and balance.

8.10 When inside routing, start the motor with the bit above the stock. When the router reaches full power, lower the bit to two times the required depth.

8.11 When routing outside edges, guide the router counter clockwise around the work.

8.12 When routing bevels, moldings and other edge work, make sure the router bit is in contact with the stock to the left of a starting point and is pointed in the correct cutting direction.

8.13 Feed the router bit into the material at a firm, controlled speed.

8.14 With softwood, you can sometimes move the router as fast as it can go. With hardwood, knotty and twisted wood, or with larger bits, cutting may be very slow.

8.15 The sound of the motor can indicate safe cutting speeds. When the router is fed into the material too slowly, the motor makes a high-pitched whine. When the router is pushed too hard, the motor makes a low growling noise.

8.16 When the type of wood or size of the bit requires going slow, make two or more passes to prevent the router from burning out or kicking back.

8.17 To decide the depth of cut and how many passes to make, test the router on scrap lumber similar to the work.

## 9.0 Circular Saws

9.1 Refer to *S3NA-305-WI2 Circular Saw Safety Card.*

## 10.0 Other Saws

10.1 Wear safety glasses.

10.2 Disconnect power supply before changing or adjusting blades.

10.3 Use lubricants when cutting metals.

10.4 Keep all cords clear of cutting area.

10.5 Position the saw beside the material before cutting and avoid entering the cut with a moving blade.

10.6 Make sure guards, if present, are installed and are working properly.

10.7 Remember sabre saws cut on the upstroke.

10.8 Secure and support stock as close as possible to the cutting line to avoid vibration.

10.9 Keeps the base or shoe of the saw in firm contact with the stock being cut.

10.10 Select the correct blade for the material being cut and allow it to cut steadily. Do not force it. Clean and sharp blades operate best.

10.11 Set the blade to go no further than 1/8 to 1/4 inch deeper than the material being cut.

10.12 Do not start cutting until the saw reaches its full power.

10.13 Do not force a saw along or around a curve. Allow the machine to turn with ease.

10.14 Do not insert a blade into or withdraw a blade from a cut or lead hole while the blade is moving.

10.15 Do not put down a saw until the motor has stopped.

10.16 Do not reach under or around the stock being cut.

10.17 Maintain control of the saw always. Avoid cutting above shoulder height.

10.18 External Cuts

10.18.1 Make sure that the blade is not in contact with the material or the saw will stall when the motor starts.

10.18.2 Hold the saw firmly down against the material and switch the saw on.

10.18.3 Feed the blade slowly into the stock, maintaining an even forward pressure.

10.19 Internal Cuts

10.19.1 Drill a lead hole slightly larger than the saw blade. With the saw switched off, insert the blade in the hole until the shoe rests firmly on the stock.

10.19.2 Do not let the blade touch the stock until the saw has been switched on.

# Hand and Power Tools Guide

S3NA-305-GL1

## 1.0 Exposure

1.1 **Employees** who use hand and power tools and are exposed to the hazards of falling, flying, abrasive, and splashing objects, or to harmful dusts, fumes, mists, vapors, or gases must be provided with the appropriate personal protective equipment (PPE) and training.

## 2.0 Basic Safety Rules

2.1 Keep all tools in good condition with regular maintenance.

2.2 Use the right tool for the job.

2.3 Examine each tool for damage before use and do not use damaged tools.

2.4 Operate tools according to the manufacturers' instructions.

2.5 Provide and use properly the right PPE.

2.6 All electrical connections for these tools must be suitable for the type of tool and the working conditions (wet, dusty, flammable vapors).

2.7 When a temporary power source is used for construction, a ground-fault circuit interrupter should be used.

2.8 Eye protection is required, and head and face protection is recommended for employees working with pneumatic tools.

2.9 Screens must also be set up to protect nearby workers from being struck by flying fragments around chippers, riveting guns, staplers, or air drills.

2.10 Compressed air guns should never be pointed toward anyone.

2.11 Workers should never "dead-end" them against themselves or anyone else.

2.12 A chip guard must be used when compressed air is used for cleaning.

2.13 Use of heavy jackhammers can cause fatigue and strains. Heavy rubber grips reduce these effects by providing a secure handhold.

2.14 Workers operating a jackhammer must wear safety glasses and safety shoes that protect them against injury if the jackhammer slips or falls. A face shield also should be used.

2.15 Hand-arm vibration exposure is associated with the use of hand tools. Consider the need for controls such as limiting your tool use time, adjusting your grip to be loose but stable, and using anti-vibration gloves.

2.16 Noise hazard is associated with pneumatic and many other tools. Working with noisy tools such as jackhammers requires proper, effective use of appropriate hearing protection.

## 3.0 Hazard Prevention Sharp Objects

3.1 **Employees**, when using saw blades, knives, or other tools, should direct the tools away from aisle areas and away from other employees working in close proximity.

3.2 Knives and scissors must be sharp; dull tools can cause more hazards than sharp ones.

3.3 Cracked saw blades and grinder disc must be removed from service.

3.4 Wrenches must not be used when jaws are sprung to the point that slippage occurs.

3.5 Impact tools such as drift pins, wedges, and chisels must be kept free of mushroomed heads.

3.6 The wooden handles of tools must not be splintered.

3.7 Iron or steel hand tools may produce sparks that can be an ignition source around flammable substances. Where this hazard exists, spark-resistant tools made of non-ferrous materials should be used where flammable gases, highly volatile liquids, and other explosive substances are stored or used.

## 4.0 Hazard Prevention of Power tools

4.1 Precautions

4.1.1 Never carry a tool by the cord or hose.

4.1.2 Never yank the cord or the hose to disconnect it from the receptacle.

4.1.3 Keep cords and hoses away from heat, oil, and sharp edges.

4.1.4 Disconnect tools when not using them, before servicing and cleaning them, and when changing accessories such as blades, bits, and cutters.

4.1.5 Keep all people not involved with the work at a safe distance from the work area.

4.1.6 Secure work with clamps or a vise, freeing both hands to operate the tool.

4.1.7 Avoid accidental starting. Do not hold fingers on the switch button while carrying a plugged-in tool.

4.1.8 Maintain tools with care; keep them sharp and clean for best performance.

4.1.9 Follow instructions in the user's manual for lubricating and changing accessories.

4.1.10 Be sure to keep good footing and maintain good balance when operating power tools.

4.1.11 Wear proper apparel for the task. Loose clothing, ties, or jewelry can become caught in moving parts.

4.1.12 Remove all damaged portable electric tools from use and tag them: "Do Not Use."

4.2 Guards

4.2.1 The exposed moving parts of power tools need to be safeguarded. Belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating, or moving parts of equipment must be guarded.

4.2.2 Machine guards, as appropriate, must be provided to protect the operator and others from the following:

- Point of operation.
- In-running nip points.
- Rotating parts.
- Flying chips and sparks.
- Safety guards must never be removed when a tool is being used. Portable circular saws having a blade greater than 2 inches (5.08 centimeters) in diameter must be equipped at all times with guards.
- An upper guard must cover the entire blade of the saw. A retractable lower guard must cover the teeth of the saw, except where it makes contact with the work material. The lower guard must automatically return to the covering position when the tool is withdrawn from the work position.

## 5.0 Operating Controls and Switches

5.1 The following hand-held power tools must be equipped with a constant-pressure switch or control that shuts off the power when pressure is released: drills; tappers; fastener drivers; horizontal, vertical, and angle grinders with wheels more than 2 inches (5.08 centimeters) in diameter; disc sanders with discs greater than

2 inches (5.08 centimeters); belt sanders; reciprocating saws; saber saws, scroll saws, and jigsaws with blade shanks greater than 1/4-inch (0.63 centimeters) wide; and other similar tools.

5.2 These tools also may be equipped with a “lock-on” control, if it allows the worker to also shut off the control in a single motion using the same finger or fingers.

5.3 The following hand-held power tools must be equipped with either a positive “on-off” control switch, a constant pressure switch, or a “lock-on” control:

5.3.1 Disc sanders with discs 2 inches (5.08 centimeters) or less in diameter.

5.3.2 Grinders with wheels 2 inches (5.08 centimeters) or less in diameter.

5.3.3 Platen sanders, routers, planers, laminate trimmers, nibblers, shears, and scroll saws; and jigsaws, saber and scroll saws with blade shanks a nominal 1/4-inch (6.35 millimeters) or less in diameter.

5.3.4 It is recommended that the constant-pressure control switch be regarded as the preferred device.

5.3.5 Other hand-held power tools such as circular saws having a blade diameter greater than 2 inches (5.08 centimeters), chain saws, and percussion tools with no means of holding accessories securely must be equipped with a constant-pressure switch.

## 6.0 Electrical Shock Caution

6.1 Electrical shocks, which can lead to injuries such as heart failure and burns, are among the major hazards associated with electric powered tools. Under certain conditions, even a small amount of electric current can result in fibrillation of the heart and death.

6.2 An electric shock also can cause the worker to fall off a ladder or other elevated work surface and be injured due to the fall.

6.3 To protect the worker from shock and burns, electric tools must have a three-wire cord with a ground and be plugged into a grounded receptacle, be double insulated, or be powered by a low-voltage isolation transformer.

6.4 Three-wire cords contain two current-carrying conductors and a grounding conductor. Any time an adapter is used to accommodate a two-hole receptacle, the adapter wire must be attached to a known ground.

6.5 The third prong must never be removed from the plug.

6.6 Double-insulated tools are available that provide protection against electrical shock without third-wire grounding. On double-insulated tools, an internal layer of protective insulation completely isolates the external housing of the tool.

## 7.0 Electric Tools General Practice

7.1 Operate electric tools within their design limitations.

7.2 Use gloves and appropriate safety footwear when using electric tools.

7.3 Store electric tools in a dry place when not in use.

7.4 Do not use electric tools in damp or wet locations unless they are approved for that purpose.

7.5 Keep work areas well lighted when operating electric tools. Ensure that cords from electric tools do not present a tripping hazard.

7.6 In the construction industry, employees who use electric tools must be protected by ground-fault circuit interrupters or an assured equipment-grounding conductor program.

## 8.0 Pneumatic Tools (powered by compressed air)

8.1 There are several dangers associated with the use of pneumatic tools. First and foremost is the danger of getting hit by one of the tool's attachments or by some kind of fastener the worker is using with the tool.

8.2 Pneumatic tools must be checked to see that the tools are fastened securely to the air hose to prevent them from becoming disconnected.

8.3 A short wire or positive locking device attaching the air hose to the tool must also be used and will serve as an added safeguard.

8.4 If an air hose is more than 1/2-inch (12.7 millimeters) in diameter, a safety excess flow valve must be installed at the source of the air supply to reduce pressure in case of hose failure.

8.5 In general, the same precautions should be taken with an air hose that are recommended for electric cords, because the hose is subject to the same kind of damage or accidental striking, and because it also presents tripping hazards.

8.6 When using pneumatic tools, a safety clip or retainer must be installed to prevent attachments such as chisels on a chipping hammer from being ejected during tool operation.

8.7 Pneumatic tools that shoot nails, rivets, staples, or similar fasteners and operate at pressures more than 100 pounds per square inch (6,890 kPa), must be equipped with a special device to keep fasteners from being ejected, unless the muzzle is pressed against the work surface.

8.8 Airless spray guns that atomize paints and fluids at pressures of 1,000 pounds or more per square inch (6,890 kPa) must be equipped with automatic or visible manual safety devices that will prevent pulling the trigger until the safety device is manually released.

## 9.0 Liquid Fuel Tools (operated with gasoline)

9.1 The worker must be careful to handle, transport, and store gas or fuel only in approved flammable liquid containers, according to proper procedures for flammable liquids.

9.2 Before refilling a fuel-powered tool tank, the worker must shut down the engine and allow it to cool to prevent accidental ignition of hazardous vapors.

9.3 When a fuel-powered tool is used inside a closed area, effective ventilation and/or proper respirators such as atmosphere-supplying respirators must be utilized to avoid breathing carbon monoxide.

9.4 Noise hazards associated with gasoline engines must be mitigated by proper hearing protection utilization. Ear plugs, ear muffs or a combination of the two must be used to protect workers from excessive noise levels.

9.5 Fire extinguishers must also be available in the area.

## 10.0 Hydraulic Power Tools (fluid run)

10.1 The fluid used in hydraulic power tools must be an approved fire-resistant fluid and must retain its operating characteristics at the most extreme temperatures to which it will be exposed. The exception to fire-resistant fluid involves all hydraulic fluids used for the insulated sections of derrick trucks, aerial lifts, and hydraulic tools that are used on or around energized lines. This hydraulic fluid shall be of the insulating type.

10.2 The manufacturer's recommended safe operating pressure for hoses, valves, pipes, filters, and other fittings must not be exceeded.

10.3 All jacks—including lever and ratchet jacks, screw jacks, and hydraulic jacks—must have a stop indicator, and the stop limit must not be exceeded. Also, the manufacturer's load limit must be permanently marked in a prominent place on the jack, and the load limit must not be exceeded.

10.4 A jack should never be used to support a lifted load. Once the load has been lifted, it must immediately be blocked up. Put a block under the base of the jack when the foundation is not firm, and place a block between the jack cap and load if the cap might slip.

10.5 To set up a jack, make certain of the following:

10.5.1 The base of the jack rests on a firm, level surface;

10.5.2 The jack is correctly centered;

10.5.3 The jack head bears against a level surface; and

10.5.4 The lift force is applied evenly.

10.6 Proper maintenance of jacks is essential for safety. All jacks must be lubricated regularly. In addition, each jack must be inspected according to the following schedule:

10.6.1 For jacks used continuously or intermittently at one site—inspected at least once every 6 months;

10.6.2 For jacks sent out of the shop for special work—inspected when sent out and inspected when returned; and

10.6.3 For jacks subjected to abnormal loads or shock—inspected before use and immediately thereafter.

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# Highway and Road Work

**S3NA-306-PR1**

## 1.0 Purpose and Scope

1.1 To address potential hazards that may occur during highway construction or during work within the right of way of a public or private roadway.

1.2 This procedure applies to all AECOM Americas-based employees and operations.

## 2.0 Terms and Definitions

2.1 **Personal Protective Equipment (PPE)** – Safety clothing and equipment worn by workers in traffic areas to provide protection and heightened visibility from physical hazards including moving vehicles and construction equipment.

2.2 **Traffic areas** – Any work area where workers are located within 20 feet of moving traffic, existing or anticipated.

2.3 **Traffic Protection Plan** – A detailed plan for the protection of workers in a work zone. The plan must contain a written description of the traffic hazards to which workers may be exposed and measures used to protect them meeting local legislation.

2.4 **Traffic Control Plan** – A detailed plan for the control of traffic during construction, maintenance, or utility operations on a highway/road, taking into account the organized, systematic, safe conduct of the project, including, as applicable, detours, staging sequences, work vehicle access and egress from work sites, temporary barriers, removal of old pavement markings and selection and planned implementation of appropriate typical layouts for traffic control. Plan must be written to meet local legislation.

2.5 **WOF –** Workers on foot.

## 3.0 References

3.1 Learning Management System (LMS)

3.2 S3NA-208-PR1 Personal Protective Equipment Program

3.3 S3NA-209-PR1 Project Hazard Assessment and Planning

3.4 Transportation Association of Canada, Manual of Uniform Traffic Control Devices for Canada (2014)

3.5 U.S. Department of Transportation – Federal Highway Administration (FHWA) – Manual of Uniform Traffic Control Devices (2009 edn. With revision number 1 and 2 incorporated, dated May 2012)

## 4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Project Manager or Supervisor**

- Responsible for administering the procedure and for determining the measures and configuration of the temporary traffic control zone in accordance with specifications for workers, motorists, and pedestrians, and the protection of AECOM employees.
- See that employees assigned to work in traffic areas are trained in the use of traffic control systems and Personal Protective Equipment (PPE).

4.1.2 **Flag Person**

- Stand in a safe position, be clearly visible, have an unobstructed view of approaching traffic, and be positioned at least 80 feet (25 meters) away from the work area unless circumstances

or space requirements, such as working at or near an intersection, dictate otherwise.

- Trained and competent and will use appropriate PPE.
- Instructed in traffic control and flagging procedures, will be provided with sufficient breaks, and will not be permitted to work alone for extended periods as per local legislation.
- Not to engage in conversation with motorists except to provide clear instructions and will stay alert at their points of duty until relieved.

4.1.3 **Site Safety Officer**

- Responsible to the **Project Manager/Supervisor** for the implementation of safety and the internal traffic protection and control plans within a highway/road worksite.
- Be responsible for traffic safety coordination on the specified project.
- Have training in the requirements of the governing transportation authority and the applicable Occupational Health and Safety legislation.
- Be involved in conducting hazard assessments, developing the mitigating strategies and Safe Job Procedures, and reviewing their implementation for any project where traffic is identified as a hazard to AECOM staff.

4.2 Training

4.2.1 **Employees** who have potential exposures to highway and road hazards shall be trained. Refer to the *S3NA-209-PR1 Project Hazard Assessment and Planning* for specific required training assigned in the LMS.

4.2.2 All staff will receive on-site orientation to the hazards and controls.

4.2.3 Only staff with appropriate flag person (traffic control) training will act as a **flag person**.

4.2.4 **Flag persons** must be instructed on the specific project traffic control plan.

4.2.5 **Flag persons** must be trained/certified in signalling methods required by the authority in charge.

4.2.6 **WOF**, **equipment operators**, and **drivers** in internal work zones must know the routes that construction vehicles will use.

4.2.7 **Equipment operators** and **signal persons** must know the hand signals used on the worksite.

4.2.8 **Operators** and **WOF** must know the visibility limits and the "blind spots" for each vehicle on site.

4.2.9 **Workers** should be made aware of the ways in which hazards associated with shift work and night work may affect their performance.

4.3 PPE

4.3.1 PPE requirements shall be determined based on the task hazard analysis. Refer to the *S3NA-208-PR1 Personal Protective Equipment Program*.

- High visibility safety vest/apparel with retro-reflective stripes (American National Standards Institute/Canadian Standards Association [ANSI/CSA] Class II at minimum).
- Work conducted at night may require that the minimum level of apparel worn be, at minimum.
- ANSI/CSA Class III, as required by governing legislation.
- Protective headwear, foot wear, safety glasses and hearing protection.
- Two-way radio or other means of effective communication.

4.4 Traffic accommodation equipment, as required by the Traffic Protection Plan

The traffic accommodation equipment could entail:

- A rooftop beacon light for the vehicle, where required

- Pylons, Glo-posts, flags, barricades and/or flagging tape, warning lights, flashing light boards
- Signage
- Flagging equipment, as required:
  - Daytime:
    - Flag person's "Stop and Slow" paddle
    - PPE including high-visibility clothing meeting local legislation.
    - Drinking water
    - Bug repellent and/or sun screen as conditions warrant
    - Optional radio communication (if required)
  - Night time (additional requirements):
    - A retro-reflective "Stop and Slow" paddle
    - A flashlight fitted with a red signaling baton
    - Flashing yellow beacons set up in advance of the **flag person**
    - Additional night time PPE

4.5 Traffic Control Plan

4.5.1 Each **Project Manager** shall prepare a project Traffic Protection Plan addressing traffic controls and worker protection appropriate for the team's exposures. The Traffic Protection Plan may be a stand-alone document, or contained within the project Health and Safety Plan or Safe Work Plan if allowed by legislation. Plans shall address the following if applicable:

- Closure zones within the project boundaries
- Work zone protections: various styles of concrete, water, sand, collapsible barriers, crash cushions, and truck mounted attenuators
- Guide vehicles
- Communications
- Night operations work within traffic controls
- PPE
- Sanitation
- Traffic control plans and permits
- Training
- Worker and heavy mobile equipment interface

4.5.2 A Traffic Control Plan will be completed for the movement of vehicles in areas where workers are conducting other tasks.

4.5.3 **Drivers**, **WOF** and pedestrians will be able to see and understand the routes they are to follow.

4.5.4 Where there are several projects, coordinated vehicle routes and communication between contractors will reduce vehicular struck-by incidents.

4.5.5 Hazard identification and plan development shall be performed in accordance with this procedure. The plans shall include the identification of the responsibility for personnel and implementation of the safety program under highway construction activities.

4.5.6 Other requirements for supporting activities such as excavations, heavy equipment usage, personal protective equipment, etc. shall be applicable and addressed in accordance with other procedures.

- A traffic protection plan will be an integral part of the Health and Safety Plan or Safe Work Plan whenever staff will be exposed to the hazards of vehicular traffic during project work (this may include surveys, drilling and soils inspections, bridge or overpass inspections, inspection of roadway construction projects).
- Work duration, road width, and traffic volume are some of the key considerations to be contemplated when designing a Traffic Protection Plan. The Traffic Protection Plan will address the specific vehicular hazards and describe the measures that will be implemented to protect employees.
- Traffic Control and Protection Plan will be developed in consultation with a qualified supervisor or manager experienced in traffic control. In addition, a supervisor will be designated to oversee the implementation of the protection plan until work is completed.
- Occupational Health and Safety regulations and associated standards or guidebooks provide instruction on the use of traffic control devices in temporary construction, maintenance, and utility work zones for worker and motorist safety and to minimize the disruption of traffic flow.
- Schedule work to avoid periods of heavy traffic.
- Alert traffic of work ahead, by placing signs or cones well ahead of the work area.
- If the work area is being managed under a Traffic Control Plan or Traffic Protection Plan, obtain copies of these plans before commencing work.
- Traffic accommodation that is adequate in good weather conditions and daylight may not be adequate under adverse weather conditions and/or hours of darkness. Reassess the accommodation based on conditions.
- Traffic accommodation will be planned to provide safe conditions for the protection and safe passage of motorists, pedestrians, and employees at all work sites. It will include all areas located within the traveled portion of a roadway including shoulders, ditches, and boulevards.

4.6 Restrictions

4.6.1 Applicable legislated requirements governing all aspects of traffic safety, including directing traffic, signage, PPE, traffic control devices in temporary construction, maintenance and utility work zones, will be reviewed in preparation for the site-specific traffic control, protection or accommodation plan.

4.6.2 No personnel will be allowed onto the site without first reviewing the project-specific Traffic Protection Plan.

4.7 Short-Term Traffic Protection

4.7.1 Always wear the appropriate PPE to maintain your visibility to vehicular traffic. Wear a tear-away fluorescent reflective vest (and retro-reflective stripes on the arms and legs for night work or during periods of limited visibility) at all times.

4.7.2 Pull your vehicles off as far to the right of the travelled portion of the road as possible. Confirm that the shoulder of the highway or street where you will park your vehicle is wide enough to allow for safe access to and egress from the vehicle.

4.7.3 Always park your vehicle at least 100 feet (30 metres) from the flag person station. The vehicle should be positioned between the **flag person** and the work crew.

4.7.4 Activate the four-way flashers and rotating beacon (if required) for your vehicle prior to exiting the vehicle.

4.7.5 Plan an escape route prior to exiting the vehicle.

4.7.6 Load and unload materials or equipment from the passenger side of the vehicle.

4.7.7 Avoid turning your back to oncoming traffic.

4.7.8 Be aware of mobile equipment that may be operating in the work area.

4.7.9 Do not enter onto the travelled portion of the road except to cross the road. Road crossings should be made at a 90 degree angle to the direction of the road.

4.8 Long-Term Traffic Protection

4.8.1 Traffic accommodation will be provided BEFORE the work starts and will be maintained until the work is completed.

4.8.2 Generally, for long-term duration work activities that are performed at construction projects, the Constructor of the project is required to develop a Traffic Protection Plan.

4.8.3 If AECOM has assumed the role of Constructor for the project, the Traffic Protection Plan will be developed and implemented prior to the commencement of work activities at the project.

4.8.4 If AECOM is not the Constructor for the project, the traffic Protection Plan for the project will be developed by our Client or a Constructor designated by the Client.

4.8.5 The Traffic Protection Plan should be reviewed with AECOM employees during orientation to the project.

4.9 Signage

4.9.1 Standard highway signs for information, speed limits, and work zones will assist drivers in identifying designated traffic paths.

4.9.2 Provide appropriate instructional signage such as: EVACUATION ROUTE; DO NOT ENTER; REDUCED SPEED AHEAD; ROAD CLOSED; and NO OUTLET.

4.9.3 Using standard highway signs for internal construction worksite traffic control will assist workers in recognizing the route they are to use at the construction site.

4.9.4 Traffic Signs

- Signage will be of acceptable standards, in good condition, clean, legible, suited to the purpose, and meeting local legislation requirements
- Signage will be secured or weighted.
- Routinely inspect signage for placement, cleanliness, and physical damage.
- Cover road traffic control signage when no activity is present.

4.10 Traffic Control Devices

4.10.1 Standard traffic control devices, signals, and message boards will instruct drivers to follow a path away from where work is being done.

4.10.2 The authority in charge will determine the approved traffic control devices such as cones, barrels, barricades, and delineator posts that will be used as part of the Traffic Control Plan.

4.11 Work Zone Protections

4.11.1 Various styles of concrete, water, sand, collapsible barriers, crash cushions, and truck-mounted attenuators shall be used to limit motorist intrusions into the construction work zone, as appropriate.

4.11.2 All AECOM staff shall be made aware of controls established by the Contractor.

4.11.3 AECOM staff shall wear the required safety equipment at all times.

4.11.4 In the absence of a contractor, when AECOM staff are in the field alone—e.g., investigations, surveys—all appropriate Department of Transportation traffic control standards and devices shall be observed and placed in position.

4.11.5 The work zone shall be made safe by its separation from traffic.

4.12 Flagging

4.12.1 **Flag persons** and others providing temporary traffic control will wear Class 2 or 3 high visibility retro-reflective clothing in compliance with local legislation.

4.12.2 Drivers should be warned in advance with signs that there will be a **flag person** ahead.

4.12.3 **Flag person** should use STOP/SLOW signs or paddles. The STOP sign should be octagonal with a red background and white letters and border. The SLOW sign should be octagonal with an orange background and black letters and a border.

4.12.4 "Flag Person Ahead" signs will be posted in advance of each flag person's station. Such signs will be removed promptly when the flagging operation terminates.

4.13 Lighting

4.13.1 Flag person stations should be illuminated. Lighting for workers on foot and equipment operators is to be at least 5 foot (1.5 meter) candles or greater.

4.13.2 Where available lighting is not sufficient, flares or chemical lighting should be used.

4.13.3 Glare affecting workers and motorists should be controlled or eliminated.

4.14 Driving

4.14.1 Seatbelts and rollover protection will be used on equipment and vehicles as stated by the manufacturer.

4.14.2 When pulling off to the side of the road, AECOM personnel will park their vehicles at minimum of 20 feet (6 meters) or the width of two traffic lanes from moving traffic.

4.15 Night Operations and Work within Traffic Controls

4.15.1 Night work on roadways should not be done unless absolutely necessary and unless the work area is adequately lit.

4.15.2 Operations with night activities will have a written plan that addresses the safety issues of working at night. The plan will address, but is not limited to:

- Reflectivity
    - All equipment used in the work zone shall have ANSI/CSA approved reflective material placed to increase the visibility of the equipment.
    - All reflective surfaces shall be cleaned as required so that the reflectivity of the material is not degraded. Any areas of reflective surface that is damaged or obscured will be replaced.
    - Personnel working at night will have reflective tape on their hardhats and will wear retro-reflective vests and each limb that meet the legislative requirements.
    - Additional measures such as white disposable coveralls, reflective bands, flashlights with red cones and personal battery-operated strobe lights may be used when practical.
- Illumination
    - Whenever feasible and practical, light plants will be used to illuminate the work area.
    - On mobile operations, additional lighting on equipment may be used to illuminate the work area.
    - All equipment shall have working lights and at a minimum, have working strobe or warning beacon lights.
    - All flag persons will be placed in illuminated areas only.

- All lighting is to be checked after setup to confirm that it is not interfering with approaching traffic, other equipment in the work zone, and meets the legislative Occupational Health and Safety requirements.

- Task Hazard Analysis and Communication
  - Prior to the start of any night operation, a detailed task hazard analysis will be made addressing the possible hazards of night work. Refer to the *S3NA-209-PR1 Project Hazard Assessment and Planning*. The task hazard analysis will be reviewed with the crews and updated as needed. At the start of each shift, a Daily Safety Reminder will be used to reaffirm the provisions of the night work requirements as found in the task hazard analysis and this policy.
  - The task hazard analysis should also provide for:
    - The selection of a competent person responsible for maintaining surveillance on the work area to alert other workers of vehicles encroaching on the work zone.
    - A method to signal workers when vehicles encroach on the work zone.
    - A system to account for workers at all times, which may include a buddy system.
    - Emergency communication or warning signals used by a worker such as a radio, signal horn, or whistle, which will be used to call for help.

4.16 Attenuator Vehicles

4.16.1 It is good construction practice to place an attenuator truck or pick-up truck (minimum) immediately ahead of workers in a work zone.

4.16.2 The vehicle of choice should be placed to provide the best protection for workers.

4.16.3 The tires should be placed so that when struck the vehicle will turn away from workers.

4.17 Closures within a Closure

4.17.1 On occasion, satellite operations may be performed under full freeway traffic closures. For this type of work, special precautions referred to as a "closure within a closure" is to be implemented in accordance with the following:

- Posted speed limits within closures should be set at 15 miles (24 kilometers) per hour.
- Signs are to be installed approximately 250 feet (76 meters) in advance of and behind the work zone to alert drivers who may approach from either direction of the upcoming work zone.
- The work area is to be completely delineated with Type 1 barricades (candlesticks).
- Any vehicle used for AECOM field work shall be equipped with a functioning four way flashers and rotating beacon placed on the roof of the vehicle.

## 5.0 Records

5.1 Traffic Protection Plans, Traffic Control Plans and completed Equipment Checklists will be maintained in project files.

## 6.0 Attachments

6.1 S3NA-306-FM1 Equipment Checklist

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# Equipment Checklist

**S3NA-306-FM1**

Name of Contractor: _____ Project Name: _____

Location: _____ Project #: _____

Date: _____ Time: _____ Weather: _____

Person Conducting Inspection _____ Title: _____

*Note: As you conduct your inspection you should be able to answer each question with a **YES**. If the answer to any question is **NO,** this deficiency should be corrected as soon as possible.*

| | YES | NO | Deficiency Corrected? OK | N/A |
|---|---|---|---|---|
| Are accident prevention signs, tags clearly visible? | ☐ | ☐ | ☐ | ☐ |
| Are danger signs used where immediate hazards exist? | ☐ | ☐ | ☐ | ☐ |
| Are caution signs used to warn against potential hazards or to caution against unsafe practices? | ☐ | ☐ | ☐ | ☐ |
| Are exit signs posted at all exit locations? | ☐ | ☐ | ☐ | ☐ |
| Are proper visual warning signs posted prior to (in advance of) the work area? | ☐ | ☐ | ☐ | ☐ |
| Are flaggers provided with signs, signals, and barricades to provide the necessary protection? | ☐ | ☐ | ☐ | ☐ |
| Are flaggers using red lights when signaling during periods of darkness? | ☐ | ☐ | ☐ | ☐ |
| Are flaggers wearing highly visible warning garments? | ☐ | ☐ | ☐ | ☐ |
| Are the flaggers trained in proper flagging procedures? | ☐ | ☐ | ☐ | ☐ |
| Are warning garments worn at night reflectorized? | ☐ | ☐ | ☐ | ☐ |
| Are highly visible flags used by the flaggers at least 18 inches (45 centimeters) square? | ☐ | ☐ | ☐ | ☐ |
| Are barricades used to totally obstruct the passage of people and vehicles to protect the work area? | ☐ | ☐ | ☐ | ☐ |
| Do barricades meet the requirements set forth in the Manual of Uniform Traffic Control Devices? | ☐ | ☐ | ☐ | ☐ |

**COMMENTS:**

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# Housekeeping, Worksite

**S3NA-307-PR1**

## 1.0 Purpose and Scope

1.1 This procedure provides AECOM's work practices as well as personal hygiene and work site sanitation standards for housekeeping.

1.2 Applies to all AECOM Americas-based staff and field worksites.

## 2.0 Terms and Definitions

2.1 None

## 3.0 References

3.1 S3NA-103-PR1 Housekeeping, Office

3.2 S3NA-208-PR1 Personal Protective Equipment Program

## 4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Supervisor (or Project Manager)**

Responsible for the procedure's implementation and the details of addressing housekeeping policy within the worksite.

4.1.2 **SH&E Department**

Monitor, assess, and report on project housekeeping when visiting worksites.

4.1.3 **Employees**

Responsible for reporting any areas of concern to the **Supervisor** for prompt resolution as well as for maintaining worksites that are free from debris, clutter, and slipping or tripping hazards.

4.2 Smoking, Eating, and Drinking

4.2.1 Eating and drinking will be permitted in designated areas at AECOM project sites and as specified on client sites.

4.2.2 Smoking will be permitted only in areas:

- designated in compliance with applicable local laws, regulations, legislation, and ordinances, by the Supervisior
- situated in locations that are not in the immediate vicinity of activities associated with work site activities
- Free of fire hazard
- That will not contaminate indoor areas and HVAC systems. Specifically, there shall be no smoking within 16 feet (5 meters ) around doorways, windows, air vents, and HVAC intakes and equipment.

Additionally, **Supervisiors** will designate each smoking area giving primary consideration to those employees who do not smoke.

4.2.3 **Employees** involved in the performance of certain activities will not be permitted to smoke, eat, drink, or use smokeless tobacco, except during breaks (e.g., HAZWOPER-controlled work areas).

4.2.4 Site **employees** will first wash hands and face after completing work activities and prior to eating or drinking.

4.3 Water Supply

Water supplies will be available for use on site and will comply with the following requirements:

- Potable Water: An adequate supply of drinking water will be available for site staff consumption. Potable water can be provided in the form of approved well or city water, bottled water, or drinking fountains. Where drinking fountains are not available, individual use cups will be provided as well as adequate disposal containers. Potable water containers will be properly identified in order to distinguish them from nonpotable water sources.
- Nonpotable Water: Nonpotable water will not be used for drinking purposes. Nonpotable water may not be used for hand washing or other personal hygiene activities but may be used for other types of cleaning activities. All containers/supplies of nonpotable water used will be properly identified and labeled as such.

4.4 Toilet Facilities

4.4.1 Toilet facilities will be available for site staff and visitors. Should subcontractor staff be located on-site for extended periods, it may become necessary to obtain temporary toilet facilities. Exceptions to this requirement will apply to mobile crews where work activities and locations permit transportation to nearby toilet facilities.

4.4.2 A minimum of one toilet will be provided for every 20 site staff, with separate toilets maintained for each sex, except where there are less than five total staff on site. For mobile crews where work activities and locations permit use of nearby toilet facilities (e.g., gas station, or rest stop), on-site facilities are not required.

4.5 Washing Facilities

4.5.1 Hand and Face: Site staff will wash hands and face after completing work activities and prior to breaks, lunch, or completion of workday.

4.5.2 Personal Cleaning Supplies: Cleaning supplies at AECOM project sites will consist of soap, water, and disposable paper towels or items of equal use/application (e.g., anti-bacterial gels, wipes, etc.).

4.6 Clothing and Personal Protective Equipment (PPE)

4.6.1 All PPE will be kept clean at all times and maintained in accordance with the manufacturer's, AECOM's. and applicable regulatory, legislative, or provincial requirements. Refer to the *S3NA--208-PR1 Personal Protective Equipment Program*.

4.6.2 General Work Areas - At all times work areas will be kept free of dirt and debris that may impact the safety of site staff and visitors. All trash receptacles will be emptied regularly.

4.6.3 Break Areas and Lunchrooms - Site staff will observe the following requirements when using break areas and lunchrooms at AECOM project sites:

4.6.4 All food and drink items will be properly stored when not in use.

4.6.5 Food items will not be stored in personal lockers for extended periods in order to prevent the potential for vermin infestation.

4.6.6 Perishable foods will be refrigerated whenever possible.

4.6.7 All waste food containers will be discarded in trash receptacles.

4.6.8 All tables, chairs, counters, sinks, and similar surfaces will be kept clean and free of dirt, waste food, and food containers at all times.

4.6.9 Refrigerators used to store food items will be maintained at 45 degrees Fahrenheit and emptied of all unclaimed food items weekly. Refrigerators used to store food will be labeled as such so that only food and drinks are stored within the refrigerator.

4.6.10 Routine cleaning of refrigerators will also be performed on a regular basis.

4.7 Vermin Control

4.7.1 Every enclosed workplace shall be constructed, equipped, and maintained, so far as reasonably practicable, to prevent the entrance or harborage of rodents, insects, and other vermin.

4.7.2 A continuing and effective extermination program shall be instituted where the presence of rodents, insects, or other vermin is detected.

4.8 General Housekeeping

4.8.1 All work areas shall be kept clean to the extent that the nature of the work allows.

4.8.2 Every work area shall be maintained, so far as practicable, in a dry condition. Where wet processes are used, drainage shall be maintained and platforms, mats, or other dry standing places shall be provided, where practicable, or appropriate waterproof footgear shall be provided.

4.8.3 Protruding objects or placement of materials on paths or foot traffic areas present a problem with regard to slips, trips, falls, and puncture wounds. Employees will use a reasonable amount of effort to keep slip, trip, and fall hazards to a minimum.

4.8.4 Excess debris and trash will be collected and stored in an appropriate container (e.g., plastic trash bags, garbage can, roll-off bin) prior to disposal.

4.8.5 At no time will debris or trash be intermingled with waste PPE or contaminated materials.

4.8.6 Material and equipment must be placed, stacked, or stored in a stable and secure manner. Stacked material or containers must be stabilized as necessary by interlocking, strapping, or other effective means of restraint to protect the safety of workers.

4.8.7 An area in which material may be dropped, dumped, or spilled must be guarded to prevent inadvertent entry by workers or protected by adequate covers and guarding.

4.8.8 Floors, platforms, ramps, stairs, and walkways available for use by workers must be maintained in a state of good repair and kept free of slipping and tripping hazards. If such areas are taken out of service, the employer must take reasonable means for preventing entry or use.

4.8.9 Site ice / snow conditions shall be assessed prior to the start of work each day and controls for removal of ice or slip risk mitigation shall be implemented as necessary.

4.8.10 Hazardous areas not intended to be accessible to workers must be secured by locked doors or equivalent means of security and must not be entered unless safe work procedures are developed and followed.

4.8.11 Worksite Offices and Trailers - Worksite offices and trailers will be maintained in accordance with *S3NA-103-PR1 Housekeeping, Office.*

## 5.0 Records

5.1 None

## 6.0 Attachments

6.1 None

# S3NA-308-PR Manual Lifting, Field

## 1.0 Purpose and Scope

1.1 This procedure provides the requirements for use when performing manual materials handling activities (e.g., lifting/handling of items or materials).

1.2 This procedure applies to all field staff for AECOM North America-based operations.

## 2.0 Terms and Definitions

2.1 **Manual Materials Handling:** Moving or handling things by lifting, lowering, pushing, pulling, carrying, holding, or restraining.

2.2 **Team Handling:** Team handling occurs when more than one person is involved during the lift.

## 3.0 Attachments

3.1 S3NA-308-WI Manual Lifting Safe Work Practices

## 4.0 Procedure

### 4.1 Roles and Responsibilities

4.1.1 The **Project Manager** will effectively implement the procedure, providing resources as required, and providing direction on proper lifting/handling techniques.

4.1.2 The **Region SH&E Manager** will assist in identifying activities with a high potential for lifting/handling strains/injuries as well as the associated mitigation strategies and training on proper lifting/manual materials handling techniques.

4.1.3 **Employees** are responsible for reviewing and following *S3NA-308-WI Manual Lifting Safe Work Practices*.

### 4.2 Mechanical Controls

4.2.1 Mechanical equipment or assistance such as dollies, carts, come-alongs, or rollers are preferable to be used whenever possible rather than the employee physically moving materials.

4.2.2 Mechanical assistance will be of proper size, have wheels sized for the terrain, and be designed to prevent pinching or undue stress on wrists.

4.2.3 Objects to be moved will be secured to prevent falling and properly balanced to prevent tipping.

### 4.3 Administrative Controls

4.4 When significant, sustained lifting work is required, it is desirable to rotate employees to spread the work load among several people and thereby avoid fatigue.

4.5 Rotation is not simply performing a different job but instead is performing a job that utilizes a completely different muscle group from the ones that have been overexerted.

## 5.0 Records

5.1 None

## 6.0 References

6.1 OSHA Technical Manual: http://www.osha.gov/dts/osta/otm/otm_vii/otm_vii_1.html

6.2 National Safety Council: www.nsc.org


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# S3NA-308-WI Manual Lifting Safe Work Practices

## 1.0 General

### 1.1 Before Performing a Lift:

1.1.1 Check to see if mechanical aids such as hoists, lift trucks/dollies, or wheelbarrows are available.

1.1.2 Do not lift if you are not sure that you can handle the load safely.

1.1.3 Confirm that, based on your own physical capabilities and medical limitations, you can lift the load without overexertion. Get help with heavy or awkward loads.

1.1.4 Confirm that the load is “free” to move.

1.1.5 Check that the planned destination of the load is free of obstacles and debris.

1.1.6 Confirm that the path to the planned destination of the load is clear. Grease, oil, water, litter, and debris can cause slips and falls.

1.1.7 Particular handling and lifting techniques are needed for different kinds of loads or materials being handled (for example, compact loads, small bags, large sacks, drums, barrels, cylinders, and sheet materials like metal or glass). See Section 2.0 for additional guidance.

### 1.2 General Tips for Lifting

1.2.1 Prepare for the lift by warming up the muscles.

1.2.2 Make certain that your balance is good. Feet should be shoulder width apart, with one foot beside and the other foot behind the object that is to be lifted.

1.2.3 Bend the knees; do not stoop. Keep the back straight, but not vertical. There is a difference. Tucking in the chin straightens the back.

1.2.4 Grip the load with the palms of your hands and your fingers. The palm grip is much more secure. Tuck in the chin again to make certain your back is straight before starting to lift.

1.2.5 Use your body weight to start the load moving, then lift by pushing up with the legs. This makes full use of the strongest set of muscles.

1.2.6 Keep the arms and elbows close to the body while lifting.

1.2.7 Carry the load close to the body. Do not twist your body while carrying the load. To change direction, shift your foot position and turn your whole body.

1.2.8 Watch where you are going!

1.2.9 To lower the object, bend the knees. Do not stoop. To deposit the load on a bench or shelf, place it on the edge and push it into position. Confirm that your hands and feet are clear when placing the load.

### 1.3 Engineering Controls:

1.3.1 Material handling tasks should be designed to minimize the weight, range of motion, and frequency of the activity.

1.3.2 Alter the task to eliminate the hazardous motion and/or change the position of the object in relation to the employee's body—such as adjusting the height of a pallet or shelf.

1.3.3 Work methods and stations should be designed to minimize the distance between the person and the object being handled.

1.3.4 High-strength push-pull requirements are undesirable, but pushing is better than pulling. Material handling equipment should be easy to move, with handles that can be easily grasped in an upright posture.

1.3.5 Workbench or workstation configurations can force people to bend over. Corrections should emphasize adjustments necessary for the employee to remain in a relaxed upright stance or fully supported seated posture. Bending the upper body and spine to reach into a bin or container is highly

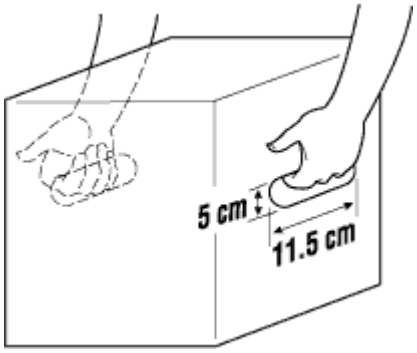

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undesirable. The bins should be elevated, tilted, or equipped with collapsible sides to improve access.

1.3.6 Repetitive or sustained twisting, stretching, or leaning to one side are undesirable. Corrections could include repositioning bins and moving employees closer to parts and conveyors.

1.3.7 Store heavy objects at waist level.

### 1.4 Whenever possible, utilize hand holds or other lifting attachments on objects being handled:



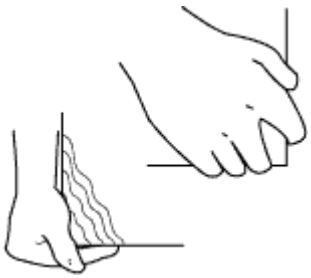

1.4.1 Use the “hook grip” on loads with cut-out handholds.

1.4.2 Curl your fingers around the edge.

1.4.3 Do not hold the load with your fingertips.

1.4.4 Use containers with handles located more than halfway up the side of the container.

1.4.5 Use the “ledge grip” to handle regularly shaped objects without handles.



1.4.6 Use vacuum lifters to handle sheet materials or plates.

1.4.7 Hold the object with hands placed diagonally.

1.4.8 Wear gloves where practical.

## 2.0 Specific Handling Techniques

The following guidance will be used when performing manual materials handling for various types of materials.

### 2.1 Square or Rectangular Objects

2.1.1 Place one foot slightly in front of the other.

2.1.2 Squat as close to the object as possible.

2.1.3 Grasp one of the top corners away from the body and the opposite bottom corner closest to the body.

2.1.4 Tilt the object slightly away from the body, tilt forward at the hips, keep the back straight, and tuck in the chin.

2.1.5 Test to confirm that the object is loose from floor and will lift without snagging.

2.1.6 Straighten the legs, keeping the backbone straight, pull the object into the body, and stand up slowly and evenly without jerking or twisting.


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2.1.7 If turning or change of direction is required, turn with feet without twisting the torso and step in the direction of travel.

2.1.8 To set an object down, reverse the sequence, being sure not to trap the bottom hand between the object and the surface on which the object is set.

## 2.2 Cylindrical Objects

2.2.1 When lifting/moving round or cylindrical objects, the objects should be rolled wherever possible. Rolling must be controlled by chute, tagline, or other means of limiting acceleration. Workers must not be positioned downhill from rolled objects. Use of the legs for pushing and tagline control of rolled objects must be stressed.

2.2.2 Cylindrical objects, such as drums that must remain upright, are to be handled manually by slightly tilting the object, using the legs for control, and balancing the object on the bottom edge. The handler then walks besides the object, with the object tilted toward the body, positioning the hands on the top edge away from the body and moving so they do not cross, thus maintaining balance and a steady, controlled, forward motion. Motion must be controlled so that ceasing to walk and moving the hands will stop forward motion.

2.2.3 Use carts or tracks to transport cylinders. Make sure that two people transport a cylinder if carts cannot be used, use lifting straps to improve grip.

- Technique for one person lifting a cylinder onto a platform:
  - Roll the cylinder to within 3 feet of the platform.
  - Position the forward foot around the cylinder, the back foot about 1 foot behind the cylinder.
  - Bend knees slightly.
  - Place one hand on the valve protective cap, the other hand underneath the cylinder about 1 foot from the ground.
  - Tilt the cylinder onto the thigh of the back leg.
  - Balance the cylinder on the thigh by pressing down with the back hand while lifting the cylinder with the forward hand.
  - Extend both knees to initiate forward movement of the cylinder and continue by pushing up and forward with the arms until the cylinder is located on the platform.
  - Climb on the platform.
  - Straddle the cylinder at the valve end.
  - Grasp the valve protective cap of the cylinder with both hands between the thighs.
  - Lean forward and straighten the knees to set the cylinder upright.

## 2.3 Bags and Sacks

2.3.1 The best way to handle a bag depends on its size, weight, and how far it is to be carried. When lifting, remember to

- Straddle the end of the bag.
- Bend the hips and knees.
- Keep the back straight.
- Grasp the bag with both hands under the closer end. Keep elbows inside the thighs.
- Lean forward, straightening the knees to set the bag upright.
- Readjust the straddle position moving feet closer to the bag.
- Readjust the grasp, with one hand clasping the bag against the body and the other under it.
- Stand up by thrusting off with the back leg and continuing in an upward and forward direction.
- Thrust the bag up with the knee while straightening the body.
- Put the bag on the shoulder opposite the knee used to thrust the bag up.
- Stabilize the bag on the shoulder.


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- Move off without bending sideways.

2.3.2 Avoid unloading a bag from the shoulder directly to floor level. Use an intermediate platform or get help from a coworker.

- Stand close to the platform.
- Place one foot in front of the platform.
- Bend hips and knees.
- Keep the back straight.
- Ease the bag off the shoulder and put it upright on the platform.
- Pull the bag slightly over the edge of the platform.
- Stand close to the platform with the bag touching the chest.
- Clasp the bag against the body with one hand, the other hand holding bottom of the bag.
- Step back.
- Bend hips and knees, keeping back straight.
- Ease the bag onto the floor.

2.3.3 Bulkier sacks are easier to carry on your back. Lift the sack onto your back from a platform:

- Move the sack to the edge of the platform.
- Put your back against the sack.
- Grasp with both hands on the upper corners of the sack.
- Ease the sack onto the back, bending hips and knees before taking the weight.
- Keep the back straight.
- Stand up and straighten the hips and knees.
- Stabilize the sack.
- Move away without bending sideways.

2.3.4 Two-person handling of a sack:

- Position one person on either side of the sack.
- Squat with one foot balancing behind the sack.
- Keep back straight.
- Grasp with the outer hand on the upper corner, the other hand holding the bottom of the sack.
- On one person's command:
  - Stand up and straighten the hips and knees.
  - Move toward the stack.
  - Put the sack on the stack.

## 2.4 Sheet Materials

2.4.1 When lifting sheet materials:

- Stand close to the pile of sheets in a walking stance.
- Grasp sheet firmly at the midpoint of its long side with the closer hand.
- Pull sheet up and toward the body.
- Change grip using your other hand and put your fingers on top of the sheet.
- Pull sheet up to the vertical position and to the side until one half is off the pile.
- Grasp the lower edge of the sheet with the free hand and support the hand by placing it on your knee.
- Stand up without bending or twisting body.


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- Whenever moving sheet materials, be cognizant of wind conditions.

2.4.2 To carry sheets:

- Use drywall carts to carry sheet materials.
- Get help from another person where carts are not available.
- Apply carrying handles for manual carrying.
- Always use gloves and carrying handle for glass and other materials with sharp edges.

2.4.3 Use team lifting and carrying where other solutions are inappropriate.

- Remember that the combined strength of the team is less than the sum of individual strength.
- Select team members of similar height and strength.
- Assign a leader to the team.
- Determine a set of commands to be used such as "lift," "walk," "stop," and "down." Make sure that everyone knows what to do when they hear the command.
- Follow the commands given by the team leader.
- Practice team lifting and carrying together before attempting the task.

## 2.5 Material Storage

2.5.1 When storing materials on site:

- Store materials at a convenient height.
- Leave the lowest shelf unused if necessary.
- Use vertically mobile shelves to avoid bending and overhead reaching.
- Use bin racks for storing small items.
- Store heavy and frequently used materials at waist height.
- Do not store materials at floor level.
- Use hand trucks with elevating devices in storage and loading areas.
- Use trucks with a tilting device to avoid bending.
- Use elevating platforms to avoid overhead reaching.


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# S3NA-309-PR Mobile or Heavy Equipment

## 1.0 Purpose and Scope

1.1 Outline the safe working requirements for working with and near mobile equipment and heavy equipment operation.

1.2 This procedure applies to all AECOM North America based employees and operations.

## 2.0 Terms and Definitions

2.1 **Heavy equipment:** All excavating equipment include scrapers, loaders, crawler or wheel tractors, excavators, backhoes, bulldozers, off-highway trucks, graders, agricultural and industrial tractors, and similar equipment.

2.2 **Operator:** Any person who operates the controls while the heavy equipment in is motion or the engine is running.

2.3 **Ground personnel/workers:** Personnel performing work on the ground around heavy equipment (note: operators are considered ground personnel when outside of the equipment cab).

## 3.0 Attachments

3.1 S3NA-309-FM1 Certification of Machinery and Mechanized Equipment

3.2 S3NA-309-FM2 Heavy Machinery Pre-Operation Checklist

3.3 S3NA-309-WI Brokk180 Safety Card

## 4.0 Procedure

4.1 For work under AECOM's control, Project Managers are responsible for ensuring all equipment is in good working order and all equipment operators are qualified on the piece of machinery they are assigned.

4.2 Staff will confirm that all rented equipment arrives in proper working order with the manufacturer's operating manual before acceptance from the supplier.

4.3 The operator of mobile equipment is the only worker permitted to ride the equipment unless the equipment is a worker transportation vehicle.

4.4 A person will not operate mobile equipment unless the person has received adequate instruction and training in the safe use of the equipment, has demonstrated to a qualified supervisor or instructor competency in operating the equipment.

4.5 The operator of mobile equipment will operate the equipment safely, maintain full control of the equipment, and comply with the laws governing the operation of the equipment

4.6 **Communication**

4.6.1 Communication between site supervisors/managers, heavy equipment operators, and other site personnel is a key method of preventing serious injury or death during heavy equipment operations.

4.6.2 The following outline the communication requirements during heavy equipment operations:

- Site supervisors/managers shall confirm that all operators are notified/informed of when, where, and how many ground personnel will be working on site.
- Site supervisors/managers shall inform all ground personnel before changes are made in the locations of designated work areas.
- Prior to work initiating onsite the site supervisor/manager is to confirm all operators and ground personnel are trained on the hand signals that will be used to communicate between operators and ground personnel.
- Personnel working around heavy equipment operations are to maintain eye contact with operators to the greatest extent possible (always face equipment). Never approach equipment from a blind spot or angle.


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- All heavy equipment whose backup view can be obstructed shall be equipped with reverse warning devices (i.e., backup alarms) that can be significantly heard over equipment and other background noise. Reverse signaling lights shall be in working order.
- When feasible, two-way radios shall be used to verify the location of nearby ground personnel.
- When an operator cannot adequately survey the working or traveling zone, a guide shall use a standard set of hand signals to provide directions. Flags or other high visibility devices may be used to highlight these signals.

## 4.7 Ground Personnel

4.7.1 Ground clearance around heavy equipment may significantly reduce hazards posed during heavy equipment operations.

4.7.2 The following outline the clearance requirements during heavy equipment operations:

- Ground personnel shall always yield to heavy equipment.
- Ground personnel shall maintain a suitable “buffer” area of clearance from all active heavy equipment.
- A job-specific hazard analysis that identifies any special precautions shall be completed and communicated to all AECOM personnel.
- Site supervisors/managers shall designate areas of heavy equipment operation and confirm that all ground personnel are aware of designated areas. Designated areas shall include boundaries and travel routes for heavy equipment. Travel routes shall be set up to reduce crossing of heavy equipment paths and to keep heavy equipment away from ground personnel.
- When feasible, site supervisors/managers shall set up physical barriers (e.g., caution tape, orange cones, concrete jersey barriers) around designated areas and confirm that unauthorized ground personnel do not enter such areas.
- Operators shall stop work whenever unauthorized personnel or equipment enter the designated area and only resume when the area has been cleared.
- Operators shall only move equipment when aware of the location of all workers and when the travel path is clear.
- Ground personnel shall never stand between two pieces of heavy equipment or other objects (i.e., steel support beams, trees, buildings, etc.).
- Ground personnel shall never stand directly below heavy equipment located on higher ground.
- If working near heavy equipment, ground personnel shall stay out of the travel and swing areas (excavators, all-terrain forklifts, hoists, etc.) of all heavy equipment.
- Ground personnel shall never work near heavy equipment.
- Personnel shall keep all extremities, hair, tools, and loose clothing away from pinch points and other moving parts on heavy equipment.
- Personnel shall not talk on a cell phone while standing or walking on a roadway or other mobile equipment path.

4.7.3 At a minimum, all ground personnel and operators outside of heavy equipment shall wear the following:

- High visibility, reflective (Class 2) safety vest that is visible from all angles and made of fluorescent material and orange, white, or yellow reflective material (confirm that vest is not faded or covered with outer garments, dirt, etc.).
- Retro-reflective striping for arms and legs (night work)
- ANSI-CSA approved hard hat
- ANSI-CSA approved safety glasses with side shields
- ANSI-CSA approved work boots (unless project requirements are more stringent)
- ANSI-CSA approved hearing protection as needed
- Appropriate work clothes (i.e., full length jeans/trousers and a sleeved shirt; no tank, crew tops or other loose clothing permitted).


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## 4.8 Prior to work commencing

4.8.1 All mobile equipment will be regularly inspected pre-shift and then regularly as required with the details of the inspection recorded in a log book.

4.8.2 The operator will report defects and conditions affecting the safe operation of the equipment to the supervisor or employer. Any repair or adjustment necessary for the safe operation of the equipment will be made before the equipment is used.

4.8.3 Exposed moving parts on mobile equipment which are a hazard to the operator or to other workers will be guarded and if a part will be exposed for proper function it will be guarded as much as is practicable consistent with the intended function of the component.

4.8.4 An approved Underwriter's Laboratories (UL) 4A40BC fire extinguisher should be present on all mobile equipment.

4.8.5 Inform the operators of the equipment that AECOM employees are in the area and inquire if there are any restricted areas or specific rules or requirements. In some industrial facilities, mobile equipment has the 'right of way'.

4.8.6 Where the operator will not have a full view of the path of travel, a signal person will be used on the ground that has a full view of the load, the operator, and the path.

4.8.7 Mobile equipment in which the operator cannot directly or by mirror or other effective device see immediately behind the machine will have an automatic audible warning device which activates whenever the equipment controls are positioned to move the equipment in reverse, and if practicable, is audible above the ambient noise level.

## 4.9 Operation

4.9.1 The operator of mobile equipment will operate the equipment safely, maintain full control of the equipment, and comply with the laws governing the operation of the equipment.

4.9.2 A supervisor will not knowingly operate or permit a worker to operate mobile equipment which is, or could create, an undue hazard to the health or safety of any person.

4.9.3 The operator of mobile equipment will not leave the controls unattended unless the equipment has been secured against inadvertent movement such as by setting the parking brake, placing the transmission in the manufacturer's specified park position, and by chocking wheels where necessary.

4.9.4 The operator will maintain the cab, floor and deck of mobile equipment free of material, tools or other objects which could create a tripping hazard, interfere with the operation of controls, or be a hazard to the operator or other occupants in the event of an accident.

4.9.5 If mobile equipment has seat belts required by law or manufacturer's specifications, the operator and passengers will use the belts whenever the equipment is in motion, or engaged in an operation which could cause the equipment to become unstable.

4.9.6 When approaching or crossing the intended path of travel of mobile equipment, establish eye contact with the operator of the mobile equipment and confirm that it is safe to proceed.

4.9.7 Have vehicle headlights on at all times when driving in the area.

4.9.8 Park motor vehicles off the haul roads, or away from the work areas.

4.9.9 Do not wear loose clothing where there is a danger of entanglement in rotating equipment.

4.9.10 Do not enter the swing area of machines such as cranes, mobile drill rigs, or excavators, without first making eye contact with the operator, and receiving permission to do so.

4.9.11 Stay out of the blind areas around mobile equipment and never assume that the equipment operators have seen them or are aware of their presence.

4.9.12 Maintain a distance of 60 cm (2 ft.) between the counterweight of swing machines and the nearest obstacle. If this distance cannot be maintained, the area will be barricaded or guarded to prevent access.

4.9.13 Vibration from moving traffic or mobile equipment can cause excavations or spoil piles to become unstable. Be aware of the risk and keep clear.

4.9.14 All heavy equipment shall be operated in a safe manner that will not endanger persons or property.

4.9.15 All heavy equipment shall be operated at safe speeds.


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4.9.16 Always move heavy equipment up and down the face of a slope. Never move equipment across the face of a slope.

4.9.17 Slow down and stay as far away as possible while operating near steep slopes, shoulders, ditches, cuts, or excavations.

4.9.18 When feasible, operators shall travel with the “load trailing”, if the load obstructs the forward view of the operator.

4.9.19 Slow down and sound horn when approaching a blind curve or intersection. Flagmen equipped with 2-way radio communications may be required to adequately control traffic.

4.9.20 Operators shall remain in cab while heavy equipment is being loaded.

4.9.21 Equipment shall be shut down prior to and during fueling. Do not smoke or use electrical devices while fueling. Fuel shall not be carried in or on heavy equipment, except in permanent fuel tanks or approved safety cans.

4.9.22 Turn off heavy equipment, place gear in neutral and set parking brake prior to leaving vehicle unattended. Buckets and blades are to be placed on the ground and with hydraulic gears in neutral. Heavy equipment parked on slopes shall have the wheels chocked.

4.9.23 Never jump on to or off of a piece of heavy equipment, always maintain 3-points of contact at a minimum.

4.9.24 Never exit heavy equipment while it is in motion.

4.9.25 Passengers shall only ride in heavy equipment designed for occupancy of passengers.

4.9.26 Never ride on the outside of a piece of heavy equipment (e.g., tailgates, buckets, steps, etc.).

4.9.27 Site vehicles will be parked in a designated parking location away from heavy equipment.

4.9.28 Operators shall never push/pull “stuck” or “broken-down” equipment unless a spotter determines that the area is cleared of all personnel around and underneath the equipment.

4.9.29 If designated for work in contaminated areas/zones, equipment shall be kept in the exclusion zone until work or the shift has been completed. Equipment will be decontaminated within designated decontamination areas.

4.9.30 Equipment left unattended at night adjacent to traveled roadways shall have appropriate lights or reflectors, or barricades equipped with appropriate lights or reflectors, to identify the location of that equipment, and shall not be closer than 6 feet (or the regulatory requirement for the work location) to the active roadway.

4.9.31 Pneumatic-tired earthmoving haulage equipment, with a maximum speed exceeding 15 miles per hour, shall be equipped with fenders on all wheels.

4.9.32 Lift trucks shall have the rated capacity clearly posted on the vehicle, and the ratings are not exceeded.

4.9.33 Steering or spinner knobs shall not be attached to steering wheels.

4.9.34 High lift rider industrial trucks shall be equipped with overhead guards.

4.9.35 When ascending or descending grades in excess of 5%, loaded trucks shall be driven with the load upgrade.

4.9.36 All belts, gears, shafts, pulleys, sprockets, spindles, drums, flywheels, chains, or other reciprocating, rotating or moving parts of equipment shall be guarded when exposed to contact by persons or when they otherwise create a hazard.

4.9.37 All hot surfaces of equipment, including exhaust pipes or other lines, shall be guarded or insulated to prevent injury and fire.

4.9.38 All equipment having a charging skip shall be provided with guards on both sides and open end of the skip area to prevent persons from walking under the skip while it is elevated.

4.9.39 Platforms, foot walks, steps, handholds, guardrails, and toeboards shall be designed, constructed, and installed on machinery and equipment to provide safe footing and access ways.

4.9.40 Substantial overhead protection shall be provided for the operators of fork lifts and similar equipment.

## 4.10 Utilities


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4.10.1 When contacted by heavy equipment, aboveground and underground utilities may cause severe injuries or death as a result of electrocution, explosion, etc.

4.10.2 The following outline the requirements while performing heavy equipment operations that may lead to contact with aboveground or underground utilities:

- Always be aware of surrounding utilities.
- Confirm all equipment (i.e., dump trailers, loaders, excavators, etc.) is lowered prior to moving underneath of aboveground utilities.
- Confirm utilities are cleared and identified prior to beginning any earthmoving operation. Contact the local utility service providers for clearance prior to performing work. Confirm documentation of the contact is made; date, number; contact name, organization, etc.

## 4.11 Training

4.11.1 The operator or other qualified supervisor will provide all on-site personnel with an orientation to the mobile equipment and its associated hazards and controls.

4.11.2 Only designated, qualified personnel shall operate heavy equipment.

4.11.3 Operators shall have all appropriate local, state, or federal licenses or training to operate a designated piece of heavy equipment.

4.11.4 Operators shall be evaluated through documented experience and routine monitoring of activities unless the equipment is operated by an AECOM operator in which case a practical evaluation is needed. Operators shall be knowledgeable and competent in the operation of a designated piece of heavy equipment.

## 4.12 Inspection and Maintenance

4.12.1 Maintenance records for any service, repair or modification which affects the safe performance of the equipment will be maintained and be reasonably available to the operator and maintenance personnel during work hours.

4.12.2 Maintenance records will be maintained on the site or project for mobile equipment.

4.12.3 Servicing, maintenance and repair of mobile equipment will not be done when the equipment is operating, unless continued operation is essential to the process and a safe means is provided.

4.12.4 All heavy equipment shall have a documented inspection and if necessary, repaired prior to use. Operators shall not operate heavy equipment that has not been cleared for use. All machinery and mechanized equipment will be certified to be in safe operating condition (certification form attached) by a competent individual seven days prior to on-site operation, and is valid for one year.

4.12.5 All heavy equipment shall be inspected at a minimum to the manufacturer's recommendations prior to each work shift. All defects shall be reported to the site supervisor/manager immediately. Inspection records shall be maintained at the site. If a manufacturer's or company-specific inspection checklist is not provided, use the Heavy Equipment Pre-Operation Inspection Checklist (attached).

4.12.6 Defective heavy equipment shall be immediately taken out of service until repaired.

## 4.13 Fueling and batteries

4.13.1 A well-ventilated area shall be used for refueling.

4.13.2 Only the type and quality of fuel recommended by the engine manufacturer shall be used.

4.13.3 Fuel tanks shall not be filled while the engine is running. All electrical switches shall be turned off.

4.13.4 No one shall spill fuel on hot surfaces. Any spillage should be cleaned before starting an engine.

4.13.5 Spilled fuel shall be cleaned with cotton rags or cloths; do not use wool or metallic cloth.

4.13.6 Open flames, lighted smoking materials, or sparking equipment shall remain well away from the fueling area.

4.13.7 Heaters in carrier cabs shall be turned off when refueling the carrier or the drill rig.

4.13.8 Portable fuel containers shall not be filled completely to allow expansion of the fuel during temperature changes.


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4.13.9 The fuel nozzle shall be kept in contact with the tank being filled to prevent static sparks from igniting the fuel.

4.13.10 Portable fuel containers shall not travel in the vehicle or carrier cab with personnel.

4.13.11 Fuel containers and transfer hoses shall be kept in contact with a metal surface during travel to prevent buildup of a static charge.

4.13.12 Batteries shall be serviced in a ventilated area while wearing appropriate PPE.

4.13.13 When a battery is removed from a vehicle or service unit, the battery shall be disconnected ground post first.

4.13.14 When installing a battery, the battery shall be connected ground post last.

4.13.15 When charging a battery, cell caps shall be loosened prior to charging to permit gas to escape.

4.13.16 When charging a battery, the power source shall be turned off to the battery before either connecting or disconnecting charger loads to the battery posts.

4.13.17 Spilled battery acid shall be immediately flushed off the skin with a continuous supply of water.

4.13.18 Should battery acid get into the eyes, the eyes shall be flushed immediately with copious amounts of water and medical attention sought immediately.

4.13.19 To avoid battery explosions, the cells shall be filled with electrolytes. A flashlight (not an open flame) shall be used to check water electrolyte levels. Avoid creating sparks around battery by shorting across a battery terminal. Lighted smoking materials and flames shall be kept at least 25 feet away from battery-charging stations.

## 5.0 Records

5.1 Inspection records shall be maintained with the equipment.

## 6.0 References

6.1 S3NA-205-PR Equipment Inspections & Maintenance


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# S3NA-309-FM1 Certification of Machinery and Mechanized Equipment

## 1.0 General Guidelines

1.1 Subcontractor equipment shall comply with all applicable requirements for motor vehicles and material handling heavy equipment contained in 29 CFR 1926 Subpart O. Heavy equipment includes, but is not limited to, drill rigs, front end loaders, backhoes, trackhoes, bulldozers, forklifts, and similar equipment used for the implementation of the project Statement of Work.

## 2.0 Equipment Safety Inspections

2.1 The following presents general guidelines for certifying equipment is in safe operating condition before activities commence at the site and during site operations. The following guidelines are not meant to be all-inclusive.

2.1.1 All machinery and mechanized equipment will be certified to be in safe operating condition (using the attached form) by a competent individual seven days prior to onsite operation. This certification is valid for one year.

2.1.2 Equipment will be inspected on a daily basis by the owner/operator and daily logs will be maintained. All discrepancies shall be corrected prior to placing the equipment in service.

2.1.3 Inspections shall include, but are not limited to, all hydraulic lines and fittings for wear and damage, all cable systems and pull ropes for damage and proper installation, exhaust systems, brake systems, and drill controls, etc.

2.1.4 Drill rigs and related support equipment and vehicles shall be inspected by the driller in charge on a daily basis. These inspections shall be recorded on the Daily Drill Rig Checklist or on equivalent subcontractor forms.

2.1.5 Exhaustive preventive maintenance shall be conducted for all equipment according to manufacturer recommendations and/or the subcontractor's internal policies, schedules, and equipment SOPs.

2.1.6 Only designated qualified persons shall operate machinery and mechanized equipment.

2.1.7 The contractor shall maintain records of tests and inspections at the site and shall make the records available upon request of the designated authority; the records shall become part of the official project file.

2.1.8 Equipment found to not be in safe operating condition or to have a deficiency that affects the safe operation of the equipment shall immediately be taken out of service and its use shall be prohibited until safe conditions have been corrected.

2.1.9 All equipment shall be kept in the exclusion zone until work or the shift has been completed. Equipment will be decontaminated within designated decontamination areas.

2.1.10 Equipment with an obstructed rear view must have an audible alarm that sounds when equipment is moving in reverse.


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TO: AECOM

DATE:

FROM:

Project Name:

Project Location:

1. This form provides certification of machinery and mechanized equipment to be used on the referenced project for the following work:

| | |
|---|---|
| Description of equipment work: | |
| Project site: | |
| Subcontractor providing equipment:<br>Address: | |
| Dates (duration) of equipment work: | |

2. Inspection and certification of machinery and mechanized equipment, as required by AECOM, has been made prior to but within seven calendar days in advance of use on the project site. Recertification will be required for equipment that is used on the project site for more than one year.

| Identification of equipment (make, model, serial no.) | | Date of Certification |
|---|---|---|
| 1 | | |
| 2 | | |
| 3 | | |

3. The above listed equipment has been inspected and tested as indicated above, and is CERTIFIED TO BE IN SAFE OPERATING CONDITION BY THE FOLLOWING COMPETENT INDIVIDUAL:

| | | | |
|---|---|---|---|
| Name | | Title | |
| Company | | | |
| Signature | | Date | |

4. If there are any questions regarding this certification, please contact the following AECOM representative:


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# S3NA-309- FM2 Heavy Equipment Pre-Operation Checklist

| **Project Name/Location:** | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Number/Name:** | | | | | | | **Make/Model:** | | | | | | | | |
| **Hour meter reading:** | | | | | | | | | | | | | | | |
| **Check the following as appropriate** | **Operator Name/Date** | | | **Operator Name/Date** | | | **Operator Name/Date** | | | **Operator Name/Date** | | | **Operator Name/Date** | | |
| | | | | | | | | | | | | | | | |
| | **SAT** | **UNSAT** | **N/A** | **SAT** | **UNSAT** | **N/A** | **SAT** | **UNSAT** | **N/A** | **SAT** | **UNSAT** | **N/A** | **SAT** | **UNSAT** | **N/A** |
| 1. Operator qualified | | | | | | | | | | | | | | | |
| 2. Overhead guard (ROPS) | | | | | | | | | | | | | | | |
| 3. Horn | | | | | | | | | | | | | | | |
| 4. Lights | | | | | | | | | | | | | | | |
| 5. Parking brake | | | | | | | | | | | | | | | |
| 6. Service brakes | | | | | | | | | | | | | | | |
| 7. Steering | | | | | | | | | | | | | | | |
| 8. Oil level | | | | | | | | | | | | | | | |
| 9. Hydraulic oil level | | | | | | | | | | | | | | | |
| 10. Radiator fluid level | | | | | | | | | | | | | | | |
| 11. Major fluid leaks | | | | | | | | | | | | | | | |
| 12. Windows | | | | | | | | | | | | | | | |
| 13. Backup alarm | | | | | | | | | | | | | | | |
| 14. Tires (visual) | | | | | | | | | | | | | | | |


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| | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 15. Seat belts | | | | | | | | | | | | | | | |
| 16. Fuel leaks | | | | | | | | | | | | | | | |
| 17. Fire extinguisher | | | | | | | | | | | | | | | |
| 18. Fuel lines secure | | | | | | | | | | | | | | | |
| 19. Electrical lines | | | | | | | | | | | | | | | |
| 20. Exhaust components | | | | | | | | | | | | | | | |
| **Comments/Remarks:** | | | | | | | | | | | | | | | |


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# S3NA-309-WI Brokk180 Safety Card




## 1.0 Objective/Overview

The Brokk 180 is an electric-powered hydraulic device used for demolishing concrete structures and refractory linings as well as excavating. This machine includes attachments designed exclusively for demolishing work (e.g., grapple, bucket, hydraulic hammer, etc.). By using the remote control unit, an operator can move the machine and attachments in different directions and speeds from afar.

## 2.0 Safe Operating Guidelines

2.1 Prior to use, complete a pre-operation inspection to determine if the unit is in safe working condition.

2.2 Position the unit to safely perform the intended task, then deploy the outriggers to stabilize the unit.

2.3 Confirm that the operator knows what the lifting capacity is; do not exceed the lifting capacity.

2.4 Complete a subsurface utility clearance prior to excavating.

2.5 Establish a minimum 15-foot clearance around the unit.

2.6 Do not allow debris to build-up around the unit. Maintain good housekeeping practices.

2.7 Prior to removing debris from under the boom, stop, disengage the unit, and position the boom so that the attachment is at rest on the ground.

2.8 Personnel operating the unit with the remote control device will be properly trained and certified by a competent person.

2.9 The operator will be able to maintain line of sight visual contact with the unit at all times to assess hazards and site security.

2.10 Maintenance in excess of preventive maintenance activities (e.g., lubrication, replenishing fluids, etc.) will be performed by manufacturer personnel ONLY.

2.11 All operations will comply with the manufacturer's recommended policies.

## 3.0 Potential Hazards

3.1 Flying debris.

3.2 Crush/impact/pinch from extendable boom, tracks, and tipping over.

3.3 Electrocution from subsurface utilities (when excavating).

3.4 Hearing loss.

## 4.0 Training Requirements

4.1 Review of applicable SOPs.

4.2 Complete knowledge and understanding of remote control functions.

4.3 Review and follow manufacturers' recommended policies and practices**.**


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## 5.0 Personal Protective Equipment (Level D ensemble)

5.1 Reflective traffic safety vest.

5.2 Hearing protection (ear plugs and/or ear muffs).

5.3 Leather gloves.

## 6.0 Other Safety Tips

6.1 Never stand under a raised boom.

6.2 Maintain a clearance of 15 feet around the unit while operating.

6.3 Pay close attention to power cords for potential tripping hazard and equipment entanglement.

6.4 Maintain line of sight visual contact with unit at al times (especially when operating from a distance).


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# S3NA-313-PR Wildlife, Plants and Insects

## 1.0 Purpose and Scope

1.1 Communicates the requirements and precautions to be taken by AECOM employees to protect against the biological hazards associated with insects, arachnids, snakes, poisonous plants, and other animals referred to herein collectively as “biological hazards”.

1.2 This procedure applies to all AECOM North America (NA) based employees and operations.

## 2.0 Terms and Definitions

2.1 **Field Work**: Field work is defined as any activity conducted at a site that contains brush, overgrown grass, leaf litter, poisonous plants, or is located near mosquito breeding areas and includes work in structures where animals might exist that harbor fleas or ticks or where spiders and mites could be present. Field work includes, but is not limited to, Phase I, Phase II, Operations Monitoring & Maintenance (OM&M), biological surveys, and other work that meets the definition of field work.

2.2 **Poisonous:** Capable of harming or killing by or as if by poison; toxic or venomous.

2.3 **Phase I Environmental Site Assessment:** Investigation of real property to determine the possibility of contamination, based on visual observation and property history, but no physical testing. Under new Environmental Protection Agency regulations that went into effect on November 1, 2006, a Phase I, as it is called for short, will be mandatory for all investors who wish to take advantage of CERCLA defenses that will shield them from liability for future cleanup, should that prove necessary. The new Phase I rules, called “All Appropriate Inquiry” or AAI, also require more investigation than previously mandated. Investors can expect to see dramatic price increases over prior experiences.

2.4 **Phase II Environmental Site Assessment:** Investigation of real property through physical samplings and analyses to determine the nature and extent of contamination and, if indicated, a description of the recommended remediation method.

## 3.0 Attachments

3.1 S3NA-313-FM Tick Test Request Form

3.2 S3NA-313-WI1 Biological Hazard Assessment Decision Flow Chart

3.3 S3NA-313-WI2 Ticks

3.4 S3NA-313-WI3 Poisonous Spider Identification

3.5 S3NA-313-WI4 Mosquito Borne Diseases

3.6 S3NA-313-WI5 Plants of Concern

3.7 S3NA-313-WI6 Wild Parsnip Identification

3.8 S3NA-313-WI7 Configuration Clothing for Protection against ticks and insects

3.9 S3NA-313-WI8 Insect Repellent Active Ingredient Product Information

3.10 S3NA-313-WI9 New York Department of Health Recommendations for Permethrin Application

3.11 S3NA-313-WI10 Bird Droppings Safe Work Practices

3.12 S3NA-313-WI11 Large Carnivores

3.13 S3NA-313-WI12 Bear Safety

3.14 S3NA-313-WI13 Small Mammals

3.15 S3NA-313-WI14 Snakes

3.16 S3NA-313-WI15 Alligators


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# 4.0 Procedure

## 4.1 Roles and Responsibilities

### 4.1.1 Project Managers and Supervisors

- **Project Managers** and **Supervisors** responsible for managing field work will work with employees conducting the work to see that a Task Hazard Analysis (THA) for the work to be conducted has been performed prior to the beginning of the field work and that it includes an assessment of potential biological hazards.
- If biological hazards are identified as an exposure risk in the workplace, control measures that may be applied at the project site will be implemented to reduce the potential for employees to be exposed to injuries and illnesses while working.
- If the exposures cannot be eliminated or managed with engineering controls, the **Project Manager** or **Supervisor** will approve the use of PPE and protective repellents and lotions and ensure that exposed employees have and use these products.

### 4.1.2 District Operations Manager

- Approve the costs associated with the PPE and materials necessary to protect employees from the biological hazards covered by this Procedure.
- During the performance of project site visits, managers will assess the precautions being taken against the requirements of this Procedure.

### 4.1.3 Region SH&E Manager

- Participate in incident reporting and investigations when appropriate.
- Work with office SH&E Department and project Safety Professionals, provide training and guidance to employees consistent with this procedure.
- Assist project teams in identifying hazards and selecting appropriate control measures.

### 4.1.4 Operational Managers

- Assure implementation of this procedure in their regions and offices.
- Participate in incident reporting and investigations when appropriate.

### 4.1.5 Employees

- Participate in required training on this procedure.
- Participate in the development of THAs for the project, identify control measures to limit exposure and request PPE, repellents, and protective lotions required by this Procedure.
- Obtain approval from **Project Managers** and/or **Supervisors** to purchase selected PPE prior to purchasing.
- Implement the precautions appropriate to prevent exposure to the hazardous wildlife, insects and plants.
- Observe requirements for reporting as detailed within the Procedure.
- Participate in incident reporting and investigations when appropriate.

## 4.2 Overview

4.2.1 The procedures discussed below are detailed because these hazards have historically posed the most significant risk to AECOM **employees**. Note that this discussion is not a fully encompassing list of hazards and as part of the Task Hazard Analysis conducted by the project team, additional consideration must be given to other biological hazards.

4.2.2 Departments of Public Health local to the worksite, as well as the Centers for Disease Control (CDC) can serve as a resource for identifying biological hazards not discussed in this Procedure.

4.2.3 If additional biological hazards are identified, the project team should contact the **Region SH&E Manager** to discuss the hazards and identify effective control measures that can be implemented at the project site.

## 4.3 Planning and Hazard Assessment

4.3.1 The AECOM project team shall ensure that the potential for exposure to specific biological hazards are assessed prior to the commencement of work and that the procedures specified by this SOP are integrated into the project planning process and conveyed to AECOM employees conducting the field work. This information shall be communicated in the site specific Safe Work Plan (SWP), Health and Safety Plan (HASP), the THA, pre-project kickoff meetings, and tailgate meetings at the project site.

*4.3.2* It is important to note that the precautions to be taken by AECOM **employees** to decrease the risk of exposure to biological hazards can directly increase the risk of heat-related illness due to thermal stresses. Therefore, heat stress monitoring and precautions shall be included as a critical component of the project-specific hazard assessments in accordance with *S3NA-511-PR Heat Stress.*

4.3.3 During the preparation of the project specific Safe Work Plan (SWP), HASP and project specific THA, **Project Managers**, **Supervisors**, and the project staff will determine what biological hazards might be encountered during the project and will prescribe the precautions to be taken to reduce the potential for exposure and the severity of resulting illnesses. Consideration will be given to conditions such as weather, proximity to breeding areas, host animals, and published information discussing the presence of the hazards.

4.3.4 It should be assumed that at least one of the biological hazards exists whenever working on undeveloped property. This can include insect activity any time that local temperatures exceed 40°F for a period of more than 24 hours. The stubble and roots of poisonous plants can be a hazard any time of year, including when some plants are dormant or mown.

4.3.5 The hazard assessments must also consider the additional hazards posed by vegetative clearing such as the increased risk of coming in contact with poison ivy, oak or sumac and hazards associated with the use of tools and equipment to remove vegetation.

4.3.6 **Employees** in the field where biological hazards exist will not enter the hazard areas unless they are wearing the appropriate protective clothing, repellents, and barrier creams specified below. If the hazard is recognized in the field but was not adequately assessed during the THA, the affected employees shall stop work and not proceed until the THA has been amended and protective measures implemented.

4.3.7 A decision flow chart and table for determining the potential for biological hazards in US states has been provided in *S3NA-313-WI1 Biological Hazard Assessment Decision Flow Chart Hazard Assessment (US States).*

## 4.4 Restrictions

4.4.1 Staff with life-threatening reactions shall not undertake work in areas infested with the allergen (e.g., wasps, poison ivy), unless precautions are met which satisfy a medical practitioner's requirements.

## 4.5 Employee Sensitivity

4.5.1 Sensitivity to toxins generated by plants, insects and animals varies according to dosage and the ability of the victim to process the toxin, therefore it is difficult to predict whether a reaction will occur, or how severe the reaction will be. Staff should be aware that there are a large number of organisms capable of causing serious irritations and allergic reactions. Some reactions will only erupt if a secondary exposure to sunlight occurs. Depending on the severity of the reaction, the result can be severe scarring, blindness or even death.

4.5.2 **Employees** also need to consider whether they are sensitive to the use of insect repellents.

## 4.6 Personal Protective Equipment

4.6.1 The selection of Personal Protective Equipment is dependent on the hazard present and a PPE Hazard Analysis should be conducted to determine situation specific PPE required. (refer to SOP *S3NA-208 Personal Protective Equipment Program*)

4.6.2 At a minimum, in addition to any project specific PPE, long sleeves and pants should be worn on field projects where the risk of biological encounter exists.

4.6.3 PPE for insects should include sunscreen, bug nets, bug jackets, or insect repellent. Socks should be pulled over pant legs and rubber boots should be worn where the threat of exposure is anticipated.

4.6.4 Epi-pens[1] or other personal medication should be carried by those staff that are aware that anaphylactic shock is a possibility for them.

## 4.7 Remedies

4.7.1 If you suspect exposure to an irritant, identify the cause including obtaining a specimen if possible. Document the occurrence as a safety precaution if the exposure should lead to complications.

4.7.2 Go to a doctor or call WorkCare for advice if necessary.

## 4.8 Training

4.8.1 Field staff must learn to recognize organisms that represent a threat in the regions in which they work – experienced field staff must provide on the job training to assist staff with hazard recognition.

4.8.2 Staff who have severe allergic reactions are strongly recommended to notify their project manager, field supervisor, and co-workers of the potential for a reaction and demonstrate what medication they might need and how it is administered.

## 4.9 Insects

4.9.1 Insects for which precautionary measures should be taken include but are not limited to: mosquitoes (potential carriers of disease aside from dermatitis), black flies, wasps, bees, ticks, Fire Ants and European Fire Ants.

4.9.2 Wasps and bees will cause a painful sting to anyone if they are harassed. They are of most concern for individuals with allergic reactions who can go into anaphylactic shock. Also, instances where an individual is exposed to multiple stings can cause a serious health concern for anyone. These insects are most likely to sting when their hive or nest is threatened.

4.9.3 Ticks can be encountered when walking in tall grass or shrubs. They crawl up clothing searching for exposed skin where they will insert mouthparts to drink blood. The most serious concern is a possibility of contracting Lyme disease which is spread by the Black-legged or Deer Tick. The larger Wood Ticks are widespread in the west but these rarely carry diseases. Occasionally a tick can cause Tick Paralysis if it is able to remain feeding for several days. Full recovery usually occurs shortly after the tick is removed.

4.9.4 The Fire Ant (southern and western US) and the European Fire Ant (northeastern US and eastern Canada) is often very abundant where it is established. It is very aggressive and commonly climbs up clothing and stings unprovoked when it comes into contact with skin. Painful irritations will persist for an hour or more.

## 4.10 Ticks

4.10.1 Data from the CDC indicates that tick-borne diseases have become increasingly prevalent. At the same time, tick repellents have become both safe and effective so it is possible to prevent the vast majority of bites and therefore most related illnesses.

4.10.2 The most common and severe tick-borne illnesses in the U.S. are Lyme disease, Ehrlichiosis, and Rocky Mountain spotted fever. A summary table listing CDC informational resources for these diseases is provided in *S3NA-313-WI2 Ticks* along with a listing of CDC information resources and maps showing the distribution of common tick-borne diseases in the U.S.

4.10.3 When working in areas where ticks may occur, it is recommended that clothes are turned inside out and shaken at the end of day; do not wear the same clothes two days in a row.

4.10.4 To remove ticks that are embedded in skin, use tweezers or fingers to carefully grasp the tick as close to the skin as possible and pull slowly upward, avoiding twisting or crushing the tick. Do not try to burn or smother the tick. Cleanse the bite area with soap and water, alcohol, or household antiseptic. Note the date and location of the bite and save the tick in a secure container such as an empty pill vial or film canister. A bit of moistened paper towel placed inside the container will keep ticks from drying out.

[1] *Epi-pens must be prescribed by a personal physician. Renew epi-pens on a regular schedule to ensure effectiveness and make sure your field companions know where it is and how to use it if you cannot self administer the dose.*


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4.10.5 Familiarize yourself with the characteristic bulls-eye pattern of Lyme disease infection surrounding the bite. If noted, report to medical help for inoculation.

4.10.6 If possible, submit any ticks found or captured to the following laboratories for species identification.

- Canada – National Microbiology Laboratory (NML) (Phone: (204) 789-2000; email: ticks@phac-aspc.gc.ca). The NML will conduct diagnostic testing for the Lyme disease agent as well as several other disease-causing agents. The NML results will not only benefit anyone bit by the tick, but will also assist the NML in their goal to accurately map the distribution of the tick species and associated diseases in Canada.
- US – IGeneX, Inc. (Phone: (800) 832-3200; www.igenex.com). IGeneX will test the tick for the presence of the Lyme bacteria. They also test ticks for *Babesia microti* and/or *Babesia duncani* (formerly WA-1), Ehrlichia, Bartonella henselae and Rickettsia (Rocky Mountain Spotted Fever). These diseases are also carried by ticks. The testing request form is attached as *S3NA-313-FM Tick Test Request Form*.

4.10.7 If you experience symptoms such as fever, headache, fatigue, and a skin rash, you should immediately visit a medical practitioner as Lyme disease is treated easily with antibiotics in the early stages, but can spread to the heart, joints, and nervous system if left untreated.

## 4.11 Chiggers

4.11.1 Chiggers are mite larvae, approximately ½ mm in size, and typically invisible to the naked eye. While chiggers are not known to carry infectious diseases, their bites and resulting rashes and itching can lead to dermatitis and a secondary infection.

4.11.2 Chiggers are typically active from the last hard freeze in the winter or spring to the first hard freeze. They are active all year in the Gulf Coast and tropical areas.

## 4.12 Spiders

4.12.1 Spiders can be found in derelict buildings, sheltered areas, basements, storage areas, well heads and even on open ground. Spiders can be found year round in sheltered areas and are often present in well heads and valve boxes.

4.12.2 Most spider bites produce wounds with localized inflammation and swelling. The Black Widow and Brown Recluse spiders in the US and others outside the US inject a toxin that causes extensive tissue damage and intense pain.

4.12.3 Additional information on spider identification can be found in attachment *S3NA-313-WI3 Poisonous Spider Identification*.

## 4.13 Mosquitoes

4.13.1 Mosquitoes can transmit the West Nile Virus and other forms of encephalitis after becoming infected by feeding on the blood of birds which carry the virus. Positive cases of West Nile Virus have been confirmed throughout North America since 2007.

4.13.2 Most people infected with the virus experience no symptoms or they have flu-like symptoms. Sometimes though, the virus can cause severe illness, resulting in hospitalization and even death ,so proper precautions should be taken. Consult a medical practitioner if you suspect you have West Nile Virus.

4.13.3 When a mosquito bites, it injects an enzyme that breaks down blood capillaries and acts as an anticoagulant. The enzymes induce an immune response in the host that results in itching and local inflammation. The tendency to scratch the bite sites can lead to secondary infections.

4.13.4 CDC data indicates that mosquito-borne illnesses, including the strains of encephalitis, are a health risk to employees working in outdoor environments. At least one of the Encephalitis strains listed below is known to exist in every area of the U.S. and in many other countries as well:

- Eastern Equine encephalitis (EEE)
- Western Equine encephalitis (WEE)
- West Nile Virus
- St. Louis encephalitis (SLE)
- La Crosse (LAC) encephalitis

4.13.5 Other diseases including Dengue Fever and Malaria are spread by mosquitoes in the sub-tropic and tropical parts of the world. See *S3NA-313-WI4 Mosquito Borne Diseases* for information on the locations where mosquito borne diseases are known to be present.

## 4.14 Bees and Hornets

4.14.1 Bees, hornets, and wasps may be found in derelict buildings, sheltered areas, and even on open ground. The flying/stinging insects are not specifically included in the scope of this procedure and the PPE and other protective measures are not normally effective against aggressive, flying insects. Avoid reaching into areas where visibility is limited.

4.14.2 If stung by a wasp or bee or hornet, notify a co-worker or someone who can help should you have an allergic reaction. Stay calm and treat the area with ice or cold water. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite or sting, or any swelling or numbness beyond the site of the bite or sting.

4.14.3 Employees with known allergies to insect stings should consult their personal physician for advice on any immediate medications that they should carry with them. AECOM highly recommends that employees with known allergies inform their co-workers of the allergy and the location of the medications they might carry for the allergy.

## 4.15 Poisonous Plants

4.15.1 Poisonous plants including poison ivy, oak and sumac, which contain the oil urushiol that produces a rash, can lead to dermatitis and infections. Exposure to urushiol produces a rash that can be irritating and cause the exposed employee to scratch the affected area, increasing susceptibility for an infection. It should be noted that each time an employee is exposed to urushiol the severity of the reaction increases. In cases that involve severe rashes, medical treatment may be necessary to control the rash.

4.15.2 Wild parsnip is found throughout the U.S. and contains a poison that produces a rash similar to poison oak and ivy. Unlike poison oak and ivy, the active oil will not be present on unbroken leaves. See *S3NA-313-WI6 Wild Parsnip Identification* for additional information and photos of wild parsnip.

4.15.3 Plants that field staff should recognize and take precautions to avoid include: Poison Sumac, Poison Ivy (terrestrial and climbing), Poison Oak, Giant Hogweed[2] (or Giant Cow Parsnip), Wild Parsnip, Devil's Club and Stinging Nettle. Many others are extremely poisonous to eat (e.g., Poison Hemlock; Water Parsnip) – do not eat anything that has not been identified.

4.15.4 See *S3NA-313-WI5 Plants of Concern* for information on locations where some of these poisonous plants are found in the US.

4.15.5 Of the toxic plants in the cashew family, Poison Ivy (*Rhus radicans*) is most widespread occurring across southern Canada. It is usually a low sprawling shrub or ground cover but in southwestern Ontario it also grows as a thick woody vine that grows high into the tree canopy. Poison Oak (*Rhus diversiloba*) is a low shrub that grows only in southwestern British Columbia and Poison Sumac (*Rhus vernix*) is a tall shrub that grows in southern Ontario but is quite rare. All of these plants possess urushiol oils in nearly all parts of the plant. Touching the plant causes an itchy skin rash that shows up several days following contact. People have a wide range of reactions which in severe cases can lead to oozing blisters on large parts of the body. Some people apparently never react and others may develop an allergy after no reaction after years of frequent contact.

4.15.6 Several plants in the carrot family contain toxic sap that causes severe dermatitis if it comes into contact with skin that is then exposed to sunlight. The most serious reaction is caused by the Giant Hogweed (*Heracleum mantegazzianum*), a garden that is spreading in southern Ontario and is also present in southwestern British Columbia. The plant is enormous, attaining up to 5 m in height, which it does in one growing season. Contact causes painful blistering that can cause permanent disfigurement. It is to be avoided. Similar but less serious reactions can be caused by Meadow Parsnip (*Pastinaca sativa*) and Cow Parsnip (*Heracleum lanatum*). Meadow Parsnip can be very abundant on disturbed sites.

4.15.7 Nettles, particularly Stinging Nettle (*Urtica dioica*) and Wood Nettle (*Laportea canadensis*) contain urticating hairs on the leaves and stems that cause sharp pain or itchiness on contact with skin. The irritation is immediate and normally lasts no more than an hour and there are no lasting consequences.

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[2] *Phytodermatisi producer: keep skin covered and wash well after exposure*


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4.15.8 Some plants contain abundant stiff spines that can present a safety hazard, particularly if one is to fall into them. Fragile Prickly Pear cactus (*Opuntia fragilis*) is common in semi arid areas of the southern Prairie Provinces and interior British Columbia. Pieces will break off and imbed into one's ankle by scarcely brushing them. Devils Club (*Oplopanax horridum*) can form dominant understorey in humid forests among the western mountains. It contains semi-soft spines on the stems that will break off in the skin causing considerable irritation for days. In some areas of Ontario, Prickly-ash (*Zanthoxylon americanum*) a tall shrub with sturdy spines, sometimes forms dense single stands that are nearly impenetrable.

4.15.9 A large number of plants are not harmful to touch but may contain poisonous berries or foliage that could cause serious complications or death if they are ingested. It goes without saying not to eat any berries or plants if you are not absolutely sure of their identity.

4.15.10 Of all the plants, Giant Hogweed presents the most serious health risk. Field staff should learn to recognize and avoid it if encountered.

4.15.11 Employees who develop a rash as a result of exposure to poisonous plants shall report the exposure immediately to their **Supervisor** or **Project Manager** who will then forward the report to the **Regional SH&E Manager**.

## 4.16 Additional Biological Hazards

4.16.1 Additional Work Instructions are provided for protection and prevention from the following:

- *S3NA-313-WI11 Large Carnivores*
- *S3NA-313-WI12 Bear Safety*
- *S3NA-313-WI13 Small Mammals*
- *S3NA-313-WI14 Snakes*
- *S3NA-313-WI15 Alligators*

## 4.17 Habitat Avoidance, Elimination, and/or Control

4.17.1 Ticks, Spiders and Insects

- The most effective method to manage worker safety and health is to eliminate, avoid and/or control hazards. Clearing the project site of brush, high grass and foliage reduces the potential for exposure to biological hazards. Clearing will not eliminate the exposure to flying insects and there might be an increased exposure to ticks, spiders, and poisonous plants during the clearing process.
- AECOM projects such as subsurface environmental assessment or remediation are often candidates for brush and overgrown grass to be cleared. In these instances, the AECOM **project manager** shall either request that the client eliminate vegetation, or request approval from the client to have vegetation clearing added to the scope of work.
- When projects must be conducted in areas that cannot or may not be cleared of foliage, personal precautions and protective measures outlined in this SOP shall be prescribed.
- Mosquitoes breed in stagnant water and typically only travel a quarter mile from their breeding site. Whenever possible, stagnant water should be drained to eliminate breeding areas. **Project Managers** and client site managers should be contacted to determine whether water can be drained and the most appropriate method for draining containers, containment areas, and other objects of standing water.
- If water cannot be drained, products similar to Mosquito Dunks® can be placed in the water to control mosquitoes. Once wet, the Mosquito Dunks® kill the immature, aquatic stage of the mosquito. The active ingredient is a beneficial organism that is lethal to mosquito larvae, but harmless to fish, humans, and other animals. Mosquito Dunks® provide long-term protection for 30 days or more.

4.17.2 Poisonous Plants

- If poisonous plants are identified in the work area, **employees** will mark the plants using either flags or marking paint, and discuss what the specific indicator will be to signal to other **employees** to avoid the designated area. If **employees** decide to use ground-marking paint to identify poisonous plants, they should discuss this tactic with the **Project Manager** and/or Client to gain approval.

- If removal of the plants is considered, it should be subcontracted to a professional landscaping service that is capable and experienced in removing the plant. If herbicides are considered for use, a discussion will need to occur with the **Project Manager** and Client to determine whether it is acceptable to apply herbicides at the work site. Application of herbicides may require a license.
- AECOM **employees** shall not attempt to physically remove poisonous plants from the work area unless a clearing procedure including PPE is prepared in advance and approved by the **Region SH&E Manager**. If a SWP or HASP is prepared for the project, the clearing procedure should be included and the required PPE specified.

4.17.3 Bird Droppings

- Bird excrement may be encountered due to the nesting of pigeons and other birds and winged animals (e.g., bats) on or in structures. Substantial accumulations of droppings can pose physical and health risks as slippery surfaces (if wet) and if the material is disturbed and becomes airborne, it can be inhaled or ingested if personal hygiene practices are not implemented. Inhalation of airborne droppings can cause diseases such as histoplasmosis. Exposure to surfaces with bird droppings shall be safeguarded by implementing proper work practices, training employees for awareness and using PPE. See *S3NA-313-WI10 Bird Droppings Safe Work Practices*.

## 4.18 Personal Precautions and Personal Protective Measures

4.18.1 Precautions

- Be aware of the potential irritants in your area and know how to recognize them.
- Modify activities to avoid encounters (diurnal rhythms, seasonal rhythms).
- Wear protective clothing.
- When working in areas where there may be small insects that “hitchhike” (e.g., ticks, spiders, scorpions), it is recommended that clothes are turned inside out and shaken at the end of day; do not wear same clothes two days in a row.
- Staff should always be aware of where they are placing their hands, or where they are sitting in order to avoid contact with potential toxins.

4.18.2 PPE

- The following recommendations may be considered by the project team to determine if the use of PPE is necessary for the type of work planned: Disposable gloves may be cotton, leather, or synthetic materials and must not be reused after removing.
- Clearing activities present the greatest risk of employee exposure but reduce the risks once completed. Recommendation – AECOM employees actively participating in clearing will use full protection from ticks and insects during the clearing activities including insect repellents, Tyvek® coveralls, and gloves.
- If the foliage being cleared includes poisonous plants, exposed skin will be treated with a dermal barrier cream such as Tecnu®’s Oak ‘n Ivy Armor or Enviroderm’s Ivy Block and either a full face respirator or a half face respirator (with goggles) fitted with a P-100 (HEPA) dust filter.
- Work in habitats with direct exposure to ticks, mosquitoes, and poisonous plants is likely and the scope of work does not allow for worksite control measures like vegetative clearing: Recommendation – Full protection from biological hazards including insect repellents, Tyvek® coveralls or full length clothing, poisonous plant barrier creams and wipes, and gloves.
- Work in habitats with direct exposure to ticks and mosquitoes and no exposure to poisonous plants is likely and the scope of work typically does allow for worksite control measures like vegetative clearing: Recommendation – Protection including insect repellents and Tyvek® coveralls or full length clothing.
- Work in habitats with direct exposure to poisonous plants and no exposure to ticks or insects is likely and the scope of work does not allow for worksite control measures like vegetative clearing: Recommendation – Full protection from poisonous plants including insect repellents, Tyvek® coveralls or full length clothing, poisonous plant barrier creams and wipes, and gloves.
- Industrial/Commercial/Office Facilities – Direct contact with biological hazards is considered unlikely or low risk: Recommendation – PPE for biological hazards are not required; however, Tyvek coveralls and insect repellentrepellent should be available if exposure to spiders, flying insects, or other biological hazards is encountered.
- Work in areas where no biological hazards are expected because of the local environment, winter weather, or property development: Recommendation – PPE for biological hazards is not required;

however, Tyvek® coveralls and insect repellentrepellent should be available if exposures to spiders, flying insects, or other biological hazards are encountered.

- The following precautions and protective measures shall be implemented by AECOM **employees** conducting field work where the biological hazards covered by this SOP exist:

4.18.3 Insects, Spiders, and Ticks

- Chemically-treated field clothing, full-length clothing, or Tyvek® coveralls.
- Application of insect repellent to clothing and/or exposed skin.
- Routine personal checks.
- Exercise care when collecting samples and avoid reaching into areas where visibility is limited. If stung by an insect or bitten by a spider or tick, attempt to identify the attacker and notify a co-worker or someone who can help should the bite site become painful, discolored, or swollen. Stay calm and treat the area with ice or cold water. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite, or any swelling or numbness beyond the site of the bite.
- Oil of lemon eucalyptus, DEET, and Permethrin have been recommended by the Centers for Disease Control and Prevention for effective protection against mosquitoes that may carry the West Nile virus and related diseases.
- Note that DEET will reduce the effectiveness of Fire Resistance Clothing (FRC) and should not be applied to this clothing. If working in FRC, **employees** can apply DEET to their skin and let dry prior to putting FRC on, or use Permethrin as it has been shown not to reduce the effectiveness of FRC. Permethrin will need to be applied to FRC well in advance of the planned work.

4.18.4 Poisonous Plants

- **Employees** working in areas where poisonous plants exist shall wear either long sleeve clothing or Tyvek® coveralls, and disposable cotton, leather or synthetic gloves. **Employees** must not touch exposed skin (neck and face) with potentially contaminated gloves. Tyvek® and gloves worn to protect from exposure to poisonous plants will be treated as contaminated, removed from the body in a manner that the contamination is not spread, and placed in plastic bags for disposal.
- Personal clothing that has been exposed to poisonous plants shall be decontaminated with a poisonous plant cleanser such as Tecnu® or removed in a careful manner, bagged and washed separately from other clothing to remove urushiol.
- Work boots will be decontaminated with either soap and water or a cleansing agent such as Tecnu® cleanser.
- Remember that in the fall and winter the hazard still exists in the form of stubble and roots.
- Employees who develop a rash as a result of exposure to poisonous plants shall report the exposure immediately to their **Supervisor** or **Project Manager** who will forward the report to the RSHEM.
- For dermatitis caused by Poison Ivy, Poison Oak, or Poison Sumac, calamine lotion is effective.

## 4.19 Selection and Configuration of Field Clothing

4.19.1 At a minimum, **employees** will wear long legged pants and long sleeve shirts or Tyvek® coveralls to reduce the amount of exposed skin when biological hazards are identified at the work site. Gloves will also be worn consistent with the recommendations of the site-specific SWP, HASP and/or THA to minimize hand exposure.

4.19.2 Where ticks, chiggers, and spiders are presumed to exist, the Tyvek® or chemically-treated clothing will be taped to the work boots.

4.19.3 See *S3NA-313-WI7 Configuration Clothing for Protection* against ticks and insects for illustrations and instructions for configuring, taping, and tucking clothing.

4.19.4 Chemical Treatment of Field Clothing

- Oil of lemon eucalyptus, DEET, and Permethrin have been recommended by the Centers for Disease Control and Prevention for effective protection against mosquitoes that may carry the West Nile virus and related diseases.
- Note that DEET will reduce the effectiveness of Fire Resistance Clothing (FRC) and should not be applied to this clothing. If working in FRC, **employees** can apply DEET to their skin prior to putting FRC on, or use Permethrin as it has been shown not to reduce the effectiveness of FRC. Permethrin will need to be applied to FRC well in advance of the planned work.

4.19.5 Permethrin

- When selected as part of a project's PPE requirements, the AECOM **Project Manager** shall ensure that field teams wear clothing treated with the chemical Permethrin, which is an insecticide with repellent properties registered with the U.S. Environmental Protection Agency (EPA), and recommended by the CDC. Information regarding the toxicity and product safety of Permethrin is provided in *S3NA-313-WI8 Insect Repellent Active Ingredient Product Information*. Permethrin is highly effective in preventing tick bites when applied to clothing, but is not effective when applied directly to the skin. Two options are available for Permethrin treatment of clothing worn during field work: 1) pre-treatment of fabric by the clothing manufacturer; or 2) employee treatment of their personal clothing using 0.5% Permethrin spray. AECOM strongly recommends the first option (employees obtaining pre-treated clothing) to avoid the time required, potential risk, and housekeeping issues involved with manually treating the clothing with spray. Purchase pre-treated clothing in accordance with *S3NA-208-PR Personal Protective Equipment Program* and with the approval of your **Supervisor**. For more information visit the AECOM NA SH&E website.
- The Permethrin pre-treatment is odorless and retains its effectiveness for approximately 25 washings. After 25 washings, the pre-treated clothing will be considered no longer effective and removed from service. Clothing that has been manually treated by employees will be considered effective for 5 wash cycles.
- Also, use of clothing that has been pre-treated with Permethrin offers a reduction in the use and application of other insect repellents that must be applied directly to the skin.. Costs for clothing shall be charged to projects as a consumable item. If charging to the project is not possible, the charges should be managed as a department expense. **Supervisor** or **Department Manager** approval is required prior to purchase.
- If an employee opts not to utilize chemically pre-treated clothing while potentially exposed to insects, spiders and/or ticks, they must either: 1) wear Tyvek® coveralls taped to the boots, 2) full length clothing consisting of long legged pants and long sleeved shirts treated with an insect repellent containing Permethrin, DEET, or an organic alternative to their work clothing.

4.19.6 Manual Treatment of Field Clothing

- If clothing pre-treated with Permethrin is not available or not purchased prior to field work, employees may manually treat their clothing with Permethrin spray. The outer surfaces of all external clothing to be worn during field work should be treated with 0.5% Permethrin spray a minimum of 2 to 4 hours prior to field work (boots, trousers, shirt, jackets, rain gear; refer to Section 4.16 for selection of field clothing) in accordance with recommendations provided by the New York State Department of Health presented in *S3NA-313-WI9 New York Department of Health Recommendations for Permethrin Application*. This will likely require treatment at home or the office prior to field mobilization. Caution should be used when applying Permethrin as it is highly toxic to fish and house cats. Clothing treatment will last for approximately 5 wash cycles (check the specific instructions for the product used.)

4.19.7 Lemon Eucalyptus

- Lemon Eucalyptus is a plant-based insect repellent on the market as Repel Lemon Eucalyptus. The products have been proven to be effective against mosquitoes, deer ticks, and no-see-ums for up to six hours. Derived from Oil of Lemon Eucalyptus, this non-greasy lotion or spray has a pleasant scent and is not known to be toxic to humans. The spray or lotions will be effective for approximately two to six hours and should be reapplied every two hours to sustain protection. Lemon Eucalyptus products cannot be applied to fire retardant clothing.

4.19.8 Purchase of PPE and Repellents and Lotions

- Costs for clothing, repellents, lotions, and other PPE shall be charged to projects as a consumable item. If charging to the project is not possible, the charges should be managed as a department expense. **Supervisor** or **Department Manager** approval is required prior to purchase.
- Material Safety Data Sheets (MSDS) for the repellents, lotions, and cleansers discussed in this Procedure are not required because the repellents, lotion, and clothing are consumer products used in the manner intended for the general public. Although not required, a MSDS should be obtained for the products used and placed into the office MSDS library and site-specific health and safety plans. Selected MSDSs are available on the AECOM NA SH&E web site.


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4.20 **Personal Hygiene and Body Checks**

4.20.1 Tick-borne diseases typically require that the tick be imbedded for four hours to begin disease transfer. The oils from poisonous plants can take up to 4 hours after exposure to penetrate the skin and react with the live proteins under the skin.

4.20.2 It is recommended that exposed skin be checked frequently for the presence of ticks, insects, rashes, or discolorations. External clothing should also be checked for the presence of ticks and insects; these should be retained for identification and to determine if medical treatment is needed.

4.20.3 **Employees** will shower as soon as practical after working in the field and examine their bodies for the presence of ticks, insect bites, rashes, or swollen areas. If imbedded ticks are found, they should be removed using the technique described in *S3NA-313-WI2 Ticks*, the tick should be preserved with the date and location of the bite noted, and retained for identification if medical treatment is needed as described in Section 4.13.1 of this Procedure.

4.20.4 The presence of an imbedded tick, rash, or abnormal reactions will be reported as an SH&E Incident to the **Project Manager** or **Supervisor** who will forward the report to the **RSHEM** for follow up.

## 5.0 Records

5.1 None

## 6.0 References

6.1 Public Health Agency of Canada (http://www.phac-aspc.gc.ca/id-mi/tickinfo-eng.php) on Ticks and Lyme Disease in Canada

6.2 Public Health Agency of Canada (http://www.phac-aspc.gc.ca/wn-no/index-eng.php) on West Nile Virus

6.3 United States Center for Disease Control (CDC) (http://www.cdc.gov/ncidod/dvbid/lyme/index.htm) on Lyme Disease

6.4 New York State Department of Health, 2007. Health Advisory, Tick and Insect Repellents. http://www.health.state.ny.us/nysdoh/westnile/pdf/2737.pdf

6.5 Spectrum Brands, 2007. Personal Insect Repellent Products. http://www.spectrumbrandshomeandgarden.com/CorpNav/AboutSpectrum/ProductCategories/insect_repellent.htm

6.6 U.S. Centers for Disease Control and Prevention, 2004. Tick Management Handbook. http://www.cdc.gov/ncidod/dvbid/lyme/resources/handbook.pdf

6.7 U.S. Environmental Protection Agency, 2006. Permethrin Facts: Preregistration Eligibility Decision Fact Sheet. http://www.epa.gov/oppsrrd1/reregistration/REDs/factsheets/permethrin_fs.htm

6.8 U.S. National Pesticide Information Center, 1997, National Pesticide Telecommunications Network Fact Sheet for Permethrin. http://npic.orst.edu/factsheets/permethrin.pdf

6.9 U.S. Environmental Protection Agency, 2005. New Pesticide Fact Sheet, Picaridin http://www.epa.gov/opprd001/factsheets/picaridin.pdf


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# S3NA-313-FM Tick Test Request Form

IGeneX, Inc.
795 San Antonio Road
Palo Alto, CA 94303
800/832-3200
www.igenex.com

**TICK TEST REQUEST FORM**

**Revised: JUNE 2008**

**TO SEND A TICK:**

- Place ticks (up to 20) in a small tube or plastic baggy with a small piece of moist cotton.
- Place container in a sealed plastic bag.
- Fill out lower portion of this form.
- Place form, check and sealed plastic bag in padded envelope or box.
- Send to IGeneX, Inc. and mark front of envelope or box with "TT".
- IGeneX does not "TYPE" or determine the species of the ticks. If you want to "TYPE" your tick, please contact your local Vector Control Center.
- Once your tick(s) have been processed, the tick can not be returned to you.
- For Multiple Ticks: up to 20 ticks will be tested together at one time unless indicated otherwise.
  If ticks are tested separately, the charge is per tick. Please test my ticks separately. Yes ☐

**Please test the tick by PCR for:**

| | | | |
|---|---|---|---|
| ☐ | Test 140 | Lyme Disease (B. burgdorferi) | $65.00 |
| ☐ | Test 689 | Babesiosis (B microti and/or B duncani) | $65.00 |
| ☐ | Test 148 | Ehrlichiosis (Ehrlichia) | $65.00 |
| ☐ | Test 290 | Bartonella henselae | $65.00 |
| ☐ | Test 975 | Rickettsia | $65.00 |

**Name and Address of Sender:**

_____

_____

_____

**Phone: (_____) _____**

**If you would like results faxed or called, please indicate below. Otherwise, results will be mailed by USPS.**

_____Please fax my completed results to:
(_____)_____-_____

_____Please call me with my results at:
(_____)_____-_____

☐ Check enclosed payable to IGeneX, Inc.

☐ Please charge my credit card for the above tests:

☐ Visa ☐ Mastercard ☐ Discover

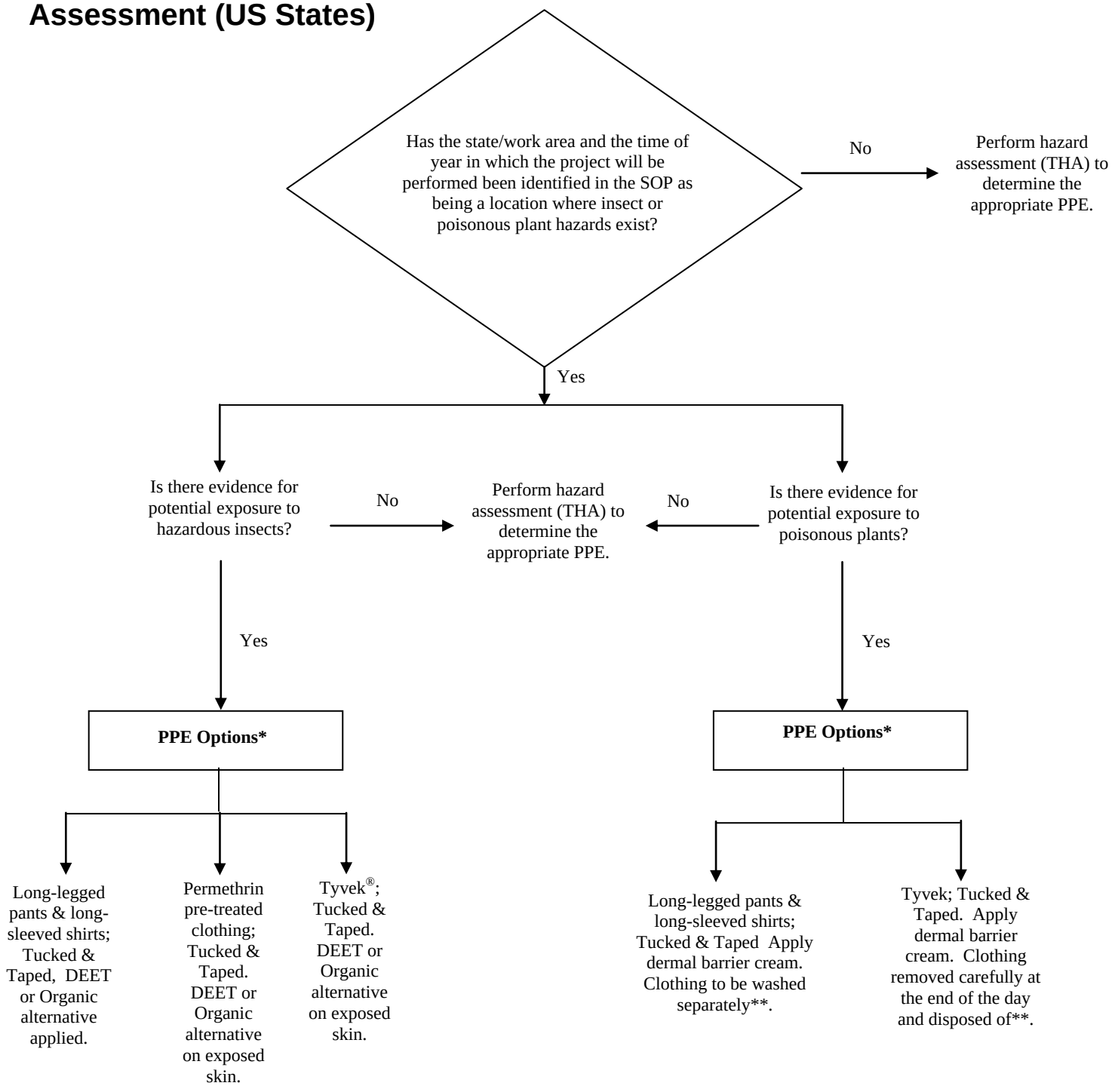
Card Number: _____

Exp. Date_____

Signature_____


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# S3NA-313-WI1 Biological Hazard Assessment Decision Flow Chart Hazard Assessment (US States)




* indicates that when both insect and poisonous plant hazards are recognized hazards at a project site, the most conservative combination of the available PPE choices will be selected.

** indicates that clothing that has been known or suspected to have come in contact with poisonous plants must be washed before it can be worn again. Similarly, Tyvek® that has been known or suspected to have come in contact with poisonous plants will be disposed of rather than reused during a subsequent day or project.


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**State by State Guideline for Exposure**

| States | Tick-Borne Diseases | Mosquito-Borne Diseases | Poisonous Plants |
|---|---|---|---|
| Alabama | Year Round<br>Low Risk | Year Round | Year round |
| Alaska | No Risk | No Risk | No Risk |
| Arizona | No Risk | March - July | March - November |
| Arkansas | March - November | March - November | March - November |
| California | Low Risk | March - November | Year Round |
| Colorado | Low Risk | March - November | No Risk |
| Connecticut | March - November | Low Risk<br>March - November | March - November |
| Delaware | March - November | Low Risk<br>March - November | March - November |
| Florida | Year Round<br>Low Risk | Year Round | Year round |
| Georgia | Year Round<br>Low Risk | Year Round | Year round |
| Hawaii | No Risk | No Risk | No Risk |
| Idaho | No Risk | Low Risk<br>March - November | No Risk |
| Illinois | March - November | March - November | March - November |
| Indiana | March - November | March - November | March - November |
| Iowa | March - November | March - November | March - November |
| Kansas | Low Risk | March - November | March - November |
| Kentucky | March - November | March - November | March - November |
| Louisiana | Year Round<br>Low Risk | Year Round | Year round |
| Maine | March - November | March - November | March - November |
| Maryland | March - November | Low Risk | March - November |
| Massachusetts | March - November | March - November | March - November |
| Michigan | March - November | March - November | March - November |
| Minnesota | March - November | March - November | March - November |
| Mississippi | Year Round | Year Round | Year round |
| Missouri | March - November | March - November | March - November |
| Montana | Low Risk<br>March - July | Low Risk<br>March - July | No Risk |
| Nebraska | Low Risk | Low Risk | Low Risk |
| Nevada | Low Risk<br>March - July | Low Risk<br>March - July | Low Risk<br>March - November |
| New Hampshire | March - November | March - November | March - November |
| New Jersey | March - November | March - November | March - November |
| New Mexico | No Risk | Low Risk<br>March - July | No Risk |
| New York | March - November | March - November | March - November |
| North Carolina | March - November | March - November | March - November |
| North Dakota | No Risk | March - November | No Risk |
| Ohio | Low Risk<br>March - November | March - November | March - November |
| Oklahoma | March - November | Low Risk<br>March - November | March - November |
| Oregon | Low Risk<br>March - November | Low Risk<br>March - November | March - November |
| Pennsylvania | March - November | March - November | March - November |
| Puerto Rico | ??? | Low Risk<br>March - November | Year round |
| Rhode Island | March - November | Low Risk<br>March - November | March - November |
| South Carolina | March - November | Low Risk<br>March - November | March - November |

| States | Tick-Borne Diseases | Mosquito-Borne Diseases | Poisonous Plants |
|---|---|---|---|
| South Dakota | Low Risk<br>March - November | March - November | March - November |
| Tennessee | March - November | March - November | March - November |
| Texas | Year Round<br>Low Risk | Year Round | Year round |
| Utah | Low Risk<br>March - July | Low Risk<br>March - July | No Risk |
| Vermont | March - November | Low Risk<br>March - November | March - November |
| Virginia | Low Risk<br>March - November | March - November | March - November |
| Washington | Low Risk<br>March - November | Low Risk<br>March - November | March - November |
| West Virginia | Low Risk<br>March - November | March - November | March - November |
| Wisconsin | March - November | March - November | March – November |
| Wyoming | No Risk<br>March - July | Low Risk<br>March - July | No Risk |


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# S3NA-313-WI2 Ticks

## 1.0 Background

1.1 The Public Health Agency of Canada (PHAC) works with the provinces, health authorities and other experts on research to define and monitor the occurrence of the ticks that carry *Borrelia burgdorferi*, the bacterium that causes Lyme disease. In Canada, the blacklegged tick (*Ixodes scapularis*; often referred to as a deer tick) and the western blacklegged tick (*Ixodes pacificus*) are the species known to transmit this disease-causing agent, as well as other less common agents.

1.2 In Quebec, blacklegged tick populations are becoming established in parts of the Monteregie and Estrie regions in the southeast of the province. In Ontario, populations can be found in Long Point; Point Pelee National Park; Rondeau Provincial Park; Turkey Point; Prince Edward Point National Wildlife Area and St. Lawrence Islands National Park in the Thousand Islands region of eastern Ontario. In Nova Scotia, blacklegged tick populations are found in the Lunenburg, Bedford and Shelburne areas. An established population has also been found in the southeastern corner of Manitoba. Western blacklegged ticks, on the other hand, are found in British Columbia; they are fairly widely distributed but populations are largest in the lower mainland, on Vancouver Island, and in the Fraser Valley.

**1.3** Although the distribution of blacklegged ticks in Canada appears to be limited, surveillance indicates that some of the established populations are spreading within certain areas of southern Canada. The potential expansion of localized tick populations makes it difficult to precisely define the geographic limits of any given population; however, people living in or visiting areas adjacent to established tick populations may have a greater chance of contact with blacklegged ticks. Although current evidence does not suggest a widespread distribution of blacklegged tick populations in Canada, the establishment of new populations appears to be an ongoing process. Hence, it is desirable to continue surveillance and to take precautions to reduce tick contact.

1.4 The rate of infection of ticks with the bacterium that causes Lyme disease varies. Infection rates are typically higher in adult ticks compared to the other stages (nymphs and larvae). Despite the lower rates of infection, people are most likely to acquire Lyme disease from a nymph because this stage is so small (see Figure 2) and thus more likely to go unnoticed and feed for a sufficient amount of time for the Lyme disease bacterium to be transmitted (24-36 hours). Infection rates are often greater in tick populations that have been established for long periods of time (such as Long Point) compared to newly established ones. As many as 60 percent of the adult ticks at Long Point are infected; however, infection rates in adults are more often between 10 and 25 percent at the other localities where ticks are established. Partly because of differences in the types of hosts that they feed upon, infection rates of the Lyme disease agent in *Ixodes pacificus* are much lower (1-3 percent) than *Ixodes scapularis*.

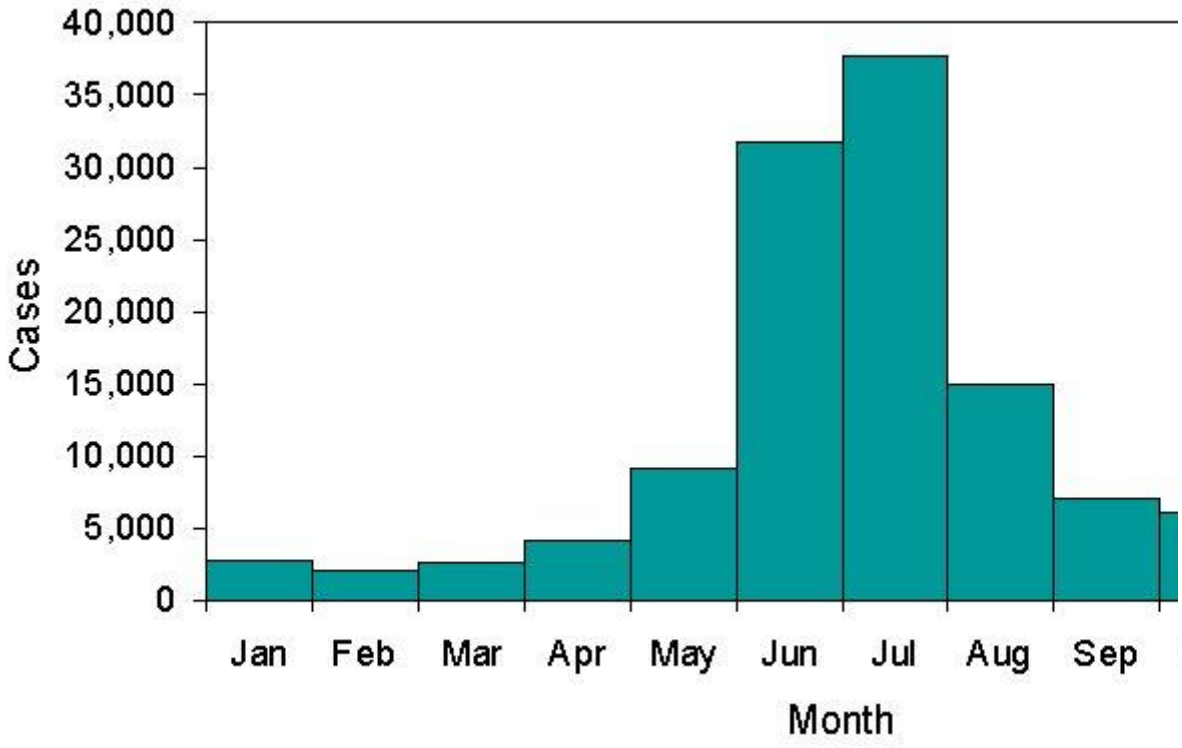
**1.5** While there is a higher risk of coming in contact with infected blacklegged ticks in areas where populations are established, there is also a low risk of Lyme disease being contracted almost anywhere in Canada because migratory birds transport infected ticks over large geographic distances. Surveillance data indicates that about 12 percent of the ticks detected outside of areas where tick populations are established, and likely transported there on migratory birds, are infected with the agent of Lyme disease.

**1.6** Source: http://www.phac-aspc.gc.ca/id-mi/tickinfo-eng.php


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**Figure 1**

**Reported Cases of Lyme Disease by Month of Illness Onset United States, 1992-2004**




Lyme disease patients are most likely to have illness onset in June, July, or August and less likely to have illness onset from December through March.

Lyme disease likelihood = April through November http://www.cdc.gov/ncidod/dvbid/lyme/ld_rptmthofill.htm

## 2.0 Tick removal tips from CDC

http://www.cdc.gov/ncidod/dvrd/ehrlichia/Q&A/Q&A.htm

## 3.0 To Remove Attached Ticks




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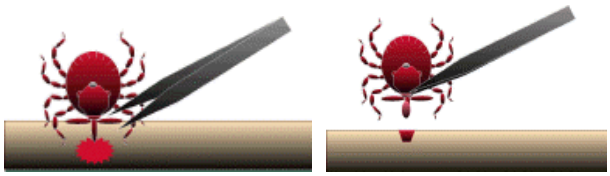
3.1 Use fine-tipped tweezers or notched tick extractor, and protect your fingers with a tissue, paper towel, or latex gloves (see figure). Persons should avoid removing ticks with bare hands.

3.2 Grasp the tick as close to the skin surface as possible and pull upward with steady, even pressure. Do not twist or jerk the tick; this may cause the mouthparts to break off and remain in the skin. (If this happens, remove mouthparts with tweezers. Consult your health care provider if illness occurs.)

3.3 After removing the tick, thoroughly disinfect the bite site and wash your hands with soap and water.

3.4 Do not squeeze, crush, or puncture the body of the tick because its fluids may contain infectious organisms. Skin accidentally exposed to tick fluids can be disinfected with iodine scrub, rubbing alcohol, or water containing detergents.

3.5 Save the tick for identification in case you become ill. This may help your doctor make an accurate diagnosis of potential diseases by determining what type of tick it is. Place the tick in a sealable plastic bag and put it in your freezer. Write the date of the bite on a piece of paper with a pencil and place it in the bag.



## 4.0 Devices Designed for Removing Ticks

**4.1** **The Tick Tool - http://www.ticktool.com/index.html**

## 5.0 Folklore Remedies Don't Work

**5.1** Folklore remedies, such as the use of petroleum jelly or hot matches, do little to encourage a tick to detach from skin. In fact, they may make matters worse by irritating the tick and stimulating it to release additional saliva or regurgitate gut contents, increasing the chances of transmitting the pathogen. These methods of tick removal should be avoided.


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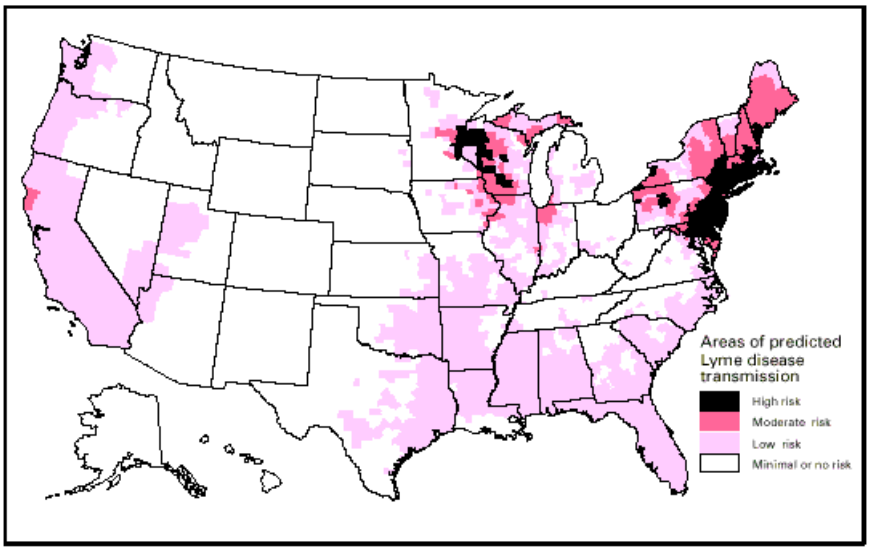
**Information Regarding Common Tick-Borne Diseases and Tick Removal Procedures**

**Table 1**
**Common Tick-Borne Diseases in the U.S. and Information Resources**

| Disease | Tick Species | CDC Informational Web Pages |
|---|---|---|
| Lyme disease | • Black-legged or deer tick<br>• Western black legged tick | http://www.cdc.gov/ncidod/dvbid/lyme/ |
| Ehrlichiosis | • Lone star tick<br>• Black-legged or deer tick<br>• Western black legged tick | http://www.cdc.gov/Ncidod/dvrd/ehrlichia/Index.htm |
| Rocky Mountain spotted fever | • American dog tick<br>• Rocky Mountain wood tick<br>• Brown dog tick | http://www.cdc.gov/ncidod/dvrd/rmsf/index.htm |

## 6.0 Distribution

**Figure 2**
**Distribution Map for Lyme Disease Risk, U.S.**

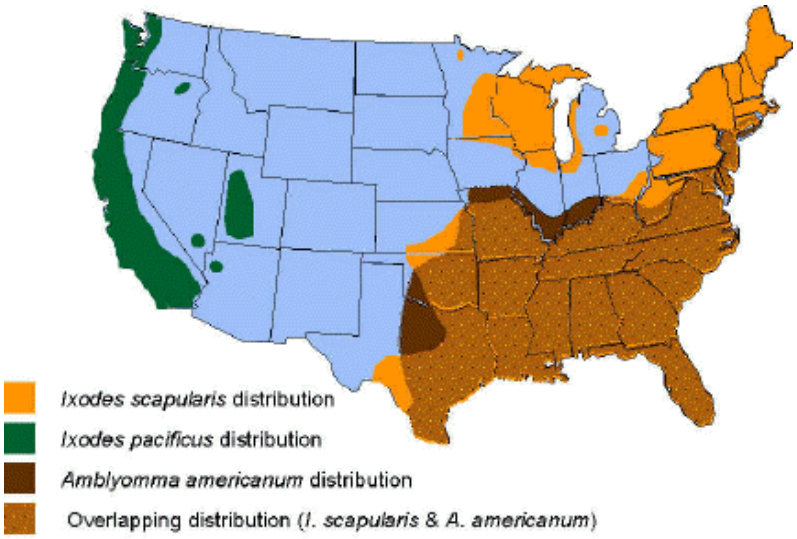



Note: This map demonstrates an approximate distribution of predicted Lyme disease risk in the United States. The true relative risk in any given county compared with other counties might differ from that shown here and might change from year to year. Risk categories are defined in the accompanying text. Information on risk distribution within states and counties is best obtained from state and local public health authorities.

Source: CDC, http://www.cdc.gov/ncidod/dvbid/lyme/riskmap.htm

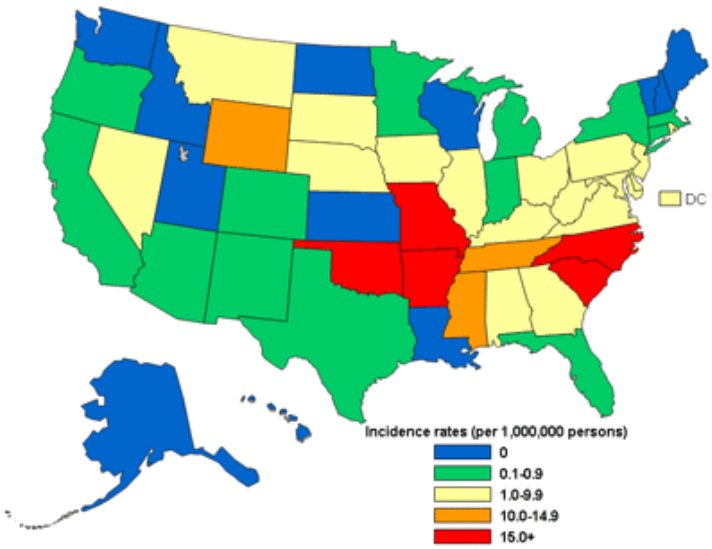
**Figure 3**
**Distribution Map of Vector**

**Tick Species for Human Ehrlichiosis, U.S.**




Source: CDC, http://www.cdc.gov/ncidod/dvrd/ehrlichia/Q&A/Q&A.htm

**Figure 4**
**Distribution Map of Annual Incidence**
**of Rocky Mountain Spotted Fever, U.S**




Data for calendar year 2002

Source: CDC, http://www.cdc.gov/ncidod/dvrd/rmsf/Epidemiology.htm


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# S3NA-313-WI3 Poisonous Spider Identification

**Black Widow Spider**





- Abdomen usually shows hourglass marking.
- The female is 3-4 centimeters in diameter.
- Have been found in well casings and flush-mount covers.
- Not aggressive, but more likely to bite if guarding eggs.
- Light, local swelling and reddening of the bite are early signs of a bite, followed by intense muscular pain, rigidity of the abdomen and legs, difficulty breathing, and nausea.
- If bitten, see physician as soon as possible.

**Brown Spiders (Recluse)**





- Central and South U.S., although in some other areas, as well.
- ¼-to-½-inch-long body and the size of silver dollar.
- Hides in decaying wood, baseboards, ceilings, cracks, and undisturbed piles of material.
- Bite either may go unnoticed or may be followed by a severe localized reaction, including scabbing, necrosis of affected tissue, and very slow healing.
- If bitten, see physician as soon as possible.

Exercise care when collecting samples and avoid reaching into areas where visibility is limited. If bitten by a spider, attempt to identify the spider, notify a co-worker or someone who can help should the bite site become painful, discolored, or swollen. Stay calm and treat the area with ice or cold water. Seek medical attention if you have any reactions to the sting such as developing a rash, excessive swelling or pain at the site of the bite or any swelling or numbness beyond the site of the bite.

Additional USA Spider Identification charts are available at http://www.termite.com/spider-identification.html


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# S3NA-313-WI4 Mosquito-Borne Diseases

## 1.0 Background

1.1 CDC data indicates that mosquito-borne illnesses, including encephalitis, are a health risk to employees working in outdoor environments.

1.2 Mosquitoes pose a risk of causing infection with various forms of encephalitis and other diseases in AECOM employees. This section will focus on the transmission of encephalitis. West Nile encephalitis is an infection of the brain that is caused by a virus known as the West Nile virus.

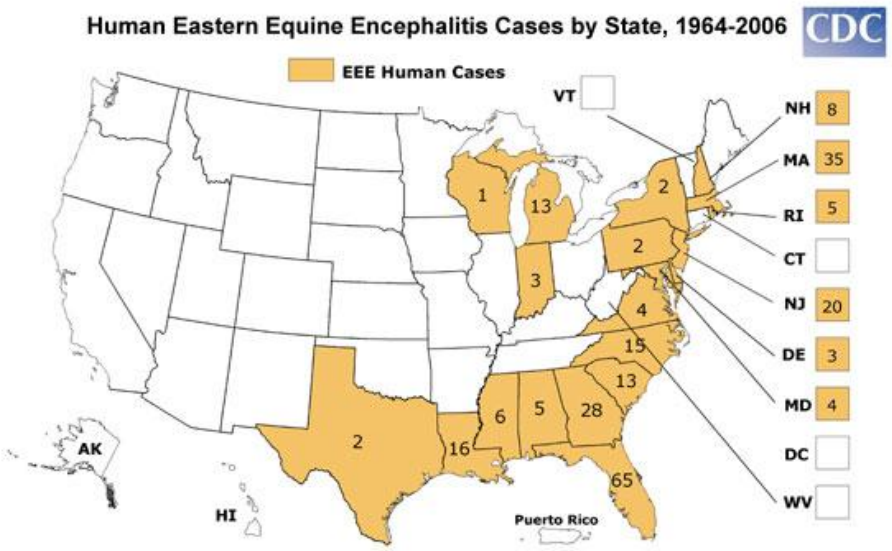
1.3 If other mosquito-borne diseases are identified in the project area, the local Public Health Department and CDC should be consulted to determine what diseases are present and exposure prevention recommendation.

1.4 According to the CDC, arboviral encephalitis is a virus that is “maintained in nature through biological transmission between susceptible vertebrate hosts by blood feeding arthropods”, e.g., mosquitoes. It exists in various forms in global distribution, and in four primary forms in the U.S.: 1) eastern equine encephalitis (EEE), 2) western equine encephalitis (WEE), 3) St. Louis encephalitis (SLE), and 4) La Crosse (LAC) encephalitis; all of which are transmitted by mosquitoes.

1.5 Mosquitoes are known to breed in standing water; therefore, when standing water is found at a job site, actions should be taken to drain the water. Typically, mosquitoes will fly only a quarter of a mile (400 meters) from their breeding location.

## 2.0 Distribution

**Figure 1**
**Distribution Map for EEE Cases**

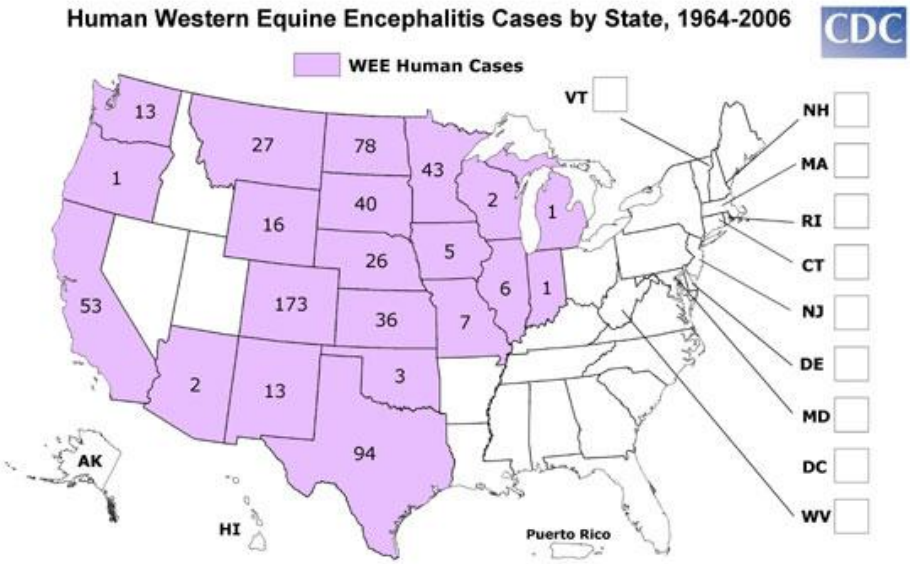



Source: http://www.cdc.gov/ncidod/dvbid/arbor/images/EEE_Map.jpg


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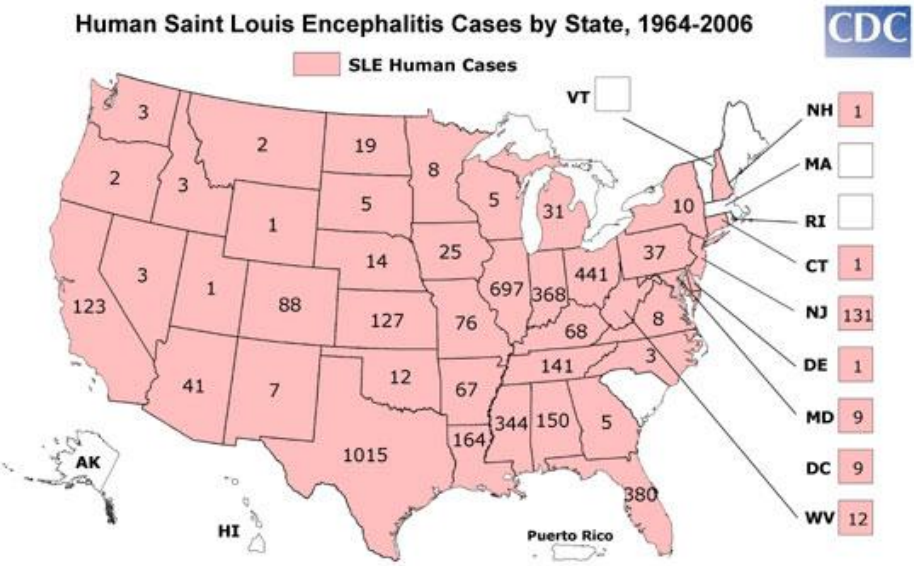
**Figure 2**

**Distribution Map for WEE Cases**




Source: http://www.cdc.gov/ncidod/dvbid/arbor/images/WEE_Map.jpg

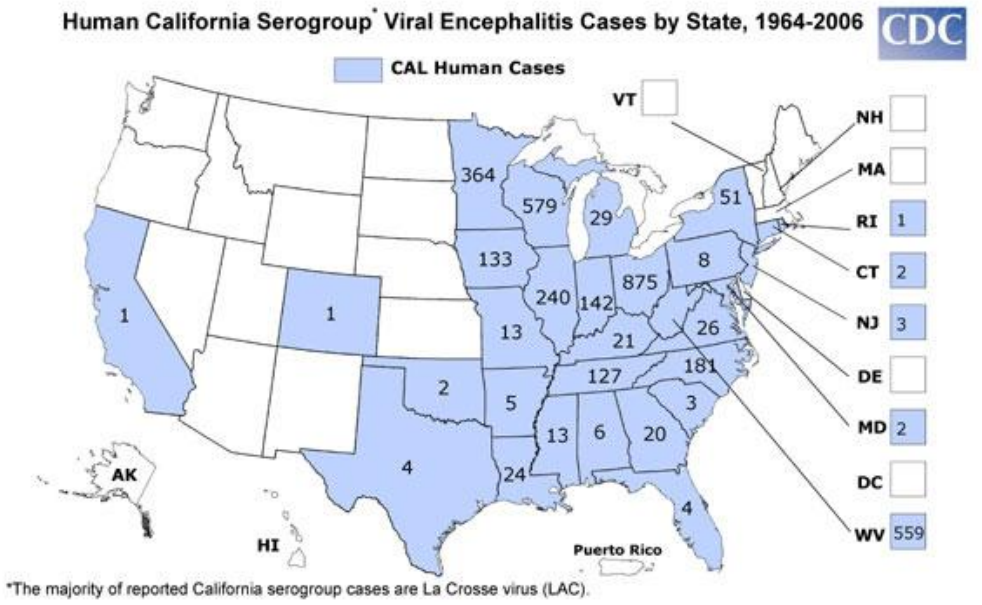
**Figure 3**
**Distribution Map for SLE Cases**




Source: http://www.cdc.gov/ncidod/dvbid/arbor/images/SLE_Map.jpg


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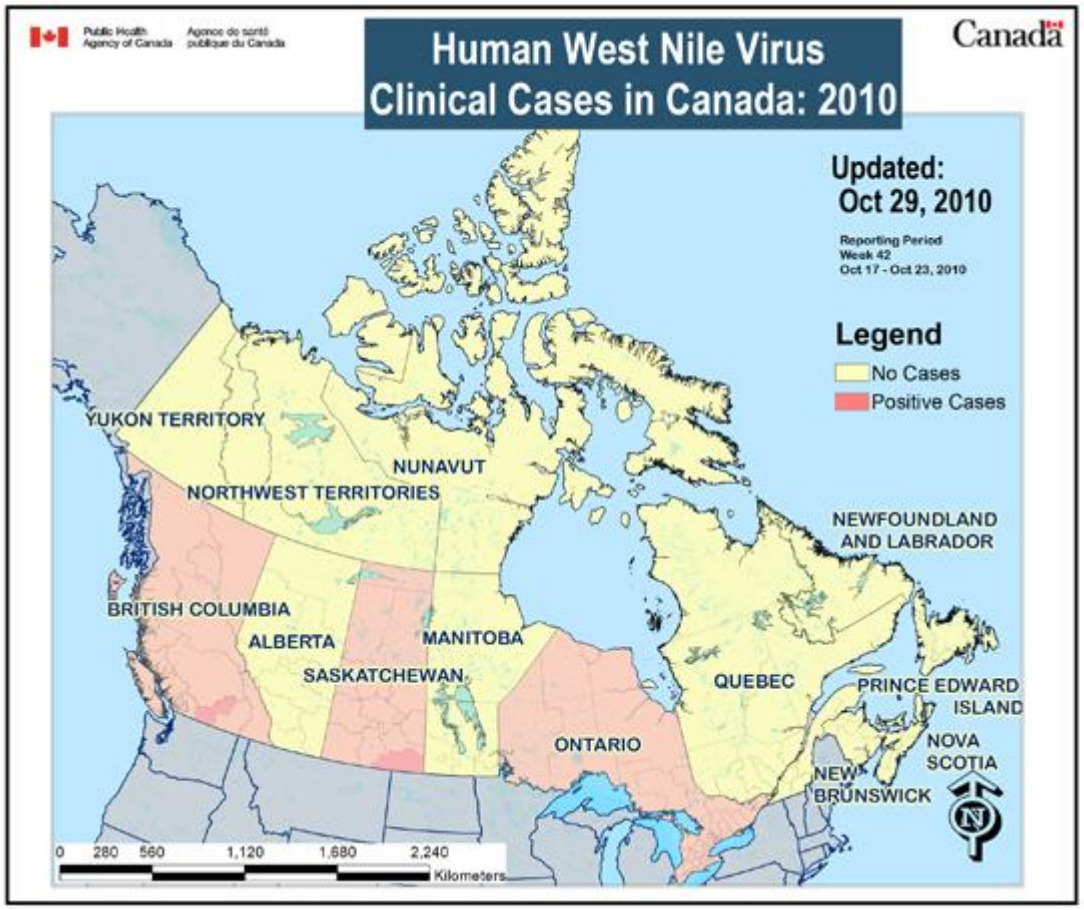
**Figure 4**
**Distribution Map for LAC Cases**




Source: http://www.cdc.gov/ncidod/dvbid/arbor/images/LAC_Map.jpg


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**Canadian Mosquito Borne Diseases**




**Source: http://www.eidgis.com/wnvmonitorca/**

| **Disease** | **Distribution** |
|---|---|
| California encephalitis | Canada-wide |
| Western equine encephalitis | Western Canada |
| Eastern equine encephalitis | Quebec, Ontario |
| St Louis encephalitis | Ontario, Quebec, Manitoba, Saskatchewan |
| Cache Valley | Ontario, Manitoba, Saskatchewan, Alberta |

Source: Paediatr Child Health. 2000 May–Jun; 5(4): 206–212.

# S3NA-313-WI5 Plants of Concern

## 1.0 Background

1.1 Poison ivy, oak and sumac (poisonous plants) pose a significant threat to AECOM employees due to the dermatitis that results from exposure to the oil on these plants, called urushiol.

1.2 Exposure to urushiol produces a rash that can be irritating and cause the exposed employee to scratch the infected area, increasing susceptibility for an infection to result from the rash.

1.3 It should be noted that each time an employee is exposed to urushiol, it increases the severity of the reaction they will have in subsequent exposures.

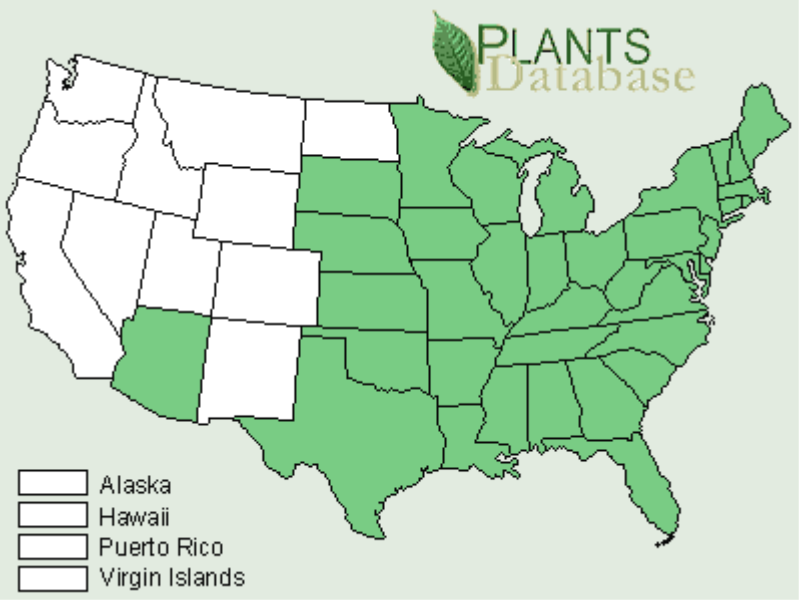
## 2.0 Treatment

2.1 In cases that involve severe rashes, medical treatment may be necessary to control the rash.

2.2 Employees that develop a rash as a result of exposure to poison ivy, oak or sumac should report the exposure immediately to their Supervisor, Project Manager and RSHEM.

**Figure 1**

**Distribution Map for Poison Ivy**





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**Figure 2**
**Distribution Map for Poison Oak**

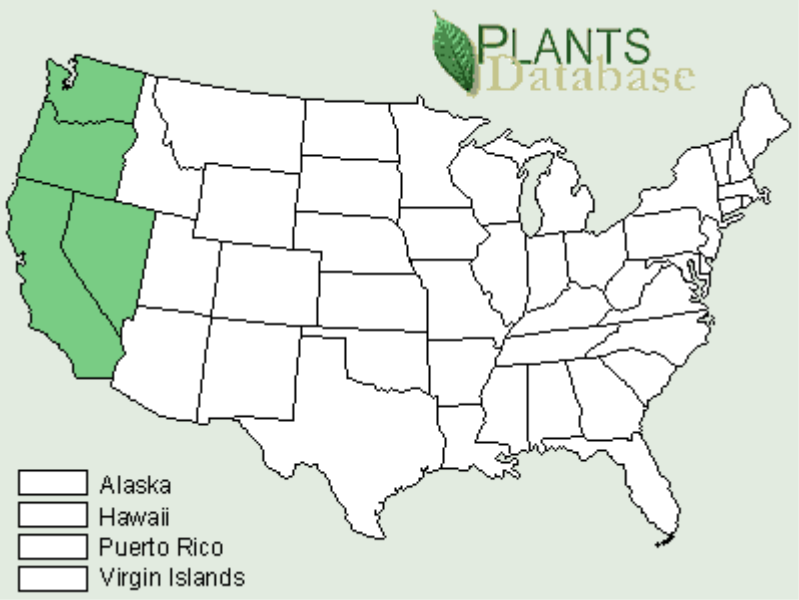
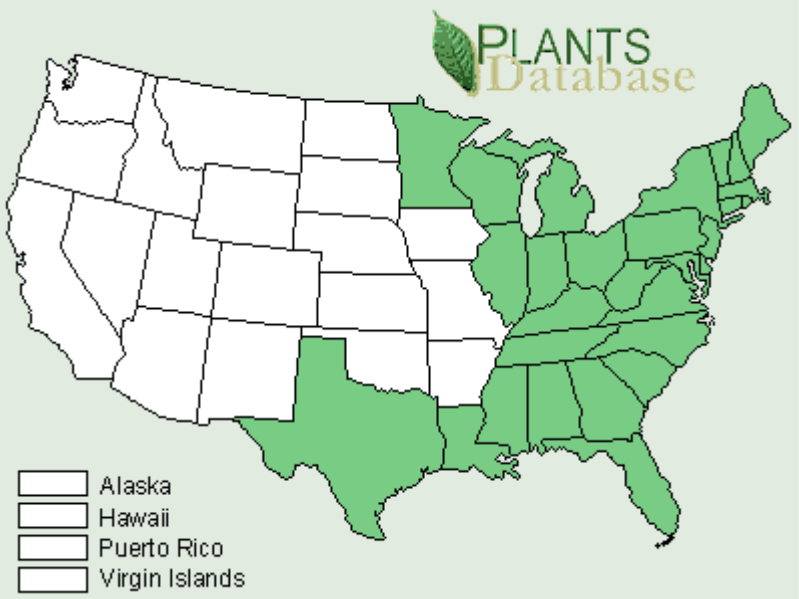



**Figure 3**
**Distribution Map for Poison Sumac**




Source for Figures 1, 2, and 3: http://www.tecnuextreme.com/plant-map.htm


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# S3NA-313-WI6 Wild Parsnip Identification

## 1.0 Background

1.1 Wild Parsnip (also known as Poison Parsnip) looks similar to a large carrot plant and is found in open places along roadsides and in waste places throughout the United States and Canada.

1.2 This plant produces a compound that causes severe blistering and discoloration after being exposed to sunlight—a condition known as photodermatitis. That is, when the skin comes in contact with this plant's juice and then is exposed to UV light, a severe burn develops.

## 2.0 Hazard

2.1 Everyone can get burned by wild parsnip. Unlike poison ivy, you don't need to be sensitized by a prior exposure. However, wild parsnip is only dangerous when the juice from broken leaves or stems gets on your skin—therefore, you can touch and brush against the undamaged plant without any danger.

2.2 If one gets some of the sap of Hogweed (or Meadow Parsnip or Cow Parsnip) in contact with skin, it is critical that they stay out of the sun for 8 hours. If one needs to remove the plant they should be completely covered with overalls, gloves, hat and safety glasses.

More information can be found at www.co.becker.mn.us/dept/soil_water/wild_parsnip.aspx





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# S3NA-313-WI7 Configuration Clothing for Protection Against Ticks and Insects

## 1.0 Configuration of Clothing

1.1 Loose-cuff trousers must be tucked into socks, wrapped with duct tape (or equivalent) completely around the cuff of the sock up on to the surface of the pant leg to prevent entry of insects between the sock and pants, and preferably reverse-wrapped with “sticky” side out (see figure below).




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# S3NA-313-WI8 Insect Repellent Active Ingredient Product Information

## 1.0 Application of Insect Repellent

1.1 Immediately prior to the commencement of work in the field, an AECOM-approved insect repellent shall be applied to exposed skin, and to the outer surface of pant leg cuffs tucked into socks, shirt tails tucked into pants at the waist, and shirt cuffs.

1.2 Table 1 provides a list of AECOM-approved insect repellent active ingredients; employees may utilize any brand containing the minimum concentration of active ingredients as listed.

1.3 All products are registered with the EPA and recommended by the CDC.

1.4 Employees should select the AECOM approved repellent which is best for them based on skin sensitivity/allergies, and personal preference, but be aware that reapplication frequency will be greater for Picaridin and lemon eucalyptus products.

1.5 Employees shall carefully read and comply with manufacturer recommendations and instructions on product labels prior to application. Repellent shall not be applied beneath clothing to minimize the potential for irritation and/or allergic reaction.

1.6 The chemical N,N-diethyl-*m*-toluamide (DEET) shall not be applied to Nomex™ fire retardant clothing as it reduces the effectiveness of the fabric.

**Table 1**
**Approved Insect Repellents**

| Active ingredient and minimum concentration | Products Available | Approximate Duration of Effectiveness | Notes and Web Link to Product Safety Information |
|---|---|---|---|
| Permethrin (0.5%) | -Repel® Permanone<br>-Coulston's Duranon™ | 2 weeks[1] | -Application to clothing and equipment only |
| DEET (23.8%) | -Deep Woods Off! ®<br>-Repel® Sportsmen Formula® | 5 hours[2] | -Cannot be applied to Nomex™ fabric |
| Picaridin (7%) | -Cutter Advanced™ | 4 hours[3] | -Protection equivalent to approximately 10% DEET |
| Oil of Lemon Eucalyptus (30%) | -Repel® Lemon Eucalyptus | 2 hours[2] | -Protection equivalent to approximately 7% DEET<br>-Natural, plant based product |

[1] – New York State Department of Health, 2007
[2] – Fradin and Day, 2002
[3] – Spectrum Brands, 2007

1.7 Repellent shall be reapplied multiple times daily over the course of the day at a frequency identified during the hazard assessment based on manufacturers' recommendations, the approximate effective period provided in Table 1, and other factors such as perspiration, precipitation, etc.

1.8 All approved repellents are available at most department or sporting goods stores.


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## Product Safety Information

Facts about the repellants recommended by AECOM are available by clicking on the embedded link.

**National Pesticide Telecommunications Network Fact Sheet: Permethrin and Picaridin**

Picaridin




Permethrin




DEET




Lemon Eucalyptus



# S3NA-313-WI9 New York Department of Health Recommendations for Permethrin Application

## 1.0 Application Recommendations

1.1 Source: New York State Department of Health, 2007. Health Advisory, Tick and Insect Repellents. **http://www.health.state.ny.us/nysdoh/westnile/pdf/2737.pdf**

1.2 Products containing permethrin are for use on clothing only—not on skin. Permethrin kills ticks and insects that come in contact with treated clothes. It is effective for two weeks or more if the clothing is not laundered.

## 2.0 Treat Clothing Only– DO NOT APPLY TO SKIN.

2.1 Read carefully and follow manufacturer's recommendations for application.

2.2 If you accidentally get the product on your skin, immediately wash with soap and water.

2.3 Apply to clothing in a well-ventilated outdoor area, protected from wind.

2.4 Only spray Permethrin products on the outer surface of clothing and shoes before you put them on - do not apply to clothing while it is being worn. Only spray enough product to lightly moisten the outer surface of the fabric causing a slight color change or darkening; do not saturate clothing. Do not exceed recommended spraying times. Pay special attention while treating socks, trouser cuffs and shirt cuffs to ensure proper coverage. Hang the treated clothing outdoors and allow clothing to dry for at least two hours (four hours under humid conditions) before wearing.

2.5 Do not treat clothing more than once every two weeks. Launder treated clothing separately from other clothing at least once before retreating.

2.6 Keep treated clothes in a separate bag. Those who frequent tick or mosquito habitats should consider having a set of clothes, preferably long-sleeved shirt, pants and socks that are used only in such settings. These clothes can be treated with a Permethrin-containing product according to the label directions, worn only when needed, and then placed in a separate bag when not in use. In hot weather, when long-sleeved shirt and pants may be uncomfortable, pants and jackets made of insect netting (either untreated or treated with repellent) can be worn. Such clothes are available in some sporting good stores and through outdoor equipment catalogs.

1. U. S. Environmental Protection Agency. 1999. Office of Pesticide Programs List of Chemicals Evaluated for Carcinogenic Potential-August 25, 1999. Office of Pesticide Programs. Washington, DC.


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# S3NA-313-WI10 Bird Droppings Safe Work Practices

## 1.0 Background

1.1 According to the National Institute for Occupational Safety and Health (NIOSH), histoplasmosis is an infectious disease caused by inhaling spores of a fungus called *Histoplasma capsulatum (*abbreviated *H. capsulatum)* that may inhabit accumulated masses of pigeon droppings and excrement of other birds and flying animals. Its symptoms vary greatly, but the disease primarily affects the lungs. Occasionally, other organs are affected. This form of the disease is called disseminated histoplasmosis, and it can be fatal if untreated. The acute respiratory disease form of histoplasmosisis is characterized by respiratory symptoms, a general ill feeling, fever, chest pains, and a dry or non-productive cough. Distinct patterns may be seen on a chest x-ray. Chronic lung disease resembles tuberculosis and can worsen over months or years. If symptoms occur, they may start within 3 to 17 days of exposure, with an average of 10 days. On a positive note, histoplasmosis is not contagious.

1.2 Psittacosis, although primarily a respiratory disease, can cause a wide variety of clinical manifestations. Generally, about 10 days after infection occurs, the clinical illness begins abruptly with fever, chills, weakness, fatigue, muscle pain, anorexia, nausea, vomiting, excessive sweating and difficulty with breathing, headache, backache, and sensitivity to light.

1.3 Hypersensitivity pneumonitis is also known as pigeon breeder's disease.

## 2.0 Symptoms

2.1 The acute form of hypersensitivity pneumonitis is clinically characterized by chills, fever, cough, breathlessness without wheezing, and malaise 4-10 hours after exposure. In general, an acute attack subsides after 18 to 24 hours.

## 3.0 Treatment

3.1 If a person should develop any of the symptoms as noted above, or others, it is important to see a physician and inform him of an exposure to pigeon/bird or bat excrement. A failure to diagnose the preceding conditions could occur if a treating physician is unaware of a patient's exposure to pigeon/bird or bat excrement.

## 4.0 Prevention

4.1 Prior to work in any area where pigeons or other flying animals may nest, a written statement from the client shall be obtained in regards to the potential for, and extent of, accumulation of excrement on/in the structure from pigeons and other winged animals.

4.2 The client shall be asked to provide appropriate details as to the basis for their statement (e.g., date of last visual survey for pigeon/bird or bat excrement accumulation, date of last excrement removal effort, etc.).

4.3 In no case will an AECOM employee or contract employee be permitted to commence structure inspection procedures without project management having received and evaluated the aforementioned written statement from the client.

4.4 According to NIOSH, the best way to prevent exposure to *H. capsulatum* spores during survey and inspection work is to avoid situations where excrement and other potentially-contaminated material can become airborne and inhaled. Therefore, it is preferable that the efforts to determine if, and to what extent, there is an accumulation of pigeon/bird or bat excrement on/in structures, or the efforts to clean-up/removal/disposal of such contaminated material, be left to the client or subcontracted out.

## 5.0 Safe Work Practices

5.1 In those cases where AECOM employees or contract employees are contracted by the client to determine the extent of accumulation of animal excrement in/on structures, the following minimum safety and health precautions shall be taken. (NOTE: precautionary measures are based on


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recommendations and best practices prescribed in the NIOSH 2004 public document titled *Histoplasmosis – Protecting Workers at Risk*).

5.2 All workers shall wear disposable protective clothing (Tyvek® coveralls). Disposable overalls with hoods shall be donned when working in areas where *H. capsulatum* spore-contaminated material is likely to fall from overhead.

5.3 All workers shall wear disposable shoe coverings fitted with ridged soles made of slip-resistant material to reduce the likelihood of slipping on wet or dusty surfaces. Gloves shall be worn.

5.4 All workers shall wear a full facepiece air purifying respirator fitted with P100 (HEPA) cartridges. If entering an enclosed area in which the extent of excrement contamination is unknown, additional protective measures shall be taken such that workers shall wear a powered air-purifying respirator (APR) with full facepiece fitted with P100 (HEPA) cartridges. Any variance from these requirements must be approved by the Regional SH&E Manager. Workers donning APRs shall be medically screened, cleared, and trained in their proper use in accordance with AECOM safety program standards.

5.5 If contaminated material must be disturbed for purposes of removal/disposal or during the structure inspect process, it shall be wetted down prior to all work and will be rewetted as necessary to minimize airborne dusting.

5.6 After working in *H. capsulatum* spore-contaminated areas and before removing any respiratory protective equipment, workers shall remove all protective clothing and shoe coverings and seal them in a heavy-duty plastic bag for disposal.

5.7 Workers shall observe a high degree of personal hygiene, even if the exposure is casual. Special care shall be taken to wash hands, face, and other areas of exposed skin thoroughly before eating, drinking or smoking.


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# S3NA-313-WI11 Large Carnivores

## 1.0 Hazard

1.1 Most wild carnivores in the feline family (cougars, lynx, and bobcat) or the canine family (wolves and coyotes) are more predictable than bears and are not predatory towards humans; however, all wild animals can be dangerous if they feel threatened or if they are sick or starving.

1.2 Most ungulates (deer, moose, elk, and caribou) will avoid humans and will flee as soon as a human is sighted; however, females with young (during May and June) and males during the mating season (September to November) can be very aggressive, especially if provoked.

## 2.0 Personal Protective Equipment

2.1 Noise makers such as bear bangers, whistles and bells can be used as deterrents for an approaching animal.

2.2 Pepper (bear) spray can be used to ward off an imminent attack.

## 3.0 Safe Work Practice

3.1 Most negative encounters with ungulates or carnivores can be avoided with a few key preventative measures:

3.1.1 When working in wilderness isolation, always travel in pairs and make lots of noise.

3.1.2 Always store food in air-tight containers away from sleeping areas (if camping) and never carry strong smelling foods which could attract animals.

3.1.3 Keep your eyes open for fresh animal signs which may indicate a dangerous situation:

- Extensive fresh rubbing on branches in the fall might indicate the presence of a rutting male ungulate that may become aggressive to defend a potential mate.
- A fresh kill or carcass which might indicate the presence of a carnivore that may become aggressive to defend its food.

3.2 Maintaining a distance of at least 30 metres (100 feet) allows large animals an escape route. If you notice any signs of aggression or behavioral changes, you should move away to a safe location. Wildlife should not be enticed by reaching out or simulating calls.

3.3 Pets should be kept secure and away from wildlife as their actions can provoke an attack. Moose, deer and other wildlife may appear quite docile; however, if a dog makes them feel threatened, their behavior can become unpredictable.

**3.4 If you are approached by a carnivore (wolf, coyote, or cougar):**

3.4.1 Pick up small children immediately.

3.4.2 Try to appear bigger, hold your arms or an object over your head.

3.4.3 Face the animal and retreat slowly. Do not run or play dead.

3.4.4 Maintain steady eye contact with the animal.

3.4.5 If the animal continues to approach, deter an attack by yelling, waving a stick or throwing rocks.

3.4.6 If you are attacked, fight back. Hit the animal with a heavy stick or rock.

**3.5 If you are approached by an ungulate (moose, elk, deer, bison or caribou):**

3.5.1 An angry moose, elk or deer will face you with its head and ears lowered.

3.5.2 Back away slowly.

3.5.3 Look for something to get behind like a tree or a car. You can go faster around an obstacle than the ungulate can.


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3.5.4 An ungulate is more likely to bluff charge but if it continues the charge and you are attacked in the open, curl up in a ball on the ground. Always protect your head with your arms and lie still.

3.5.5 Stay still after the attack until the ungulate moves away.


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# S3NA-313-WI12 Bear Safety

## 1.0 Hazard

1.1 An encounter with a bear of any species can have a wide variety of outcomes, ranging from a simple sighting, to a false charge, to a serious mauling or even death. Consequently, the risk of a bear encounter must be taken very seriously.

1.2 The hazard or risk associated with a bear encounter varies significantly depending on the location. It is important to research the project area before field work commences to determine the expected probability of encountering a bear. Remoteness from urbanized areas should not be a criterion, as bears have been encountered within city limits, especially near landfills.

1.3 The risk associated with a bear encounter also varies with the species of bear, the season, and the circumstances under which the bear is encountered.

1.4 Preparing staff for any type of encounter is key to managing the risk.

## 2.0 Personal Protective Equipment

2.1 The best deterrent of a “bad bear encounter” is knowledge: a good understanding of the ecology and the behavior of the bears that will likely be encountered.

2.2 **Bear Spray and Bear Bangers**

2.2.1 Staff must have hands-on training for the safe use of bear spray (a pre-season practice run is a good use of expired bear spray).

2.2.2 Prior to work commencing, staff must ensure that the bear spray they are carrying is still valid and not past its expiration date.

2.2.3 During travel, bear spray must be sealed in an airtight container or bag and must not travel in the cab of a vehicle, aircraft, or helicopter.

2.3 **Firearms**

2.3.1 Environments and conditions which pose a high risk of bear encounters, may warrant the use of an armed wildlife monitor. Project managers, in consultation with appropriate project staff and SH&E Management, are responsible for determining the level of risk for their projects and whether or not such measures are required.

2.3.2 A person hired as an armed bear monitor must be properly trained in wildlife monitoring as well as certified in the expert usage of firearms.

2.3.3 The usage of an armed bear monitor is intended only as an additional precautionary measure to be used in specific environments to ensure the protection of field staff; staff should still be equipped and trained appropriately for the risk.

## 3.0 Restrictions

3.1 Staff must not work alone in areas where there is a medium or high risk of a bear encounter.

3.2 Generally, AECOM personnel shall not carry a firearm and attempt to function as a wildlife monitor and/or perform their professional duties. This can only be over-ridden with expressed permission of Regional Management.

## 4.0 Training

4.1 In-house Bear Awareness training must be undertaken by all field staff who work in bear country every three years at a minimum, or more often as required.

4.2 The Bear Awareness training involves testing and improving the employee’s knowledge about bear encounters, watching videos regarding bear awareness and behavior, and participating in group discussions about how to avoid and how to respond to bear encounters.

4.3 Specific considerations are given to black bear, grizzly bear, and polar bear encounters.


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## 5.0 Safe Work Practice

5.1 Staff must be aware of wildlife signs and avoid wildlife encounters.

### 5.2 Bear Sign

5.2.1 **Fresh tracks**: It is often better to see the bear's tracks than to see the actual bear. If you can tell the direction that the bear is travelling in, it is prudent to change your course of direction. Bears will travel down the same pathways as people or other large animals use. If you have a clear track you can determine which type of bear has passed through the area. If you see more than one track, you can tell that it is possibly a female with cubs. Avoid females with cubs!

5.2.2 **Scat:** Bear scat will look different depending upon the bear's diet. Close examination of bear scat can sometimes give you an indication of what the bears have been eating at that time of year. If the scat contains remnants of human garbage, there is a human food conditioned bear in the area. These bears associate people with food and can be the most dangerous type of bear to encounter.

5.2.3 **Animal carcasses**: IF YOU COME ACROSS A CARCASS, LEAVE THE AREA IMMEDIATELY. Grizzly bears will often cover their kills for a few days and let it rot, then come back and eat it. THE BEAR WILL STAY CLOSE BY. Grizzly bears will defend their kill and this is a situation that could prompt a defensive attack by a bear.

5.2.4 **Torn-Up Logs and Stumps**: Bears will forage for insects in dead logs and rotting trees. You will often see torn up logs and stumps, evidence of their foraging.

5.2.5 **Evidence of Digging**: Holes dug into the ground are often made by grizzly bears digging for roots or ground squirrels. In particular Grizzlies will dig for food in the early spring soon after they leave their dens.

5.2.6 **Claw Marks on Trees**: Claw marks can be left on trees by black bears when they have climbed up a tree. Grizzly bears will also leave claw marks on trees and on the ground. Bears will often chew a small tree or a sign-post, so watch for signs of chew marks along the trail.

5.2.7 **Hair on Trees**: Bears will rub against trees, usually trees with rough bark, to scratch themselves. You can find evidence of bears by the hair left in the tree's bark. The higher the hair left on the tree, the bigger the bear. Remember that the bear will often stand on its back legs to scratch its back on the tree.

5.2.8 **Daybeds:** Bears will be most active in the early morning and in the evening. It would be prudent for field staff to restrict their field activities during the bear's most active foraging times as much as possible. During the heat of the day, bears will rest in daybeds. These can be shallow depressions of piled up leaves in the forest, trampled vegetation, a shallow scrape or a hole. Daybeds are usually located in cool places. Bears will make daybeds along streams and rivers. Daybeds are often associated with feeding places and therefore should be avoided.

### 5.3 Prevention

5.3.1 Your best defense against bears is to actively practice bear avoidance techniques when working in the field. You can prevent chance encounters by taking the following precautions:

- Know the areas and habitats bears use at different times of the year, and attempt to avoid such areas or be extremely cautious if you have to travel through them.
- Contact the local Fish & Wildlife Office to get current information on the bears in the area. Ask what other camps are in the area and if they are following good bear avoidance practices. (i.e., do they keep a clean camp?) If there are nearby human food sources available, e.g., an open dumpsite, the local bears may not be afraid to approach your camp.
- Always be aware of your surroundings. Stay alert. Watch for signs of bears along your route.
- Use binoculars to look around for bears when you are in open terrain.
- Never approach a bear if you see one feeding in the distance.
- Note the behavior of other wildlife in the area. Flocks of ravens can alert you to a possible animal carcass, and perhaps a bear. The area should be avoided. Bird or squirrel alarm calls might be telling you that a bear is near.
- Whenever possible, travel in daylight and try to avoid areas with restricted visibility. (dense brush)


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- Make lots of noise, especially when travelling in dense vegetation. Sing, shout, or talk loudly. You can carry portable air horns or cans of rocks. (Please note that bear bells are not effective – they do not make enough noise to warn a bear that you are approaching. You need to be loud so the bear can hear you coming!) Remember that the noise you make can be masked by loud natural sounds such as the wind or water. Therefore it is possible that the noise you make can go unnoticed by a bear whose attention is focused on feeding. You must make every attempt not to surprise a bear. In areas of loud natural noise, be louder!
- Stay together and travel in groups. Bears are less likely to attack groups of people. When travelling in groups, stay close together. Being in a group doesn't help if the individuals have spread apart along the trail!
- Pets should not accompany you when you are travelling in bear country. If you must take your pet, keep the animal on a short leash at all times. Unleashed dogs will harass bears and once scared, run back to their owner with an angry bear in pursuit.
- Do not wear perfumes or cosmetic products when you are travelling in bear country. Do not mask your human scent.
- Women should use internal sanitary protection, (i.e. tampons) when menstruating and burn all used sanitary products after usage. Keep all used sanitary supplies in sealed bags until you have a chance to burn.
- Children should be kept very close by in bear country.
- Carry bear deterrents and know their limitations. Be familiar with how to use the deterrents, how to transport the deterrent safely and under what conditions it is most effective. Carry the deterrent in a belt, out in front and ready to grab at a moment's notice, never in your backpack.

## 5.4 Field Workers: Precautions in Bear Country

5.4.1 Field workers should take extra precautions when working in bear country.

5.4.2 Make every effort to go out into the field with another person; you should not be working alone in the field. One person can act as a lookout for the other. Keep watch for bear signs.

5.4.3 Never approach a bear.

5.4.4 Report where you are going and when you will return every time you leave camp. Have a plan of action if someone does not report back to camp at a specified time.

5.4.5 Bears do get used to a camp's schedule and you will have fewer surprise encounters if everyone in the camp comes and goes at the same time every day.

5.4.6 Take a two-way radio with you when you go out into the field.

5.4.7 Always carry bear deterrents with you in the field and understand each deterrent's limitations. Carry your deterrents on a belt, out in front and ready to use instantly. Do not carry your deterrents in your backpack.

5.4.8 Keep any food that you take with you sealed in odor-proof/bear proof containers. Make every attempt to take odorless food with you, not something with a heavy scent.

5.4.9 Pack out any garbage in odor-proof containers and burn once you return to camp.

5.4.10 The noise of an ATV or skidoo can scare off a bear. Starting the machine and revving it up can scare off a curious bear. DO NOT CHASE A BEAR WITH AN ATV OR SKIDOO. You may need to drive the ATV around in circles to scare off the bear, but do not chase the bear.

5.4.11 Take extra precautions when travelling along lakes or stream beds; bears use streams and river beds as travel routes. Be sure to carry noise makers.

5.4.12 Limit your workday so you are not out in the early morning or evening when bears are most likely to be foraging.

5.4.13 All Field Workers should be proficient in First Aid. Do not go out into the field without first aid training.

5.4.14 All Field Camps should have a First Aid Kit.

5.4.15 All Field Camps should have means of communication with local ambulance or Air-ambulance personnel.

5.4.16 A person's best defense against bears is to avoid them. If this is not possible, then being heard, smelled, or seen may lessen your chances of surprising a bear and/or provoking an attack.

5.4.17 All wildlife should be respected, avoided, and not harassed at any time.

5.4.18 Cooking in remote areas should be avoided. Any food should be stored in airtight containers and all garbage should be managed appropriately: “pack it in, pack it out”.

5.4.19 A bear in camp or within human structures is not a chance encounter. If this bear challenges you, you must fight, scream, and do whatever is necessary to live, no matter what species the bear is!

5.4.20 In general, there are two types of bear encounters: Defensive and Non-defensive for grizzly bears and black bears. Your response will vary based on your assessment of the situation (your training will help you in identifying these situations and the appropriate response).

## 6.0 Encounters

### 6.1 General Recommendations When Encountering a Bear

6.1.1 Consider your surroundings and assess the situation before you act.

6.1.2 Remain calm. Do not turn your back to a bear.

6.1.3 DO NOT RUN – You will trigger the bear’s natural response to chase you. Bears are extremely fast and you cannot outrun a bear. (They are as fast as an Olympic sprinter, so if you are not faster than an Olympic sprinter, don’t run! They can run 40 km/hr and you can’t!) You cannot outswim a bear either.

### 6.2 Bear Encounters in the Field

6.2.1 Your response will depend upon the type of encounter.

6.2.2 There are several different encounters listed.

6.2.3 Bears are more predictable than once believed and you can determine your best course of action in a confrontation by understanding the bear’s characteristics and motivation. There are two pieces of information you should be aware of in any bear encounter:

- The type of bear you are dealing with; and
- The reason for the encounter.

6.2.4 Some people believe that when you stand your ground against a predatory black bear attack, the bear will feel threatened and leave. This has been effective in some cases. HOWEVER, it is not effective against a grizzly bear predatory attack and it is very difficult to know when it will be effective against black bears. Polar bears do not follow the same behavioral patterns as grizzly and black bears, they are almost always aggressive and will not back down. Special considerations must be given to projects where polar bear encounters are anticipated.

### 6.3 If you can leave undetected:

6.3.1 Leave the area quietly in the same direction that you came from.

6.3.2 Move while the bear’s head is down. Stop moving when the bear lifts its head to check its surroundings.

6.3.3 Stay downwind so the bear will not pick up your scent.

6.3.4 When you have moved a safe distance away, you can either watch and wait until the bear leaves or make a wide detour around the bear.

6.3.5 If the bear is unaware of you and approaching: Allow the bear the right of way.

### 6.4 If you cannot leave undetected:

6.4.1 Let the bear know that you are present by smell first; therefore move upwind so they can pick up your scent.

6.4.2 If it is possible, try to keep the bear in your sight. Watch to see if the bear leaves when it smells that a person is nearby.

6.4.3 Attempt to move out of the way without being noticed by the bear. If you cannot do this, talk loudly to let the bear know where you are.


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6.5 **If the bear is aware of you but in the distance:**

6.5.1 Remain calm.

6.5.2 Continue walking slowly in the same general direction, but head away from the bear.

6.5.3 DO NOT RUN. The bear can quickly outrun you if it is so inclined.

6.5.4 If the bear begins to follow you, drop your pack or some article, (not food) to distract the bear. This may distract the bear long enough for you to escape. If you drop food for the bear – you will help the bear associate food with humans and teach it that aggressive behaviour will be rewarded with food.

6.5.5 If it is a grizzly following you, climb a tree if there is a large tree around. Although grizzlies can climb trees, they are often not motivated enough to try. Very large grizzlies are not able to climb trees well. If grizzlies climb, they can go 3 to 4 meters. Grizzlies will try and push trees over so do not climb a small tree.

6.6 **If the bear is aware of you and close:**

6.6.1 A bear will feel threatened in a close confrontation. The bear's natural tendency will be to reduce or to remove the threat. Assist the bear by acting as non-threatening as possible.

6.6.2 Do not make direct eye contact with the bear.

6.6.3 Do not make any sudden moves.

6.6.4 Do not run!

6.6.5 The bear needs to identify you as a person, so talk in low tones and slowly wave your arms over your head.

6.6.6 Attempt to give the bear an opportunity to leave. Be sure the bear has an open escape route. Do not corner a wild animal.

6.6.7 Try to back away slowly and/or climb a tree if appropriate.

6.6.8 Attempt to deter the bear if you are in a safe position.

6.7 **If the bear is close and threatening:**

6.7.1 If you have a deterrent such as a bear banger or bear spray, be prepared to use it depending on how close the bear is. Try to scare the bear off.

6.7.2 If you do not have a deterrent, or if using the deterrent is not successful, act as non-threatening as possible.

6.7.3 Talk to the bear in a calm authoritative tone of voice.

6.7.4 Do not startle or provoke the bear by making sudden moves.

6.7.5 Never imitate the bear's aggressive sounds, signals or posture. The bear is attempting to establish dominance and imitating its moves is a challenge to its dominance.

6.7.6 Back slowly away from the bear and drop a pack or some other article in order to distract the bear momentarily.

6.7.7 Remember that the bear may be defending cubs that you have not yet seen or they have a food cache nearby. Attempt to look as non-threatening as possible.

6.8 **If the bear is very close and approaching:**

6.8.1 A distance of less than 50 meters in an open area and closer in a forested area.

6.8.2 If the bear continues to approach, use your deterrent.

6.8.3 If the bear does not respond to the deterrent you must now STAND YOUR GROUND!

6.8.4 If the bear continues to approach and is acting aggressive, YOU MAY HAVE TO SHOOT if you are carrying a firearm.

6.9 **If the Bear Charges!**

6.9.1 A bear will charge you at high speed down on all four legs and often crouched low to the ground.

6.9.2 Bears do not charge when standing up on its hind legs.


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6.9.3 Many charges are bluffs and the bear will often stop or veer off just at the last minute. It is difficult to know if the bear is bluff charging or not until it gets very close.

6.9.4 When faced with a charging bear you have two options:

- Use your bear deterrent; or
- Roll into a ball and cover your neck and head with your arms if you are unarmed and have no other choice.

6.10 **Playing Dead:**

6.10.1 Note: Playing dead is a very controversial topic among seasoned field personnel. Some will tell you to never play dead in any situation, others will swear that it is the only thing you should do. Playing dead is a personal choice that you will have to make.

6.10.2 If you play dead it is possible that you can prevent serious injuries if a chance encounter with a bear results in an attack. Playing dead may reduce the threat that you represent to the bear.

6.10.3 If you decide to play dead, it is important to protect your vital areas. The older information that is still found online states that the person should roll into a ball to protect their vital organs. This has been replaced and you are now advised to lie in the prone position. Lie flat on your stomach and lace your fingers behind your neck (to protect it), Spread your legs apart to provide stability if the bear tries to turn you over. Stay in this position. If the bear manages to roll you over, immediately roll back onto your stomach to protect your face, neck and vital areas. Do not try to resist or struggle as this will intensify or prolong the attack. Once the attack is over, DO NOT MOVE until the bear has left the area. Look around and be very sure that the bear is gone before moving. (If the bear is a female with cubs, she will leave and move her cubs to safety.) If the bear covers you with leaves and vegetation, it probably thinks you are dead. Grizzly's will often cover their prey with vegetation and leave the carcass to ripen for a few days.

6.10.4 It is important to note that if the bear attack is prolonged or if the bear begins to eat you, the attack has changed from what you may have first believed to be a defensive attack, to a predatory attack. Fight back in a predatory attack. Concentrate your efforts on the face, eyes and nose of the bear.

# S3NA-313-WI13 Small Mammals

## 1.0 Hazard

1.1 Working in the field either directly or indirectly with small mammals has inherent risks of injury or exposure to zoonotic diseases (infectious diseases that can be transmitted from animals to humans) that all field staff need to protect themselves against.

1.2 The risks are usually higher when there is direct contact with a wild animal, either through a break in the skin (blood), saliva, or excrement; however, there are also risks through air-borne diseases (e.g., Hantavirus).

1.3 Obviously, wildlife biologists directly handling wildlife, dead or alive, or working with wildlife feces or in enclosed habitats (such as caves), have an increased risk of exposure to a wider range of zoonotic diseases and should take extra precautions.

## 2.0 Personal Protective Equipment

2.1 Full-length clothing (long sleeves and pants).

2.2 Insect repellent.

2.3 Respiratory equipment (when directly handling wildlife).

2.4 Gloves (when directly handling wildlife).

## 3.0 Restrictions

3.1 Wildlife handling must only be completed under direct supervision of an experienced individual.

## 4.0 Training

4.1 Any staff that will be handling wildlife must be adequately trained and/or supervised by a wildlife biologist experienced in the job task.

## 5.0 Safe Work Practice

5.1 Wild animals can carry a variety of diseases that humans can contract: viral, parasitic, bacterial, and protozoal. Basic PPE such as full-length clothing, gloves and a respiratory mask will greatly reduce the risk of exposure.

5.2 Whenever a wild animal must be handled, the procedure must be accomplished as safely and quickly as possible.

5.3 Proper techniques must be employed to avoid or minimize the risk of personal injury while, at the same time, avoiding or minimizing injury to the animal.

5.4 Gloves, catch sticks, caging, and other appropriate equipment may be necessary when handling a wild animal. Most of these animals will be extremely stressed, resisting every restraint attempt.

5.5 In the unfortunate circumstance that a person is bitten or scratched, he or she should cleanse the wound thoroughly with soap and flush with water immediately, providing for a mechanical removal of potentially infective organisms. This should be followed by cleansing under medical supervision and consultation with a physician to consider the potential exposure to the rabies virus.

## 6.0 Rabies

6.1 You will not be able to accurately determine if an animal has rabies simply by observation as traditional symptoms of rabies (foaming at the mouth, biting, etc.) do not occur in all animals nor at all stages. There are some mammals that are at a higher risk than others for the rabies virus, such as raccoons, skunks, stray cats and dogs, foxes, coyotes, rodents. and bats; however, any mammal can contract the virus.


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6.2 Rabies is contracted by contact of an infected animal's saliva with an open wound – a bite or a scratch.

6.3 Symptoms of rabies in humans usually do not present themselves for a minimum of 10 days to a year or longer (the average is 30 to 50 days). Symptoms are typical of a flu, including malaise, loss of appetite, fatigue, headache, and fever. Over half of all patients have pain (sometimes itching) or numbness at the site of exposure. They may complain of insomnia or depression. Two to 10 days later, signs of nervous system damage appear; hyperactivity and hypersensitivity, disorientation, hallucinations, seizures, and paralysis.

6.4 Because rabies is so difficult to detect and positively identify, it is very important to consult a physician immediately. If rabies is a possibility, begin treatment with the rabies vaccine as soon as possible (unlike other vaccines, rabies vaccination begins after exposure because the virus takes a comparatively long time to induce disease).

## 7.0 Hantavirus

7.1 Rodents can carry a variety of diseases; of notable concern is the North American hantavirus which can cause Hantavirus Pulmonary Syndrome (HPS).

7.2 A common host of the hantavirus is deer mouse and related species (*Peromyscus spp*.), which are common throughout much of North America.

7.3 Although infection is rare, it can be fatal and; therefore, it is necessary that risk of exposure be minimized. Infection can be spread to humans when they:

7.3.1 Breathe air contaminated by deer mouse saliva, urine or feces containing infectious hantaviruses; or

7.3.2 Accidentally rub eyes, mouth or broken skin with hantavirus-infected deer mouse saliva, urine or feces.

7.4 The following precautions will be taken for all field operations:

7.4.1 Limit exposure to soils handling and use gloves where appropriate.

7.4.2 Wash or sanitize hands often throughout the day and before meals.

7.4.3 Equipment bags, storage areas, and vehicles will be inspected daily for signs of deer mouse infestation.

7.4.4 Rodent-proof storage containers will be used when practical.

7.4.5 Do not enter buildings infested with deer mice without adequate respiratory protection.

7.4.6 Droppings should never be removed by vacuuming or sweeping. Wetting down an area with a mixture of 1:9 household bleach and water solution will reduce risk of airborne exposure.

7.5 If flu-like symptoms develop three days to six weeks after exposure to rodents, a doctor should be contacted immediately (mechanical ventilation is the primary method of treatment).

## 8.0 References

8.1 Trapping and Tagging Small Mammals. A RIC Standard for British Columbia. 1993. Dr. Todd Zimmerling.


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# S3NA-313-WI14 Snakes

## 1.0 Hazard

1.1 **Snakes have the ability to inject venom.** A bite from a venomous snake, which may inject varying degrees of toxic venom, is rarely fatal but should always be considered a medical emergency.

## 2.0 Personal Protective Equipment

2.1 Long pants and shirts.

2.2 Heavy gloves if staff will be handling debris or be close to the ground.

2.3 Rubber boots, or boots that fully cover the foot (not sandals!) and preferably are at least 10” high.

2.4 Snake Chaps that cover at least the shin.

2.5 Personal first aid kit.

## 3.0 Restrictions

3.1 Staff must not work alone in areas where the risk of a snake encounter is high.

## 4.0 Training

4.1 Staff must be notified of the hazard before work commences.

## 5.0 Safe Work Practice

5.1 Staff working in areas known to be inhabited by venomous snakes should take extra precautions, be able to identify the local snake species, and understand the best practices for administering first aid.

5.2 Most snakes in Canada are non-venomous; and most snake bites are not fatal, only painful. Learning to identify snake species will assist you in responding appropriately to an encounter, and will assist medical professionals in determining if antivenin needs to be administered if anyone is bit.

5.3 Most snakes are non-aggressive and will only attack if immediately threatened.

5.4 **Prevention**

5.4.1 Before venturing out into the wilderness, familiarize yourself with the snakes in your area, both venomous and non-venomous species.

5.4.2 Learn which habitats the venomous species in your region are likely to be encountered in, and use caution when in those habitats.

5.4.3 Try as much as possible not to take a snake by surprise.

5.4.4 Stay on trails where possible, and watch where you place your hands and feet, especially when climbing or stepping over fences, large rocks, and logs, or when collecting firewood. Take care when overturning any objects on the ground when in snake country.

5.4.5 If you see a snake, give it as much room as possible. Most snakes have a strike distance that is only half the length of their body.

5.4.6 If you get very close to a rattlesnake, hold very still until it calms down and starts to move away. Then slowly move backwards until you are at least one snake-body length away.

5.5 **Treatment**

5.5.1 Venomous snakebites are rare, and they are rarely fatal to humans. Of the 8,000 snakebite victims in the United States each year, only about 10 to 15 die. In Canada the number of snake bites each year is very small. However, for any snakebite the best course of action is to get medical care as soon as possible.


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5.5.2 Try to keep the snakebite victim still, as movement helps the venom spread through the body.

5.5.3 Keep the injured body part motionless and just below heart level.

5.5.4 Keep the victim warm, calm, and at rest, and transport him or her immediately to medical care.

5.5.5 Do not allow him to eat or drink anything.

5.5.6 If medical care is more than half an hour away, wrap a bandage a few inches above the bite, keeping it loose enough to enable blood flow (you should be able to fit a finger beneath it). Do not cut off blood flow with a tight tourniquet. Leave the bandage in place until reaching medical care.

5.5.7 If you have a snakebite kit, wash the bite, and place the kit's suction device over the bite. (Do not suck the poison out with your mouth.) Do not remove the suction device until you reach a medical facility.

5.5.8 Identify the snake that caused the bite to determine if it is venomous, and if antivenin needs to be administered. Do not waste time or endanger yourself trying to capture or kill it. Note the shape & color of the snake's head.

5.5.9 If you are alone and on foot, start walking slowly toward help, exerting the injured area as little as possible.

- Note that there are several species of snakes that superficially resemble rattlesnakes. Several species, including Bull, Milk, Fox, and Rat Snakes will even rattle their tails when startled.
- Massasauga Rattlesnake is recognized as a Threatened Species in Ontario and it is an offence to harass, , or destroy the habitat of this species.
- One scorpion species, the Northern Scorpion (*Paruroctonus boreus*) occurs in semi-arid areas of southern British Columbia, Alberta, and Saskatchewan. It carries a stinger on the end of its tail. The sting is painful but not life threatening unless there is an allergic reaction.

## 6.0 Species

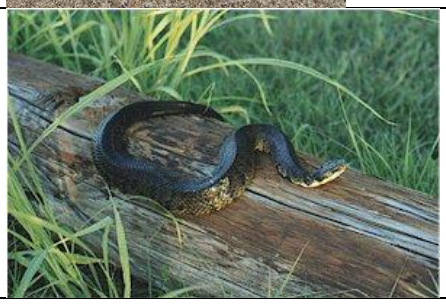
### 6.1 Venomous Snakes in Canada

| | |
|---|---|
| Eastern Massasauga Rattlesnake (*Sistrurus catenatus*) found around Wainfleet, Windsor, Bruce Penninsula and eastern Georgian Bay in Ontario. | <br>Eastern Massasauga Rattlesnake picture by Michael Redmer/Courtesy Lincoln Park Zoo |
| Northern Pacific Rattlesnake (*Crotalus viridis*) found primarily in Okanagan and Thompson River valleys of southern British Columbia. |  |


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| | |
|---|---|
| Prairie Rattlesnake (*Crotalus viridis*) found in south eastern Alberta, and south western Saskatchewan. |  |

## 6.2 Venomous snakes in the U.S.

| | |
|---|---|
| Rattlesnake(*Crotalus cerastes)* found mostly concentrated in the southwestern United States, they extend north, east and south in diminishing numbers and varieties. Every contiguous state has one or more varieties of rattlesnake.<br><br>The rattlesnake is found in many different biomes ranging from along the coast at sea level, the inland prairies and desert areas to the mountains at elevations of more than 10,000 feet.<br>Species include: Sidewinder, Santa Catalina, Western, Mojave, Red Diamond, Western Diamond, Ridge Nosed, Eastern Diamondback, and Pigmy. |  Western Rattlesnake<br> Eastern Diamondback |
| Copperhead (*Agkistrodon contortrix*) is the most common venomous snake found in the eastern US. It can be found in the states of Texas, Oklahoma, Kansas, Missouri, Arkansas, Louisiana, Mississippi, Alabama, Georgia, Florida, South Carolina, North Carolina, Tennessee, Kentucky, Virginia, Illinois, Indiana, Ohio, Iowa, Pennsylvania, Maryland, New Jersey, Delaware, New York, Connecticut, and Massachusetts. |  |
| Cottonmouths (water moccasins) (*Agkistrodon piscivorus)* found in the eastern United States from Virginia, south through the Florida peninsula and west to Arkansas, eastern and southern Oklahoma, and east and central Texas.. |  |


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| | |
|---|---|
| Coral Snake (*Micrurus sp.)* found in the southern range of many temperate US states including North Carolina, Georgia, Alabama, Mississippi, Louisiana, Texas, Arkansas, Kentucky, Arizona, and New Mexico. | <br>Eastern Coral Snake, *Micrurus fulvius* |

## 7.0 References


7.1 *The Eastern Massasauga Rattlesnake Stewardship Guide. A resource and field guide for living with rattlesnakes in Ontario.* Sponsored by the Government of Canada, and distributed on behalf of the Toronto Zoo and the Eastern Massasauga Rattlesnake Recover Team.

7.2 http://www.rattlesnakes.us/

7.3 http://drdavidson.ucsd.edu/Portals/0/snake/Crotalus.htm



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# S3NA-313-WI15 Alligators

## 1.0 Hazard

1.1 Your chance of encountering an alligator is greatest during the animal's courtship and mating season, which takes place from March through September. This is when male alligators become most dominant and aggressive as they try to intimidate rival males and attract females by their show of power. Some males end up having to travel to find a mate. July through September is when mother alligators are guarding nests.

1.2 Mating season takes up much of the warmer months - a very popular time in the southeastern USA for outdoor activities - and alligators are solar-powered, so-to-speak. The warmth from the sun fires up their metabolism, giving them renewed energy; and renewed energy means great potential for conflict.



## 2.0 Encounter

2.1 The alligator is naturally wary of humans, and will flee quickly if you get too close to it, or it may utter a very audible and compelling warning hiss. In some cases; however, alligators may charge or attack. Here are some examples of such cases:

2.1.1 An alligator that is accustomed to being fed by humans may not be so shy.

2.1.2 An alligator that is surprised and alarmed by your approach may attack, thinking that it is being attacked itself.

2.1.3 A mother alligator caring for her nest or for live babies. If you see alligator babies, or if you encounter a nest (usually a mound of vegetation mixed with mud), remove yourself to a safe distance, the mother alligator is sure to be close by. If you get close, the mother may sound a very audible and intimidating warning hiss. Such a nest may be difficult to identify for a non-expert, but it is likely the mother will issue you a warning.

2.1.4 Alligator mothers are well-known to be practically fearless when defending their offspring, whether the little ones have hatched or not. A mother alligator was observed leaping, jaws agape, to attack a helicopter as it approached the nest area to land! (The helicopter carried biologists studying alligator nests.)

2.2 Also be careful near heavy vegetation in or near the water's edge. This is where an alligator likes to enjoy privacy and peace during the daylight hours. If you trudge through there and surprise it, the outcome may not be positive.

2.3 Generally, a good minimum distance to keep between you and an alligator or nest is 15 feet/ 4.6 meters.

2.4 When trying to get past an alligator, make sure not to walk between the alligator and the water, because if it's spooked, it's going to run to the water.

2.5 If an alligator does approach in a threatening manner, make as much noise and movement as possible. This should show the alligator that he has taken on more than he can handle and he'll back away.

## 3.0 Alligator Charge

3.1 The alligator is not a natural runner. Those short legs obviously don't serve it like a horse's legs do, and the alligator can actually tire out in a relatively short time. When it charges after a human or animal, it is either trying to scare it away or seize it. It has a fast and furious burst of energy which serves it well for stealth hunting -- grabbing prey when it doesn't expect it. Furthermore, the reptile is


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opportunistic, which means, quite simply, it doesn't like to work very hard to get its food if it doesn't have to.

3.2 In the very rare event you are charged or chased by an alligator, move in as straight a line as possible away from it as fast as you reasonably can. In many cases, the vegetation features of the wild will serve to protect you by slowing the alligator down, like trees, bumps, bushes, etc. -- your comparatively long legs usually make it easier for you to maneuver through the trees and brush than an alligator's short legs do.

3.3 Most adult humans can outrun even a fast crocodilian, which has been clocked at a maximum of about 10 mph/17 kilometers per hour (kph), compared to a human speed of 15-17 mph/24-27 kph. But this doesn't matter much; an alligator will often give up the chase because it sees that the runner is moving away too quickly, and realizes that too much effort will be required to continue pursuit.

3.4 You may have heard somewhere that the zigzag run (running in a "z" pattern, side-to-side) is a good idea, but this is not only an unnecessary maneuver but probably a very unwise one. Here's why:

3.4.1 Unless you're an Olympic athlete, running zigzag over natural topography increases your risk of tripping and falling over rocks, plants, roots, and the like. And it goes without saying that falling while being pursued by an alligator is not good.

3.4.2 Furthermore, an alligator doesn't have the degree of stereoscopic vision we have. It actually has a small 'blind spot' directly in front of it. Hence, the alligator's vision is most effective in the 'sides' of its field of view. So, running zigzag not only slows your rate of distance from your pursuer, it may clearly indicate to the animal exactly where you are; even this point hardly matters since in many cases the alligator may keep its eyes shut while pursuing so as not to get them hit by twigs, grass stalks and branches in its path.

3.4.3 Finally, an alligator bites very effectively in a side-swiping motion, so if you are trying to run zigzag and are slowed down by plants, rocks, or other obstacles, the backwards flying leg of a running human is an optimal target for side-swiping, chomping jaws (the operative word here is "side").

3.5 Simply put, when faced with an attack, move directly away from the alligator as quickly as possible, navigating the terrain as carefully as possible. The zigzag idea will likely not serve you well.

## 4.0 Alligator Attack

4.1 If it seizes prey, and the prey fights back hard, the alligator may release it, depending on factors such as its own size relative to that of the victim, its own level of aggression, and its measure of hunger. Merely struggling to break free may not be enough counter-aggression to stop an alligator, and may actually prompt a devastating "death roll" response, in which the reptile furiously spins on its central axis to tear muscle and bone free of the victim's body.

4.2 These armored saurian are among the toughest beasts in the animal kingdom, so an attack victim should channel his or her nervous energy and will to survive and take the offensive by fighting hard. Not struggling...fighting very, very, very hard. Others on hand during such an event may be able to help by fighting the reptile, too. This should include punching the snout, poking the eyes, and even jabbing the ears, which are seen as small slits behind the eyes.

## 5.0 Additional Resources

5.1 Additional resources can be found at:

5.1.1 http://www.tpwd.state.tx.us/huntwild/wild/species/alligator/index.phtml

5.1.2 http://corkscrew.audubon.org/Wildlife/Alligators.html


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# S3NA-314-PR Working Alone and Remote Travel

## 1.0 Purpose and Scope

1.1 This Procedure establishes the requirements for communication and accountability between personnel at a work site to reduce the potential for incidents occurring to one employee without help readily available and to facilitate the rapid mustering of assistance to employees in the event of an emergency.

1.2 This procedure applies to all AECOM North America-based employees and operations.

## 2.0 Terms and Definitions

2.1 **Buddy System**: A system of organizing employees at a work site in such a manner that each employee is accompanied by at least one other employee or is escorted by a client or contractor representative during work site activities.

2.2 **Controlled Work Areas**: One or more designated work areas on a field project site where hazardous activities and/or strictly defined operations take place. Such controlled work areas include, but are not limited to, remediation or construction sites; a restricted radius where a critical lift operation will take place could be declared a controlled work area. On a HAZWOPER site, the controlled work area is divided into the exclusion zone, the contaminated reduction zone, and the support zone.

2.3 **Working Alone**: Performing work with no line of sight or direct voice communication with another person who is aware of your assignment and capable of initiating emergency response.

## 3.0 Attachments

3.1 S3NA-314-ST Working Alone

3.2 S3NA-314-WI Wilderness Isolation

## 4.0 Procedure

4.1 Employees are discouraged from working alone on any site. If they will be out of contact with other employees, they will establish a buddy system or check-in procedure with another employee or responsible person.

4.2 When traveling alone, staff will take appropriate precautions, including notifying someone of their travel plans as well as carrying a communication device and safety equipment, as appropriate.

4.3 Managers will provide the resources (staff, communication devices, etc.) and plans (emergency response plans, check-in procedures, etc.) necessary so that employees are not working alone or have a buddy system in place.

4.4 No staff person shall work by themselves or out of contact with other personnel if they are conducting a hazardous job task. On the following tasks, a buddy system will be established:

- Working from heights
- Working in a confined space
- Working in a trench
- Lock out/tag out
- Working with electricity
- Working with power tools/equipment
- Working with hazardous substances or materials
- Working with material under pressure
- Working where there is a possible threat of violence
- Working in isolation from first aid services or immediate/emergency assistance
- Traveling in severe weather
- Working in avalanche areas
- Working on water or ice


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- Working in remote or wilderness isolation
- Working in a controlled area
- Extreme heat or cold stress environments
- Working around high traffic or mobile equipment

## 4.5 Office Work

4.5.1 Each office will have in place and will communicate as part of its local safety orientation its procedures for the safety and security of an employee working alone in the office.

4.5.2 Employees working in the office after regular working hours or in situations where they are working alone will keep the entrance to the office locked.

4.5.3 If the building is monitored by a security service, employees working in the office after regular working hours or working alone will notify the security guard of their presence and anticipated hours. If the building does not have a security service, it is advisable that a staff person working alone notify a family member, friend, or manager of his or her location.

4.5.4 During all working hours, employees shall stay alert to unauthorized entries into the building and to other suspicious activities and shall report them immediately.

4.5.5 Contact numbers to be used in case of emergency are posted at all major exits.

## 4.6 Field Work

4.6.1 Prior to work commencing, a hazard assessment shall be prepared for all assignments on which employees are to work alone (in accordance with *S3NA-209-PR Project Hazard Assessment and Planning*). The hazard assessment shall consider travel time, weather, available communications, and the hazards associated with the task and work environment.

4.6.2 The assessment should also consider whether the employee assigned to work alone has sufficient training in the tasks to be performed to allow the employee to work safely alone. The employee's personal medical conditions may be considered if the employee has voluntarily made the medical condition know to the Supervisor or Project Manager.

4.6.3 The hazard assessment should identify the controls required for the safety of employees as applicable to the job task and location. Some controls associated with working alone or in remote isolation include a buddy system, standardized check-in times, specialized communication devices, and enhanced emergency supply kits.

## 4.7 Buddy System

4.7.1 When conducting hazardous work, staff will work with a buddy (another responsible individual) at all times.

4.7.2 Client or contractor personnel may be substituted for an AECOM employee's buddy only if they are designated by the client or contractor, are properly trained in this Standard Operating Procedure, and are properly trained in the site's emergency response procedures.

4.7.3 Once assigned as buddies, personnel shall remain in each other's line of sight and in direct voice contact at all times.

4.7.4 When unusual conditions do not permit line of sight and direct voice contact, the site supervisor will be informed. If permission from the site supervisor is obtained to continue the work, voice contact will be achieved using electronic communication devices such as, but not limited to, hand-held radio or cell phone.

4.7.5 When electronic communication devices are used, a protocol will be established and agreed to by each buddy to confirm that periodic effective and faultless communications are maintained:

- The person in communication with the field employee working alone will have direct communication with the employee at a frequency not to exceed each hour.
- The frequency shall be established considering task hazards, weather conditions, personal medical conditions, and the availability of emergency response.
- A missed communication event shall trigger emergency response procedures. The results of each communication event shall be documented in the project files.

## 4.8 Check-In Procedures

4.8.1 All field crews will establish check-in procedures prior to leaving the office and confirmed with the assigned Check-In Person.

4.8.2 The timing and frequency of those check-in procedures schedule shall be established prior to the initiation of field operations and will vary depending on the task and location of the work.

- At a minimum, all crews will check-in by 5:00 p.m.
- Crews working in isolation or on hazardous sites will increase their check-in times accordingly (e.g., noon and 5:00 p.m.).

4.8.3 If crews will separate once they reach their field site, they will then be considered to be “working alone” and will establish a buddy system with the other members of the crew.

4.8.4 Staff working alone or in small crews in remote isolation will have an effective means of communication system including cell/radio/satellite phone as well as established check-in times.

4.8.5 The Check-In Procedure will be reviewed daily as part of the Task Hazard Analysis review or more frequently if there is a change in work arrangements that could adversely affect a worker's well-being or a report that the system is not working effectively.

## 4.9 Emergency Response Procedures (ERP)

4.9.1 All field staff AND the Check-In Person will be provided with the Emergency Response Plan (which is documented on the Task Hazard Analysis, if an ERP does not already exist for the site).

4.9.2 The Check-In Person will have access to a route map or understands their anticipated route of travel.

4.9.3 If communication is lost between buddies or a check-in time is missed, it will be assumed that an emergency situation exists (e.g., severe injury, illness, other accident situation), and the site’s emergency response procedures will be implemented. Site work will cease until the emergency is resolved and the site supervisor directs personnel to restart work.

4.9.4 The established contact person will follow the procedures below if a field staff member has missed a check-in:

- First, they will attempt to make contact with the field staff directly.
- If that fails to provide a response, they will contact other persons who may have been on site, including client supervisors, or other locations where the field staff might be (e.g., hotel, home, office).
- If the field staff still cannot be located, the emergency contact person notifies the project manager or manager responsible for the staff.
- Depending on the location and situation, they will then dispatch either another AECOM staff member, another on-site supervisor, or an appropriate emergency response agency (e.g., police) to travel to the last known location of the field staff.
- If the dispatched responder arrives at the site but cannot locate the field staff, the appropriate public emergency contacts (e.g., police, search and rescue) will be made and the staff members’ personal contacts shall be notified by Human Resources or the manager (if HR is unavailable).
- If the dispatched responder finds the crew in an emergency situation (medical, environmental, structural, etc.), the appropriate steps will be taken to isolate the hazard, administer first aid, and notify the appropriate agencies and emergency support services.

## 4.10 Training

4.10.1 All staff will receive an initial orientation that includes the hazards and controls associated with working alone.

4.10.2 If working in wilderness, all field staff will be able to orienteer using a map and compass—if not, the basic skills of orienteering will be provided by an experienced staff member before work commences.

4.10.3 Staff regularly working in remote, isolated wilderness locations will either participate in a wilderness survival course from a qualified provider (1 or 2 day) or will obtain management approval based on their level of experience/competence in wilderness situations.


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## 5.0 Records

5.1 None

## 6.0 References

6.1 Canadian Centre for Occupational Health and Safety (http://www.ccohs.ca/oshanswers/hsprograms/workingalone.html)

6.2 Health Canada (http://www.hc-sc.gc.ca/ewh-semt/pubs/water-eau/outdoor-plein_air-eng.php)


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# S3NA-314-ST Working Alone

The following Occupational Health and Safety regulations apply directly to working alone (and not with a specific job task):

| Jurisdiction | Regulation |
|---|---|
| **United States** | |
| **OSHA** | n/a |
| **Canada** | |
| **Alberta** | OHS Code (2009) Sect 393, 394<br>Alberta's Occupational Health and Safety Code: An Explanation of the "Working Alone" Requirements (November 2006)<br>Working Alone Safely - A Guide for Employers and Employees (September 2000) |
| **British Columbia** | OHS Regulation (1997) Sect 4.20.1 – 4.22 |
| **Manitoba** | Workplace Health and Safety Regulation (217/2006) Sect 9.1 – 9.3 |
| **New Brunswick** | Code of Practice for Working Alone Regulation - Occupational Health and Safety Act (N.B. Reg. 92-133) |
| **Newfoundland/Labrador** | n/a |
| **Nova Scotia** | n/a |
| **NWT/NU Territories** | General Safety Regulations (R.R.N.W.T. 1990, c. S-1), Safety Act (SI-013-92) Sect 14 |
| **Ontario** | n/a |
| **Prince Edward Island** | OHS Regulations (EC180/87) Sect 53.1 – 53.5 |
| **Quebec** | OHS Regulation (R.R.Q., c. S-2.1, r.19.01 O.C. 885-2001) Sect 322<br>Safety Code for the Construction Industry (R.R.Q. 1981, c. S-2.1, r. 6) Sect 3.22.1 |
| **Saskatchewan** | OHS Regulation (R.R.S., c. O-1, r. 1) Sect 35 |
| **Yukon Territory** | n/a |


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# S3NA-314-WI Wilderness Isolation

## 1.0 Planning

1.1 Working in wilderness isolation presents many more potential hazards and should only be conducted by teams with documented experience, safety plans, and equipment appropriate for the tasks and conditions of the work.

1.2 A Safe Work Plan will be approved by the Regional SH&E Manager.

## 2.0 Safety Equipment

2.1 All field staff should regularly carry a compass, fire starter, a small folding saw, and a map on their person.

2.2 All field staff should regularly carry a first aid kit and survival equipment applicable to the situation.

2.3 All field staff will be equipped with (or have access to) communication devices appropriate to the type of coverage anticipated in the project area.

2.4 When hiking long distances, it is recommended that a “mini survival kit” that includes the following items be carried:

- Lighter, matches, or a "flint' of fire steel
- Fire starter (tinder). Cotton balls with lip balm work well, or paper egg cartons with cotton balls and paraffin wax; if buying commercial fire starter, test it after several months.
- A whistle
- Heavy tinfoil (to melt snow, to cook on, or to boil water in)
- Some high-energy food
- A Mora knife or folding saw (Japanese tooth rake is best) or "camp chainsaw in a can"
- Cordage/rope (about 50 feet)
- Bear spray (and/or bear bangers)

2.5 When using an ATV or helicopter for isolated work, it is recommended that a survival bag or backpack that can be left at a known muster point be put together. This bag should include the following items:

- Additional fire starter (tinder)
- Matches, fire steel
- A multi-tool (like a Swiss Army knife)
- A folding saw
- 3-8'x6" tarps plus one 12 X 16" tarp or larger (or a tent)
- 100 " of utility cord or parachute cord
- A small pot
- Lean spoon
- A small stove (a small folding military stoves with trioxethelyne tablets will work well)
- Closed cell foam pads or several square feet of double-wall bubble insulation (the silver sided bubble wrap used in construction) to use as a sleeping pad or for hypothermia treatment
- Food
- Water
- Sleeping bag with a mylar bivy sack to be used as a vapor barrier inside


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## 3.0 Drinking Water

3.1 No surface water can be considered safe for human consumption without treatment. Even the cleanest looking spring water could be polluted. Untreated water may be contaminated with bacteria, viruses, or protozoa.

3.2 On short trips, carry treated water or obtain water from another safe source.

3.3 When field projects take you into remote isolation where there is the potential for not having access to clean drinking water, be sure to take the appropriate tools with you: a water filter, tin foil or a pot for boiling water, or tablets or chemicals for treating the water prior to consumption.

3.4 Generally, the chances of finding safe drinking water in the mountains increase as you gain altitude. Intense sunlight at high altitudes kills undesirable bacteria and viruses but harmful cysts are unaffected.

3.5 Runoff water from streams below glaciers is often cloudy with silt and should be filtered.

3.6 Well water, fast-moving rivers, and the deepest parts of lakes are the best locations to obtain water. Avoid stagnant water, shoreline water, and water close to human habitations and campsites.

3.7 During the winter, it is best to use an open water source or to obtain water through a hole in the ice. Check the safety of the ice first. Melting ice and snow consumes fuel and takes extra time. Eating snow or ice directly can lead to chilling and hypothermia and could also cause stomach cramps and headaches. Beware of colored snow, which indicates the presence of algae that could cause diarrhea if ingested. Even in winter, all water should be purified.

### 3.8 Water Treatment

3.8.1 Each method of water treatment has its advantages and disadvantages. Use only treated or boiled water for drinking, brushing teeth, or washing fruits and vegetables that will be eaten raw.

3.8.2 Boiling. Heat is the oldest, safest and most effective method of purifying water. Bring the water to a boil for at least one minute (adding one more minute for each 300 m (1000 ft.) above sea level. If the water is cloudy, filter it before boiling. Boiling will give your water a flat taste that can be remedied by pouring the water quickly back and forth from one clean container to another, by letting the water cool, or by adding a pinch of salt per litre of water.

3.8.3 Chemical Purification. When boiling is not practical because of time and lack of a heat source, disinfection with chlorine or iodine compounds may be effective. Use two water containers: one for treating water and the other for carrying purified water. After disinfection, shake the container vigorously. Wait five minutes. Shake it again with the lid loose so that some water leaks out to cleanse the mouth of the container. Disinfection alone may not kill some protozoa. Pass the water first through a filter with a pore size of 0.5 micron (absolute) or less to remove protozoa, then disinfect it to kill viruses and bacteria. Disinfection will give the water a peculiar taste. If you find it unpleasant, try using flavoured drink crystals or concentrated citrus juice to mask the taste of the disinfectant. Add drink powders or juice only after the treatment time has elapsed.

3.8.4 Filtration. Water filters for use in the wilderness are available, but be wary when making your choice. Avoid filters that allow particles larger than 0.5 microns to pass. Filters with a pore size of 0.1 to 0.3 micron can remove protozoa and bacteria but may not remove viruses. Filtration alone is insufficient to purify water; hence, it should be combined with disinfection to remove viruses. Follow the operating and maintenance instructions carefully.

**Table 1: Summary of Water Purification Methods**

| | Boiling | Chlorine | Iodine | Filters |
|---|---|---|---|---|
| Bacteria | E | E | E | M |
| Viruses | E | E | E | N |
| Protozoa | E | M | M | M |
| Chemicals | M | N | N | N |

E = effective M = may be effective (see text) N = not effective


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3.9 Some water-borne diseases are difficult to diagnose. If you are not feeling well and have recently drunk water from a source in the wild, inform your doctor that you may have consumed untreated water.


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# S3NA-405-PR Drilling, Boring, and Direct Push Probing

## 1.0 Purpose and Scope

1.1 Provides the minimum requirements to be followed when drilling and boring work are performed.

1.2 This procedure applies to all AECOM North America-based employees and operations.

## 2.0 Terms and Definitions

2.1 None

## 3.0 Attachments

3.1 S3NA-405-FM1 Drill Rig Inspection

3.2 S3NA-405-FM2 Subsurface Investigation Checklist

3.3 S3NA-405-ST Drilling and Boring

3.4 S3NA-405-WI Core Drilling Machine Safety Card

## 4.0 Procedure

4.1 All client on-site safety procedures shall be understood and adhered to.

4.2 Be aware of the provincial/territorial regulations that govern drill rig operations and exposed moving parts.

4.3 **Roles and Responsibilities**

4.3.1 **Project Manager or Resident Engineer** is responsible for ensuring that sound principles of safety, training, inspection, maintenance, and operation consistent with all resource data available from the manufacturer, OSHA, and ANSI is provided to the operator and users by the Contractor or operating entity.

4.3.2 **Site Safety Coordinator (SSC)** shall assist the **Project Manager** in compliance with the requirements of this procedure.

4.3.3 The **SH&E Department** shall assist site management with guidance about this procedure.

4.3.4 **AECOM employees** engaged in project field activities shall be cognizant of contractor activities that may affect their safety and shall follow these procedures.

4.3.5 **AECOM Equipment Operator**

- In cases where AECOM owns and operates drilling, boring, or probing equipment, the lead equipment operator is responsible for the maintenance and safe operation of equipment under their control consistent with those responsibilities of a Contractor.
- Operations will be terminated during an electrical storm, and all crew members will move away from the rig. If lightning is observed, shut down all rig operations immediately.

4.3.6 **Contractors**

- **Contractors** have direct control over the application and operation of all drilling, boring, and probing equipment owned by their organization.
- It is the **Equipment Contractor** operator's responsibility to implement safe work practices provided by the **Contractor's** project management or supervisory staff supplemented by good judgment, safe control, and caution whenever operating drilling, boring, and probing equipment.

4.3.7 **Safety Representative**: Unless the **Contractor** has a designated **Safety Representative**, the **Contractor'**s responsible person for safety for the drill crew will be the drill rig operator. The safety person's responsibilities are to

- Consider the "responsibility" for safety and the "authority" to enforce safety to be a matter of first importance.


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- Be the leader in using proper personal protective equipment (PPE) and set an example in following the rules that are being enforced on others. See section 4.5 for PPE required by this SOP.
- Enforce the use of proper safety equipment and take appropriate corrective action when proper PPE is not being used.
- Understand that the proper maintenance of tools and equipment and general housekeeping on the drill rig will provide an environment that promotes and enforces safety. See Sections 4.7 and 4.9 for housekeeping and maintenance requirements of this SOP.
- Ensure that the operator has had adequate training and is thoroughly familiar with the rig, its controls, and its capabilities prior to commencement of drilling activities.
- Inspect the l rig at least daily for structural damage, loose bolts and nuts, proper tension in chain drives, loose or missing guards or protective covers, fluid leaks, damaged hoses, and/or damaged pressure gauges and pressure relief valves. A Rig Inspection Form has been provided in S3NA-405-FM1 Drill Rig Inspection for use in performing inspections when the Contractor does not have their own.
- Check and test all safety devices such as emergency shutdown switches at least daily and preferably at the start of a work shift. Rig operation should not be permitted until all emergency shutdown and warning systems are working correctly. Wiring around, bypassing, or removing an emergency device is not permitted.
- Check that all gauges, warning lights, and control levers are functioning properly, and listen for unusual sounds on each starting of an engine.
- Ensure that all new rig workers are informed of safe operating practices on and around the rig. Provide each new rig worker with a copy of the organization's drilling operations safety procedures and, when appropriate, the rig manufacturer's operations and maintenance manual. The safety person should ensure that each new employee reads and understands the safety procedures.
- Ensure that a first aid kit and fire extinguishers are available and properly maintained on each rig and on each additional vehicle.
- Be well trained and capable of using a first aid kit, a fire extinguisher, and all other safety devices and equipment.
- Maintain a list of addresses and telephone numbers of emergency assistance units (ambulance services, police, hospitals, etc.), and inform other members of the drill crew of its location.
- See that new workers are instructed in rig safety, and observe the new worker's progress toward understanding safe operating practices.
- Observe the mental, emotional, and physical capability of workers to perform the assigned work in a proper and safe manner. Dismiss from the job site any worker whose mental and physical capabilities might cause injury to the worker or coworkers.
- Rig Crew and Other Field Personnel (Those employees involved in fieldwork): All personnel engaged in site activities are required to become thoroughly familiar with, and to conform to, the provisions of AECOM's safety plan, procedures, and such other safety directives as may be considered appropriate by **Project Managers**, **Safety Officers,** and **Supervisors**.
- Rig Workers: Personnel are encouraged to offer ideas, suggestions, or recommendations regarding any operational condition, procedure, or practice that may enhance the safety of site personnel or the public. Their primary responsibilities will be:
    - Perform all required work safely.
    - Familiarize themselves with and understand the plan, including proper use of personal protective equipment.
    - Report any unsafe conditions to supervisory personnel.
    - Be aware of signs and symptoms of thermal stress.

## 4.4 Training

4.4.1 All staff shall be provided with on-site orientation to the rig and its operator.

4.4.2 All operators and assistants shall have industry-standard safety training and be versed in the equipment to be utilized. This may include, but is not limited to, HAZWOPER, Petroleum Safety Training (or Construction Safety Training), and H2S Alive as appropriate.


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## 4.5 Personal Protective Equipment

4.6 For most geotechnical, mineral, and/or groundwater drilling projects, PPE should include

- Hard hat: Hard hats shall be worn by everyone working at a drilling/boring site. Hats should meet the requirements of ANSI Z89 and be kept clean and in good repair with the headband and crown straps properly adjusted for the employee.
- Safety shoes: Safety shoes or boots shall be worn by all drilling personnel and all visitors to the site who observe operations within close proximity of the rig. Safety shoes or boots should meet the requirements of ANSI Z4 1.1.
- Safety glasses: All rig personnel shall wear safety glasses meeting the requirements of ANSI Z87.1.
- High Visibility Class II Safety Vest shall be worn by all **AECOM employees**. All rig personnel should attempt to wear high-visibility clothing that should be close fitting and not have large cuffs or loose material that can catch on rotating or translating components of the rig.
- Close fitting gloves and clothing: All rig personnel should wear gloves for hand protection against cuts and abrasions that could occur while handling wire rope or cable and from contact with sharp edges and burrs on drill rods and other drilling or sampling tools. Gloves should be close fitting and not have large cuffs or loose ties which can catch on rotating or translating components of the rig.
- Other protective equipment: For some operations, the project may dictate use of other protective equipment. The management of the contractor and its safety person shall determine the requirements. Such equipment might include face or ear protection or reflective clothing. The design and composition of the protective equipment and clothing should be determined as a joint effort of management and the client.
- Each worker should wear noise reducing ear protectors around operating equipment or during elevated noise levels.
- When drilling, boring, or probing is performed in chemically or radiological contaminated ground, special protective equipment and clothing will probably be required.
- The clothing of the individual rig worker is not generally considered protective equipment; however, clothing should be close fitting and comfortable without loose ends, straps, draw strings or belts or otherwise unfastened parts that might catch on some rotating or translating component of the rig. Rings and jewelry should not be worn during a work shift.

## 4.7 Housekeeping

4.7.1 A key requirement for safe field operations is that the Contractor safety person understands and fulfills the responsibility for maintenance and “housekeeping” on and around the drill rig, including the following:

- Suitable storage locations should be provided for all tools, materials, and supplies so that tools, materials, and supplies can be conveniently and safely handled without hitting or falling on a member of the crew or a visitor.
- Storage or transporting tools, materials, or supplies within or on the mast (derrick) of the rig should be avoided.
- Pipe, drill rods, probe rods, casing augers, and similar tooling should be orderly stacked on racks or sills to prevent spreading, rolling, or sliding.
- Penetration or other driving hammers should be placed at a safe location on the ground or be secured to prevent movement when not in use.
- Work areas, platforms, walkways, scaffolding and other accesses should be kept free of materials, debris and obstructions and substances such as ice, grease, or oil that could cause a surface to become slick or otherwise hazardous.
- All controls, control linkages, warning and operation lights, and lenses should be kept free of oil, grease, and/or ice.
- Do not store gasoline in any portable container other than a non-sparking, red safety container with a flame arrester in the fill spout and having the word “gasoline” easily visible.


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## 4.8 Traffic Control

4.8.1 When operating near public vehicular and pedestrian traffic, the on-site personnel shall take every precaution necessary to see that the work zone is properly established, identified, and isolated from both moving traffic and passerby pedestrians.

4.8.2 All traffic control devices shall be installed, placed, and maintained in accordance with the Traffic Control Plan, client specifications, and/or the Manual of Uniform Traffic Control Devices (MUTCD). Traffic control devices shall consist of and not be limited to:

- Directional and informational signage;
- High visibility barricades, cones, or barrels;
- Lighting; and
- Other equipment and devices as required.

## 4.9 Maintenance & Inspection

4.9.1 Good maintenance and thorough inspection will make operations safer. Maintenance tasks should be done safely by a qualified maintenance person. Inspection and maintenance tasks include but are not limited to the following requirements:

- Inspections shall be completed at the beginning of each day by the equipment operator and in the presence of an AECOM employee when the equipment is not owned and operated by AECOM. A Rig Inspection Form is provided in S3NA-405-FM1 Drill Rig Inspection for use in performing inspections.
- Safety glasses should be worn when performing maintenance on a rig or on drilling or probing tools.
- The drill rig engine should be shut down to make repairs or adjustments to a drill rig or to lubricate fittings (except repairs or adjustments that can only be made with the engine running).
- Precautions should be taken to prevent accidental starting of an engine during maintenance by removing or tagging the ignition key.
- Wheels or the lowering of leveling jacks or both should be blocked ("zero energy state") and hand brakes set before working under a drill rig.
- When possible and appropriate, all pressure on the hydraulic systems should be released as well as the drilling fluid system and the air pressure systems of the drill rig prior to performing maintenance. In other words, reduce the drill rig and operating systems to a “zero energy state” before performing maintenance. Use extreme caution when opening drain plugs and radiator caps and other pressurized plugs and caps.
- Personnel shall not touch an engine or the exhaust system of an engine following its operation until the engine and exhaust system have adequate time to cool.
- Welding and cutting shall not occur on or near a fuel tank.
- Wire rope safety factors shall be in accordance with American National Standards Institute B 30.5-1968 or SAE J959-1966.
- Gasoline or other volatile or flammable liquids shall not be used as a cleaning agent on or around an l rig.
- The manufacturer's recommendations should be followed for applying the proper quantity and quality of lubricants, hydraulic oils, and/or coolants.
- All caps, filler plugs, protective guards, panels, high-pressure hose clamps, chains, or cables that have been removed for maintenance should be replaced.

## 4.10 Hand Tools

4.10.1 A large number of hand tools can be used on or around a drill or probe rig and in repair shops and more than an equal number of instructions for proper use exist. “Use the tool for its intended purpose” is the most important rule. Additionally, equipment operators and assistants should not use their hand in place of the proper tool; work shall be stopped until the correct tool can be found. The following are a few specific and some general suggestions that apply to the safe use of several hand tools that are often used on and around rigs:

- When a tool becomes damaged, either repair it before using it again or get rid of it.
- When using a hammer, any kind of hammer for any purpose, wear safety glasses and require all others around you to wear safety glasses.

- When using a chisel, any kind of chisel, for any purpose, wear safety glasses and require all others around you to wear safety glasses.
- Keep all tools cleaned and orderly stored when not in use.
- Use wrenches on nuts; don't use pliers on nuts.
- Use screwdrivers with blades that fit the screw slot.
- When using a wrench on a tight nut, first use some penetrating oil, use the largest wrench available that fits the nut, when possible pull on the wrench handle rather than pushing, and apply force to the wrench with both hands when possible and with both feet firmly placed. Don't push or pull with one or both feet on the drill rig or the side of a mud pit or some other blocking-off device. Always assume that you may lose your footing – check the place where you may fall for sharp objects.
- Keep all pipe wrenches clean and in good repair. The jaws of pipe wrenches should be wire brushed frequently to prevent an accumulation of dirt and grease which would otherwise build up and cause wrenches to slip. Replace hook and heel jaws when they become visibly worn.
- Avoid the use pipe wrenches in place of a rod-holding device whenever possible.
- When breaking tool joints on the ground or on a drilling platform, position your hands so that your fingers will not be smashed between the wrench handle and the ground or the platform, should the wrench slip or the joint suddenly let go.

## 4.11 Clearing Work Areas

4.11.1 Prior to set up, adequate site clearing and leveling should be performed to accommodate the rig and supplies and provide a safe working area. Clearing the site includes clearing the intended drilling area of underground utilities in accordance with *S3NA-417-PR Utilities*, *Underground*. Drilling or probing should not be commenced when tree limbs, unstable ground or site obstructions cause unsafe tool handling conditions.

4.11.2 Start-Up

- All rig personnel and visitors should be instructed to "stand clear" of the rig immediately prior to and during starting of an engine.
- Make sure all gear boxes are in neutral, all hoist levers are disengaged, all hydraulic levers are in the neutral-actuating positions, and the cathead rope is not on the cathead before starting a drill rig engine.
- Start all engines according to the manufacturer's manual.

## 4.12 Drilling and Probing Operations

4.12.1 The following safety measures shall be taken during drilling and probing operations on-site:

- The operator and helper shall be present during all active rig operations.
- Site personnel shall remain within visual contact of the rig operator.
- Hard hats, approved safety boots and hearing protection shall be worn in the presence of a rig.
- Services shall be cleared prior to drilling or probing.
- Hands shall be kept away from moving parts (augers).
- The emergency shut-off switch on the rig should be identified to site personnel and tested on a regular basis by the operator.
- Unauthorized personnel shall be kept clear of the rig.

4.12.2 Safety requires the attention and cooperation of every worker and site visitor.

- Do not drive the rig from hole to hole with the mast (derrick) in the raised position.
- Before raising the mast (derrick) look up to check for overhead obstructions. Refer to *S3NA-417-PR Utilities, Underground* and *S3NA-406-PR Electrical Lines, Overhead*.
- Before raising the mast (derrick), all rig personnel (with the exception of the operator) and visitors should be cleared from the areas immediately to the rear and the sides of the mast. All rig personnel and visitors should be informed that the mast is being raised prior to raising it.
- Before the mast (derrick) of a drill rig is raised and drilling is commenced, the drill rig shall be first leveled and stabilized with leveling jacks and/or solid cribbing. The drill rig should be releveled if it settles after initial set up. Lower the mast (derrick) only when the leveling jacks are down, and do not raise the leveling jack pads until the mast (derrick) is lowered completely.


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- Before starting drilling operations, secure and/or lock the mast (derrick) if required according to the drill manufacturer's recommendations.
- The operator of a rig should only operate a drill rig from the position of the controls. If the operator of the rig shall leave the area of the controls, the operator should shift the transmission controlling the rotary drive into neutral and place the feed control lever in neutral. The operator should shut down the drill engine before leaving the vicinity of the drill.
- Throwing or dropping tools will not be permitted. All tools should be carefully passed by hand between personnel or a hoist line should be used.
- Do not consume alcoholic beverages or other depressants or chemical stimulants prior to starting work on a rig or while on the job.
- If it is necessary to operate the rig within an enclosed area, make certain that exhaust fumes are conducted out of the area. Exhaust fumes can be toxic and some cannot be detected by smell.
- Clean mud and grease from your boots before mounting a rig platform and use hand holds and railings. Watch for slippery ground when dismounting from the platform.
- During freezing weather, do not touch any metal parts of the rig with exposed flesh. Freezing of moist skin to metal can occur almost instantaneously.
- All air and water lines and pumps should be drained when not in use if freezing weather is expected.
- All unattended bore holes shall be adequately covered or otherwise protected to prevent rig personnel, site visitors, or animals from stepping or falling into the hole. All open bore holes should be covered, protected, or backfilled adequately and according to local or state regulations on completion of the drilling project.
- “Horsing around” within the vicinity of the drill rig and tool and supply storage areas should never be allowed, even when the rig is shut down.
- When using a ladder on a rig, face the ladder and grasp either the side rails or the rungs with both hands while ascending or descending. Always use adequate fall protection and a full body harness when climbing above six feet of the ground. Do not attempt to use one or both hands to carry a tool while on a ladder. Use a hoist line and a tool “bucket” or a safety hook to raise or lower hand tools.

## 4.13 Elevated Derrick Platforms

4.13.1 The following precautions should be used:

- When a rig worker first arrives at a derrick platform, the platform should immediately be inspected for broken members, loose connections, and loose tools or other loose materials.
- A derrick platform over 4 feet (1.2 m) above ground surface should have toe boards and safety railings that are in good condition.
- When climbing to a derrick platform that is higher than 6 feet (am), a fall arresting device shall be used. The fall arresting device should consist of a full body harness and fall protection. The harness should fit snugly but comfortably. The lifeline when attached to the derrick should be less than 6 feet (2 m) long and attached to a fall arrester. The harness and lifeline should be strong enough to withstand the dynamic force of a 250-pound (115 kg) weight (contained within the belt) falling 6 feet (2 m).
- When a rig worker is on a derrick platform, the lifeline should be fastened to the derrick just above the derrick platform and to a structural member that is not attached to the platform or to other lines or cables supporting the platform.
- Tools should be securely attached to the platform with safety lines. Do not attach a tool to a line attached to your wrist or any other part of your body.
- When you are working on a derrick platform, do not guide drill rods or pipe into racks or other supports by taking hold of a moving hoist line or a traveling block.
- Loose tools and similar items should not be left on the derrick platform or on structural members of the derrick.
- Workers on the ground or the drilling floor should avoid being under rig workers on elevated platforms whenever possible.


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## 4.14 Lifting Heavy Objects

4.14.1 Before lifting any object without using a hoist, make sure that the load is within your personal lifting capacity. If it is too heavy, ask for assistance.

4.14.2 Before lifting a relatively heavy object, approach the object by bending at the knees, keeping your back vertical and unarched while obtaining a firm footing. Grasp the object firmly with both hands and stand slowly and squarely while keeping your back vertical and unarched. In other words, perform the lifting with the muscles in your legs, not with the muscles in your lower back.

4.14.3 If a heavy object shall be moved some distance without the aid of machinery, keep your back straight and unarched. Change directions by moving your feet, not by twisting your body.

4.14.4 Move heavy objects with the aid of handcarts or lifting devices whenever possible.

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## 4.15 Use of Wire Line Hoists, Wire Rope, and Hoisting Hardware

4.15.1 The use of wire line hoists, wire rope, and hoisting hardware should be as stipulated by the American Iron Steel Institute, Wire Rope Users Manual.

- All wire ropes and fittings should be visually inspected during use and thoroughly inspected at least once a week for abrasion, broken wires, wear, reduction in rope diameter, reduction in wire diameter, fatigue, corrosion, damage from heat, improper revving, jamming, crushing, bird caging, kinking, care protrusion, and damage to lifting hardware. Wire ropes should be replaced when inspection indicates excessive damage according to the Wire Rope Users Manual. All wire ropes that have not been used for a period of a month or more should be thoroughly inspected before being returned to service.
- End fittings and connections consist of spliced eyes and various manufactured devices. All manufactured end fittings and connections should be installed according to the manufacturer’s instructions and loaded according to the manufacturer's specifications.
- If a ball-bearing type hoisting swivel is used to hoist drill rods, swivel bearings should be inspected and lubricated daily to ensure that the swivel freely rotates under load.
- If a rod-slipping device is used to hoist drill or probe rods, do not drill through or rotate drill rods through the slipping device; do not hoist more than 1 foot (.3 m) of the rod column above the top of the mast (derrick); and do not hoist a rod column with loose tool joints while the rod column is being supported by a rod slipping device. If rods should slip back into the hole, do not attempt to break the fall of the rods with your hands or by applying tension to the slipping device.
- Most sheaves on exploration drill rigs are stationary with a single part line. The number of parts of line should never be increased without first consulting with the manufacturer of the drill rig.
- Wire ropes shall be properly matched with each sheave. If the rope is too large, the sheave will pinch the wire rope; if the rope is too small, it will groove the sheave. Once the sheave is grooved, it will severely pinch and damage larger-sized wire ropes and therefore shall be replaced.

4.15.2 The following procedures and precautions shall be understood and implemented for safe use of wire ropes and rigging hardware.

- Use tool-handling hoists only for vertical lifting of tools (except when angle hole drilling). Do not use tool-handling hoists to pull on objects always from the rig; however, drills may be moved using the main hoist if the wire rope is spooled through proper sheaves according to the manufacturer's recommendations.
- When struck tools or similar loads cannot be raised with a hoist, disconnect the hoist line and connect the stuck tools directly to the feed mechanism of the drill. Do not use hydraulic leveling jacks for added pull to the hoist line or the feed mechanism of the drill.
- When attempting to pull out a mired down vehicle or drill rig carrier, only use a winch on the front or rear of the vehicle and stay as far as possible away from the wire rope. Do not attempt to use tool hoists to pull out a mired down vehicle or drill rig carrier.
- Minimize shock loading of a wire rope. Apply loads smoothly and steadily. Avoid sudden loading in cold weather.
- Never use frozen ropes.
- Protect wire rope from sharp corners or edges.
- Replace faulty guides and rollers.


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- Replace damaged safety latches on safety hooks before using.
- Know the safe working load of the equipment and tackle being used. Never exceed this limit.
- Clutches and brakes of hoists should be periodically inspected and tested.
- Know and do not exceed the rated capacity of hooks, rings, links, swivels, shackles, and other lifting aids.
- Always wear gloves when handling wire ropes.
- Do not guide wire rope on hoist drums with your hands.
- Following the installation of a new wire rope, first lift a light load to allow the wire rope to adjust.
- Never carry out any hoisting operations when the weather conditions are such that hazards to personnel, the public, or property are created.
- Never leave a load suspended in the air when the hoist is unattended.
- Keep your hands away from hoists, wire rope, hoisting hooks, sheaves, and pinch points while slack is being taken up and when the load is being hoisted.
- Never hoist the load over the head, body, or feet of any personnel. Never use a hoist line to "ride" up the mast (derrick) of a drill rig.
- Replacement wire ropes should conform to the drill rig manufacturer's specifications.

## 4.16 Use of Cathead and Rope Hoists

4.16.1 The following safety procedures should be employed when using a cathead hoist:

- Keep the cathead clean and free of rust and oil and/or grease. The cathead should be cleaned with a wire brush if it becomes rusty.
- Check the cathead periodically, when the engine is not running, for rope wear grooves. If a rope groove forms to a depth greater than 1/8 inches (3 mm), the cathead should be replaced.
- Always use a clean, dry, sound rope. A wet or oily rope may “grab” the cathead and cause drill tools or other items to be rapidly hoisted to the top of the mast.
- Should the rope “grab” the cathead or otherwise become tangled in the drum, release the rope and sound an appropriate alarm for all personnel to rapidly back away and stay clear. The operator should also back away and stay clear. If the rope “grabs” the cathead, and tools are hoisted to the sheaves at the top of the mast, the rope will often break, releasing the tools. If the rope does not break, stay clear of the drill rig until the operator cautiously returns to turn off the drill rig engine and appropriate action is taken to release the tools. The operator should keep careful watch on the suspended tools and should quickly back away after turning off the engine.
- The rope should always be protected from contact with all chemicals. Chemicals can cause deterioration of the rope that may not be visibly detectable.
- Never wrap the rope from the cathead (or any other rope, wire rope or cable on the drill rig) around a hand, wrist, arm, foot, ankle, leg or any other part of your body.
- Always maintain a minimum of 18 inches of clearance between the operating hand and the cathead drum when driving samplers, casing or other tools with the cathead and rope method. Be aware that the rope advances toward the cathead with each hammer blow as the sampler or other drilling tool advances into the ground.
- Never operate a cathead (or perform any other task around a drill rig) with loose unbuttoned or otherwise unfastened clothing or when wearing gloves with large cuffs or loose straps or lacings.
- Do not use a rope that is any longer than necessary. A rope that is too long can form a ground loop or otherwise become entangled with the operator's legs.
- Do not use more rope wraps than are required to hoist a load.
- Do not leave a cathead unattended with the rope wrapped on the drum. Position all other hoist lines to prevent contact with the operating cathead rope.
- When using the cathead and rope for driving or back driving, make sure that all threaded connections are tight and stay as far away as possible from the hammer impact point.
- The cathead operator shall be able to operate the cathead standing on a level surface with good, firm footing conditions without distraction or disturbance.


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## 4.17 Use of Augers

4.17.1 The following general procedures should be used when starting a boring with continuous flight of hollow-stem augers:

- Prepare to start an auger boring with the drill rig level, the clutch or hydraulic rotation control disengaged, the transmission in low gear, and the engine running at low RPM.
- Apply an adequate amount of down pressure prior to rotation to seat the auger head below the ground surface.
- Look at the auger head while slowly engaging the clutch or rotation control and starting rotation. Stay clear of the auger.
- Slowly rotate the auger and auger head while continuing to apply down pressure. Keep one hand on the clutch or the rotation control at all times until the auger has penetrated about one foot or more below ground surface.
- If the auger head slides out of alignment, disengage the clutch or hydraulic rotation control and repeat the hole starting process.
- An auger guide can facilitate the starting of a straight hole through hard ground or a pavement.
- The operator and tool handler should establish a system of responsibility for the series of various activities required for auger drilling, such as connecting and disconnection auger sections, and inserting and removing the auger fork. The operator shall ensure that the tool handler is well away from the auger column and that the auger fork is removed before starting rotation.
- Only use the manufacturer's recommended method of securing the auger to the power coupling. Do not touch the coupling or the auger with your hands, a wrench, or any other tools during rotation.
- Whenever possible, use tool hoists to handle auger sections.
- Never place hands or fingers under the bottom of an auger section when hoisting the auger over the top of the auger section in the ground or other hard surfaces such as the drill rig platform.
- Never allow feet to get under the auger section that is being hoisted.
- When rotating augers, stay clear of the rotating auger and other rotating components of the drill rig. Never reach behind or around a rotating auger for any reason.
- Use a long-handled shovel to move auger cuttings away from the auger. Never use your hands or feet to move cuttings away from the auger.
- Do not attempt to remove earth from rotating augers. Augers should be cleaned only when the drill rig is in neutral and the augers are stopped from rotating.

## 4.18 Rotary and Core Drilling

4.18.1 Rotary drilling tools should be safety checked prior to drilling:

- Water swivels and hoisting plugs should be lubricated and checked for "frozen" bearings before use.
- Drill rod chuck jaws should be checked periodically and replaced when necessary.
- The capacities of hoists and sheaves should be checked against the anticipated weight to the drill rod string plus other expected hoisting loads.

4.18.2 Special precautions that should be taken for safe rotary or core drilling involve chucking, joint break, hoisting, and lowering of drill rods:

- Only the operator of the drill rig should brake or set a manual chuck so that rotation of the chuck will not occur prior to removing the wrench from the chuck.
- Drill rods should not be braked during lowering into the hole with drill rod chuck jaws. Drill rods should not be held or lowered into the hole with pipe wrenches.
- If a string of drill rods are accidentally or inadvertently released into the hole, do not attempt to grab the falling rods with your hands or a wrench.
- In the event of a plugged bit or other circulation blockage, the high pressure in the piping and hose between the pump and the obstruction should be relieved or bled down before breaking the first tool joint.
- When drill rods are hoisted from the hole, they should be cleaned for safe handling with a rubber or other suitable rod wiper. Do not use your hands to clean drilling fluids from drill rods.


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- If work shall progress over a portable drilling fluid (mud) pit, do not attempt to stand on narrow sides or cross members. The mud pit should be equipped with rough-surfaced, fitted cover panels of adequate strength to hold drill rig personnel.
- Drill rods should not be lifted and leaned unsecured against the mast. Either provide some method of securing the upper ends of the drill rod sections for safe vertical storage or lay the rods down.

## 4.19 Site Movement of Equipment

4.19.1 The individual who transports a rig on and off a drilling site should:

- Be properly licensed and should only operate the vehicle according to federal, state, and local regulations.
- Know the traveling height (overhead clearance), width, length and weight of the rig with carrier and know highway and bridge load, width and overhead limits, making sure these limits are not exceeded with and adequate margin.
- Never move an l rig unless the vehicle brakes are in sound working order.
- Allow for mast overhand when cornering or approaching other vehicles or structures.
- Be aware that the canopies of service stations and motels are often too low for a drill rig mast to clear with the mast in the travel position.
- Watch for low hanging electrical lines, particularly at the entrances to drilling sites or restaurants, motels, other commercial sites.
- Never travel on a street, road, or highway with the mast (derrick) of the rig in the raised or partially raised position.
- Remove all ignition keys if rig is left unattended.

4.19.2 Loading and Unloading

- Use ramps of adequate design that are solid and substantial enough to bear the weight of the rig with carrier, including tools.
- Load and unload on level ground.
- Use the assistance of someone on the ground as a guide.
- Check the brakes on the rig carrier before approaching loading ramps.
- Distribute the weight of the rig, carrier, and tools on the trailer so that the center of eight is approximately on the centerline of the trailer and so that some of the trailer load is transferred to the high of the pulling vehicle. Refer to the trailer manufacturer's weight distribution recommendations.
- The rig and tools should be secured to the hauling vehicle with ties, chains, and/or load binders of adequate capacity.

4.19.3 Off-Road Movement

The following safety suggestions relate to off-road movement:

- Before moving a drill rig, first walk the route of travel, inspecting for depressions, stumps, gullies, ruts, and similar obstacles.
- Always check the brakes of a drill rig carrier before traveling, particularly on rough, uneven, or hilly ground.
- Check the complete drive train of a carrier at least weekly for loose or damaged bolts, nuts, studs, shafts, and mountings.
- Discharge all passengers before moving a drill rig on rough or hilly terrain.
- Engage the front axle (for 4 x 4, 6 x 6, etc. vehicles or carriers) when traveling off highway on hilly terrain.
- Use caution when traveling side-hill. Conservatively evaluate side-hill capability of drill rigs, because the arbitrary addition of drilling tools may raise the center of mass. When possible, travel directly uphill or downhill. Increase tire pressures before traveling in hilly terrain (do not exceed rated tire pressure).
- Attempt to cross obstacles such as small logs and small erosion channels or ditches squarely, not at an angle.
- Use the assistance of someone on the ground as a guide when lateral or overhead clearance is close.


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- After the drill has been moved to a new drilling site, set all brakes and/or locks. Always block/chock the wheels.

## 4.20 Tires, Batteries, and Fuel

4.20.1 Tires on the rig shall be checked daily for safety and during extended travel for loss of air and they shall be maintained and/or repaired in a safe manner. If tires are deflated to reduce ground pressure for movement on soft ground, the tires should be inflated to normal pressures before movement on firm or hilly ground or on streets, roads and highways. Under-inflated tires are not as stable on firm ground as properly inflated tires. Air pressures should be maintained for travel on streets, roads, and highways according to the manufacturer's recommendations. During air pressure checks, inspect for:

- Missing or loose wheel lugs.
- Objects wedged between dual or embedded in the tire casing. Damaged or poorly fitting rims or rim flanges.
- Abnormal wear, cuts, breaks, or tears in the casing.
- The repair of truck and off-highway tires should only be made with required special tools and following the recommendations of a tire manufacturer’s repair manual.

4.20.2 Batteries contain strong acid. Use extreme caution when servicing batteries.

- Batteries should only be serviced in a ventilated area while wearing safety glasses.
- When a battery is removed from a vehicle or service unit, disconnect the battery ground clamp first.
- When installing a battery, connect the battery ground clamp last.
- When charging a battery with a battery charger, turn off the power source to the battery before either connecting or disconnecting charger leads to the battery posts. Cell caps should be loosened prior to charging to permit the escape of gas.
- Spilled battery acid can burn your skin and damage your eyes. Spilled battery acid should be immediately flushed off of your skin with lots of water. Should battery acid get into someone's eyes, flush immediately with large amounts of water and see a physician at once.
- To avoid battery explosions, keep the cells filled with electrolyte; use a flashlight (not an open flame) to check electrolyte levels and avoid creating sparks around the battery by shorting across a battery terminal. Keep lighted smoking materials and flames away from batteries.

4.20.3 Special precautions shall be taken for handling fuel and refueling the rig or carrier. Only use the type and quality of fuel recommended by the engine manufacturer.

- Refuel in a well-ventilated area.
- Do not fill fuel tanks while the engine is running. Turn off all electrical switches. Do not spill fuel on hot surfaces. Clean any spillage before starting an engine. Wipe up spilled fuel with cotton rags or cloths. Do not use wool or metallic cloth.
- Keep open lights, lighted smoking materials, and flames or sparking equipment well away from the fueling area.
- Turn off heaters in carrier cabs when refueling the carrier or the drill rig.
- Do not fill portable fuel containers completely full to allow expansion of the fuel during temperature changes.
- Keep the fuel nozzle in contact with the tank being filled to prevent static sparks from igniting the fuel.
- Do not transport portable fuel containers in the vehicle or carrier cab with personnel.
- Fuel containers and hoses should remain in contact with a metal surface during travel to prevent the buildup of static charge.

## 4.21 First Aid (see S3NA-207-PR Medical Services and First Aid)

4.21.1 At least one member of the crew (and if only one, preferably the drilling and safety supervisor) should be trained to perform first aid. First aid is taught on a person-to-person basis, not by providing or reading a manual. Manuals should only provide continuing reminders and be used for reference. It is suggested that courses provided or sponsored by the American Red Cross or a similar organization would best satisfy the requirements of first aid training for drill crews.

4.21.2 For drilling and probing operations it is particularly important that the individual responsible for first aid should be able to recognize the symptoms and be able to provide first aid for electrical shock, heart


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attack, stroke, broken bones, eye injury, snake bite, and cuts or abrasions to the skin. Again, first aid for these situations is best taught to drill crewmembers by instructors qualified by an agency such as the American Red Cross.

4.21.3 A first aid kit should be available and well maintained on each drill site. The contents of the first aid kit shall be placed in a weatherproof container with individual sealed packages for each type of item.

4.22 **Rig Utilization**

4.22.1 Do not attempt to exceed manufacturers' ratings of speed, force, torque, pressure, flow, etc.

4.22.2 Only use the drill rig and tools for the purposes that they are intended and designed.

4.23 **Rig Alterations**

4.23.1 Alterations to a rig or drilling or probing tools should only be made by qualified personnel and only after consultation with the manufacturer.

## 5.0 Records

5.1 None

## 6.0 References

6.1 None


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# S3NA-405-FM1 Drill Rig Inspection

**Project Name**:
**Project Number**:
**Date**:
**Subcontractor Inspected**:
**Site Manager**:

| General Safety | | |
|---|---|---|
| Safety Officer Designated for Job: | ☐ Yes | ☐ No |
| Name: | | |
| Safety Meeting Performed (Daily) | ☐ Yes | ☐ No |

| Personal Protective Equipment (PPE) | | |
|---|---|---|
| Hard Hats | ☐ Yes | ☐ No |
| Safety Glasses | ☐ Yes | ☐ No |
| Steel-toed Boots | ☐ Yes | ☐ No |
| Hearing Protection | ☐ Yes | ☐ No |
| Work Gloves | ☐ Yes | ☐ No |
| Orange Work Vests | ☐ Yes | ☐ No |
| Traffic Cones and Signs | ☐ Yes | ☐ No |
| Other | ☐ Yes | ☐ No |
| Disposal of PPE in Proper Waste Containers (if applicable) | ☐ Yes | ☐ No |
| Comments: | | |

| Daily Inspections of Drill Rig | | |
|---|---|---|
| Structural Damage, Loose Bolts | ☐ Yes | ☐ No |
| Proper Tension in Chain Drives | ☐ Yes | ☐ No |
| Loose or Missing Guards, Fluid Leaks | ☐ Yes | ☐ No |
| Damaged Hoses and/or Damaged Pressure | ☐ Yes | ☐ No |
| Gauges and Pressure Relief Valves | ☐ Yes | ☐ No |
| Comments: | | |


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| Check and test all safety devices such as: | | |
|---|---|---|
| Emergency shutdown switches, at least daily | ☐ Yes | ☐ No |
| All gauges and warning lights, and ensure control levers are functioning properly | ☐ Yes | ☐ No |
| First aid and fire extinguishers on drill rig | ☐ Yes | ☐ No |
| Back up alarm functioning properly | ☐ Yes | ☐ No |
| Comments: | | |

| **Drill Crew Training Requirements** | | |
|---|---|---|
| 40-hour OSHA Training | ☐ Yes | ☐ No |
| 8-hour Annual Refresher Training | ☐ Yes | ☐ No |
| Drill Rig Training/Safe Operating Practices | ☐ Yes | ☐ No |
| First Aid/CPR | ☐ Yes | ☐ No |
| Emergency Procedures | ☐ Yes | ☐ No |
| Emergency Phone Numbers Posted | ☐ Yes | ☐ No |
| Site Orientation | ☐ Yes | ☐ No |
| Health and Safety Plan Review | ☐ Yes | ☐ No |
| Comments: | | |

| **Housekeeping** | | |
|---|---|---|
| Suitable storage for tools, materials, and supplies | ☐ Yes | ☐ No |
| Pipes, drill rods, casing, and augers stacked on racks to prevent rolling and sliding | ☐ Yes | ☐ No |
| Platforms and other work areas free of debris materials and obstructions | ☐ Yes | ☐ No |
| Comments: | | |


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| Hand Tools | | |
|---|---|---|
| Tools in good condition | ☐ Yes | ☐ No |
| Broken tools discarded and replaced | ☐ Yes | ☐ No |
| Right tool used for the right job | ☐ Yes | ☐ No |
| Comments: | | |

| Drilling Operations | | |
|---|---|---|
| Mast or derrick down when moving rig | ☐ Yes | ☐ No |
| Overhead obstructions identified before mast is raised | ☐ Yes | ☐ No |
| Drill rig stabilized using leveling jacks or solid cribbing | ☐ Yes | ☐ No |
| Secure and lock derrick | ☐ Yes | ☐ No |
| Comments: | | |

| Overhead and Buried Utilities | | |
|---|---|---|
| Buried utilities identified and marked | ☐ Yes | ☐ No |
| Safe distance of drill rig from overhead power lines | ☐ Yes | ☐ No |
| Comments: | | |

| Wire Line Hoists, Wire Rope, and Hardware | | |
|---|---|---|
| Inspection for broken wires where reduction in rope diameter, wire diameter, fatigue, corrosion, damage from gear jamming, crushing, bird caging, kinking | ☐ Yes | ☐ No |
| Inspect and lubricate parts daily | ☐ Yes | ☐ No |
| Comments: | | |


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**Auger Operations—what to look for:**

- A system of responsibility between the operator and the tool handler when connecting and disconnecting auger sections and inserting and removing auger fork.
- During connecting and disconnecting auger sections and inserting auger for the tool, handler should position himself away from the auger column while it is rotating.
- When securing the auger to the power coupling, pin should be inserted and tapped into place using a hammer or other similar device.
- Tool hoist should be used to lower second section of auger into place.
- Both operators should be clear of auger as it is being lifted into place.
- Long-handled shovel should be used to move dirt away from auger.

**Overall Summary:**


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# S3NA-405-FM2 Subsurface Investigation Checklist

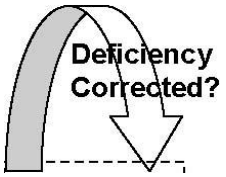
Name of Contractor:

Location: Project #:

Date: Time: Weather:

Person Conducting Inspection: Title:

*Note: As you conduct your inspection, you should be able to answer each question with a **YES**.*
*If the answer to any question is **NO,** this deficiency should be corrected as soon as possible.*




| | | YES | NO | OK | N/A |
|---|---|---|---|---|---|
| 1. | Do on-site personnel have required-level PPE (steel-toe boots, safety vests, hard hats, safety glasses, and gloves)? | ☐ | ☐ | ☐ | ☐ |
| 2. | Is there a copy of HASP and EAP available at each drill rig location? | ☐ | ☐ | ☐ | ☐ |
| 3. | Are there a PID, multi-gas meter, and a colorimetric pump available at each drill rig location? | ☐ | ☐ | ☐ | ☐ |
| 4. | Has the field screening equipment been calibrated in the morning? | ☐ | ☐ | ☐ | ☐ |
| 5. | Are calibration gases available at the site? | ☐ | ☐ | ☐ | ☐ |
| 6. | Are drilling fluids contained in the mud tub? | ☐ | ☐ | ☐ | ☐ |
| | 6a. Does mud tub setup provide adequate splash guards to protect the public? | ☐ | ☐ | ☐ | ☐ |
| | 6b. Does setup present five (5) feet of walk space for the public? | ☐ | ☐ | ☐ | ☐ |
| | 6c. Will the mud tub be emptied at end of day? | ☐ | ☐ | ☐ | ☐ |
| | 6d. Explain how the mud tub will be covered to prevent an accident. | ☐ | ☐ | ☐ | ☐ |
| | 6e. Are adequate containment practices being implemented to prevent mud tub liquids from being released onto pedestrian walkways? | ☐ | ☐ | ☐ | ☐ |
| 7. | Is the drill rig properly grounded? | ☐ | ☐ | ☐ | ☐ |
| 8. | Is there a DOT permit available on site at each drill rig location? | ☐ | ☐ | ☐ | ☐ |
| | 8a. Are operations in compliance with DOT permit? | ☐ | ☐ | ☐ | ☐ |
| 9. | Is there an orange snow fence with appropriate warning signage erected as a site barrier around the drill rig to keep pedestrians out of the work area? | ☐ | ☐ | ☐ | ☐ |
| 10. | Are hydrant water hoses out of the pedestrian sidewalk? | ☐ | ☐ | ☐ | ☐ |
| 11. | Are smoking and eating prohibited in the immediate work area? | ☐ | ☐ | ☐ | ☐ |
| 12. | Does each drill rig have a fire extinguisher, absorbent materials to cleanup a spill, and a first aid kit? | ☐ | ☐ | ☐ | ☐ |
| 13. | Is the waste from the mud tub properly contained in 55-gallon drums? | ☐ | ☐ | ☐ | ☐ |
| | 13a. Are drums properly labeled? | ☐ | ☐ | ☐ | ☐ |
| 14. | Are proper housekeeping procedures followed to avoid slips, trips, and falls? | ☐ | ☐ | ☐ | ☐ |
| 15. | Are decontamination/hand washing facilities available at the site? | ☐ | ☐ | ☐ | ☐ |


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**COMMENTS:**


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# S3NA-405-ST Drilling and Boring

| Jurisdiction | Regulation |
|---|---|
| **United States** | |
| **OSHA** | 29CFR 1910.212 |
| **Canada** | |
| **Alberta** | OHS Code (2009) Sect 310, 362 |
| **British Columbia** | OHS Regulation (1997) Sect 8.10, 16.27, 16.28 |
| **Manitoba** | Workplace Health and Safety Regulation (217/2006) Sect 16.5, 22.5 |
| **New Brunswick** | OHS Regulation (91-191) Sect 237, 241, 242 |
| **Newfoundland/Labrador** | OHS Regulation (C.N.L.R. 1165/96) Sect 52, 61, 68, 71, 73 |
| **Nova Scotia** | OHS Regulation (N.S. Reg. 44/99) Sect 87, 88 |
| **NWT/NU Territories** | General Safety Regulations (R.R.N.W.T. 1990, c. S-1), Safety Act (SI-013-92) Sect 39, 97, 141, 220 |
| **Ontario** | O. Reg. 851 Sect 24 |
| **Prince Edward Island** | OHS Regulations (EC180/87) Sect 30.2, 30.8 |
| **Quebec** | OHS Regulation (R.R.Q., c. S-2.1, r.19.01 O.C. 885-2001) Sect 340<br>Safety Code for the Construction Industry (R.R.Q. 1981, c. S-2.1, r. 6) Sect 2.10.2, 3.10.13 |
| **Saskatchewan** | OHS Regulation (R.R.S., c. O-1, r. 1) Sect 135 |
| **Yukon Territory** | OHS Regulations (O.I.C. 2006/178) Sect 1.12, 7.19 |


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# S3NA-405-WI Core Drilling Machine Safety Card

## 1.0 Objective / Overview

1.1 Core drilling machines are used on all types of jobs. They can be electrical or gas powered and come with a stand or can be hand held. Caution should be used when operating such a machine. It may look harmless and easy to run, but drilling machines have many hazards.

## 2.0 Safe Operating Guidelines

2.1 Clean the flanges before mounting the blade.

2.2 Make sure the blade is correct for the material being cut and that the arrow on the blade corresponds with the direction of rotation of the machine spindle.

2.3 Avoid tilting the blade when cutting.

2.4 Use only the machines that have an approved safety guard.

2.5 Remove the diamond blade from the machine during transit to prevent accidental damage.

2.6 Inspect the blades frequently to detect cracks or undercutting of the steel center.

2.7 Don't let excessive heat be generated at the cutting edge of the blade.

2.8 Use adequate water supply to both sides of the blade.

2.9 Follow the manufacturers recommended pulley sizes and operating speeds for specific blade diameters.

2.10 Make sure to tighten drive belts to ensure full available power.

2.11 Don't force the blade on the blade shaft or mount blade on an undersized spindle.



## 3.0 Potential Hazards

3.1 Electrical shock.

3.2 Flying debris.

3.3 Severe cuts.

3.4 Hearing loss.

3.5 Breathing fumes or dust.

3.6 Binding/biting – torque control.

## 4.0 Training Requirements

4.1 Review of Applicable SOPs (e.g., *S3NA-305-PR Hand and Power Tools*; *S3NA-302-PR Electrical, General*).

4.2 Demonstrated knowledge on the use of a coring machine.

4.3 Review and follow manufacturers' operating guidelines.

## 5.0 Personal Protective Equipment (Level D PPE)

5.1 Leather gloves.

5.2 Face shield.

5.3 Steel-toed/composite-toed boots.

5.4 Hearing protection.


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5.5 Respirator or dust mask.

## 6.0 Other Safety Tips

6.1 Keep fingers and hands away from the cutting edge.

6.2 Hold handle firmly when operating.

6.3 A subsurface utility clearance should be performed prior to initiating drilling operations.

6.4 Stand firmly and apply body weight at anchored side of guarded platform.


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# S3NA-406-PR Electrical Lines, Overhead

## 1.0 Purpose and Scope

1.1 Provides the safe work requirements to be observed where overhead power lines are present on a job site.

1.2 This procedure applies to all AECOM North America-based employees and operations.

## 2.0 Terms and Definitions

2.1 Types of overhead lines:

2.1.1 Overhead power lines

2.1.2 Structural cable supports

2.1.3 Guy wires

2.1.4 Cable television / communication lines

## 3.0 Attachments

3.1 S3NA-406-FM Overhead Electrical Lines Acknowledgement Form

## 4.0 Procedure

4.1 An appropriate distance must be kept between equipment and overhead utility lines.

4.2 **Employees** must contact the power line operator before work is done or before equipment is operated within 15.25 metres (50 feet) of an energized overhead power line, in order to:

4.2.1 Determine the voltage of the power line, and

4.2.2 Establish the appropriate safe limit of approach distance as identified by provincial/territorial regulations.

4.3 The safe limit of approach distances do not apply to a load, equipment, or building that is transported under energized overhead power lines if the total height, including equipment transporting it, is less than 4.15 metres (13.5 feet).

4.4 **Employers** or **Project Managers** must formally notify (using the *S3NA-406-FM Overhead Electrical Lines Acknowledgement form*) all subcontractors or equipment operators of an energized overhead power line before work is done or equipment is operated in the vicinity of the power line at distances less than the safe limit of approach distances and obtain the operator's assistance in protecting workers involved.

4.5 **Employees** must not place earth or other material under or beside an overhead power line if doing so reduces the safe clearance to less than the safe limit of approach distances.

4.6 To maintain minimum safe clearances:

4.6.1 Install warning devices and signs (hang a sign from and mark all guy wires to warn traffic of low clearance; provide warning signage for all overhead services).

4.6.2 Install telescopic, nonconductive posts and flagging across right-of-way at the minimum allowable clearance as allowed by regulations for the line voltage.

4.6.3 Position signs or other devices to determine the “Danger Zone.”

4.6.4 Inform all on-site staff with the on-site clearances required.

4.6.5 Beware of atmospheric conditions, such as temperature, humidity, and wind, that may dictate more stringent safety procedures.

4.7 Operation of heavy equipment and cranes in areas with overhead power lines represents a significant hazard to all personnel on the job site. Accidental contact with an energized line or arcing between a


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high power line and grounded equipment can cause electrocution of equipment operators or nearby ground personnel, and damage to power transmission and operating equipment. Although maintaining a safe distance from all energized lines is the preferred means for control of this hazard, site conditions may not always accommodate this. If work will (or may) occur within 50 feet of any energized line, the procedures outlined below will be observed.

4.8 Overhead power lines will be identified on each job site before the work commences. For each identified line, the **Project Manager** must determine whether it is energized (and the operating voltage for energized lines), and whether work operations will require that activities with heavy equipment (excavators, loaders, cranes, etc.) will occur within 50 feet (15.25 metres) of the line. Unless verified, it will be assumed that all lines are energized.

4.9 Safe working distance is the minimum distance that must be maintained between any energized electrical line and any part of the operating equipment to maintain adequate safety margins and is based on the line voltage of the power line. Figure 4-1 lists the line voltages in kilovolts and the Minimum Safe Work Distance in the United States and Figure 4-2 indicates the Nominal Phase to Phase voltage rating in kilovolts for Canada. The following safe working distance criteria will be applied for all AECOM operations:

**Figure 4-1: United States Overhead Line Criteria**

| Line Voltage (Kilovolts) | Minimum Safe Working Distance |
|---|---|
| 0 – 50 | 10 feet |
| >50 – 200 | 15 feet |
| >200 – 350 | 20 feet |
| >350 – 500 | 25 feet |
| >500 – 750 | 35 feet |
| >750 – 1,000 | 45 feet |

Source: American National Standards Institute, Publication B30.5.

**Figure 4-2: Canadian Overhead Line Criteria**

| Column 1 | Column 2 |
|---|---|
| Nominal phase-to-phase voltage rating | Minimum Distance |
| Over 425 to 12,000 | 3.0 metres |
| Over 12,000 to 22,000 | 3.0 metres |
| Over 22,000 to 50,000 | 3.0 metres |
| Over 50,000 to 90,000 | 4.5 metres |
| Over 90,000 to 120,000 | 4.5 metres |
| Over 120,000 to 150,000 | 6.0 metres |
| Over 150,000 to 250,000 | 6.0 metres |
| Over 250,000 to 300,000 | 7.5 metres |
| Over 300,000 to 350,000 | 7.5 metres |
| Over 350,000 to 400,000 | 9.0 metres |

Source: Canada Occupational Health and Safety Regulations Electrical Safety- Subsection 8.5(6).


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4.10 Under no circumstances will any object pass closer than 3 metres to any energised, uninsulated electrical line.

4.11 Formally notify all subcontractors of Overhead Power lines with the attached *S3NA-406-FM Overhead Electrical Lines Acknowledgement* form.

## 4.12 Acceptable Safety Procedures

4.12.1 Where any work task will not allow the minimum safe working distance to be maintained at all times, an alternate means of protection must be identified and approved by the **SH&E Department.** In order of preference, acceptable procedures are

- De-energize the power line(s)/lockout by local utility authorities
- Install insulated sleeves on power lines
- Assign line spotters to assist the equipment operator

4.12.2 De-energize Power Lines

- Elimination of electrical power provides the most acceptable means of ensuring safety of personnel. While temporary site power lines are under the control of the site manager (and can be de-energized locally), electrical distribution and transmission lines can be de-energized only by the owner of the line (generally the local electrical utility). Therefore, de-energizing of a line requires advance coordination with the line owner; generally, at least one week advance notice should be provided.

4.12.3 Install Insulating Sleeves

- Insulating sleeves can be placed over power lines to provide a contact and arcing barrier if work must occur closer to the power lines than the accepted safe work distance. Although not as desirable as line de-energizing, the use of these sleeves can provide an acceptable alternative where electrical lines are required to remain in service.
- As with de-energizing of distribution and transmission lines, placement of insulating sleeves can be performed only by the line owner. This requires advance coordination with the line owner; generally, at least one week advance notice should be provided. To install the sleeves, representatives of the line owner will require access to the job site.

4.12.4 Assign Line Spotters

- A line spotter is a person located at ground level who is assigned to observe equipment operations, with the specific duty of assisting the equipment operator to ensure that no part of the equipment gets too close to an energized, unprotected electrical line.
- Persons assigned to act as line spotters must meet the following requirements:
    - While acting as a line spotter, no other duties may be performed (e.g., the line spotter cannot also act as the load spotter during a lifting operations).
    - The spotter will have a radio or other direct means of communicating with the equipment operator at all times.
    - The spotter will be positioned at a right angle to the equipment operator's line of sight to maximize the sight angles between the personnel.

**Under no circumstances will any portion of a piece of equipment pass closer than 10 feet to any energized, uninsulated electrical line.**

## 4.13 Additional Safety Measures

4.13.1 The following additional safety measures can be implemented as needed when working around energized power lines:

- Provide equipment with proximity warning devices. These provide an audible alarm if any part of the equipment gets too close to a line.
- Install ground safety stops. These prevent vehicles from accidentally entering hazardous areas.
- Equip cranes with a boom-cage guard. This prevents the boom from becoming energized if an electrical line is contacted.
- Utilize insulated links and polypropylene tag lines. These prevent the transmission of electricity to loads or tag line handlers if an electrical line is contacted.


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NOTE: These additional safeguards are intended as supplemental protection. Use of these measures is not permissible as a substitute for maintaining the safe working distance or implementation of the procedures in Section 4.1.

4.13.2 If an electrical power line is hit or an electrical arc occurs:

- All ground personnel must evacuate IMMEDIATELY to a distance of at least 50 feet (15.25 metres). DO NOT attempt to rescue any injured person until the line can be de-energized.
- The operator should remain in the cab until the line can be de-energized and should carefully try to extricate the equipment from the power line. This may not be possible where melting of insulator material or metal has occurred.
- Contact the line owner to report the line contact and request that the line be de-energized immediately.
- Once the line has been confirmed to be de-energized, the operator can safely evacuate the cab and rescue can commence for any injured personnel.
- Contact the **SH&E Department** to report the incident and implement any instructions provided.
- If the operator must evacuate while the line is still energized (because of fire or other life-threatening condition) he/she should jump clear of the equipment (making sure to avoid touching the equipment and the ground simultaneously), and land upright and with feet together. Once on the ground, proceed in a direct line away from the equipment using a short, shuffling gait (feet touching, sliding each foot no more than 1 foot forward at a time) to minimize shock hazard from electrical energy being transmitted through the ground.

## 5.0 Records

5.1 None

## 6.0 References

6.1 None


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# S3NA-406-FM Overhead Electrical Lines Acknowledgement

| **Company information** | | |
|---|---|---|
| **Name of Employer or Contracting Operation:** | | |
| **Address:** | | |
| **City:** | **Province:** | **Postal Code:** |
| **Telephone:** | **Fax:** | |
| **Project name:** | | |
| **AECOM contact name:** | | |
| **Acknowledgement** | | |
| I acknowledge that I have received a copy of the *S3NA-406-PR Electrical Lines, Overhead*, I understand that this project site may have Overhead Electrical Hazards, and I have discussed this procedure with all of our company staff who will be on this site. | | |
| | | |
| **Name and Title (Print)** | **Signature** | **Date** |


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# S3NA-417-PR Utilities, Underground

## 1.0 Purpose and Scope

1.1 Establishes requirements to ensure that underground installations are identified properly before excavation work commences.

1.2 This procedure applies to all AECOM North America-based employees and operations.

## 2.0 Terms and Definitions

2.1 **Underground Utilities:** All utility systems located beneath grade level, including, but not limited to, gas, electrical, water, compressed air, sewage, signaling and communications, etc.

2.2 **Ground Disturbance (GD):** Any indentation, interruption, intrusion, excavation, construction, or other activity in the earth's surface as a result of work that results in the penetration of the ground.

## 3.0 Attachments

3.1 S3NA-417-FM Identifying Underground Installations Checklist

3.2 S3NA-417-WI One Call System Definition and Directory

3.3 S3NA-417-ST Underground Utilities

## 4.0 Procedure

4.1 Ground disturbance may be a conducted for a variety of purposes, including, but not limited to, exposing existing buried lines, soil sampling, remedial excavations, or installing monitoring wells or test pits.

4.2 Improper ground disturbance may impact a buried pipeline or utility line and cause a major release of a hazardous substance, flood, or electrocution. Serious injuries and significant property damage have resulted from insufficient/inadequate identification of underground installations during the course of ground disturbance work.

4.3 To control hazards associated with coming in contact with such installations, the American Public Works Association's (APWA) guidelines for the uniform identification of underground installations has been adopted.

4.4 **Project Managers** are responsible for ensuring that all work, including the identification, location, and access to all underground utilities, is planned and performed in accordance with contract specifications and safety requirements.

4.4.1 The planning for associated work and avoidance of contacting underground utilities shall be part of the project safety planning in the HASP.

4.5 The **Lead Site Manager or Supervisor** is responsible for the execution of work in accordance with this and other associated AECOM SOPs, including:

- The review of the HASP.
- Verification that all steps have been taken to identify existing underground utilities in the area to be disturbed.

4.6 **Region SH&E Manager** provides guidance as needed.

4.7 **Personal Protective Equipment**

- Long sleeved shirt and pants (coveralls/Nomex LILA for upstream oil and gas)
- Safety toe boots
- Hard hat
- High-visibility clothing
- Gloves
- Respirator with organic vapor/particulate filter cartridge (for use when the exposure exceeds the occupational exposure limit stated on the MSDS), as required


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- Hydrogen Sulfide (H2S) Monitor (for areas with known or suspected H2S

## 4.8 Training

4.8.1 Staff shall successfully complete a Ground Disturbance training course.

4.8.2 Some clients may also have required client-based Ground Disturbance training.

## 4.9 Underground Utility Lines

4.9.1 To avoid injury from electrical and other utilities on site, utility lines shall be located and marked prior to conducting any drilling or digging on site. If available, refer to site drawings or client interviews for information pertaining to utilities on site.

4.9.2 Types of underground lines:

- Gas line
- Potable water line
- Raw water line
- Sewer line
- Power line
- Cable television/communication line
- Cathodic protection lines
- Grounding cable
- Process piping/flow line

4.9.3 Prior to conducting the ground disturbance, you shall locate all pipelines and utilities that pass within (30 m) of the work area. This is your search and control area. To do so, you need to do the following:

- Notify all pipeline and utility companies, and confirm that their notification requirements are fulfilled prior to conducting a ground disturbance.
- Identify pipelines, power lines, utilities, and irrigation canals in a 30-foot (9.1 m) zone of the work area with the owner of the utility.
- On private property, a properly trained and competent third party utility locator shall be used.
- Get approval for work within a right-of-way (ROW) or within 15 feet (4.6 m) of a line if there is no ROW.
- Prepare a site map identifying the search area, the ground disturbance area, and known underground utilities.
- Confirm that all pipelines, power lines, and utilities are marked.

4.9.4 Look for pipeline indicators:

- Look for warning signs where pipelines cross roads or water courses.
- Look for cut lines, wells, tanks, or valves that may indicate the presence of pipelines.
- Look for ground settling from previous work.
- Talk to nearby landowners and residents.
- Look for vegetation appearing “different” from the surrounding vegetation (e.g., greener, taller, shorter, or more brown than surrounding vegetation).

4.9.5 When you are working within a pipeline right-of-way, you shall get written approval from the pipeline owner prior to doing your work.

4.9.6 Call the pipeline owner at least two full working days before you dig so the pipeline can be located and marked.

4.9.7 Expose the pipeline by hand/hydrovac before digging within 15 feet (4.6 m) of the pipeline with machinery (no machinery comes may come within 2 feet [60 cm] of the pipeline) with the supervision of the owner or their representative, and call the owner at least one full day before you cover the exposed line.


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4.9.8 During ground disturbance:

- All underground utilities shall be hand exposed or hydrovac'd within 3.3 feet (1 m) of a mark out or within the distance required by the owner of the utility before operating any mechanized equipment.
- Make arrangements for supervision ("a Signal Person") during hand exposure.
- If for any reason these hand excavations are temporarily filled in, mark them.
- Make arrangements for supervision ("a Signal Person") during any mechanical excavation within 5 m of the underground utility.
- Make arrangements for supervision ("a Signal Person") during backfilling of utilities.
- Cutting back and shoring of excavations shall be completed to ensure that there are no cave-ins (follow *SOP S3NA-303-PR Excavation and Trenching*).
- Do not damage utilities by shovels when hand exposing and picks should not be used.
- Remember that all workers have the right and responsibility to refuse to carry out any work or procedures that they feel are unsafe.
- If the ground disturbance is deeper than 3.3 feet (1 m), all crew members shall have appropriate training for excavations and trenches and shall be protected from cave-ins or sliding/rolling materials (follow *SOP S3NA-303-PR Excavation and Trenching*).
- Remember that incidents, injuries, and near misses shall be reported immediately.
- Review the site-specific emergency response plan.

4.9.9 If you hit an underground facility, stop the work immediately and notify the owner of the facility.

- The owner shall be informed of the location of the contact and the type of damage that resulted.
- If the facility is a pipeline, the company (client) shall immediately notify the required agencies and regulatory bodies of the location of the contact and the type of damage that resulted.
- The government agencies will require a written record and the company (client) should conduct an incident investigation into the causes and make recommendations for the future prevention of this incident.

## 4.10 Identification of Installations

4.10.1 Various forms of underground utility lines or pipes may be encountered during AECOM deployments to field sites. Damaged utilities, in particular, can present other hazards including asbestos, explosion, electric shock, scalding, etc., and they shall be avoided. The presence of damaged utilities at any work location shall be immediately brought to the attention of the field Lead Manager or other member of the AECOM site management team.

4.10.2 Guidance will be provided on the appropriate action to be taken, which could include suspension of work until the responsible utility agency is contacted and the hazard is either isolated or eliminated.

4.10.3 Extreme caution shall always be exercised when attempting to locate underground utilities. The location of utilities can be in some cases not consistent as shown on drawings, as indicated by the placement of surface signage, or as described by personnel. Coordination and planning of the job shall be required with the client or owner.

- Prior to digging and drilling operations, the client shall always be informed of the potential location(s) of underground utility systems.
- If a utility permit is required from the client or owner, it shall be secured.
- The client shall explain how the utility line may be identified—e.g., red concrete encasement.
- All underground installations shall be considered "live" and "operational" until the owner, client, or utility authority isolates any hazardous energy or deactivates the system and can demonstrate that condition.
- Where a line placement and depth is known or suspected and where there is potential for contact, hand digging, or hand auguring, instrumentation and other investigative techniques shall be used.

4.10.4 The One Call System Definition and Directory or its equivalent shall be used to prepare for excavation work in the event the identity of an underground installation(s) is unknown.

4.10.5 Line location documentation (or appropriate regional agency or company) provides a listing of companies that have registered buried facilities in the proposed work area. Some public utilities and private companies are not members of the One Call System. In order to give line operators sufficient


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time to respond to a request to locate, a minimum waiting period of 72 business hours is required prior to beginning work.

4.10.6 Once the underground installation has been identified, proper surface markings shall be made in accordance with the guidelines contained in this SOP or as contract-specified.

### 4.11 Surface Markings

4.11.1 Color-coded surface marks (paints or similar coatings) shall be used to indicate the type, location, and route of buried installations. Additionally, to increase visibility, color-coded vertical markers (temporary stakes or flags) shall supplement surface marks.

4.11.2 All marks and markers shall indicate the name, initials, or logo of the company that owns or operates the installation and the width of the installation if it is greater than two inches.

4.11.3 If the surface over the buried installation is to be removed, supplemental offset marking shall be used. Offset markings shall be on a uniform alignment and shall clearly indicate that the actual installation is a specific distance away.

### 4.12 Uniform Color-Coding

4.12.1 The colors and corresponding installation type are as follows unless otherwise contract-specified.

4.12.2 Red: Electric Power Lines, Cables, Conduit, and Lighting Cables

4.12.3 Yellow : Gas, Oil, Stream, Petroleum, or Gaseous Materials

4.12.4 Orange :Communication, Alarm or Signal Lines, Cables, or Conduit

4.12.5 Green: Sewers and Drain Lines

4.12.6 White : Proposed Ground Disturbance area

4.12.7 Pink: Temporary Survey Markings

4.12.8 Purple: Nonpotable Water

## 5.0 Records

5.1 The following records on the identification of and response to underground utilities will be maintained in the project files:

5.1.1 All information regarding the identification of underground installations (this information can also be transferred to the appropriate drawings and/or prints and shall be available on site).

5.1.2 Drawings and/or prints shall be maintained for the life of this project.

5.1.3 Identifying Underground Installations Checklist.

## 6.0 References

6.1 American Public Works Association, Excavator’s Damage Prevention Guide and One-Call System Directory International 1990-1991, Utility Location and Coordination Committee.


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# S3NA-417-FM Identifying Underground Installations Checklist

Name of Contractor:

Location: Project #:

Type of Ground Disturbance Planned:

Date: Time: Weather:

Person Conducting Inspection: Title:

**Responsibilities of the Ground Disturbance Contractor**

***Supply as much pertinent information as possible when calling in location (house #, pole #, facility #, landmark to measure distance, nearest intersection, etc.)***

| | Completed | N/A |
|---|---|---|
| Notify the One-Call Center 3 business days in advance but no more than 10 days prior to activities. | ☐ | ☐ |
| Hand expose or hydrovac within 2 feet (60cm) of a mark out or within the distance required by the owner of the utility before operating any mechanized equipment. | ☐ | ☐ |
| Mark and identify perimeter of proposed site of excavation or boring locations in white. | ☐ | ☐ |
| Protect and preserve markings, staking, or other designations until no longer necessary for safe excavation, demolition, or blasting. | ☐ | ☐ |
| Obtain new ticket every 30 business days. | ☐ | ☐ |
| Check surrounding area before initiating ground disturbance. | ☐ | ☐ |
| **Recordkeeping** | | |
| Confirmation number received. | ☐ | ☐ |
| Copy of mark-out ticket readily available. | ☐ | ☐ |
| Site Map documenting ground disturbance area and identified utilities completed. | ☐ | ☐ |
| Records have been maintained to document any damage. | ☐ | ☐ |

Comments:


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# S3NA-417-WI One Call System Definition and Directory

## 1.0 What Is It?

1.1 It is a communication system established by two or more utilities, governmental agencies, or other operators of underground facilities to provide one telephone number for excavating contractors and the general public to call for notification of their intent to use equipment for excavating, tunneling, demolition, or any other similar work. This one-call system provides the participating members an opportunity to identify and locate their underground facilities.

## 2.0 Why Is It Needed?

2.1 Damage to underground facilities increased considerably following the building boom of the 1950s, 1960s, and early 1970s when the trend was to go underground with utilities. Thousands of miles of underground facilities were vulnerable to excavating machines such as backhoes, and the resulting damage interrupted utility service and threatened life, health, and property.

## 3.0 How to Get It

3.1 Write or call the number of the Utility Location and Coordination Council (ULCC) One-Call Systems International Committee representing the area within your American Public Works Association (APWA) region shown on the map. They will be pleased to assist you. For further information on ULCC programs, write APWA headquarters.

## 4.0 Disclaimer

4.1 The purpose of this directory is to illustrate the extent of one-call service available. The accuracy of information is not guaranteed by APWA or the one-call systems. Users must verify information including the extent and limit of service from local sources.

| Province/State | One-Call Agency | Number |
|---|---|---|
| Canada | | |
| British Columbia | http://www.bconecall.bc.ca/ | 1.800.474.6886 |
| Alberta | http://www.alberta1call.com/ | 1.800.242.3447 |
| Saskatchewan | http://www.sask1stcall.com/ | 1.866.828.4888 |
| Manitoba | www.callb4udig.mb.ca/ | 1.800.827.5094 |
| Ontario | http://www.on1call.com/ | 1.800.400.2255 |
| Québec | http://www.info-ex.com/ | 1.800.663.9228 |
| British Columbia | http://www.bconecall.bc.ca/ | 1.800.474.6886 |
| United States | http://www.mail-house.com/utility.htm | 811 |
| Alabama | Alabama Line Location Center, Inc. | 1.800.292.8525 |
| Alaska | Locate Call Center of Alaska, Inc. | 1.800.478.3121 |
| Arizona | Arizona Blue Stake, Inc. | 1.800.STAKE.IT (1.800.782.5348) |
| Arkansas | Arkansas One Call System, Inc. | 1.800.482.8998 |
| California | Underground Service Alert North | 1.800.227.2600 |
| Colorado | Utility Notification Center of Colorado | 1.800.922.1987 |


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| Province/State | One-Call Agency | Number |
|---|---|---|
| Connecticut | Call Before You Dig | 1.800.922.4455 |
| Delaware | Miss Utility of Delmarva | 1.800.282.8555 |
| Florida | Call Sunshine | 1.800.432.4770 |
| Georgia | Utilities Protection Center, Inc. | 1.800.282.7411 |
| Idaho | Dig Line | 1.800.342.1585 |
| | Kootenai County Utility Coordinating Council | 1.800.428.4950 |
| | One Call Concepts – Idaho | 1.800.626.4950 |
| | Palouse Empire Underground Coordinating Council | 1.800.822.1974 |
| | Shoshone County One Call | 1.800.398.3285 |
| | Utilities Underground Location Center | 1.800.424.5555 |
| Illinois | Digger (Chicago Utility Alert Network) | 312.744.7000 |
| | Julie, Inc. | 1.800.892.0123 |
| Indiana | Indiana Underground Plant Protection Services, Inc. | 1.800.382.5544 |
| Iowa | Underground Plant Location Service, Inc. | 1.800.292.8989 |
| Kansas | Kansas One-Call Center | 1.800.DIG.SAFE |
| Kentucky | Kentucky Underground Protection Inc. | 1.800.752.6007 |
| Louisiana | Louisiana One Call System, Inc. | 1.800.272.3020 |
| Maine | Dig Safe – Maine | 1.800.225.4977 |
| Maryland | Miss Utility | 1.800.257.7777 |
| | Miss Utility of Delmarva | 1.800.282.8555 |
| Massachusetts | Dig Safe – Massachusetts | 1.800.322.4844 |
| Michigan | Miss Dig System, Inc. | 1.800.482.7171 |
| Minnesota | Gopher State One Call | 1.800.252.1166 |
| Mississippi | Mississippi One-Call System, Inc. | 1.800.227.6477 |
| Missouri | Missouri One Call System, Inc. | 1.800.344.7483 |
| Montana | Utilities Underground Location Center | 1.800.424.5555 |
| Nebraska | Diggers Hotline | 1.800.331.5666 |
| Nevada | Underground Service Alert North | 1.800.227.2600 |
| New Hampshire | Dig Safe – New Hampshire | 1.800.225.4977 |
| New Jersey | Garden State Underground Plant Location Service | 1.800.272.1000 |
| New Mexico | New Mexico One Call System, Inc. | 1.800.321.ALERT |
| New York | New York City – Long Island One Call Center | 1.800.272.4480 |
| | Underground Facilities Protective Organization "UFPO" | 1.800.962.7962 |
| North Carolina | The North Carolina One Call Center, Inc. | 1.800.632.4949 |


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| Province/State | One-Call Agency | Number |
|---|---|---|
| North Dakota | Utilities Underground Location Center | 1.800.454.5555 |
| Ohio | Ohio Utilities Protection Service | 1.800.362.2764 |
| Oklahoma | Call Okie | 1.800.522.6543 |
| Oregon | Douglas Utilities Coordinating Council | 1.503.673.6676 |
| | Josephine Utilities Coordinating Council | 1.503.476.6676 |
| | Rogue Basin Utility Coordinating Council | 1.503.779.6676 |
| | Utilities Notification Center | 1.800.332.2344 |
| | Utilities Underground Location Center | 1.800.424.5555 |
| Pennsylvania | Pennsylvania One Call System, Inc. | 1.800.242.1776 |
| Rhode Island | Dig Safe – Rhode Island | 1.800.225.4977 |
| South Carolina | Palmetto Utility Protection Service Inc. "PUPS" | 1.800.922.0983 |
| South Dakota | South Dakota One Call | 1.800.781.7474 |
| Tennessee | Tennessee One-Call System, Inc. | 1.800.351.1111 |
| | Rogue Basin Utility Coordinating Council | 1.503.779.6676 |
| | Utilities Notification Center | 1.800.332.2344 |
| Utah | Blue Stakes Location Center | 1.800.662.4111 |
| Vermont | Dig Safe – Vermont | 1.800.225.4977 |
| Virginia | Miss Utility | 1.800.257.7777 |
| | Miss Utility of Delmarva | 1.800.441.8355 |
| | Miss Utility of Virginia | 1.800.552.7001 |
| Washington | Chelan-Douglas Utilities Coordinating Council | 1.509.663.6111 |
| | Grays Harbor & Pacific County Utility Coordinating Council | 1.206.532.3550 |
| | Inland Empire Utility Coordinating Council | 1.509.456.8000 |
| Utah | Blue Stakes Location Center | 1.800.662.4111 |
| Vermont | Dig Safe – Vermont | 1.800.225.4977 |
| Virginia | Miss Utility | 1.800.257.7777 |
| | Miss Utility of Delmarva | 1.800.441.8355 |
| | Miss Utility of Virginia | 1.800.552.7001 |
| Washington | Chelan-Douglas Utilities Coordinating Council | 1.509.663.6111 |
| | Grays Harbor & Pacific County Utility Coordinating Council | 1.206.532.3550 |
| | Palouse Empire Utilities Coordinating Council | 1.800.822.1974 |
| | Upper Yakima County Underground Utilities Council | 1.800.553.4344 |
| | Utilities Council of Cowlitz County | 1.360.425.2506 |
| | Utilities Notification Center | 1.800.332.2344 |
| | Utilities Underground Location Center | 1.800.424.5555 |
| West Virginia | Miss Utility of West Virginia, Inc. | 1.800.245.4848 |
| Wisconsin | Diggers Hotline, Inc. | 1.800.982.0299 |
| Wyoming | Albany County Utility Coordinating Council | 1.307.742.3615 |
| | Call-in Dig-in Safety Council | 1.307.382.9811 |
| | Carbon County Underground Utility Coordinating Council | 1.307.324.6666 |
| | Central Wyoming Utilities Coordinating Council | 1.800.759.8035 |


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| Province/State | One-Call Agency | Number |
|---|---|---|
| | Converse County Utility Coordination Council | 1.800.562.5561 |
| | Fremont County Utility Coordinating Council | 1.800.489.8023 |
| | Southeast Wyoming Utilities Coordinating Council | 1.307.638.6666 |
| | Southwest Wyoming One Call | 1.307.362.8888 |
| | Utilities Underground Location Center | 1.800.454.5555 |
| | Wyoming One-Call | 1.800.348.1030 |
| | Palouse Empire Utilities Coordinating Council | 1.800.822.1974 |
| | Upper Yakima County Underground Utilities Council | 1.800.553.4344 |
| | Utilities Council of Cowlitz County | 1.360.425.2506 |
| | Utilities Notification Center | 1.800.332.2344 |
| | Utilities Underground Location Center | 1.800.424.5555 |
| West Virginia | Miss Utility of West Virginia, Inc. | 1.800.245.4848 |


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# S3NA-417-ST Underground Utilities

## 1.0 Regulations

1.1 Every province and territory has strict regulations governing the procedures and practices that MUST be followed. As these regulations vary slightly, before work can commence, the Project Manager MUST review these documents and identify how all of the hazards will be addressed and how the regulations will be adhered to:

1.1.1 Occupational Health and Safety Code

1.1.2 Regional or industry-specific regulations (e.g., Alberta EUB (Pipeline Act).

## 2.0 Occupational Health and Safety Regulations

2.1 The following Occupational Health and Safety regulations apply directly to ground disturbance:

| Jurisdiction | Regulation |
|---|---|
| **United States** | |
| **OSHA** | CFR 1926.651 |
| **Canada** | |
| **Alberta** | OHS Code (2009) Sect 441 – 464, Schedule 9 |
| **British Columbia** | OHS Regulation (1997) Sect 20.78 – 20.101 |
| **Manitoba** | Workplace Health and Safety Regulation (217/2006) Sect 26.0 – 26.47 |
| **New Brunswick** | OHS Regulation (91-191) Sect 93 – 94.1, 180 – 188 |
| **Newfoundland/Labrador** | OHS Regulation (C.N.L.R. 1165/96) Sect 139 – 148 |
| **Nova Scotia** | OHS Regulation (N.S. Reg. 44/99) Sect 153, 166 – 173 |
| **NWT/NU Territories** | General Safety Regulations (R.R.N.W.T. 1990, c. S-1), Safety Act (SI-013-92) Sect 396 – 432 |
| **Ontario** | O. Reg. 213/91 Sect 6, 7, 222 – 242 |
| **Prince Edward Island** | OHS Regulations (EC180/87) Sect 12.1 – 12.15 |
| **Quebec** | Safety Code for the Construction Industry (R.R.Q. 1981, c. S-2.1, r. 6) Sect 3.15.1 – 3.15.10 |
| **Saskatchewan** | OHS Regulation (R.R.S., c. O-1, r. 1) Sect 257 – 265, Schedule Table 17 |
| **Yukon Territory** | OHS Regulations (O.I.C. 2006/178) Sect 10.62 – 10.72 |


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# S3NA-505-PR Cold Stress Prevention

## 1.0 Purpose and Scope

1.1 To protect workers from the severest effects of cold stress (hypothermia) and cold injury and to identify exposures to cold working conditions under which it is believed nearly all workers can be repeatedly exposed without adverse health effects.

1.2 This procedure applies to all AECOM North America-based employees and operations.

## 2.0 Terms and Definitions

2.1 **Cold Stress:** The production of physiological effects due to cold temperatures and\or wind chill.

2.2 **Equivalent Chill Temperature (ECT):** Also known as Wind Chill (see below)

2.3 **Frostnip:** Superficial cooling of tissues without cellular destruction.

2.4 **Frostbite:** Freezing of tissue, resulting in tissue destruction.

2.5 **Hypothermia:** Condition of reduced core body temperature to 95$^{o}$F (35$^{o}$C) resulting in loss of dexterity, loss of mental alertness, collapse, and possible death.

2.6 **Wind Chill:** The combined effect of air temperature and wind. Also expressed as "equivalent chill temperature" (ECT), wind chill is defined as heat loss resulting from the effects of air temperature and wind velocity upon exposed skin.

## 3.0 Attachments

3.1 S3NA-505-WI1 Temperature Thresholds

3.2 S3NA-505-WI2 Symptoms and Treatment

3.3 S3NA-505-ST Cold Exposure

## 4.0 Procedure

### 4.1 Restrictions

4.1.1 Staff working in extreme cold (wind chill or ECT below 10$^{o}$F or -12$^{o}$C) shall not work alone.

4.1.2 All staff working in extreme cold or snow conditions should understand the following guidelines for preventing and detecting hypothermia and frost bite.

- If you experience frost bite or hypothermia, find shelter and warmth and contact a medical practitioner if symptoms persist.
- Take frequent short breaks in warm dry shelters to allow your body to warm up. Limit time of exposure.
- Schedule work for the warmest part of the day or when the wind is most calm.
- Avoid exhaustion or fatigue because energy is needed to keep muscles warm.
- Because prolonged exposure to cold air or to immersion in cold water at temperatures even well above freezing can lead to dangerous hypothermia, whole-body protection shall be used.

### 4.2 Roles and Responsibilities

4.2.1 **Project Managers/field task managers**

- Implement cold stress prevention measures as applicable at each work site.
- Develop/coordinate a work-warning regimen, as applicable.
- Confirm cold stress hazard assessments/evaluations were completed for the planned activities.
- Assign personnel physically capable of performing the assigned tasks. Consider acclimation to cold weather when evaluating worker capability.
- Confirm personnel are properly trained to recognize the symptoms of cold stress.


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4.2.2 **Region SH&E Managers**

- Conduct/support cold stress assessments/evaluations.
- Conduct/support incident investigations related to potential cold stress-related illnesses.
- Assist project teams develop appropriate work-warming regimens.
- Provide cold stress awareness training.

4.2.3 **Supervisors**

- Identify the tasks that may be most impacted by cold stress and communicate the hazard to the assigned employees.
- Confirm that employees have been trained on the recognition of cold stress-related illnesses.
- Confirm that adequate supplies of warm fluids/drinks are readily available to employees.
- Confirm that a warm/sheltered rest area is available, as applicable.
- Conduct cold stress monitoring, as applicable.
- Implement the work-warming regimen.
- Confirm that first aid measures are implemented once cold stress symptoms are identified.
- Confirm that personnel are physically capable of performing the assigned tasks and are not in a physically compromised condition.

4.2.4 **Employees**

- Observe each other for the early symptoms of cold stress-related illnesses.
- Maintain an adequate intake of available fluids.
- Report to work in a properly vested condition.
- Report all suspected cold stress-related illnesses.

## 4.3 Training

4.3.1 Before they begin work in a cold environment, project staff who might be exposed to cold stress will be informed of the potential for cold stress and how to prevent cold stress. Workers that have not had the training within the twelve prior months shall repeat the training before exposure to cold stress.

4.3.2 Personnel potentially exposed to cold stress will receive training including, but not limited to:

- Sources of cold stress, the influence of protective clothing, and the importance of acclimatization
- How the body loses heat.
- Recognition of cold-related illness symptoms
- Cold stress preventative/corrective measures
- Tthe harmful effects of excessive alcohol consumption in a cold stress environment
- The hazards associated with unstable snow or ice build ups
- First aid procedures for symptoms related to cold stress

## 4.4 Personal Protective Equipment

4.4.1 Wear multiple layers of loose fitting clothing to maintain immobile layers of warm air next to the body.

4.4.2 Avoid cotton, especially blue jeans.

4.4.3 Wear proper clothing, including head coverings and gloves or mittens for cold, wet, and windy conditions.

4.4.4 Use insulated footwear with adequate traction to prevent slips and falls.

4.4.5 Confirm extra blankets or sleeping bags are on-site.

4.4.6 Sunglasses and sunscreen should be used when there is a persistent combination of snow and direct sun.

4.4.7 If shelter is not readily available, consider supplying temporary shelters

4.4.8 Confirm that staff carry fire starter materials ifworking in remote areas..

4.4.9 Pack warm, sweet drinks, and high calorie food for snacks.


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## 4.5 General Cold Stress Prevention Measures

4.5.1 In order to prevent hypothermia:

- Wear multiple layers of clothing to maintain immobile layers of warm air next to the body. Avoid cotton, especially blue jeans.
- When active, ventilate excess heat by opening or removing outer layers of clothing to avoid sweating.
    - Start with the mitten or gloves, unless protection from ice, snow, or cold metal surfaces is needed.
    - Next remove head gear and neck wrappings.
    - Then coats/parkas should be opened at the waist and sleeves.
    - Finally, layers of clothing should be taken off.
    - When resting or tired, or colder conditions are encountered, add additional layers of clothing/ close outer layers in the reverse of the above order, or get out of the cold. Have a sweet drink but do not indulge in heavy eating.
- Garments worn to keep out rain and spray should also allow water vapor to escape.
- Take advantage of heat from the sun and stay out of the wind as much as possible.
- Have available emergency shelter providing protection from wind and rain and insulation from the ground.
- Replace wet clothing. If wet clothing cannot be replaced, then cover it with a layer of non-breathing material to prevent evaporation. Place an insulation layer over this non-breathing material.
- Get adequate rest; conserve energy.
- Get adequate nutrition to replenish energy stores; rest after meals.
- Drink adequate fluids to avoid dehydration.
- If any project staff member shows signs of hypothermia, stop and treat him/her.

4.5.2 In order to prevent frost bite:

- Dress to prevent hypothermia and protect the feet and hands.
- Avoid obstruction of circulation by, for example, tight boots or tightly fitting clothing.
- Avoid nicotine, particularly cigarettes, and alcohol.
- Keep ears and nose covered and out of the wind.
- Frostbite of the corneas of the eyes can be prevented by protective goggles.
- Adopt a “buddy system” of constantly watching the faces of others in the party for white skin tissue, which is evidence of frostbite (frostnip).
- Practice constant personal vigilance for signs of trouble in one’s own fingers and toes; when in doubt, investigate thoroughly before it is too late.

4.5.3 Adequate, insulating dry clothing that will help maintain core temperatures above 96.8$^{o}$F (37$^{o}$C) shall be provided to workers if work is performed in air temperatures below 40$^{o}$F (5$^{o}$C). Wind chill cooling rate and the cooling power of air are critical factors. The higher the wind speed and the lower the temperature in the work area, the greater the insulation value of the protective clothing required.

4.5.4 An Equivalent Chill Temperature (ECT) chart relating the actual dry bulb air temperature and the wind velocity is presented in *S3NA-505-WI1 Temperature Thresholds.* Unless unusual or extenuating circumstances exist, cold injury to other than hands, feet, and head is not likely to occur without the development of the initial signs of hypothermia. Superficial or deep local tissue freezing will occur only at temperatures below 32$^{o}$F (0$^{o}$ C) regardless of wind speed. However, older workers or workers with circulatory problems require special precautionary protection against cold injury. The use of extra insulating clothing and/or a reduction in the duration of the exposure period are among the special precautions that should be considered.

4.5.5 Continuous exposure of skin should not be permitted when the air speed and temperature results in an ECT of –25$^{o}$F (-32$^{o}$ C) or below.

4.5.6 At air temperatures of 40$^{o}$F (5$^{o}$C) or less, it is imperative that workers who become immersed in water or whose clothing becomes wet be immediately removed from the cold environment, provided a change of clothing, and be treated for hypothermia.


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4.5.7 If the air velocity at the job site is increased by wind, draft, or artificial ventilating equipment, the cooling effect of the wind should be reduced by shielding the work area or by wearing an easily removable windbreak garment.

4.5.8 Adequate protection, such as general ventilation, shall be incorporated into any warming shelter design to prevent carbon monoxide poisoning.

4.5.9 Operation of internal combustion or similar devices within warming shelters is prohibited.

4.5.10 If the available clothing does not give adequate protection to prevent hypothermia or frostbite, work should be modified or suspended until adequate clothing is made available or until weather conditions improve.

4.5.11 Walking and working surfaces shall be cleared of ice and snow to prevent slips and falls.

4.5.12 Supplies such as PPE, fuels, enclosures, de-icing, traction aids, warm drinks, and batteries will be specified by the SH&E Manager and/or the Project Manager. These supplies will be inspected at least weekly during cold weather projects and replaced when necessary.

## 4.6 Cold Stress Prevention Measures for the Hands

4.6.1 Special protection of the hands is required to maintain manual dexterity for the prevention of accidents including, but not limited to the following:

- If fine work is to be performed with bare hands for more than 10 to 20 minutes in an environment below 60$^{o}$F (15$^{o}$ C), special provisions should be established for keeping the workers' hands warm. For this purpose, warm air jets, radiant heaters (fuel burner or electric radiator), or contact warm plates may be utilized. Metal handles of tools and control bars should be covered by thermal insulating material at temperatures below 30$^{o}$F (-1$^{o}$ C).
- If the air temperature falls below 60$^{o}$F (15$^{o}$ C) for sedentary work, 40$^{o}$F (5$^{o}$ C) for light work, or 20$^{o}$F (-6$^{o}$ C) for moderate work, and fine manual dexterity is not required, workers should use gloves.

4.6.2 To prevent contact frostbite, workers should wear anti-contact gloves:

- When cold surfaces below 20$^{o}$F (-6$^{o}$ C) are within reach, each worker should be warned to prevent inadvertent contact by bare skin.
- If the air temperature is 0$^{o}$F (-18$^{o}$ C) or less, workers should protect their hands with mittens. Machine controls and tools for use in cold conditions should be designed so that they can be handled without removing the mittens.

4.6.3 Provisions for additional total body protection are required if work is performed in an environment at or below 40$^{o}$F (5$^{o}$ C). The workers should wear cold protective clothing appropriate for the level of cold and physical activity.

4.6.4 Additional Cold Stress Prevention Measures For work practices at or below 10$^{o}$F (-12$^{o}$ C) ECT, the following will apply:

- The worker should be under constant protective observation (buddy system or supervision).
- The work rate should not be so high as to cause heavy sweating that will result in wet clothing. If heavy work is being performed, rest periods should be taken in heated shelters and opportunities to change into dry clothing should be provided.
- New employees should not be required to work full time in the cold during the first days of employment until they become acclimated to the working conditions and required protective clothing.
- The weight and bulkiness of clothing should be included in estimating the required work performance and weights to be lifted by the worker.
- The work should be arranged in such a way that sitting still or standing still for long periods is minimized. Unprotected metal chair seats should not be used. The worker should be protected from drafts to the greatest extent possible.
- Workers should be instructed in safety and health procedures, which should address:
  - Proper rewarming procedures and appropriate first aid treatment.
  - Proper clothing practices.
  - Proper eating and drinking habits.
  - Recognition of impending frostbite.


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- Recognition of signs and symptoms of impending hypothermia or excessive cooling of the body even when shivering does not occur.
- Safe work practices.

4.6.5 Eye protection for workers employed outdoors in a snow and/or ice-covered terrain should be supplied. Special safety goggles to protect against blowing ice crystals and ultraviolet light and glare (which can produce temporary conjunctivitis and/or temporary loss of vision) should be required when there is an expanse of snow coverage causing a potential eye exposure hazard.

4.6.6 Workers handling evaporative liquid (gasoline, alcohol, or cleaning fluids) at air temperatures below 40$^{o}$F should take special precautions to avoid soaking of clothing or gloves with the liquids because of the added danger of cold injury due to evaporative cooling. Special note should be taken of the particularly acute effects of splashes of “cryogenic fluids” or those liquids with a boiling point that is just above ambient temperature.

4.6.7 Trauma sustained in freezing or subzero conditions requires special attention, because an injured worker is predisposed to cold injury. Special provisions should be made to prevent hypothermia and freezing of damaged tissue in addition to providing for first aid treatment.

4.7 **Work-Warming Regimen**

4.7.1 If work is performed continuously in the cold at an equivalent chill temperature (ECT) at or below -15$^{o}$F (–26$^{o}$C), heated warming shelters (tents, cabins, rest rooms, etc.) should be made available nearby. The workers should be encouraged to use these shelters at regular intervals; the frequency will depend on the severity of the environmental exposure.

4.7.2 The onset of heavy shivering, minor frostbite (frostnip), the feeling of excessive fatigue, drowsiness, irritability, or euphoria are indications for immediate return to the shelter.

4.7.3 When entering the heated shelter, the outer layer of clothing should be removed and the remainder of the clothing should be loosened to permit sweat evaporation or a change of dry work clothing provided.

4.7.4 A change of dry work clothing should be provided as necessary to prevent workers from returning to the cold environment with wet clothing.

## 5.0 Records

5.1 Training records will be maintained by the SH&E Department

5.2 Exposure assessments will be documented in the project files.

## 6.0 References

6.1 See attachment S3NA-505-WI1 Temperature Thresholds.


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# S3NA-505-WI1 Temperature Thresholds

## 1.0 Purpose and Scope

1.1 The following table gives apparent temperatures (wind chill) for various combinations of wind and air temperature, as well as guidelines to the danger of skin exposure.

**Table 1. Wind Chill Chart (C)**

| Actual Temp (°C) | Wind Speed in km/hour | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 8 | 16 | 24 | 32 | 40 | 48 | 56 | 64 | 72 | 80 |
| | Ambient Temperature (°C) | | | | | | | | | |
| 0 | -2 | -8 | -11 | -14 | -16 | -17 | -18 | -19 | -19 | -20 |
| -5 | -7 | -14 | -18 | -21 | -23 | -25 | -26 | -27 | -28 | -28 |
| -10 | -12 | -20 | -25 | -28 | -31 | -33 | -34 | -35 | -36 | -36 |
| -15 | -18 | -26 | -32 | -35 | -38 | -40 | -42 | -43 | -43 | -44 |
| -20 | -23 | -32 | -38 | -43 | -46 | -48 | -50 | -51 | -52 | -52 |
| -25 | -28 | -38 | -45 | -50 | -53 | -56 | -57 | -59 | -59 | -60 |
| -30 | -33 | -45 | -52 | -57 | -61 | -63 | -65 | -67 | -67 | -68 |
| -35 | -39 | -51 | -59 | -64 | -68 | -71 | -73 | -75 | -75 | -76 |
| -40 | -44 | -57 | -65 | -71 | -75 | -79 | -81 | -83 | -83 | -84 |
| -45 | -49 | -63 | -72 | -78 | -83 | -86 | -89 | -90 | -91 | -92 |
| -50 | -54 | -69 | -79 | -85 | -90 | -94 | -96 | -98 | -99 | -100 |

*Note: A. Little Danger: if less than one hour of exposure to dry skin.*
*B. Danger: Exposed flesh freezes within one minute.*
*C. Great Danger: Flesh may freeze with in 30 seconds.*

*Source: *Threshold Limit Values (TLV™) and Biological Exposure Indices (BEI™) booklet; published by ACGIH, Cincinnati, Ohio.*

**Table 2. Equivalent Chill Temperature Chart (F)**

| Estimated Wind Speed (mph) | Actual Temperature Reading (°F) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 50 | 40 | 30 | 20 | 10 | 0 | -10 | -20 | -30 | -40 |
| | Equivalent Chill Temperature (°F) | | | | | | | | | |
| Calm | 50 | 40 | 30 | 20 | 10 | 0 | -10 | -20 | -30 | -20 |
| 5 | 48 | 37 | 27 | 16 | 6 | -5 | -15 | -26 | -36 | -47 |
| 10 | 40 | 28 | 16 | 4 | -9 | -24 | -33 | -46 | -58 | -70 |
| 15 | 36 | 22 | 9 | -5 | 18 | -32 | -45 | -58 | -72 | -85 |
| 20 | 32 | 18 | 4 | -10 | -25 | -39 | -53 | -67 | -82 | -96 |
| 25 | 30 | 16 | 0 | -15 | -29 | -44 | -59 | -75 | -88 | -104 |
| 30 | 28 | 13 | -2 | -18 | -33 | -48 | -63 | -79 | -94 | -109 |
| 35 | 27 | 11 | -4 | -20 | 35 | -51 | -67 | -82 | -98 | -113 |
| 40 | 26 | 10 | -6 | -21 | -37 | -53 | -69 | -85 | -100 | -116 |
| Wind speeds >40 mph have little additional effect | LITTLE DANGER | | | | INCREASING DANGER | | | GREAT DANGER | | |
| | Trenchfoot and immersion foot may occur at any point on this chart. | | | | | | | | | |


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**Table 3. Work-Warming Schedule Guidelines**

| Air Temp. (Sunny Sky) °F | No Noticeable Wind | | 5 mph Wind | | 10 mph Wind | | 15 mph Wind | | 20 mph Wind | | 25 mph Wind | | Air Temp. (Sunny Sky) °C |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Max. Work Period | Breaks | Max. Work Period | Breaks | Max. Work Period | Breaks | Max. Work Period | Breaks | Max. Work Period | Breaks | Max. Work Period | Breaks | |
| above 5° | Normal Work Schedule | | Normal Work Schedule | | Normal Work Schedule | | Normal Work Schedule | | Normal Work Schedule | | Normal Work Schedule | | above -15° |
| 5° to –1° | | | | | | | | | | | 100 min | 2 | -15° to -17° |
| 0° to –4° | | | | | | | | | 100 min | 2 | 75 min | 2 | -18° to -20° |
| -5° to –9° | | | | | | | 100 min | 2 | 75 min | 2 | 55 min | 3 | -21° to -22° |
| -10° to –14° | | | | | 100 min | 2 | 75 min | 2 | 55 min | 3 | 40 min | 4 | -23° to -25° |
| -15° to –19° | | | 100 min | 2 | 75 min | 2 | 55 min | 3 | 40 min | 4 | 30 min | 5 | -26° to -28° |
| -20° to –24° | 100 min | 2 | 75 min | 2 | 55 min | 3 | 40 min | 4 | 30 min | 5 | Cease Work | | -29° to -31° |
| -25° to –29° | 75 min | 2 | 55 min | 3 | 40 min | 4 | 30 min | 5 | Cease Work | | | | -32° to -34° |
| -30° to –34° | 55 min | 3 | 40 min | 4 | 30 min | 5 | Cease Work | | | | | | -35° to -37° |
| -35° to –39° | 40 min | 4 | 30 min | 5 | Cease Work | | | | | | | | -38° to -39° |
| -40° to –44° | 30 min | 5 | Cease Work | | | | | | | | | | -40° to -42° |
| -44° & below | Cease Work | | | | | | | | | | | | -43° & below |

Modified from ACGIH 2002 Threshold Limit Values for Chemical Substances and Physical Agents.

Note 1: Schedule describes the maximum continuous duration of work and number of 10-15 minute breaks to be observed during any 4-hour work period and assumes that period will be followed by an extended warm-up period (e.g., lunch). Allowed breaks should be taken in a warm environment.

Note 2: Schedule applies to moderate to heavy work performed by acclimated workers wearing appropriate layered clothing. For light to moderate work apply the schedule for conditions one step lower. For unacclimated workers apply the schedule for conditions two steps lower. These modifications are additive.

Note 3: For work under 25%–50% overcast/clouds, apply the schedule for conditions one step lower. For work at night or under greater then 50% overcast/clouds, apply the schedule for conditions two steps lower. These modifications are additive with any applicable modifications from Note 2.

Note 4: For wind speeds in excess of 25 mph, cease all nonemergency work when temperatures fall below 5°F.


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# S3NA-505-WI2 Symptoms and Treatment

## 1.0 Cold Stress-related Illnesses

### 1.1 Frostbite

1.1.1 Frostbite is a localized cold injury characterized by freezing of the tissues with ice crystal formation.

1.1.2 This injury is almost always limited to the upper and lower extremities or to such appendages as the ears or nose.

1.1.3 Conditions conducive to frostbite include sub-zero temperatures, hypothermia (most important predisposing factor), dehydration, obstruction of the blood supply to the extremities (by constricting clothing, especially on the feet or at the wrists or ankles), contact with cold metal, contact with organic liquids (such as gasoline or solvents that have been left outdoors in sub-zero temperatures), use of substances that cause vasoconstriction (such as smoking tobacco), or other injury or shock.

1.1.4 Symptoms of frostbite include:

- Pain in the involved tissue is the earliest symptom.
- Sudden and complete cessation of cold or discomfort in affected fingers or toes, often followed by a pleasant feeling of warmth.
- Subsequently the only symptom may be the absence of any sensation in the frozen part.
- Paleness in the affected tissues.
- Firm or hard tissues.
- Purple tissue, if a large area, such as an entire hand or food, is frostbitten.

1.1.5 If exposure occurs in temperatures that are below freezing (32ºF or below), frostbite or trench foot (immersion foot) may accompany or complicate the symptoms of hypothermia. Frostbite is the freezing of living tissues with a resultant breakdown of cell structure. Symptoms due to frostbite may include, but is not limited to:

- Superficial redness of the skin
- Slight numbness
- Blisters
- Obstruction of blood flow (ischemia)
- Blood clots (thrombosis)
- Skin discoloration due to insufficient oxygen in the blood (cyanosis)

1.1.6 Frostbite may occur if the skin comes into contact with objects with a surface temperature below freezing, such as metal tool handles. Trench foot is caused by continuous exposure to cold combined with persistent dampness or immersion in water. Injuries in this case include permanent tissue damage due to oxygen deficiency, damage to capillary walls, severe pain, blistering, tissue death, and ulceration.

1.1.7 Additionally, cold exposures may either induce or intensify vascular abnormalities. These include chilblain (a swelling or sore), Raynaud's disease, acrocyanosis (blueness of hands and feet) and thromboangiitis (inflammation of the innermost walls of blood vessels with accompanying clot formation). Workers suffering from these ailments should take particular precautions to avoid chilling.

### 1.2 Hypothermia

1.2.1 Hypothermia is a lower than normal body temperature that occurs when outer cold cools the body faster than the body can produce heat to stay warm.

1.2.2 Hypothermia can be caused by exposure to wind, cold, and/or moisture. The combination of wind, cold, and moisture can be deadly.

1.2.3 Early warning signs of hypothermia:

- Feeling of being cold and tired.
- Heavier breathing and increased pulse rate.
- Tendency to keep moving (e.g., stamping feet, rubbing hands, continued walking/pacing).
- Goose bumps, holding arms tightly wrapped around the body, hunching of shoulders.


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- Shivering.

1.2.4 Hypothermia damages both the body's internal temperature mechanisms (hypothalamus) and the peripheral mechanisms to prevent heat loss (vasoconstriction and perspiration.) These effects may last up to three years after the initial hypothermia episode. Symptoms of hypothermia may include, but are not limited to:

- Pain in the extremities.
- Severe shivering and numbness.
- Low core body temperature.
- Drowsiness and muscular weakness.
- Apathy.
- Mental confusion.
- Loss of consciousness.
- Shock.
- Decreasing pulse and breathing rate.

## 2.0 Recommended Treatment for Cold Stress-related Illnesses

### 2.1 Frostbite

2.1.1 Wrap the victim in woolen blanket and keep dry until he or she can be brought inside.

2.1.2 Remove the victim from the cold environment.

2.1.3 Do not rub, chafe, or manipulate frozen parts.

2.1.4 Place the victim in warm water (102ºF to 105ºF) and make sure the water remains warm. Test the water by pouring it on the inner surface of your forearm. Never thaw affected body parts if the victim has to go back out into the cold; refreezing can cause significant tissue damage.

2.1.5 Do not use hot water bottles or a heat lamp, and do not place the victim near a hot stove.

2.1.6 Do not allow the victim to walk if his or her feet are affected.

2.1.7 Have the victim gently exercise the affected parts once they are thawed.

2.1.8 Seek immediate medical attention for thawing of serious frostbite.

### 2.2 Hypothermia

2.2.1 Bring the victim into a warm room or shelter as quickly as possible.

2.2.2 Give artificial respiration and stop any bleeding, if necessary.

2.2.3 If the victim cannot be moved (spinal injury, etc.), carefully place newspapers, blankets, or some other insulation between the victim and the ground.

2.2.4 Remove all wet clothing.

2.2.5 Provide an external heat source, because the body cannot generate its own heat. Wrap the victim in prewarmed blankets, place him or her in the liner of a portable hypothermia treatment unit, put the torso (not the extremities) into a tub of warm water, or use body-to-body contact to rewarm the body core. These measures will slowly reopen the peripheral circulation, minimizing the possibility of after-shock or after-drop (the flowing of cooled, stagnated blood from the limbs to the heart), which may cause ventricular fibrillation, cardiac arrest, or death.

2.2.6 Do not allow the victim to sleep.

2.2.7 Give warm, sweet drinks. Do not give alcohol or pain relievers.

2.2.8 Keep the victim still. Do not try to walk.

2.2.9 Do not rub numb skin.

2.2.10 Get medical attention as soon as possible.


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# S3NA-505-ST Cold Exposure

The following Occupational Health and Safety regulations apply directly to cold and snow hazards:

| Jurisdiction | Regulation |
|---|---|
| **United States** | |
| **OSHA** | Title 29, Code of Federal Regulations, Sections 1910.1027 and 1926.1127 |
| **Canada** | |
| **Alberta** | n/a |
| **British Columbia** | OHS Regulation (1997) Sect 7.33 – 7.38 |
| **Manitoba** | Workplace Health and Safety Regulation (217/2006) Sect 4.12, 4.14 |
| **New Brunswick** | OHS Regulation (91-191) Sect 44 |
| **Newfoundland/Labrador** | OHS Regulation (C.N.L.R. 1165/96) Sect 10 |
| **Nova Scotia** | n/a |
| **NWT/NU Territories** | n/a |
| **Ontario** | O. Reg. 851 Sect 39, 129 |
| **Prince Edward Island** | OHS Regulations (EC180/87) Sect 42.1 |
| **Quebec** | OHS Regulation (R.R.Q., c. S-2.1, r.19.01 O.C. 885-2001) Schedule 4 |
| **Saskatchewan** | OHS Regulation (R.R.S., c. O-1, r. 1) Sect 70<br>Cold Conditions Guidelines for Outside Workers |
| **Yukon Territory** | Occupational Health Regulations (O.I.C. 1986/164) Sect 9 |


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Americas

# Compressed Gases

S3NA-506-PR1

## 1.0 Purpose and Scope

1.1 This procedure provides the requirements for using, handling, storing, transporting, disposition and/or decommissioning compressed gas cylinders in accordance with 29 CFR 1910.

1.2 This procedure applies to all AECOM Americas based employees and operations.

## 2.0 Terms and Definitions

2.1 **Compressed Air (Non-Breathable)** – Air that is at a pressure greater than that of the atmosphere. Compressed air shall not be used for cleaning purposes except where reduced to less than 30 psi and then only with effective chip guarding and personal protective equipment. Utilized for tools, equipment, and mechanical machinery and cleaning purposes as described in this procedure.

2.2 **Compressed Gas** – Any material or mixture in a pressure vessel having:

- An absolute pressure exceeding 40 pounds per square inch (PSI) at 70°F (25 pounds per square inch gauge); or
- An absolute pressure exceeding 104 Psia at 130°F, regardless of the pressure at 70°F.

2.3 **Cylinder –** Pressure vessel designed for pressures higher than 40 Psia and having a circular cross section.

2.4 **Pneumatics –** The use of pressurized air to affect mechanical motion for machinery, equipment and tools.

2.5 **Psi** – Pounds per square inch.

2.6 **Psia –** Pounds per square inch absolute (i.e., pressure in a container that would appear on an ordinary gauge plus the local atmospheric pressure [14.696 psi at sea level]), psig- pounds per square inch gauge.

2.7 **Psig** – Pounds per square inch gauge. The pressure in a vessel or container as registered on a gauge attached to the container. This reading does not include the pressure of the atmosphere outside the container.

2.8 **Disposition** – Recycling, treatment, or disposal of a compressed gas cylinder and/or its contents.

2.9 **Decommission –** The removal of a compressed gas cylinder from service by rendering it permanently unusable.

## 3.0 References

3.1 29 CFR 1910.101 Handling of Compressed Gas Cylinders

3.2 Compressed Gas Association Pamphlet P-1-1965

3.3 DOT's Emergency Response Guidebook

3.4 S3NA-003-PR1 SH&E Training

3.5 S3NA-208-PR1 Personal Protective Equipment Program

3.6 S3NA-209-PR1 Project Hazard Assessment and Planning

3.7 S3NA-418-PR1 Welding, Cutting, and Other Hot Work

3.8 S3NA-508-PR1 Hazardous Materials Handling, Shipping, and Manifesting

3.9 S3NA-602-PR1 Exposure Monitoring

3.10 S4NA-514-PR1 Munitions and Explosives of Concern / Unexploded Ordnance (MEC-UXO) (US)

# 4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Project Manager**

- Ensuring the safety of employees on their project sites, consistent with *S3NA-506-ST Compressed Gases* standards.
- Implement these procedures during all activities involving compressed gases.
- Seek consultation with the SH&E Department when unknown compressed gas cylinders are encountered.
- Confirm employees have received the appropriate training as it relates to compressed gases/compressed gas cylinders.
- Confirm a hazard assessment/evaluation of the activities involving compressed gases has been completed.
- Contact the SH&E Department prior to any compressed gas cylinder operation.
- Immediately report any leaking/suspected leaking compressed gas cylinder(s) to the SH&E Department and implement the appropriate emergency action(s).
- Immediately report the discovery of any unknown compressed gas cylinder(s) to the SH&E Department and cordon off the area in all directions a minimum of 50 feet.
- Confirm that all compressed gas cylinders are properly inspected, stored, and, secured.
- Confirm that all compressed gas cylinders are handled in a safe manner, protecting both the person and cylinder.
- Confirm that all compressed gas cylinder manifolds and connections are properly made and inspected.
- Contact local emergency services prior to the start of any compressed gas cylinder operation.

4.1.2 **Region SH&E Manager / SH&E Department**

- Review and authorize all compressed gas cylinder operations.
- Conduct/support compressed gas hazard assessments/evaluations.
- Provide awareness training to project teams regarding hazards of encountered compressed gases.
- Support the identification/disposition of unknown compressed gas cylinders.
- Support the development of a site-specific cylinder plan.

4.1.3 **Employee**

- Immediately report any leaking/suspected leaking compressed gas cylinder(s) to Project Manager.
- Immediately report the discovery of any unknown compressed gas cylinders to Project Manager.
- Properly handle all compressed gas cylinders.
- Shall be supervised by employees experienced in the operation of compressed gas tools and equipment.

4.2 Training

On-site orientation to the use and hazards of the equipment shall be completed for all **employees** handling or coming into contact with compressed air tools and equipment or compressed gas cylinders, refer to *S3NA-003-PR1 SH&E Training* and *S3NA-506-WI1 Compressor Safety Card*.

4.3 Personal Protective Equipment

All PPE will comply with the requirements of *S3NA-208-PR1 Personal Protective Equipment* and *S3NA-506-WI1 Compressor Safety Card*.

4.3.1 The inspection of cylinders containing unknown substances will be performed in a Level A (PPE) ensemble as a minimum, while cylinders containing known substances, and in good condition, will be inspected in an appropriate ensemble designated within the site-specific Health and Safety Plan (HASP), refer to *S3NA-209-PR1 Project Hazard Assessment and Planning*.

4.3.2 Where the use of a Level A or B ensemble is anticipated, the **SH&E Department** shall be contacted during the pre-task planning to determine the appropriate Level ensemble components, and **employees** involved in the activity. The use of a Level A PPE ensembles are required to be approved by the **Region SH&E Manager**.

4.3.3 PPE includes, but is not limited to:

- Eye and face protection
- Steel toed work boots
- Hearing protection
- Gloves
- Respiratory equipment, as required

4.4 General Use of Compressed Air or Gas

4.4.1 Compressed air or other compressed gases are not to be used to blow dirt, chips, or dust from clothing while it is being worn. Compressed air used for other types of cleaning (other than clothing/persons) is to be limited to 30 psig.

4.4.2 The use of blown compressed air is to be controlled, and proper personal protective equipment or safeguards utilized, to protect against the possibility of eye injury to the operator or other persons.

4.4.3 Compressed air or gases are not to be used to empty containers of liquids.

4.4.4 Compressed gases are not to be used to elevate or otherwise transfer any hazardous substance from one container to another unless the containers are designed to withstand the operating gas pressure with a safety factor of at least four.

4.5 Air Compressor Operations

4.5.1 Air compressor equipment should be operated only by authorized and trained **employees**.

4.5.2 The air intake should be from a clean, outside, fresh air source. Screens or filters can be used to clean the air.

4.5.3 Air compressors should never be operated at speeds faster than the manufacturer's recommendation.

4.5.4 Equipment should not become overheated.

4.5.5 Moving parts, such as compressor flywheels, pulleys, and belts that could be hazardous should be effectively guarded.

4.5.6 Keep the air supplied tools clean and dry. Dust, moisture, and corrosive fumes can damage tools.

4.5.7 Keep tools clean, lubricated, and maintained according to manufacturer's instructions.

4.5.8 Only use attachments and accessories recommended by the manufacturer.

4.5.9 Review the manufacturer's instruction before using a tool.

4.5.10 Post warning signs where pneumatic tools are used.

4.5.11 Set up screens or shields in areas where nearby workers may be exposed to flying fragments, chips, dust, and excessive noise.

4.5.12 Be aware of proper handling and ergonomics while using the tool.

4.5.13 Reduce physical fatigue by supporting heavy tools with a counter-balance wherever possible.

4.6 Air Hoses

4.6.1 Use the proper hose and fittings of the correct diameter.

4.6.2 Use hoses specifically designed to resist abrasion, cutting, crushing and failure from continuous flexing.

4.6.3 Choose air-supply hoses that have a minimum working pressure rating of 1035 kPa (150 psig) or 150% of the maximum pressure produced in the system, whichever is higher.

4.6.4 Check hoses regularly for cuts, bulges and abrasions. Tag and replace, if defective.

4.6.5 Blow out the air line before connecting a tool. Hold hose firmly and blow away from yourself and others.

4.6.6 Make sure that hose connections fit properly and are equipped with a mechanical means of securing the connection (e.g., chain, wire, or positive locking device).

4.6.7 Install quick disconnects of a pressure-release type rather than a disengagement type. Attach the male end of the connector to the tool, NOT the hose.

4.6.8 Do not operate the tool at a pressure above the manufacturer's rating.

4.6.9 Turn off the air pressure to hose when not in use or when changing power tools.

4.6.10 Do not carry a pneumatic tool by its hose.

4.6.11 Do not use compressed air to blow debris or to clean dirt from clothes.

4.6.12 All pipes, hoses, and fittings shall have a rating of the maximum pressure of the compressor. Compressed air pipelines should be identified (psi) as to maximum working pressure.

4.6.13 Air supply shutoff valves should be located (as near as possible) at the point-of-operation.

4.6.14 Air hoses should be kept free of grease and oil to reduce the possibility of deterioration.

4.6.15 Avoid trip hazards. Hoses should not be strung across floors or aisles where they are liable to cause **employees** to trip and fall. When possible, air supply hoses should be suspended overhead, or otherwise located to afford efficient access and protection against damage.

4.6.16 Hose ends shall be secured to prevent whipping if an accidental cut or break occurs.

4.6.17 Pneumatic impact tools, such as riveting guns, should never be pointed at a person.

4.6.18 Before a pneumatic tool is disconnected (unless it has quick disconnect plugs), the air supply shall be turned off at the control valve and the tool bled.

4.6.19 Shop air used for cleaning should be regulated to15 psi unless equipped with diffuser nozzles to provide lesser pressure.

4.6.20 Goggles, face shields or other eye protection shall be worn by **employees** using compressed air for cleaning equipment.

4.6.21 Static electricity can be generated through the use of pneumatic tools. This type of equipment shall be grounded or bonded if it is used where fuel, flammable vapors or explosive atmospheres are present.

4.6.22 The following are hazards associated with the use of compressed air tools and equipment:

- Poorly designed tool (wrist strain);
- Vibration (vibration-induced white finger);

- Noise (hearing loss); and
- Dust (respiratory problems).

4.6.23 The following hazards have the potential to cause serious bodily injury when working with compressed air:

- Incorrect tool selection;
- Use of damaged tool;
- Improper, inadequate, or no guards;
- Rotating shaft (entanglement);
- Wheel breakage (grinder);
- Flying chips;
- Whipping of the hose;
- Accidental start up;
- Compressed air entering the body;
- Dropped tool; and
- Tripping over hose.

4.7 Compressed Air Equipment Maintenance

4.7.1 Only authorized and trained **employees** should service and maintain air compressor equipment.

4.7.2 Exposed, non-current-carrying, metal parts of compressor should be effectively grounded.

4.7.3 High flash point lubricants should not be used on compressors because of its high operating temperatures that could cause a fine or explosion.

4.7.4 Equipment should not be over lubricated.

4.7.5 Gasoline or diesel fuel powered compressors shall not be used indoors.

4.7.6 Equipment placed outside but near buildings should have the exhausts directed away from doors, windows and fresh air intakes.

4.7.7 Soapy water of lye solutions can be used to clean compressor parts of carbon deposits, but kerosene or other flammable substances should not be used. Frequent cleaning is necessary to keep compressors in good working condition.

4.7.8 The air systems should be completely purged after each cleaning.

4.7.9 During maintenance work, the switches of electrically operated compressors should be locked open and tagged to prevent accidental starting.

4.7.10 Portable electric compressors should be disconnected from the power supply before performing maintenance.

4.8 Compressed Gas Cylinder Requirements

4.8.1 Cylinders are not to be used unless they bear Department of Transportation (DOT) markings showing that they have been tested as required by DOT regulations.

4.8.2 Cylinders shall never be dropped, struck, or permitted to strike each other violently. Cylinders may be moved by tilting and rolling them on their bottom edges.

4.8.3 Valve protection caps shall always be kept on cylinders when they are being moved or stored, and until ready for use.

4.8.4 Do not lift cylinders by the valve protection cap.

4.8.5 Cylinder valves are to be kept closed except when gas is being used or when connected to a permanent manifold. Valves of empty cylinders shall be closed.

4.8.6 Cylinders shall never be used as rollers or supports, or for any purpose other than carrying gas.

4.8.7 Threads on regulator connections or other auxiliary equipment shall be the same as those on the cylinder valve outlet.

4.8.8 When withdrawing cylinder content, open the cylinder valve slowly. Point the valve opening away from yourself and other persons.

4.8.9 Before a regulator is removed from a cylinder, close the cylinder valve and release all pressure from the regulator. This procedure also serves as a check to confirm that the main cylinder valve is completely closed.

4.8.10 Never hammer the valve wheel in attempting to open or close the valve.

4.8.11 No person, except the owner of the cylinder or person authorized by the owner, shall refill a cylinder (Exceptions to this includes the filling self-contained breathing apparatus cylinders with compressed air or the filling of the [Foxboro] Organic Vapor Analyzer (OVA) hydrogen cylinders). Disposable cylinders shall not be refilled with any material after use of the original contents.

4.8.12 Cylinders of compressed gas shall be stored in areas where they are protected from external heat sources such as flame impingement, intense radiant heat, electric arc, or high-temperature steam lines.

4.8.13 Cylinders are to be stored in an assigned area, with full and empty cylinders stored separately. Empty cylinders shall be marked empty.

4.8.14 Stored fuel gases and oxygen cylinders are to be separated by at least 20 feet, or by a fire wall at least 5 feet high that has a fire-resistance rating of at least ½ hour.

4.8.15 Oxygen, nitrogen, helium, or freon cylinders shall only be stored or transported in an upright or horizontal position. Acetylene cylinders shall always be kept in an upright position. All horizontally-placed cylinders are to be secured by chocks or ties to prevent rolling.

4.8.16 Cylinders are to be secured to a fixed object by chain or equivalent fastening device whenever they are placed in an upright position. The protective cap is not to be removed or the cylinder valve opened until the cylinder is secured.

4.8.17 Repair of leaks shall never be attempted on a pressurized system. System pressure should be reduced to atmospheric pressure as rapidly as possible, and the **Project Manager** notified immediately.

4.8.18 Compressed gas cylinders shall be legibly marked for the purpose of identifying the gas content with either the chemical or the trade name of the gas. Such marking is to be done by means of stencilling, stamping or labelling, and shall not be readily removable. Whenever practical, the marking is to be located on the shoulder of the cylinder. Positive identification of the gas in any cylinder is required before connecting cylinders for use.

4.8.19 Gas cylinders moved by hoist shall be handled in suitable cradles or job-made “skip” (materials) boxes. Any slings used for this purpose shall be specifically designed for that cylinder handling.

4.8.20 Cylinders shall not be placed where they might form part of an electrical circuit.

4.8.21 Transfer of compressed gases (including acetylene) from one cylinder to another, or mixing of gases in a cylinder, is prohibited.

4.8.22 Oxygen cylinders are never to be stored near:

- Highly combustible materials, especially oil and grease;
- Reserve stocks of acetylene or other fuel gas cylinders; and
- Any other substance likely to cause or accelerate fire.

4.8.23 Compressed oxygen is never to be used:

- As breathing air;
- To purge pipelines, tanks, or any confined area;
- To supply a head-pressure tank;
- In pneumatic tools;
- In oil preheating burners;
- To start internal combustion engines;
- For ventilation;
- For cleaning clothing; and
- In any other way as a substitute for compressed air.

4.8.24 Use of a cylinder's contents for purposes other than those intended by the supplier is prohibited.

4.8.25 Cylinders of compressed natural gas or propane equipped with a pressure relief device shall always be positioned in a manner that this device remains above the liquid level (i.e., if stored or installed horizontally on a forklift, relief device is positioned at the top).

4.9 Special Precautions for Compressed Gas Cylinders Containing Hydrogen

4.9.1 Inside buildings, cylinders of hydrogen should be separated from oxygen cylinders by a minimum distance of 20 feet or by a barrier of non-combustible material at least 5 feet high having a fire resistance rating of at least one half hour.

4.9.2 Conspicuous signs should be posted in hydrogen storage areas forbidding smoking, open flames or the use of lights or lighting not approved for use in flammable areas.

4.9.3 Although not required for gaseous hydrogen systems having a total hydrogen content of less than 400 cubic feet, it is recommended that hydrogen storage areas are labeled, "Hydrogen-Flammable Gas-No Smoking-No Open Flame" or equivalent.

4.10 Inspection of Compressed Gas Cylinders

4.10.1 Prior to formally accepting any delivered compressed gas cylinders, a visual inspection of each cylinder will be documented as specified below. In addition, all compressed gas cylinders stored at an AECOM facility will be routinely inspected.

- Visually inspect the cylinder, refer to *S3NA-506-FM1 Cylinder Inspection.*
- Verify that all the required markings are on the cylinder.
- If required, determine when the cylinder was last hydrostatically-tested.
- Inspect the safety relief devices, if required.
- If any defects are noted during the inspection, the cylinder should be refused on delivery and a new delivery requested (notify the **Project Manager).**

4.10.2 Where compressed gas cylinders are stored at an AECOM facility, a qualified person will be designated to confirm cylinder activities comply with the requirements in this procedure. Inspection entails the evaluation of the integrity of the cylinder as well as the serviceability of any attached manifold and valve fittings. Remote cylinder inspection is recommended for worker and public safety. The inspection of any cylinder will be conducted by a qualified person, refer to *S3NA-506-FM1 Cylinder Inspection*.

4.11 Cylinder Inspection Procedures

4.11.1 All cylinder inspection procedures will adhere to the procedures identified in CGA P-22, The Responsible Management & Disposition of Compressed Gases & Their Containers (most current edition). For valve or fitting identification, the information contained in CGA V-1, Compressed Gas

Association Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections (most current edition). At a minimum, the inspection process will include the following procedures:

- Observe the cylinder from a safe distance to identify any visual markings or other information.
- Inspect the cylinder size, shape, and general condition (if visible, include the valve system/stem in the inspection process).
- If the cylinder or valve system appears to be in poor condition or has lost structural integrity, do not approach the cylinder. Observations indicating a cylinder is in poor condition may include:
  - Leaking,
  - Hissing sound,
  - Odor in vicinity of the cylinder,
  - Rusty components,
  - Bulging side wall or end, and/or
  - Corroded valve system.

4.11.2 If the cylinder is determined to be in poor condition, cordon the area off and limit access to necessary **employees** only.

4.11.3 Wear applicable PPE and approach the cylinder with the appropriate direct reading air monitoring instrument (do not approach from the ends of the cylinder), then determine the airborne contaminant concentrations in the immediate area.

4.11.4 Document cylinder information (i.e., visible markings, labels, placards, etc.).

4.12 Ground Transport of Compressed Gas Cylinders

4.12.1 AECOM will transport (drive/haul) quantities of compressed gases which do not exceed Materials of Trade (MOT) quantities, whereas the transport of placardable quantities is prohibited without the proper DOT licenses/credentials and consultation with the **SH&E Department**.

4.12.2 Compressed gas cylinders in portable service are to be conveyed by suitable trucks, to which they are securely fastened. All gas cylinders in service shall be securely held in substantial racks or secured to other rigid structures so that they will not fall or be knocked over.

4.13 Air/Common Carrier Transport

4.13.1 All shipping of compressed gases via air/common carrier including instrument gases, regardless of quantity, shall be conducted by a qualified and trained HazMat Shipper (Level 1-2 Shipper), and shall conducted under the oversight of a designated DOT/International Air Transport Association (IATA) shipping specialist, refer to *S3NA-508-PR1 Hazardous Materials Handling, Shipping, and Manifesting.*

4.13.2 No compressed gas cylinder, regardless of contents or quantity, will be shipped via an external carrier vendor (i.e., UPS, FedEx, etc.) without the authorization of:

- **Region SH&E Manager**, and
- DOT/IATA shipping specialist.

4.14 Cylinder Disposition & Decommissioning Activities

4.14.1 All cylinders shall be inventoried, staged, and inspected.

4.14.2 Prior to the commencement of cylinder activities, local emergency response agencies (i.e., Fire Department, Medical, and Emergency Response, if separate) shall be contacted and activities coordinated with the local agencies.

4.14.3 Air monitoring is mandatory during cylinder operations.

4.14.4 A **Region SH&E Manager** shall be contacted during the planning stages of a cylinder effort in order to determine whether a site-specific cylinder plan is required.

4.14.5 A copy of the DOT Emergency Response Guidebook (most current edition) and applicable Compressed Gas Association, Inc. (CGA) guidelines shall be on site during activities.

4.15 Cylinder Color Coding Determination

4.15.1 The color coding of compressed gas cylinders is governed by the CGA, which has assigned specific colors to categories or classes of chemicals/substances.

4.15.2 While recently manufactured cylinders reflect the color coding guidance established by the CGA, older cylinders may not reflect this nomenclature. It is also possible for cylinders to have been repainted a different color from their original.

4.15.3 Cylinder contents should never be determined by the color of the cylinder alone.

4.15.4 The following table provides general guidance on the standard color coding scheme and potential contents associated with those colors.

| Standard Color (Color of Cylinder) | Class of Material |
|---|---|
| Yellow | *Flammable Materials*. All materials known ordinarily as flammables or combustibles. |
| Brown | *Toxic and Poisonous Materials*. All materials extremely hazardous to life or health under normal conditions, such as toxics or poisons. |
| Blue | *Anesthetics and Harmful Materials*. All materials productive of anesthetic vapors and all liquid chemicals and compounds hazardous to life and property but not normally productive of dangerous quantities of fumes or vapors. |
| Green | *Oxidizing Materials*. All materials, which readily furnish oxygen for combustion and fire producers that react explosively or with the evolution of heat in contact with many other materials. |
| Gray | *Physically Dangerous Materials*. All materials, not dangerous in themselves, which are asphyxiating in confined areas or which are generally handled in a dangerous physical state of pressure or temperature. |
| Red | *Fire Protection Materials*. All materials provided in piping systems or in compressed gas cylinders exclusively for use in fire protection. |

Note: Old cylinders that predate the CGA standard color scheme may not adhere to the color schemes shown above; therefore, additional characteristics such as color bands or identifying decals should also be evaluated. Also, the CGA *Handbook of Compressed Gases*, (most current edition) should be consulted for further information.

4.16 Air Monitoring Requirements

4.16.1 Air monitoring requirements are dependent upon the specific substances contained within the cylinders and will be specified within the individual HASP prepared prior to commencement of field activities. Air monitoring parameters, refer to *S3NA-602-PR1 Exposure Monitoring*, may include, but are not limited to:

- Explosivity (i.e., lower explosive limit [LEL]), and
- Chemical-specific substance (e.g., chlorine, ammonia, arsine, etc.).

4.16.2 Action levels will be identified in the site-specific HASP.

4.17 Cylinder Staging

4.17.1 Staging involves the organization, and sometimes consolidation, of cylinders that have similar contents or characteristics.

4.17.2 The staging of cylinders will occur in a remote location at the site in order to minimize the potential injury or property damage from an accidental release or emergency decompression (if the integrity of the cylinder is in question, it should not be moved).

4.17.3 Safe distances will be based on the evacuation distances provided in DOT's Emergency Response Guidebook (most current edition).

4.17.4 When multiple cylinders containing different substances are present, the distance should be based on the greatest evacuation distance required by the substances present.

4.18 Cylinder Disposition Operations

4.18.1 Disposition refers to the recycling, treatment, or disposal of a compressed gas cylinder and/or its contents.

4.18.2 Recovery and recycling of materials are preferred over any other method of disposition. Cylinder disposition activities shall be approved by the **Region SH&E Manager**.

4.18.3 An effort should be made to recover and recycle the contents of a cylinder; however, if recovering or recycling the contents is not possible, then other options include:

- Venting to the Atmosphere,
- Flaring,
- Neutralization, and
- Detonation.

4.18.4 Under no circumstances will poisonous, toxic, or ozone-depleting substances be vented to the atmosphere. Only cylinders containing flammable gases should be detonated, as the flammable contents will be consumed in the subsequent explosion.

4.18.5 If the cylinder valve has been determined to be inoperable, then the available options for disposition are limited to having an outside vendor perform the remote opening and sampling of the cylinder, or detonation of the cylinder where the cylinder contents are consumed in the subsequent explosion (flammable gases only).

4.19 Venting to the Atmosphere

Cylinders that contain non-flammable, non-toxic materials can be vented to the atmosphere. All venting activities will be performed in accordance with the following procedures:

- Atmospheric venting will be accomplished at a remote location and in compliance with all applicable environmental air regulatory requirements.
- Atmospheric venting activities will be completed in a Level B Ensemble (unless otherwise specified in the site-specific HASP and cylinder plan).
- Venting activities will be dependent upon a wind direction that does not carry the outgas plume in the direction of an adjacent public structure.
- The cylinder will be properly grounded to confirm a static charge is not generated, potentially resulting in ignition of a flammable gas.
- All tools used on the cylinder will be non-sparking.
- Low-pressure discharging will not exceed 15 pounds per square inch gauge (psig).
- Once discharging has started, all workers will retreat to the exclusion zone (minimum 100 feet) around the remote location until the discharging process is complete.

4.20 Flaring

Flaring activities involve the combustion of the cylinder contents through the discharge of a low-intensity flame. Flaring activities will be performed in accordance with the following procedures:

- Flaring will be accomplished at a remote location and in compliance with all applicable environmental air regulatory requirements.

- Flaring activities will be completed in a Level B Ensemble (in addition, the flaring team members will don Nomex fire-retardant forearm-length gloves and other fire-retardant clothing as specified in the site-specific cylinder plan).
- Flaring activities will be dependent upon a wind direction that does not carry the combustion plume in the direction of any offsite structure or activity, or into uncontrolled (public access) areas.
- The cylinder will be properly grounded to confirm a static charge is not generated, potentially resulting in ignition of a flammable gas.
- All tools used on the cylinder will be non-sparking.
- Low-pressure discharging will not exceed 15 pounds per square inch gauge (psig).
- A hot work permit shall be completed prior to the start of flaring activities, refer to *S3NA-418-PR1 Welding, Cutting, and Other Hot Work*.
- No other cylinders will be within 35 feet of the cylinder being flared.
- Flaring activities will use a low-pressure discharge and maintain a small, low-intensity flame.
- A firewatch will be established, with a worker stationed outside the exclusion zone with a fire extinguisher (20A:100B:C) during flaring activities (i.e., fire watch). During the work the worker assigned to the firewatch will have no other duties.
- The flare will be positioned so that it is not pointing toward any flammable materials, persons, or equipment in the immediate area.

4.21 Neutralization

Neutralization refers to the on-site neutralization of the cylinder contents through a controlled chemical reaction process. Specialized equipment may be necessary based on the chemical involved, as well as reaction by-products, catalysts, or physical conditions (i.e., temperature, acidic, basic, etc.). Neutralization activities will be performed in accordance with the following procedures:

- Neutralization is the required disposition method for cylinders containing acid gases, as well as many alkaline gases.
- The neutralization process shall be approved by a professional engineer (e.g., chemical) or based on a published chemical-specific neutralization methodology.
- Liquid levels in the reaction vessels will be maintained at least 12 inches below the top of the vessel.
- Based on the specific chemical reaction, the temperature of the reaction vessel and its contents will be monitored continuously and controlled accordingly.
- Pressure levels will be maintained within acceptable limits to prevent the reaction from accelerating, unwanted by-product formation, or the break-through of the chemical intended to be neutralized.
- **Employees** will wear the PPE identified within the site-specific HASP and cylinder plan.

4.22 Detonation

4.22.1 Detonation refers to the use of explosives to open and subsequently consume the contents of the cylinder by the heat generated during the explosion. Detonation activities will be performed in accordance with the following procedures:

4.22.2 A detonation plan shall be submitted to and approved by the **Region SH&E Manager** prior to the commencement of cylinder detonation activities.

4.22.3 The detonation of compressed gas cylinders will be completed under the guidance of experienced ordnance and explosives (OE) professional who is licensed in the use of explosives, refer to *S4NA-514-PR1 Munitions and Explosives of Concern / Unexploded Ordnance (MEC-UXO) (US*).

4.22.4 A sufficient amount of explosives will be used to consume the entire contents of the cylinder (flammable gases only).

4.22.5 A blast pit will be excavated where all detonations will take place.

4.22.6 The OE professional will determine the blast hazard zone/potential debris impact zone, and this area will be evacuated prior to the detonation.

4.22.7 The OE professional will sound a warning signal (e.g., horn or equivalent) three times to indicate that a detonation is imminent and confirm all persons have evacuated the blast hazard zone prior to detonation.

4.22.8 **Employees** will be on standby outside the blast hazard zone with fire extinguishers (minimum rating of 20A:100B:C).

4.23 Cylinder Decommissioning Operations

4.23.1 Decommissioning refers to the removal of a compressed gas cylinder from service by rendering it permanently unusable.

4.23.2 Prior to decommissioning, cylinder contents will be verified, removed from the cylinder, and the cylinder purged with an inert gas (e.g., nitrogen, carbon dioxide, etc.).

4.23.3 All identifying marks or decals will be removed from the cylinder.

4.23.4 The **Region SH&E Manager** shall be contacted prior to the decommissioning of compressed gas cylinders that contain or previously contained:

- Ethylene oxide,
- Arsine,
- Diborane,
- Hydrogen selenide,
- Cyanogen chloride,
- Amines,
- Hydrogen sulphide,
- Acetylene, or
- Methyl mercaptan.

4.23.5 Additional safety precautions may be necessary due to highly reactive residues left behind by these substances.

4.23.6 The recommended methods of decommissioning include:

- Burning/torch-cutting an elongated hole into the side of the cylinder, refer to *S3NA-418-PR1 Welding, Cutting and Other Hot Work;*
- Torch-cutting the cylinder in half; and
- Crushing the cylinder.

## 5.0 Records

5.1 None.

## 6.0 Attachments

6.1 S3NA-506-WI1 Compressor Safety Card

6.2 S3NA-506-FM1 Cylinder Inspection

6.3 S3NA-506-ST Compressed Gases

**Americas**

# Compressor Safety Card

**S3NA-506-WI1**

## 1.0 Objective / Overview

1.1 Compressors should be used with extreme caution in order to prevent personal injury.

1.2 When using a compressor it's important to follow the manufacturer's instructions to avoid injuring someone or damaging your compressor.

1.3 Allow only trained, authorized personnel to operate the compressor. Along with training, other safety measures include: proper maintenance of equipment and personal protective equipment.

## 2.0 Safe Operating Guidelines

2.1 Follow manufactures recommended operating instructions, every compressor is not the same. Maintain adequate ventilation.

2.2 Gas and Diesel powered generators emit carbon monoxide (CO). Never operate a fuel-powered compressor in an enclosed building without proper ventilation.

2.3 Turn the compressor off to refuel. Gasoline and its vapors may ignite if they come into contact with hot components or an electrical spark, store fuel in a properly designed container in a secure location.

2.4 Operators shall perform a pre-operational check of all air hoses, couplings, and connections to determine if leakage or other damage exists. Tag unsafe equipment and take out of service immediately.

2.5 Decompress air from the compressor prior to removing any caps or air equipment attachments such as jackhammers, drills, etc.

2.6 Keep oil and flammable material clear of air fittings and joints.

2.7 Make sure connections are secure to avoid a hose coming loose during use.

2.8 To avoid a shock, make sure that your hands are dry and you're standing in a dry place whenever you operate an electrically powered compressor.

2.9 Use only UL-listed, three-prong extension cords. Be sure the extension cord is the proper size (wire-gauge) to handle the electric load that will be plugged into it.

2.10 Have a Class A:B:C fire extinguisher readily available at all times.

## 3.0 Potential Hazards



3.1 Burns from contact with the hot muffler or engine

3.2 Shocks/electrocution

3.3 Noise exposure

3.4 Inhaling exhaust gases, CO

3.5 Contact with pressurized air

## 4.0 Training Requirements

4.1 Review of Applicable SOPs.

4.2 Demonstrated knowledge on the use of the compressor.

4.3 Review of manufacturers operating guidelines.

## 5.0 Personal Protective Equipment (Level D PPE)

5.1 Leather Gloves

5.2 Hearing Protection

5.3 Long Sleeve Shirt (e.g., to shield from burns, etc.)

**Americas**

# Cylinder Inspection

**S3NA-506-FM1**

| | |
|---|---|
| | |
| **Basic Cylinder Information** | |
| Serial Number: | Cylinder Size: |
| Pressure Rating: | Current Pressure: |
| Vendor/Owner: | Contents: |
| Date of Receipt: | Date of Inspection: |
| Inspected by (*Name*): | |

| Condition | Yes | No |
|---|---|---|
| DOT container specification number present on cylinder? | | |
| Proper DOT shipping name, ID # and hazard class on cylinder? | | |
| Manufacturer's name and appropriate hazard warnings present? | | |
| Serial number of cylinder and inspectors official mark present? | | |
| Most recent hydrostatic test date marked and within 5 years? | | |
| Cylinder valve and neck ring free of oil, grease or other foreign matter? | | |
| Valve threads clean and in good condition? | | |
| Pressure rating of cylinder not exceeded? | | |
| Cylinder surface is free of cracks, and dents, gouges, weld defects, etc.? | | |
| Cylinder surface is free of arc burns and fire burns? | | |
| Cylinder cap is present and threaded in place? | | |
| Cylinder surface, particularly bottom, is free of excessive corrosion, and pitting? | | |

This checklist will be used by employees who accept the delivery of compressed gas cylinders at an office, laboratory, or project location to document the condition of the cylinder upon receipt. In offices where cylinders are stored, used or shipped to project locations on a regular basis, the qualified person designated to oversee cylinder operations will use this checklist to perform routine cylinder inspections and create a historical file on the condition of each cylinder.

Americas

# Compressed Gases

S3NA-506-ST

| Jurisdiction | Regulation |
|---|---|
| **United States** | |
| **OSHA** | 49 CFR (Transportation), Parts 100-185 Hazardous Materials Regulations |
| | 29 CFR 1910 (General Industry) Subpart H Hazardous Materials |
| | 29 CFR 1926 (Construction) Subpart J .350 Gas Welding and Cutting |
| **DOT** | Emergency Response Guidebook (latest edition) |
| **Compressed Gas Association, Inc. (CGA)** | CGA Guidelines and CGA Handbook of Compressed Gases (latest editions) |
| **Canada** | |
| **Alberta** | OHS Code (2009) Sect 171 |
| **British Columbia** | OHS Regulation (1997) Sect 4.41 |
| **Manitoba** | Workplace Health and Safety Regulation (217/2006) Sect 27.1 – 27.3 |
| **New Brunswick** | OHS Regulation (91-191) Sect 74 – 79 |
| **Newfoundland/Labrador** | OHS Regulation (C.N.L.R. 1165/96) Sect 75 |
| **Nova Scotia** | OHS Regulation (N.S. Reg. 44/99) Sect 45 – 49 |
| **NWT/NU Territories** | General Safety Regulations (R.R.N.W.T. 1990, c. S-1), Safety Act (SI-013-92) Sect 155 – 162 |
| **Ontario** | O. Reg. 213/91 Sect 6, 42<br>O. Reg. 851 Sect 49 |
| **Prince Edward Island** | OHS Regulations (EC180/87) Sect 37.18 – 37.23 |
| **Quebec** | OHS Regulation (R.R.Q., c. S-2.1, r.19.01 O.C. 885-2001) Sect 77, 78, 325 – 328<br>Safety Code for the Construction Industry (R.R.Q. 1981, c. S-2.1, r. 6) Sect 3.13.4 – 3.13.10 |
| **Saskatchewan** | OHS Regulation (R.R.S., c. O-1, r. 1) Sect 371, 372 |
| **Yukon Territory** | OHS Regulations (O.I.C. 2006/178) Sect 4.05, 4.06, 8.20, 8.21 |

The following standards apply to compressed gas tools and equipment:

| Association | Standard |
|---|---|
| **Canadian Standards Association (CSA)** | CAN/CSA Standard-Z275.3-M86 (R2004), Occupational Safety Code for Construction Work in Compressed Air |
| **OSHA** | 29 CFR 1926 (Construction) Subpart I .300-307 Tools-Hand and Power |

**Americas**

# Hazardous Materials Communication/WHMIS

**S3NA-507-PR1**

## 1.0 Purpose and Scope

1.1 Provides a Hazard Communication Program so that AECOM employees are informed of the hazards of the chemicals to which they may be exposed in the course of their work by way of container labeling and other forms of warning, safety data sheets (SDS), and employee training.

1.2 This procedure applies to all AECOM Americas-based employees and operations.

1.3 The program applies to the use of any hazardous substances which are known to be present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency.

## 2.0 Terms and Definitions

2.1 **Acute Effect** – An adverse effect on the human body with immediate onset of symptoms.

2.2 **Article** – A manufactured item: (1) which is formed to a specific shape or design during manufacture; (2) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and, (3) which does not release or otherwise result in exposure to, a hazardous chemical, under normal conditions of use.

2.3 **Carcinogen –** Those chemicals appearing in any of the following reference sources are established as carcinogens for hazard communication purposes:

- National Toxicology Program (NTP) Annual Report on Carcinogens.
- International Agency for Research on Cancer (IARC) Monographs, Volumes 1-34. Note: The Registry of Toxic Effects of Chemical Substances published by NIOSH indicates whether a substance has been found by NTP or IARC to be a potential carcinogen.

2.4 **Chemical Name –** The scientific designation of a substance in accordance with the nomenclature system developed by the International Union of Pure and Applied Chemistry or the system developed by the Chemical Abstracts Service.

2.5 **Chronic Effect –** An adverse effect on the human body with symptoms which develop slowly over a long period of time or which frequently recur.

2.6 **Combustible Liquid –** Any liquid having a flash point at or above 100°F (37.8°C) but below 200°F (93.3°C), except any mixture having components with flash points of 200°F (93.3°C), or higher, the total volume of which makes up 99% or more of the total volume of the mixture.

2.7 **Common Name –** Any designation or identification such as code name, code number, trade name or brand name used to identify a substance other than by its chemical name.

2.8 **Container –** Any bag, barrel, bottle, box, can, cylinder, drum, reaction vessel, storage tank or the like that contains a hazardous chemical. For purposes of this Safety Operating Procedure (SOP) and Occupational Safety and Health Administration (OSHA) standard, pipes or piping systems, and engines, fuel tanks, or other operating systems in a vehicle are not considered to be containers.

2.9 **Establishment –** Any separate and distinct AECOM office, laboratory or other company facility.

2.10 **Exposure –** Any situation arising from work operations where an employee may ingest, inhale, absorb through the skin or eyes or otherwise come into contact with a hazardous substance.

2.11 **Flammable –** A substance that falls into one of the following categories:

2.11.1 **Flammable Aerosol** – An aerosol that when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening or flashback (a flame extending back to the valve) at any degree of valve opening;

2.11.2 **Flammable Gas** – A gas that at ambient temperature and pressure:

- Forms a flammable mixture with air at a concentration of 13% of volume or less; or
- Forms a range of flammable mixtures with air wider than 12% by volume, regardless of the lower limit.

2.11.3 **Flammable Liquid** – Any liquid having a flash point below 100°F (37.8°C), except any mixture having components with flash points of 100°F (37.8°C) or higher, the total of which make up 99% or more of the total volume of the mixture**.**

2.11.4 **Flammable Solid** – A solid, other than a blasting agent or explosive as defined in 8 CCR 5237(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change or retained heat from manufacturing or processing or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard**.**

A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

2.12 **Flash Point –** Minimum temperature of a liquid at which it gives off sufficient vapors to form an ignitable mixture with the air near the surface of the liquid or within the container used.

2.13 **Hazardous Chemical –** Those chemicals appearing in any of the following reference sources are established as hazardous chemicals for hazard communication purposes.

- 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances, OSHA.
- Hazardous Products Act, R.C.S. 1985, c. H-3, section 2, Canada.
- For operations within the state of California, the list of hazardous substances prepared by the California Director of Industrial Relations pursuant to Labor Code Section 6382. The concentrations and footnotes, which are applicable to the list, shall be understood to modify the same substance on all other source lists or hazard determinations set forth in § 8 CCR 5194(d)(3)(B) and (d)(5)(D).

2.14 **Hazardous Substance –** A hazardous chemical or carcinogen, or a product or mixture containing a hazardous chemical or carcinogen provided that:

2.14.1 The hazardous chemical is 1% or more of the mixture or product or 2% if the hazardous chemical exists as an impurity in the mixture; or

2.14.2 The carcinogen is 0.1%or more of the mixture or product;

2.14.3 Manufacturers, importers and distributors will be relied upon to perform the appropriate hazard determination for the substances they produce or sell.

2.14.4 The following materials are not covered by the Hazard Communication Standard:

- Any hazardous waste as defined by the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 USC 6901 et seq.) when subject to regulations issued under that act by the Environmental Protection Agency.
- Tobacco or tobacco products;
- Wood or wood products. Note: Wood dust is not exempt since the hazards of wood dust are not “self-evident” as are the hazards of wood or wood products;
- Consumer products (including pens, pencils, adhesive tape) used in the work place under typical consumer usage;
- Articles (i.e. plastic chairs);
- Foods, drugs, or cosmetics intended for personal consumption by employees while in the work place;

- Foods, drugs, cosmetics in retail store packaged for retail sale; and
- Any drug in solid form used for direct administration to the patient (i.e., tablets or pills).

2.15 **Hazardous Substance Inventory (HSI) / WHMIS Log –** A listing of all chemicals stored or used at an office or project site. Note that the list may be imbedded in a project Health and Safety Plan.

2.16 **Immediate Use –** Means that the hazardous chemical will be under the control of and used only by the person who transfers it from a labeled container and only within the work shift in which it is transferred.

2.17 **SDS –** A Safety Data Sheet prepared pursuant to state and federal regulations, OSHA Form 174 and Canada regulations (Controlled Products regulations, schedule 1).

2.18 **SDS Administrator –** The individual or group designated by the Office Manager (Operations) or Project Manager to maintain the establishment-specific inventory list or log and the SDS binder required if that establishment uses or stores hazardous substances.

2.19 **NFPA –** A system of categories, colors and numbers was created to provide basic hazard information. It enables firefighters and other emergency personnel to easily decide whether or not to evacuate an area or proceed with emergency control operations. The three principal categories of identification are Health, Flammability and Instability. A numerical range of “0 to 4” indicates the severity of the hazard. A “4” indicates the most severe and a “0” indicates a minimal hazard.

2.20 **Mixture –** Any solution or intimate admixture of two or more substances which do not react chemically with each other.

2.21 **Reactivity** – A measure of the tendency of a substance to undergo chemical reaction with the release of energy.

2.22 **Solubility –** The ability of substance to blend and mix uniformly with another.

2.23 **Specific Gravity (density) –** Ratio of the weight of a substance to the weight of the same volume of another substance. As used in this directive, specific gravity or density refers to the weight of substance as compared to the weight of an equal volume of water.

2.24 **Vapor Density –** The weight of a vapor-air mixture resulting from the vaporization of a volatile liquid at equilibrium temperature and pressure conditions, as compared with the weight of an equal volume of air under the same conditions.

2.25 **WHMIS –** The Workplace Hazardous Materials Information System (WHMIS) is Canada's national hazard communication standard. The key elements of the system are cautionary labeling of containers of WHMIS "controlled products", the provision of material safety data sheets (SDSs) and worker education and training programs.

## 3.0 References

3.1 Additional definitions can be found in the Hazardous Material Regulations (HMR), the Transportation of Dangerous Goods (TDG) Regulations, and the International Air Transport Association (IATA) Dangerous Goods Regulation (DGR)

3.2 S3NA-003-PR1 SH&E Training

3.3 S3NA-208-PR1 Personal Protective Equipment Program

3.4 S3NA-209-PR1 Project Hazard Assessment and Planning

3.5 S3NA-509-PR1 Hazardous Waste Operations and Emergency Response

# 4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Region SH&E Manager / SH&E Department**

- Audit their regional offices to assure that they maintain an establishment-specific Hazardous Substance Inventory (HSI).
- Audit their regional offices to assure that if an establishment-specific HSI is required, that SDSs are available for each substance listed on the HSI.
- Provide interpretation of SDSs and hazard information for WHMIS labels/NFPA labels and other information to assist in training employees.
- Provide hazard communication training to AECOM employees and file documents of this training.
- Review SDS for adequacy of completion to meet the OSHA and Canadian standard and returning them to supplier, if necessary.

4.1.2 **Project Manager / Site Safety Officer (SSO)**

- Access or obtain, and maintain copies of SDS from:
  - All AECOM subcontractors bringing chemicals onto the project site; and
  - The client, for all of the client's chemicals to which AECOM or AECOM subcontract employees are potentially exposed.

4.1.3 **Office Manager (Operations)**

- Have an operations-specific, written hazard communication program which at least describes how the requirements of this Procedure and the US OSHA and Canadian Hazard Communication requirements for labels and other forms of warning, material safety data sheets, and employee information and training will be met.
- Appoint an SDS administrator for their establishment if they store or use hazardous substances.
- Confirm, if required, that the SDS Administrator maintains an HSI for their establishment.
- Confirm that SDS are available for all substances listed on their establishment's HSI.
- Confirm that a copy of this Procedure and the site-specific SDS are available to all employees. Employees shall be instructed in the location of this Procedure and the SDS.
- Confirm that all employees in their office affected by the HAZCOM standard are provided with the appropriate training, including new employees.

4.1.4 **Supervisor**

- Confirm that all employees under their supervision have received the initial and periodic training required by this SOP prior to assigning employees to tasks involve the use of, or potential exposure to, hazardous substances.
- Notify employees of hazardous substances covered by this SOP that are used in their work area.
- Determine the potential fire, toxic, or reactivity hazards which are likely to be encountered in the handling or utilization of a hazardous substance and will communicate this information to their affected employees, before any are permitted to work with it.
- Confirm that an SDS is available for each hazardous substance used, or potentially encountered, in the work areas or on the projects that are under their supervision.
- Notify subcontractors (working for AECOM) of any hazardous substances that are used or stored by AECOM to which the subcontractor's employees may be exposed.

- Notify clients or property owner/operators of chemicals brought onto their property by AECOM or AECOM's subcontractors.
- Request SDSs from all subcontractor organization for the relevant chemicals they bring onto an AECOM controlled site.

4.1.5 **Employee**

- Confirm that they have received appropriate hazard communication training prior to working with materials that fall under the standard.
- Only work with materials for which they have been instructed on how to find an SDS and how to work with that material safely.
- Provide a copy of all SDSs received to the SDS Administrator at their facility.
- Verify that an SDS is available in their work area for each hazardous substance that they use.

4.2 General Procedure

4.2.1 Confirm that containers of hazardous substances that they use are properly labelled. All employees have a right to, and should, know the properties and potential hazards of substances to which they may be exposed.

4.2.2 Should AECOM assign employees that do not read and speak English to tasks with chemical exposures, communications will be provided in the language understood by that employee.

4.3 Employee Information and Training

4.3.1 Each AECOM employee who handles or is exposed to hazardous substances must be provided information and training, refer to *S3NA-003-PR1 SH&E Training*, on hazardous substances in their work area:

- At the time of their initial assignment; and
- Whenever a new hazard is introduced into their work area.

4.3.2 As a minimum, the training requirements apply to employees in the following job categories:

- All employees who perform field work that involves the use of, or potential exposure to, hazardous substances; and
- Laboratory Employees.

4.3.3 The Initial Training will provide instruction in the following:

- Methods and observations that may be used to detect the presence or release of a hazardous substance in the work area (such as personal monitoring, visual appearance or odor of hazardous substances being released, etc.);
- The physical and health hazards of substances in the work area and measures and procedures AECOM has implemented to protect employees; and
- The details of this hazard communication program (SOP), including an explanation of the labelling system and the SDS, and how he/she can obtain and use appropriate hazard information.
- Any operations in their work area in which hazardous substances are present;
- Location and availability of this written hazard communications program (SOP);
- Their right to personally receive information regarding hazardous substances to which they may be exposed;
- Their right to have their physician receive information regarding hazardous substances to which they may be exposed; and

- Their right against discharge or other discrimination (in California) due to the employee's exercise of rights afforded pursuant to provisions of the California Hazardous Substances Information and Training Act.

4.3.4 Periodic Training and Training for Non-Routine Tasks

Additional training will be provided to employees who have received initial training whenever:

- A new hazardous substance is introduced into their work area;
- A new or revised SDS is received, which indicates significantly increased risks to employee health as compared to those stated on the previous SDS; and
- Non-routine tasks are performed, which will potentially result in exposure to hazardous substances, or exposure under circumstances, which were not addressed during initial training.

Supervisors, in coordination with their **Region SH&E Manager**, shall provide such training through an explanation of the information on the contents of the SDS for that substance.

When training their employees, supervisors shall explain:

- Any health hazards associated with use of the substance or mixture;
- Proper precautions for handling;
- Necessary personal protective equipment or other safety precautions to prevent or minimize exposure; and
- Emergency procedures for spills, fire, disposal, and first aid.

For most projects involving field work, this periodic training requirement will be facilitated through the implementation of the site specific HASP that has been developed for the project.

4.3.5 Documentation of Initial and Periodic Training

- All training required shall be documented at the time it is performed by having the employee sign a copy of a training attendance sheet.

4.4 Hazardous Waste Exemption

4.4.1 In the U.S., hazardous wastes are excluded from the state and federal Hazard Communication standards. AECOM employees who handle or are otherwise exposed to hazardous wastes are covered by the requirements of the Resource Conservation and Recovery Act (RCRA) and other local waste related laws and regulations and the OSHA Hazardous Waste Operations and Emergency Response (HAZWOPER) standard at 29 CFR 1910.120 and *S3NA-509-PR1 Hazardous Waste Operations and Emergency Response.*

4.5 Hazardous Substance Inventory and Chemical Usage

Establishment of a Specific Hazardous Substance Inventory (HSI) or WHMIS Log, as referenced or contained within the safe to work plan, refer *S3NA-209-PR1 Project Hazard Assessment and Planning*, shall include:

- If an AECOM establishment uses or stores additional hazardous substances, an establishment-specific HSI must be maintained at that establishment.
- If it is determined that an office-specific HSI is needed, the **Office Manager (Operations)** shall assure that one is developed and maintained by someone appointed as the establishment's SDS Administrator.
- The content of the office-specific written inventory shall be updated as new hazardous substances are procured for, or removed from, the establishment and shall be verified by the **Region SH&E Manager** through regular inspections of the establishment.

- In order to meet the 30-years-after-employment-termination record retention requirement, the office or project specific HSIs shall be managed as a permanent record.

Prior to using any chemical, a Task Hazard Analysis (THA) shall be completed by the employees assigned to use the chemical. The analysis will identify the hazards associated with the tasks to be performed and prescribe the Personal Protective Equipment (PPE) to be used, refer to *S3NA-208-PR1 Personal Protective Equipment Program.*

4.6 Safety Data Sheets (SDS)

4.6.1 Establishment-Specific SDS Inventory

- If it is determined that an AECOM establishment is required to maintain an establishment-specific inventory SDSs for the specific hazardous substances must be maintained on file at that establishment.
- The **Region SH&E Manager** shall audit the local office or project for SDS request and maintenance and report deficiencies to the appropriate management level, as necessary, to assure compliance with this SOP.

4.6.2 Field Project Sites and Client Facilities

- The **Project Manager** and/or the **Site Safety Officer** shall access or obtain, and maintain copies of SDS from:
  - All AECOM subcontractors bringing chemicals onto the project site; and
  - The client, for all of the client's chemicals to which AECOM or AECOM subcontract employees are potentially exposed.

4.6.3 Employee Access to SDSs

SDSs should be maintained at the local establishment that uses that hazardous substance. Copies of the SDS should be made available to the employee upon request to the office's SDS Administrator.

4.6.4 Field Access to SDSs

When hazardous substances are brought into the field, the user must assure that a copy of the SDS for that substance accompanies it and is available at the field location where it is to be used.

4.6.5 SDSs for AECOM Products

It is unlikely that AECOM activities would create a chemical for which a new SDS were needed. If such a chemical were created, the **SH&E Department** shall work with the appropriate operations groups to draft, review, and publish the new SDS.

4.6.6 Content of the Safety Data Sheet:

- Safety Data Sheets, previously referred to as Material Safety Data Sheets, will now require a 16-section format that is essentially the same as the ANSI standard for *Hazardous Workplace Chemicals-Hazard Evaluation and Safety Data Sheets and Precautionary Labeling Preparation* (ANSI Z400.1 & Z129.1 – 2010).
- Section 1, Identification includes product identifier; manufacturer or distributor name, address, phone number; emergency phone number; recommended use; restrictions on use.
- Section 2, Hazard(s) identification includes all hazards regarding the chemical; required label elements.
- Section 3, Composition/information on ingredients includes information on chemical ingredients; trade secret claims.
- Section 4, First-aid measures includes important symptoms/ effects, acute, delayed; required treatment.

- Section 5, Fire-fighting measures lists suitable extinguishing techniques, equipment; chemical hazards from fire.
- Section 6, Accidental release measures lists emergency procedures; protective equipment; proper methods of containment and cleanup.
- Section 7, Handling and storage lists precautions for safe handling and storage, including incompatibilities.
- Section 8, Exposure controls/personal protection lists OSHA's Permissible Exposure Limits (PELs); Threshold Limit Values (TLVs); appropriate engineering controls; personal protective equipment (PPE).
- Section 9, lists the chemical's characteristics.
- Section 10, Stability and reactivity lists chemical stability and possibility of hazardous reactions.
- Section 11, Toxicological information includes routes of exposure; related symptoms, acute and Section 9, Physical and chemical properties chronic effects; numerical measures of toxicity.
- Section 12, Ecological information
- Section 13, Disposal considerations
- Section 14, Transport information
- Section 15, Regulatory information
- Section 16, Other information, includes the date of preparation or last revision.

SDSs that do not contain this information shall be returned to the distributor or manufacturer to be updated.

4.6.7 Trade Secrets

Some hazardous substance suppliers may claim the information requested on SDSs is proprietary and not provide the information to AECOM.

When SDSs supplied to the **Region SH&E Manager** indicate that proprietary information has been withheld, the **Region SH&E Manager** will either obtain the necessary information to make a hazard assessment or reject the material for use within AECOM.

4.6.8 For Canadian operations, all relevant SDS must be current (no more than 3 years old) and readily available (in French and English) for all hazardous materials.

4.7 Labeling

4.7.1 Containers of hazardous substances used or stored in each AECOM establishment must be labeled, tagged or marked with the following information:

- Product name or Identifier;
- Hazard Pictogram;
- Signal Word;
- Physical, Health, Environmental Statements;
- Supplemental Information;
- Precautionary Measures and Pictograms;
- First Aid Statements;
- Name and Address of Company; and
- Telephone Number.

4.7.2 Labels on containers shall not be removed or defaced. Labels or other forms of warning shall be legible, in English and French (Canada), and prominently displayed on the container.

4.7.3 Any failure to have the appropriate labeling information on a container at any time will be cause to suspend use of the product until the container is properly labeled.

4.7.4 Carcinogen Labeling

Chemicals which have been indicated as positive or suspect carcinogens by either OSHA, ACGIH, the International Agency for Research on Cancer (IARC) (World Health Organization), or the National Toxicology Program (NTP) will be considered to be carcinogenic for purpose of the HCS. The following pictogram will be used to identify carcinogens:



4.7.5 Stationary Process Containers

If there is stationary process equipment within a work area, signs, placards, process sheets, batch tickets, operating procedures, or other such written materials may be used in lieu of fixed labels on the containers, as long as the alternative method conveys the appropriate hazard information. The written materials shall be readily accessible to the employees in the work area.

4.7.6 Portable Containers

Portable containers of hazardous substances need not be labelled when the substance is transferred from labelled containers and is intended for immediate use of the employee who performs the transfer.

Containers of hazardous substances transferred from labelled containers and not intended for the immediate use of the employee performing the transfer shall be labelled with the chemical name and a hazard warning label in accordance with the National Fire Protection Association's (NFPA) 704M Hazard Identification System shall be attached.

4.8 Chemical Storage

4.8.1 Hazardous chemicals are to be stored in labeled containers with the lids securely closed and taped if possible.

4.8.2 Flammable and combustible materials must be stored in fire impervious cabinets in designated stockroom areas. Chemicals must be stored in compliance with instructions provided on their labels, SDS, or the manufacturer's specifications.

4.8.3 All hazardous chemicals must be stored in a manner that prevents spillage and leakage from exposing people or the environment to the chemical.

4.8.4 Hazardous chemicals shall not be stored with foods or beverages. Food and beverages shall not be consumed in areas where hazardous chemicals are used or stored.

4.9 Chemical Use in Offices

4.9.1 In general, hazardous substances should not be taken into office areas, conference rooms, or break areas, contact the **SH&E Department** for guidance If this general requirement is infeasible.

4.9.2 General exceptions to this rule are the following:

- Liquid paper;
- Toner;
- Cleaners;
- Isobutylene calibration gas; and
- pH calibration solutions for instruments.

4.9.3 Each office or location using or storing hazardous materials will develop a written office/ location-specific Hazard Communication/WHMIS Program.

4.9.4 If the local office decides to implement the requirements of the standard in any way that differs from this procedure, they shall verify the changes with the **SH&E Department**, document the changes, and communicate the differences to all affected employees.

4.10 Canada-specific

4.10.1 Consumer products are exempt from supplier labels and SDS requirements. Some cleaning solvents may be packaged as consumer products and these must be labeled in accordance with the Consumer Product Act requirements.

4.10.2 In addition to the labelling of storage containers in the workplace, the contents of process piping (including valves), process vessels and reaction vessels are required to be identified through the use of colour coding, labels, placards or other modes of identifications that must be communicated to workers through training programs. It is very important for employees to be aware of and understand Client labelling requirements for these types of process systems.

## 5.0 Records

5.1 None

## 6.0 Attachments

6.1 None

# S3NA-510-PR Hearing Conservation Program

## 1.0 Purpose and Scope

1.1 Establishes procedures to ensure that personal noise exposure remains within acceptable limits and establishes the requirements of an acceptable hearing conservation program.

1.2 This procedure applies to all AECOM Americas-based employees and operations.

## 2.0 Terms and Definitions

2.1 **Decibel (dB):** Logarithmic unit of measurement of sound level.

2.2 **Action Level:** An eight-hour, time-weighted average of 85 decibels measured on the A-scale, slow response, or equivalently; a noise dose of 50 percent.

2.3 **Standard Threshold Shift (STS):** When one's hearing threshold has changed (relative to the baseline audiogram) an average of 10 dB or more at 2000, 3000, or 4000 Hz in either ear).

2.4 **Noise Reduction Rating (NRR):** The measure, in decibels, of how well a hearing protector reduces noise, as specified by the Environmental Protection Agency.

## 3.0 Attachments

3.1 S3NA-510-FM Site-Specific Hearing Conservation Program

3.2 S3NA-510-WI Hearing Protection Guidelines

## 4.0 Procedure

### 4.1 Roles and Responsibilities

4.1.1 **Region SH&E Managers** or their designate

- Provide access to initial and refresher hearing conservation training.
- Inform employees of noise monitoring results when full-shift noise exposure is at or above the action level.
- Designate areas and tasks where employees' exposure is at or above the action level.
- Conduct noise monitoring, as applicable, and support hazardous noise assessment/evaluation efforts.

4.1.2 **Project or Office Managers**

- Implement the hearing conservation program.
- Confirm that a hazardous noise assessment/evaluation has been conducted.
- Confirm that a hazardous noise assessment/evaluation is conducted when a change in equipment, procedures, or personnel may increase employee exposure to noise.
- Implement engineering controls to reduce noise levels when such measures are considered feasible and when required by regulation.
- Purchase, monitor, and replenish for employees' use a supply of hearing protection devices with a minimum Noise Reduction Rating (NRR) of 26 dBA.
- Confirm that individuals included in the program receive training and that the training meets the criteria outlined in this program.
- Investigate and implement corrective action to all reports of non-conformance with this procedure, including reports of standard threshold shifts or employees' failure to wear hearing protectors in designated areas.


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4.1.3 **Supervisors**

- Maintain an awareness of the noise levels in work areas for which he/she is responsible.
- Place warning signs in areas where sound levels would require the use of hearing protectors.
- Request that a hazardous noise assessment/evaluation be conducted when a change in equipment, procedures, or personnel may increase employee exposure to noise.
- Confirm that all employees are aware of the requirements for hearing protection for any designated area or task.
- Enforce the use of hearing protection by employees in designated areas and for designated tasks.

### 4.1.4 Employees

- Comply with the requirements of the Hearing Conservation program.
- Wear hearing protection devices in designated areas or for designated tasks.
- Inspect and maintain hearing protection devices.
- Report any suspected change in noise levels of work area to supervisor.
- Report any signs or symptoms experienced that could be the result of overexposure to noise to supervisor.
- Participate in audiometric testing and hearing protection training when required.

## 4.2 Requirements

4.2.1 The requirements of this procedure apply to all locations/facilities/projects where employee noise exposure may equal or exceed 50 percent of the allowable noise dose or Permissible Exposure Limit (PEL). Table 1 provides information relative to the current PEL for noise exposure expressed as a time-weighted average.

**Table 1. Permissible Exposure Limit**

| SOUND LEVEL (dBA) | TIME (hours) |
|---|---|
| 85 | 8 |
| 90 | 4 |
| 95 | 2 |
| 100 | 1 |
| 105 | 0.5 |
| 110 | 0.25 |
| 115 | 0.125 |

4.2.2 Table 2 provides information relative to the Action Level (or 50 percent allowable noise dose) expressed as a time-weighted average. The action levels outlined in the table below and PELs described in Table 1 are calculated without regard to the protection afforded by the use of hearing protectors.

**Table 2. Action Levels for Hearing Conservation Program**

| SOUND LEVEL (dBA) | TIME (hours) |
|---|---|
| 85 | 4 |
| 90 | 2 |
| 95 | 1 |
| 100 | 0.5 |
| 105 | 0.25 |
| 110 | 0.125 |
| 115 | 0.0625 |


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## 4.3 Training Program

4.3.1 All employees with potential exposure above the action levels established in Table 2 of this procedure or who otherwise utilize any type of hearing protector will participate in a hearing conservation training program.

4.3.2 The initial and subsequent annual hearing conservation training will address, at a minimum, the following topics:

- The effects of noise on hearing, recognizing hazardous noise, and symptoms of overexposure to hazardous noise.
- When and/or where hearing protectors are required to be worn.
- The purpose of hearing protectors.
- The advantages, disadvantages, and effectiveness of various types of protectors.
- Instructions on how to select, use, fit, and care for hearing protectors.
- The purpose of audiometric testing, including an explanation of the test procedures.
- Hearing Conservation Program requirements and responsibilities.

4.3.3 Hearing protection training is conducted biannually for all affected employees or more frequently for employees who do not properly use hearing protectors or otherwise fail to comply with this policy.

## 4.4 Audiometric Testing

4.4.1 All AECOM personnel with exposure greater than the action level may be enrolled in the medical surveillance program and undergo a baseline audiogram within 6 months of the first exposure. Thereafter, annual audiograms will be compared with the baseline exam.

4.4.2 Enrolled employees will receive audiograms during their exit physicals.

4.4.3 When a Standard Threshold Shift (STS), as identified by the AECOM Medical Consultant, is noted between the last valid baseline and the annual audiogram, the following steps will be taken:

- A retest will be conducted within 30 days to confirm the STS. The employee will not be exposed to workplace/hobby noise for 14 hours or will be provided with adequate hearing protection prior to testing.
- If the STS persists, ear protection will be upgraded to one with a greater NRR. The minimum NRR will be 26 dBA.
- The employee will be counselled and AECOM will obtain information regarding the employee's possible noise exposure away from the workplace or existing ear pathology.
- Qualified medical personnel will review the audiograms. This group will determine the need for a medical referral.
- The employee will be notified in writing by either the SH&E Department or the AECOM Medical Provider of the STS, within 21 days of determination, as required by regulation.
- The employee's supervisor will be notified of the shift in hearing threshold.

4.4.4 If the employee who has experienced a STS is exposed to 85 dBA for eight hours or 80 dBA for 12 hours, mandatory use of ear protection is required.

## 4.5 Monitoring of Noise Levels

4.5.1 As deemed necessary by an SH&E Professional, or a Project Safety Plan AECOM will periodically monitor personal and area noise levels using noise dosimetry and/or sound level meters.

## 4.6 Hearing Protectors

4.6.1 Selection of appropriate hearing protectors must be based on actual or anticipated exposure levels. At a minimum, hearing protectors must provide a level of protection that brings actual or anticipated exposure below the PEL established for the time period shown in the table above. Additional information relative to hearing protector use is as follows:

- Hearing protection will be mandatory for all employees exposed to 85 dBA for eight hours.


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- Hearing protection will be mandatory for all employees working in any area that has not been evaluated for noise exposure and the ambient noise level in the area is such that you must raise your voice to have a normal conversation with someone less than four feet from you and/or when within 25 feet of an operating piece of heavy equipment.
- Hearing protection will be mandatory for all employees who work on or near heavy equipment unless personal dosimetry or other techniques have been used to document actual exposure.
- Hearing protectors will be made available to all employees at no cost to the employees who may be exposed to 85 dBA for eight hours.
- Hearing protection will be mandatory for all employees exposed to 85 dBA for any period of time and who have experienced an STS.

## 5.0 Records

5.1.1 Noise exposure measurement records will be retained for three years at the project/facility.

5.1.2 Audiogram records will be retained in the employee's medical records as per AECOM's Medical Surveillance Procedure for a period as directed by regulation or AECOM's Medical Provider.

5.1.3 Employee training session documentation will be retained for the duration of employment.

## 6.0 References

6.1 29 CFR 1910.95 Occupational Noise Exposure

6.2 Canadian Standards Association (CSA) Standard Z94.2-M1984

6.3 American National Standards Institute (ANSI) S3.19-1974.

6.4 S3NA_003_PR SH&E Training

6.5 S3NA_208_PR Personal Protective Equipment

6.6 S3NA_605_PR Medical Surveillance


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# S3NA-510-WI Hearing Protection Guidelines

## 1.0 Comparison

| Comparison of Hearing Protection | |
|---|---|
| **Ear Plugs** | **Ear Muffs** |
| ***Advantages:***<br>• small and easily carried<br>• convenient to use with other personal protection equipment (can be worn with ear muffs)<br>• more comfortable for long-term wear in hot, humid work areas<br>• convenient for use in confined work areas | ***Advantages:***<br>• less attenuation variability among users<br>• designed so that one size fits most head sizes<br>• easily seen at a distance to assist in the monitoring of their use<br>• not easily misplaced or lost<br>• may be worn with minor ear infections |
| ***Disadvantages:***<br>• requires more time to fit<br>• more difficult to insert and remove<br>• require good hygiene practices<br>• may irritate the ear canal<br>• easily misplaced<br>• more difficult to see and monitor usage | ***Disadvantages:***<br>• less portable and heavier<br>• more inconvenient for use with other personal protective equipment<br>• more uncomfortable in hot, humid work area<br>• more inconvenient for use in confined work areas<br>• may interfere with the wearing of safety or prescription glasses; wearing glasses results in breaking the seal between the ear muff and the skin and results in decreased hearing protection |

## 2.0 Care and Use

2.1 Follow the manufacturer's instructions.

2.2 Check hearing protection regularly for wear and tear.

2.3 Replace ear cushions or plugs that are no longer pliable.

2.4 Replace a unit when head bands are so stretched that they do not keep ear cushions snugly against the head.

2.5 Disassemble ear muffs to clean.

2.6 Wash ear muffs with a mild liquid detergent in warm water, and then rinse in clear warm water. Sound-attenuating material inside the ear cushions must not get wet.

2.7 Use a soft brush to remove skin oil and dirt that can harden ear cushions.

2.8 Squeeze excess moisture from the plugs or cushions and then place them on a clean surface to air dry.


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# S3NA-510-FM Site-Specific Hearing Conservation Program

## Site (Project)

## 1.0 Monitoring

As per regulation, noise monitoring will be conducted by the following procedure:

Such monitoring will consist of (*check those that apply*):

☐ Noise Dosimetry ☐ Sound Level Meter Survey

Specific instrumentation to be used is (make/model):

| Make | Model |
|---|---|
| | |
| | |
| | |

and will be calibrated at a frequency of and documented in the .

Monitoring strategy is as follows (*list all equipment and activities on site that may involve sound pressure levels above 80 dBA and an explanation of the strategy to document actual exposures*):

| Area/Equipment | Monitoring Strategy |
|---|---|
| | |
| | |
| | |
| | |
| | |

Where areas or equipment are not clearly identified, all monitoring will be documented utilizing an illustrated layout (*attach form developed for the specific site*). Monitoring frequency will be in accordance with the strategy outlined above and when the following changes in site conditions/activities occur:

| |
|---|
| 1. |
| 2. |
| 3. |
| 4. |
| 5. |


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## 2.0 Employee Notification

All site employees exposed above the regulated action level (85 dBA – 8 hour TWA) will be notified of the monitoring results by (*insert name/title*) at an interval not to exceed after completion of monitoring.

Notification shall be written, with a copy to the SH&E Department. Documentation of employee notifications and corresponding signatures of notified employees will be kept in the site health and safety logbook/files.

## 3.0 Observation of Monitoring

All employees affected by the monitoring, or a designated employee representative, shall be given the opportunity to observe noise monitoring procedures. This will be achieved by:

| |
|---|
| |
| |
| |

## 4.0 Audiometric Testing Program and Requirements

AECOM personnel who perform field activities where noise exposure above action levels is expected are required to participate in an audiometric testing program. Additionally, any subcontractors performing work on AECOM projects where noise levels exceeding action level will be required to provide documentation that they participate in an audiometric testing program that meets the applicable regulations. Documentation of participation in the testing program will be maintained by and will be located at .

## 5.0 Hearing Protectors and Estimating Attenuation

A selection of suitable hearing protectors will be made available to all employees who are expected to have 8-hour TWA noise exposures above 85 dBA. The types anticipated to be available include:

| Protection Type | Attenuation |
|---|---|
| | |
| | |
| | |
| | |

Hearing protector attenuation will be evaluated by for specific noise environments according to the following method prior to determining their suitability for use:

| |
|---|
| 1. |
| 2. |
| 3. |

The following site personnel will be required to wear hearing protectors during specific activities and the results of site-specific monitoring conducted in accordance with this procedure. (*This section can be completed after monitoring, if necessary*).

| Employee Name | Activity Type | Type of Protection |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

Hearing protectors will be properly fitted by upon initial distribution to site workers.

Training in the use and care of hearing protectors shall be conducted by during the initial site-specific health and safety training. Training contents shall meet the requirements set forth in this procedure and the applicable regulations.

Hearing protectors will be distributed by from the storage location at the .

## 6.0 Access to Information and Training Materials

All information required by regulation to be made available to the employees will be posted by (*insert name/title*) at the .

Local Occupational Health and Safety Regulations will also be kept on site.

## 7.0 Recordkeeping

Records required by AECOM's Hearing Conservation Program and Regulations shall be completed by and shall be maintained at the and placed on permanent file at the for the minimum duration required by the standard. Employees can access their individual records by contacting .

All records required by this section will be transferred to any employee's successive employer if AECOM ceases to do business.

## 8.0 Approvals

Project Manager: Date:

SH&E Representative: Date:


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# S3NA-511-PR Heat Stress

## 1.0 Purpose and Scope

1.1 Establishes a heat stress prevention program to help ensure that employees know and recognize the symptoms of heat stress-related illnesses and are prepared to take appropriate corrective action.

1.2 This procedure applies to all AECOM North America-based employees and operations.

## 2.0 Terms and Definitions

2.1 **Acclimated**: Workers who have developed physiological adaptation to hot environments characterized by increased sweating efficiency, circulation stability, and tolerance of high temperatures without stress. Acclimatization occurs after 7 to 10 consecutive days of exposure to heat and much of its benefit may be lost if exposure to hot environments is discontinued for a week.

2.2 **Chemical Protective Clothing (CPC):** Apparel that is constructed of relatively impermeable materials intended to act as a barrier to physical contact of the worker with potentially hazardous materials in the workplace. Such materials include: Tyvek® coveralls (all types) and polyvinyl chloride (PVC) coveralls and rain suits.

2.3 **Unacclimated**: Workers who have not been exposed to hot work conditions for one week or more or who have become heat-intolerant due to illness or other reasons.

2.4 **Heat Cramps**: A form of heat stress brought on by profuse sweating and the resultant loss of salt from the body.

2.5 **Heat Exhaustion**: A form of heat stress brought about by the pooling of blood in the vessels of the skin and in the extremities.

2.6 **Heat Rash**: A heat-induced condition characterized by a red, bumpy rash with severe itching.

2.7 **Heat Stress.** The combination of environmental and physical work factors that constitute the total heat load imposed on the body.

2.8 **Heat Stroke**: The most serious form of heat stress, which involves a profound disturbance of the body's heat-regulating mechanism.

2.9 **Sunburn**: Is caused by unprotected exposure to ultraviolet light that is damaging to the skin. The injury is characterized by red painful skin, blisters, and/or peeling.

## 3.0 Attachments

3.1 S3NA-511-FM Heat Stress Monitoring Log

3.2 S3NA-511-WI1 Temperature Thresholds

3.3 S3NA-511-WI2 Symptoms and Treatment

3.4 S3NA-511-ST Heat Exposure

## 4.0 Procedures

### 4.1 Restrictions

4.1.1 Staff working in extreme heat or sun for extended periods of time away from a shelter or vehicle must not work alone.

4.1.2 Staff shall not be exposed to levels that exceed those listed in the screening criteria for heat stress exposure in the heat stress and strain section of the ACGIH Standard.

4.1.3 Clothing corrections shall be applied in accordance with the heat stress and strain section of the ACGIH Standard.


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## 4.2 Roles and Responsibilities

4.2.1 **Project Managers'/field task managers'** responsibilities:

- Evaluate the need for heat stress prevention measures and incorporate as appropriate into the Health and Safety Plan.
- Implement heat stress prevention measures, as applicable, at each work site.
- Develop/coordinate a work-rest schedule, as applicable.
- Ensure heat stress hazard assessments/evaluations were completed for the planned activities.
- Assign personnel physically capable of performing the assigned tasks.
- Ensure that personnel are properly trained in the recognition of heat stress-related symptoms.

4.2.2 **Region SH&E Managers'** responsibilities**:**

- Provide heat stress awareness training.
- Assist project teams develop appropriate work-rest schedules.
- Conduct/support incident investigations related to potential heat stress-related illnesses.

4.2.3 **Site Supervisors'** responsibilities**:**

- Identify those tasks that may be most impacted by heat stress and communicate the hazard to the assigned employees.
- Ensure that employees have been trained on the recognition of heat stress-related illness.
- Ensure that adequate supplies of appropriate fluids are readily available to employees.
- Ensure that a proper rest area is available.
- Conduct heat stress monitoring, as applicable.
- Implement the work-rest schedule.
- Ensure that first aid measures are implemented once heat stress symptoms are identified.
- Ensure personnel are physically capable of performing the assigned tasks and are not in a physically compromised condition.
- Report all suspected heat stress-related illnesses.

4.2.4 **Employees'** responsibilities:

- Observe each other for the early symptoms of heat stress-related illnesses.
- Maintain an adequate intake of available fluids.
- Be familiar with heat stress hazards, predisposing factors, and preventative measures.
- Report to work in a properly rested and hydrated condition.
- Report all suspected heat stress-related illnesses.

## 4.3 Controls

4.3.1 If staff are or may be exposed, the supervisor shall:

- Conduct a heat stress assessment to determine the potential for hazardous exposure of workers, and
- Develop and implement a heat stress exposure control plan.

4.3.2 If staff are or may be exposed, the supervisor shall implement engineering controls (e.g., shelters, cooling devises, etc.) to reduce the exposure of staff to levels below those listed in the screening criteria for heat stress exposure in the heat stress and strain section of the ACGIH Standard.

4.3.3 If engineering controls are not practicable, the supervisor shall reduce the exposure of workers to levels below those listed in the screening criteria for heat stress exposure in the heat stress and strain section of the ACGIH Standard by providing administrative controls, including a work-rest cycle or personal protective equipment, if the equipment provides protection equally effective as administrative controls.

4.3.4 If staff are or may be exposed, the supervisor shall provide and maintain an adequate supply of cool, potable water close to the work area for the use of a heat exposed worker.

4.3.5 If a staff person shows signs or reports symptoms of heat stress or strain, they shall be removed from the hot environment and treated by an appropriate first aid attendant, if available, or by a physician.


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4.3.6 Heat stress can be a significant field site hazard, especially for workers wearing CPC. The workforce will gradually work up to a full workload under potentially stressful conditions to allow for proper acclimation.

4.3.7 Site personnel shall be instructed in the recognition of heat stress symptoms, the first aid treatment procedures for severe heat stress, and the prevention of heat stress injuries. Workers must be encouraged to immediately report any heat stress that they may experience or observe in fellow workers. Supervisors must use such information to adjust the work-rest schedule to accommodate such problems.

4.3.8 Wherever possible, a designated break area should be established in an air conditioned space, or in shaded areas where air conditioning is impractical. The break area should be equipped to allow workers to loosen or remove protective clothing, and sufficient seating should be available for all personnel. During breaks, workers must be encouraged to drink plenty of water or other liquids, even if not thirsty, to replace lost fluids and to help cool off. Cool water should be available at all times in the break area, and in the work area itself unless hygiene/chemical exposure issues prevent it.

## 4.4 Symptoms and Treatment

4.4.1 Workers who exhibit ANY signs of significant heat stress (e.g., profuse sweating, confusion and irritability, pale, clammy skin), shall be relieved of all duties at once, made to rest in a cool location, and provided with large amounts of cool water.

4.4.2 Anyone exhibiting symptoms of heat stroke (red, dry skin, or unconsciousness) must be taken immediately to the nearest medical facility, taking steps to cool the person during transportation (clothing removal, wet the skin, air conditioning, etc.).

4.4.3 Severe heat stress (heat stroke) is a life-threatening condition that must be treated by a competent medical authority.

## 4.5 Prevention

4.5.1 All staff working in extreme heat or sun should understand the following guidelines for preventing and detecting heat exhaustion and heat stroke.

- If you experience heat exhaustion or heat stroke you must immediately seek shelter and water.
- Take frequent short breaks in areas sheltered from direct sunlight; eat and drink small amounts frequently.
- Try to schedule work for the coolest part of the day, early morning and evening.

4.5.2 Prevention of heat-related illnesses:

- Avoid strenuous physical activity outdoors during the hottest part of the day.
- Wear a hat and light-colored, loose-fitting clothing to reflect the sun.
- Avoid sudden changes of temperature. Air out a hot vehicle before getting into it.
- If you take diuretics, ask your doctor about taking a lower dose during hot weather.
- Drink 8 to 10 glasses of water per day. Drink even more if you are working or exercising in hot weather.
- Avoid caffeine and alcohol as they increase dehydration.
- If you exercise strenuously in hot weather, drink more liquid than your thirst seems to require.

## 4.6 Personal Protective Equipment

- Wear a hat and light-colored, loose-fitting clothing to reflect the sun.
- Apply sunscreen to exposed skin (SPF 30 or greater, follow directions on label).
- Wear sunglasses with UV protection.
- Pack extra water to avoid dehydration (try freezing water in bottles overnight to help keep the water cooler for longer during the day).

## 4.7 Work-Rest Schedule Practices

- Intake of fluid will be increased beyond that which satisfies thirst, and it is important to avoid "fluid debt," which will not be made up as long as the individual is sweating.
- Two 8-ounce glasses of water should be taken prior to beginning work, then up to 32 oz. per hour during the work shift; fluid replacement at frequent intervals is most effective.


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- The best fluid to drink is water; liquids like coffee or soda do not provide efficient hydration and may increase loss of water.
- If commercial electrolyte drinks (e.g., Gatorade) are used, the drink should be diluted with water, or 8 ounces of water should be taken with each 8 ounces of electrolyte beverage.
- Additional salt is usually not needed and salt tablets should not be taken.
- Replacement fluids should be cool, but not cold.
- Breaks will be taken in a cool, shaded location, and any impermeable clothing should be opened or removed.
- Dry clothing or towels will be available to minimize chills when taking breaks.
- Manual labor will not be performed during breaks, other than paperwork or similar light tasks.
- Other controls that may be used include:
    - Scheduling work at night or during the cooler parts of the day (6 am–10 am, 3 pm–7 pm).
    - Erecting a cover or partition to shade the work area.
    - Wearing cooling devices such as vortex tubes or cooling vests beneath protective garments. If cooling devices are worn, only physiological monitoring will be used to determine work activity.

## 4.8 Evaluating the Work-Rest Schedule's Effectiveness

4.8.1 Once a work-rest schedule is established, the work supervisor must continually evaluate its effectiveness through observation of workers for signs/symptoms of heart stress. Measurement of each worker's vitals (e.g., pulse, blood pressure, and temperature) can provide additional information in determining if the schedule is adequate, and is accomplished as follows:

4.8.2 At the start of the workday each worker's baseline pulse rate (in beats per minute – bpm) is determined by taking a pulse count for 15 seconds and multiplying the result by four or an automated pulse count device may be utilized. Worker pulse rates can then be measured at the beginning and end of each break period to determine if the rest period allows adequate cooling by applying the following criteria:

- Each worker's maximum heart rate at the start of any break should be less than [180 minus worker's age] bpm. If this value is exceeded for any worker, the duration of the following work period will be decreased by at least 10 minutes.
- At the end of each work period all workers' heart rates must have returned to within +10% of the baseline pulse rate. If any worker's pulse rate exceeds this value the break period will be extended for at least 5 minutes, at the end of which pulse rates will be remeasured and the end-of-break criteria again applied.

4.8.3 Use a clinical thermometer or similar device to measure the oral/ear temperature at the beginning (before drinking liquids) and end of each break period and apply the following criteria:

- If the oral temperature exceeds 99.6$^{o}$F, shorten the next work cycle by one-third without changing the rest period.
- If the oral temperature still exceeds 99.6$^{o}$F (36.6$^{o}$C) at the beginning of the next rest period, shorten the following work cycle by one-third.

4.8.4 Use of an automated or similar blood pressure device will be used to assess each employee's blood pressure at the beginning and end of each break period to determine if the rest period allows adequate cooling by applying the following criteria:

- If the blood pressure of an employee is outside of 90/60 to 150/90, then the employee will not be allowed to begin or resume work; extend the break period by at least five minutes, at the end of which blood pressure rates will be remeasured and the end-of-break criteria again applied.

4.8.5 All physiological monitoring of heat stress will be documented using *S3NA-511-FM Heat/Cold Stress Monitoring Log*.

## 4.9 Training

4.9.1 Project staff and their supervisors that may be exposed to the hazard will be oriented to the hazard and the controls prior to work commencing.

4.9.2 Those personnel potentially exposed to heat stress will receive training including, but not limited to

- Sources of heat stress, influence of protective clothing, and importance of acclimatization.

- How the body handles heat.
- Recognition of heat-related illness symptoms.
- Preventative/corrective measures.
    - Employees will be informed of the harmful effects of excessive alcohol consumption in the prevention of heat stress.
    - All employees will be informed of the importance of adequate rest and proper diet in the prevention of heat stress.
- First aid procedures for heat stress-related illnesses.

## 5.0 Records

5.1 None

## 6.0 References

6.1 S3NA-003-PR SH&E Training

6.2 S3NA-208-PR Personal Protective Equipment

6.3 S3NA-314-PR Working Alone and Remote Travel


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# S3NA-511-FM Heat Stress Monitoring Log

The purpose of this form is to track entry into hot zones wearing chemically protective clothing and monitor employees for heat stress-related illness. It is the responsibility of the foreman or supervisor-in-charge to ensure that each person entering the hot zone completes the required information. Vital signs must be taken by a competent person.

| **Project Name:** | | | **Foreman/Supervisor:** | | | | | | | | **Work/Rest Schedule1:** IN *(min)* OUT *(min)* | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Date:** | **Water Provided[2]** | | **Acclimated[3]** | | **Initial Vitals[3]** | **Vital Signs and Time In/Out[4]** | | | | | | | | | | |
| Employee Name | Yes | No | Yes | No | **Vitals** | In | Out | **Vitals** | In | Out | **Vitals** | In | Out | **Vitals** | In | Out |
| | | | | | **P** | | | **P** | | | **P** | | | **P** | | |
| | | | | | **BP** | | | **BP** | | | **BP** | | | **BP** | | |
| | | | | | **Temp** | | | **Temp** | | | **Temp** | | | **Temp** | | |
| | | | | | **P** | | | **P** | | | **P** | | | **P** | | |
| | | | | | **BP** | | | **BP** | | | **BP** | | | **BP** | | |
| | | | | | **Temp** | | | **Temp** | | | **Temp** | | | **Temp** | | |
| | | | | | **P** | | | **P** | | | **P** | | | **P** | | |
| | | | | | **BP** | | | **BP** | | | **BP** | | | **BP** | | |
| | | | | | **Temp** | | | **Temp** | | | **Temp** | | | **Temp** | | |
| | | | | | **P** | | | **P** | | | **P** | | | **P** | | |
| | | | | | **BP** | | | **BP** | | | **BP** | | | **BP** | | |
| | | | | | **Temp** | | | **Temp** | | | **Temp** | | | **Temp** | | |
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| | | | | | **P** | | | **P** | | | **P** | | | **P** | | |
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| | | | | | **Temp** | | | **Temp** | | | **Temp** | | | **Temp** | | |

1. Please refer to S3NA-511-PR, Heat Stress. Section 6.3 provides specific details on how to develop a work-rest schedule.
2. Each employee should be provided a sufficient amount of water or sports drink before entering the hot zone. Drinks such as coffee and cola should be discouraged.
3. A worker is “acclimated” if he/she has worked in a hot environment for at least 7 to 10 consecutive days. If a worker is acclimated, check “Yes.” If a worker is not acclimated, check “No” and reduce the “Min In” by 50 percent for that employee until the 7- to 10-day period is reached.
4. “Vitals” refers to employee vital signs (e.g., pulse [P], blood pressure [BP], body temperature [Temp], etc.). Initial vitals must be taken and recorded before the start of work operations in the hot zone. Each time the employee exits the hot zone, vitals must be taken and evaluated for heat stress criteria. Section 6.4 of S3NA-511-PR *Heat Stress* provides specific instructions for taking and evaluating employee vital signs.
5. Body temperature vital signs will be recorded in °F.



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# S3NA-511-WI1 Temperature Thresholds

## 1.0 Work-Rest Schedule

The prevention of heat stress is best performed through supervisor observation of employees and routine heat stress awareness training activities. However, it is also necessary to implement a work routine that incorporates adequate rest periods to allow workers to remove protective clothing, drink fluids (vital when extreme sweating is occurring), rest and recover. The frequency and length of work breaks must be determined by the work supervisor based upon the ambient temperature, amount of sunshine, humidity, the amount of physical labor being performed, the physical condition of the workers (e.g., acclimated/not), and protective clothing being used.

1.1 Establishing a Work-Rest Schedule

1.1.1 AECOM permits the use of either of two techniques to initially determine an appropriate daily work-rest schedule. These methods are:

- Wet Bulb Globe Thermometer (WBGT) Method: This method is preferred, if a WBGT meter is available.
- Adjusted Temperature Method:This method should be used only if WBGT data is not available.

1.1.2 Either procedure will provide the work supervisor with a recommended routine; however, adjustments to this routine may be required to accommodate the specific daily conditions at the work site.

1.2 WBGT Work-Rest Schedule Guidelines

1.2.1 Table 1, the Non-CPC Activities WBGT Chart, is intended for use where personnel are not utilizing CPC. Where workers are required to utilize CPC, Table 2, the CPC Activities WBGT Chart, will be used.

1.2.2 WBGT readings are compared directly with the values the applicable WBGT Chart for the applicable work rate (where light work corresponds to minimal physical activity besides standing/watching; very heavy work corresponds to significant, continuous physical labor) to determine the work-rest frequency.

Table 1. Non-CPC Activities WBGT Chart

| Work-Rest Regimen | WBGT | | | |
|---|---|---|---|---|
| | Light Work | Moderate Work | Heavy Work | Very Heavy Work |
| Continuous Work | 85°F (29.4°C) | 81°F (27.2°C) | 78°F (25.6°C) | |
| 75% Work – 25% Rest | 86°F (30°C) | 83°F (28.3°C) | 81°F (27.2°C) | |
| 50% Work – 50% Rest | 88°F (31.1°C) | 85°F (29.4°C) | 83°F (28.3°C) | 81°F (27.2°C) |
| 25% Work – 75% Rest | 90°F (32.2°C) | 87°F (30.6°C) | 86°F (30°C) | 85°F (29.4°C) |

Modified from ACGIH's 2002 *Threshold Limit Values for Chemical Substances and Physical Agents*, for acclimatized workers

Table 2. CPC Activities WBGT chart

| Work-Rest Regimen | WBGT | | | |
|---|---|---|---|---|
| | Light Work | Moderate Work | Heavy Work | Very Heavy Work |
| Continuous Work | 74°F (23.3°C) | 70°F (21.1°C) | 67°F (19.4°C) | |
| 75% Work – 25% Rest | 75°F (23.9°C) | 72°F (22.2°C) | 70°F (21.1°C) | |


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| | | | | |
|---|---|---|---|---|
| 50% Work – 50% Rest | 77°F (25°C) | 74°F (23.3°C) | 72°F (22.2°C) | 70°F (21.1°C) |
| 25% Work – 75% Rest | 79°F (26.1°C) | 76°F (24.4°C) | 75°F (23.9°C) | 74°F (23.3°C) |

Modified from ACGIH's 2002 *Threshold Limit Values for Chemical Substances and Physical Agents*, for acclimatized workers

1.3 Adjusted Temperature Work-Rest Schedule Guidelines

This method can be utilized where WBGT data is not available, and requires only that the ambient temperature be known. Adjustment factors are applied to the ambient temperature to account for departures from ideal conditions (sunny conditions, light winds, moderate humidity and a fully acclimated work force). The adjustments will be made by addition or subtraction to the ambient temperature reading, or changes in table position, as indicated in Table 3. Adjustments are independent and cumulative, all applicable adjustments should be applied. The result is the Adjusted Temperature, which can be compared with the values in Table 4 for the applicable work rate (where light work corresponds to minimal physical activity besides standing/watching; very heavy work corresponds to significant, continuous physical labor) to determine the work-rest schedule.

**Table 3. Temperature Adjustment Factors**

| | |
|---|---|
| **Time of Day** | |
| Before daily temperature peak[1] | +2°F (+1.11°C) |
| 10 am – 2 pm (peak sunshine) | +2°F (+1.11°C) |
| **Sunshine** | |
| No clouds | +1°F (+0.56°C) |
| Partly Cloudy (3/8 – 5/8 cloud cover) | -3°F (-1.67°C) |
| Mostly Cloudy (5/8 – 7/8 cloud cover) | -5°F (-2.78°C) |
| Cloudy (>7/8 cloud cover) | -7°F (-3.89°C) |
| Indoor or nighttime work | -7°F (-3.89°C) |
| **Wind (*ignore if indoors or wearing CPC*)** | |
| Gusts greater than 5 miles per hour at least once per minute | -1°F (-0.56°C) |
| Gusts greater than 10 miles per hour at least once per minute | +2°F (+1.11°C) |
| Sustained greater than 5 miles per hour | -3°F (-1.67°C) |
| Sustained greater than 10 miles per hour | -5°F (-2.78°C) |
| **Humidity (*ignore if wearing CPC*)** | |
| Relative Humidity greater than 90% | +5°F (+2.78°C) |
| Relative Humidity greater than 80% | +2°F (+1.11°C) |
| Relative Humidity less than 50% | -4°F (-2.23°C) |
| **Chemical Protective Clothing (CPC)** | |
| Modified Level D (coveralls, no respirator) | +5°F (+2.78°C) |
| Level C (coveralls w/o hood, full-face respirator) | +8°F (+4.45°C) |
| Level C (coveralls with hood, full-face respirator) | +10°F (+5°C) |
| Level B with airline system | +9°F (+5.56°C) |
| Level B with SCBA | +9°F (+5.56°C) and right one column[2] |
| Level A | +14°F (+7.78°C) and right one column[2] |
| Other | Specified in the HASP |
| **Miscellaneous** | |

[1] This adjustment accounts for temperature rise during the day. If the temperature has already reached its daytime peak it can be ignored.

[2] Locate the proper column based on work rate, then move one column to the right (next higher work rate) before locating the corresponding adjusted temperature.


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| | |
|---|---|
| Unacclimated work force | +5°F (+2.78°C) |
| Partially acclimated work force | +2°F (+1.11°C) |
| Working in shade | -3°F (-1.67°C) |
| Breaks taken in air conditioned space | -3°F (-1.67°C) |

**Table 4. Work-Rest Schedule Based on Adjusted Temperature**

| Work-Rest Regimen | Adjusted Temperature | | | |
|---|---|---|---|---|
| | Light Work | Moderate Work | Heavy Work | Very Heavy Work |
| No specified requirements | < 80°F (22.67°C) | < 75 (23.88°C) | < 70 (21.11°C) | < 65 (18.33°C) |
| 15 minute break every 90 minutes of work | 80°F – 90°F (22.67°C) - (32.22°C) | 75 – 85 (23.88°C) - (29.44°C) | 70 – 80 (21.11°C) - (22.67°C) | 65 – 75 (37.77°C) - (23.88°C) |
| 15 minute break every 60 minutes of work | >90 – 100 (32.22°C) - (37.77°C) | > 85 – 95 (23.88°C) - (35°C) | >80 – 85 (22.67°C) - (23.88°C) | >75 – 80 (23.88°C) - (22.67°C) |
| 15 minute break every 45 minutes of work | >100 – 110 (37.77°C) - (43.33°C) | >95 – 100 (35°C) - (37.77°C) | >85 – 90 (23.88°C) - (32.22°C) | >80 – 85 (22.67°C) - (23.88°C) |
| 15 minute break every 30 minutes of work | >110 – 115 (43.33°C) - (46.11°C) | >100 – 105 (37.77°C) – (40.55°C) | >90 – 95 (32.22°C) - (35°C) | >85 – 90 (23.88°C) - (32.22°C) |
| 15 minute break every 15 minutes of work | >115 – 120 (46.11°C) - (48.88°C) | >105 – 110 (40.55°C) - (43.33°C) | >95 -100 (35°C) - (37.77°C) | >90 – 95 (32.22°C) - (35°C) |
| **Stop Work** | **>120** (48.88°C) | **>110** (43.33°C) | **>100** (37.77°C) | **>95** (35°C) |

Note: Time spent performing decontamination or donning/doffing CPC should not be included in calculating work or break time lengths.


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# S3NA-511-WI2 Symptoms and Treatment

## 1.0 Heat Stress-related Illness Symptoms

1.1 There are three stages of heat-related illness:

1.1.1 Heat Cramps

- Heat cramps are painful muscle cramps caused by over-exertion in extreme heat.
  - Muscle spasms, and
  - Pain in the hands, feet, and abdomen

1.1.2 Heat Exhaustion

- Heat exhaustion is the next stage. Symptoms include:
  - Cool, moist, pale, flushed or red skin
  - Heavy sweating
  - Headache
  - Nausea or vomiting
  - Dizziness, and
  - Exhaustion.
- Mood changes (irritable, or confused/can't think straight)
- Pale, cool, moist skin
- Heavy sweating
- Dizziness
- Nausea
- Fainting

1.1.3 Heat Stroke

- Heat stroke. Heat exhaustion can sometimes lead to heat stroke, which can be fatal and requires emergency treatment. Heat stroke happens when you stop sweating and your body temperature continues to rise, often to 105° F (40.5° C) or higher. Symptoms of heat stroke:
  - Vomiting
  - Decreased alertness level or complete loss of consciousness
  - High body temperature (sometimes as high as 105° F (40.5° C) )
  - Skin may still be moist or the victim may stop sweating and the skin may be red, hot, and dry
  - Rapid, weak pulse, and
  - Rapid, shallow breathing.
- Red, hot, usually dry skin
- Lack of or reduced perspiration
- Nausea
- Dizziness and confusion
- Strong rapid pulse
- Coma

## 2.0 Recommended Treatment for Heat Stress-related Illnesses

2.1 Heat Cramps

2.1.1 Treatment:

- Gently stretch the cramped muscle and hold the stretch for about 20 seconds, then gently massage the muscle. Repeat these steps if necessary.
- Take more frequent breaks and drink more water.
- Move victim to a cool place.
- Administer drinks of cool water.


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- Apply manual pressure to cramped muscles.
- Seek medical attention if symptoms are not alleviated or if more serious problems are indicated.

2.1.2 Heat Exhaustion

- Treatment of heat exhaustion:
  - Get out of the sun to a cool location and drink lots of water, a little at a time.
  - Remove or loosen tight clothing.
  - If you are nauseated or dizzy, lie down.
- Move the victim to a cool place.
- Remove as much clothing as possible and elevate the feet.
- Administer drinks of cool water and fan to cool.
- Seek medical attention immediately.

2.1.3 Heat Stroke

- Treatment of heat stroke, or if a person's temperature exceeds 102° F (38.9 ° C) :
- Call for immediate medical help and then try to lower the temperature as quickly as possible:
  - Apply cool (not cold) water the person's whole body, then fan the person.
  - Stop cooling once the person's temperature appears to be down; be careful not to overcool.
  - Do not give aspirin or acetaminophen to reduce the temperature.
- Treat as a true medical emergency. Seek medical help immediately
- Reduce body temperature quickly
- Douse with cool water (not cold water)
- Wrap in wet sheet
- If available, use cold packs under arms, neck, and ankles
- Protect from injury during convulsion
- Ensure that the person's airway is open.
- Transfer to a medical facility immediately.


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# S3NA-511-ST Heat Exposure

The following Occupational Health and Safety regulations apply directly to heat stress hazards:

| Jurisdiction | Regulation |
|---|---|
| **United States** | |
| **OSHA** | 1910.132 |
| **Canada** | |
| **Alberta** | n/a |
| **British Columbia** | OHS Regulation (1997) Sect 7.28 – 7.32, 8.21, 12.72, 12.73 |
| **Manitoba** | Workplace Health and Safety Regulation (217/2006) Sect 4.12, 4.13 |
| **New Brunswick** | OHS Regulation (91-191) Sect 44 |
| **Newfoundland/Labrador** | OHS Regulation (C.N.L.R. 1165/96) Sect 10 |
| **Nova Scotia** | n/a |
| **NWT/NU Territories** | n/a |
| **Ontario** | O. Reg. 213/91 Sect 112<br>O. Reg. 851 Sect 129<br>Heat Stress (Health and Safety Guidelines) (April 2003) |
| **Prince Edward Island** | OHS Regulations (EC180/87) Sect 42.1 |
| **Quebec** | OHS Regulation (R.R.Q., c. S-2.1, r.19.01 O.C. 885-2001) Sect 121 – 124, Schedule 4, Schedule 5 |
| **Saskatchewan** | OHS Regulation (R.R.S., c. O-1, r. 1) Sect 70 |
| **Yukon Territory** | Occupational Health Regulations (O.I.C. 1986/164) Sect 9, 12 |


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**Americas**

# Respiratory Protection Program

**S3NA-519-PR1**

## 1.0 Purpose and Scope

1.1 This procedure establishes a written respiratory protection program with the required elements and work site-specific procedures for respirator selection, use, and maintenance for any workplace where respirators are necessary to protect the health of an **E**mployee.

1.2 Prior to implementation of this program, the primary objective shall be to prevent atmospheric contamination as far as feasible by accepted engineering control measures (e.g. enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials).

1.3 This procedure applies to all AECOM Americas**-**based employees and operations, except where local or governmental regulations are more stringent.

## 2.0 Terms and Definitions

2.1 **Air-purifying respirator** – A respirator with an air-purifying filter, cartridge, or canister that removes specific air contaminants by passing ambient air through the air-purifying element.

2.2 **Approved** – Equipment tested and listed by the Bureau of Mines, jointly by the Mining Enforcement and Safety Administration (MESA), and the National Institute for Occupational Safety and Health (NIOSH), or jointly by the Mine Safety and Health Administration (MSHA) and NIOSH.

2.3 **Assigned protection factor (APF)** – The ratio of the ambient concentration of an airborne substance (outside the respirator) to the concentration of the substance inside the respirator.

2.4 **Atmosphere-supplying respirator** – A respirator that supplies the user with breathing air from a source independent of the ambient atmosphere, including supplied-air respirators (SARs) and self-contained breathing apparatus (SCBA) units.

2.5 **Breakthrough** – The first perception of an odor, taste or irritation experienced while wearing an air-purifying respirator. Breakthrough is generally an indication that the cartridges are saturated and are no longer filtering out the contaminant. Breakthrough can also be an indication of an improperly functioning respirator.

2.6 **CNP** – Controlled Negative Pressure testing protocol

2.7 **Filtering facepiece (dust mask) –** A negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium.

2.8 **Fit factor** – A quantitative estimate of the fit of a particular respirator to a specific individual, typically estimating the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn.

2.9 **Fit test –** The use of a protocol to qualitatively or quantitatively evaluate the fit of a respirator on an individual. (See also Qualitative fit test [QLFT] and Quantitative fit test [QNFT].)

2.10 **Hazardous atmosphere –** Any atmosphere, either immediately or not immediately dangerous to life or health, that is oxygen-deficient or that contains a toxic or disease-producing contaminant exceeding the legally established permissible exposure limit (PEL) or, where applicable, the Threshold Limit Value established by the American Conference of Governmental Industrial Hygienists.

2.11 **Immediately dangerous to life or health (IDLH)** – An atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere.

2.12 **Maximum use concentration (MUC) –** The assigned protection factor (APF) of an approved respirator assembly times the **PEL:** MUC = APF x PEL

2.13 **Negative pressure respirator (tight fitting) –** A respirator in which the air pressure inside the facepiece is negative during inhalation with respect to the ambient air pressure outside the respirator.

2.14 **Oxygen-deficient atmosphere** – An atmosphere with oxygen content below 19.5 percent by volume.

2.15 **Physician or other licensed health care professional (PLHCP) –** An individual whose legally permitted scope of practice (i.e., license, registration, or certification) allows him or her to independently provide or be delegated the responsibility to provide some or all of the health care services required by local or governmental respiratory protection standards.

2.16 **Positive pressure respirator** – A respirator in which the pressure inside the respiratory inlet covering exceeds the ambient air pressure outside the respirator.

2.17 **Powered air-purifying respirator (PAPR)** – An air-purifying respirator that uses a blower to force the ambient air through air-purifying elements to the inlet covering.

2.18 **Pressure demand respirator** – A positive pressure atmosphere-supplying respirator that admits breathing air to the facepiece when the positive pressure is reduced inside the facepiece by inhalation.

2.19 **Qualitative fit test (QLFT)** – A pass/fail fit test to assess the adequacy of respirator fit that relies on the individual's response to the test agent.

2.20 **Quantitative fit test (QNFT) –** An assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.

2.21 **Self-contained breathing apparatus (SCBA) –** An atmosphere-supplying respirator for which the breathing air source is designed to be carried by the user.

2.22 **Supplied-air respirator (SAR) or airline respirator** – An atmosphere-supplying respirator for which the source of breathing air is not designed to be carried by the user.

2.23 **Tight-fitting facepiece** – A respiratory inlet covering that forms a complete seal with the face.

2.24 **User seal check** – An action conducted by the respirator user to determine if the respirator is properly sealed to the face.

## 3.0 References

3.1 Canadian Standards Association (CSA), Z180.1-00, Compressed Breathing Air and Systems

3.2 CSA, Z94.4-02, Selection, Use and Care of Respirators

3.3 Occupational Safety and Health Administration (OSHA), Title 29 Code of Federal Regulation (CFR), Part 1910.134, Respiratory Protection

3.4 OSHA, 29 CFR 1926.103, Respiratory Protection

3.5 S3NA-003-PR1 SH&E Training

3.6 S3NA-506-PR1 Compressed Gases

3.7 S3NA-604-PR1 Medical Records

3.8 S3NA-605-PR1 Medical Surveillance Program

## 4.0 Procedure

4.1 Roles and Responsibilities

4.1.1 **Respiratory Protection Program Administrator**

The Americas Safety, Health and Environment (SH&E) Director is the Respiratory Protection Program Administrator.

- Verify full compliance with this standard operating procedure (SOP).

- Determine the need for medical evaluations or any other additional medical attention related to the use of a respirator.
- Perform the program evaluations described in this SOP.

4.1.2 **Office Manager (Operations) / Project Manager /Supervisor**

- Verify compliance with the respiratory protection program set forth in this procedure.
- Verify that only those employees who are medically qualified, properly trained, and fit tested are assigned to respirator work.
- Verify that respirators are provided, repaired, or replaced as may be required due to wear and deterioration.

4.1.3 **Site Safety Officer**

- Confirm that the service is available to respond prior to any employees entering the IDLH area.

4.1.4 **Region SH&E Manager**

- Monitor compliance with the various aspects of this program.
- Provide technical assistance regarding respirator selection and use, evaluate the effectiveness of this program, and support respirator training and fit testing.
- Audit company compliance with this procedure.

4.1.5 **Employee**

- Use respiratory protection in accordance with instructions and training received.
- Maintain the respirator in accordance with this SOP and the manufacturer's instructions.
- Immediately report any malfunction of the respirator to the Supervisor or Project Manager or other responsible person.

4.2 Training

4.2.1 **Employees** who wear respiratory protection must receive training before they are assigned to a task that requires the use of respiratory protection.

4.2.2 **Employees** that may be exposed to a respiratory hazard will be oriented to the hazard and the controls prior to beginning work.

4.2.3 Atmospheric testing will be carried out by someone trained in the use, calibration, and interpretation of the test equipment.

4.2.4 Retraining shall be administered annually, and when the following situations occur:

- Changes in the workplace or the type of respirator render previous training obsolete;
- Inadequacies in the Employee's knowledge or use of the respirator indicate that the Employee has not retained the requisite understanding or skill; or
- Any other situation arises in which retraining appears necessary to verify safe respirator use.

4.2.5 Basic Respirator Training Program

Respirator training classes will include, at a minimum, the following:

- Instruction in the nature of the respiratory hazards, whether acute, chronic, or both, and a description of potential health effects if the respirators are not used;
- Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator;
- The limitations and capabilities of the respirator;

- Proper fitting, including demonstrations and practice in wearing, adjusting, determining the fit of, and performing a user seal check (in accordance with *S3NA-519-WI1 Fit Testing Protocol, S3NA-519-FM1 Respiratory Equipment Fit Test* and *S3NA-519-WI2 User Seal Check Procedures)* each time respirator is donned;
- How to inspect, put on, use and remove the respirator;
- How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions;
- The procedures for maintenance and storage of the respirator;
- How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators; and
- The general requirements of local or governmental Respiratory Protection Standards.

4.3 Medical Surveillance

4.3.1 No **Employee** shall be assigned to a task that requires the use of a respirator unless it has been determined that he/she is physically able to perform the work while using the required respirator.

4.3.2 Prior to wearing a respirator, **Employees** will complete an initial baseline medical surveillance examination performed by a PLHCP in accordance with the requirements of *S3NA-605-PR1 Medical Surveillance Program.*

4.3.3 Additional medical examinations will be provided to employees who wear respirators when:

- An **Employee** reports medical signs or symptoms that are related to ability to use a respirator;
- A **PLHCP**, **Supervisor**, or the **Respiratory Protection Program Administrator** determines that an Employee needs to be reevaluated;
- Information from the Respiratory Protection Program, including observations made during fit testing and program evaluation, indicates a need for Employee reevaluation; or
- A change occurs in workplace conditions (e.g., physical work effort, protective clothing, temperature, etc.) that may result in a substantial increase in the physiological burden placed on an **Employee**.

4.3.4 All medical surveillance examinations shall occur during normal working hours; shall be convenient, understandable, and confidential; and the **Employee** will be given chance to discuss results with examining physician.

4.4 Respirator Selection

4.4.1 **Project Managers** shall select and provide an appropriate respirator based on the respiratory hazard(s) to which the **Employee** is exposed and workplace or user factors that may affect respirator performance and reliability.

4.4.2 **Project Managers** shall identify and evaluate the respiratory hazard(s) in the workplace. Evaluations shall include a reasonable estimate of employee exposures to respiratory hazard(s) and an identification of the contaminant's chemical state and physical form.

4.4.3 Where the employee exposure cannot be identified or reasonably estimated, the atmosphere shall be considered IDLH.

4.4.4 Only approved respirators shall be selected and they shall be used in compliance with the conditions of their certification.

4.4.5 Respirators shall be selected from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the user.

4.5 Fit Testing Procedures

4.5.1 **Employees** using a tight-fitting respirator shall pass an appropriate QLFT or QNFT prior to initial use of the respirator, whenever a different respirator facepiece (size, style, model or make) is used, and at least annually thereafter.

4.5.2 Additional fit tests will be performed:

- Whenever there is an indication that changes in the **Employee's** physical condition might have an effect on respirator fit (such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight);
- If the **Employee** notifies his/her **Supervisor** or **Region SH&E Manager** that the fit of his/her respirator is unacceptable.

4.5.3 The fit test shall be administered using a QLFT or QNFT protocol accepted by local or governmental regulations.

4.5.4 QLFT may only be used to fit test negative pressure air-purifying respirators that must achieve a fit factor of 100 or less.

4.6 Interference with Gas-Tight Seal

4.6.1 The employer shall not permit respirators with tight-fitting facepieces to be worn by **Employees** who have:

- Facial hair that comes between the sealing surface of the facepiece and the face or that interferes with valve function; or
- Any condition that interferes with the face-to-facepiece seal or valve function.

4.6.2 If an **employee** wears corrective glasses or goggles or other personal protective equipment, the **Supervisor** or **Project Manager** shall ensure that such equipment is worn in a manner that does not interfere with the seal of the facepiece to the face of the user.

4.6.3 **Employees** shall perform a user seal check each time they don the respirator.

4.7 Specification of Proper Level of Respiratory Protection

4.7.1 The **Region SH&E Manager** or his/her designated and qualified representative shall provide guidance on the proper selection and use of all respiratory protective devices, including half-face and full-face air purifying respirators, airline respirators, and self-contained breathing apparatus. This information is generally specified as part of the written site-specific Health and Safety Plan (HASP).

4.7.2 **Employees** engaged in activities not covered by a HASP must consult with the **Region SH&E Manager** or his/her designated representative to determine the proper equipment prior to use. Whenever appropriate, exposure levels will be measured to verify that the actual use conditions are within the limitations of the approvals specified by NIOSH/MSHA for the selected respirator.

4.8 Change Out Schedule

Filter cartridges shall be changed out whenever an increase in breathing resistance is detected by the user.

4.8.1 When available, chemical cartridges that are equipped with end-of-service life indicators (ESLI) shall be utilized. In those cases, cartridges should be changed when indicated by the ESLI.

4.8.2 In the absence of cartridges equipped with an ESLI, **employees** shall change chemical cartridges on the following schedule:

- Immediately if breakthrough is perceived; and
- In accordance with the change out schedule based upon the anticipated contaminant concentration, environmental conditions, employee work rate, and the specific data provided by manufacturer.

4.8.3 When PAPRs are worn, the same rules apply with the exception that filter cartridges should be changed when airflow through the filter elements decreases to an unacceptable level, as indicated by the manufacturer's test device.

4.9 Air-Supplying Respirator Use

4.9.1 Air-supplying respirators will be specified for use when it has been determined that any of the following conditions exist:

- The oxygen concentration is less than 19.5 percent;
- The contaminant is unknown or its concentration cannot be quantified;
- The airborne contaminant concentration is above its IDLH;
- An air-purifying respirator canister or cartridge that removes the contaminant is not available;
- The contaminant concentration is above the concentration for which an air-purifying canister or cartridge is approved; or
- The contaminant concentration is above the MUC of a full-face air-purifying respirator.

4.9.2 No **Employee** may engage in an operation requiring the use of an air-supplied respirator unless the **Region SH&E Manager** has reviewed the operation and approved its use.

4.9.3 The determination of the type of air-supplying respirator (i.e., SCBA, airline, demand, pressure demand, etc.) which is appropriate for the job, outside standby persons, communication, proper training and equipment, notification procedures, and necessary action all require planning. Mandatory equipment including SCBA or SAR with auxiliary air supply and emergency appropriate retrieval equipment or equivalent rescue means will be made by the **Region SH&E Manager** or his/her designated representative at the time of review. The need for any additional precautions (i.e., equipment specific training, on-site health and safety support, etc.) will also be determined by the **Region SH&E Manager**.

4.10 Minimum Procedures for IDLH atmospheres

4.10.1 One **Employee** or, when needed, more than one **Employee** shall be located outside the IDLH atmosphere. This **employee** shall be responsible for communicating with the **Employees** in the IDLH atmosphere, alerting rescue services if needed, and restricting entrance to the IDLH area by untrained and unapproved persons.

4.10.2 Visual, voice, or signal line communication shall be maintained between the **Employee**(s) in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere.

4.10.3 The **Employee**(s) located outside the IDLH atmosphere shall be trained and equipped to provide effective emergency rescue or to initiate on-site rescue services.

4.10.4 If on-site rescue services are to be used, the **Site Safety Officer** shall confirm that the service is available to respond prior to any employees entering the IDLH area.

4.10.5 **Employee**(s) located outside the IDLH area and/or on-site rescue services shall be equipped with:

- Pressure demand or other positive pressure SCBAs, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA; and either
- Appropriate retrieval equipment for removing the employee(s) who enter(s) these hazardous atmospheres where retrieval equipment would contribute to the rescue of the employee(s) and would not increase the overall risk resulting from entry; or
- Equivalent means for rescue where retrieval equipment would create a hazard to the Employees in the IDLH area.

4.11 Breathing Air

4.11.1 Compressed air used for respiration shall be of high purity and shall meet, as a minimum, the requirements of the specification for Grade D breathing air as described in Compressed Gas Association Specification G-7.1 (ANSI Z86.1).

4.11.2 Oxygen shall NOT be used as a source of breathing air at any time in open-circuit SCBAs or airline respirators.

4.11.3 Compressor Supplied Breathing Air

All compressors used for filling SCBA air cylinders or for supplying airline respirators shall be equipped with the following safety and standby devices:

- The compressor intake shall be located to verify that only respirable (uncontaminated) air is admitted. This requires attention to the location of the compressor intake with respect to compressor engine exhaust, chemical storage or use areas, and suitable intake screening or filtration.
- Alarms to indicate compressor failure (such as low-pressure air horns, etc.) shall be installed in the system.
- A receiver of sufficient capacity to enable the respirator wearer to exit from a contaminated atmosphere shall be provided.

If an oil-lubricated compressor is used to supply breathing air, it shall be equipped with both of the following devices:

- A continuous reading carbon monoxide monitoring system set to alarm should the carbon monoxide concentration exceed 10 parts per million; and,
- A high temperature alarm which will activate when the discharge air exceeds 110 percent of the normal operating temperature in degrees Fahrenheit.

An in-line purifying filter assembly to remove oil, condensed water, particulates, odors, and organic vapors shall be used in conjunction with the air compressor.

4.11.4 Routine inspection and maintenance of air compressor shall be performed and documented with the *S3NA-519-FM3 Respiratory Equipment Inspection*. Compressed Air Cylinder Systems for Airline Respirators

- Compressed Air Cylinders shall meet the requirements of S3NA-506-PR1 Compressed Gases
- Compressed air cylinder systems used to supply airline respirators shall be equipped with low pressure warning bells (e.g., Scott Pak-Alarm) or similar warning devices to indicate air pressure in the manifold below 500 pounds per square inch (psi). When such systems are used, one **employee** shall be assigned as safety standby within audible range of the low pressure alarm.
- Airline hose couplings shall be incompatible with outlets for other gas systems to prevent inadvertently supplying airline respirators with nonrespirable gases or oxygen.
- The air pressure at the hose connection to airline respiratory equipment shall be within the range specified in the approval of the equipment by the manufacturer.

4.11.5 Compressed Air Cylinder Systems for Recharging SCBAs

- When a cascade system is used to recharge SCBA air cylinders, it shall be equipped with a high-pressure supply hose and coupling rated at a capacity of at least 3,000 psi.

4.11.6 Escape/Egress Units

- Escape/egress unit respirators are intended for use in areas where escape with a short-term (5 minutes) air supply is necessary.

- They may be used as adjuncts to airline pressure demand respirators as a backup air supply or as independent emergency devices in areas where respiratory protection is not normally required.
- Appropriate training shall be conducted and documented prior to assigning **Employees** to tasks or locations subject to the use of these respirators.
- Escape/egress units (5 minutes) shall never be used to enter a hazardous atmosphere or as primary standby respirators for confined space entry.

4.12 Respirator Inspection, Cleaning, Maintenance, and Storage

When respirator use is required, only properly cleaned and maintained NIOSH/MSHA approved respirators shall be used.

4.12.1 Inspection

- Respirators should be inspected before and after use. Those for emergency use should be inspected once per month.
- All connections, including gaskets, o-rings should be checked for damage and tightness.
- The facepiece should be inspected for cracks and rubber or elastomer parts should be checked for deterioration and pliability.
- All respirators shall be inspected routinely by the user before, during, and after each use. Defects shall be reported to their **Supervisor** or **Project Manager**. No defective respirator shall be issued or worn.
- Routinely used respiratory equipment shall be inspected by an individual qualified by experience or training to do the work.

4.12.2 Cleaning and Maintenance

- Respirator facepiece assemblies shall be cleaned and sanitized minimally after each day of use in accordance with the requirements specified in *S3NA-519-WI3 Respirator Cleaning Procedures*.
- Respiratory equipment shall not be passed from one person to another until it has been cleaned and sanitized.
- Respiratory equipment shall be maintained according to manufacturer's instructions.
- Where respirators are assigned to individual employees, management shall verify compliance with cleaning and maintenance requirements by periodic inspection and field audits of respiratory equipment and document is with the *S3NA-519-FM2 Respiratory Equipment Maintenance Log*.
- The respirator should then be inspected for any damaged parts (repair should only be done by trained personnel with the proper tools) and cleaned with a hot water/mild detergent solution.
- In field situations, a premoistened towelette (e.g., baby wipes) can be used. The mask should then be rinsed with clean warm water and dried.
- Alcohol should never be used to clean masks as it can damage the facepieces and rubber parts.

4.12.3 Storage

- Store clean respirators so that they are protected from dust, excessive moisture, damaging chemicals, temperature extremes and direct sunlight. They should be placed in a sealed plastic bag and stored in the original box.

4.13 Hygiene

**Employees** must leave the work area to wash, change cartridges, or if they detect breakthrough or resistance.

4.14 Costs

The costs for training, medical examinations, fit testing, respirators, and cleaning materials should be considered as operational costs.

4.15 Program Evaluation

4.15.1 The **Region SH&E Manager** will conduct evaluations of the workplace as necessary to verify that the provisions of the current written program are being effectively implemented and that it continues to be effective.

4.15.2 The **Region SH&E Manager** will regularly (i.e., during annual training) consult **Employees** required to use respirators to assess their views on program effectiveness and to identify any problems. Any problems that are identified during this assessment shall be corrected. Factors to be assessed include but are not limited to:

- Respirator fit (including the ability to use the respirator without interfering with effective workplace performance);
- Appropriate respirator selection for the hazards to which the **Employee** is exposed;
- Proper respirator use under the workplace conditions the **Employee** encounters; and
- Proper respirator maintenance.

## 5.0 Records

5.1 Medical Records under this section will be maintained at a minimum in accordance with *S3NA-604-PR1 Medical Record*s.

5.2 Fit Test Records must be maintained in the Employee's health and safety records. *S3NA-519-FM1 Respiratory Equipment Fit Test* will be used to document each fit test.

5.3 Training Records shall be maintained in accordance with *S3NA-003-PR1 SH&E Training.*

## 6.0 Attachments

6.1 S3NA-519-WI1 Fit Testing Protocol

6.2 S3NA-519-WI2 User Seal Check Procedures

6.3 S3NA-519-WI3 Respirator Cleaning Procedures

6.4 S3NA-519-FM1 Respiratory Equipment Fit Test

6.5 S3NA-519-FM2 Respiratory Equipment Maintenance Log

6.6 S3NA-519-FM3 Respiratory Equipment Inspection

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# Fit Testing Protocol

**S3NA-519-WI1**

## 1.0 Selection

1.1 The Employee shall be allowed to pick the most acceptable respirator from a sufficient number of respirator models and sizes so that the respirator is acceptable to, and correctly fits, the Employee.

1.2 Prior to the selection process, the Employee shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension, and how to determine an acceptable fit. A mirror shall be available to assist the Employee in evaluating the fit and positioning of the respirator. This instruction may not constitute the Employee's formal training on respirator use, because it is only a review.

1.3 The Employee shall be informed that he/she is being asked to select the respirator that provides the most acceptable fit. Each respirator represents a different size and shape and if fitted and used properly will provide adequate protection.

## 2.0 Comfort

2.1 The Employee shall be instructed to hold each chosen face piece up to the face and to eliminate those that obviously do not give an acceptable fit.

2.2 The more acceptable face pieces are noted in case the one selected proves unacceptable; the most comfortable mask is donned and worn at least 5 minutes to assess comfort.

2.3 If the Employee is not familiar with using a particular respirator, he/she shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper tension on the straps.

2.4 Assessment of comfort shall include a review of the following points with the Employee and allowing he/she adequate time to determine the comfort of the respirator:

- Position of the mask on the nose;
- Room for eye protection;
- Room to talk; and
- Position of mask on face and cheeks.

## 3.0 Fit Test Criteria

3.1 The following criteria shall be used to help determine the adequacy of the respirator fit:

- Chin properly placed;
- Adequate strap tension, not overly tightened;
- Fit across nose bridge;
- Respirator of proper size to span distance from nose to chin;
- Tendency of respirator to slip; and
- Self-observation in mirror to evaluate fit and respirator position.

3.2 The Employee shall conduct a user seal check, either the negative and positive pressure seal checks described in *S3NA-519-WI2 User Seal Check Procedures* or those recommended by the respirator manufacturer that provide equivalent protection to the procedures in *S3NA-519-WI2 User Seal Check Procedures.*

3.3 Before conducting the negative and positive pressure checks, the Employee shall be told to seat the mask on the face by moving the head from side to side and up and down slowly while taking in a few slow deep breaths. Another face piece shall be selected and retested if the Employee fails the user seal check tests.

3.4 The test shall not be conducted if there is any hair growth between the skin and the face piece sealing surface, such as stubble beard growth, beard, moustache, or sideburns that cross the respirator sealing surface. Any type of apparel that interferes with a satisfactory fit shall be altered or removed.

3.5 If an Employee exhibits difficulty in breathing during the tests, she or he shall be referred to a physician or other licensed health care professional, as appropriate, to determine whether the Employee can wear a respirator while performing her or his duties.

3.6 If the Employee finds the fit of the respirator unacceptable, the Employee shall be given the opportunity to select a different respirator and to be retested.

## 4.0 Exercise Regimen

4.1 Prior to the commencement of the fit test, the Employee shall be given a description of the fit test and their responsibilities during the test procedure. The description of the process shall include a description of the test exercises that will be performed. The respirator to be tested shall be worn for at least 5 minutes before the start of the fit test.

4.2 The fit test shall be performed while the Employee is wearing any applicable safety equipment that may be worn during actual respirator use and that could interfere with respirator fit.

## 5.0 General Test Exercises

5.1 The following test exercises are to be performed for all fit testing methods prescribed in this procedure, except for the Controlled Negative Pressure (CNP REDON) method. A separate fit testing exercise regimen is contained in the CNP protocol. The Employee shall perform exercises, in the test environment, in the following manner:

5.1.1 **Normal breathing**. In a normal standing position, without talking, the Employee shall breathe normally.

5.1.2 **Deep breathing.** In a normal standing position, the Employee shall breathe slowly and deeply, taking caution so as not to hyperventilate.

5.1.3 **Turning head side to side.** Standing in place, the Employee shall slowly turn his/her head from side to side between the extreme positions on each side. The head shall be held at each extreme momentarily so the Employee can inhale at each side.

5.1.4 **Moving head up and down.** Standing in place, the Employee shall slowly move his/her head up and down. The Employee shall be instructed to inhale in the up position (i.e., when looking toward the ceiling).

5.1.5 **Talking.** The Employee shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The Employee can read from a prepared text such as the Rainbow Passage, count backward from 100, or recite a memorized poem or song.

- Rainbow Passage. "When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch with its path high above and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow."

5.1.6 **Grimace.** The Employee shall grimace by smiling or frowning. (This applies only to QNFT testing; it is not performed for QLFT.)

5.1.7 **Bending over.** The Employee shall bend at the waist as if he/she were to touch his/her toes. Jogging in place shall be substituted for this exercise in those test environments such as shroud-type QNFT or QLFT units that do not permit bending over at the waist.

5.1.8 **Normal breathing**. In a normal standing position, without talking, the Employee shall breathe normally (this is the same as the first test).

5.2 Each test exercise shall be performed for one minute except for the grimace exercise, which shall be performed for 15 seconds.

5.3 The Employee shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried.

5.4 The respirator shall not be adjusted once the fit test exercises begin. Any adjustment voids the test and the fit test must be repeated.

## 6.0 Qualitative Fit Test (QLFT) Protocols

6.1 **General**

- AECOM will ensure that persons administering QLFT are able to calibrate equipment and perform tests properly, recognize invalid tests, and ensure that test equipment is in proper working order.
- AECOM will ensure that that QLFT equipment is kept clean and well maintained so as to operate within the parameters for which it was designed.

6.2 **Irritant Smoke (Stannic Chloride) Protocol**

6.2.1 This QLFT uses a person's response to the irritating chemicals released in the "smoke" produced by a stannic chloride ventilation smoke tube to detect leakage into the respirator.

6.2.2 **General Requirements and Precautions**

- The respirator to be tested shall be equipped with high-efficiency particulate air (HEPA) or P100 series filter(s).
- Only stannic chloride smoke tubes shall be used for this protocol.
- No form of test enclosure or hood for the Employee shall be used.
- The smoke can be irritating to the eyes, lungs, and nasal passages. The test conductor shall take precautions to minimize the Employee's exposure to irritant smoke. Sensitivity varies, and certain individuals may respond to a greater degree to irritant smoke. Care shall be taken when performing the sensitivity screening checks that determine whether the Employee can detect irritant smoke to use only the minimum amount of smoke necessary to elicit a response from the Employee.
- The fit test shall be performed in an area with adequate ventilation to prevent exposure of the person conducting the fit test or the build-up of irritant smoke in the general atmosphere.

6.2.3 **Sensitivity Screening Check**

The Employee to be tested must demonstrate his or her ability to detect a weak concentration of the irritant smoke.

- The test operator shall break both ends of a ventilation smoke tube containing stannic chloride and attach one end of the smoke tube to a low flow air pump set to deliver 200 milliliters per minute or to an aspirator squeeze bulb. The test operator shall cover the other end of the smoke tube with a short piece of tubing to prevent potential injury from the jagged end of the smoke tube.
- The test operator shall advise the Employee that the smoke can be irritating to the eyes, lungs, and nasal passages and instruct the Employee to keep his/her eyes closed while the test is performed.

- The Employee shall be allowed to smell a weak concentration of the irritant smoke before the respirator is donned to become familiar with its irritating properties and to determine if he/she can detect the irritating properties of the smoke. The test operator shall carefully direct a small amount of the irritant smoke in the Employee's direction to determine that he/she can detect it.

6.2.4 **Irritant Smoke Fit Test Procedure**

- The Employee being fit tested shall don the respirator without assistance, and perform the required user seal check(s).
- The Employee shall be instructed to keep his/her eyes closed.
- The test operator shall direct the stream of irritant smoke from the smoke tube toward the face seal area of the Employee, using the low-flow pump or the squeeze bulb. The test operator shall begin at least 12 inches from the facepiece and move the smoke stream around the whole perimeter of the mask. The operator shall gradually make two more passes around the perimeter of the mask, moving to within 6 inches of the respirator.
- If the Employee being tested has not had an involuntary response and/or has not detected the irritant smoke, proceed with the test exercises.
- The General Test Exercises shall be performed by the Employee while the respirator seal is being continually challenged by the smoke, directed around the perimeter of the respirator at a distance of 6 inches.
- If the Employee being fit tested reports detecting the irritant smoke at any time, the test is failed. The Employee being retested must repeat the entire sensitivity check and fit test procedure.
- Each Employee passing the irritant smoke test without evidence of a response (involuntary cough, irritation) shall be given a second sensitivity screening check, with the smoke from the same smoke tube used during the fit test, once the respirator has been removed, to determine whether he/she still reacts to the smoke. Failure to evoke a response shall void the fit test.
- If a response is produced during this second sensitivity check, then the fit test is passed.

# 7.0 Quantitative Fit Test (QNFT) Protocols

7.1 **General**

- AECOM will confirm that persons administering QNFT are able to calibrate equipment and perform tests properly, recognize invalid tests, calculate fit factors properly, and ensure that test equipment is in proper working order.
- AECOM will ensure that QNFT equipment is kept clean and is maintained and calibrated according to the manufacturer's instructions so as to operate at the parameters for which it was designed.

7.2 **Ambient Aerosol Condensation Nuclei Counter (CNC) Quantitative Fit Testing Protocol**

7.2.1 The ambient aerosol CNC quantitative fit testing (Portacount$^{TM}$) protocol quantitatively fit tests respirators with the use of a probe. The probed respirator is only used for QNFTs. A probed respirator has a special sampling device installed on the respirator to allow the probe to sample the air from inside the mask. A probed respirator is required for each make, style, model, and size that the employer uses and can be obtained from the respirator manufacturer or distributor. The CNC instrument manufacturer, TSI Inc., also provides probe attachments (TSI sampling adapters) that permit fit testing in an Employee's own respirator. A minimum fit factor pass level of at least 100 is necessary for a half-mask respirator, and a minimum fit factor pass level of at least 500 is required for a full facepiece negative pressure respirator. The entire screening and testing procedure shall be explained to the Employee prior to the conduct of the screening test.

### 7.2.2 Portacount Fit Test Requirements

- Check the respirator to make sure the sampling probe and line are properly attached to the face piece and that the respirator is fitted with a particulate filter capable of preventing significant penetration by the ambient particles used for the fit test (e.g., National Institute for Occupational Safety and Health, Title 42 Code of Federal Regulations 84 series 100, series 99, or series 95 particulate filter) according to the manufacturer's instructions.
- Instruct the Employee to be tested to don the respirator for 5 minutes before the fit test starts. This purges the ambient particles trapped inside the respirator and permits the wearer to make certain the respirator is comfortable. This Employee shall already have been trained on how to wear the respirator properly.
- Check the following conditions for the adequacy of the respirator fit: chin properly placed; adequate strap tension, not overly tightened; fit across nose bridge; respirator of proper size to span distance from nose to chin; tendency of the respirator to slip; self-observation in a mirror to evaluate fit and respirator position.
- Have the person wearing the respirator do a user seal check. If leakage is detected, determine the cause. If leakage is from a poorly fitting face piece, try another size of the same model respirator, or another model of respirator.
- Follow the manufacturer's instructions for operating the Portacount and proceed with the test.
- The Employee shall be instructed to perform the exercises in General Test Exercises.
- After the test exercises, the Employee shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become unacceptable, another model of respirator shall be tried.

### 7.2.3 Portacount Test Instrument

- The Portacount will automatically stop and calculate the overall fit factor for the entire set of exercises. The overall fit factor is what counts. The Pass or Fail message will indicate whether or not the test was successful. If the test was a Pass, the fit test is over.
- Since the pass or fail criterion of the Portacount is Employee programmable, the test operator shall confirm that the pass or fail criterion meet the requirements for minimum respirator performance.
- A record of the test needs to be kept on file, assuming the fit test was successful. The record must contain the Employee's name; overall fit factor; make, model, style, and size of respirator used; and date tested.

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# User Seal Check Procedures

**S3NA-519-WI2**

## 1.0 Requirements

1.1 The Employee who uses a tight-fitting respirator is to perform a user seal check to confirm that an adequate seal is achieved each time the respirator is put on.

1.2 Either the positive and negative pressure checks listed here or the respirator manufacturer's recommended user seal check method shall be used.

1.3 User seal checks are not substitutes for qualitative or quantitative fit tests.

## 2.0 Facepiece Positive and/or Negative Pressure Checks

2.1 **Positive pressure check**

- Close off the exhalation valve and exhale gently into the facepiece.
- The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal.
- For most respirators, this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replacing it after the test.

2.2 **Negative pressure check**

- Close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing the filter seal(s), inhale gently so that the facepiece collapses slightly, and hold your breath for 10 seconds.
- The design of the inlet opening of some cartridges cannot be effectively covered with the palm of the hand.
- The test can be performed by covering the inlet opening of the cartridge with a thin latex or nitrile glove.
- If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

## 3.0 Manufacturer's Recommended User Seal Check Procedures

3.1 The respirator manufacturer's recommended procedures for performing a user seal check may be used instead of the positive and/or negative pressure check procedures, provided that the employer demonstrates that the manufacturer's procedures are equally effective.

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# Respirator Clean Procedures

**S3NA-519-WI3**

## 1.0 Requirements

1.1 These procedures are general in nature. The cleaning recommendations provided by the manufacturer may be used for the respirators used by their employees, provided such procedures are as effective as those listed here.

1.2 Equivalent effectiveness simply means that the procedures used must accomplish the objectives set forth (i.e., confirm that the respirator is properly cleaned and disinfected in a manner that prevents damage to the respirator and does not cause harm to the user).

## 2.0 Procedures for Cleaning Respirators

2.1 Remove filters, cartridges, or canisters. Disassemble facepieces by removing speaking diaphragms, demand and pressure-demand valve assemblies, hoses, or any components recommended by the manufacturer. Discard or repair any defective parts.

2.2 Wash components in warm (110 degree Fahrenheit [°F]; 43 degree Celsuis [°C] maximum) water with a mild detergent or with a cleaner recommended by the manufacturer. A stiff bristle (not wire) brush may be used to facilitate the removal of dirt.

2.3 Rinse components thoroughly in clean, warm (110°F [43°C] maximum), preferably running water. Drain.

2.4 When the cleaner used does not contain a disinfecting agent, respirator components should be immersed for 2 minutes in one of the following:

- Hypochlorite solution (50 parts per million [ppm] of chlorine) made by adding approximately one milliliter of laundry bleach to one liter of water at 110°F (43°C); or,
- Aqueous solution of iodine (50 ppm iodine) made by adding approximately 0.8 milliliters of tincture of iodine (6-8 grams ammonium and/or potassium iodide/100 cc of 45 percent alcohol) to one liter of water at 110°F (43°C); or,
- Other commercially available cleansers of equivalent disinfectant quality when used as directed, if their use is recommended or approved by the respirator manufacturer.

2.5 Rinse components thoroughly in clean, warm (110°F [43°C] maximum), preferably running water. Drain. The importance of thorough rinsing cannot be overemphasized. Detergents or disinfectants that dry on facepieces may result in dermatitis. In addition, some disinfectants may cause deterioration of rubber or corrosion of metal parts if not completely removed.

2.6 Components should be hand dried with a clean, lint-free cloth or air dried.

2.7 Reassemble facepiece, replacing filters, cartridges, and canisters where necessary.

2.8 Test the respirator to ensure that all components work properly.

2.9 After the fit test, wipe down the respirator with a sanitary swab.

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# Respiratory Equipment Fit Test

**S3NA-519-FM1**

| | | | |
|---|---|---|---|
| **Date of Testing:** | | **Respirator Type(s):** | |
| **Employee Name:** | | **Location:** | |
| **Method & Testing Agent:** | | | |
| **Test Exercise** | **Pass / Fail** | **Test Exercise** | **Pass / Fail** |
| Sensitivity Check | | Normal Breathing | |
| Deep Breathing | | Turning Head (side to side) | |
| Moving Head (up/down) | | Rainbow Passage* | |
| Bending Over | | Normal Breathing | |

**Successful Respirator Fit Determined:** ☐ **Yes** ☐ **No**

I certify that I have been tested with the respirator(s) listed above. I have also had the opportunity to ask questions and those questions have been answered to my satisfaction. I also understand that the above fit test is voided if respirator limitations are not followed or the respirator is not worn or if conditions (e.g., facial hair) prevent a good face seal.

| | |
|---|---|
| Employee Signature: | Date: |
| Signature of Tester: | Date: |

***Rainbow Passage.** "When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch with its path high above and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow."*

| | | | | | | |
|---|---|---|---|---|---|---|
| Date:<br>Tester: | MSA Comfo II HM<br>S ☐ M ☐ L ☐ | MSA Ultra Twin FM<br>S ☐ M ☐ L ☐ | North 7700 HM<br>S ☐ M ☐ L ☐ | North 7600 FM<br>S ☐ M/L ☐ | HM<br>S ☐ M ☐ L ☐ | FM<br>S ☐ M ☐ L ☐ |
| Qualitative Test Agent(s):<br>IAA ☐ Smoke ☐ | Pass ☐ Fail ☐ | Pass ☐ Fail ☐ | Pass ☐ Fail ☐ | Pass ☐ Fail ☐ | Pass ☐ Fail ☐ | Pass ☐ Fail ☐ |
| Quantitative Test Device | Overall Fit Factor | Overall Fit Factor | Overall Fit Factor | Overall Fit Factor | Overall Fit Factor | Overall Fit Factor |
| Date:<br>Tester: | MSA Comfo II HM<br>S ☐ M ☐ L ☐ | MSA Ultra Twin FM<br>S ☐ M ☐ L☐ | North 7700 HM<br>S ☐ M ☐ L ☐ | North 7600 FM<br>S ☐ M/L ☐ | HM<br>S ☐ M ☐ L ☐ | FM<br>S ☐ M ☐ L ☐ |
| Qualitative Test Agent(s):<br>IAA ☐ Smoke ☐ | Pass ☐ Fail ☐ | Pass ☐ Fail ☐ | Pass ☐ Fail ☐ | Pass ☐ Fail ☐ | Pass ☐ Fail ☐ | Pass ☐ Fail ☐ |
| Quantitative Test Device | Overall Fit Factor | Overall Fit Factor | Overall Fit Factor | Overall Fit Factor | Overall Fit Factor | Overall Fit Factor |
| Date:<br>Tester: | MSA Comfo II HM<br>S ☐ M ☐ L ☐ | MSA Ultra Twin FM<br>S ☐ M ☐ L ☐ | North 7700 HM<br>S ☐ M ☐ L ☐ | North 7600 FM<br>S ☐ M/L ☐ | HM<br>S ☐ M ☐ L ☐ | FM<br>S ☐ M ☐ L ☐ |
| Qualitative Test Agent(s):<br>IAA ☐ Smoke ☐ | Pass ☐ Fail ☐ | Pass ☐ Fail ☐ | Pass ☐ Fail ☐ | Pass ☐ Fail ☐ | Pass ☐ Fail ☐ | Pass ☐ Fail ☐ |
| Quantitative Test Device | Overall Fit Factor | Overall Fit Factor | Overall Fit Factor | Overall Fit Factor | Overall Fit Factor | Overall Fit Factor |

Instructions

1. Complete the Employee Information at the top of the record (one record per Employee).
2. Enter the date of the test and the name of the person conducting the fit test.
3. Circle the brand and model of respirator tested (e.g., MSA Comfo II, North 7700, etc.) or enter another brand and model in one of the last two columns.
4. Circle the size of the respirator tested.
5. For qualitative fit tests, circle the test agent used - IAA = Isoamyl Acetate, Smoke = Irritant Smoke (Stannic Chloride) and the outcome of the test (i.e., Pass or Fail).
6. For quantitative fit tests, enter the name of the instrument used and the overall fit factor measured by the test.
7. Keep a copy in the Employee's training files and enter subsequent (e.g., annual) tests until the record is filled.

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# Respiratory Equipment Maintenance Log

**S3NA-519-FM2**

| Unit No. | Respirator Type | Cleaned | Sterilized | Date | Performed by |
|---|---|---|---|---|---|
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# Respiratory Equipment Inspection

**S3NA-519-FM3**

| | | | |
|---|---|---|---|
| **Date:** | | **Inspected by:** | |
| **Air Purifier Unit #:** | | | |

| | N/A | Pass | Fail |
|---|---|---|---|
| **Examine Face Piece for**: | | | |
| Excessive dirt | ☐ | ☐ | ☐ |
| Cracks, tears, holes, or distortion from improper storage | ☐ | ☐ | ☐ |
| Inflexibility (stretch and massage to restore flexibility) | ☐ | ☐ | ☐ |
| Cracked or badly scratched lenses in full facepieces | ☐ | ☐ | ☐ |
| Incorrectly mounted full facepiece lens or broken or missing mounting clips | ☐ | ☐ | ☐ |
| Lens sealed properly in receptacle, retaining clamp secured | ☐ | ☐ | ☐ |
| Cracked or broken air-purifying element holder(s), badly worn threads or missing gasket(s) (if appropriate) | ☐ | ☐ | ☐ |
| **Examine the Head Straps or Head Harness for:** | | | |
| Breaks | ☐ | ☐ | ☐ |
| Loss of elasticity | ☐ | ☐ | ☐ |
| Broken or malfunctioning buckles and attachments | ☐ | ☐ | ☐ |
| Excessively worn serrations on the head harness that might permit slippage (full facepieces only) | ☐ | ☐ | ☐ |
| Tears in headband at cradle attachment | ☐ | ☐ | ☐ |
| **Examine the Inhalation and Exhalation Valves for:** | | | |
| Foreign material, such as detergent residue, dust particles, or human hair under the valve seat | ☐ | ☐ | ☐ |
| Cracks, tears, or distortion in the valve material | ☐ | ☐ | ☐ |
| Improper insertion of the valve body in the facepiece | ☐ | ☐ | ☐ |
| Cracks, breaks, or chips in the valve body, particularly in the sealing surface | ☐ | ☐ | ☐ |
| Missing or defective valve cover | ☐ | ☐ | ☐ |
| **Examine the Air Purifying Elements for:** | | | |
| Incorrect cartridge, canister, or filter for the hazard | ☐ | ☐ | ☐ |
| Incorrect installation, loose connection, missing or worn gaskets, or cross-threading in the holder | ☐ | ☐ | ☐ |
| Expired shelf life date on cartridge or canister | ☐ | ☐ | ☐ |

Defects Noted:

| | | |
|---|---|---|
| Unit Deemed Suitable for Use | ☐ Yes | ☐ No |

# S3NA-521-PR Decontamination

## 1.0 Purpose and Scope

1.1 To define appropriate procedures to decontaminate both equipment and personnel when exposure to hazardous chemicals or physical agents has occurred.

1.2 This procedure applies to all AECOM North America based operations and employees.

## 2.0 Terms and Definitions

2.1 **Contamination Reduction Zone (CRZ):** the transition area between the contaminated area and the clean area where decontamination activities occur.

2.2 **Decontamination:** the process of removing or neutralizing contaminants that have accumulated on personnel or equipment.

2.3 **Exclusion Zone (EZ):** the area where primary activities occur, such as sampling, remediation operations, installation of wells, cleanup work, etc.

2.4 **Support Zone (SZ):** an uncontaminated zone where administrative and other support functions, such as first aid, equipment supply, emergency information, etc., are located.

## 3.0 Attachments

3.1 None

## 4.0 Procedure

### 4.1 Roles & Responsibilities

4.1.1 **Project Managers** will be responsible for the following:

- Authorizing the procurement of the necessary decontamination supplies
- Verifying that the applicable decontamination steps are clearly defined in the approved work plan
- Verifying staff are appropriately trained to execute the defined decontamination procedures
- Verifying that adequate staffing is available to safely conduct the applicable decontamination steps

4.1.2 **Supervisor** will be responsible for the following:

- Establishing the designated site work zones (i.e., EZ, CRZ, SP, etc.)
- Conduct site-specific training on the applicable decontamination steps/procedures, as required
- Procuring the necessary decontamination supplies and establishing the decon line
- Enforcing the applicable decontamination steps as defined in the approved work plan

4.1.3 **Employees** will be responsible for the following:

- Following the defined decontamination steps as stated in the approved work plan

4.1.4 **Region SH&E Manager**

- Advise project managers and site supervisors as to the necessary decontamination procedures based on the known or reasonably anticipated chemical hazards and physical agents associated with the planned scope of work
- Support the project team to verify that adequate supplied-air respiratory protection measures are in-place, as applicable

### 4.2 General Requirements


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4.2.1 When possible, all necessary steps shall be taken to reduce or minimize contact with chemicals and impacted materials while performing field activities (e.g., avoid sitting or leaning on, walking through, dragging equipment over, tracking, or splashing potential or known impacted materials).

4.2.2 All personal decontamination activities shall be performed with an attendant (buddy) to provide assistance to personnel that are performing decontamination activities. Depending on specific site hazards, attendants may be required to wear a level of protection that is equal to the required level in the exclusion zone.

4.2.3 All persons and equipment entering the EZ shall be considered contaminated, and thus, must be properly decontaminated prior to entering the SZ.

4.2.4 Decontamination procedures may vary based on site conditions and nature of the contaminant. If chemicals or decontamination solutions are used, care should be taken to minimize reactions between the solutions and contaminated materials. In addition, personnel must assess the potential exposures created by the decontamination chemical(s) or solutions. The MSDS must be reviewed, implemented, and filed by personnel contacting the chemicals/solutions.

4.2.5 All contaminated personal protective equipment (PPE) and decontamination materials shall be stored and disposed of in accordance with site-specific requirements identified in the approved work plan.

4.2.6 For all Level B and A ensembles, adequate supplied air must be available to allow the employee to safely complete all necessary decontamination steps.

4.2.7 Where decontamination procedures involving radioactive materials are required, the removable limits for both personnel and equipment will be specified by a Certified Health Physicist in the project's approved Radiation Protection Plan or approved safety planning document.

## 4.3 Materials Needed to Decontaminate Personnel and/or Equipment

4.3.1 The equipment required to perform decontamination may vary based on site-specific conditions and nature of the contaminant(s). The following equipment is commonly used for decontamination purposes:

- Soft-bristle scrub brushes or long-handled brushes to remove contaminants;
- Hoses, buckets of water or garden sprayers for rinsing;
- Large plastic/galvanized wash tubs or children's wading pools for washing and rinsing solutions;
- Large plastic garbage cans or similar containers lined with plastic bags for the storage of contaminated clothing and equipment;
- Metal or plastic cans or drums for the temporary storage of contaminated liquids;
- Paper or cloth towels for drying protective clothing and equipment; and
- Poly or plastic sheeting to lay down and form the base for the CRZ, as well as to contain contaminants and decontamination fluids.

## 4.4 Personal Decontamination Steps: Level D Ensemble

4.4.1 Remove residual or caked on soil from boots using a dry method (i.e., soft-bristle scrub brush to knock off the soil)

4.4.2 Wash exposed skin with soap and water, as applicable.

## 4.5 Personal Decontamination Steps: Modified Level D Ensemble

4.5.1 In the Exclusion Zone

- Equipment drop on plastic sheet
- Remove the majority of gross contamination
- Wash boot covers and outer gloves
- Rinse boot covers and outer gloves
- Remove tape
- Remove boot covers and outer gloves

4.5.2 In the Contaminant Reduction Zone (keep the most contaminated equipment near the EZ)

- Wash protective suits and safety boots
- Rinse protective suits and safety boots
- Safety boot removal
- Remove protective suit
- Wash inner gloves
- Rinse inner gloves
- Remove inner gloves.
- Remove inner clothing (if necessary)

4.5.3 In the Support Zone

- Finish with personal decon/hygiene wash procedures
- Redress (if necessary).

## 4.6 Personal Decontamination Steps: Level C Ensemble

4.6.1 In the Exclusion Zone

- Equipment drop on plastic sheet
- Remove the majority of gross contamination
- Wash boot covers and outer gloves
- Rinse boot covers and outer gloves
- Remove tape
- Remove boot covers and outer gloves

4.6.2 In the Contaminant Reduction Zone (keep the most contaminated equipment near the EZ)

- Wash protective suits and safety boots
- Rinse protective suits and safety boots
- Change out (if required): Filter/mask change and redress (boot covers and outer gloves)
- Safety boot removal
- Remove protective suit
- Wash inner gloves
- Rinse inner gloves
- Remove respirator/mask
- Remove inner gloves
- Remove inner clothing (if necessary)

4.6.3 In the Support Zone

- Finish with personal decon/hygiene wash procedures
- Redress (if necessary)

## 4.7 Personal Decontamination Steps: Level B Ensemble

4.7.1 In the Exclusion Zone

- Equipment drop on plastic sheet
- Remove the majority of gross contamination
- Wash boot covers and outer gloves
- Rinse boot covers and outer gloves
- Remove tape
- Remove boot covers and outer gloves

4.7.2 In the Contaminant Reduction Zone (keep the most contaminated equipment near the EZ)

- Wash SCBA/airline equipment, protective suits and safety boots

- Rinse SCBA/airline equipment, protective suits and safety boots
- Change out (if required): Tank change and redress (boot covers and outer gloves)
- Safety boot removal
- SCBA backpack or airline equipment removal
- Remove protective suit and/or splash suit
- Wash inner gloves
- Rinse inner gloves
- Remove face piece/mask
- Remove inner gloves
- Remove inner clothing (if necessary)

4.7.3 In the Support Zone

- Finish with personal decon/hygiene wash procedures
- Redress (if necessary)

## 4.8 Personal Decontamination Steps: Level A Ensemble

4.8.1 In the Exclusion Zone

- Equipment drop on plastic sheet
- Remove the majority of gross contamination
- Wash boot covers and outer gloves (if applicable to ensemble)
- Rinse boot covers and outer gloves (if applicable to ensemble)
- Remove tape (if applicable to ensemble)
- Remove boot covers and outer gloves (if applicable to ensemble)

4.8.2 In the Contaminant Reduction Zone (keep the most contaminated equipment near the EZ)

- Wash protective suite and safety boots
- Rinse protective suits and safety boots
- Change out (if required): Tank change and redress (boot covers and outer gloves)
- Safety boot removal
- Remove fully encapsulating suit and hard hat
- Remove SCBA backpack
- Wash inner gloves
- Rinse inner gloves
- Remove face piece/mask
- Remove inner gloves
- Remove inner clothing (if necessary)

4.8.3 In the Support Zone

- Finish with personal decon/hygiene wash procedures
- Redress (if necessary)

## 4.9 Decontamination Steps during a Medical Emergency

4.9.1 If decontamination can be done:

- Wash, rinse and/or cut off protective clothing and equipment

4.9.2 If decontamination cannot be done:

- Wrap the victim in blankets, plastic sheeting, or rubber to reduce contamination of other personnel
- Alert emergency and offsite medical personnel to potential contamination
- Instruct them about specific decontamination procedures if necessary

## 4.10 Equipment Decontamination Steps


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4.10.1 All equipment leaving the EZ shall be considered contaminated and must be properly decontaminated to minimize the potential for exposure and off-site migration of impacted materials. Such equipment may include, but is not limited to: sampling tools, heavy equipment, vehicles, PPE (hoses, cylinders, etc.), and various handheld tools.

4.10.2 All employees performing equipment decontamination shall wear the appropriate PPE to protect against exposure to contaminated materials. The level of PPE may be equivalent to the level of protection required in the EZ. Other PPE may include splash protection, such as face-shields and splash suits, and knee protectors. Following equipment decontamination, employees may be required to follow the proper personal decontamination procedures above.

4.10.3 For larger equipment, a high-pressure washer may need to be used. Some contaminants require the use of a detergent or chemical solution and scrub brushes to ensure proper decontamination.

4.10.4 For smaller equipment, use the following steps for decontamination:

1. Remove majority of visible gross contamination in EZ.
2. Wash equipment in decontamination solution with a scrub brush and/or power wash heavy equipment.
3. Rinse equipment.
4. Visually inspect for remaining contamination.
5. Follow appropriate personal decontamination steps outlined above.

4.10.5 All decontaminated equipment shall be visually inspected for contamination prior to leaving the CRZ. Signs of visible contamination may include an oily sheen, residue or contaminated soils left on the equipment. All equipment with visible signs of contamination shall be discarded or re-decontaminated until clean. Depending on the nature of the contaminant, equipment may have to be analyzed using a wipe method or other means.

## 5.0 Records

5.1 None

## 6.0 References

6.1 Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, National Institute of Occupational Safety and Health (NIOSH) 85-115, 1985.



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## Appendix D
## Site Safety and Health Officer Certificate

LeNina Vivian Renee Bennerson

USACE# 1890

UXO Technician school: May2007- June 2007 Texas Engineering Extension Service Bryan, TX

U.S.Army Ammunition: Sep. 2001- Dec. 2001 Redstone Arsenal Huntsville, AL

Other Pertinent Training: Hazwoper 40 hour, 8hr refresher, Excavator, Backhoe, EM-61, Marsh Excavator and Forklift certified

---

MILITARY EXPERIENCE:

| | |
|---|---|
| Jul. 2001 –Jan. 2002 | Ammunition Specialist, U.S. Army, Redstone Arsenal Attended Basic training and A.I.T. perform the knowledge and skills needed for my job performance. |
| Mar. 2002 – Oct 2002 | Ammo Specialist/ SAAS-MOD Clerk, U.S. ARMY, 63rd Ord co. Bahgram, Afghanistan. Performed ammunition supply stock control accounting duties using automated and Manual procedures. |
| Jan. 2004 – Feb. 2005 | Ammunition Specialist/ SAAS-MOD Clerk, U.S. ARMY, Balad, Iraq. Supervised Others and provided technical guidance in the accomplishment in SAAS-MOD Procedures and ammunition others accomplishment in SAAS-MOD procedures and Ammunition handling. Unpacking, shelving, or placing items in proper storage locations; Transporting and delivering munitions by ground or air. |

---

Civilian Experience:

| | |
|---|---|
| Aug 2005- Sep.2005 | Ammunition Handler, KBR, Balad, Iraq. Received, shipped and store both U.S military And coalition forces ammunition. Conducted daily inventories for accountability. |
| April 2006 - April 2007 | Ammunition Handler, TETRATECH, Iraq. Assist UXO technicians in the recovery and Of captured munitions. |

---

Civilian UXO Experience: 7.25

Sep. 2007 - Dec. 2007 UXO Tech I, TETRATECH, Ft. Bragg, NC

| | |
|---|---|
| | Locate, identify and the removal of munitions and components. |
| Feb. 200 8- Feb 2009 | UXO Tech I, Pika Inc., Ft. McClellan, Anniston, AL |
| | Removal of surface and subsurface munitions. Operated EM-61 and Excavator. |
| Feb 2009 - Feb 2010 | UXO Tech I, Pika Inc. Ft. McClellan, Anniston, Al. Employed by Aerotek |
| | Removal of surface and subsurface munitions. Operated EM-61 Excavator. |
| May 2010 - Aug 2010 | UXO Tech I, TETRATECH, Lowry, CO |
| | Surface and subsurface removal. Training in Geophysical data survey and collection. |
| Aug 2010 - Mar. 2011 | UXO Tech I, EODT, Ft McClellan, Anniston, AL |
| | Surface and subsurface removal of munition debris, via magnetometers, em-61 |
| Aug 2011- Oct 2011 | UXO Tech II, AECOM, Udari, Kuwait |
| | Construction support of heavy equipment operations. Removal of munitions debris |
| Nov 2011- Dec 2011 | UXO Tech II, Pika Inc., Camp William, Utah Employed by Aerotek |
| | Surface and subsurface removal of munitions and munitions related items. |
| April 2012 - Oct 2012 | UXO Tech II, RORE, F.E. Warren AFB, WY |
| | Surface and subsurface uxo clearance. Operated EM-61; performed demolition. |
| Nov 2012 - Mar. 2013 | UXO Tech II, USAE, Jackson Park, Bremerton, WA. |
| | UXO clearance. Operated Marsh Excavator to assist in lower tidal area clearance. |
| Apr. 2013- Jun. 2013 | UXO Tech II, Pika Inc., Ft. Carson, CO. Employed by Aerotek |
| | Surface and subsurface investigation and clearance of UXO. |
| Jun 2013 – Mar. 2014 | UXO Tech II, USAE Jackson Park Bremerton, WA |
| | UXO clearance. Operated Marsh Excavator to assist in lower tidal area clearance. |
| Jun. 2014- Sep. 2014 | UXO Tech II, USAE Jackson Park Bremerton, WA |
| | UXO clearance. Operated Marsh Excavator to assist in lower tidal area clearance. |
| Nov. 2014 – Apr. 2015 | UXO Tech II, AECOM, Ft. McClellan, Anniston, AL. |
| | Brush and Survey Escort. Surface and sub surface UXO clearance. Demo team member. |
| Jun. 2015 – Sep. 2015 | UXO Tech II, AECOM, Boca Chica Key West, Fl. |
| | Surface and sub surface UXO clearance for sifting operations. Demo team member. |
| Sep. 2015 – Mar. 2016 | UXO Tech II, ECC, Ft. Bragg, NC. Employed by Aerotek |
| | Surface and sub surface UXO clearance. |
| Apr. 2016-Present | UXO Tech II, HGL, Parson, KS. Employed by Aerotek |
| | Clean up of sifting operations munitions |

LeNina Vivian Renee Bennerson

360 Gator Court s.e.

Olympia, WA 98503

lil_twin12@hotmail.com

253-376-7133

UXO Tech II/ 7.25 yrs.

Citizenship, US

# TEXAS ENGINEERING EXTENSION SERVICE

The Texas A&M University System

TRAIN ▪ SERVE ▪ RESPOND

## *LeNina V. Bennerson*

**has successfully completed**

## Unexploded Ordnance Technician Level I

**Bryan, TX**

**200 Hours**

**May 29 - June 29, 2007**

*Gary F. Sera, Interim Director*
*Texas Engineering Extension Service*

*Thomas N. Shehan, Division Director*
*Public Safety and Security*

State Board for Educator Certification #5001

OEC-7036161

# CERTIFICATE OF COMPLETION

OSHA EDUCATION CENTER

American Safety Council

KELLY LURIE

Has diligently and with merit completed a

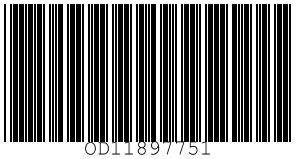
30-Hour OSHA Hazard Recognition Training for the Construction Industry Course on 4/18/2016

from the OSHA Education Center and the American Safety Council Inc.



Director: **Jeffrey Pairan**

AECOM
GRETA WHITE
2019 BRAINARD STATION ROAD
BRAINARD, NY 12024



OEC-7037051

# CERTIFICATE OF COMPLETION

OSHA EDUCATION CENTER

American Safety Council

GRETA WHITE

Has diligently and with merit completed a

30-Hour OSHA Hazard Recognition Training for the Construction Industry Course on 6/10/2016

from the OSHA Education Center and the American Safety Council Inc.



Director: **Jeffrey Pairan**

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## Appendix E
## HAZWOPER Training and Medical Monitoring Documentation

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**Appendix E.1**
**8-Hour Certificates**

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# Certificate of Completion

*This certifies that*

## LeNina Bennerson

Has Successfully completed

## 8 Hour HAZWOPER Refresher Training

Refresher certification does NOT necessarily indicate initial 24 or 40 Hour HAZWOPER certification

**In Accordance w/Federal OSHA Regulation 29 CFR 1910.120(e) & (p)**

And all State OSHA and EPA Regulations As Well

This course is approved for 8 Contact Hours (0.8 CEUs) of continuing education per the California Department of Public Health for Registered Environmental Health Specialist (REHS) issued by Safety Unlimited, Inc. (Accreditation # 044)

| *Julius P. Griggs* | 1509265150421 | 9/26/2015 |
|---|---|---|
| Julius P. Griggs<br>Instructor #892 | Certificate Number | Issue Date |

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www.safetyunlimited.com

Proof of initial certification and subsequent refresher training is NOT required to take refresher training
Want to be sure this certificate is valid? Visit safetyunlimited.com/verification

# CERTIFICATE OF COMPLETION

AECOM

This is to recognize that

## Eric N Celebrezze

Has completed

**HAZWOPER 8-hour Refresher Online**

on

**05-19-2015**

CONTENT DELIVERED BY PureSafety

Peter Sullivan, CET, CIT
NA SH&E Training Director

AECOM University

# Certificate of Completion

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## Certificate of Completion

## 8 Hour HAZWOPER Refresher

This certifies that

## Michael R Glinski

Has completed eight hours of annual refresher training for hazardous waste/materials workers under OSHA 29 CFR 1910.120.

Completed on 6/1/2016



*Mike de Bettencourt, Director*

*Safety, Health and Environment Training and Development*

AECOM University

# Certificate of Completion

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## Certificate of Completion

## 8 Hour HAZWOPER Refresher

This certifies that

## Kelly A Lurie

Has completed eight hours of annual refresher training for hazardous waste/materials workers under OSHA 29 CFR 1910.120.

Completed on 1/20/2016



*Mike de Bettencourt, Director*

*Safety, Health and Environment Training and Development*

# CERTIFICATE OF COMPLETION

## 2016 HAZWOPER 8-Hour Refresher Training

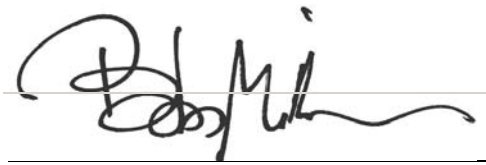
This is to recognize that

## Amanda Martin

Has completed AECOM SH&E Training Course *HAZWOPER 8-Hour Refresher Training*, required by 29 CFR 1910.120(e) and AECOM SH&E SOP *S3NA-509-PR Hazardous Waste HAZWOPER Activities* on *February 22, 2016.*

Course Content:

- Safety For Life
- Task Hazard Assessment.
- Biological Hazards
- Site Control and Decontamination
- Fall Protection
- 4-HR HAZWOPER Annual Refresher Live Instruction



Bob Miller, DC and Mid-Atlantic Area Safety, Health, Environment Manager

# CERTIFICATE OF COMPLETION

## 2016 HAZWOPER 8-Hour Refresher Training

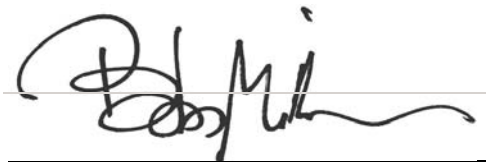
This is to recognize that

## Kathryn Priess

Has completed AECOM SH&E Training Course *HAZWOPER 8-Hour Refresher Training*, required by 29 CFR 1910.120(e) and AECOM SH&E SOP *S3NA-509-PR Hazardous Waste HAZWOPER Activities* on *February 22, 2016.*

Course Content:

- Safety For Life
- Task Hazard Assessment.
- Biological Hazards
- Site Control and Decontamination
- Fall Protection
- 4-HR HAZWOPER Annual Refresher Live Instruction



Bob Miller, DC and Mid-Atlantic Area Safety, Health, Environment Manager

# Certificate of Completion

*This certifies that*

## Nicole M Schulman

*Has successfully completed*

## 8-HR HAZWOPER Classroom 2016

Completed on 4/13/2016 04:00 PM America/New York

---

Instructor

AECOM University

# Certificate of Completion

AECOM
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## Certificate of Completion

## 8 Hour HAZWOPER Refresher

This certifies that

## Greta L White

Has completed eight hours of annual refresher training for hazardous waste/materials workers under OSHA 29 CFR 1910.120.

Completed on 1/20/2016



*Mike de Bettencourt, Director*

*Safety, Health and Environment Training and Development*

# Certificate of Completion

*This certifies that*

## Matthew Emmert

Has Successfully completed

## 8 Hour HAZWOPER Refresher Training

Refresher certification does NOT necessarily indicate initial 24 or 40 Hour HAZWOPER certification

**In Accordance w/Federal OSHA Regulation 29 CFR 1910.120(e) & (p)**

And all State OSHA and EPA Regulations As Well

This course is approved for 8 Contact Hours (0.8 CEUs) of continuing education per the California Department of Public Health for Registered Environmental Health Specialist (REHS) issued by Safety Unlimited, Inc. (Accreditation # 044)

| *Julius P. Griggs* | 1506235143557 | 6/23/2015 |
|---|---|---|
| Julius P. Griggs<br>Instructor #892 | Certificate Number | Issue Date |


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# Certificate of Completion

*This certifies that*

## John C Schroeder

Has Successfully completed

## 8 Hour HAZWOPER Refresher Training

Refresher certification does NOT necessarily indicate initial 24 or 40 Hour HAZWOPER certification

**In Accordance w/Federal OSHA Regulation 29 CFR 1910.120(e) & (p)**

And all State OSHA and EPA Regulations As Well

This course (Version 1) is approved for 8 Contact Hours (0.8 CEUs) of continuing education per the California Department of Public Health for Registered Environmental Health Specialist (REHS) issued by Safety Unlimited, Inc. (Accreditation # 044)

| | | |
|---|---|---|
| *Julius P. Griggs* | 1602035160537 | 2/3/2016 |
| Julius P. Griggs<br>Instructor #892 | Certificate Number | Issue Date |

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OSHA Compliant Safety Training Since 1993

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102%

**Appendix E.2**
**40-Hour Certificates**

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# Certificate of Course Completion

| LeNina V Bennerson | Hazwoper 40 Hour Course | 08/03/07 |
|---|---|---|
| Student's Name | Course Title | Course Completion Date |

LeNina V. Bennerson
Student's Signature

709594
Certificate Number

40
# of hours approved

**I hereby attest that I have completed the above named Safety course In accordance with the ethical guidelines Defined by International Board of Environmental Health & Safety. I acknowledge that I consumed all information and took All Pertinent Quizzes and/or final tests.**

**Classroom Online**
**5702 Taylor Draper Cove Ste B**
**Austin, TX 78759**
**T: 866.439.5908**
**F: 888.742.6518**

**Compliance Solutions**

*"Today's Training... Tomorrow's Solution"*

10515 E 40th Ave, Suite 116, Denver Colorado 80239 800-711-2706

*Student Affiliation:*
*Earth Tech*
*200534663*

# *Certificate of Completion*

This is to certify that

***Eric Celebrezze***

has successfully completed the classroom requirements for

***40-Hour HAZWOPER***

***29 CFR 1910.120(e)***

**Presented**

*Monday, April 23, 2007*

## *Compliance Solutions Occupational Trainers, Inc.*

*Certificate Number: 7541630*

Neval Gupta
***Vice President***

Jeffrey Kline
***President/CEO***

UXO GLOBAL

# MATT A. EMMERT

*having completed the necessary 200 hours of study and having satisfied all requirements in accordance with Department of Defense Explosives Safety Board Technical Paper 18 is hereby declared a certified*

## UXO TECHNICIAN LEVEL 1

*and is awarded this certificate with all the honors and privileges pertaining thereto.*

*In testimony whereof the signatures of the Lead Instructor and Director of Training have been affixed this day, August 6, 2010.*

MEANINGFUL. EFFECTIVE. SUSTAINABLE.

*"Incendia In Aula"*

Director of Training, D. Kevin Cooper

Lead Instructor, John Galanaitis

SEAL 2003 COLORADO

Training in accordance with DDESB TP-18 Chapter 3 has been satisfied including:

- Range Clearance Activities
- Measurements and Mathematical Computations
- Electricity
- Physics
- Explosives and Explosive Effects
- Military Fuze Functioning
- Munitions and Explosives of Concern (MEC) and Explosive Safety Precautions
- Surface Munitions Identification
- Air Ordnance Identification (dropped or launched)
- Chemical Munitions Identification (Chemical Munitions and Chemical Warfare Material (CWM))
- Pyrotechnic Munitions Identification
- Underwater Munitions Identification
- Detection Equipment
- Munitions Response Planning
- Personal Protective Equipment
- Demolition Materials
- Demilitarization Procedures
- Storage, Handling and Transportation of Explosives (Military and Commercial)
- Operation of Detection Equipment
- Designing and Constructing Firing Systems
- Design, Construction and Detonation of Demolition Explosives
- ORDATA
- Ordnance Reconnaissance
- GPS Theory
- Garmin GPS Use
- Wilderness First Aid
- CPR
- AED
- Resume Writing

Misty Streeter, Admissions Officer

UXO GLOBAL

# MATT A. EMMERT

*having completed the necessary 40 hours of study and having satisfied all requirements in accordance with 29 CFR 1910.120 (q) & (e) is hereby declared a certified*

# HAZARDOUS WASTE OPERATOR

*and is awarded this certificate with all the honors and privileges pertaining thereto. In testimony whereof the signatures of the Lead Instructor and Director of Training have been affixed this day, August 6, 2010.*

*"Subsisto Tutus""*

Director of Training, D. Kevin Cooper

Lead Instructor, Tyler Drage

UXO GLOBAL
UNEXPLODED ORDNANCE (UXO)
TECH 1 PROGRAM

1419 W. 29TH ST, LOVELAND, CO 80538 WWW.UXOGLOBAL.COM OFFICE: 970. 292.2030

Approved and Regulated by the Colorado Department of Higher Education, Private Occupational School Board

# Memorandum

From: Admissions Officer

Date: 8/6/2010

Re: UXO Tech 1 Certification Statement

Training in accordance with the Department of Defense Explosive Safety Board, Technical Paper Eighteen (DDESB TP-18) Chapter 3 has been satisfied. The students listed here were taught, evaluated, and tested during a 200 hour program.

| | | |
|---|---|---|
| Travis E. Allen | Mitchell R. Fowler | Jose Ramos Rivera |
| Brian L. Ashton | Daniel C. Hughes | Melvin Rosa Esperanza |
| Kevin L. Brown | Joshua M. Jenkins | Lucas K. Rulon |
| Jeremy D. Cochran | Michelle M. Klomp | Aaron J. Spoor |
| Allen R. Cochran | Daryle S. McGinnis | Joshua C. Starkey |
| Matt A. Emmert | Victor J. Orozco | Frank D. Swopes |
| Adam J. Foster | Edwin Ortiz Esperanza | |

**Course of Study**

| | |
|---|---|
| Range Clearance Activities | Munition Response Planning |
| Measurements and Mathematical Computations | Personal Protective Equipment |
| Electricity | Demolition Materials |
| Physics | Demilitarization Procedures |
| Explosives and Explosive Effects | Storage, Handling, and Trans. Of Explosives |
| Military Fuze Functioning | Operation of Detection Equipment |
| Munitions and Explosives Concern (MEC) | Designing and Const. Firing Systems |
| Explosive Safety Precautions | Design, Const., and Detonation of Explosives |
| Surface Munitions Identification | GPS Theory |
| Air Ordnance Identification (dropped or launched) | Garmin GPS Use |
| Chemical Munitions Identification (CM and CWM) | Ordata |
| Pyrotechnic Munitions Identification | Resume Writing |
| Underwater Munitions Identification | Wilderness First Aid |
| Detection Equipment | CPR |
| Ordnance Reconnaissance | AED |

Misty Streeter, Admissions Officer

# STL PRECISION

*CERTIFIES THAT*

**MICHAEL GLINSKI**

*HAS SUCCESSFULLY MET CERTIFICATE REQUIREMENTS FOR THE COURSE ENTITLED*

**40 HOUR HAZMAT/HEALTH & SAFETY TRAINING**

*IN ACCORDANCE WITH: OSHA 29CFR1910.120(e)(3)(i)*
*AND IN EVIDENCE THEREOF IS AWARDED THIS*

## CERTIFICATE OF COMPLETION

**on the twenty-eighth day of August, 2000**

Trained to Level B

CERTIFICATE NO.
6010

*Expires one year from date of issue*

Robert W. Pope, Corporate Environmental Health Officer

Training Provided By:

STL Precision, 10200 USA Today Way, Miramar, Florida 33025, 954-431-4550

This is to certify that

# Kelly Robertson

has completed

## 29 CFR 1910.120 – 40 Hour HAZWOPER Training

Instructor: R. Kip Score

Date: October 8-10,12, 2001

Saratoga Safety
Gansevoort, New York



# ALL AMERICAN ENVIRONMENTAL SERVICES, INC.

## This is to certify that

**AMANDA MARTIN**

## has successfully completed

**"HAZARDOUS WASTE SITE WORKER" 40-HOUR COURSE**
**SATISFYING OSHA 29 CFR 1910.120 (e) (3) (i)**

## at

**ALL AMERICAN SCHOOL OF OCCUPATIONAL SAFETY AND HEALTH**
**HANOVER, MARYLAND**

School Director

**SEPTEMBER 10-14, 2012**
**40S-1209A**

# The New England Consortium

(Partially supported by the National Institute of Environmental Health Sciences)

This is to certify that

## Kathryn Priess

Certificate #: 50540810

has successfully completed the

## (101) 40hr. Hazardous Waste Site Worker

Health & Safety Training per requirements of 29 CFR 1910.120

Training Date(s): January 7-11, 2013

Event #: 1165398

CEUs: 4.0 / TCH: 40.0

This training was delivered in conjunction with:

Connecti COSH
Mass COSH
New Hampshire COSH
RI COSH
Western Mass COSH

To verify authenticity of this certificate, please call The New England Consortium at (978) 934-3257

Paul Morse, Project Director/co-PI

David Coffey, Training Manager

This is to certify that

**John C. Schroeder**
**has completed**
**29 CFR 1910.120-40 Hour HAZWOPER Training**

Instructor: R. Kip Scare
Date: January 28-31, 2008

Saratoga Safety Inc.
Schuylerville, New York
(518) 695-3330

Title: NMB-HSCERT-JAN2010-HS001
Type: 40 HOUR OSHA HAZWOPER, JAN 2010

# CERTIFICATE OF TRAINING

## *Nicole Brownell*

***Has Successfully Completed A Course Of Instruction On***

***40-Hour HAZWOPER***

*AS REQUIRED BY OSHA (29 CFR 1910.120(e)(q))*

*Friday, January 15, 2010*

MILLER ENVIRONMENTAL GROUP INC.

538 Edwards Ave.
Calverton, NY 11933 USA

**Course Number: 20100005**
**Certificate Number: 20100005-12105**

Tony Pepitone
*Instructor*

George Wallace III
*Director of Training*

**Compliance SolutionsOccupational Trainers, Inc.**

**Certificate of Completion**

Student Name: Greta Spinner

Company: Jacques Whitford Company, Inc.

I Certify that the above named student has completed the

**40-Hour HAZWOPER**

**29 CFR 1910.120(e)**

**Date of Issue: Friday, June 02, 2006**

By:_____

**William Niedzwiedz** **Instructor**

**Compliance SolutionsOccupational Trainers, Inc.**

**Certificate of Completion**

Student Name: Greta Spinner

Company: Jacques Whitford Company, Inc.

I Certify that the above named student has completed the

**40-Hour HAZWOPER**

**29 CFR 1910.120(e)**

**Date of Issue: Friday, June 02, 2006**

By:_____

**William Niedzwiedz** **Instructor**

# Appendix E.3
# Medical Monitoring

**This page intentionally left blank.**

Clinic #: 15350 eScreen Account #: 129216-987 Confirmation #: AI1380472752

eScreen
an Aiere company

7500 W. 110th Street Suite 500
Overland Park, KS 66210-2328
(800)-881-0722 PHONE

# MEDICAL CLEARANCE CERTIFICATE

**EMPLOYEE NAME:** LeNina V.R. Bennerson **S.S. #:** xxx-xx-9606 **DATE:** 10/23/2015

## Section 1: Medical Surveillance Examination for Hazardous Waste Operations

☑ Hazardous materials evaluation (29CFR 1910.120)

The above named individual was evaluated for medical fitness to work with hazardous materials and:

☐ May work with hazardous materials without restriction
- ☐ 1 Year Certification
- ☑ 2 Year Certification
  - ☐ Pending review of laboratory results and/or chest x-ray

☐ May work with hazardous materials with the following ☐ Temporary ☐ Permanent Restrictions: _____

☐ May NOT work with hazardous materials

☐ Temporarily deferred pending further evaluation of: _____

## Section 2: Certificate for Respirator Use (29CFR1910.134)

☑ Physician's Written Opinion (PWO) for Medical Clearance to wear a Respirator (29CFR1910.134)
☑ Physical Exam ☑ Questionnaire

The above named individual was evaluated for medical fitness to wear a respirator and:

☑ May wear a respirator without restriction or accommodations

☐ May wear a respirator with the following ☐ Temporary ☐ Permanent restrictions: _____

1) A powered air purifying respirator (PAPR) is required for this employee ☐ Yes ☐ No
2) Does the employee require corrective lenses at work? ☐ No ☐ Glasses ☐ Contacts
   A spectacle kit is required when using a full-face respirator? ☐ Yes ☐ No

Notes regarding restrictions: _____

☐ Is NOT medically qualified to wear respirator.

☐ Temporarily deferred pending further evaluation of: _____

**REQUIRED:**

☑ **Licensed Healthcare Provider has provided individual with a copy of Physician's Written Opinion and has advised the individual of the findings of the evaluation.**

| | | |
|---|---|---|
| Physician Signature | Justin Adams<br>Physician Printed Name | 10/23/15<br>Date |
| 413 Oven Dr Fay NC 28304<br>Address, State, Zip | | 910 323-3183<br>Phone Number |

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WorkCare™
MAKING HEALTH COUNT

# WORK STATUS REPORT

**Employer Copy**

**TYPE OF EXAMINATION:** **AECOM-Annual Hazmat Exam**
**EXAM CLASSIFICATION:** **Periodic Examination**

| | | | |
|---|---|---|---|
| **EMPLOYEE:** | **Celebrezze, Eric** | **COMPANY:** | **AECOM** |
| **ID:** | **656299** | **POSITION:** | **Geophysicist** |
| **DATE OF EXAM:** | **05/19/2015** | **LOCATION:** | **AECOM-Glen Allen, VA - 4840 Cox (EM)** |
| **EXPIRATION DATE:** | **05/19/2016** | **SITE:** | **41001.000.0000.221099.00.0000** |

The following recommendations are based on a review of one or all of the following: a base history questionnaire, supporting diagnostic tests, physical examination, and the essential functions of the position applied for or occupied by the individual named above.

| | Yes | No | Undecided |
|---|---|---|---|
| Has the employee any detected medical conditions that would increase his/her risk of material health impairment from occupational exposure in accordance with 29 CFR §1910.120 (Hazwoper)? | ☐ | ☒ | ☐ |
| Has the employee any limitations in accordance with 29 CFR §1910.134 (Respirator)? | ☐ | ☒ | ☐ |

**STATUS**

☒ **QUALIFIED** The examination indicates no significant medical condition. Employee can be assigned any work consistent with skills and training.

☐ **QUALIFIED - WITH LIMITATIONS** The examination indicates that a medical condition currently exists that limits work assignments on the following basis:

☐ **NOT QUALIFIED**

☐ **DEFERRED** The examination indicated that additional information is necessary. The employee has been given the following instructions.

**COMMENTS:**

I have reviewed the medical data of the above named employee, and informed the employee of the results of the medical examination and any medical conditions that require follow-up examination or treatment.

Name of Physician: Peter P. Greaney, M.D. Date: 06/01/15

Signature: Peter P Greaney MD

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## Release to Duty

**Clinic Instructions:**
Please complete the following form and give to employee before they leave the facility.

Date: 8/24/15

Employee Name: Matthew Emmert

Clinic Name: Intermountain Worksmed- S. Jordan

Company Name: Intermountain Health care

Company Location: South Jordan, Utah

**Complete only if applicable:**

To work with hazardous materials in accordance with 29 CFR 1910.120 ☒ Yes ☐ No

To use respiratory protective equipment in accordance with 29 CFR 1910.134 ☒ Yes ☐ No

Based on the limited information WorkCare has requested me to review, I find no necessity for immediate restrictions and I release this employee for duty. It is understood and agreed upon by the employer or potential employer of this examinee that subsequent comprehensive review of all laboratory and other test data by WorkCare, may detect health conditions not apparent to me. It is further agreed that such health conditions may necessitate the need for workplace restrictions. Examination has been performed in compliance with 1910.120 and 1910.134.

Signed: _____ NP M.D./D.O.

Date: 8/24/15

300 S. Harbor Blvd., Ste. 600 • Anaheim, CA 92805 • (800) 455-6155 • Fax: (714) 456-2154
1320 Harbor Bay Parkway, #115 • Alameda, CA 94502 • (510) 748-6900 • Fax: (510) 748-6915
info@workcare.com • [redacted]

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Last Modified: March 27, 2015

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# WORK STATUS REPORT

**Employer Copy**

**TYPE OF EXAMINATION:** **AECOM-Annual Hazmat Exam**
**EXAM CLASSIFICATION:** **Periodic Examination**

| | | | |
|---|---|---|---|
| **EMPLOYEE:** | **Glinski, Michael A.** | **COMPANY:** | **AECOM** |
| **ID:** | **657077** | **POSITION:** | **Geologist** |
| **DATE OF EXAM:** | **08/04/2015** | **LOCATION:** | **AECOM-Alexandria, VA - N Wash (EM)** |
| **EXPIRATION DATE:** | **08/04/2016** | **SITE:** | **41001.000.0000.221099.00.0000** |

The following recommendations are based on a review of one or all of the following: a base history questionnaire, supporting diagnostic tests, physical examination, and the essential functions of the position applied for or occupied by the individual named above.

| | Yes | No | Undecided |
|---|---|---|---|
| Has the employee any detected medical conditions that would increase his/her risk of material health impairment from occupational exposure in accordance with 29 CFR §1910.120 (Hazwoper)? | ☐ | ☒ | ☐ |
| Has the employee any limitations in accordance with 29 CFR §1910.134 (Respirator)? | ☐ | ☒ | ☐ |

**STATUS**

☒ **QUALIFIED** The examination indicates no significant medical condition. Employee can be assigned any work consistent with skills and training.

☐ **QUALIFIED - WITH LIMITATIONS** The examination indicates that a medical condition currently exists that limits work assignments on the following basis:

☐ **NOT QUALIFIED**

☐ **DEFERRED** The examination indicated that additional information is necessary. The employee has been given the following instructions.

**COMMENTS:**

I have reviewed the medical data of the above named employee, and informed the employee of the results of the medical examination and any medical conditions that require follow-up examination or treatment.

Name of Physician: Peter P. Greaney, M.D. Date: 08/10/15

Signature: Peter P Greaney MD

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# WORK STATUS REPORT

**Employer Copy**

**TYPE OF EXAMINATION:** **AECOM-Annual Hazmat Exam**
**EXAM CLASSIFICATION:** **Periodic Examination**

| | | | |
|---|---|---|---|
| **EMPLOYEE:** | **Lurie, Kelly A.** | **COMPANY:** | **AECOM** |
| **ID:** | **656718** | **POSITION:** | **Geochemist** |
| **DATE OF EXAM:** | **12/22/2015** | **LOCATION:** | **AECOM-Latham, NY (EM)** |
| **EXPIRATION DATE:** | **12/22/2016** | **SITE:** | **04107950.0001** |

The following recommendations are based on a review of one or all of the following: a base history questionnaire, supporting diagnostic tests, physical examination, and the essential functions of the position applied for or occupied by the individual named above.

| | Yes | No | Undecided |
|---|---|---|---|
| Has the employee any detected medical conditions that would increase his/her risk of material health impairment from occupational exposure in accordance with 29 CFR §1910.120 (Hazwoper)? | ☐ | ☒ | ☐ |
| Has the employee any limitations in accordance with 29 CFR §1910.134 (Respirator)? | ☐ | ☒ | ☐ |

**STATUS**

☒ **QUALIFIED** The examination indicates no significant medical condition. Employee can be assigned any work consistent with skills and training.

☐ **QUALIFIED - WITH LIMITATIONS** The examination indicates that a medical condition currently exists that limits work assignments on the following basis:

☐ **NOT QUALIFIED**

☐ **DEFERRED** The examination indicated that additional information is necessary. The employee has been given the following instructions.

**COMMENTS:**

I have reviewed the medical data of the above named employee, and informed the employee of the results of the medical examination and any medical conditions that require follow-up examination or treatment.

Name of Physician: Peter P. Greaney, M.D. Date: 12/29/15

Signature: Peter P Greaney MD

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# WORK STATUS REPORT

**Employer Copy**

**TYPE OF EXAMINATION:** **AECOM-Annual Hazmat Exam**
**EXAM CLASSIFICATION:** **Periodic Examination**

| | | | |
|---|---|---|---|
| **EMPLOYEE:** | **Martin, Amanda** | **COMPANY:** | **AECOM** |
| **ID:** | **DEPT 5899** | **POSITION:** | **Environmental Engineer I** |
| **DATE OF EXAM:** | **08/31/2015** | **LOCATION:** | **AECOM-Alexandria, VA - N Wash (EM)** |
| **EXPIRATION DATE:** | **08/31/2016** | **SITE:** | **41001.000.0000.221099.00.0000** |

The following recommendations are based on a review of one or all of the following: a base history questionnaire, supporting diagnostic tests, physical examination, and the essential functions of the position applied for or occupied by the individual named above.

| | Yes | No | Undecided |
|---|---|---|---|
| Has the employee any detected medical conditions that would increase his/her risk of material health impairment from occupational exposure in accordance with 29 CFR §1910.120 (Hazwoper)? | ☐ | ☒ | ☐ |
| Has the employee any limitations in accordance with 29 CFR §1910.134 (Respirator)? | ☐ | ☒ | ☐ |

**STATUS**

☒ **QUALIFIED** The examination indicates no significant medical condition. Employee can be assigned any work consistent with skills and training.

☐ **QUALIFIED - WITH LIMITATIONS** The examination indicates that a medical condition currently exists that limits work assignments on the following basis:

☐ **NOT QUALIFIED**

☐ **DEFERRED** The examination indicated that additional information is necessary. The employee has been given the following instructions.

**COMMENTS:**

I have reviewed the medical data of the above named employee, and informed the employee of the results of the medical examination and any medical conditions that require follow-up examination or treatment.

Name of Physician: Peter P. Greaney, M.D. Date: 09/03/15

Signature: Peter P Greaney MD

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# WORK STATUS REPORT

**Employer Copy**

**TYPE OF EXAMINATION:** ECC - Annual Exam
**EXAM CLASSIFICATION:** Periodic Examination

| | | | |
|---|---|---|---|
| **EMPLOYEE:** | **Priess, Kathyrn** | **COMPANY:** | **ECC** |
| **ID:** | | **POSITION:** | **Environmental Scientist** |
| **DATE OF EXAM:** | **11/14/2014** | **LOCATION:** | **ECC** |
| **EXPIRATION DATE:** | **11/14/2016** | **SITE:** | |

The following recommendations are based on a review of one or all of the following: a base history questionnaire, supporting diagnostic tests, physical examination, and the essential functions of the position applied for or occupied by the individual named above.

| | Yes | No | Undecided |
|---|---|---|---|
| Has the employee any detected medical conditions that would increase his/her risk of material health impairment from occupational exposure in accordance with 29 CFR §1910.120? | ☐ | ☒ | ☐ |
| Does the employee have any limitations in the use of respirators in accordance with 29 CFR §1910.134? | ☐ | ☒ | ☐ |

**STATUS**

☒ **QUALIFIED** The examination indicates no significant medical condition. Employee can be assigned any work consistent with skills and training.

☐ **QUALIFIED - WITH LIMITATIONS** The examination indicates that a medical condition currently exists that limits work assignments on the following basis:

☐ **NOT QUALIFIED**

☐ **DEFERRED** The examination indicated that additional information is necessary. The employee has been given the following instructions.

**COMMENTS:**

***Negative Drug Screen.***

I have reviewed the medical data of the above named employee, and informed the employee of the results of the medical examination and any medical conditions that require follow-up examination or treatment.

Name of Physician: Irene L. Grace, M.D. Date: 11/19/14

Signature: Irene L. Grace, MD

WorkCare
MAKING HEALTH COUNT

300 S. Harbor Blvd., Suite 600, Anaheim, CA 92805
Ph: (800) 455-6155 Fax: (714) 456 2154



**PERSONAL AND CONFIDENTIAL**

**Schroeder, John**
**4 Stillwood Lane**
**South Glens Falls, NY 12803**

Dear Mr. Schroeder,

I am writing with regards to your recent examination which was performed only to assess whether you have any medical problems that could interfere with your ability to perform work. It is not meant to be a substitute for regular medical care or a complete medical examination.

*The history and physical should have been discussed with you at the time of the exam. If you have any questions that were not addressed by the examining physician or have any further questions, please contact WorkCare at the number listed above.*

Your vital signs revealed the following:
Vitals: Height: 65.0 inches Weight: 151.0 lbs Blood Pressure: 110 / 70
Your vital signs were found to be within normal limits.

Body Mass Index: 25.13
Body Mass Index (BMI) is used to determine healthy weights for people. The formula correlates highly with body fat and is expressed as weight in kilograms divided by height in meters squared. Cutoff points for desirable BMI ranges can be identified based on the relationship between BMI and health outcome.
* A BMI greater than 26 is considered to be overweight. See your physician regarding a weight control program.

Your audiogram revealed the following:

| | 500hz | 1000hz | 2000hz | 3000hz | 4000hz | 6000hz | 8000hz |
|---|---|---|---|---|---|---|---|
| Left | 5 | 5 | 0 | 0 | 10 | 0 | 5 |
| Right | 5 | 25 | 0 | 5 | 0 | 5 | 0 |

Your average hearing in the left ear was normal.
Your average hearing in the right ear was normal.

Your pulmonary function test revealed the following: Previous: 02/11/2015

| Current: | | | | | | | |
|---|---|---|---|---|---|---|---|
| FVC: | 4.420 | % Predicted: | 101.93% | Change: 5.74 | FVC: 4.180 | % Predicted: | 89.66% |
| FEV1: | 3.160 | % Predicted: | 87.87% | Change: 1.60 | FEV1: 3.110 | % Predicted: | 81.17% |
| FEV1/FVC: | 71.49 | % Predicted: | 86.20% | | | | |

Your pulmonary function tests were normal.

Your Chest X-Ray (1 View - With Interp.) revealed the following:
Chest X-Ray (1 View - With Interp.) result for 01/29/2016 : Normal

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300 S. Harbor Blvd., Suite 600, Anaheim, CA 92805
Ph: (800) 455-6155 Fax: (714) 456 2154



In addition to the results, the following are additional comments regarding your medical examination. You should share this information with your personal physician:
*Routine follow up care.*

As a result of the above medical conditions, the following work status and restrictions are being recommended to your employer:
*NO WORK RESTRICTIONS*

I appreciate the opportunity to review your examination for AECOM. If you have any questions now or in the future, please feel free to call me at (800) 455-6155.

Sincerely,

Peter P Greaney MD

WorkCare MD

Peter P. Greaney, M.D.

If you would like further information on the laboratory tests and a general explanation of test results, please visit our web site at http://www.workcare.com. Click on "Knowledge Center/Resources" and use the "Health Fact Sheets" link to access this information.

Americas

# Respiratory Equipment Fit Test

S3NA-123-FM1

| | |
|---|---|
| **Date of Testing:** 6/13/2016 | **Respirator Type(s):** Full Face APR - Negative Pressure |
| **Employee Name:** John Schroeder | **Respirator Model & Size:** MSA - Medium |
| **Method & Testing Agent:** Qualitative - Bitrex | |
| **Corrective lenses needed:** ☒ Yes ☐ No | |
| **Is the employee medically qualified to wear a respirator?** ☒ Yes ☐ No **Date of last medical exam** (if applicable): **01/29/2016** | |
| **Is the employee trained on the fundamental principles of respiratory protection, use, selection, inspection, cleaning, maintenance, and storage of equipment?** ☑ Yes ☐ No | |

| Test Exercise | | Test Exercise | |
|---|---|---|---|
| Sensitivity Check | ☑ Pass ☐ Fail | Normal Breathing | ☑ Pass ☐ Fail |
| Deep Breathing | ☑ Pass ☐ Fail | Turning Head (side to side) | ☑ Pass ☐ Fail |
| Moving Head (up/down) | ☑ Pass ☐ Fail | Rainbow Passage* | ☑ Pass ☐ Fail |
| Bending Over | ☑ Pass ☐ Fail | Normal Breathing | ☑ Pass ☐ Fail |

**Successful Respirator Fit Determined:** ☑ Yes ☐ No

I certify that I have been tested with the respirator(s) listed above. I have also had the opportunity to ask questions and those questions have been answered to my satisfaction. I also understand that the above fit test is voided if respirator limitations are not followed or the respirator is not worn or if conditions (e.g., facial hair) prevent a good face seal.

| | |
|---|---|
| Employee Signature: John Schroeder | Date: 06/13/16 |
| Signature of Tester: | Date: 6/13/16 |

***Rainbow Passage.** "When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch with its path high above and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow."*

# *URS Corporation*

## WORK STATUS REPORT

**Employer Copy**

**TYPE OF EXAMINATION: URS Corp - Periodic Exam**

| | | | |
|---|---|---|---|
| **EMPLOYEE:** | **Schulman, Nicole** | **COMPANY:** | **URS IE** |
| | | **POSITION:** | **Environmental Scientist** |
| **DATE OF EXAM:** | **06/19/15** | **LOCATION:** | **URS IE-Albany (DM)** |
| **EXPIRATION DATE:** | **06/19/16** | **SITE:** | |

The following recommendations are based on a review of one or all of the following: a base history questionnaire, supporting diagnostic tests, physical examination, and the essential functions of the position applied for or occupied by the individual named above.

| | Yes | No | Undecided |
|---|---|---|---|
| Has the employee any detected medical conditions that would increase his/her risk of material health impairment from occupational exposure in accordance with 29 CFR §1910.120? | ☐ | ☒ | ☐ |
| Does the employee have any limitations in the use of respirators in accordance with 29 CFR §1910.134? | ☒ | ☐ | ☐ |

**STATUS**

1. ☐ **QUALIFIED** The examination indicates no significant medical condition. Employee can be assigned any work consistent with skills and training.

2. ☒ **QUALIFIED - WITH LIMITATIONS** The examination indicates that a medical condition currently exists that limits work assignments on the following basis:

   ☒ **Temporary: No work that creates a potential for direct contact with toxic material. Evaluate the potential for exposure and the use of the respirator protection. No lifting over 50 lbs.**

3. ☐ **NOT QUALIFIED**

4. ☐ **DEFERRED** The examination indicated that additional information is necessary. The employee has been given the following instructions.

**COMMENTS:**

I have reviewed the medical data of the above named employee, and informed the employee of the results of the medical examination and any medical conditions that require follow-up examination or treatment.

Name of Physician: Dennis W Stephens, M.D. Date: 06/29/15

Signature: _____

300 S. Harbor Blvd., Suite 600, Anaheim, CA 92805 • (714) 978-7488 • (800) 455-6155 • FAX (714) 456-2154

Temporary: No work that creates a potential for direct contact with toxic material. Evaluate the potential for exposure and the use of the respirator protection. No lifting over 50 lbs.

AECOM

# MEDICAL RELEASE

**Instructions:**

**Employee**: Please ask your health care provider to complete this form and return the completed form to your Leave Specialist **prior** to your release to work date. You are **not authorized** to return to work until this medical release form is completed and returned to me.

**Health Care Provider**: Please complete this form and return it to the patient for further processing.

Employee name: Nicole Schulman

Date the condition began: 7/16/15

**Please check one of the following:**

√ The employee is able to work a full, regular schedule with no restrictions, beginning 09/02/15 (date)

__ The employee is unable to return to work until _____(date)

__ The employee is able to return to work on a reduced schedule for ___ hours a day from _____(date) through_____ (date)

__ The employee is able to return to work with restrictions from_____ (date) through_____ (date).

**Please indicate restrictions, if any, below for:**

Standing (number of hours): _____

Walking (number of hours): _____

Sitting (number of hours): _____

Lifting (number of pounds): _____

Carrying (number of pounds): _____

Use of hands (repetitive motions, pushing, pulling): _____

Any other restrictions: _____

_____

_____

Signature of Health Care Provider: _____

Printed Name of Health Care Provider: Megan Lochner

Date: 10/27/15

Phone Number: 631. 821. 4444

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# WORK STATUS REPORT

**Employer Copy**

**TYPE OF EXAMINATION:** **AECOM-Annual Hazmat Exam**
**EXAM CLASSIFICATION:** **Periodic Examination**

| | | | |
|---|---|---|---|
| **EMPLOYEE:** | **White, Greta** | **COMPANY:** | **AECOM** |
| **ID:** | | **POSITION:** | **Geologist** |
| **DATE OF EXAM:** | **08/28/2015** | **LOCATION:** | **AECOM-Latham, NY (EM)** |
| **EXPIRATION DATE:** | **08/28/2016** | **SITE:** | **04115812.0001** |

The following recommendations are based on a review of one or all of the following: a base history questionnaire, supporting diagnostic tests, physical examination, and the essential functions of the position applied for or occupied by the individual named above.

| | Yes | No | Undecided |
|---|---|---|---|
| Has the employee any detected medical conditions that would increase his/her risk of material health impairment from occupational exposure in accordance with 29 CFR §1910.120 (Hazwoper)? | ☐ | ☒ | ☐ |
| Has the employee any limitations in accordance with 29 CFR §1910.134 (Respirator)? | ☐ | ☒ | ☐ |

**STATUS**

☒ **QUALIFIED** The examination indicates no significant medical condition. Employee can be assigned any work consistent with skills and training.

☐ **QUALIFIED - WITH LIMITATIONS** The examination indicates that a medical condition currently exists that limits work assignments on the following basis:

☐ **NOT QUALIFIED**

☐ **DEFERRED** The examination indicated that additional information is necessary. The employee has been given the following instructions.

**COMMENTS:**

I have reviewed the medical data of the above named employee, and informed the employee of the results of the medical examination and any medical conditions that require follow-up examination or treatment.

Name of Physician: Peter P. Greaney, M.D. Date: 09/02/15

Signature: Peter P Greaney MD

300 S. Harbor Blvd., Ste. 600, Anaheim, CA 92805

**Appendix E.4**
**Additional Certificates**

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# Certificate of Completion

*This certifies that*

## Kelly Lurie

Has Successfully completed

## 8 Hour HAZWOPER Supervisor Training

This certificate does not in itself indicate initial 24 or 40 Hour HAZWOPER Training

**In Accordance With Federal OSHA Regulation 29 CFR 1910.120(e)(4)**

And all State OSHA/EPA Regulations as well

This course is approved for 8 Contact Hours (0.8 CEUs) of continuing education per the California Department of Public Health for Registered Environmental Health Specialist (REHS) issued by Safety Unlimited, Inc. (Accreditation # 044)

*Julius P. Griggs*
Julius P. Griggs
Instructor #892

**1602234153691**
Certificate Number

**2/23/2016**
Issue Date

SAFETY UNLIMITED, Inc.
OSHA Compliant Safety Training Since 1993

2139 Tapo St., Suite 228 Simi Valley, CA 93063
888 309-SAFE (7233) or 805 306-8027 866-869-7097 (fax)
www.safetyunlimited.com

Annual Refresher Training NOT Required
Want to be sure this certificate is valid? Visit safetyunlimited.com/verification

# CERTIFICATE OF COMPLETION

AECOM

This is to recognize that

## Amanda Martin

Has completed

## AECOM HAZWOPER Supervisor

on

**01-19-2016**

CONTENT DELIVERED BY PureSafety

Peter Sullivan, CET, CIT
NA SH&E Training Director

## Appendix F
## First Aid and CPR Trained Individuals

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HEARTSAVER FIRST AID CPR AED

Heartsaver®
First Aid CPR AED

American Heart Association.

PEEL HERE

Kelly Lurie

This card certifies that the above individual has successfully completed the objectives and skills evaluations in accordance with the curriculum of the AHA Heartsaver First Aid CPR AED Program. Optional completed modules are those **NOT** marked out:

Child CPR AED | Infant CPR | Written test

10-21-2015 — Issue Date

10-2017 — Recommended Renewal Date

HEARTSAVER FIRST AID CPR AED

Training Center Name: CPRofessionals, Inc.

TC ID #: NJ15293

TC Info: 25 Pine Street, Rockaway, NJ 07866

TC PH: (973) 331-0900

Course Location: AECOM

Instructor Name: Petros Gregory

Inst. ID #: ( 02130152352 )

Holder's Signature

© 2011 American Heart Association *Tampering with this card will alter its appearance.* 90-1815

**Replacement fee for lost card = $10**

Strike through the modules ***NOT*** completed.

This card contains unique security features to protect against forgery.

90-1815 3/11

American Red Cross

# Amanda Martin

has successfully completed requirements for

Adult First Aid/CPR/AED: valid 2 Years

**Date Completed: 11/19/2015**

conducted by: American Red Cross

Instructor: Roxanne N Paul

Betty Jean Jones

ID: GSIR9P

Scan code or visit:

redcross.org/confirm

American Red Cross

# Kathryn Priess

has successfully completed requirements for

Adult First Aid/CPR/AED: valid 2 Years

**Date Completed: 09/24/2014**

conducted by: American Red Cross

Instructor: Jeanne D Howlett

ID: 0VYP3W

Scan code or visit:

redcross.org/confirm

HEARTSAVER FIRST AID CPR AED

Heartsaver®
First Aid CPR AED

American Heart Association®

PEEL HERE

Greta White

This card certifies that the above individual has successfully completed the objectives and skills evaluations in accordance with the curriculum of the AHA Heartsaver First Aid CPR AED Program. Optional completed modules are those **NOT** marked out:

Child CPR AED | Infant CPR | Written test

10-21-2015
Issue Date

10-2017
Recommended Renewal Date

HEARTSAVER FIRST AID CPR AED

Training Center Name: CPRofessionals, Inc.
TC ID #: NJ15293

TC Info: 25 Pine Street, Rockaway, NJ 07866
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© 2011 American Heart Association *Tampering with this card will alter its appearance.* 90-1815

**Replacement fee for lost card = $10**

Strike through the modules ***NOT*** completed.
This card contains unique security features to protect against forgery.

90-1815 3/11

# Appendix G
# Site Safety and Health Plan

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**FINAL**

# APPENDIX G
# SITE SAFETY AND HEALTH PLAN

## Remedial Investigation, Feasibility Study, Proposed Plan and Decision Document Former Camp Hero, Montauk, New York

**Revision: 0**

**Prepared for:**

US Army Corps of Engineers®

**U.S. Army Corps of Engineers, New York District**
**26 Federal Plaza**
**New York, New York, 10278**

**and**

**U.S. Army Corps of Engineers, New England District**
**696 Virginia Road**
**Concord, Massachusetts 01742**

**Prepared By:**

**A Joint Venture of AECOM – Tidewater**
**3101 Wilson Boulevard**
**Suite 900**
**Arlington, VA 22201**

**June 2016**

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Attachment 2 SSHP Revision Table
Attachment 3 Activity Hazard Analyses
Attachment 4 Route Map to Emergency Medical Facility

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## List of Acronyms and Abbreviations

| | |
|---|---|
| ACGIH | American Conference of Governmental Industrial Hygienists |
| AHA | Activity Hazard Analysis |
| ANSI | American National Standards Institute |
| APP | Accident Prevention Plan |
| $^{o}$C | Degrees Celsius |
| CAIS | Chemical Agent Identification Sets |
| CIH | Certified Industrial Hygienist |
| CPR | Cardio Pulmonary Resuscitation |
| CRZ | Contaminant Reduction Zone |
| CSP | Certified Safety Professional |
| DD | Decision Document |
| DDESB | Department of Defense Explosives Safety Board |
| DPM | Deputy Project Manager |
| ERP | Emergency Response Plan |
| ERT | Emergency Response Team |
| EC | Emergency Coordinator |
| ECP | Entry Control Point |
| EZ | Exclusion Zone |
| FS | Feasibility Study |
| FUDS | Formerly Used Defense Site |
| HAZWOPER | Hazardous Waste Operations and Emergency Response |
| JV | Joint Venture |
| MEC | Munitions and Explosives of Concern |
| NE | New England |
| NIOSH | National Institute for Occupational Safety and Health |
| NY | New York |
| NYSDEC | New York State Department of Environmental Conservation |
| PDS | Personnel Decontamination Station |
| PM | Project Manager |
| PP | Proposed Plan |
| PPE | Personal Protective Equipment |
| ppm | Parts per million |
| RI | Remedial Investigation |
| SAP | Sampling and Analysis Plan |
| SH&E | Safety, Health, and Environmental |
| SOP | Standard Operating Procedure |

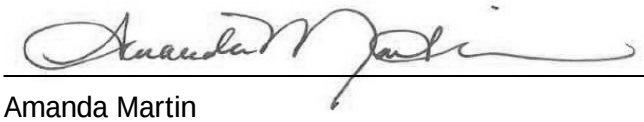
| | |
|---|---|
| SSHO | Site Safety Health Officer |
| SSHP | Site Safety and Health Plan |
| SZ | Support Zone |
| TLV | Threshold Limit Value |
| USACE | United States Army Corp of Engineers |
| UXO | Unexploded Ordnance |

**SIGNATURE SHEET**

This Site Safety and Health Plan (SSHP) was prepared for employees performing field activities at Former Camp Hero, Montauk, New York. It was prepared based on the best available information regarding the physical and chemical hazards known or suspected to be present at the project site. While it is not possible to discover, evaluate, and protect in advance against all possible hazards that may be encountered during the completion of the project, adherence to the safety and health program requirements of this SSHP will significantly reduce the potential for occupational injury.

By signing below, I acknowledge that I have reviewed and hereby approve this SSHP for the field activities at Camp Hero. This SSHP has been written for exclusive use by the AECOM-Tidewater JV employees and its subcontractors. This SSHP was written for specified site conditions, dates, and personnel, and must be amended if these conditions change.

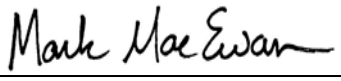
Plan Preparer:



Date: January 14, 2016

Amanda Martin
Safety, Health, & Environmental Representative
AECOM-Tidewater JV

Plan Review:



Date: January 14, 2016

Mark MacEwan
Project Manager
AECOM-Tidewater JV

Plan Concurrence:



Date: January 27, 2016

Bob Miller, CSP
Safety, Health, & Environmental Manager
AECOM-Tidewater JV

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## G.1. INTRODUCTION

The provisions of this Site Safety and Health Plan (SSHP) are mandatory for all the AECOM-Tidewater JV personnel (including both AECOM and Tidewater employees, as applicable) engaged in fieldwork associated with the environmental services being conducted at the subject site. For the purposes of this SSHP, the term "AECOM-Tidewater JV" means an employee of either of the two firms. A copy of this SSHP and any applicable SSHP supplements shall be accessible on site and available for review at all times. Recordkeeping will be maintained in accordance with this SSHP and the applicable Standard Operating Procedures (SOPs) referenced throughout this document and the Accident Prevention Plan (APP). SOPs are available in Appendix C of the APP. In the event of a conflict between this SSHP, the SOPs and federal, provincial, state, and local regulations, workers shall follow the most stringent/protective requirements. Concurrence with the provisions of this SSHP is mandatory for all personnel covered by this SSHP and personnel must sign the acknowledgement page in Attachment 1 to indicate they have read and understand the SSHP. All changes to this SSHP must be documented using the form in Attachment 2.

## G.2. SITE DESCRIPTION AND CONTAMINANT CHARACTERIZATION

### G.2.1 General Description

The AECOM-Tidewater JV will conduct a RI at the former Camp Hero, a Formerly Used Defense Site (FUDS). The areas of concern (AOCs) at Camp Hero include (but are not limited to) former waste disposal areas, former coal storage areas, abandoned drum locations, and former storage tanks.
RI activities will include geophysical surveying, test pitting, surface and subsurface soil sampling, groundwater sampling, and monitoring well installation. The RI phase of the project is limited to the investigation of these sites (i.e., no remediation); however, the exception will include proposed disposal of empty containers at the Camp Hero State Park bluffs and at former drum sites.

A FS, PP, and DD will be prepared based on the results of the RI. Throughout the investigation of Camp Hero, the AECOM-Tidewater JV will support the client with public involvement including coordination with landowners and other stakeholders, as well as answering miscellaneous inquiries from concerned citizens, which will include the solicitation of interest in a Restoration Advisory Board (RAB) for this FUDS, and assisting in the operation of a RAB, should a RAB be formed. The AECOM-Tidewater JV will prepare a Client Draft, Draft and Final Public Information Plan fact sheets.

### G.2.2 Site Background and History

Camp Hero State Park is located on the eastern tip of the south fork of Long Island, New York, approximately 5 miles east of the Village of Montauk in Suffolk County, NY (Figure 2-1 of the APP). The Camp is bounded by Montauk Highway (Route 27) to the north, the Atlantic Ocean to the

south, Montauk Point State Park to the east, and Camp Hero State Park's undeveloped sanctuary area to the west.

The former Camp Hero was established in early 1942 as a Coastal Defense Installation to defend the approaches to New York and was named in honor of Major General Andrew Hero. Three self-sufficient batteries (Battery 112, 113, and 216) and supporting facilities were constructed which included barracks, mess halls, hospital facilities, a motor repair shop, a recreation facility, sentry boxes, and water supply and sewage facilities. A total of 600 enlisted men and 37 officers were stationed at the Camp. Battery 216 (identified as Bunker 216 on maps) contained two 6-inch shielded guns that were delivered to the battery in January 1943. Battery 113 (identified as Bunker 113 on maps) consisted of two Navy 16-inch casemated guns that were completed on June 5, 1943. Additionally, 37mm weapons and .50-caliber antiaircraft weapon platoons were assigned to protect the Camp from air attack. The Camp's weaponry was periodically fired to practice over water but was never fired as a result of an act of hostility.

The Camp was placed on inactive status on July 31, 1947 and ultimately declared surplus by the Department of the Army on December 31, 1949. Simultaneously a portion of the former Camp Hero lands was also transferred to the Department of the Air Force for an aircraft control and warning station. On January 24, 1951 the former Camp Hero was withdrawn from surplus and designated for use as a firing range and field exercise area for antiaircraft artillery from Fort Totten, NY. Arrangements were made for the permanent Army cadre at the Camp and 90mm and quad .50-caliber antiaircraft artillery began firing exercises from firing positions established in the southern bluff overlooking the Atlantic Ocean.

In 1952 the Air Force property was renamed the Montauk Air Force Station and was occupied by the Aircraft Control and Warning Squadron (ACWS). Training continued using 90mm and 120 mm guns, 3.5-inch rockets, and .50 caliber guns occurred until 1957. The facility was inactive until October 1958 when the ACWS was re-designated as the Radar Squadron with a new mission to provide surveillance data of air traffic in the area. In order to accomplish this mission, an advanced Specific Frequency Diversity Search Radar was built in late 1960 (AN/FPS-35 Radar Tower and Antenna). The AN/FPS-35 Radar Tower and Antenna is listed under the National Register of Historic Places (Department of Interior, National Park Service).

The facility was closed in 1982. Between 1974 and 1984 all site lands were transferred to State, Local, and other Federal agencies. The current Camp Hero State Park consists of 415.35 acres and is owned by the State of New York (NY), New York State Parks Commission.

### G.2.3 Previous Investigations

No previous investigations have been completed at Camp Hero.

### G.2.4 Potential Hazards

The areas of concern (AOCs) at Camp Hero identified for inclusion in the Remedial Investigation included former waste disposal areas, sewage treatment systems, former coal storage areas, abandoned drum locations, former petroleum storage tanks, areas of possible DoD-related disposal, former boilers, a motor pool, and a former power plant. Underground storage tank (UST) closure reports indicated elevated levels of lead at the location of two former UST locations. Additionally, a previous investigation of transformers indicated elevated levels of Polychlorinated biphenyls in concrete staining in three buildings included in the investigation.

Otherwise, no previous investigations have been conducted to identify contaminants of potential concern (COPCs). This investigation will include soil and groundwater sample collection for analysis of volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), PCBs, herbicides, pesticides, and metals.

PCBs may be present at some Camp Hero AOCs. Routes of exposure to PCBs include inhalation, absorption, ingestion, and skin/eye contact. Symptoms of exposure are: irritation of eyes; chloracne; liver damage; and reproductive effects. OSHA has established a Permissible Exposure Limit (PEL) of 0.5 milligrams per cubic meter ($mg/m^3$) of air as an 8-hour time-weighted average (TWA) for PCBs containing 54% chlorine and 1 $mg/m^3$ as an 8-hour TWA for PCBs containing 42% chlorine. The National Institute for Occupational Safety and Health (NIOSH) has established a Recommended Exposure Limit (REL) of 0.001 $mg/m^3$ for both forms, and an Immediately Dangerous to Life or Health (IDLH) concentration of 5 $mg/m^3$. NIOSH considers PCBs an occupational carcinogen.

PCBs and lead in dust only comprise a small percentage of the total dust composition, which depends on the concentration of lead and PCBs in the soil/dust. Exposure to dust in excess of the general OSHA PEL of 15 $mg/m^3$ for dust is not expected. The OSHA PEL would be protective of workers' potential exposure to lead and PCBs.

Hexane is used as a solvent when collecting wipe samples of PCB-containing materials. Routes of exposure to hexane include inhalation, ingestion, and skin/eye contact. Symptoms of exposure are: irritated eyes, nose; nausea, headache, dizziness; peripheral neuropathy, numbness of the extremities, muscle weakness; and dermatitis. OSHA has established a PEL of 500 ppm of air as an 8-hour time-weighted average (TWA). NIOSH has established a REL of 50 ppm, and an Immediately Dangerous to Life or Health (IDLH) concentration of 1100 ppm.

Exposure to chemical hazards may have adverse effects on organs or systems of the body, and can occur through four routes of exposure:

- ingestion
- inhalation
- skin/eye absorption
- skin/eye contact

Potential hazards for all possible routes of entry may be minimized by protecting against exposures through use of good work practices, engineering controls, and appropriate PPE.

Chemical Agent Identification Sets (CAIS) have been identified in the Archive Search (USACE, 2000) and may be present at Camp Hero. CAIS are dilute training aids (vials) and may include:

- Dilute Mustard (H) (2 ml) in Chloroform (38 ml)
- Dilute Lewisite (L) (2 ml) in Chloroform (38 ml)
- Dilute Chloropicrin (PS) (20 ml) in Chloroform (20 ml)
- Industrial chemical Phosgene (CG) 40 ml

The probability of encountering Unexploded Ordnance (UXO), munitions and explosives of concern (MEC), or Chemical Warfare Materiel (CWM), present as chemical agent identification sets (CAIS) is low at Camp Hero; however, if they are encountered, STOP WORK AUTHORITY will be used, personnel will move up wind, and the authorities will be notified (refer to table G-7).

## G.3. ACTIVITY HAZARD ANALYSIS

Tasks that require an Activity Hazard Analysis (AHA) include:

- Mobilization/Demobilization
- Vegetation Removal
- Utility Clearance and Metal Anomaly Avoidance
- Geophysical Survey
- Drilling Oversight (Direct Push and Hollow Stem Auger)
- Direct Push Soil and Groundwater Sampling
- Monitoring Well Sampling and Development
- Mechanical Excavation (Test Pitting)
- Land surveying
- Assessment of Abandoned Buildings

AHAs for all work tasks that will be conducted during this phase of work are included in Attachment 3.

## G.4. STAFF ORGANIZATION, QUALIFICATIONS, AND RESPONSIBILITIES

### G.4.1 Program Manager [John Franz]

The AECOM-Tidewater JV Program Manager is responsible for supporting the establishment and oversight of the overall health and safety program presented in the APP.

### G.4.2 Safety, Health, and Environmental Manager [Bob Miller, CSP]

The SH&E Manager is assigned to provide guidance and technical support for the project. Duties include the following:

- Approving this SSHP and any required changes
- Approving the designated Site Safety Health Officer (SSHO)
- Reviewing all personal exposure monitoring results
- Investigating any reported unsafe acts or conditions

The SH&E Manager may designate another safety professional as the direct liaison for this project; if that is the case, he will remain available for any or all of the tasks listed here or elsewhere in this SSHP in lieu of the designee.

### G.4.3 Project Manager [Mark MacEwan]

The AECOM-Tidewater JV Project Manager (PM) has overall management authority and responsibility for all site operations, including safety. The PM will provide the Site Supervisor (SS) with work plans, staff, and budgetary resources, which are appropriate to meet the safety needs of the project operations.

### G.4.4 Deputy Project Manager [Megan Donahue]

The AECOM-Tidewater JV Deputy Project Manager (DPM) reports to the PM and has overall management authority and responsibility for all site operations, including safety in PM's absence. The DPM also coordinates with the SS and Site Safety and Health Officer (SSHO) to ensure the fulfillment of the safety needs of the project operations.

### G.4.5 Site Supervisor [Amanda Martin]

The SS has the overall responsibility and authority to direct work operations at the job site according to the provided work plans. The PM may act as the SS while on site.

### G.4.5.1 Responsibilities

The SS is responsible to:

- Discuss deviations from the work plan with the SSHO and PM
- Discuss safety issues with the PM, SSHO, and field personnel
- Assist the SSHO with the development and implementation of corrective actions for site safety deficiencies
- Assist the SSHO with the implementation of this SSHP and ensuring compliance
- Assist the SSHO with inspections of the site for compliance with this SSHP and applicable SOPs

### G.4.5.2 Authority

The SS has authority to:

- Verify that all operations are in compliance with the requirements of this SSHP, and halt any activity that poses a potential hazard to personnel, property, or the environment
- Temporarily suspend individuals from field activities for infractions against the SSHP pending consideration by the SSHO, the SH&E Manager or designee, and the PM

### G.4.5.3 Qualifications

In addition to being Hazardous Waste Operations and Emergency Response (HAZWOPER)-qualified, the SS is required to have completed the 8-hour HAZWOPER Supervisor Training Course in accordance with 29 Code of Federal Regulation 1910.120 (e)(4).

## G.4.6 Site Safety Health Officer [Kelly Lurie, Greta White]

### G.4.6.1 Responsibilities

The SSHO is responsible to:

- Update the site-specific SSHP to reflect changes in site conditions or the scope of work. SSHP updates must be reviewed and approved by the SH&E Manager or designee. Updates must be documented using the Revision History in Attachment 2.
- Be aware of changes in AECOM-Tidewater JV Safety Policies, Programmatic Health and Safety Plan, or SOPs.
- Monitor the lost time incidence rate for this project and work toward improving it.
- Inspect the site for compliance with this SSHP and the SOPs using the appropriate audit inspection checklist provided by the SH&E Manager or designee.

- Work with the SS and PM to develop and implement corrective action plans to correct deficiencies discovered during site inspections. Deficiencies will be discussed with project management to determine appropriate corrective action(s).
- Contact the SH&E Manager or designee for technical advice regarding safety issues.
- Determine emergency evacuation routes, establishing and posting local emergency telephone numbers, and arranging emergency transportation.
- Check that all site personnel and visitors have received the proper training and medical clearance prior to entering the site.
- Establish any necessary controlled work areas (as designated in this SSHP or other safety documentation).
- Present tailgate safety meetings and maintain attendance logs and records in accordance with SH&E SOP *5-210-Tailgate Safety Meeting Log* (Appendix C of the APP).
- Discuss potential health and safety hazards with the SS, the SH&E Manager or designee, and the PM.
- Select an alternate SSHO by name and inform him/her of their duties, in the event that the SSHO must leave or is absent from the site. The alternate SSHO must be approved by the PM.
- Be able to communicate will all site personnel via phone or radio to the SSHO at all times.

#### G.4.6.2 Authority

The SSHO has authority to:

- Verify that all operations are in compliance with the requirements of this SSHP
- Issue a "Stop Work Order" under the conditions set forth in this SSHP
- Temporarily suspend individuals from field activities for infractions against the SSHP pending consideration by the SH&E Manager or designee and the PM

#### G.4.6.3 Qualifications

In addition to being HAZWOPER-qualified, the SSHO is required to have completed the 8-hour HAZWOPER Supervisor Training Course in accordance with 29 Code of Federal Regulation 1910.120 (e)(4).

### G.4.7 UXO Technician II [Nina Bennerson]

#### G.4.7.1 UXO Technician II Responsibilities

Based on a UXO probability analysis completed by USACE Baltimore District, it has been determined that the Camp Hero site activities have a low probability of encountering munitions and explosives of concern (MEC), except for areas H and K, which will not be entered at any point during RI field activities. Anomaly avoidance will be conducted in accordance with EM 385-1-97 during subsurface

investigations. “Anomaly avoidance” is defined as the avoidance of surface MEC and any subsurface anomalies where the specific activity can be moved to another location. A UXO Technician II will conduct anomaly avoidance during RI field activities. Responsibilities of the UXO Technician II associated with this project include, but are not limited to:

- Conduct anomaly avoidance during subsurface investigations during the RI field activities
- Assess any MEC concerns from the SSHO, SS, or any employee on site while investigation activities are occurring
- Stop work if unacceptable safety and health conditions exist, and take necessary action to re-establish and maintain safe working conditions

#### G.4.7.2 UXO Technician II Authority

The authority of the UXO Technician II assigned to the site includes the following:

- The right and duty to stop work when conditions in relation to suspected MEC are unsafe, and to assist in correcting these conditions, or where specified safety precautions are not adequate or fully understood
- The right to contact the SSHO or the SH&E Manager or designee at any time to discuss potential concerns

#### G.4.7.3 UXO Technician II Qualifications

In addition to being HAZWOPER-qualified, the UXO Technician II will have the appropriate level of training and experience as stated in Department of Defense Explosives Safety Board (DDESB) Technical Paper 18.

### G.4.8 Employees

#### G.4.8.1 Employee Responsibilities

Responsibilities of employees associated with this project include, but are not limited to:

- Understanding and abiding by the policies and procedures specified in the SSHP and other applicable safety policies, and clarifying those areas where understanding is incomplete
- Providing feedback to health and safety management relating to omissions and modifications in the SSHP or other safety policies
- Notifying the SSHO, in writing, of unsafe conditions and acts

#### G.4.8.2 Employee Authority

The health and safety authority of each employee assigned to the site includes the following:

- The right to refuse to work and/or stop work authority when the employee feels that the work is unsafe (including subcontractors or team contractors), or where specified safety precautions are not adequate or fully understood
- The right to refuse to work on any site or operation where the safety procedures specified in this SSHP or other safety policies are not being followed
- The right to contact the SSHO or the SH&E Manager or designee at any time to discuss potential concerns
- The right and duty to stop work when conditions are unsafe, and to assist in correcting these conditions

#### G.4.8.3 Qualifications

All members of the field team must he HAZWOPER 40-hour certified, with up-to-date annual 8-hour refresher training and medical monitoring.

## G.5. TRAINING, GENERAL AND PROJECT SPECIFIC

### G.5.1 HAZWOPER Qualifications

Personnel performing work at the job site must be qualified as HAZWOPER workers (unless otherwise noted in specific AHAs or by the SSHO), and must meet the medical monitoring and training requirements specified in the AECOM-Tidewater JV SH&E SOPs. In addition to HAZWOPER training, onsite management and supervisors directly responsible for, or who supervise employees engaged in, hazardous waste operations shall receive at least eight additional hours of specialized hazardous waste operations management training.

In addition to HAZWOPER training, onsite management and supervisors who act as the SSHO shall receive the OSHA 30-hour General Industry or Construction Industry Procedures Training. The SSHO's OSHA 30-Hour Training Certificate is provided in Appendix D.

If site monitoring procedures indicate that a possible hazardous material exposure has occurred above the Occupational Safety and Health Administration permissible exposure limit, employees may be required to receive supplemental medical testing to document any symptoms that may be specific to the particular materials present.

### G.5.2 Site-Specific Safety Training

**General Training Requirements.** All AECOM-Tidewater JV personnel performing activities at the site will be trained in accordance with SH&E SOP *5-003-SH&E Training* (Appendix C of the APP). All

personnel are required to remain current in all of their required training and evaluate their need for additional training when there is a change in work. In addition to the general health and safety training programs, personnel will be required to complete any supplemental task specific training developed for the tasks to be performed. Administration and compliance with the requirements for additional task-specific training will be the responsibility of the project or lead manager. Any additional required training that is completed will be documented and tracked in the project files.

**Ordnance Recognition Training.** Prior to beginning field operations, all field personnel, including AECOM-Tidewater JV employees and subcontractors, will complete Ordnance Recognition Training in order to understand anomaly avoidance procedures.

**Chemical Warfare Materiel Recognition Training:** Prior to beginning field operations, all field personnel, including AECOM-Tidewater JV employees and subcontractors, will complete Chemical Warfare Material and Chemical Agent Identification Sets (CAIS) Training in order to recognize CWM and CAIS and exposure to it.

CWM and CIAS specific training will address acute and chronic effects of exposure to hazardous substances, such as chemical agents, the potential routes and symptoms of exposure and for these substances, the exposure limits, the level of personnel exposure that can be anticipated, and personnel decontamination procedures if encountered. The training will address the following items: exposure routs and potential health effects, signs and symptoms of exposure, and safe work practices (e.g. use of the buddy system, contaminant control procedures, etc.). Emergencies and emergency procedures including reasons to evacuate and excavation procedures, first aid, hospital routes, emergency contacts will be discussed.

**Stop work authority will be used immediately if ordnance or Chemical Warfare Materiel (CWM) is suspected. Personnel will move upwind to a safe location and contact the appropriate authorities.**

**Competent Person Training Requirements.** Competent persons are qualified individuals that can identify existing and predictable hazards in the working environment or working conditions that are dangerous to personnel and have authorization to take prompt corrective measures to eliminate them. No planned tasks require the designation of competent persons at Camp Hero.

In order to complete certain specified tasks (drill rig operation, excavation inspections, etc.), a designated subcontractor competent person must be on site to perform the required daily inspections of certain equipment and/or operations. No work may be performed on these tasks unless the subcontractor competent person is present on the job site.

### G.5.3 Geophysicist Qualifications

The geophysical operations will be overseen by a registered geophysicist with experience in locating UST.

### G.5.4 UXO Technician II Qualifications

The UXO Technician II will have the appropriate level of training and experience as stated in DDESB Technical Paper 18.

## G.6. PERSONAL PROTECTIVE EQUIPMENT

The purpose of personal protective equipment (PPE) is to provide a barrier, which will shield or isolate individuals from the chemical and/or physical hazards that may be encountered during work activities. SH&E SOP *5-208-Personal Protective Equipment Program* (Appendix C of the APP) lists the general requirements for selection and usage of PPE. Table G-1 lists the minimum PPE required during site operations and additional PPE that may be necessary. The specific PPE requirements for each work task are specified in the individual AHAs.

Level D personal protective equipment (PPE) will be worn during general work activities. Level D for this project consists of work clothes, steel-toed boots/shoes, safety glasses with side shields, reflective vest, gloves appropriate for the work task, and hard hat.

A half mask or full-face respirator equipped with a P100/organic vapor cartridges will be used when collecting samples of suspect PCBs. A half mask or full-face respirator equipped with a P100 cartridge will be used if working in old or abandoned buildings with potential mold, avian or rodent droppings, or other biological hazards. Disposable coveralls and boot covers will be worn if personnel expect to become contaminated or come into contract with debris or dust which may contain PCBs, for example while accessing a dusty crawl space. The SSHO may modify the levels of PPE in response to additional site information. See additional details in *SOP 5-519 Respiratory Protection Program*.

By signing this SSHP, the employee agrees having been trained in the use, limitations, care, and maintenance of the protective equipment to be used by the employee at this project. If training has not been provided, request same of the PM/SSHO for the proper training before signing.

**Table G-1**
**Personal Protective Equipment**

| PPE | Type | Additional Information |
|---|---|---|
| **Minimum PPE** | | |

| | | |
|---|---|---|
| **Safety Boots** | Leather | ANSI approved safety toe. Do not use steel-toe during geophysical instrument usage |
| **Safety Glasses** | ANSI Z87.1 | ANSI Approved; ≥98% UV protection |
| **Hard Hat** | ANSI Z89.1 | ANSI Approved; recommended wide-brim, not to be used during anomaly avoidance unless overhead hazard present |
| **Chemical Protective Gloves** | Nitrile | Must be worn at all times during sample collection and handling. |
| **Work Uniform** | | No shorts/cutoff jeans or sleeveless shirts |
| **Additional PPE** | | |
| **Work Gloves** | Leather | If working with sharp objects or powered equipment. |
| **Respirator** | Half mask or full-face respirator with a P100/organic vapor cartridges | If working in areas of suspected PCB-containing dust or particulates. |
| **Respirator** | Half mask or full-face respirator with a P100 cartridge | If working in old or abandoned buildings with potential mold, avian or rodent droppings, or other biological hazards. |
| **Disposable coveralls** | Tyvek | If working in areas of suspected PCB-containing dust/particulates or oil staining. |
| **Rubber over-booties** | Rubber | If working in areas of suspected PCB-containing dust/particulates or oil staining. |
| **Protective Chemical Gloves** | Inner: Chemical resistant | Use during handling of all potentially impacted media. |

### G.6.1 PPE Doffing and Donning (UTILIZATION) Information

The following information is to provide field personnel with helpful hints that, when applied, make donning and doffing of PPE a more safe and manageable task:

- Never cut disposable booties from your feet with basic utility knives. This has resulted in workers cutting through the booty and the underlying sturdy leather work boot, resulting in significant cuts to the legs/ankles. Use a pair of scissors or a package/letter opener (cut above and parallel with the work boot) to start a cut in the edge of the booty, then manually tear the material down to the sole of the booty for easy removal.
- When applying duct tape to PPE interfaces (wrist, lower leg, around respirator, etc.) and zippers, leave approximately one inch at the end of the tape to fold over onto itself. This will make it much easier to remove the tape by providing a small handle to grab while still wearing gloves. Without this fold, trying to pull up the tape end with multiple gloves on may be difficult and result in premature tearing of the PPE.
- Decontamination will include discarding of gloves and other disposable PPE and wiping of respirators. Personnel are to wash hands and face upon completion of sampling and/or prior to eating, drinking, or smoking and are advised to shower as soon as possible after leaving the site.

- Have a "buddy" check your ensemble to ensure proper donning before entering controlled work areas. Without mirrors, the most obvious discrepancies can go unnoticed and may result in a potential exposure situation.

Never perform personal decontamination with a pressure washer.

## G.7. MEDICAL SURVEILLANCE

Medical Records for Resolutions Consultants employees working at Camp Hero are included in Appendix F.3 of the APP.

## G.8. EXPOSURE MONITORING AND AIR SAMPLING PROGRAM

Monitoring shall be performed where there may be a question of employee exposure to hazardous concentrations of hazardous substances in order to assure proper selection of engineering controls, work practices, and PPE. Employees should not be exposed to levels, which exceed permissible exposure limits, or published exposure levels, without the use of acceptable protective measures.

Air monitoring shall be used to identify and quantify airborne levels of hazardous substances and safety and health hazards in order to determine the appropriate level of employee protection needed on site. Periodic monitoring shall be conducted when the possibility of an IDLH condition or flammable atmosphere has developed or when there is indication that exposures may have risen over permissible exposure limits or published exposure levels since prior monitoring. Situations where it shall be considered whether the possibility that exposures have risen are as follows:

- When work begins on a different portion of the site
- When contaminants other than those previously identified are being handled
- When a different type of operation is initiated (e.g., drum opening as opposed to exploratory well drilling)
- When employees are handling leaking drums or containers or working in areas with obvious liquid contamination

The field personnel will monitor their breathing zones during project activities at AOCs where VOC samples are being collected using a PID. An action level for respiratory protection has been established at 5 ppm as averaged over a 15-minute time period. If this limit is exceeded, work will stop and the SSHO and PM will determine how to proceed.

Exposure to dust in excess of the OSHA PEL of 15 $mg/m^3$ is not expected. The OSHA PEL would be protective of workers' potential exposure to lead and PCBs. The field personnel will monitor their

breathing zones during project activities using a dust monitor. If this limit is exceeded, work will stop and the SSHO and PM will determine how to proceed.

Table G-2 contains monitoring instruments, manufacturer information, and the substances that each instrument detects.

**Table G-2**
**Monitoring Parameters and Equipment**

| Instrument | Manufacturer/Model* | Substances Detected |
|---|---|---|
| Photo Ionization Detector (PID) | RAE Systems Mini-RAE or Multi-RAE or equivalent (min. 10.6 eV bulb) | Petroleum hydrocarbons, organic solvents |
| Dust Monitor | Met One Aerocet-531S Mass Particle Counter/Dust Monitor (or equivalent) | Dust [mass size ranges (PM1, PM2.5, PM4, PM7, PM10, and TSP) or particle count by sizes (> 0.5, 1.0, 5.0 and10.0 microns)] |

**Notes:**
N/A = Not applicable
*Or similar unit, as approved by the AECOM-Tidewater JV Safety Health and Environmental Manager or designee

### G.8.1 Health and Safety Action Levels

An action level is a point at which increased protection is required due to the concentration of contaminants in the work area or other environmental conditions. The concentration level (above background level) and the ability of the PPE to protect against that specific contaminant determine each action level. The action levels are based on concentrations in the breathing zone. Action levels are based upon sound scientific principles as expressed by various regulatory agencies or industry groups.

If ambient levels are measured, which exceed the action levels in areas accessible to unprotected personnel, necessary control measures (removal from area, barricades, warning signs, and mitigative actions to limit, etc.) must be implemented prior to commencing activities at the specific work area. Personnel should also be able to upgrade or downgrade their level of protection with the concurrence of SSHO or the SH&E Manager or designee.

Reasons to upgrade:

- Known or suspected presence of dermal hazards
- Occurrence or likely occurrence of gas, vapor, or dust emission
- Change in work task that will increase the exposure or potential exposure to hazardous materials

Reasons to downgrade:

- New information indicating that the situation is less hazardous than was originally suspected
- Change in site conditions that decrease the potential hazard
- Change in work task that will reduce exposure to hazardous materials

### G.8.2 Monitoring Procedures

The SSHO will assess the atmosphere for acceptable concentrations/levels using the prescribed hand-held direct read instrumentation (or other approved alternative) prior to any personnel entering into the area and continuously thereafter. Air monitoring will occur for the duration of time field personnel are working in the exclusion zone (EZ). The monitoring devices may then be assigned to individual personnel working within the EZ, as warranted. Care should be taken to apply all necessary correction factors to your monitoring results (Volatile organic compounds and Explosive Atmosphere channels) specific to the contaminants of concern. Table G-3 lists the monitoring procedures and action levels.

**Table G-3**
**Monitoring Procedures and Action Levels**

| Parameter | Location and Interval | Action Level (Meter Units/ppm Above Background) | Response if Action Level is Met |
|---|---|---|---|
| Hydrocarbons, CVOCs, SVOCs (Total by PID) | Continuous in the worker's breathing zone or in the immediate work area for average reading over a 15-minute time period while worker is in EZ | < 5 ppm | Level D work and continue monitoring (not applicable for initial assessment of unknown drums or containers). |
| | | ≥ 5 ppm | Not consistent with chemical contamination and concentrations identified in the specifications. Stop Work and exit the area. Contact the SSO or AECOM-Tidewater JV H&S Manager or designee. |
| Dust | Continuous in the worker's breathing zone or in the immediate work area | > 15 mg/$m^3$ | Stop Work and exit the area. Contact the SSO or AECOM-Tidewater JV H&S Manager or designee. |

**Notes:**
N/A = Not applicable
Ppm = Part per million

Based on the scope of work and work methods, dust is not expected to be of concern. Exposure to dust in excess of the OSHA PEL of 15 mg/$m^3$ is not expected. The OSHA PEL would be protective of workers' potential exposure to lead and PCBs. Nevertheless, dust concentrations will monitored using a dust monitor device, and work will temporarily be stopped and dust control measures shall

be implemented if the PEL is exceeded. Specific measures will be determined by the SSHO and PM based on the activities and site conditions.

### G.8.3 Monitoring Equipment Calibration

All instruments used will be calibrated to the appropriate level at the beginning of each work shift, in accordance with the manufacturer's recommendations (bump test, span gas calibration). If the owner's manual is not available, the personnel operating the equipment will contact the applicable office representative, rental agency, or manufacturer for technical guidance for proper calibration.

If equipment cannot be pre-calibrated to specifications, site operations requiring monitoring for worker exposure or offsite migration of contaminants will be postponed or temporarily ceased until this requirement is completed.

### G.8.4 Personal Sampling

Personal sampling is not expected to be necessary at during field activities at Camp Hero. General monitoring procedures for VOCs and dust (see above) should provide sufficient monitoring to protect employee health. However, should site activities warrant performing personal sampling (breathing zone) to better assess chemical exposures experienced by AECOM-Tidewater JV employees, the SSHO, under the direction of a Certified Industrial Hygienist or a Certified Safety Professional will be responsible for specifying the monitoring required. Within five working days after the receipt of monitoring results, the Certified Industrial Hygienist or Certified Safety Professional will notify each employee, in writing, of the results that represent that employee's exposure. Copies of air sampling results will be maintained in the SSHO project files.

If the site activities warrant, the subcontractor will ensure its employees' exposures are quantified via the use of appropriate sampling techniques. The subcontractor shall notify the employees sampled in accordance with health and safety regulations, and provide the results to the SSHO for use in determining the potential for other employees' exposure.

## G.9. HEAT AND COLD STRESS

Heat and cold stress may vary based upon work activities, PPE/clothing selection, geographical locations, and weather conditions. To reduce the potential of developing heat/cold stress, be aware of the signs and symptoms of heat stress and watch fellow employees for signs of heat/cold stress.

### G.9.1 Responding to Heat-Related Illness

Heat stress can be a significant field site hazard, particularly for non-acclimated personnel operating in a hot, humid setting. Site personnel will be instructed in the identification of a heat

stress victim, the first-aid treatment procedures for the victim and the prevention of heat stress casualties. Work-rest cycles will be determined and the appropriate measures taken to prevent heat stress as outlined in SH&E SOP *5-511-Heat Stress Prevention* (Appendix C of the APP). The guidance presented in Table G-4 will be used in identifying and treating heat-related illness.

**Table G-4**
**Identification and Treatment of Heat-Related Illness**

| Type of Heat-Related Illness | Description | First Aid |
|---|---|---|
| Mild Heat Strain | The mildest form of heat-related illness. Victims exhibit irritability, lethargy, and significant sweating. The victim may complain of headache or nausea. This is the initial stage of overheating, and prompt action at this point may prevent more severe heat-related illness from occurring. | • Provide the victim with a work break during which he/she may relax, remove any excess protective clothing, and drink cool fluids.<br>• If an air-conditioned spot is available, this is an ideal break location.<br>• Once the victim shows improvement, he/she may resume working; however, the work pace should be moderated to prevent recurrence of the symptoms. |
| Heat Exhaustion | Usually begins with muscular weakness and cramping, dizziness, staggering gait, and nausea. The victim will have pale, clammy moist skin and may perspire profusely. The pulse is weak and fast and the victim may faint unless they lie down. The bowels may move involuntarily. | • Immediately remove the victim from the work area to a shady or cool area with good air circulation (*avoid drafts or sudden chilling*).<br>• Remove all protective outerwear.<br>• Call a physician.<br>• Treat the victim for shock. (*Make the victim lie down, raise his or her feet 6–12 inches, and keep him/her cool by loosening all clothing*).<br>• If the victim is conscious, it may be helpful to give him/her sips of water.<br>• Transport victim to a medical facility as soon as possible. |
| Heat Stroke | The most serious of heat illness, heat stroke represents the collapse of the body's cooling mechanisms. As a result, body temperature may rise to 104 degrees Fahrenheit or higher. As the victim progresses toward heat stroke, symptoms such as headache, dizziness, nausea can be noted, and the skin is observed to be dry, red, and hot. Sudden collapse and loss of consciousness follows quickly and death is imminent if exposure continues. Heat stroke can occur suddenly. | • Immediately evacuate the victim to a cool/shady area.<br>• Remove all protective outerwear and as much personal clothing as decency permits.<br>• Lay the victim on his/her back w/the feet slightly elevated.<br>• Apply cold wet towels or ice bags to the head, armpits, and thighs.<br>• Sponge off the bare skin with cool water.<br>• The main objective is to cool without chilling the victim.<br>• Give no stimulants or hot drinks.<br>• Since heat stroke is a severe medical condition requiring professional medical attention, emergency medical help should be summoned immediately to provide onsite treatment of the victim and proper transport to a medical facility. |

### G.9.2 Responding to Cold-Related Illness

If work on this project is conducted in the winter months, thermal injury due to cold exposure can become a problem for field personnel. Work will cease under unusually hazardous conditions if necessary (e.g., wind-chill less than 0°F, or wind-chill less than 10°F with precipitation). Systemic cold exposure is referred to as hypothermia. Localized cold exposure is generally labeled frostbite.

Recognition of the symptoms of cold related illness will be discussed during the health and safety briefing conducted prior to the onset of site activities. Refer to the 2003 ACGIH TLVs for Chemical Substances and Physical Agents for additional information on cold stress prevention, monitoring, and work-warming regimens. Work-rest cycles will be determined if necessary and the appropriate measures taken to prevent cold stress as outlined in SH&E SOP *5-505-Cold Stress* (Appendix C of the APP).

#### G.9.2.1 Hypothermia

Hypothermia is a life-threatening condition in which the core body temperature falls below 95°F. Hypothermia can occur at temperatures above freezing particularly, when the skin or clothing becomes wet. During exposure to cold, maximum shivering occurs when the core temperature falls to 95°F. As hypothermia progresses, depression of the central nervous system becomes increasingly more severe. Symptoms and warning signs progressively worsen and range from sluggishness and slurred speech to disorientation and eventually unconsciousness (see Table G-5).

**Table G-5 Progressive Clinical Symptoms of Hypothermia**

| Core Temperature (°F) | Clinical Signs |
|---|---|
| 95° | Maximum shivering |
| 87° — 89° | Consciousness clouded; blood pressure becomes difficult to obtain; pupils dilated |
| 84° — 86° | Progressive loss of consciousness; muscular rigidity; respiratory rate decreases |
| 79° | Victim rarely conscious |
| 70° — 72° | Maximum risk of ventricular fibrillation |

The ability to sustain metabolic rate and to reduce skin blood flow is diminished by fatigue. Thus, fatigue increases the risk of severe hypothermia by decreasing metabolic heat. Additionally, because blood flow through the skin is reduced to conserve heat, the skin and underlying tissues become more susceptible to frostbite.

#### G.9.2.2 Frostbite

Frostbite is both the general and medical term given to areas of cold injury. Unlike hypothermia, frostbite rarely occurs unless environmental temperatures are less than freezing and

usually less than 20°F. Frostbite injuries occur most commonly on the distal parts of the body (nose, earlobes, hands, and feet) that are subject to intense vasoconstriction.

The three general categories of frostbite are:

- Frostnip — A whitened area of the skin, which is slightly burning or painful.
- Superficial frostbite — Waxy, white skin with a firm sensation but with some resiliency. Symptomatically feels “warm” to the victim with a notable cessation of pain.
- Deep frostbite — Tissue damage deeper than the skin, at times, down to the bone. The skin is cold, numb, and hard.

### G.9.2.3 Preventing Cold Related Illness

The following are precautions that will be taken to prevent illness relating to cold stress:

- Educate worker to recognize the symptoms of frostbite and hypothermia.
- Ensure the availability of an enclosed, heated environment within the vehicles. The nearest heated environment will be the interior of the vehicles at the site.
- Ensure the availability of dry changes of clothes.
- Record temperature readings.
- Ensure the availability of warm beverages, preferably non-caffeinated.

### G.9.2.4 Monitoring for Cold Exposure

Cold stress monitoring will be conducted in accordance with the ACGIH cold stress TLV. The TLV objective is to prevent the deep body core temperature from falling below 96.8°F and to prevent cold injury to body extremities. Temperature monitoring and recording will be initiated in the following situations:

- At the SSHO discretion when suspicion is based on changes in worker's performance or mental status
- At worker's request
- As a screening measure whenever any one worker on the site develops hypothermia
- Any person developing moderate hypothermia (a core temperature of 92°F) cannot return to work for 48 hours

## G.10. STANDARD OPERATING PROCEDURES, ENGINEERING CONTROLS, AND WORK PRACTICES

### G.10.1 Site Rules and Prohibitions

All site personnel shall conduct themselves in a safe manner and maintain a working environment that is free of additional hazards, in adherence to SH&E SOPs *5-001-Safe Work Standards and Rules* and *5-307-Housekeeping, Worksite* (Appendix C of the APP).

#### G.10.1.1 Housekeeping

During site activities, work areas will be continuously policed for identification of excess trash and unnecessary debris. Excess debris and trash will be collected and stored in an appropriate container (e.g., plastic trash bags, garbage can, roll-off bin) prior to disposal. At no time will debris or trash be intermingled with waste PPE or contaminated materials.

#### G.10.1.2 Smoking, Eating, or Drinking

Smoking, eating, and drinking will not be permitted inside any controlled work area at any time. Field workers will first wash hands and face immediately after leaving controlled work areas (and always prior to eating or drinking). Consumption of alcoholic beverages is prohibited at any AECOM-Tidewater JV site. Smoking, eating, or drinking must be in an approved area.

#### G.10.1.3 Personal Hygiene

The following personal hygiene requirements will be observed:

***Water Supply:*** A water supply meeting the following requirements will be utilized:

*Potable Water* — An adequate supply of potable water will be available for field personnel consumption. Potable water can be provided in the form of water bottles, canteens, water coolers, or drinking fountains. Where drinking fountains are not available, individual-use cups will be provided as well as adequate disposal containers. Staff sharing a potables cooler shall not introduce individually opened containers into the team cooler in an effort to minimize concerns for indirect contamination. Additionally, each potable cooler will be sealed to protect the water quality.

Potable water containers will be properly identified in order to distinguish them from non-potable water sources. All containers of potable water will be marked with a label stating:

*Potable Water ONLY*
*Not Intended for Sample Storage*

*Non-Potable Water* — Non-potable water may be used for hand washing and cleaning activities. Non-potable water will not be used for drinking purposes. All containers of non-potable water will be marked with a label stating:

***Non-Potable Water***
***Not Intended for Drinking Water Consumption***

***Toilet Facilities:*** A minimum of one toilet will be provided for every 20 personnel on site, with separate toilets maintained for each sex except where there are less than 5 total personnel on site. For mobile crews where work activities and locations permit transportation to nearby toilet facilities onsite facilities are not required.

***Washing Facilities:*** Employees will be provided washing facilities (e.g., buckets with water and Alconox, waterless hand sanitizers) at each work location. The use of water and hand soap (or similar substance) will be required by all employees following exit from the Exclusion Zone (EZ), prior to breaks, and at the end of daily work activities.

### G.10.1.4 Buddy System

All field personnel will use the buddy system when working within any controlled work area. Personnel belonging to another organization on site can serve as "buddies" for AECOM-Tidewater JV personnel. Under no circumstances will any employee be present alone in a controlled work area.

### G.10.1.5 Stop Work Authority

All employees have the right and duty to stop work when conditions are unsafe, and to assist in correcting these conditions as outlined in SH&E SOP *5-002-Stop Work Authority* (refer to Appendix C in the APP). Whenever the SSHO determines that workplace conditions present an uncontrolled risk of injury or illness to employees, immediate resolution with the appropriate supervisor shall be sought. Should the supervisor be unable or unwilling to correct the unsafe conditions, the SSHO is authorized and required to stop work, which shall be immediately binding on all affected AECOM-Tidewater JV employees and subcontractors.

Upon issuing the stop work order, the SSHO shall implement corrective actions so that operations may be safely resumed. Resumption of safe operations is the primary objective; however, operations shall not resume until the SH&E Manager or designee has concurred that workplace conditions meet acceptable safety standards.

#### G.10.1.6 Client Specific Safety Requirements

There are no additional client specific requirements. This SSHP has been developed in accordance with ER 385-1-92, *Safety and Occupational Health Requirements for Hazardous, Toxic, and Radioactive Waste Activities*. The SSHP covers elements outlined in Section 28.A.02 b of EM 385-1-1 (United States Army Corps of Engineers, 2008).

### G.10.2 Work Permit Requirements

There are no work permit requirements during this phase of work.

### G.10.3 Material Handling Procedures

Manual Material Handling Procedures are included in *SH&E SOP 5-308-Manual Lifting Field* (Appendix C of the APP) Standard Operating Procedures.

### G.10.4 Drum, Container, Tank Handling

All investigation derived waste will be containerized in U.S. Department of Transportation approved steel open-top drums or closed-top (depending upon matrix). The drums and/or tank will be labeled as investigation derived waste, the generation date, generator name, and contact phone number. If a tank is utilized to hold purge water, it will be locked to prevent tampering. Resolution Consultants will sample the drums for disposal parameters and assist the Navy in making arrangements for disposal within 90-days of generation. All manifests and waste profiles will be signed by the USACE Representative.

### G.10.5 Comprehensive AHA of Treatment Technologies

There are no treatment technologies identified for this project.

## G.11. SITE CONTROL MEASURES

### G.11.1 General

The purpose of site control is to minimize potential contamination of workers, protect the public from site hazards, and prevent vandalism. The degree of site control necessary depends on the site characteristics, site size, and the surrounding community.

Controlled work areas will be established at each work location, and if required, will be established directly prior to the work being conducted. Diagrams designating specific controlled work areas will be drawn on site maps, posted in the support vehicle or trailer, and discussed during the daily safety meetings. If the site layout changes, the new areas and their potential hazards will be discussed immediately after the changes are made.

### G.11.2 Controlled Work Areas

The scope of this project may require the implementation of HAZWOPER work zones. The SSHO shall determine the applicability and breadth of this requirement.

Each HAZWOPER controlled work area will consist of the following three zones:

- *EZ:* Contaminated work area
- *Contamination Reduction Zone (CRZ)*: Decontamination area
- *Support Zone (SZ):* Uncontaminated or "clean area" where personnel should not be exposed to hazardous conditions

Each zone will be periodically monitored in accordance with the air monitoring requirements established in this SSHP. The EZ and the CRZ are considered work areas. The SZ is accessible to the public (e.g., visitors, vendors, inspectors).

#### G.11.2.1 Exclusion Zone

The EZ is the area where primary activities occur, such as sampling, remediation operations, installation of wells, cleanup work, etc. This area must be clearly marked with hazard tape, barricades or cones, or enclosed by fences or ropes. Only personnel involved in work activities, and meeting the requirements specified in the applicable AHA and this SSHP will be allowed in an EZ. The extent of each area will be sufficient to ensure that personnel located at/beyond its boundaries will not be affected in any substantial way by hazards associated with sample collection activities.

All personnel should be alert to prevent unauthorized, accidental entrance into controlled-access areas (the EZ and CRZ). If such an entry should occur, the trespasser should be immediately escorted outside the area, or all HAZWOPER-related work must cease. All personnel, equipment, and supplies that enter controlled-access areas must be decontaminated or containerized as waste prior to leaving (through the CRZ only).

#### G.11.2.2 Contamination Reduction Zone

The CRZ is the transition area between the contaminated area and the clean area. Decontamination is the main focus in this area. The decontamination of workers and equipment limits the physical transfer of hazardous substances into the clean area. This area must also be clearly marked with hazard tape and access limited to personnel involved in decontamination. This area will clearly show the entrance and exit lanes for access to the EZ.

### G.11.2.3 Support Zone

The SZ is an uncontaminated zone where administrative and other support functions, such as first aid, equipment supply, emergency information, etc., are located. The SZ shall have minimal potential for significant exposure to contaminants (i.e., background levels).

Employees will establish a SZ (if necessary) at the site before the commencement of site activities. The SZ would also serve as the entry point for controlling site access.

### G.11.3 Site Access Documentation

If implemented by the PM or SSHO, all personnel entering the site shall complete the "Site Entry/Exit Log" located at the site trailer or primary site support vehicle.

### G.11.4 Site Security

Depending upon the jobsite location and the proximity to unauthorized pedestrian traffic and other areas of interest site security may be necessary. The PM or SSHO shall determine if site security is necessary for the jobsite.

Site security is necessary to:

- Prevent the exposure of unauthorized, unprotected people to site hazards
- Avoid the increased hazards from vandals or persons seeking to abandon other wastes on the site
- Prevent theft
- Avoid interference with safe working procedures

To maintain site security during working hours:

- Maintain security in the SZ and at ECPs.
- Establish an identification system to identify authorized persons and limitations to their approved activities.
- Assign responsibility for enforcing authority for entry and exit requirements.
- When feasible, install fencing or other physical barrier around the site.
- If the site is not fenced, post signs around the perimeter and whenever possible, use guards to patrol the perimeter. Guards must be fully apprised of the hazards involved and trained in emergency procedures.
- Have the PM approve all visitors to the site. Make sure they have a valid purpose for entering the site. Have trained site personnel accompany visitors at all times and require them to wear the appropriate protective equipment.

To maintain site security during off-duty hours:

- If possible, assign trained, in-house technicians for site surveillance. They will be familiar with the site, the nature of the work, the site's hazards, and respiratory protection techniques.
- If necessary, use security guards to patrol the site boundary. Such personnel may be less expensive than trained technicians, but will be more difficult to train in safety procedures and will be less confident in reacting to problems around hazardous substances.
- Enlist public enforcement agencies, such as the local police department, if the site presents a significant risk to local health and safety.
- Secure the equipment.

## G.12. EQUIPMENT DECONTAMINATION

### G.12.1 General Requirements

All possible and necessary steps shall be taken to reduce or minimize contact with chemicals and contaminated/impacted materials while performing field activities (e.g., avoid sitting or leaning on, walking through, dragging equipment through or over, tracking, or splashing potential or known contaminated/impacted materials, etc.).

All personal decontamination activities shall be performed with an attendant (buddy) to provide assistance to personnel that are performing decontamination activities. Depending on specific site hazards, attendants may be required to wear a level of protection that is equal to the required level in the EZ but shall be no lower than 1 step below the EZ PPE ensemble (e.g., EZ is Level B, Decon is Level C).

All persons and equipment entering the EZ shall be considered contaminated, and thus, must be properly decontaminated prior to entering the SZ.

Decontamination procedures may vary based on site conditions and nature of the contaminant(s). If chemicals or decontamination solutions are used, care should be taken to minimize reactions between the solutions and contaminated materials. In addition, personnel must assess the potential exposures created by the decontamination chemical(s) or solutions. The applicable SDS must be reviewed, implemented, and filed by personnel contacting the chemicals/solutions.

All contaminated PPE and decontamination materials shall be contained, stored, and disposed of in accordance with site-specific requirements determined by site management. More details on site-

specific decontamination requirements are detailing the site-specific Sampling and Analysis Plan (SAP), an attachment to the RI Work Plan, submitted under separate cover (AECOM, 2016).

### G.12.2 Decontamination Equipment

The equipment required to perform decontamination may vary based on site-specific conditions and the nature of the contaminant(s). The following equipment is commonly used for decontamination purposes:

- Soft-bristle scrub brushes or long-handled brushes to remove contaminants
- Hoses, buckets of water, or garden sprayers for rinsing
- Large plastic/galvanized wash tubs or children's wading pools for washing and rinsing solutions
- Large plastic garbage cans or similar containers lined with plastic bags for the storage of contaminated clothing and equipment
- Metal or plastic cans or drums for the temporary storage of contaminated liquids
- Paper or cloth towels for drying protective clothing and equipment

Site-specific equipment decontamination requirements are detailing the site-specific Sampling and Analysis Plan (SAP), an attachment to the RI Work Plan, submitted under separate cover (AECOM, 2016).

### G.12.3 Personal/Equipment Decontamination

All equipment leaving the EZ shall be considered contaminated and must be properly decontaminated to minimize the potential for exposure and offsite migration of impacted materials. Such equipment may include, but is not limited to sampling tools, heavy equipment, vehicles, PPE, support devices (e.g., hoses, cylinders, etc.), and various handheld tools.

All employees performing equipment decontamination shall wear the appropriate PPE to protect against exposure to contaminated materials. The level of PPE may be equivalent to the level of PPE required in the EZ. Other PPE may include splash protection, such as face-shields and splash suits, and knee protectors. Following equipment decontamination, employees may be required to follow the proper personal decontamination procedures above.

PPE used onsite may be considered disposable and if so, can be removed and containerized in the CRZ during decontamination activities. Suits and booties will be removed first, and gloves last.

For Glove removal:

- Grasp the cuff of the dominant hand and pull glove over the bulk of the hand, leaving the fingers inside the glove
- Use the dominant hand to grasp the cuff of the non-dominant hand and pull the glove completely off (inside-out) and place inside of the dominant hand glove
- Once removed, employee should only touch the inside material of the dominant hand glove
- Thoroughly wash hands

For larger equipment (not personnel), a high-pressure washer may need to be used. Some contaminants require the use of a detergent or chemical solution and scrub brushes to ensure proper decontamination. Before heavy equipment and trucks are taken offsite, the SS and/or SSHO will visually inspect them for signs of contamination. If contamination is present, the equipment must be returned to the decontamination process.

For equipment, use the following steps for decontamination:

- Remove majority of visible gross contamination in EZ (use shovels, scrapers, brooms, etc.)
- Wash equipment in decontamination solution with a scrub brush and/or power wash heavy equipment
- Rinse equipment
- Visually inspect for remaining contamination
- Follow appropriate personal decontamination steps outlined above

All decontaminated equipment shall be visually inspected for contamination prior to leaving the CRZ. Signs of visible contamination may include an oily sheen, residue or contaminated soils left on the equipment. All equipment with visible signs of contamination shall be discarded or re-decontaminated until clean. Depending on the nature of the contaminant, equipment may have to be analyzed using a wipe method or other means. A more detailed explanation can be found in the Camp Hero Sampling and Analysis Plan (SAP).

## G.13. EMERGENCY EQUIPMENT AND FIRST AID

A first aid kit will be available at all times while work is being conducted at the site.

## G.14. EMERGENCY RESPONSE PLAN (ERP) AND CONTINGENCY PROCEDURES

### G.14.1 Pre-Emergency Planning

Prior to the start of site operations, the Emergency Coordinator* (EC) will complete Table G-6 with any site-specific information regarding evacuations, muster points, communication, and other site-specific emergency procedures.

**Table G-6**
**Emergency Planning**

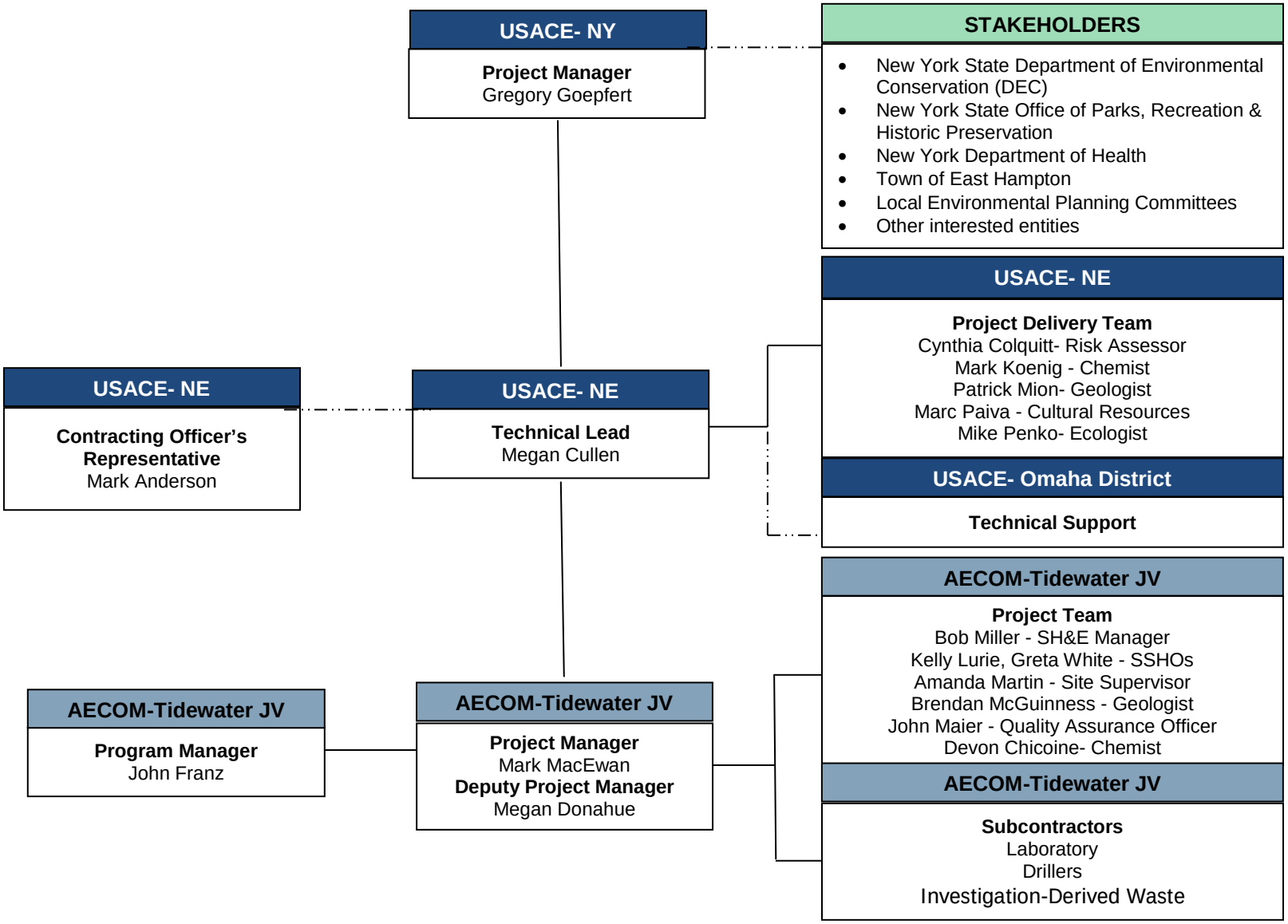
| Emergency | Evacuation Route | Muster Location | Communication |
|---|---|---|---|
| **Chemical Spill** | • Upwind | • Site vehicles | Refer to Table G-7 for communications and reporting requirements. |
| **Fire/Explosion** | • Upwind | • Site vehicles | |
| **Tornado/Severe Weather** | • Closest available tornado shelter | • Building # (TBD by SSHO) | |
| **Lightning** | • Closest available shelter | • Site vehicle | |
| **CAIS Encounter** | • Upwind | • Site vehicle | |
| **CAIS Exposure** | • Decontaminate at Personnel Decontamination Station (PDS) | • Decontaminated personnel will report to local hospital | |
| **MEC Encounter** | • Evacuate Area | • Site vehicle | |

| **Additional Information** | |
|---|---|
| **Communication Procedures** | Direct verbal communications. Must be supplemented when voices cannot be clearly perceived above ambient noise levels and when a clear line-of-sight cannot be maintained by personnel. Personnel will bring a mobile phone to the site to ensure that communications with local emergency responders is maintained, when necessary. |
| **CPR/First Aid Trained Personnel** | Amanda Martin, SS; Kelly Lurie, SSHO; Greta White, SSHO; Kathryn Priess, Environmental Scientist |
| **Site-Specific Spill Response Procedures** | Chemicals brought onsite will be limited to fuel for vehicles and small quantities of laboratory preservatives. In the event of a minor spill, sorbent material will be placed on the spill and then transferred to a container for disposal. Field personnel will immediately notify the PM who in turn will notify the account manager and the Department project representative. |

**Note:**
* EC will be the SSHO or designee

Figure G-1 contains the project organization chart showing lines of communication and authority if an emergency situations arises during the project.

**Figure G-1 — Personnel and Lines of Authority for Emergency Situations**



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The duties of the EC (SSHO) include:

- Implement the Emergency Response Plan (ERP) based on the identified emergency condition
- Notify the appropriate project and SH&E Department personnel of the emergency (Table G-7)
- Verify emergency evacuation routes and muster points are accessible
- Conduct routine ERP drills and evaluate compliance with the ERP

### G.14.2 Criteria and Procedures for Emergency Recognition and Site Evacuation

Although the potential for an emergency to occur is remote, an emergency action plan has been prepared for this project should such critical situations arise. The ERP will be reviewed by all personnel prior to the start of field activities. On long term sites, a test of the ERP will be performed within the first three (3) days of the project field operations. This test will be evaluated and documented in the project records.

Four major categories of emergencies could occur during site operations:

1. Illnesses and physical injuries (including injury-causing chemical exposure including CAIS exposure)
2. Catastrophic events (fire, explosion, earthquake, or chemical)
3. Workplace Violence, Bomb Threat
4. Safety equipment problems

### G.14.3 Decontamination and Medical Treatment of Injured Personnel

Personnel who may become injured onsite will require an appropriate level of decontamination to ensure that medical personnel or emergency service workers are not exposed to chemical hazards posed onsite. We expect our employees to encounter very low levels of chemical contaminants that should not pose a hazard to medical or emergency response personnel; however, we will still provide personal hygiene supplies and appropriate levels of emergency decontamination.

A Personnel Decontamination Station (PDS) will be located at the motor pool where a water source (outside faucet) is available. If the motor pool is locked, the backup decontamination station will be located where the equipment is decontaminated.

The following decontamination procedures will be observed:

- Team member should remove their clothes; however, if they are uncomfortable removing all their clothes, stripping down to underwear is a reasonable compromise.

- If they must lift clothes over their head, they should avoid inhalation or ingestion by closing their mouth and to use their hands and arms to keep the clothing as far from their face and head as possible.

Before rinsing with water, they should:

- Cover all open wounds.
- Thoroughly wash and rinse contaminated skin and hair.
- Avoid breaking or abrading their skin.
- Tilt their heads back, raise their arms, and spread their legs to expose their armpits and groin.
- Prevent runoff from their head or hair from getting into their eyes, nose, or mouth.
- Turn 90 degrees (a 1/4 turn) periodically to expose their entire body to the cross stream of water.

If the contamination involves:

- A particulate, fine aerosol, or gas: they should rub with their hands, a soft cloth, or a sponge to remove contaminants, starting with their head and proceeding down their body to their feet.
- A liquid: Rubbing without the aid of soap is not recommended, since it may spread the agent over a larger surface area of the body, increasing the medical risk. Soap or a solution of detergent and water should be used as soon as possible, but its absence should not delay primary decontamination with water.

Wash time should be at least 30 seconds but no longer than 3 minutes to ensure thorough soaking. (After 3 minutes, tissue damage from increased chemical absorption may occur with some chemical agents.)

If clothing is heavily soiled and/or exhibits chemical odors, personnel shall have their clothing removed and provided temporary covering. Personnel will practice acceptable hygienic steps before being transported for medical treatment. If an injured employee is incapacitated, site personnel will perform this task for them.

### G.14.4 Route Map to Emergency Medical Facilities and Phone Numbers for Emergency Responders

The nearest hospital to Camp Hero is Southampton Hospital in Southampton, NY, approximately one hour from the site, at 240 Meeting House Lane. The Montauk Ambulance Squad will likely

deliver severe injuries to the Southampton Hospital; however, the EMT will determine the most appropriate facility for treatment. In the event of a less complex injury or issue, East Hampton Urgent Care is approximately 26 mins from Camp Hero and could be considered. East Hampton Urgent Care is located at 470 Montauk Highway, approximately 0.5 miles east of Town Hall, on the south side of Montauk Highway, across the road from Domaine Franey Wines & Spirits. Route maps to both medical facilities are included as Attachment 4. Table G-7 lists the emergency contacts and their phone numbers.

### G.14.5 Criteria for Alerting the Local Community Responders

Base emergency alerting phone numbers are expressed in the Table G-7 and should be followed in the event of an emergency.

**Table G-7**
**Emergency Contacts**

| **Emergency Coordinators/Emergency Response Team** | | | |
|---|---|---|---|
| **Name** | **Title/Workstation** | **Telephone Number** | **Mobile Phone** |
| Tom Dess | State Park Superintendent | 631-668-2765 | 631-740-6255 |
| - | Montauk State Park Office | 631-668-3781 | - |
| Gregory Goepfert | USACE Project Manager | 917-790-8235 | 732-841-8062 |
| Megan Cullen | USACE Technical Lead | 978-318-8423 | 781-799-0310 |
| Mark MacEwan | AECOM Project Manager | 703-682-9092 | 202-375-9353 |
| Megan Donahue | AECOM Deputy Project Manager | 703-682-9142 | 808-375-0410 |
| Kelly Lurie | AECOM SSHO | 518-951-2298 | 518-542-2944 |
| Greta White | AECOM SSHO (Alternate) | 518-951-2200 | 518-698-3012 |
| Amanda Martin | AECOM SS | 703-399-3953 | 434-664-8047 |
| Bob Miller, CSP | AECOM SH&E Manager | - | 540-431-7908 |
| Nina Bennerson | UXO Technician II | - | 253-376-7133 |
| **Incident Reporting** | **AECOM Personnel** | **800-348-5046** | - |
| Ann-Alyssa Hill | AECOM TDG/IATA Shipping Expert | 804-515-8506 | 804-640-4815 |
| **Additional Key Personnel** | | | |
| Michael English | Park Manager 1 | 631-668-2554 | 631-358-1190 |
| Charles Redlinger | Golf Course Manager 2 | 631-668-2756 | 516-250-2723 |
| Cynthia Colquitt | USACE Risk Assessor | 978-318-8042 | 781-999-0967 |
| Mark Keonig | USACE Chemist | 978-318-8312 | - |
| Patrick Mion | USACE Geologist | 978-318-8437 | 518-788-7367 |
| Marc Paiva | USACE Cultural Resources | 978-318-8796 | - |
| Mike Penko | USACE Ecologist | 978-318-8139 | 508-320-2651 |
| Paul Young | USACE | - | 978-430-0856 |
| Brendan McGuinness | AECOM Technical Lead | 703-682-1564 | 703-618-2280 |
| Nicole Schulman | AECOM Geologist | 518-688-0015 | 518-764-3792 |
| Mike Glinski | AECOM Geologist | - | 786-374-8985 |
| Katie Priess | AECOM Environmental Scientist | 949-351-7615 | 703-399-3920 |

**Table G-7**
**Emergency Contacts**

| | | | |
|---|---|---|---|
| Steve Glenn | AECOM Botanist | 631-662-8443 | 732-564-3961 |
| **Emergency Organizations / Agencies** | | | |
| **Name** | | | **Telephone Number** |
| General Emergency | | | 911 |
| MEC Discovery/Suspected MEC<br>Contact New York State Park Police and Montauk State Park Office after dialing 911 | | | 911 |
| CWM or CAIs Discovery<br>**CALL 911**<br>Chemical Warfare Design Center (CEHNC-OEC) at USAESCH (Wilson Walters)<br>20th Support Command | | | <br>911<br>256-895-1180<br>410-322-7145 |
| State Park Police – Hither Hills Station | | | 631-668-2946 |
| State Park Police – Babylon Headquarters | | | 631-321-3700 |
| Montauk Police Department | | | 631-668-3709 |
| Montauk Volunteer Fire Department & Ambulance Squad<br>***(EMT will determine appropriate hospital for treatment)*** | | | 631-668-5695 |
| Emergency Hospital ***(Use by site personnel is only for emergency cases)***<br>Southampton Hospital<br>240 Meeting House Lane<br>Southampton, NY 11968<br>***See Attachment 4 for Emergency Hospital Route*** | | | 631-726-8420 |
| Urgent Medical Care<br>East Hampton Urgent Care<br>470 Montauk Hwy<br>East Hampton, NY 11937<br>***See Attachment 4 for Urgent Care Route*** | | | 631-329-5900 |
| Poison Control Center | | | 800-222-1222 |
| Pollution Emergency | | | 800-292-4706 |
| National Response Center | | | 800-424-8802 |
| Title 3 Hotline | | | 800-424-9346 |
| **Public Utilities** | | | |
| **Name** | | | **Telephone Number** |
| Dig Safely New Yok | | | 811 or 1-800-962-7962 |

**Attachment 1**
**SSHP Acknowledgement Form**

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**SSHP Acknowledgement Form**
**Former Camp Hero, Montauk, New York**

| Print Name | Signature | Organization | Date |
|---|---|---|---|
| | | | |
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**Attachment 2**
**SSHP Revision Table**

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**Site Health and Safety Plan Revision History**
**Former Camp Hero, Montauk, New York**

| Revision No. | Revision Date | Approved By (Initials) | Changes, Discussion |
|---|---|---|---|
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**Attachment 3**
**Activity Hazard Analyses**

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# Activity Hazard Analysis (AHA)

| | | |
|---|---|---|
| Activity/Work Task: **Mobilization/Demobilization** | Overall Risk Assessment Code (RAC) (Use highest code) | **M** |
| Project Location: Camp Hero, Montauk, New York | **Risk Assessment Code (RAC) Matrix** | |
| Project Number: W912DR-13-D-0016, Task Order DB01 | **Severity** / **Probability** | |
| Date Prepared: 1/12/2016 | | |
| Prepared by (Name/Title): Amanda Martin | | |
| Reviewed by (Name/Title): Bob Miller, CSP | | |
| **Notes: (**Field Notes, Review Comments, etc.) | | |

| Severity | Frequent | Likely | Occasional | Seldom | Unlikely |
|---|---|---|---|---|---|
| Catastrophic | E | E | H | H | M |
| Critical | E | H | H | M | L |
| Marginal | H | M | M | L | L |
| Negligible | M | L | L | L | L |

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

**"Probability"** is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

**"Severity"** is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

**RAC Chart**

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| Travel (Driving To/From/On Site) | Vehicular Incident<br>-Injury<br>-Property Damage<br>-Vehicle Damage | • Slowly exit from parking spaces; Seek eye contact with other drivers or pedestrians. Before changing lanes, signal well in advance, check mirrors and over shoulder. Maintain safe distances behind vehicles and stay out of other vehicles' blind spots. DRIVE DEFENSIVELY. Move eyes and scan mirrors at least every 2 seconds. Back into parking spaces (or "pull through") when appropriate. Use a spotter when backing-up or maneuvering around objects or other vehicles<br>• Be familiar with the handling and operation of company or rental vehicles<br>• Assure tires are properly inflated and there is sufficient tread (including spare). | **M** |
| | Fatigue (long hours, repetitive tasks) | • Buddy system. Rotation of shifts. Frequent breaks. | **L** |
| | Inclement weather | • Evaluate weather conditions prior to beginning the travel to determine if travel should proceed. Verify your vehicle is equipped to travel in poor weather. Have supplies on hand in the event that you become stranded, including a communication device to call for help. | **L** |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| Loading/Unloading Vehicle | Lifting Injury/Back Strain | • Use a partner while lifting heavy or large objects. Use proper lifting techniques | **M** |
| | Pinch Points | • Locate potential pinch points and guard as needed. Warn others prior to closing doors and tailgates | **M** |
| | Struck by | • Stage equipment on an even surface. Tall objects should be tipped onto side to prevent tipping | **M** |
| | Shifting Loads | • Secure loads with a cargo net, straps, or other mechanical device. Do not store unsecured items on passenger seats. | **M** |
| Set Up Work Area | Traffic | • Wear high visibility safety vest. Use buddy system while placing traffic cones/barricades. Work facing traffic pattern. | **M** |
| | Overhead Hazards | • Observe overhead conditions and avoid staging near overhead utilities, trees, etc. | **L** |
| | Public | • Setup exclusion zone. | **L** |
| Site Clean-Up | Public Entering Exclusion Zone | • Secure work area from public entrance. | **M** |
| | Injury due to end of day rush | • Work methodically at end of day. Do not rush or take short cuts. | **L** |

| Chemical Hazards and Monitoring Procedures | |
|---|---|
| **Chemical Hazard(s) (list):** | N/A |
| **Applicable SSHP Section(s):** | H.2 |
| **Monitoring Instrument(s):** | N/A |

## Additional Safety Considerations

1. Ensure all personnel have read the SSHP.
3. Follow safe driving procedures. Always use the buddy system when moving vehicles. Plan your travel path ahead of time. Use maps and known construction zones to make your selection. Consult with the other team members before making any changes to travel path.
4. Use an equipment checklist to verify you have the appropriate equipment/tools for your tasks. Consult appropriate AHAs or SOPs.
5. Stow all materials in vehicle properly, use appropriate cases and bags. Secure equipment in bed of truck with netting or straps. Do not leave any equipment loose in the cab or bed of the truck. It can cause property damage or serious injuries by falling from vehicle.
7. Maintain good housekeeping practices.
8. Wear nitrile gloves when collecting samples in soil to avoid dermal contact with potential contaminants. Be observant for tripping hazards, holes, stickups, vines, old fence wire, etc.

| Additional Operational Safety Procedures | PPE |
|---|---|
| S3NA-001 Safety Rules<br>S3NA-002 Stop Work Order<br>S3NA-005 Vehicle and Driver Safety Program<br>S3NA-210 Project Safety Meetings<br>S3NA-306 Highway and Road Work<br>S3NA-307 Housekeeping<br>S3NA-308 Manual Lifting<br>S3NA-314 Working Alone and Remote Travel<br>S3NA-507 Hazardous Material Communication | LEVEL D<br>• ANSI approved hard hat<br>• ANSI approved safety glasses<br>• Shirts with sleeves and full-length pants<br>• ANSI approved steel safety-toe boots or approved equivalent<br>• High visibility reflective traffic vest if near moving vehicles<br>• Leather work gloves<br>• First aid kit (located in vehicle)<br>• Fire extinguisher (located in vehicle) |

## Acknowledgement

All employees, subcontractors, and visitors must sign the Acknowledgement form, in this section, before conducting field activities at this site.

By signing this form, AECOM-Tidewater JV employees agree that:

- I have read this Activity Hazard Analysis and I understand the requirements of the AHA.
- I will conduct work at this site in accordance with the requirements of the AHA.

By signing this form, subcontractors and visitors agree that:

- I have read and understood the potential hazards associated with the site.
- I will ensure compliance with my company's policies on health and safety.

| Print Name & Company | Date | Signature |
|---|---|---|
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# Activity Hazard Analysis (AHA)

| | | |
|---|---|---|
| Activity/Work Task: **Direct Push Soil and Groundwater Sampling** | Overall Risk Assessment Code (RAC) (Use highest code) | **M** |
| Project Location: Camp Hero, Montauk, New York | **Risk Assessment Code (RAC) Matrix** | |
| Project Number: W912DR-13-D-0016, Task Order DB01 | | |
| Date Prepared: 1/16/2016 | | |
| Prepared by (Name/Title): Amanda Martin | | |
| Reviewed by (Name/Title): Bob Miller, CSP | | |
| **Notes: (**Field Notes, Review Comments, etc.) | | |

| **Severity** | **Probability** | | | | |
|---|---|---|---|---|---|
| | Frequent | Likely | Occasional | Seldom | Unlikely |
| Catastrophic | **E** | **E** | **H** | **H** | **M** |
| Critical | **E** | **H** | **H** | **M** | **L** |
| Marginal | **H** | **M** | **M** | **L** | **L** |
| Negligible | **M** | **L** | **L** | **L** | **L** |

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

**"Probability**" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

**"Severity"** is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

**RAC Chart**

**E = Extremely High Risk**
**H = High Risk**
**M = Moderate Risk**
**L = Low Risk**

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| Travel | Driving | • Complete a pre-use visual inspection. No hand-held electronic devises. Be aware of road conditions and drive only to your comfort level.<br>• Use spotter when driving on-site or around equipment | **L** |
| | Fatigue (long hours ,repetitive tasks) | • Buddy system. Rotation of shifts. Frequent breaks. | **L** |
| | Inclement weather | • Evaluate weather conditions prior to beginning the travel to determine if travel should proceed. Verify your vehicle is equipped to travel in poor weather. Have supplies on hand in the event that you become stranded, including a communication device to call for help. | **L** |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| General Physical Hazards | Slip/Trip/Fall | • Take inventory of your surroundings noting any conditions which may pose a slip, trip or fall hazard. Clear and walk your pathway prior to work beginning.<br>• Make any corrective actions to eliminate hazards, erect barricades or place warning signs and cones to raise awareness to hazards that can't be engineered out.<br>• Maintain strong housekeeping habits. Keep worksites clean and free from debris, spills or other slip/trip hazards.<br>• Watch your step and ensure proper footing.<br>• Maintain 3 points of contact when climbing into vehicle | **L** |
| | Cold/Heat Stress | • Provide drinking water and first aid kit.<br>• Wear appropriate clothing for weather conditions.<br>• Buddy system; heat stress monitoring; heat stress control plan (including shelters, work rotation, methods of cooling) | **L** |
| | Biological Hazards | • Assess work area for poisonous plants and animals and communicate observations to avoid them.<br>• If hazardous insects or plants such as ticks, poison oaks are identified or suspected in a work area, controls including the use of disposable (Tyvek) coveralls, insect repellent (23.8% DEET or similar), light colored clothing, barrier creams, frequent tick checks should be implemented.<br>• Additionally, all field clothing and equipment should be thoroughly cleaned, removed and/or segregated from clean clothing, equipment and supplies to avoid transfer of hazardous plants/insects.<br>• All employees should bath immediately following fieldwork and use soaps/cleansers designed to remove oils associated with poison oak, and conduct a full body tick check using a mirror. | **L** |
| | Cuts/Scrapes/Bruises | • Level D PPE required.<br>• Wear appropriate work gloves for task | **L** |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| | Manual lifting | • Wear appropriate work gloves for task<br>• Use proper lifting techniques by bending and lifting with legs and not back, and do not over extend or twist (Do not lift over 49lb. without assistance)<br>• Use dollies, carts, come-alongs, or rollers whenever possible rather than the employee physically moving materials. Use appropriate lifting techniques if required to manually lift an object. Seek assistance when needed. | L |
| | Adverse Weather | • Be aware of changing weather condition and provide appropriate weather gear.<br>• When work is halted due to inclement weather, personnel are to seek shelter in vehicles or building designated Shelter in Place (SIP) | L |
| | Traffic in roadways and parking lots | • Use combination of vehicles, cones, traffic barriers and caution tape.<br>• A traffic plan may be necessary depending on location. | L |
| Mobilization / Set-up / Demobilization | Cuts/scrapes | • Wear leather or Kevlar gloves. | L |
| | Struck by | • Exercise caution when moving auger extensions to avoid contact with other objects | L |
| Boring Process | Cuts | • Wear appropriate work gloves to prevent cuts, lacerations. | L |
| | Dermal Contact | • Wear appropriate protective clothing to avoid dermal or personal clothing contact with sampled material. | M |
| | Slips, Trips, Falls | • Clear trees, roots, weeds, limbs and other ground hazards from the drilling location. Practice good housekeeping to keep the ground around the drilling site clear of obstructions, equipment and other tripping hazards. Wear appropriate foot protection to prevent slips and trips. Use caution when working on uneven and wet ground surfaces. | L |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| | Volatile Organic Compounds | • If the results of previous surveys indicate the presence of VOC's in hazardous levels, rig operators should be prepared to protect both personnel and equipment for VOC inhalation and flammable atmospheres. | **M** |
| | Proximity to Rig | • Stay clear of drilling rig when operating<br>• Wear hard hat and ear protection | **M** |
| Sampling Process – Soil, Groundwater | Subsurface structures | • Watch for changes in soil types or other indications of backfill or non-native material.<br>• Stop if unanticipated items (e.g., steel objects) noted. | **M** |
| | Cuts/scrapes | • Use appropriate cutting devices for tubing boxes and proper tools for pump repairs/maintenance.<br>• Wear appropriate work gloves for task | **L** |
| | Underground utilities | • Inspect for buried and overhead utilities in the vicinity of the drilling location. Clearance will be required, as stipulated in the HASP. | **L** |
| | Exposure potential | • Wear modified level D PPE when necessary (Tyvek and face shields or dust masks).<br>• Wear nitrile gloves while taking flow rates, collecting samples, handling sample bottleware, etc.<br>• Wear safety glasses when there is potential for splashing.<br>• Monitor breathing zone continuously during sampling event.<br>• Use respiratory protection, depending on measurements. | **L** |
| | Manual lifting | • Items over 49 pounds need two people to lift. Lift with legs, not with the back.<br>• Minimize body strain by taking stretching breaks, especially when soil logging.<br>• Use dollies, carts, come-alongs, or rollers whenever possible rather than the employee physically moving materials. | **M** |
| IDW handling | Chemical exposure potential | • Follow proper decontamination procedures | **L** |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| | Chemical exposure potential | • Wear nitrile gloves while handling IDW containers, etc.<br>• Wear safety glasses when there is potential for splashing | |
| | Splash Hazard / Spills | • Inspect Drums/Containers prior to use for integrity and contaminants<br>• Pour water from buckets into drums/containers as soon as practicable.<br>• Place used PPE and disposable sampling equipment in garbage bags to be disposed of properly. | L |
| Sample packaging | Cuts/Scrapes | • Inspect glassware for breakage and avoid sharp edges and wear gloves (nitrile and cut resistant leather or Kevlar) | L |
| | Manual lifting of equipment | • Use proper lifting techniques and do not over-extend | L |
| | Chemical exposure potential | • Wear modified level D PPE when necessary (Tyvek and face shields or dust masks)<br>• Have portable eyewash on site<br>• Pour water from buckets into drums/containers as soon as practicable and lifting with legs. | L |
| Decontamination | Chemical exposure potential | • Wear modified level D PPE when necessary (Tyvek and face shields or dust masks).<br>• Have portable eyewash on site. | L |
| | Cuts/Scrapes | • Use appropriate cutting devices for tubing boxes and proper tools for pump repairs/maintenance.<br>• Wear appropriate work gloves for task. | L |
| | Manual lifting of equipment | • Pour water from buckets into drums/containers as soon as practicable and lifting with legs.<br>• Items over 49 pounds need two people to lift. Lift with legs, not with the back.<br>• Minimize body strain by taking stretching breaks. | L |

| Chemical Hazards and Monitoring Procedures | |
|---|---|
| **Chemical Hazard(s) (list):** | **Unknown** |
| **Applicable SSHP Section(s):** | **H.8** |
| **Monitoring Instrument(s):** | **PID (10.6 eV)** |

## Additional Safety Considerations

1. Ensure all personnel have read the SSHP.
2. Ensure all equipment is equipped with necessary fire extinguishers (min 5 lbs BC).
3. Follow safe driving procedures. Plan your travel path ahead of time. Use maps and known construction zones to make your selection. Consult with the other team members before making any changes to travel path.
4. Use an equipment checklist to verify you have the appropriate equipment/tools for your tasks. Consult appropriate AHAs or SOPs.
5. Stow all materials in vehicle properly, use appropriate cases and bags. Secure equipment in bed of truck with netting or straps. Do not leave any equipment loose in the cab or bed of the truck. It can cause property damage or serious injuries by falling from vehicle.
6. When securing equipment, watch for pinch points. Straps and netting can get caught on objects and snap back as well as trap a finger if hand placement is not correct. Use a buddy to help secure equipment when possible.
7. Maintain good housekeeping practices. When possible, use mechanical equipment to perform lifting of heavy objects. When lifting, follow safe lifting practices. Use the buddy system when lifting.
8. Wear nitrile gloves when collecting samples in soil to avoid dermal contact with potential contaminants. Be observant for tripping hazards, holes, stickups, vines, old fence wire, etc.

| Additional Operational Safety Procedures | PPE |
|---|---|
| S3NA-001 Safety Rules<br>S3NA-002 Stop Work Order<br>S3NA-005 Vehicle and Driver Safety Program<br>S3NA-205 Equipment Inspections and Maintenance<br>S3NA-208 Personal Protective Equipment<br>S3NA-210 Project Safety Meetings<br>S3NA-213 Subcontractors<br>S3NA-305 Hand and Power Tools<br>S3NA-306 Highway and Road Work<br>S3NA-307 Housekeeping<br>S3NA-308 Manual Lifting Field<br>S3NA-309 Mobile or Heavy Equipment<br>S3NA-313 Biological Hazard Assessment, Wildlife, Plants, Insects<br>S3NA-405 Drilling, Boring, and Direct Push Probing<br>S3NA-417 Underground Utilities<br>S3NA-507 Hazardous Material Communication<br>S3NA-510 Hearing Conservation Program<br>S3NA-511 Heat Stress Prevention | LEVEL D<br>• ANSI approved hard hat<br>• ANSI approved safety glasses<br>• Shirts with sleeves and full-length pants.<br>• ANSI approved steel safety-toe boots or approved equivalent.<br>• High visibility reflective traffic vest if near moving vehicles<br>• Nitrile Gloves<br>• Leather work gloves<br>• First aid kit (located in vehicle).<br>• Have a radio, cell phone or other communication device for emergency use<br>• Fire extinguisher (located in vehicle). |

| Equipment to be Used | Training Requirements/Competent or Qualified Personnel name(s) | Inspection Requirements |
|---|---|---|
| Hand auger | To be performed by qualified person. | Equipment will be inspected prior to use. Any safety deficiencies detected will require cessation of sampling activities until appropriate repairs have been made. |
| DPT Rig | Sampling to be performed by competent person as certified by employer. | Equipment will be inspected daily by DPT rig operator. Any safety deficiencies detected will require cessation of sampling activities until appropriate repairs have been made. |

## Acknowledgement

All employees, subcontractors, and visitors must sign the Acknowledgement form, in this section, before conducting field activities at this site.

By signing this form, AECOM-Tidewater JV employees agree that:

- I have read this Activity Hazard Analysis and I understand the requirements of the AHA.
- I will conduct work at this site in accordance with the requirements of the AHA.

By signing this form, subcontractors and visitors agree that:

- I have read and understood the potential hazards associated with the site.
- I will ensure compliance with my company's policies on health and safety.

| Print Name & Company | Date | Signature |
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# Activity Hazard Analysis (AHA)

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|---|---|---|
| Activity/Work Task: **Drilling Oversight (Direct Push and Hollow Stem Auger)** | Overall Risk Assessment Code (RAC) (Use highest code) | **M** |
| Project Location: Camp Hero, Montauk, New York | **Risk Assessment Code (RAC) Matrix** | |
| Project Number: W912DR-13-D-0016, Task Order DB01 | **Severity** / **Probability** | |
| Date Prepared: 1/12/2016 | | |
| Prepared by (Name/Title): Amanda Martin | | |
| Reviewed by (Name/Title): Bob Miller, CSP | | |

| Severity | Frequent | Likely | Occasional | Seldom | Unlikely |
|---|---|---|---|---|---|
| Catastrophic | E | E | H | H | M |
| Critical | E | H | H | M | L |
| Marginal | H | M | M | L | L |
| Negligible | M | L | L | L | L |

**Notes: (**Field Notes, Review Comments, etc.)

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

**"Probability**" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

**"Severity"** is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

**RAC Chart**

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

**Recommended PPE:**

__X__ Safety Glasses With Sideshields __X__ Steel-Toed Boots __X__ Hard Hat __X__ Nitrile Gloves ___ Leather Gloves __X__ Hearing Protection ___ Flame Retardant Clothing

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| Mobilization / Site Set Up | • Slips, Trips, Falls | 1. All equipment will be properly secured during transport.<br>2. All vehicles and equipment will comply with DOT requirements.<br>3. Never move the DPT rig with the mast upright. Ensure the sampling site foundation is stable and as level as possible.<br>4. Use a ground guide along with a functioning back-up alarm during equipment backing.<br>5. Inspect for buried and overhead utilities in the vicinity of the drilling location.<br>6. Clear trees, roots, weeds, limbs and other ground hazards from the drilling location. Practice good housekeeping to keep the ground around the drilling site clear of obstructions, equipment and other tripping hazards. Wear appropriate foot protection to prevent slips and trips. Use caution when working on uneven and wet ground surfaces. | **L** |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| Boring Process | • Cuts | 1. Wear appropriate work gloves to prevent cuts, lacerations. | **L** |
| | • Dermal Contact | 2. Wear appropriate protective clothing to avoid dermal or personal clothing contact with sampled material. | **L** |
| | • Slips, Trips, Falls | 3. Clear trees, roots, weeds, limbs and other ground hazards from the drilling location. Practice good housekeeping to keep the ground around the drilling site clear of obstructions, equipment and other tripping hazards. Wear appropriate foot protection to prevent slips and trips. Use caution when working on uneven and wet ground surfaces. | **L** |
| | • Volatile Organic Compounds | 4. If the results of previous surveys indicate the presence of VOC's in hazardous levels, rig operators should be prepared to protect both personnel and equipment for VOC inhalation and flammable atmospheres. | **L** |
| | • Proximity to Rig | 5. Stay clear of drilling rig when operating<br>6. Wear hard hat and ear protection | **M** |

## Additional Safety Considerations

1. Ensure all personnel have read the SSHP.
2. Ensure all equipment is equipped with necessary fire extinguishers (min 5 lbs BC).
3. Follow safe driving procedures. Plan your travel path ahead of time. Use maps and known construction zones to make your selection. Consult with the other team members before making any changes to travel path.
4. Use an equipment checklist to verify you have the appropriate equipment/tools for your tasks. Consult appropriate AHAs or SOPs.
5. Stow all materials in vehicle properly, use appropriate cases and bags. Secure equipment in bed of truck with netting or straps. Do not leave any equipment loose in the cab or bed of the truck. It can cause property damage or serious injuries by falling from vehicle.
6. When securing equipment, watch for pinch points. Straps and netting can get caught on objects and snap back as well as trap a finger if hand placement is not correct. Use a buddy to help secure equipment when possible.
7. Maintain good housekeeping practices. When possible, use mechanical equipment to perform lifting of heavy objects. When lifting, follow safe lifting practices. Use the buddy system when lifting.
8. Wear nitrile gloves when collecting samples in soil to avoid dermal contact with potential contaminants. Be observant for tripping hazards, holes, stickups, vines, old fence wire, etc.

| Additional Operational Safety Procedures | PPE |
|---|---|
| S3NA-001 Safety Rules<br>S3NA-002 Stop Work Order<br>S3NA-005 Vehicle and Driver Safety Program<br>S3NA-205 Equipment Inspections and Maintenance<br>S3NA-208 Personal Protective Equipment<br>S3NA-210 Project Safety Meetings<br>S3NA-213 Subcontractors<br>S3NA-305 Hand and Power Tools<br>S3NA-306 Highway and Road Work<br>S3NA-307 Housekeeping<br>S3NA-308 Manual Lifting Field<br>S3NA-309 Mobile or Heavy Equipment<br>S3NA-313 Biological Hazard Assessment, Wildlife, Plants, Insects<br>S3NA-405 Drilling, Boring, and Direct Push Probing<br>S3NA-417 Underground Utilities<br>S3NA-505 Cold Stress Prevention<br>S3NA-507 Hazardous Material Communication<br>S3NA-510 Hearing Conservation Program<br>S3NA-511 Heat Stress Prevention | LEVEL D<br>• ANSI approved hard hat<br>• ANSI approved safety glasses<br>• Shirts with sleeves and full-length pants.<br>• ANSI approved steel safety-toe boots or approved equivalent.<br>• High visibility reflective traffic vest if near moving vehicles<br>• Nitrile Gloves<br>• Leather work gloves<br>• First aid kit (located in vehicle).<br>• Have a radio, cell phone or other communication device for emergency use<br>• Fire extinguisher (located in vehicle). |

| Equipment to be Used | Training Requirements/Competent or Qualified Personnel name(s) | Inspection Requirements |
|---|---|---|
| DPT of HSA Drilling Rig | Sampling to be performed by competent person as certified by employer. | Equipment will be inspected daily by DPT or HSA rig operator. Any safety deficiencies detected will require cessation of sampling activities until appropriate repairs have been made. |

## Acknowledgement

All employees, subcontractors, and visitors must sign the Acknowledgement form, in this section, before conducting field activities at this site.

By signing this form, Resolution Consultants employees agree that:

- I have read this Activity Hazard Analysis and I understand the requirements of the AHA.
- I will conduct work at this site in accordance with the requirements of the AHA.

By signing this form, subcontractors and visitors agree that:

- I have read and understood the potential hazards associated with the site.
- I will ensure compliance with my company's policies on health and safety.

| Print Name & Company | Date | Signature |
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# Activity Hazard Analysis (AHA)

| | | |
|---|---|---|
| Activity/Work Task: **Geophysical Survey** | Overall Risk Assessment Code (RAC) (Use highest code) | **L** |
| Project Location: Camp Hero, Montauk, New York | **Risk Assessment Code (RAC) Matrix** | |
| Project Number: W912DR-13-D-0016, Task Order DB01 | **Severity** / **Probability** | |
| Date Prepared: 1/12/2016 | | |
| Prepared by (Name/Title): Amanda Martin | | |
| Reviewed by (Name/Title): Bob Miller, CSP | | |
| **Notes:** (Field Notes, Review Comments, etc.) | | |

| Severity | Frequent | Likely | Occasional | Seldom | Unlikely |
|---|---|---|---|---|---|
| Catastrophic | **E** | **E** | **H** | **H** | **M** |
| Critical | **E** | **H** | **H** | **M** | **L** |
| Marginal | **H** | **M** | **M** | **L** | **L** |
| Negligible | **M** | **L** | **L** | **L** | **L** |

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

**"Probability"** is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

**"Severity"** is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

**RAC Chart**

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| General Hazards | Unexpected storm – lightning, rain, snow, wind | Check local weather forecast, have a weather radio for remote sites, observation and communication among team members. Discuss weather issues during tailgate safety meeting. At the first sign of lightning, thunder or strong winds, immediately stop or move away and take shelter. Do not resume until 30 minutes have passed without signs of storm. | **L** |
| | Heat stress | Know the symptoms of heat stress, and the potential for its occurrence based on expected weather conditions. Take precautions to avoid it. Refer to the SSHP and SH&E 511. | **L** |
| | Sunburn/windburn | • Use sunscreen/barrier cream as necessary.<br>• Dress for the weather. Wear wide brimmed hats and long sleeved shirts.<br>• Refer to SH&E 517. | **L** |
| | Cuts and abrasions | • Wear work gloves when handling materials.<br>• Gloves must be used and the object inspected for metal slivers, jagged edges, burrs, or rough surface. | **L** |
| | Slips, trips, and falls | • Watch where you step and be aware that sticks, rocks, or other items can be concealed by leaves and grass.<br>• Continually inspect work areas for slip, trip and fall hazards.<br>• Determine best access route before transporting | **L** |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| | | equipment.<br>• Flag inconspicuous holes to protect against fall.<br>• Look before you step and ensure safe and secure footing.<br>• Keep work area free of loose equipment and materials.<br>• Avoid routing cords and hoses across pathways.<br>• Wear approved and appropriate work boots with traction soles. | |
| | Heavy lifting | • Evaluate the load and when lifting heavy or awkward objects, get help when needed.<br>• Personnel trained in safe lifting techniques (bend knees, straight back, load close to body).<br>• Lifts of 40 lbs or greater requires assistance or mechanical means.<br>• Do not load shovel with more weight than you can handle.<br>• Do not twist body when moving soil with shovel. | **L** |
| | Cumulative trauma prevention | • Supervisors monitor physical activities that stress body's capabilities to ensure they are designed to match worker capability.<br>• Warm-up and stretch prior to commencing work.<br>• Rotate tasks between team members.<br>• Recognize hazards, isolate causative factors, inform and train workers. | **L** |
| | Flying debris, dirt, dust etc. | • Wear safety glasses/goggles.<br>• Ensure that eyewash is in proper working condition. | **L** |
| | General medical considerations | • Advise employees to notify supervisor of all prescribed medications in case emergency medical treatment becomes necessary. | **L** |
| | Poison ivy and ticks | • Areas where present will be mapped out by UXOSO and/or SSHO and relayed to teams.<br>• When entering into work areas that contain, upgrade to modified level D PPE and follow all proper decontamination procedures.<br>• Watch for signs of rash within 24-48 hours and report any immediately.<br>• For ticks, use repellent (DEET) or permethrin treated clothing. | |
| Assembling and mounting the survey equipment | Musculoskeletal injury. | • Care should be taken to ensure that the unit is properly handled while trying to mount on the employee. Use of team lift if necessary to help mitigate the likelihood of having a back or shoulder | **L** |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| | | injury. | |
| Performing the survey | Slips, Trips, Falls.<br>Lacerations from tree limbs, etc.<br>Biological exposure. | • Ensure that your travel path is cleared or prepared prior to performing the survey. Utilize 'eyes on path' to ensure that you have inspected your walking surface both under and ahead of your feet.<br>• If vegetation is thick, you should use a long sleeve work shirt to protect exposed skin. Safety glasses should always be worn to protect the eye from tree limbs, vegetation, vines, etc.<br>• Long sleeve shirts, barrier creams or protective suits should be used to protect exposed skin from biological hazards in the survey area. | **L** |
| Removing the equipment after the survey is complete | Musculoskeletal injury. | • Care should be taken to ensure that the unit is properly handled while trying to mount on the employee. Use of team lift if necessary to help mitigate the likelihood of having a back or shoulder injury. | **L** |
| Geophysical Survey Unit. | Only trained, authorized, and competent people will operate the unit. | • Equipment will be inspected daily by equipment operator. Any safety deficiencies detected will require cessation of survey activities until appropriate repairs have been made. | **L** |

| Chemical Hazards and Monitoring Procedures | |
|---|---|
| **Chemical Hazard(s) (list):** | **NA** |
| **Applicable HASP Section(s):** | **see APP and ESS** |
| **Monitoring Instrument(s):** | **NA** |

| Additional Safety Considerations |
|---|
| 1. Ensure all personnel have read the APP/SSHP.<br>2. Ensure all equipment is equipped with necessary fire extinguishers (min 5 lbs BC).<br>3. Maintain good housekeeping practices. When possible, use mechanical equipment to perform lifting of heavy objects. When lifting, follow safe lifting practices. Use the buddy system when lifting.<br>4. Coordinate with Navy personnel regarding availability of and access to emergency services within the installation. |

| Additional Operational Safety Procedures | PPE |
|---|---|
| S3NA-206 Fire Protection<br>S3NA-205 Equipment Inspections & Maintenance<br>S3NA-207 Medical Services and First Aid<br>S3NA-208 Personal Protective Equipment Program<br>S3NA-305 Hand & Power Tools<br>S3NA-307 Housekeeping<br>S3NA-308 Manual Lifting<br>S3NA-309 Mobile or Heavy Equipment<br>S3NA-313 Wildlife, Plants, and Insects<br>S3NA-406 Overhead Electrical Lines<br>S3NA-417 Underground Utilities<br>S3NA-505 Cold Stress Prevention<br>S3NA-511 Heat Stress Prevention | LEVEL D<br>• ANSI approved safety glasses<br>• ANSI approved hard hat<br>• Hearing protection required when around operating machines (85 dBA).<br>• Shirts with sleeves and full-length pants.<br>• ANSI approved steel safety-toe boots or approved equivalent.<br>• High visibility reflective traffic vest<br>• Leather work gloves<br>• First aid kit (located in vehicle).<br>• Fire extinguisher (located in vehicle) |

| Equipment to be Used | Training Requirements/Competent or Qualified Personnel name(s) | Inspection Requirements |
|---|---|---|
| Geophysical Survey Equipment | • Only qualified personnel to operate during geophysical survey | Daily Instrument Verification Checks |
| Utility Vehicles | • Training Complete.<br>• Familiarity with the vehicle being operated. | Daily Preventative Maintenance Checks |
| Communications Equipment | • Familiarity with the equipment.<br>• Knowledge of Emergency Response Procedures. | Daily communications Checks |
| Fire Extinguishers | • Limitations and placement of the extinguishers.<br>• Techniques for the use of the extinguishers. | Initial and Monthly Serviceability Checks |
| First Aid Kit (s) | • First Aid/CPR training current.<br>• Universal safety precautions for blood borne pathogens. | Weekly Inspection/Inventory |

## Acknowledgement

All employees, subcontractors, and visitors must sign the Acknowledgement form, in this section, before conducting field activities at this site.

By signing this form, the AECOM-Tidewater JV employees agree that:

- I have read this Activity Hazard Analysis and I understand the requirements of the AHA.
- I will conduct work at this site in accordance with the requirements of the AHA.

By signing this form, subcontractors and visitors agree that:

- I have read and understood the potential hazards associated with the site.
- I will ensure compliance with my company's policies on health and safety.

| Print Name & Company | Date | Signature |
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# Activity Hazard Analysis (AHA)

| | | |
|---|---|---|
| Activity/Work Task: **Land Survey** | Overall Risk Assessment Code (RAC) (Use highest code) | **L** |
| Project Location: Camp Hero, Montauk, New York | **Risk Assessment Code (RAC) Matrix** | |
| Project Number: W912DR-13-D-0016, Task Order DB01 | **Severity** / **Probability** | |
| Date Prepared: 1/12/2016 | | |
| Prepared by (Name/Title): Amanda Martin | | |
| Reviewed by (Name/Title): Bob Miller, CSP | | |
| **Notes: (**Field Notes, Review Comments, etc.) | | |

| Severity | Frequent | Likely | Occasional | Seldom | Unlikely |
|---|---|---|---|---|---|
| Catastrophic | **E** | **E** | **H** | **H** | **M** |
| Critical | **E** | **H** | **H** | **M** | **L** |
| Marginal | **H** | **M** | **M** | **L** | **L** |
| Negligible | **M** | **L** | **L** | **L** | **L** |

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

**"Probability"** is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

**"Severity"** is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

**RAC Chart**

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| General Hazards | Unexpected storm – lightning, rain, snow, wind | Check local weather forecast, have a weather radio for remote sites, observation and communication among team members. Discuss weather issues during tailgate safety meeting. At the first sign of lightning, thunder or strong winds, immediately stop or move away and take shelter. Do not resume until 30 minutes have passed without signs of storm. | **L** |
| | Heat stress | Know the symptoms of heat stress, and the potential for its occurrence based on expected weather conditions. Take precautions to avoid it. Refer to the SSHP and SH&E 511. | **L** |
| | Sunburn/windburn | • Use sunscreen/barrier cream as necessary.<br>• Dress for the weather. Wear wide brimmed hats and long sleeved shirts.<br>• Refer to SH&E 517. | **L** |
| | Cuts and abrasions | • Wear work gloves when handling materials.<br>• Gloves must be used and the object inspected for metal slivers, jagged edges, burrs, or rough surface. | **L** |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| | Slips, trips, and falls | • Watch where you step and be aware that sticks, rocks, or other items can be concealed by leaves and grass.<br>• Continually inspect work areas for slip, trip and fall hazards.<br>• Determine best access route before transporting equipment.<br>• Flag inconspicuous holes to protect against fall.<br>• Look before you step and ensure safe and secure footing.<br>• Keep work area free of loose equipment and materials<br>• Avoid routing cords and hoses across pathways.<br>• Wear approved and appropriate work boots with traction soles. | **L** |
| | Heavy lifting | • Evaluate the load and when lifting heavy or awkward objects, get help when needed.<br>• Personnel trained in safe lifting techniques (bend knees, straight back, load close to body).<br>• Lifts of 40 lbs or greater requires assistance or mechanical means.<br>• Do not load shovel with more weight than you can handle.<br>• Do not twist body when moving soil with shovel.<br>• Use mechanical lifting devices whenever possible. | **L** |
| | Cumulative trauma prevention | • Supervisors monitor physical activities that stress body's capabilities to ensure they are designed to match worker capability.<br>• Warm-up and stretch prior to commencing work.<br>• Rotate tasks between team members.<br>• Keep hands warm.<br>• Recognize hazards, isolate causative factors, inform and train workers. | **L** |
| | Flying debris, dirt, dust etc. | • Wear safety glasses/goggles.<br>• Ensure that eyewash is in proper working condition. | **L** |
| | General medical considerations | • Advise employees to notify supervisor of all prescribed medications in case emergency medical treatment becomes necessary. | **L** |
| | Poison ivy and ticks | • Areas where present will be mapped out by SSHO and relayed to teams.<br>• When entering into work areas that contain, upgrade to modified level D PPE and follow all proper decontamination procedures. | **L** |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| | | • Watch for signs of rash within 24-48 hours and report any immediately.<br>• For ticks, use repellent (DEET) or permethrin treated clothing. | |

| Chemical Hazards and Monitoring Procedures | |
|---|---|
| **Chemical Hazard(s) (list):** | **NA** |
| **Applicable APP/SSHP Section(s):** | **see APP and ESS** |
| **Monitoring Instrument(s):** | **NA** |

## Additional Safety Considerations

1. Ensure all personnel have read the APP/SSHP.
2. Ensure all equipment is equipped with necessary fire extinguishers (min 5 lbs BC).
3. Maintain good housekeeping practices. When possible, use mechanical equipment to perform lifting of heavy objects. When lifting, follow safe lifting practices.
4. Coordinate with Navy personnel regarding availability of and access to emergency services within the installation.

| Additional Operational Safety Procedures | PPE |
|---|---|
| S3NA-205 Equipment Inspections & Maintenance<br>S3NA-206 Fire Protection, Field<br>S3NA-207 Medical Services and First Aid<br>S3NA-208 Personal Protective Equipment Program<br>S3NA-307 Housekeeping<br>S3NA-308 Manual Lifting<br>S3NA-313 Wildlife, Plants, and Insects<br>S3NA-505 Cold Stress Prevention<br>S3NA-511 Heat Stress Prevention | LEVEL D<br>• ANSI approved safety glasses.<br>• Shirts with sleeves and full-length pants.<br>• Leather boots.<br>• High visibility reflective traffic vest.<br>• Leather work gloves.<br>• First aid kit (located in vehicle).<br>• Fire extinguisher (located in vehicle). |

| Equipment to be Used | Training Requirements/Competent or Qualified Personnel name(s) | Inspection Requirements |
|---|---|---|
| Utility Vehicles | • Training Complete.<br>• Familiarity with the vehicle being operated. | Daily Preventative Maintenance Checks |
| Communications Equipment | • Familiarity with the equipment.<br>• Knowledge of Emergency Response Procedures. | Daily communications Checks |
| Fire Extinguishers | • Limitations and placement of the extinguishers.<br>• Techniques for the use of the extinguishers. | Initial and Monthly Serviceability Checks |
| First Aid Kit (s) | • First Aid/CPR training current.<br>• Universal safety precautions for blood borne pathogens. | Weekly Inspection/Inventory |
| | <u>Other Training:</u><br>• Evacuation, Emergency Response and Notifications Procedures IAW APP.<br>• MEC/MPPEH Hazards and Safety Precautions.<br>• Safe work practices and precautions IAW APP.<br>• OSHA qualifications and training as required IAW APP. | |

## Acknowledgement

All employees, subcontractors, and visitors must sign the Acknowledgement form, in this section, before conducting field activities at this site.

By signing this form, AECOM-Tidewater JV employees agree that:

- I have read this Activity Hazard Analysis and I understand the requirements of the AHA.
- I will conduct work at this site in accordance with the requirements of the AHA.

By signing this form, subcontractors and visitors agree that:

- I have read and understood the potential hazards associated with the site.
- I will ensure compliance with my company's policies on health and safety.

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# Activity Hazard Analysis (AHA)

| | | |
|---|---|---|
| Activity/Work Task: **Mechanical Excavation** | Overall Risk Assessment Code (RAC) (Use highest code) | **M** |
| Project Location: Camp Hero, Montauk, New York | **Risk Assessment Code (RAC) Matrix** | |
| Project Number: W912DR-13-D-0016, Task Order DB01 | **Severity** / **Probability** | |
| Date Prepared: 1/12/2016 | | |
| Prepared by (Name/Title): Amanda Martin | | |
| Reviewed by (Name/Title): Bob Miller, CSP | | |
| **Notes: (**Field Notes, Review Comments, etc.) | | |

| Severity | Frequent | Likely | Occasional | Seldom | Unlikely |
|---|---|---|---|---|---|
| Catastrophic | **E** | **E** | **H** | **H** | **M** |
| Critical | **E** | **H** | **H** | **M** | **L** |
| Marginal | **H** | **M** | **M** | **L** | **L** |
| Negligible | **M** | **L** | **L** | **L** | **L** |

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

**"Probability"** is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

**"Severity"** is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

**RAC Chart**

**E = Extremely High Risk**
**H = High Risk**
**M = Moderate Risk**
**L = Low Risk**

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| General Hazards | Unexpected storm – lightning, rain, snow, wind | Check local weather forecast, have a weather radio for remote sites, observation and communication among team members. Discuss weather issues during tailgate safety meeting. At the first sign of lightning, thunder or strong winds, immediately stop or move away and take shelter. Do not resume until 30 minutes have passed without signs of storm. | **L** |
| | Heat stress | Know the symptoms of heat stress, and the potential for its occurrence based on expected weather conditions. Take precautions to avoid it. Refer to the SSHP and SH&E 511. Heavy equipment with closed cab will be equipped with air conditioning. | **L** |
| | Electrical hazards | • All connections to facilities from power drop or generator are to be made by licensed electrician per local code/regulations.<br>• If the use of power tolls is needed, ensure generator is properly grounded and use GFCI.<br>• Inspect all tools and cords for cuts/abrasions and ensure grounding plug is intact. | **L** |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| | Sunburn/windburn | • Use sunscreen/barrier cream as necessary.<br>• Dress for the weather. Wear wide brimmed hats and long sleeved shirts.<br>• Refer to SH&E 517. | L |
| | Cuts and abrasions | • Wear work gloves when handling materials.<br>• Gloves must be used and the object inspected for metal slivers, jagged edges, burrs, or rough surface. | L |
| | Slips, trips, and falls | • Watch where you step and be aware that sticks, rocks, or other items can be concealed by leaves and grass.<br>• Continually inspect work areas for slip, trip and fall hazards.<br>• Determine best access route before transporting equipment.<br>• Flag inconspicuous holes to protect against fall.<br>• Look before you step and ensure safe and secure footing.<br>• Keep work area free of loose equipment and materials.<br>• Avoid routing cords and hoses across pathways.<br>• Wear approved and appropriate work boots with traction soles. | L |
| | Heavy lifting | • Evaluate the load and when lifting heavy or awkward objects, get help when needed.<br>• Personnel trained in safe lifting techniques (bend knees, straight back, load close to body).<br>• Lifts of 40 lbs or greater requires assistance or mechanical means. | L |
| | Cumulative trauma prevention | • Supervisors monitor physical activities that stress body's capabilities to ensure they are designed to match worker capability.<br>• Warm-up and stretch prior to commencing work.<br>• Rotate tasks between team members.<br>• Recognize hazards, isolate causative factors, inform and train workers. | L |
| | Flying debris, dirt, dust etc. | • Wear safety glasses/goggles.<br>• Ensure that eyewash is in proper working condition.<br>• Monitor airborne dust emissions and implement dust control with water suppression if visible, sustained dust present. | L |
| | General medical considerations | • Advise employees to notify supervisor of all prescribed medications in case emergency medical treatment becomes necessary. | L |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| Mechanized excavation of soil | Heavy equipment hazards | • Only trained and qualified personnel operate equipment.<br>• Ensure manufacturer owner's manual maintained with equipment.<br>• Maintain and inspect A:B:C fire extinguisher with each piece of equipment.<br>• Inspect equipment before each shift and document inspections daily.<br>• Serious safety hazards should be flagged, documented, and the equipment should be taken out of service.<br>• Use experienced spotter when moving equipment around the site except when prohibited by the exclusion zone.<br>• Ensure all equipment equipped with rollover protective structure and reverse signal alarms.<br>• Document maintenance and repair actions on inspection documents.<br>• Ground all attachments when equipment is parked or idle.<br>• Follow pre-arranged haul routes for transportation of excavated sediment.<br>• Use earplugs and/or earmuffs as directed by the SSHO.<br>• Observe manufacturer recommended grade limits while working on inclined portions of the ditch. | **M** |

| Chemical Hazards and Monitoring Procedures | |
|---|---|
| **Chemical Hazard(s) (list):** | **NA** |
| **Applicable APP/SSHP Section(s):** | **see APP/SSHP** |
| **Monitoring Instrument(s):** | **NA** |

## Additional Safety Considerations

1. Ensure all personnel have read the APP/SSHP.
2. Ensure all equipment is equipped with necessary fire extinguishers (min 5 lbs BC).
3. Maintain good housekeeping practices. When possible, use mechanical equipment to perform lifting of heavy objects. When lifting, follow safe lifting practices.
4. Coordinate with USACE personnel regarding availability of and access to emergency services within the installation.

| Additional Operational Safety Procedures | PPE |
|---|---|
| S3NA-106 Fire Protection<br>S3NA-205 Equipment Inspections & Maintenance<br>S3NA-207 Medical Services and First Aid<br>S3NA-208 Personal Protective Equipment Program<br>S3NA-305 Hand & Power Tools<br>S3NA-307 Housekeeping<br>S3NA-308 Manual Lifting<br>S3NA-309 Mobile or Heavy Equipment<br>S3NA-313 Wildlife, Plants, and Insects<br>S3NA-406 Overhead Electrical Lines<br>S3NA-417 Underground Utilities<br>S3NA-505 Cold Stress Prevention<br>S3NA-511 Heat Stress Prevention | LEVEL D<br>• ANSI approved safety glasses<br>• ANSI approved hard hat<br>• Hearing protection required when around operating machines (85 dBA).<br>• Shirts with sleeves and full-length pants.<br>• ANSI approved steel safety-toe boots or approved equivalent.<br>• High visibility reflective traffic vest<br>• Leather work gloves<br>• First aid kit (located in vehicle).<br>• Fire extinguisher (located in vehicle) |

| Equipment to be Used | Training Requirements/Competent or Qualified Personnel name(s) | Inspection Requirements |
|---|---|---|
| Utility Vehicles | • Training Complete<br>• Familiarity with the vehicle being operated | Daily Preventative Maintenance Checks |
| Communications Equipment | • Familiarity with the equipment<br>• Knowledge of Emergency Response Procedures | Daily communications Checks |
| Fire Extinguishers | • Limitations and placement of the extinguishers<br>• Techniques for the use of the extinguishers | Initial and Monthly Serviceability Checks |
| First Aid Kit (s) | • First Aid/CPR training current<br>• Universal safety precautions for blood borne pathogens | Weekly Inspection/Inventory |
| | <u>Other Training:</u><br>• Evacuation, Emergency Response and Notifications Procedures<br>• Safe work practices and precautions OSHA qualifications and training as required | |

## Acknowledgement

All employees, subcontractors, and visitors must sign the Acknowledgement form, in this section, before conducting field activities at this site.

By signing this form, Resolution Consultants employees agree that:

- I have read this Activity Hazard Analysis and I understand the requirements of the AHA.
- I will conduct work at this site in accordance with the requirements of the AHA.

By signing this form, subcontractors and visitors agree that:

- I have read and understood the potential hazards associated with the site.
- I will ensure compliance with my company's policies on health and safety.

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# Activity Hazard Analysis (AHA)

| | | |
|---|---|---|
| Activity/Work Task: **Groundwater Monitoring Well Sampling and Development** | Overall Risk Assessment Code (RAC) (Use highest code) | **M** |
| Project Location: Camp Hero, Montauk, New York | **Risk Assessment Code (RAC) Matrix** | |
| Project Number: W912DR-13-D-0016, Task Order DB01 | **Severity** / **Probability** | |
| Date Prepared: 1/12/2016 | | |
| Prepared by (Name/Title): Amanda Martin | | |
| Reviewed by (Name/Title): Bob Miller, CSP | | |

| Severity | Frequent | Likely | Occasional | Seldom | Unlikely |
|---|---|---|---|---|---|
| Catastrophic | E | E | H | H | M |
| Critical | E | H | H | M | L |
| Marginal | H | M | M | L | L |
| Negligible | M | L | L | L | L |

**Notes: (**Field Notes, Review Comments, etc.)

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

**"Probability"** is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

**"Severity"** is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

**RAC Chart**

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| Travel | Driving | • Complete a pre-use visual inspection. No hand-held electronic devises. Be aware of road conditions and drive only to your comfort level.<br>• Use spotter when driving on-site or around equipment<br>• Do not drive faster than conditions allow. | **M** |
| | Fatigue (long hours, repetitive tasks) | • Buddy system. Rotation of shifts. Frequent breaks. | **L** |
| | Inclement weather | • Evaluate weather conditions prior to beginning the travel to determine if travel should proceed. Verify your vehicle is equipped to travel in poor weather. Have supplies on hand in the event that you become stranded, including a communication device to call for help. | **L** |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| General Physical Hazards | Slip/Trip/Fall | • Take inventory of your surroundings noting any conditions which may pose a slip, trip or fall hazard. Clear and walk your pathway prior to work beginning.<br>• Make any corrective actions to eliminate hazards, erect barricades or place warning signs and cones to raise awareness to hazards that can't be engineered out.<br>• Maintain strong housekeeping habits. Keep worksites clean and free from debris, spills or other slip/trip hazards.<br>• Watch your step and ensure proper footing.<br>• Maintain 3 points of contact when climbing into vehicle | **L** |
| | Cold/Heat Stress | • Provide drinking water and first aid kit.<br>• Wear appropriate clothing for weather conditions.<br>• Buddy system; cold/heat stress monitoring; cold/heat stress control plan (including shelters, work rotation, methods of cooling/heating as necessary). | **L** |
| | Biological Hazards | • Assess work area for poisonous plants and animals and communicate observations to avoid them.<br>• Inspect the work area for dead animals before starting work. If dead animals are present, avoid going near them.<br>• If hazardous insects or plants such as ticks, poison oaks are identified or suspected in a work area, controls including the use of disposable (Tyvek) coveralls, insect repellent (23.8% DEET or similar), light colored clothing, barrier creams, frequent tick checks should be implemented.<br>• Additionally, all field clothing and equipment should be thoroughly cleaned, removed and/or segregated from clean clothing, equipment and supplies to avoid transfer of hazardous plants/insects.<br>• All employees should bath immediately following fieldwork and use soaps/cleansers designed to remove oils associated with poison oak, and conduct a full body tick check using a mirror. | **M** |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| | Cuts/Scrapes/Bruises | • Level D PPE required.<br>• Wear appropriate work gloves for task. | L |
| | Manual lifting | • Wear appropriate work gloves for task.<br>• Use proper lifting techniques by bending and lifting with legs and not back, and do not over extend or twist (Do not lift over 49lb. without assistance).<br>• Use dollies, carts, come-alongs, or rollers whenever possible rather than the employee physically moving materials. Use appropriate lifting techniques if required to manually lift an object. Seek assistance when needed. | L |
| | Adverse Weather | • Be aware of changing weather condition and provide appropriate weather gear.<br>• When work is halted due to inclement weather, personnel are to seek shelter in vehicles or building designated Shelter in Place (SIP). | L |
| | Puncture wounds | • Visually inspect work area and all sampling equipment for hypodermic needles or syringes.<br>• All workers should be aware of this potential hazard and be prepared to don cut-resistant gloves, such as Kevlar, to avoid coming in direct contact with debris. | L |
| Establish EZ around well and unload/set-up equipment | Traffic in roadways and parking lots | • Use combination of vehicles, cones, traffic barriers and caution tape.<br>• A traffic plan may be necessary depending on location. | L |
| | Cuts/scrapes | • Wear leather gloves. | L |
| | Stacking heights | • Avoid stacking equipment and boxes. | L |
| Open well and take water level measurement | Cuts/scrapes | • Wear leather gloves when un-bolting well lid | L |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| | Biological Hazards | • Look for spiders, scorpions, etc. in the well head. | |
| | Exposure potential | • Use ventilation procedures on each well, monitoring at well head and breathing zone.<br>• Use respiratory protection, depending on measurements.<br>• Wear nitrile gloves to remove plug and taking measurement. | **L** |
| Sample/develop purge using a bailer or pump (well will be purged prior to sampling) | Exposure potential | • Wear nitrile gloves while taking flow rates<br>• Monitor breathing zone continuously during sampling event.<br>• Use respiratory protection, depending on measurements. | **L** |
| | Cuts/scrapes | • Use appropriate cutting devices for tubing boxes and proper tools for pump repairs/maintenance.<br>• Wear appropriate work gloves for task | **L** |
| | Electrical | • Ensure employees are properly trained in the use of the compressors, e.g., use correct contacts for 12 volt batteries and avoid arcing situations | **L** |
| | Compressed gas cylinders | • Cylinders are not to be used unless they have standardized markings showing that they have been tested as required by regulations.<br>• All cylinders shall be stored upright, with caps in place; and secured<br>• Inspect cylinders prior to use. | **L** |
| | Manual lifting | • Wear appropriate work gloves for task<br>• Use proper lifting techniques by bending and lifting with legs and not back, and do not over extend or twist (Do not lift over 49lb. without assistance)<br>• Use dollies, carts, come-alongs, or rollers whenever possible rather than the employee physically moving materials. Use appropriate lifting techniques if required to manually lift an object. Seek assistance when needed. | **L** |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| IDW handling | Chemical Exposure | • Wear modified level D PPE when necessary (Tyvek and face shields or dust masks).<br>• Use respiratory protection, depending on measurements.<br>• Have portable eyewash on site. | **L** |
| | Manual lifting | • Items over 49 pounds need two people to lift. Lift with legs, not with the back.<br>• Minimize body strain by taking stretching breaks<br>• Use dollies, carts, come-alongs, or rollers whenever possible rather than the employee physically moving materials.<br>• Pour water from buckets into drums/containers as soon as practicable. | **L** |
| | Splash Hazard | • Wear modified level D PPE when necessary (Tyvek and face shields or dust masks).<br>• Inspect Drums/Containers prior to use for integrity and contaminants.<br>• Pour water from buckets into drums/containers as soon as practicable. | **L** |
| | Spills | • Inspect Drums/Containers prior to use for integrity and contaminants.<br>• Pour water from buckets into drums/containers as soon as practicable.<br>• Place used PPE and disposable sampling equipment in garbage bags to be disposed of properly. | **L** |
| Sample collection and packaging | Chemical exposure potential | • Follow proper decontamination procedures | **L** |
| | Cuts/Scrapes | • Inspect glassware for breakage and avoid sharp edges and wear gloves (nitrile and cut resistant leather or Kevlar). | **L** |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| | Manual lifting of equipment | • Use proper lifting techniques and do not over-extend.<br>• Items over 49 pounds need two people to lift. Lift with legs, not with the back.<br>• Use dollies, carts, come-alongs, or rollers whenever possible rather than the employee physically moving materials. | **L** |
| Decontamination | Chemical exposure potential | • Wear modified level D PPE when necessary (Tyvek and face shields or dust masks).<br>• Have portable eyewash on site. | **L** |
| | Cuts/Scrapes | • Use appropriate cutting devices for tubing boxes and proper tools for pump repairs/maintenance.<br>• Wear appropriate work gloves for task. | **L** |
| | Manual lifting of equipment | • Pour water from buckets into drums/containers as soon as practicable and lifting with legs.<br>• Items over 49 pounds need two people to lift. Lift with legs, not with the back.<br>• Minimize body strain by taking stretching breaks. | **L** |

| Chemical Hazards and Monitoring Procedures | |
|---|---|
| **Chemical Hazard(s) (list):** | Unknown |
| **Applicable HASP Section(s):** | H.8 |
| **Monitoring Instrument(s):** | PID (10.6 eV) |

## Additional Safety Considerations

1. Ensure all personnel have read the SSHP.
2. Ensure all equipment is equipped with necessary fire extinguishers (min 5 lbs BC).
3. Follow safe driving procedures. Always use the buddy system when moving vehicles. Plan your travel path ahead of time. Use maps and known construction zones to make your selection. Consult with the other team members before making any changes to travel path.
4. Use an equipment checklist to verify you have the appropriate equipment/tools for your tasks. Consult appropriate AHAs or SOPs.
5. Stow all materials in vehicle properly, use appropriate cases and bags. Secure equipment in bed of truck with netting or straps. Do not leave any equipment loose in the cab or bed of the truck. It can cause property damage or serious injuries by falling from vehicle.

## Additional Safety Considerations

6. When securing equipment, watch for pinch points. Straps and netting can get caught on objects and snap back as well as trap a finger if hand placement is not correct. Use a buddy to help secure equipment when possible.
7. Maintain good housekeeping practices. When possible, use mechanical equipment to perform lifting of heavy objects. When lifting, follow safe lifting practices. Use the buddy system when lifting.
8. Wear nitrile gloves when collecting samples in soil to avoid dermal contact with potential contaminants. Be observant for tripping hazards, holes, stickups, vines, old fence wire, etc.

| Additional Operational Safety Procedures | PPE |
|---|---|
| S3NA-001 Safety Rules<br>S3NA-002 Stop Work Order<br>S3NA-005 Vehicle and Driver Safety Program<br>S3NA-205 Equipment Inspections and Maintenance<br>S3NA-208 Personal Protective Equipment<br>S3NA-210 Project Safety Meetings<br>S3NA-305 Hand and Power Tools<br>S3NA-306 Highway and Road Work<br>S3NA-307 Housekeeping<br>S3NA-308 Manual Lifting Field<br>S3NA-313 Biological Hazard Assessment, Wildlife, Plants, Insects<br>S3NA-417 Underground Utilities<br>S3NA-505 Cold Stress Prevention<br>S3NA-506 Compressed Gases<br>S3NA-507 Hazardous Material Communication<br>S3NA-511 Heat Stress Prevention | LEVEL D<br>• ANSI approved hard hat<br>• ANSI approved safety glasses<br>• Shirts with sleeves and full-length pants.<br>• ANSI approved steel safety-toe boots or approved equivalent.<br>• High visibility reflective traffic vest if near moving vehicles<br>• Nitrile Gloves<br>• Leather work gloves<br>• First aid kit (located in vehicle).<br>• Fire extinguisher (located in vehicle). |

| Equipment to be Used | Training Requirements/Competent or Qualified Personnel name(s) | Inspection Requirements |
|---|---|---|
| Pump (peristaltic or bladder) | Development and sampling to be performed by qualified person. | Equipment will be inspected prior to use. Any safety deficiencies detected will require cessation of sampling activities until appropriate repairs have been made. |
| PID (MiniRAE 3000 or equivalent) | Operation of equipment only by trained person. | Equipment will be inspected prior to use. Any safety deficiencies detected will require cessation of sampling activities until appropriate repairs have been made. Fresh air calibration reads 0.0 ppm ±3.0 ppm, span gas calibration (isobutylene) reads 100.0 ppm ±3.0 ppm. |
| Water Quality Meter (YSI 6920 V2 or equivalent) | Operation of equipment only by trained person. | Equipment will be inspected prior to use. |
| Compressor/<br>Controller (QED MP50 or equivalent) | Operation of equipment only by trained person. | Equipment will be inspected prior to use. |
| Water Level Meter (Solinist 101 or equivalent) | Operation of equipment only by trained person. | Equipment will be inspected prior to use. |

## Acknowledgement

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By signing this form, AECOM-Tidewater JV employees agree that:

- I have read this Activity Hazard Analysis and I understand the requirements of the AHA.
- I will conduct work at this site in accordance with the requirements of the AHA.

By signing this form, subcontractors and visitors agree that:

- I have read and understood the potential hazards associated with the site.
- I will ensure compliance with my company's policies on health and safety.

| Print Name & Company | Date | Signature |
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# Activity Hazard Analysis (AHA)

| | | |
|---|---|---|
| Activity/Work Task: **Utility Investigation Oversight and Metal Anomaly Avoidance** | Overall Risk Assessment Code (RAC) (Use highest code) | **M** |
| Project Location: Camp Hero, Montauk, New York | **Risk Assessment Code (RAC) Matrix** | |
| Project Number: W912DR-13-D-0016, Task Order DB01 | **Severity** / **Probability** | |
| Date Prepared: 1/12/2016 | | |
| Prepared by (Name/Title): Amanda Martin | | |
| Reviewed by (Name/Title): Bob Miller, CSP | | |

| Severity | Frequent | Likely | Occasional | Seldom | Unlikely |
|---|---|---|---|---|---|
| Catastrophic | E | E | H | H | M |
| Critical | E | H | H | M | L |
| Marginal | H | M | M | L | L |
| Negligible | M | L | L | L | L |

**Notes: (**Field Notes, Review Comments, etc.)

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

**"Probability**" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

**"Severity"** is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

**RAC Chart**

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| Travel | Driving | • Complete a pre-use visual inspection. No hand-held electronic devises. Be aware of road conditions and drive only to your comfort level.<br>• Use spotter when driving on-site or around equipment | L |
| | Fatigue (long hours, repetitive tasks) | • Buddy system. Rotation of shifts. Frequent breaks. | L |
| | Inclement weather | • Evaluate weather conditions prior to beginning the travel to determine if travel should proceed. Verify your vehicle is equipped to travel in poor weather. Have supplies on hand in the event that you become stranded, including a communication device to call for help. | L |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| General Physical Hazards | Slip/Trip/Fall | • Take inventory of your surroundings noting any conditions which may pose a slip, trip or fall hazard. Clear and walk your pathway prior to work beginning.<br>• Make any corrective actions to eliminate hazards, erect barricades or place warning signs and cones to raise awareness to hazards that can't be engineered out.<br>• Maintain strong housekeeping habits. Keep worksites clean and free from debris, spills or other slip/trip hazards.<br>• Watch your step and ensure proper footing.<br>• Maintain 3 points of contact when climbing into vehicle | **L** |
| | Cold/Heat Stress | • Provide drinking water and first aid kit.<br>• Wear appropriate clothing for weather conditions.<br>• Buddy system; cold/heat stress monitoring; cold/heat stress control plan (including shelters, work rotation, methods of cooling/heating as necessary). | **L** |
| | Biological Hazards | • Assess work area for poisonous plants and animals and communicate observations to avoid them.<br>• If hazardous insects or plants such as ticks, poison oaks are identified or suspected in a work area, controls including the use of disposable (Tyvek) coveralls, insect repellent (23.8% DEET or similar), light colored clothing, barrier creams, frequent tick checks should be implemented.<br>• Additionally, all field clothing and equipment should be thoroughly cleaned, removed and/or segregated from clean clothing, equipment and supplies to avoid transfer of hazardous plants/insects.<br>• All employees should bath immediately following fieldwork and use soaps/cleansers designed to remove oils associated with poison oak, and conduct a full body tick check using a mirror. | **M** |
| | Cuts/Scrapes/Bruises | • Level D PPE required. | **L** |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| | Adverse Weather | • Be aware of changing weather condition and provide appropriate weather gear.<br>• When work is halted due to inclement weather, personnel are to seek shelter in vehicles or building designated Shelter in Place (SIP) | **L** |
| Metal Anomaly Avoidance<br>Conduct visual survey aided by geophysical instrument over work areas<br>Mark and avoid surface metal debris/anomalies encountered<br>Escort personnel around the metal debris/anomalies | Encountering metal anomalies while drilling | • Field personnel should inspect all areas for metal debris anomalies prior to investigative work.<br>• Observe all safety precautions and safe work practices, specifically anomaly avoidance.<br>• Escort personnel so that they do not strike or disturb metal debris/anomalies.<br>• Locations where placement of markers (e.g., survey flags) will first be checked with the geophysical instrument prior to performing tasks.<br>• Do not permit geophysical instrument probes to come in contact with metal debris/anomalies.<br>• Do not place equipment directly on metal debris/anomalies.<br>• Post barriers and barricades as necessary prior to commencing operations and maintain positive site control.<br>• Be alert. Maintain positive site control; cease operations if unauthorized entry is made or unsafe conditions arise. | **M** |

| Chemical Hazards and Monitoring Procedures | |
|---|---|
| **Chemical Hazard(s) (list):** | N/A |
| **Applicable SSHP Section(s):** | H.2 |
| **Monitoring Instrument(s):** | N/A |

## Additional Safety Considerations

1. Ensure all personnel have read the SSHP.
3. Follow safe driving procedures. Always use the buddy system when moving vehicles. Plan your travel path ahead of time. Use maps and known construction zones to make your selection. Consult with the other team members before making any changes to travel path.
4. Use an equipment checklist to verify you have the appropriate equipment/tools for your tasks. Consult appropriate AHAs or SOPs.
5. Stow all materials in vehicle properly, use appropriate cases and bags. Secure equipment in bed of truck with netting or straps. Do not leave any equipment loose in the cab or bed of the truck. It can cause property damage or serious injuries by falling from vehicle.
7. Maintain good housekeeping practices.
8. Wear nitrile gloves when collecting samples in soil to avoid dermal contact with potential contaminants. Be observant for tripping hazards, holes, stickups, vines, old fence wire, etc.

| Additional Operational Safety Procedures | PPE |
|---|---|
| S3NA-001 Safety Rules<br>S3NA-002 Stop Work Order<br>S3NA-005 Vehicle and Driver Safety Program<br>S3NA-205 Equipment Inspections and Maintenance<br>S3NA-208 Personal Protective Equipment<br>S3NA-210 Project Safety Meetings<br>S3NA-305 Hand and Power Tools<br>S3NA-306 Highway and Road Work<br>S3NA-307 Housekeeping<br>S3NA-313 Biological Hazard Assessment, Wildlife, Plants, Insects<br>S3NA-417 Underground Utilities<br>S3NA-505 Cold Stress Prevention<br>S3NA-507 Hazardous Material Communication<br>S3NA-511 Heat Stress Prevention | LEVEL D<br>• ANSI approved hard hat<br>• ANSI approved safety glasses<br>• Shirts with sleeves and full-length pants.<br>• ANSI approved steel safety-toe boots or approved equivalent.<br>• High visibility reflective traffic vest if near moving vehicles<br>• Nitrile Gloves<br>• Leather work gloves<br>• First aid kit (located in vehicle).<br>• Fire extinguisher (located in vehicle). |

## Acknowledgement

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- I have read this Activity Hazard Analysis and I understand the requirements of the AHA.
- I will conduct work at this site in accordance with the requirements of the AHA.

By signing this form, subcontractors and visitors agree that:

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- I will ensure compliance with my company's policies on health and safety.

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| Print Name & Company | Date | Signature |

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# Activity Hazard Analysis (AHA)

| | | |
|---|---|---|
| Activity/Work Task: **Vegetation Removal** | Overall Risk Assessment Code (RAC) (Use highest code) | **M** |
| Project Location: Camp Hero, Montauk, New York | **Risk Assessment Code (RAC) Matrix** | |
| Project Number: W912DR-13-D-0016, Task Order DB01 | **Severity** / **Probability** | |
| Date Prepared: 1/12/2016 | | |
| Prepared by (Name/Title): Amanda Martin | | |
| Reviewed by (Name/Title): Bob Miller, CSP | | |
| **Notes: (**Field Notes, Review Comments, etc.) | | |

| Severity | Frequent | Likely | Occasional | Seldom | Unlikely |
|---|---|---|---|---|---|
| Catastrophic | **E** | **E** | **H** | **H** | **M** |
| Critical | **E** | **H** | **H** | **M** | **L** |
| Marginal | **H** | **M** | **M** | **L** | **L** |
| Negligible | **M** | **L** | **L** | **L** | **L** |

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

**"Probability"** is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

**"Severity"** is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

**RAC Chart**

**E = Extremely High Risk**
**H = High Risk**
**M = Moderate Risk**
**L = Low Risk**

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| General Hazards | Unexpected storm – lightning, rain, snow, wind | Check local weather forecast, have a weather radio for remote sites, observation and communication among team members. Discuss weather issues during tailgate safety meeting. At the first sign of lightning, thunder or strong winds, immediately stop or move away and take shelter. Do not resume until 30 minutes have passed without signs of storm. | **L** |
| | Heat stress | Know the symptoms of heat stress, and the potential for its occurrence based on expected weather conditions. Take precautions to avoid it. Refer to the SSHP and SH&E 511. | **L** |
| | Sunburn/windburn | • Use sunscreen/barrier cream as necessary.<br>• Dress for the weather. Wear wide brimmed hats and long sleeved shirts.<br>• Refer to SH&E 517. | **L** |
| | Cuts and abrasions | • Wear work gloves when handling materials.<br>• Gloves must be used and the object inspected for metal slivers, jagged edges, burrs, or rough surface. | **L** |
| | Slips, trips, and falls | • Watch where you step and be aware that sticks, rocks, or other items can be concealed by leaves and grass.<br>• Continually inspect work areas for slip, trip and fall | **L** |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| | | hazards.<br>• Determine best access route before transporting equipment.<br>• Flag inconspicuous holes to protect against fall.<br>• Look before you step and ensure safe and secure footing.<br>• Keep work area free of loose equipment and materials.<br>• Avoid routing cords and hoses across pathways.<br>• Wear approved and appropriate work boots with traction soles. | |
| | Heavy lifting | • Evaluate the load and when lifting heavy or awkward objects, get help when needed.<br>• Personnel trained in safe lifting techniques (bend knees, straight back, load close to body).<br>• Lifts of 40 lbs or greater requires assistance or mechanical means. | **L** |
| | Cumulative trauma prevention | • Supervisors monitor physical activities that stress body's capabilities to ensure they are designed to match worker capability.<br>• Warm-up and stretch prior to commencing work.<br>• Rotate tasks between team members.<br>• Recognize hazards, isolate causative factors, inform and train workers. | **L** |
| | Flying debris, dirt, dust etc. | • Wear safety glasses/goggles.<br>• Ensure that eyewash is in proper working condition. | **L** |
| | General medical considerations | • Advise employees to notify supervisor of all prescribed medications in case emergency medical treatment becomes necessary. | **L** |
| | Poison ivy and ticks | • Areas where present will be mapped out by SSHO and relayed to teams.<br>• When entering into work areas that contain, upgrade to modified level D PPE and follow all proper decontamination procedures.<br>• Watch for signs of rash within 24-48 hours and report any immediately.<br>• For ticks, use repellent (DEET) or permethrin treated clothing. | **L** |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| Vegetation Removal with powered tools and motive equipment | Chain saw and weed wacker operation | • Work in areas clear of encumbrances.<br>• Wear proper safety eyewear and/or face shield.<br>• Maintain functional eyewash.<br>• Non-essential personnel maintain safe distance from equipment.<br>• Use chain saws and weed wackers in accordance with manufacturer instructions.<br>• Ensure chain is secured to machine at all times.<br>• Lubricate chain saw as needed in accordance with manufacturer instructions.<br>• Wear protective chaps, boots and gloves. | **M** |
| | Heavy equipment hazards | • Only trained and qualified personnel operate equipment.<br>• Ensure manufacturer owner's manual maintained with equipment.<br>• Maintain and inspect A:B:C fire extinguisher with each piece of equipment.<br>• Inspect equipment before each shift and document inspections daily.<br>• Serious safety hazards should be flagged, documented, and the equipment should be taken out of service.<br>• Use experienced spotter when moving equipment around the site except when prohibited by the exclusion zone.<br>• Ensure all equipment equipped with rollover protective structure and reverse signal alarms.<br>• Document maintenance and repair actions on inspection documents.<br>• Ground all attachments when equipment is parked or idle.<br>• Follow pre-arranged haul routes for transportation of excavated sediment.<br>• Use earplugs and/or earmuffs as directed by the SSHO.<br>• Observe manufacturer recommended grade limits while working on inclined portions of the ditch. | **M** |

| Chemical Hazards and Monitoring Procedures | |
|---|---|
| **Chemical Hazard(s) (list):** | **NA** |
| **Applicable HASP Section(s):** | **see APP and ESS** |
| **Monitoring Instrument(s):** | **NA** |

| Additional Safety Considerations |
|---|
| 1. Ensure all personnel have read the APP/SSHP.<br>2. Ensure all equipment is equipped with necessary fire extinguishers (min 5 lbs BC).<br>3. Maintain good housekeeping practices. When possible, use mechanical equipment to perform lifting of heavy objects. When lifting, follow safe lifting practices.<br>4. Coordinate with Navy personnel regarding availability of and access to emergency services within the installation. |

| Additional Operational Safety Procedures | PPE |
|---|---|
| S3NA-206 Fire Protection, Field<br>S3NA-205 Equipment Inspections & Maintenance<br>S3NA-207 Medical Services and First Aid<br>S3NA-208 Personal Protective Equipment Program<br>S3NA-305 Hand & Power Tools<br>S3NA-307 Housekeeping<br>S3NA-308 Manual Lifting<br>S3NA-309 Mobile or Heavy Equipment<br>S3NA-313 Wildlife, Plants, and Insects<br>S3NA-406 Overhead Electrical Lines<br>S3NA-417 Underground Utilities<br>S3NA-505 Cold Stress Prevention<br>S3NA-511 Heat Stress Prevention | LEVEL D<br>• ANSI approved safety glasses<br>• Shirts with sleeves and full-length pants<br>• Leather boots<br>• Hard hat<br>• Leather chaps.<br>• High visibility reflective traffic vest<br>• Leather work gloves<br>• First aid kit (located in vehicle)<br>• Fire extinguisher (located in vehicle) |

| Equipment to be Used | Training Requirements/Competent or Qualified Personnel name(s) | Inspection Requirements |
|---|---|---|
| Geophysical Survey Equipment | • Only qualified personnel to operate during anomaly avoidance. | Daily Instrument Verification Strip Checks |
| Utility Vehicles | • Training Complete.<br>• Familiarity with the vehicle being operated. | Daily Preventative Maintenance Checks |
| Communications Equipment | • Familiarity with the equipment.<br>• Knowledge of Emergency Response Procedures. | Daily communications Checks |
| Fire Extinguishers | • Limitations and placement of the extinguishers.<br>• Techniques for the use of the extinguishers. | Initial and Monthly Serviceability Checks |
| First Aid Kit (s) | • First Aid/CPR training current.<br>• Universal safety precautions for blood borne pathogens. | Weekly Inspection/Inventory |

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# Activity Hazard Analysis (AHA)

| | | |
|---|---|---|
| Activity/Work Task: **Assessment of Abandoned Buildings** | Overall Risk Assessment Code (RAC) (Use highest code) | **L** |
| Project Location: Camp Hero, Montauk, New York | **Risk Assessment Code (RAC) Matrix** | |
| Project Number: W912DR-13-D-0016, Task Order DB01 | | |
| Date Prepared: 3/10/2016 | | |
| Prepared by (Name/Title): Amanda Martin | | |
| Reviewed by (Name/Title): Bob Miller, CSP | | |
| **Notes: (**Field Notes, Review Comments, etc.) | | |

| **Severity** | **Probability** | | | | |
|---|---|---|---|---|---|
| | Frequent | Likely | Occasional | Seldom | Unlikely |
| Catastrophic | **E** | **E** | **H** | **H** | **M** |
| Critical | **E** | **H** | **H** | **M** | **L** |
| Marginal | **H** | **M** | **M** | **L** | **L** |
| Negligible | **M** | **L** | **L** | **L** | **L** |

Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)

**"Probability"** is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.

**"Severity"** is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible

Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" on AHA. Annotate the overall highest RAC at the top of AHA.

**RAC Chart**

- **E = Extremely High Risk**
- **H = High Risk**
- **M = Moderate Risk**
- **L = Low Risk**

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| Conduct Visual Survey of Abandoned/Old Buildings | Obstructions in walkway; slippery surfaces; inadequate lighting; dirty/dusty environments; overhead hazards; hand hazards; operating machinery | • Wear Level D personal protective equipment (PPE) – hard hat, safety glasses w/side shields, steel-toed boots/shoes, gloves appropriate for the work task<br>• Use flashlights in case of low light levels<br>• Maintain an appropriate distance from fans or other equipment to avoid body parts or clothing being caught in machinery<br>• Do not place hands in areas that cannot be seen<br>• Bring disposable coveralls to site and don as necessary<br>• Wash hands and face after exiting project site | **L** |
| | Heat stress (from wearing PPE during sampling) | • Establish work/rest schedules when temperatures exceed 80 $^{o}$F (standard work clothes) or 70 $^{o}$F (impermeable coveralls).<br>• Have adequate fluids available<br>• Be aware of the symptoms of heat illness and exit project area when any symptoms are experienced<br>• Take breaks in cool areas | **L** |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| | Biological Hazards | • Avoid contact with rodent nests/droppings<br>• Avoid contact with standing water/liquid.<br>• Use repellants for insects/do not disturb areas where spiders may be present<br>• Use universal precautions when administering first aid/CPR (bring bloodborne pathogen kit to site) | L |
| | Contact/inhalation/ingestion of chemicals, biological hazards, or mold | • Minimize contact with potential contamination on outside of components or containers; wear nitrile gloves and safety glasses during survey.<br>• Do not contact chemicals; if broken or damaged components are encountered, notify SSHO<br>• Wear coveralls as needed to prevent contamination of clothing<br>• Do not open containers of solvents, paints, or cleaners<br>• Wear half-face or full-face APR with P100 filters in areas of heavy mold or avian/rodent dropping contamination<br>• Discard disposable PPE, wipe down respirator, if used, and wash hands and face upon completion of survey | L |
| | Manual lifting | • Wear appropriate work gloves for task<br>• Use proper lifting techniques by bending and lifting with legs and not back, and do not over extend or twist (Do not lift over 49lb. without assistance)<br>• Use dollies, carts, come-alongs, or rollers whenever possible rather than the employee physically moving materials. Use appropriate lifting techniques if required to manually lift an object. Seek assistance when needed. | L |
| Collect concrete chip and surface wipe samples | Exposures to PCBs and hexane | • Wear half-face or full-face APR with P100/organic vapor cartridges when collecting samples<br>• Wear coveralls as needed to prevent contamination of clothing<br>• Follow proper decontamination procedures | L |
| Sample packaging | Cuts/Scrapes | • Inspect glassware for breakage and avoid sharp edges and wear gloves (nitrile and cut resistant leather or Kevlar) | L |
| | Manual lifting of equipment | • Use proper lifting techniques and do not over-extend | L |

| Job Steps | Hazards | Controls | RAC |
|---|---|---|---|
| | Chemical exposure potential | • Wear modified level D PPE when necessary (Tyvek and face shields or dust masks)<br>• Have portable eyewash on site<br>• Pour water from buckets into drums/containers as soon as practicable and lifting with legs. | **L** |
| Decontamination | Chemical exposure potential | • Wear modified level D PPE when necessary (Tyvek and face shields or dust masks).<br>• Have portable eyewash on site. | **L** |
| | Cuts/Scrapes | • Use appropriate cutting devices for tubing boxes and proper tools for pump repairs/maintenance.<br>• Wear appropriate work gloves for task. | **L** |

| Chemical Hazards and Monitoring Procedures | |
|---|---|
| **Chemical Hazard(s) (list):** | **Unknown** |
| **Applicable SSHP Section(s):** | **H.8** |
| **Monitoring Instrument(s):** | **PID (10.6 eV)** |

## Additional Safety Considerations

1. Ensure all personnel have read the SSHP.
2. Ensure all equipment is equipped with necessary fire extinguishers (min 5 lbs BC).
3. Follow safe driving procedures. Plan your travel path ahead of time. Use maps and known construction zones to make your selection. Consult with the other team members before making any changes to travel path.
4. Use an equipment checklist to verify you have the appropriate equipment/tools for your tasks. Consult appropriate AHAs or SOPs.
5. Stow all materials in vehicle properly, use appropriate cases and bags. Secure equipment in bed of truck with netting or straps. Do not leave any equipment loose in the cab or bed of the truck. It can cause property damage or serious injuries by falling from vehicle.
6. When securing equipment, watch for pinch points. Straps and netting can get caught on objects and snap back as well as trap a finger if hand placement is not correct. Use a buddy to help secure equipment when possible.
7. Maintain good housekeeping practices. When possible, use mechanical equipment to perform lifting of heavy objects. When lifting, follow safe lifting practices. Use the buddy system when lifting.
8. Wear nitrile gloves when collecting samples in soil to avoid dermal contact with potential contaminants. Be observant for tripping hazards, holes, stickups, vines, old fence wire, etc.

| Additional Operational Safety Procedures | PPE |
|---|---|
| S3NA-001 Safety Rules<br>S3NA-002 Stop Work Order<br>S3NA-208 Personal Protective Equipment<br>S3NA-210 Project Safety Meetings<br>S3NA-213 Subcontractors<br>S3NA-307 Housekeeping<br>S3NA-313 Biological Hazard Assessment, Wildlife, Plants, Insects<br>S3NA-507 Hazardous Material Communication<br>S3NA-511 Heat Stress Prevention | LEVEL D<br>• ANSI approved hard hat<br>• ANSI approved safety glasses<br>• Shirts with sleeves and full-length pants.<br>• ANSI approved steel safety-toe boots or approved equivalent.<br>• High visibility reflective traffic vest if near moving vehicles<br>• Nitrile Gloves<br>• Leather work gloves<br>• First aid kit (located in vehicle).<br>• Have a radio, cell phone or other communication device for emergency use<br>• Fire extinguisher (located in vehicle).<br><br>MODIFIED LEVEL D<br>• Air-purifying respirator (half mask or full mask) with P100 cartridges<br>• Disposable Tyvek coveralls<br>• Disposable rubber booties |

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**Attachment 4**
**Route Map to Medical Facility**

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# ROUTE MAP AND DIRECTIONS TO EMERGENCY HOSPITAL

FROM: CAMP HERO STATE PARK, MONTAUK, NEW YORK

TO: SOUTHAMPTON HOSPITAL, 240 MEETING HOUSE LANE, SOUTHAMPTON, NY 11968

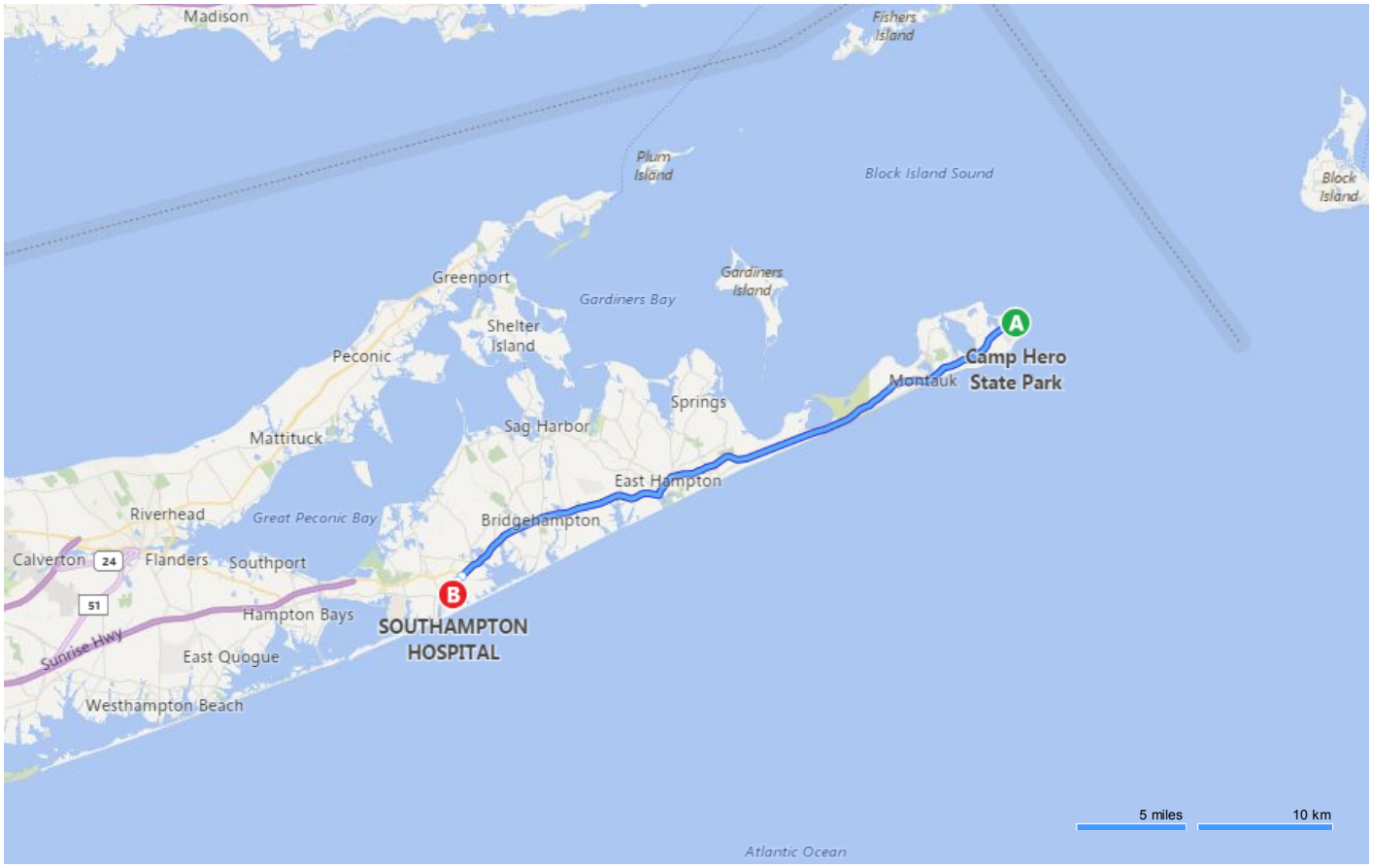
1 hr 05 min, 31.4 mi

Light traffic
55 min without traffic
Via RT-27

Camp Hero State Park

| | | | |
|---|---|---|---|
| ↑ | Depart Camp Hero Rd toward RT-27 / Montauk Hwy<br>• *Private Road* | 36 ft | |
| ↰ | Turn left onto RT-27 / Montauk Hwy<br>Pass 7-Eleven in 5.1 mi | 30.3 mi | 51 min |
| ↑ | Keep straight onto Montauk Hwy | 0.3 mi | |
| ↑ | Road name changes to Hampton Rd | 0.4 mi | |
| ↰ | Turn left onto Old Town Rd<br>Gulf on the corner | 0.4 mi | |
| ↱ | Turn right onto Meetinghouse Ln | 358 ft | |
| | Arrive at Meetinghouse Ln<br>The last intersection is Old Town Rd<br>If you reach Lewis St, you've gone too far | | |

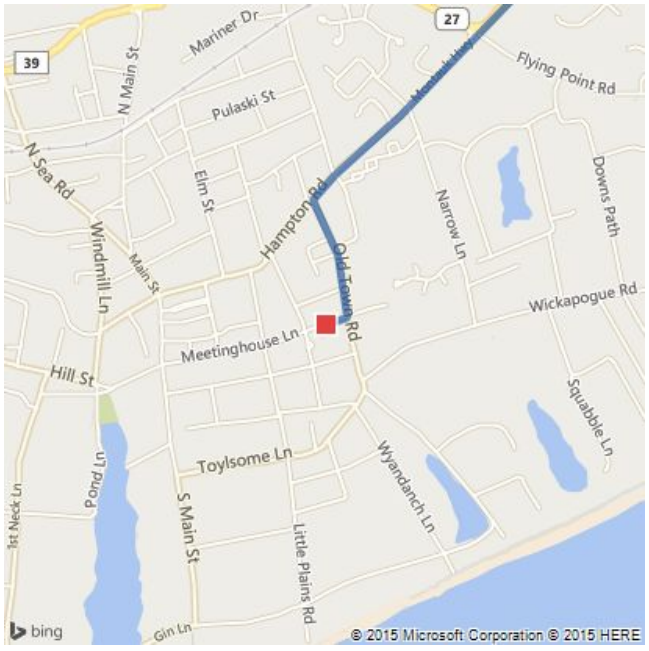
SOUTHAMPTON HOSPITAL
240 MEETING HOUSE Lane, SOUTHAMPTON, NY 11968




CAMP HERO STATE PARK




SOUTHAMPTON HOSPITAL



# ROUTE MAP AND DIRECTIONS TO URGENT CARE FACILITY

FROM: CAMP HERO STATE PARK, MONTAUK, NEW YORK

TO: EAST HAMPTON URGENT CARE, 470 MONTAUK HWY, EAST HAMPTON, NY 11937

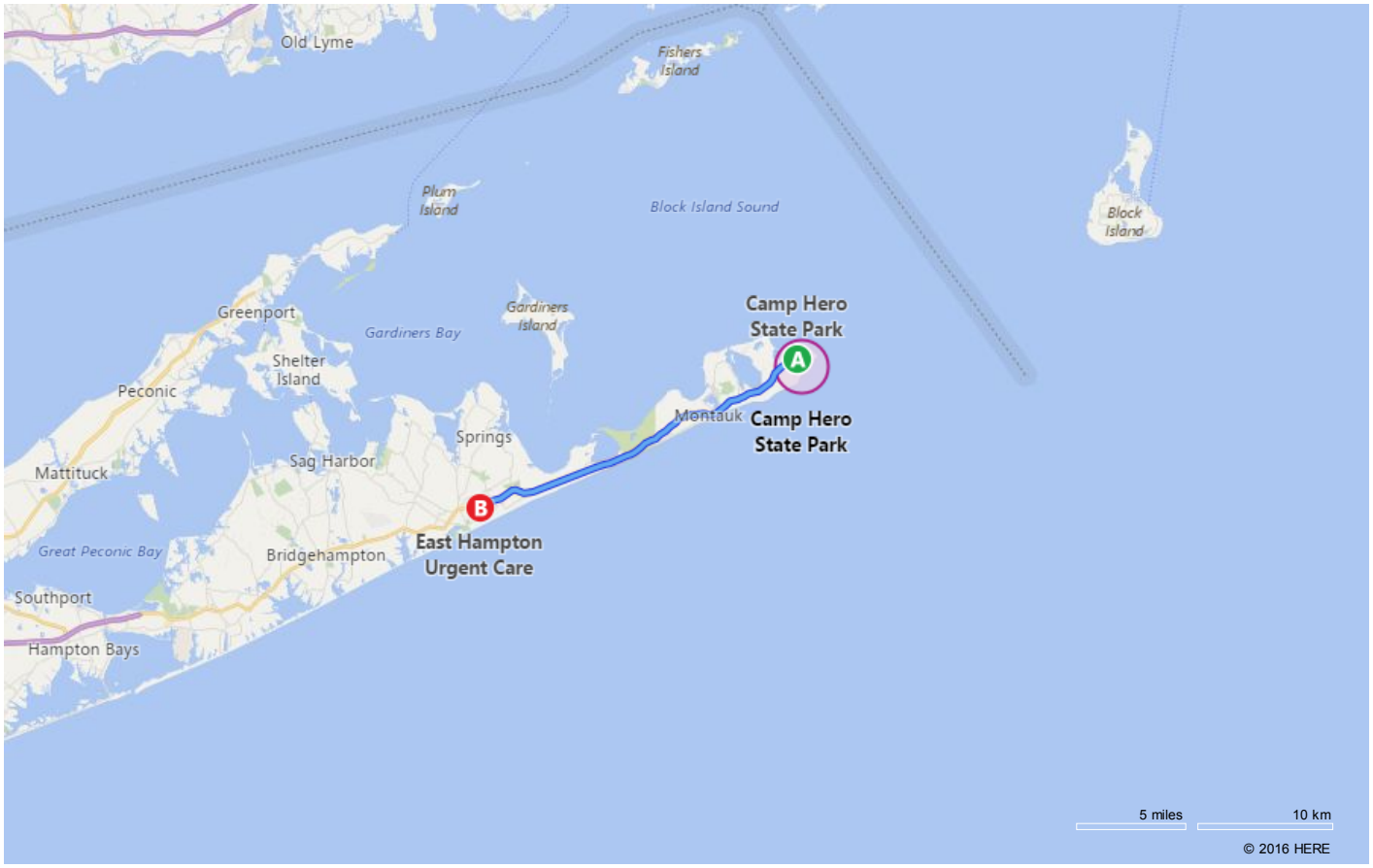
29 min, 17.3 mi

Light traffic
26 min without traffic
Via RT-27

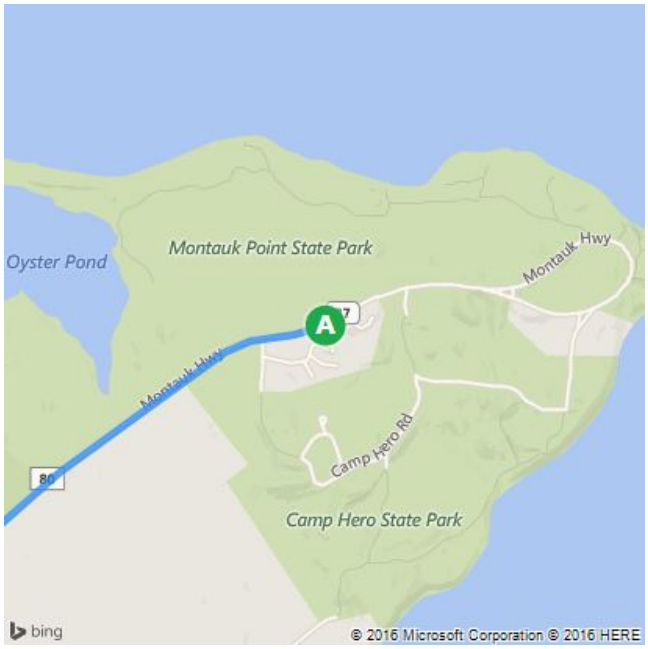
Camp Hero State Park
1898 Montauk Hwy, Montauk, NY 11954

| | | | | |
|---|---|---|---|---|
| ↑ | 1. | Depart **RT-27 / Montauk Hwy** toward Camp Hero Rd | 17.3 mi | 26 min |
| | 2. | Arrive at **RT-27 / Montauk Hwy**<br>If you reach Skimhampton Rd, you've gone too far | | |

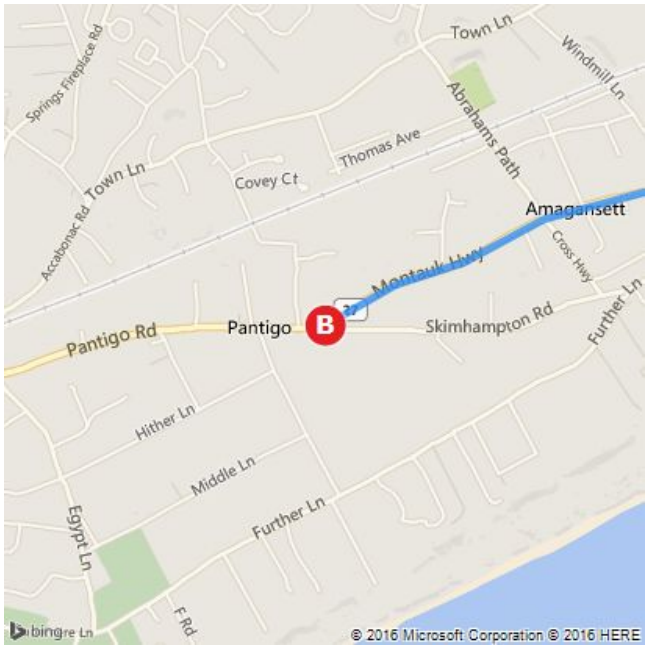
East Hampton Urgent Care
470 Montauk Hwy, East Hampton, NY 11937




## CAMP HERO STATE PARK




## EAST HAMPTON URGENT CARE



# Appendix F

## Risk Assessment Guidance for Superfund - Table 4s for Current/Future Human Receptors

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# Appendix F
# RAGS Part D Table 4s

## List of Tables


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Table F-5 Future: Soil – Incidental Ingestion and Dermal Exposures
Table F-6 Future: Soil – Inhalation Exposures
Table F-7 Future: Groundwater – Ingestion and Dermal Exposures
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**Table F-1 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations, Incidental Ingestion and Dermal Contact with Soil**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Current/Future |
| Medium: | Soil |
| Exposure Medium: | Surface and Subsurface Soil |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| Incidental Ingestion | Outdoor Maintenance Worker | Adult | Surface Soil and Surface/Subsurface Soil [1] | DI | Daily Intake | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents**<br>Daily Intake (mg/kg-day) for carcinogens =<br>(CS x IRsoil x FI x EF x ED x CF) / (BW x AT-C)<br><br>Daily Intake (mg/kg-day) for noncarcinogens =<br>(CS x IRsoil x FI x EF x ED x CF) / (BW x AT-N) |
| | | | | CS | Exposure Point Concentration in Soil | Based on soil sampling data | mg/kg | -- | |
| | | | | IRsoil | Ingestion Rate, soil | 100 | mg/day | USEPA, 2014a (USEPA, 1991; same as adult resident) | |
| | | | | FI | Fraction Ingested from Source | 1 | unitless | USEPA, 1989 (all of the soil contacted is presumed to be contaminated) | |
| | | | | EF | Exposure Frequency | 40 | days/year | Site-specific assumption (biweekly from November through March (winter months); weekly from April through October (non-winter months) | |
| | | | | ED | Exposure Duration | 25 | years | USEPA, 2014a (USEPA 1991) | |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 9,125 | days | ED x 365 days/year | |
| | Recreational Users | Adult/Child | Surface Soil and Surface/Subsurface Soil [1] | DI | Daily Intake | Calculated | mg/kg-day | -- | **Non-Mutagenic Constituents**<br>Daily Intake (mg/kg-day) for carcinogens =<br>(CS x IRsoila x FI x EFa x EDa x CF) / (BWa x AT-C) +<br>(CS x IRsoilc x FI x EFc x EDc x CF) / (BWc x AT-C)<br><br>Daily Intake (mg/kg-day) for noncarcinogens (adult) =<br>(CS x IRsoila x FI x EFa x EDa x CF) / (BWa x AT-Na)<br><br>Daily Intake (mg/kg-day) for noncarcinogens (child) =<br>(CS x IRsoilc x FI x EFc x EDc x CF) / (BWc x AT-Nc)<br><br>**Mutagenic Constituents**<br>Daily Intake (mg/kg-day) for mutagenic carcinogens (adult) =<br>[(CS x IRsoila x FI x EFa x $ED_{6-16}$ x $ADAF_{6-16}$ x CF) + (CS x IRsoila x FI x EFa x $ED_{16-26}$ x $ADAF_{16-26}$ x CF)] / (BWa x AT-C)<br><br>Daily Intake (mg/kg-day) for mutagenic carcinogens (child) =<br>[(CS x IRsoilc x FI x EFc x $ED_{0-2}$ x $ADAF_{0-2}$ x CF) + (CS x IRsoilc x FI x EFc x $ED_{2-6}$ x $ADAF_{2-6}$ x CF)] / (BWc x AT-C)<br><br>**Where:**<br>Daily Intake for mutagenic carcinogens (mg/kg-day) =<br>[DI (adult) + DI (child)] |
| | | | | CS | Exposure Point Concentration in Soil | Based on soil sampling data | mg/kg | -- | |
| | | | | IRsoila | Ingestion Rate, soil - adult | 100 | mg/day | USEPA, 2014a (USEPA, 1991) | |
| | | | | IRsoilc | Ingestion Rate, soil - child | 200 | mg/day | USEPA, 2014a (USEPA, 2011; Table 5-1; "upper-bound values" accounting for both soil and dust ingestion) | |
| | | | | FI | Fraction Ingested from Source | 1 | unitless | USEPA, 1989 (all of the soil contacted is presumed to be contaminated) | |
| | | | | EFa | Exposure Frequency - adult | 176 [(2)] | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | |
| | | | | EFc | Exposure Frequency - child | 176 [(2)] | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | |
| | | | | EDa | Exposure Duration - adult | 20 | years | USEPA, 2014a (Resident Exposure of 26 years (USEPA, 2011; Table 16-108; 90th percentile for current residence time) minus Resident Duration for child (6 years)). | |
| | | | | $ED_{6-16}$ | Exposure Duration, 6-16 years | 10 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{6-16}$ | Age depend. adjust. factor, 6-16 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ED_{16-26}$ | Exposure Duration, 16-26 years | 10 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{16-26}$ | Age depend. adjust. factor, 16-26 years | 1 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | EDc | Exposure Duration - child | 6 | years | USEPA, 2014a (USEPA, 1991) | |
| | | | | $ED_{0-2}$ | Exposure Duration. 0-2 years | 2 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{0-2}$ | Age depend. adjust. factor, 0-2 years | 10 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ED_{2-6}$ | Exposure Duration, 2-6 years | 4 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{2-6}$ | Age depend. adjust. factor, 2-6 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | |
| | | | | BWa | Body Weight - adult | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | BWc | Body Weight -child | 15 | kg | USEPA, 2014a (USEPA, 2011; Table 8-1; weighted average of mean body weights (birth to <6 years)) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-Na | Averaging Time, noncarcinogens (Adult) | 7,300 | days | EDa x 365 days/year | |
| | | | | AT-Nc | Averaging Time, noncarcinogens (Child) | 2190 | days | EDc x 365 days/year | |

**Table F-1 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations, Incidental Ingestion and Dermal Contact with Soil**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Current/Future |
| Medium: | Soil |
| Exposure Medium: | Surface and Subsurface Soil |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| Dermal | Outdoor Maintenance Worker | Adult | Surface Soil and Surface/Subsurface Soil [1] | DAD | Dermally Absorbed Dose | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CS | Exposure Point Concentration in Soil | Based on soil sampling data | mg/kg | -- | |
| | | | | SA | Skin surface area for contact | 3,527 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Tables 7-12 and 7-13; Weighted average of mean values for head, hands, and forearms (male and female, 21+years)) | Dermally Absorbed Dose (mg/kg-day) for carcinogens = (DA-event x EV x EF x ED x SA) / (BW x AT-C) |
| | | | | AF | Soil-to-skin adherence factor | 0.12 | $mg/cm^2$-event | USEPA, 2014a (USEPA, 2011; Table 7-20 and Section 7.2.2; arithmetic mean of weighted average of body part-specific (hands, forearms, and face) mean adherence factors for adult commercial/industrial activities) | Dermally Absorbed Dose (mg/kg-day) for noncarcinogens = (DA-event x EV x EF x ED x SA) / (BW x AT-N) |
| | | | | ABS | Soil Absorption Factor | Chemical-specific | unitless | USEPA, 2004 (Exhibit 3-4) | |
| | | | | EV | Event Frequency | 1 | events/day | USEPA, 2004 | |
| | | | | EF | Exposure Frequency | 40 | days/year | Site-specific assumption (biweekly from November through March (winter months); weekly from April through October (non-winter months) | **Where:** Absorbed Dose per Event (DA-event) ($mg/cm^2$-event) = CS x AF x ABS x CF |
| | | | | ED | Exposure Duration | 25 | years | USEPA, 2014a (USEPA 1991) | |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 9125 | days | ED x 365 days/year | |
| | Recreational Users | Adult/Child | Surface Soil and Surface/Subsurface Soil [1] | DAD | Dermally Absorbed Dose | Calculated | mg/kg-day | -- | **Non-Mutagenic Constituents** |
| | | | | CS | Exposure Point Concentration in Soil | Based on soil sampling data | mg/kg | -- | |
| | | | | SAa | Skin surface area for contact -adult | 6,032 | $cm^2$ | USEPA, 2014a (USEPA, 2011; Tables 7-12 and 7-13; weighted average of mean values for head, hands, forearms, and lower legs (male and female, 21+years)) | Dermally Absorbed Dose (mg/kg-day) for carcinogens = (DA-event x EV x EFa x EDa x SAa) / (BWa x AT-C) + (DA-event x EV x EFc x EDc x SAc) / (BWc x AT-C) |
| | | | | SAc | Skin surface area for contact - child | 2,373 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Tables 7-2 and 7-8; weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, birth to < 6 years) (forearm and lower leg-specific data used when available, ratios for nearest available age group used elsewhere)). | Dermally Absorbed Dose (mg/kg-day) for noncarcinogens (adult) = (DA-eventa x EV x EFa x EDa x SAa) / (BWa x AT-Na) |
| | | | | AFa | Soil-to-skin adherence factor -adult | 0.07 | $mg/cm^2$-event | USEPA, 2014a (USEPA, 2004, Exhibit 3-5) | **Where:** |
| | | | | AFc | Soil-to-skin adherence factor - child | 0.2 | $mg/cm^2$-event | USEPA, 2014a (USEPA, 2004, Exhibit 3-5) | Absorbed Dose per Event (DA-event) ($mg/cm^2$-event) = CS x AFc x ABS x CF |
| | | | | ABS | Soil Absorption Factor | Chemical-specific | unitless | USEPA, 2004 (Exhibit 3-4) | |
| | | | | EV | Event Frequency | 1 | events/day | USEPA, 2004 | |
| | | | | EFa | Exposure Frequency - adult | 176 [(2)] | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | Dermally Absorbed Dose (mg/kg-day) for noncarcinogens (child) = (DA-eventc x EV x EFc x EDc x SAc) / (BWc x AT-Nc) |
| | | | | EFc | Exposure Frequency - child | 176 [(2)] | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | |
| | | | | EDa | Exposure Duration - adult | 20 | years | USEPA, 2014a (Resident Exposure of 26 years (USEPA, 2011; Table 16-108; 90th percentile for current residence time) minus Resident Duration for child (6 years)). | **Where:** Absorbed Dose per Event (DA-event) ($mg/cm^2$-event) = CS x AFc x ABS x CF |
| | | | | EDc | Exposure Duration - child | 6 | years | USEPA, 2014a (USEPA, 1991) | |

**Table F-1 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations, Incidental Ingestion and Dermal Contact with Soil**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Current/Future |
| Medium: | Soil |
| Exposure Medium: | Surface and Subsurface Soil |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| | Recreational Users | Adult/Child | Surface Soil and Surface/Subsurface Soil [1] | $ED_{6-16}$ | Exposure Duration, 6-16 years | 10 | years | USEPA, 2005. Mutagenic calculations. | **Mutagenic Constituents** |
| | | | | $ADAF_{6-16}$ | Age depend. adjust. factor, 6-16 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $SA_{6-16}$ | Skin surface area for contact, 6-16 years | 3,749 | $cm^2$ | USEPA 2011; Tables 7-2; weighted average of mean values for head, hands, forearms, and lower legs (male and female, 6 to <16 years). | Dermally Absorbed Dose (mg/kg-day) for mutagenic carcinogens (adult) = |
| | | | | $ED_{16-26}$ | Exposure Duration, 16-26 years | 10 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{16-26}$ | Age depend. adjust. factor, 16-26 years | 1 | unitless | USEPA, 2005. Mutagenic calculations. | [(DA-event x EV x EFa x $ED_{6-16}$ x $ADAF_{6-16}$ x $SA_{6-16}$) + (DA-event x EV x EFa x $ED_{16-26}$ x $ADAF_{16-26}$ x $SA_{16-26}$)] / (BWa x AT-C) |
| | | | | $SA_{16-26}$ | Skin surface area for contact , 16-26 years | 6,032 | $cm^2$ | USEPA, 2014a (USEPA, 2011; Tables 7-12 and 7-13; weighted average of mean values for head, hands, forearms, and lower legs (male and female, 21+years)) | |
| | | | | $ED_{0-2}$ | Exposure Duration. 0-2 years | 2 | years | USEPA, 2005. Mutagenic calculations. | **Where:** |
| | | | | $ADAF_{0-2}$ | Age depend. adjust. factor, 0-2 years | 10 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $SA_{0-2}$ | Skin surface area for contact, 0-2 years | 1,741 | $cm^2$ | USEPA, 2011; Tables 7-2; Weighted average of mean values for head, hands, forearms, and lower legs (male and female, birth to <2 years). | Absorbed Dose per Event (DA-event) ($mg/cm^2$-event) = CS x AFa x ABS x CF |
| | | | | $ED_{2-6}$ | Exposure Duration, 2-6 years | 4 | years | USEPA, 2005. Mutagenic calculations. | Dermally Absorbed Dose (mg/kg-day) for mutagenic carcinogens (child) = |
| | | | | $ADAF_{2-6}$ | Age depend. adjust. factor, 2-6 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $SA_{2-6}$ | Skin surface area for contact, 2-6 years | 2,373 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Tables 7-2 and 7-8; weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, birth to < 6 years) (forearm and lower leg-specific data used when available, ratios for nearest available age group used elsewhere)). | [(DA-event x EV x EFc x $ED_{0-2}$ x $ADAF_{0-2}$ x $SA_{0-2}$) + (DA-event x EV x EFc x $ED_{2-6}$ x $ADAF_{2-6}$ x $SA_{2-6}$)] / (BWc x AT-C) |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | **Where:** |
| | | | | BWa | Body Weight - adult | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | Absorbed Dose per Event (DA-event) ($mg/cm^2$-event) = CS x AFc x ABS x CF |
| | | | | BWc | Body Weight -child | 15 | kg | USEPA, 2014a (USEPA, 2011; Table 8-1; weighted average of mean body weights (birth to <6 years)) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | Dermally Absorbed Dose (mg/kg-day) for mutagenic carcinogens = [DAD (adult) + DAD (child)] |
| | | | | AT-Na | Averaging Time, noncarcinogens (Adult) | 7,300 | days | EDa x 365 days/year | |
| | | | | AT-Nc | Averaging Time, noncarcinogens (Child) | 2,190 | days | $ED_c$ x 365 days/year | |

Notes:

(1) Assumes a future excavation re-deposits mixed surface/subsurface soil as surface soil.

(2) Potentially to be revised based on site specific information.

References:


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USEPA, 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum, EPA, Washington, DC. 20460, EPA/630/R-03/003F. March.

USEPA, 2011. Exposure Factors Handbook: 2011 Edition. EPA/ 600/ R-090/052F, September 2011.

USEPA, 2014a and 2015. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February. Amended September 14, 2015.

**Table F-2 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Current/Future |
| Medium: | Soil |
| Exposure Medium: | Air |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| Inhalation | Outdoor Maintenance Worker | Adult | Particulates from Surface Soil and Surface/Subsurface Soil [1] and Vapors from Soil | ECcancer | Exposure concentration for estimating cancer risk | Calculated | µg/m$^3$ | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | ECnoncancer | Exposure concentration (chronic exposure) for estimating non-cancer HQ | Calculated | µg/m$^3$ | -- | ECcancer = (CA x ET x EF x ED) / AT-C<br>ECnoncancer = (CA x ET x EF x ED) / AT-N |
| | | | | CA | Exposure Point Concentration - Air | Modeled from soil | ug/m$^3$ | See Intake Equations | |
| | | | | CS | Exposure Point Concentration - Soil | Based on soil sampling data | mg/kg | -- | |
| | | | | PEF | Particulate Emission Factor | Site-specific | m$^3$/kg | USEPA, 2002 | **Where:** |
| | | | | VF | Volatilization Factor | Chemical-specific | m$^3$/kg | USEPA, 2002 | CA = (CS / PEF) x CF (particulates) |
| | | | | ET | Exposure Time | 8 | hour/day | USEPA, 2014a (Work day - assumed to be 8 hour day) | CA = (CS / VF) x CF (vapors) |
| | | | | EF | Exposure Frequency | 40 | days/year | Site-specific assumption (biweekly from November through March (winter months); weekly from April through October (non-winter months) | |
| | | | | ED | Exposure Duration | 25 | years | USEPA, 2014a (USEPA 1991) | |
| | | | | CF | Conversion Factor | 1000 | ug/mg | -- | |
| | | | | AT-C | Averaging Time, carcinogens | 613,200 | hours | 70 [lifetime in years] x 365 day/year x 24 hours/day | |
| | | | | AT-N | Averaging Time, noncarcinogens | 219,000 | hours | ED x 365 day/year x 24 hours/day | |
| | Recreational Users | Adult/Child | Particulates from Surface Soil and Surface/Subsurface Soil [1] and Vapors from Soil | ECcancer | Exposure concentration for estimating cancer risk | Calculated | µg/m$^3$ | -- | **Non-Mutagenic Constituents** |
| | | | | ECnoncancer | Exposure concentration (chronic exposure) for estimating non-cancer HQ | Calculated | µg/m$^3$ | -- | ECcancer = (CA x ET x EF x EDr) / AT-C<br>ECnoncancer (adult) = (CA x ET x EF x EDa) / AT-Na<br>ECnoncancer (child) = (CA x ET x EF x EDc) / AT-Nc |
| | | | | CA | Exposure Point Concentration - Air | Modeled from soil | µg/m$^3$ | See Intake Equations | |
| | | | | CS | Exposure Point Concentration - Soil | Based on soil sampling data | mg/kg | -- | |
| | | | | PEF | Particulate Emission Factor | Site-specific | m$^3$/kg | USEPA, 2002 | **Where:** |
| | | | | VF | Volatilization Factor | Chemical-specific | m$^3$/kg | USEPA, 2002 | CA = (CS / PEF) x CF (particulates)<br>CA = (CS / VF) x CF (vapors) |
| | | | | ET | Exposure Time | 3 | hour/day | USEPA, 2011; Table 16-26; mean value for time spent for doing outdoor recreational activities in the Northeast Region of US. | |
| | | | | EF | Exposure Frequency | 176 [(2)] | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | |
| | | | | EDa | Exposure Duration - adult | 20 | years | USEPA, 2014a (Resident Exposure of 26 years (USEPA, 2011; Table 16-108; 90th percentile for current residence time) minus Resident Duration for child (6 years)). | |
| | | | | EDc | Exposure Duration - child | 6 | years | USEPA, 2014a (USEPA, 1991) | |
| | | | | $ED_{6-16}$ | Exposure Duration, 6-16 years | 10 | years | USEPA, 2005. Mutagenic calculations. | **Mutagenic Constituents** |
| | | | | $ADAF_{6-16}$ | Age depend. adjust. factor, 6-16 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ED_{16-26}$ | Exposure Duration, 16-26 years | 10 | years | USEPA, 2005. Mutagenic calculations. | ECcancer (adult) = [(CA x ET x EF x $ED_{6-16}$ x $ADAF_{6-16}$) + (CA x ET x EF x $ED_{16-26}$ x $ADAF_{16-26}$)] / AT-C |
| | | | | $ADAF_{16-26}$ | Age depend. adjust. factor, 16-26 years | 1 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ED_{0-2}$ | Exposure Duration. 0-2 years | 2 | years | USEPA, 2005. Mutagenic calculations. | ECcancer (child) = [(CA x ET x EF x $ED_{0-2}$ x $ADAF_{0-2}$) + (CA x ET x EF x $ED_{2-6}$ x $ADAF_{2-6}$)] / AT-C |
| | | | | $ADAF_{0-2}$ | Age depend. adjust. factor, 0-2 years | 10 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ED_{2-6}$ | Exposure Duration, 2-6 years | 4 | years | USEPA, 2005. Mutagenic calculations. | |

**Table F-2 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Current/Future |
| Medium: | Soil |
| Exposure Medium: | Air |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| | Recreational Users | Adult/Child | Particulates from Surface Soil and Surface/Subsurface Soil [1] and Vapors from Soil | $ADAF_{2-6}$ | Age depend. adjust. factor, 2-6 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | **Where:** |
| | | | | EDr | Exposure Duration - resident (adult/child) | 26 | years | USEPA, 2014a (USEPA 2011, Table 16-108; 90th percentile for current residence time). | CA = (CS / PEF) x CF (particulates)<br>CA = (CS / VF) x CF (vapors) |
| | | | | CF | Conversion Factor | 1000 | µg/mg | -- | |
| | | | | AT-C | Averaging Time, carcinogens | 613,200 | hours | 70 [lifetime in years] x 365 day/year x 24 hours/day | Mutagenic ECcancer = [ECcancer (adult) + ECcancer (child)] |
| | | | | AT-Na | Averaging Time, noncarcinogens (Adult) | 175,200 | hours | EDa x 365 day/year x 24 hours/day | |
| | | | | AT-Nc | Averaging Time, noncarcinogens (Child) | 52,560 | hours | $ED_c$ x 365 day/year x 24 hours/day | |

Notes:

(1) Assumes a future excavation re-deposits mixed surface/subsurface soil as surface soil.

(2) Potentially to be revised based on site specific information.

References:

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors". June 1991.

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USEPA, 2011. Exposure Factors Handbook: 2011 Edition. EPA/ 600/ R-090/052F, September 2011.

USEPA, 2014a. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February.

**Table F-3 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Current/Future |
| Medium: | Sediment |
| Exposure Medium: | Sediment |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| Incidental Ingestion | Outdoor Maintenance Worker | Adult | Sediment | DI | Daily Intake | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CSD | Exposure Point Concentration in Sediment | Based on sediment sampling data | mg/kg | -- | Daily Intake (mg/kg-day) for carcinogens = (CSD x IRsediment x FI x EF x ED x CF) / (BW x AT-C) |
| | | | | IRsediment | Ingestion Rate, sediment | 100 | mg/day | USEPA, 2014a (USEPA, 1991; same as adult resident soil ingestion rate) | |
| | | | | FI | Fraction Ingested from Source | 1 | unitless | USEPA, 1989 (all of the sediment contacted is presumed to be contaminated) | |
| | | | | EF | Exposure Frequency | 40 | days/year | Site-specific assumption (biweekly from November through March (winter months); weekly from April through October (non-winter months) | Daily Intake (mg/kg-day) for noncarcinogens = (CSD x IRsediment x FI x EF x ED x CF) / (BW x AT-N) |
| | | | | ED | Exposure Duration | 25 | years | USEPA, 2014a (USEPA 1991) | |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 9,125 | days | ED x 365 days/year | |
| | Recreational Users | Adult/Child | Sediment | DI | Daily Intake | Calculated | mg/kg-day | -- | **Non-Mutagenic Constituents** |
| | | | | CSD | Exposure Point Concentration in Sediment | Based on sediment sampling data | mg/kg | -- | Daily Intake (mg/kg-day) for carcinogens = (CSD x IRsedimenta x FI x EFa x EDa x CF) / (BWa x AT-C) + (CSD x IRsedimentc x FI x EFc x EDc x CF) / (BWc x AT-C) |
| | | | | IRsedimenta | Ingestion Rate, sediment - adult | 100 | mg/day | USEPA, 2014a (USEPA, 1991; assumed same as soil) | |
| | | | | IRsedimentc | Ingestion Rate, sediment - child | 200 | mg/day | USEPA, 2014a (USEPA, 2011; Table 5-1; "upper-bound values" accounting for both soil and dust ingestion) (Assumed same as soil) | Daily Intake (mg/kg-day) for noncarcinogens (adult) = (CSD x IRsedimenta x FI x EFa x EDa x CF) / (BWa x AT-Na) |
| | | | | FI | Fraction Ingested from Source | 1 | unitless | USEPA, 1989 (all of the sediment contacted is presumed to be contaminated) | |
| | | | | EFa | Exposure Frequency - adult | 176 (1) | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | Daily Intake (mg/kg-day) for noncarcinogens (child) = (CSD x IRsedimentc x FI x EFc x EDc x CF) / (BWc x AT-Nc) |
| | | | | EFc | Exposure Frequency - child | 176 (1) | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | |
| | | | | EDa | Exposure Duration - adult | 20 | years | USEPA, 2014a (Resident Exposure of 26 years (USEPA, 2011; Table 16-108; 90th percentile for current residence time) minus Resident Duration for child (6 years)). | |
| | | | | $ED_{6-16}$ | Exposure Duration, 6-16 years | 10 | years | USEPA, 2005. Mutagenic calculations. | **Mutagenic Constituents** |
| | | | | $ADAF_{6-16}$ | Age depend. adjust. factor, 6-16 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | Daily Intake (mg/kg-day) for mutagenic carcinogens (adult) = [(CSD x IRsedimenta x FI x EFa x $ED_{6-16}$ x $ADAF_{6-16}$ x CF) + (CSD x IRsedimenta x FI x EFa x $ED_{16-26}$ x $ADAF_{16-26}$ x CF)] / (BWa x AT-C) |
| | | | | $ED_{16-26}$ | Exposure Duration, 16-26 years | 10 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{16-26}$ | Age depend. adjust. factor, 16-26 years | 1 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | EDc | Exposure Duration - child | 6 | years | USEPA, 2014a (USEPA, 1991) | |
| | | | | $ED_{0-2}$ | Exposure Duration. 0-2 years | 2 | years | USEPA, 2005. Mutagenic calculations. | Daily Intake (mg/kg-day) for mutagenic carcinogens (child) = [(CSD x IRsedimentc x FI x EFc x $ED_{0-2}$ x $ADAF_{0-2}$ x CF) + (CSD x IRsedimentc x FI x EFc x $ED_{2-6}$ x $ADAF_{2-6}$ x CF)] / (BWc x AT-C) |
| | | | | $ADAF_{0-2}$ | Age depend. adjust. factor, 0-2 years | 10 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ED_{2-6}$ | Exposure Duration, 2-6 years | 4 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{2-6}$ | Age depend. adjust. factor, 2-6 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | **Where:** |
| | | | | BWa | Body Weight - adult | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | Daily Intake for mutagenic carcinogens (mg/kg-day) = DI (adult) + DI (child) |
| | | | | BWc | Body Weight -child | 15 | kg | USEPA, 2014a (USEPA, 2011; Table 8-1; weighted average of mean body weights (birth to <6 years)) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-Na | Averaging Time, noncarcinogens (Adult) | 7,300 | days | EDa x 365 days/year | |
| | | | | AT-Nc | Averaging Time, noncarcinogens (Child) | 2,190 | days | EDc x 365 days/year | |

**Table F-3 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Current/Future |
| Medium: | Sediment |
| Exposure Medium: | Sediment |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| Dermal | Outdoor Maintenance Worker | Adult | Sediment | DAD | Dermally Absorbed Dose | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CSD | Exposure Point Concentration in Sediment | Based on sediment sampling data | mg/kg | -- | Dermally Absorbed Dose (DAD) (mg/kg-day) for carcinogens = (DA-event x EV x EF x ED x SA) / (BW x AT-C) |
| | | | | SA | Skin surface area for contact | 3,527 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Tables 7-12 and 7-13; Weighted average of mean values for head, hands, and forearms (male and female, 21+years)) | |
| | | | | AF | Sediment-to-skin adherence factor | 0.12 | $mg/cm^2$-event | USEPA, 2014a (USEPA, 2011; Table 7-20 and Section 7.2.2; arithmetic mean of weighted average of body part-specific (hands, forearms, and face) mean adherence factors for adult commercial/industrial activities) | Dermally Absorbed Dose (DAD) (mg/kg-day) for carcinogens = (DA-event x EV x EF x ED x SA) / (BW x AT-N) |
| | | | | ABS | Sediment Absorption Factor | Chemical-specific | unitless | USEPA, 2004 (Exhibit 3-4) | |
| | | | | EV | Event Frequency | 1 | events/day | USEPA, 2004 | **Where:** |
| | | | | EF | Exposure Frequency | 40 | days/year | Site-specific assumption (biweekly from November through March (winter months); weekly from April through October (non-winter months) | Absorbed Dose per Event (DA-event) (mg/cm2-event) = CSD x AF x ABS x CF |
| | | | | ED | Exposure Duration | 25 | years | USEPA, 2014a (USEPA 1991) | |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 9,125 | days | ED x 365 days/year | |
| | Recreational Users | Adult/Child | Sediment | DAD | Dermally Absorbed Dose | Calculated | mg/kg-day | -- | **Non-Mutagenic Constituents** |
| | | | | CSD | Exposure Point Concentration in Sediment | Based on sediment sampling data | mg/kg | -- | Dermally Absorbed Dose (DAD) (mg/kg-day) for carcinogens = (DA-event x EV x EFa x EDa x SAa) / (BWa x AT-C) + (DA-event x EV x EFc x EDc x SAc) / (BWc x AT-C) |
| | | | | SAa | Skin surface area for contact -adult | 6,032 | $cm^2$ | USEPA, 2014a (USEPA, 2011; Tables 7-12 and 7-13; weighted average of mean values for head, hands, forearms, and lower legs (male and female, 21+years)) | |
| | | | | SAc | Skin surface area for contact - child | 2,373 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Tables 7-2 and 7-8; weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, birth to < 6 years) (forearm and lower leg-specific data used when available, ratios for nearest available age group used elsewhere)). | Dermally Absorbed Dose (DAD) (mg/kg-day) for noncarcinogens (adult) = (DA-eventa x EV x EFa x EDa x SAa) / (BWa x AT-Na) |
| | | | | AFa | Sediment-to-skin adherence factor -adult | 0.07 | $mg/cm^2$-event | USEPA, 2014a (USEPA, 2004) (Assumed same as soil) | Where: Absorbed Dose per Event (DA-eventa) (mg/cm2-event) for adult = CSD x AFa x ABS x CF |
| | | | | AFc | Sediment-to-skin adherence factor - child | 0.2 | $mg/cm^2$-event | USEPA, 2014a (USEPA, 2004) (Assumed same as soil) | |
| | | | | ABS | Sediment Absorption Factor | Chemical-specific | unitless | USEPA, 2004 (Exhibit 3-4) | Dermally Absorbed Dose (DAD) (mg/kg-day) for noncarcinogens (child) = (DA-eventc x EV x EFc x EDc x SAc) / (BWc x AT-Nc) |
| | | | | EV | Event Frequency | 1 | events/day | USEPA, 2014a (USEPA, 2004, Exhibit 3-5) - assumed same as soil | |
| | | | | EFa | Exposure Frequency - adult | 176 (1) | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | Where: Absorbed Dose per Event (DA-eventc) (mg/cm2-event) for child = CSD x AFc x ABS x CF |
| | | | | EFc | Exposure Frequency - child | 176 (1) | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | |
| | | | | EDa | Exposure Duration - adult | 20 | years | USEPA, 2014a (Resident Exposure of 26 years (USEPA, 2011; Table 16-108; 90th percentile for current residence time) minus Resident Duration for child (6 years)). | |
| | | | | EDc | Exposure Duration - child | 6 | years | USEPA, 2014a (USEPA, 1991) | |

**Table F-3 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Current/Future |
| Medium: | Sediment |
| Exposure Medium: | Sediment |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| | Recreational Users | Adult/Child | Sediment | $ED_{6-16}$ | Exposure Duration, 6-16 years | 10 | years | USEPA, 2005. Mutagenic calculations. | **Mutagenic Constituents** |
| | | | | $ADAF_{6-16}$ | Age depend. adjust. factor, 6-16 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | Dermally Absorbed Dose (mg/kg-day) for mutagenic carcinogens (adult) = |
| | | | | $SA_{6-16}$ | Skin surface area for contact, 6-16 years | 3,749 | $cm^2$ | USEPA 2011; Tables 7-2; weighted average of mean values for head, hands, forearms, and lower legs (male and female, 6 to <16 years). | [(DA-event x EV x EFa x $ED_{6-16}$ x $ADAF_{6-16}$ x $SA_{6-16}$) + (DA-event x EV x EFa x $ED_{16-26}$ x $ADAF_{16-26}$ x $SA_{16-26}$)] / (BWa x AT-C) |
| | | | | $ED_{16-26}$ | Exposure Duration, 16-26 years | 10 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{16-26}$ | Age depend. adjust. factor, 16-26 years | 1 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $SA_{16-26}$ | Skin surface area for contact , 16-26 years | 6,032 | $cm^2$ | USEPA, 2014a (USEPA, 2011; Tables 7-12 and 7-13; weighted average of mean values for head, hands, forearms, and lower legs (male and female, 21+years)) | **Where:**<br>Absorbed Dose per Event (DA-event) ($mg/cm^2$-event) for adult =<br>CSD x AFa x ABS x CF |
| | | | | $ED_{0-2}$ | Exposure Duration. 0-2 years | 2 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{0-2}$ | Age depend. adjust. factor, 0-2 years | 10 | unitless | USEPA, 2005. Mutagenic calculations. | Dermally Absorbed Dose (mg/kg-day) for mutagenic carcinogens (child) = |
| | | | | $SA_{0-2}$ | Skin surface area for contact, 0-2 years | 1,741 | $cm^2$ | USEPA, 2011; Tables 7-2; Weighted average of mean values for head, hands, forearms, and lower legs (male and female, birth to <2 years). | [(DA-event x EV x EFc x $ED_{0-2}$ x $ADAF_{0-2}$ x $SA_{0-2}$) + (DA-event x EV x EFc x $ED_{2-6}$ x $ADAF_{2-6}$ x $SA_{2-6}$)] / (BWc x AT-C) |
| | | | | $ED_{2-6}$ | Exposure Duration, 2-6 years | 4 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{2-6}$ | Age depend. adjust. factor, 2-6 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $SA_{2-6}$ | Skin surface area for contact, 2-6 years | 2,373 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Tables 7-2 and 7-8; weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, birth to < 6 years) (forearm and lower leg-specific data used when available, ratios for nearest available age group used elsewhere)). | **Where:**<br>Absorbed Dose per Event (DA-event) ($mg/cm^2$-event) for child =<br>CSD x AFc x ABS x CF |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | |
| | | | | BWa | Body Weight - adult | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | Dermally Absorbed Dose (mg/kg-day) for mutagenic carcinogens = [DAD (adult) + DAD (child)] |
| | | | | BWc | Body Weight -child | 15 | kg | USEPA, 2014a (USEPA, 2011; Table 8-1; weighted average of mean body weights (birth to <6 years)) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-Na | Averaging Time, noncarcinogens (Adult) | 7,300 | days | EDa x 365 days/year | |
| | | | | AT-Nc | Averaging Time, noncarcinogens (Child) | 2,190 | days | $ED_c$ x 365 days/year | |

Notes:
(1) Potentially to be revised based on site specific information.

References:

USEPA, 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540?1-89/002. December.
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors". June 1991.
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USEPA, 2014a and 2015. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February. Amended September 14, 2015.

**Table F-4 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Current/Future |
| Medium: | Surface Water |
| Exposure Medium: | Surface Water |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| Incidental Ingestion | Outdoor Maintenance Worker | Adult | Surface Water | DI | Daily Intake | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CSW | Exposure Point Concentration - Surface Water | Based on surface water sampling data | mg/L | -- | |
| | | | | IRSW | Ingestion Rate, surface water | 0.02 | L/day | Ingestion rate of 0.005 L/hr during wading (VDEQ, 2014) and assumes 4 hours/day exposure to surface water. | Daily Intake (mg/kg-day) for carcinogens = (CSW x IRSW x EF x ED) / (BW x AT-C) |
| | | | | EF | Exposure Frequency | 40 | days/year | Site-specific assumption (biweekly from November through March (winter months); weekly from April through October (non-winter months) | Daily Intake (mg/kg-day) for noncarcinogen = (CSW x IRSW x EF x ED) / (BW x AT-N) |
| | | | | ED | Exposure Duration | 25 | years | USEPA, 2014a (USEPA 1991) | |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 9,125 | days | ED x 365 days/year | |
| | Recreational Users | Adult/Child | Surface Water | DI | Daily Intake | Calculated | mg/kg-day | -- | **Non-Mutagenic Constituents** |
| | | | | CSW | Exposure Point Concentration - Surface Water | Based on surface water sampling data | mg/L | -- | Daily Intake (mg/kg-day) for carcinogens = (CSW x IRSWa x EFa x EDa) / (BWa x AT-C) + (CSW x IRSWc x EFc x EDc) / (BWc x AT-C) |
| | | | | IRSWa | Ingestion Rate, surface water - adult | 0.015 | L/day | Ingestion rate of 0.005 L/hr during wading (VDEQ, 2014) and assumes 3 hours/day exposure to surface water (USEPA, 2011; Table 16-26). | |
| | | | | IRSWc | Ingestion Rate, surface water - child | 0.015 | L/day | | Daily Intake (mg/kg-day) for noncarcinogens (adult) = (CSW x IRSWa x EFa x EDa) / (BWa x AT-Na) |
| | | | | EFa | Exposure Frequency - adult | 176 (1) | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | |
| | | | | EFc | Exposure Frequency - child | 176 (1) | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | Daily Intake (mg/kg-day) for noncarcinogens (child) = (CSW x IRSWc x EFc x EDc) / (BWc x AT-Nc) |
| | | | | EDa | Exposure Duration -adult | 20 | years | USEPA, 2014a (Resident Exposure of 26 years (USEPA, 2011; Table 16-108; 90th percentile for current residence time) minus Resident Duration for child (6 years)). | |
| | | | | $ED_{6-16}$ | Exposure Duration, 6-16 years | 10 | years | USEPA, 2005. Mutagenic calculations. | **Mutagenic Constituents** |
| | | | | $ADAF_{6-16}$ | Age depend. adjust. factor, 6-16 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ED_{16-26}$ | Exposure Duration, 16-26 years | 10 | years | USEPA, 2005. Mutagenic calculations. | Daily Intake (mg/kg-day) for mutagenic carcinogens (adult) = ((CSW x IRSWa x EFa x $ED_{6-16}$ x $ADAF_{6-16}$) + (CSW x IRSWa x EFa x $ED_{16-26}$ x $ADAF_{16-26}$)) / (BWa x AT-C) |
| | | | | $ADAF_{16-26}$ | Age depend. adjust. factor, 16-26 years | 1 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | EDc | Exposure Duration - child | 6 | years | USEPA, 2014a (USEPA, 1991) | |
| | | | | $ED_{0-2}$ | Exposure Duration. 0-2 years | 2 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{0-2}$ | Age depend. adjust. factor, 0-2 years | 10 | unitless | USEPA, 2005. Mutagenic calculations. | Daily Intake (mg/kg-day) for mutagenic carcinogens (child) = ((CSW x IRSWc x EFc x $ED_{0-2}$ x $ADAF_{0-2}$) + (CSW x IRSWc x EFc x $ED_{2-6}$ x $ADAF_{2-6}$) / (BWc x AT-C) |
| | | | | $ED_{2-6}$ | Exposure Duration, 2-6 years | 4 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{2-6}$ | Age depend. adjust. factor, 2-6 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | BWa | Body Weight - adult | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | Where: |
| | | | | BWc | Body Weight - child | 15 | kg | USEPA, 2014a (USEPA, 2011; Table 8-1; weighted average of mean body weights (birth to <6 years)) | Daily Intake for mutagenic carcinogens (mg/kg-day) = DI (adult) + DI (child) |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-Na | Averaging Time, noncarcinogens (Adult) | 7,300 | days | EDa x 365 days/year | |
| | | | | AT-Nc | Averaging Time, noncarcinogens (Child) | 2,190 | days | EDc x 365 day/year | |
| Dermal | Outdoor Maintenance Worker | Adult | Surface Water | DAD | Dermally Absorbed Dose | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CSW | Exposure Point Concentration - Surface Water | Based on surface water sampling data | mg/L | -- | Dermally Absorbed Dose (mg/kg-day) for carcinogens = (DA-event x EV x EF x ED x SA) / (BW x AT-C) |
| | | | | FA | Fraction Absorbed Water | Chemical-specific | unitless | USEPA, 2004 | |
| | | | | Kp | Dermal Permeability Coefficient | Chemical-specific | cm/hr | USEPA, 2004 | |
| | | | | SA | Body Area Available for Contact | 3,527 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Tables 7-12 and 7-13; Weighted average of mean values for head, hands, and forearms (male and female, 21+years)). Assume receptor is wearing water-proof work boots. | Dermally Absorbed Dose (mg/kg-day) for noncarcinogens = (DA-event x EV x EF x ED x SA) / (BW x AT-N) |
| | | | | tau-event | Lag Time per Event | Chemical-specific | hours/event | USEPA, 2004 | **Where:** |
| | | | | t-event | Event Duration | 4 | hours/event | Assumes 4 hrs/day exposure to surface water | For organic compounds in which t-event is less than or equal to t-tau: |
| | | | | B | Ratio of Kp of a Compound through the Stratum Corneum Relative to Its Kp across the Viable Epidermis | Chemical-specific | unitless | USEPA, 2004 | DA-event (Absorbed Dose per Event [mg/$cm^2$-event] ) = 2 x FA x Kp x CSW x CF x SQRT([6 x tau-event x t-event] / π) |

**Table F-4 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Current/Future |
| Medium: | Surface Water |
| Exposure Medium: | Surface Water |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| | | | | EV | Event Frequency | 1 | event/day | USEPA, 2004 | |
| | | | | EF | Exposure Frequency | 40 | days/year | Site-specific assumption (biweekly from November through March (winter months); weekly from April through October (non-winter months) | For organics where t-event is greater than t-tau:<br>DA-event = FA x Kp x CSW x CF x {[t-event/(1+B)] + 2 x tau-event x [ (1 + 3B + 3B $^2$) / (1 + B)$^2$ ] } |
| | | | | ED | Exposure Duration | 25 | years | USEPA, 2014a (USEPA 1991) | |
| | | | | CF | Conversion Factor | 0.001 | L/cm$^3$ | -- | For inorganic compounds,<br>DA-event = Kp x CSW x CF x t-event |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 9,125 | days | ED x 365 days/year | |
| | Recreational Users | Adult/Child | Surface Water | DAD | Dermally Absorbed Dose | Calculated | mg/kg-day | -- | **Non-Mutagenic Constituents** |
| | | | | CSW | Exposure Point Concentration - Surface Water | Based on surface water sampling data | mg/L | -- | Dermally Absorbed Dose (mg/kg-day) for carcinogens =<br>(DA-eventa x EV x EFa x EDa x SAa) / (BWa x AT-C) +<br>(DA-eventc x EV x EFc x EDc x SAc) / (BWc x AT-C) |
| | | | | FA | Fraction Absorbed Water | Chemical-specific | unitless | USEPA, 2004 | |
| | | | | Kp | Dermal Permeability Coefficient | Chemical-specific | cm/hr | USEPA, 2004 | Dermally Absorbed Dose (mg/kg-day) for noncarcinogens (adult) =<br>(DA-eventa x EV x EFa x EDa x SAa) / (BWa x AT-Na) |
| | | | | SAa | Body Area Available for Contact -adult | 7,327 | cm$^2$ | USEPA, 2011; Table 7-2; weighted average of mean values for head, hands, forearms, legs, and feet (male and female, 21+years) | |
| | | | | SAc | Body Area Available for Contact - child | 2,583 | cm$^2$ | USEPA, 2011; Table 7-2; weighted average of mean values for head, hands, arms, legs, and feet (male and female, 2 to <6 years). | Dermally Absorbed Dose (mg/kg-day) for noncarcinogens (child) =<br>(DA-eventc x EV x EFc x EDc x SAc) / (BWc x AT-Nc) |
| | | | | tau-event | Lag Time per Event | Chemical-specific | hours/event | USEPA, 2004 | |
| | | | | t-eventa | Event Duration - adult | 3 | hours/event | USEPA, 2011; Table 16-26; mean value for time spent for doing outdoor recreational activities in the Northeast Region of US. | **Where:** |
| | | | | t-eventc | Event Duration - child | 3 | hours/event | | For organic compounds in which t-event is less than or equal to t-tau: |
| | | | | B | Ratio of Kp of a Compound through the Stratum Corneum Relative to Its Kp across the Viable Epidermis | Chemical-specific | unitless | USEPA, 2004 | DA-event (Absorbed Dose per Event [mg/cm$^2$-event] ) =<br>2 x FA x Kp x CSW x CF x SQRT([6 x tau-event x t-event] / π) |
| | | | | EV | Event Frequency | 1 | event/day | USEPA, 2004 | |
| | | | | EFa | Exposure Frequency - adult | 176 (1) | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | For organics where t-event is greater than t-tau: |
| | | | | EFc | Exposure Frequency - child | 176 (1) | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | DA-event = FA x Kp x CSW x CF x {[t-event/(1+B)] + 2 x tau-event x [ (1 + 3B + 3B $^2$) / (1 + B)$^2$ ] } |
| | | | | EDa | Exposure Duration - adult | 20 | years | USEPA, 2014a (Resident Exposure of 26 years (USEPA, 2011; Table 16-108; 90th percentile for current residence time) minus Resident Duration for child (6 years)). | For inorganic compounds,<br>DA-event = Kp x CSW x CF x t-event |
| | | | | EDc | Exposure Duration - child | 6 | years | USEPA, 2014a (USEPA, 1991) | |
| | | | | $ED_{6-16}$ | Exposure Duration, 6-16 years | 10 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{6-16}$ | Age depend. adjust. factor, 6-16 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | **Mutagenic Constituents** |
| | | | | $SA_{6-16}$ | Skin surface area for contact, 6-16 years | 4,639 | cm$^2$ | USEPA, 2011; Tables 7-2; weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, 6 to <16 years). | Dermally Absorbed Dose (DAD) (mg/kg/day) for mutagenic carcinogens (adult) = |
| | | | | $ED_{16-26}$ | Exposure Duration, 16-26 years | 10 | years | USEPA, 2005. Mutagenic calculations. | [(DA-event x EV x EFa x $SA_{6-16}$ x $ED_{6-16}$ x $ADAF_{6-16}$) + (DA-event x EV x EFa x $SA_{16-26}$ x $ED_{16-26}$ x $ADAF_{16-26}$)] / (BWa x AT-C) |
| | | | | $ADAF_{16-26}$ | Age depend. adjust. factor, 16-26 years | 1 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $SA_{16-26}$ | Skin surface area for contact , 16-26 years | 7,327 | cm$^2$ | USEPA, 2011; Table 7-2; weighted average of mean values for head, hands, forearms, legs, and feet (male and female, 21+years) | Dermally Absorbed Dose (DAD) (mg/kg/day) for mutagenic carcinogens (child) = |
| | | | | $ED_{0-2}$ | Exposure Duration. 0-2 years | 2 | years | USEPA, 2005. Mutagenic calculations. | [(DA-event x EV x EFc x $SA_{0-2}$ x $ED_{0-2}$ x $ADAF_{0-2}$) + (DA-event x EV x EFc x $SA_{2-6}$ x $ED_{2-6}$ x $ADAF_{2-6}$)] / (BWc x AT-C) |
| | | | | $ADAF_{0-2}$ | Age depend. adjust. factor, 0-2 years | 10 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $SA_{0-2}$ | Skin surface area for contact, 0-2 years | 2,035 | cm$^2$ | USEPA, 2011; Table 7-2; weighted average of mean values for head, hands, forearms, legs, and feet (male and female, birth to <2 years). | **Where:** |
| | | | | $ED_{2-6}$ | Exposure Duration, 2-6 years | 4 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{2-6}$ | Age depend. adjust. factor, 2-6 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | DAD (mg/kg/day) for mutagenic carcinogens = [DAD (adult) + DAD (child)] |
| | | | | $SA_{2-6}$ | Skin surface area for contact, 2-6 years | 2,583 | cm$^2$ | USEPA, 2011; Table 7-2; weighted average of mean values for head, hands, arms, legs, and feet (male and female, 2 to <6 years). | |
| | | | | CF | Conversion Factor | 0.001 | L/cm$^3$ | -- | |
| | | | | BWa | Body Weight - adult | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |

**Table F-4 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Current/Future |
| Medium: | Surface Water |
| Exposure Medium: | Surface Water |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| | | | | BWc | Body Weight - child | 15 | kg | USEPA, 2014a (USEPA, 2011; Table 8-1; weighted average of mean body weights (birth to <6 years)) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-Na | Averaging Time, noncarcinogens (Adult) | 7,300 | days | EDa x 365 days/year | |
| | | | | AT-Nc | Averaging Time, noncarcinogens (Child) | 2,190 | days | EDc x 365 day/year | |

Notes:
(1) Potentially to be revised based on site specific information.

References:

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**Table F-5 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Future |
| Medium: | Soil |
| Exposure Medium: | Surface and Subsurface Soil |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| Incidental Ingestion | Outdoor Workers | Adult | Surface Soil and Surface/Subsurface Soil [1] | DI | Daily Intake | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CS | Exposure Point Concentration in Soil | Based on soil sampling data | mg/kg | -- | Daily Intake (mg/kg-day) for carcinogens = |
| | | | | IRsoil | Ingestion Rate, soil | 100 | mg/day | USEPA, 2014a (USEPA, 1991; same as adult resident) | (CS x IRsoil x FI x EF x ED x CF) / (BW x AT-C) |
| | | | | FI | Fraction Ingested from Source | 1 | unitless | USEPA, 1989 (all of the soil contacted is presumed to be contaminated) | |
| | | | | EF | Exposure Frequency | 225 | days/year | USEPA, 2014a (USEPA 1991) | Daily Intake (mg/kg-day) for noncarcinogens = |
| | | | | ED | Exposure Duration | 25 | years | USEPA, 2014a (USEPA 1991) | (CS x IRsoil x FI x EF x ED x CF) / (BW x AT-N) |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 9,125 | days | ED x 365 days/year | |
| | Construction Worker | Adult | Surface/Subsurface Soil | DI | Daily Intake | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CS | Exposure Point Concentration in Soil | Based on soil sampling data | mg/kg | -- | Daily Intake (mg/kg-day) for carcinogens = |
| | | | | IRsoil | Ingestion Rate, soil | 330 | mg/day | USEPA, 2002 | (CS x IRsoil x FI x EF x ED x CF) / (BW x AT-C) |
| | | | | FI | Fraction Ingested from Source | 1 | unitless | USEPA, 1989 (all of the soil contacted is presumed to be contaminated) | |
| | | | | EF | Exposure Frequency | 250 | days/year | USEPA, 2002 | Daily Intake (mg/kg-day) for noncarcinogens = |
| | | | | ED | Exposure Duration | 0.5 | years | Assumes construction for one-half year duration | (CS x IRsoil x FI x EF x ED x CF) / (BW x AT-N) |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 182.5 | days | ED x 365 days/year | |
| | On-site Residents | Adult/Child | Surface Soil and Surface/Subsurface Soil [1] | DI | Daily Intake | Calculated | mg/kg-day | -- | **Non-Mutagenic Constituents** |
| | | | | CS | Exposure Point Concentration in Soil | Based on soil sampling data | mg/kg | -- | Daily Intake (mg/kg-day) for carcinogens = |
| | | | | IRsoila | Ingestion Rate, soil - adult | 100 | mg/day | USEPA, 2014a (USEPA, 1991) | (CS x IRsoila x FI x EFa x EDa x CF) / (BWa x AT-C) + |
| | | | | IRsoilc | Ingestion Rate, soil - child | 200 | mg/day | USEPA, 2014a (USEPA, 2011; Table 5-1; "upper-bound values" accounting for both soil and dust ingestion) | (CS x IRsoilc x FI x EFc x EDc x CF) / (BWc x AT-C) |
| | | | | FI | Fraction Ingested from Source | 1 | unitless | USEPA, 1989 (all of the soil contacted is presumed to be contaminated) | Daily Intake (mg/kg-day) for noncarcinogens (adult) = (CS x IRsoila x FI x EFa x EDa x CF) / (BWa x AT-Na) |
| | | | | EFa | Exposure Frequency - adult | 350 | days/year | USEPA, 2014a (USEPA 1991) | |
| | | | | EFc | Exposure Frequency - child | 350 | days/year | USEPA, 2014a (USEPA 1991) | Daily Intake (mg/kg-day) for noncarcinogens (child) = (CS x IRsoilc x FI x EFc x EDc x CF) / (BWc x AT-Nc) |
| | | | | EDa | Exposure Duration - adult | 20 | years | USEPA, 2014a (Resident Exposure of 26 years (USEPA, 2011; Table 16-108; 90th percentile for current residence time) minus Resident Duration for child (6 years)). | |
| | | | | $ED_{6-16}$ | Exposure Duration, 6-16 years | 10 | years | USEPA, 2005. Mutagenic calculations. | **Mutagenic Constituents** |
| | | | | $ADAF_{6-16}$ | Age depend. adjust. factor, 6-16 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | Daily Intake (mg/kg-day) for mutagenic carcinogens (adult) = [(CS x IRsoila x FI x EFa x $ED_{6-16}$ x $ADAF_{6-16}$ x CF) + (CS x IRsoila x FI x EFa x $ED_{16-26}$ x $ADAF_{16-26}$ x CF)] / (BWa x AT-C) |
| | | | | $ED_{16-26}$ | Exposure Duration, 16-26 years | 10 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{16-26}$ | Age depend. adjust. factor, 16-26 years | 1 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | EDc | Exposure Duration - child | 6 | years | USEPA, 2014a (USEPA, 1991) | |
| | | | | $ED_{0-2}$ | Exposure Duration. 0-2 years | 2 | years | USEPA, 2005. Mutagenic calculations. | Daily Intake (mg/kg-day) for mutagenic carcinogens (child) = [(CS x IRsoilc x FI x EFc x $ED_{0-2}$ x $ADAF_{0-2}$ x CF) + (CS x IRsoilc x FI x EFc x $ED_{2-6}$ x $ADAF_{2-6}$ x CF)] / (BWc x AT-C) |
| | | | | $ADAF_{0-2}$ | Age depend. adjust. factor, 0-2 years | 10 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ED_{2-6}$ | Exposure Duration, 2-6 years | 4 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{2-6}$ | Age depend. adjust. factor, 2-6 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | |

**Table F-5 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Future |
| Medium: | Soil |
| Exposure Medium: | Surface and Subsurface Soil |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| | On-site Residents | Adult/Child | Surface Soil and Surface/Subsurface Soil [1] | BWa | Body Weight - adult | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | **Where:** |
| | | | | BWc | Body Weight -child | 15 | kg | USEPA, 2014a (USEPA, 2011; Table 8-1; weighted average of mean body weights (birth to <6 years)) | Daily Intake (DI) for mutagenic carcinogens (mg/kg-day) = [DI (adult) + DI (child)] |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-Na | Averaging Time, noncarcinogens (Adult) | 7,300 | days | EDa x 365 days/year | |
| | | | | AT-Nc | Averaging Time, noncarcinogens (Child) | 2,190 | days | $ED_c$ x 365 days/year | |
| Dermal | Outdoor Workers | Adult | Surface/Subsurface Soil [1] | DAD | Dermally Absorbed Dose | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CS | Exposure Point Concentration in Soil | Based on soil sampling data | mg/kg | -- | |
| | | | | SA | Skin surface area for contact | 3,527 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Tables 7-12 and 7-13; Weighted average of mean values for head, hands, and forearms (male and female, 21+years)) | Dermally Absorbed Dose (mg/kg-day) for carcinogens = (DA-event x EV x EF x ED x SA) / (BW x AT-C) |
| | | | | AF | Soil-to-skin adherence factor | 0.12 | $mg/cm^2$-event | USEPA, 2014a (USEPA, 2011; Table 7-20 and Section 7.2.2 arithmetic mean of weighted average of body parts-specific (hands, forearms, and face) mean adherence factors for adult commercial/industrial activities) | Dermally Absorbed Dose (mg/kg-day) for noncarcinogens = (DA-event x EV x EF x ED x SA) / (BW x AT-N) |
| | | | | ABS | Soil Absorption Factor | Chemical-specific | unitless | USEPA, 2004 (Exhibit 3-4) | **Where:** |
| | | | | EV | Event Frequency | 1 | events/day | USEPA, 2002 | Absorbed Dose per Event (DA-event) ($mg/cm^2$-event) = |
| | | | | EF | Exposure Frequency | 225 | days/year | USEPA, 2014a (USEPA 1991) | CS x AF x ABS x CF |
| | | | | ED | Exposure Duration | 25 | years | USEPA, 2014a (USEPA 1991) | |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 9125 | days | ED x 365 days/year | |
| | Construction Worker | Adult | Surface/Subsurface Soil | DAD | Dermally Absorbed Dose | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CS | Exposure Point Concentration in Soil | Based on soil sampling data | mg/kg | -- | |
| | | | | SA | Skin surface area for contact | 3,527 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Tables 7-12 and 7-13; Weighted average of mean values for head, hands, and forearms (male and female, 21+years)) | Dermally Absorbed Dose (mg/kg-day) for carcinogens = DA-event x EV x EF x ED x SA) / (BW x AT-C) |
| | | | | AF | Soil-to-skin adherence factor | 0.3 | $mg/cm^2$-event | USEPA, 2004 | |
| | | | | ABS | Soil Absorption Factor | Chemical-specific | unitless | USEPA, 2004 (Exhibit 3-4) | Dermally Absorbed Dose (mg/kg-day) for noncarcinogens = |
| | | | | EV | Event Frequency | 1 | events/day | USEPA, 2002 | (DA-event x EV x EF x ED x SA) / (BW x AT-N) |
| | | | | EF | Exposure Frequency | 250 | days/year | USEPA, 2002 | |
| | | | | ED | Exposure Duration | 0.5 | years | Assumes construction for one-half year duration | **Where:** |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | Absorbed Dose per Event (DA-event) ($mg/cm^2$-event) = |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | CS x AF x ABS x CF |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 182.5 | days | ED x 365 days/year | |
| | On-Site Resident | Adult/Child | Surface Soil and Surface/Subsurface Soil [1] | DAD | Dermally Absorbed Dose | Calculated | mg/kg-day | -- | **Non-Mutagenic Constituents** |
| | | | | CS | Exposure Point Concentration in Soil | Based on soil sampling data | mg/kg | -- | |
| | | | | SAa | Skin surface area for contact -adult | 6,032 | $cm^2$ | USEPA, 2014a (USEPA, 2011; Tables 7-12 and 7-13; weighted average of mean values for head, hands, forearms, and lower legs (male and female, 21+years)) | Dermally Absorbed Dose (mg/kg-day) for carcinogens = (DA-eventa x EV x EFa x EDa x SAa) / (BWa x AT-C) + (DA-eventc x EV x EFc x EDc x SAc) / (BWc x AT-C) |
| | | | | SAc | Skin surface area for contact - child | 2,373 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Tables 7-2 and 7-8; weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, birth to < 6 years) (forearm and lower leg-specific data used when available, ratios for nearest available age group used elsewhere)). | Dermally Absorbed Dose (mg/kg-day) for noncarcinogens (adult) = (DA-eventa x EV x EFa x EDa x SAa) / (BWa x AT-Na) |

**Table F-5 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Future |
| Medium: | Soil |
| Exposure Medium: | Surface and Subsurface Soil |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| | On-Site Resident | Adult/Child | Surface Soil and Surface/Subsurface Soil [1] | AFa | Soil-to-skin adherence factor -adult | 0.07 | mg/cm$^2$-event | USEPA, 2014a (USEPA, 2004) (Assumed same as soil) | **Where:**<br>Absorbed Dose per Event - Adult (DA-eventa) (mg/cm$^2$-event) =<br>CS x AFa x ABS x CF<br><br>Dermally Absorbed Dose (mg/kg-day) for noncarcinogens (child) = (DA-eventc x EV x EFc x EDc x SAc) / (BWc x AT-Nc)<br><br>**Where:**<br>Absorbed Dose per Event - Child (DA-eventc) (mg/cm$^2$-event) =<br>CS x AFc x ABS x CF<br><br>**Mutagenic Constituents**<br><br>Dermally Absorbed Dose (mg/kg-day) for mutagenic carcinogens (adult) = [(DA-event x EV x EFa x $ED_{6-16}$ x $ADAF_{6-16}$ x $SA_{6-16}$) + (DA-event x EV x EFa x $ED_{16-26}$ x $ADAF_{16-26}$ x $SA_{16-26}$)] / (BWa x AT-C)<br><br>**Where:**<br>Absorbed Dose per Event (DA-event) (mg/cm$^2$-event) =<br>CS x AFa x ABS x CF<br><br>Dermally Absorbed Dose (mg/kg-day) for mutagenic carcinogens (child) = [(DA-event x EV x EFc x $ED_{0-2}$ x $ADAF_{0-2}$ x $SA_{0-2}$) + (DA-event x EV x EFc x $ED_{2-6}$ x $ADAF_{2-6}$ x $SA_{2-6}$)] / (BWc x AT-C)<br><br>**Where:**<br>Absorbed Dose per Event (DA-event) (mg/cm$^2$-event) =<br>CS x AFc x ABS x CF<br><br>Dermally Absorbed Dose (DAD) (mg/kg-day) for mutagenic carcinogens = [DAD (adult) + DAD (child)] |
| | | | | EV | Event Frequency | 1 | events/day | USEPA, 2004 | |
| | | | | EFa | Exposure Frequency - adult | 350 | days/year | USEPA, 2014a (USEPA 1991) | |
| | | | | EFc | Exposure Frequency - child | 350 | days/year | USEPA, 2014a (USEPA 1991) | |
| | | | | EDa | Exposure Duration - adult | 20 | years | USEPA, 2014a (Resident Exposure of 26 years (USEPA, 2011; Table 16-108; 90th percentile for current residence time) minus Resident Duration for child (6 years)). | |
| | | | | EDc | Exposure Duration - child | 6 | years | USEPA, 2014a (USEPA, 1991) | |
| | | | | $ED_{6-16}$ | Exposure Duration, 6-16 years | 10 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{6-16}$ | Age depend. adjust. factor, 6-16 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $SA_{6-16}$ | Skin surface area for contact, 6-16 years | 3,749 | cm$^2$ | USEPA 2011; Tables 7-2; weighted average of mean values for head, hands, forearms, and lower legs (male and female, 6 to <16 years). | |
| | | | | $ED_{16-26}$ | Exposure Duration, 16-26 years | 10 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{16-26}$ | Age depend. adjust. factor, 16-26 years | 1 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $SA_{16-26}$ | Skin surface area for contact , 16-26 years | 6,032 | cm$^2$ | USEPA, 2014a (USEPA, 2011; Tables 7-12 and 7-13; weighted average of mean values for head, hands, forearms, and lower legs (male and female, 21+years)) | |
| | | | | $ED_{0-2}$ | Exposure Duration. 0-2 years | 2 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{0-2}$ | Age depend. adjust. factor, 0-2 years | 10 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $SA_{0-2}$ | Skin surface area for contact, 0-2 years | 1,741 | cm$^2$ | USEPA, 2011; Tables 7-2; Weighted average of mean values for head, hands, forearms, and lower legs (male and female, birth to <2 years). | |
| | | | | $ED_{2-6}$ | Exposure Duration, 2-6 years | 4 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{2-6}$ | Age depend. adjust. factor, 2-6 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $SA_{2-6}$ | Skin surface area for contact, 2-6 years | 2,373 | cm$^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Tables 7-2 and 7-8; weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, birth to < 6 years) (forearm and lower leg-specific data used when available, ratios for nearest available age group used elsewhere)). | |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | |
| | | | | BWa | Body Weight - adult | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | BWc | Body Weight -child | 15 | kg | USEPA, 2014a (USEPA, 2011; Table 8-1; weighted average of mean body weights (birth to <6 years)) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-Na | Averaging Time, noncarcinogens (Adult) | 7,300 | days | EDa x 365 days/year | |
| | | | | AT-Nc | Averaging Time, noncarcinogens (Child) | 2,190 | days | $ED_c$ x 365 days/year | |

Notes:
(1) Assumes a future excavation re-deposits mixed surface/subsurface soil as surface soil.

References:


USEPA, 1989. Risk Assessment Guidance for Superfund, Volume I, Human Health Evaluation Manual (Part A), Interim Final. EPA/540?1-89/002. December.

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors". June 1991.

USEPA, 2002. Supplemental Guidance for Development of Soil Screening Levels for Superfund Sites, Office of Emergency and Remedial Response, OSWER Directive 9355.4-24. December 2002.

USEPA, 2004. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final, July 2004.

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USEPA, 2011. Exposure Factors Handbook: 2011 Edition. EPA/ 600/ R-090/052F, September 2011.

USEPA, 2014a. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February.

**Table F-6 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Future |
| Medium: | Soil |
| Exposure Medium: | Air |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| Inhalation | Outdoor Workers | Adult | Particulates from Surface Soil and Surface/Subsurface Soil [1] and Vapors from Soil | ECcancer | Exposure concentration for estimating cancer risk | Calculated | µg/m$^3$ | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | ECnoncancer | Exposure concentration (chronic exposure) for estimating non-cancer HQ | Calculated | µg/m$^3$ | -- | ECcancer = (CA x ET x EF x ED) / AT-C |
| | | | | CA | Exposure Point Concentration - Air | Modeled from soil | µg/m$^3$ | See Intake Equations | ECnoncancer = (CA x ET x EF x ED) / AT-N |
| | | | | CS | Exposure Point Concentration - Soil | Based on soil sampling data | mg/kg | -- | |
| | | | | PEF | Particulate Emission Factor | Site-specific | m$^3$/kg | USEPA, 2002 | **Where:** |
| | | | | VF | Volatilization Factor | Chemical-specific | m$^3$/kg | USEPA, 2002 | CA = (CS / PEF) x CF (particulates) |
| | | | | ET | Exposure Time | 8 | hour/day | USEPA, 2014a (Work day - assumed to be 8 hour day) | CA = (CS / VF) x CF (vapors) |
| | | | | EF | Exposure Frequency | 225 | days/year | USEPA, 2014a (USEPA 1991) | |
| | | | | ED | Exposure Duration | 25 | years | USEPA, 2014a (USEPA 1991) | |
| | | | | CF | Conversion Factor | 1000 | µg/mg | -- | |
| | | | | AT-C | Averaging Time, carcinogens | 613,200 | hours | 70 [lifetime in years] x 365 day/year x 24 hours/day | |
| | | | | AT-N | Averaging Time, noncarcinogens | 219,000 | hours | ED x 365 day/year x 24 hours/day | |
| | Construction Worker | Adult | Particulates from Surface/Subsurface Soil and Vapors from Soil | ECcancer | Exposure concentration for estimating cancer risk | Calculated | µg/m$^3$ | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | ECnoncancer | Exposure concentration (chronic exposure) for estimating non-cancer HQ | Calculated | µg/m$^3$ | -- | ECcancer = (CA x ET x EF x ED) / AT-C |
| | | | | CA | Exposure Point Concentration - Air | Modeled from soil | µg/m$^3$ | See Intake Equations | ECnoncancer = (CA x ET x EF x ED) / AT-N |
| | | | | CS | Exposure Point Concentration - Soil | Based on soil sampling data | mg/kg | -- | |
| | | | | PEF | Particulate Emission Factor | Site-specific | m$^3$/kg | -- | **Where:** |
| | | | | VF | Volatilization Factor | Chemical-specific | m$^3$/kg | USEPA, 2002 | CA = (CS / PEF) x CF (particulates) |
| | | | | ET | Exposure Time | 8 | hour/day | USEPA, 2014a (Work day - assumed to be 8 hour day) | CA = (CS / VF) x CF (vapors) |
| | | | | EF | Exposure Frequency | 250 | days/year | USEPA, 2002 | |
| | | | | ED | Exposure Duration | 0.5 | years | Assumes construction for one-half year duration | |
| | | | | CF | Conversion Factor | 1000 | µg/mg | -- | |
| | | | | AT-C | Averaging Time, carcinogens | 613,200 | hours | 70 [lifetime in years] x 365 day/year x 24 hours/day | |
| | | | | AT-N | Averaging Time, noncarcinogens | 4,380 | hours | ED x 365 day/year x 24 hours/day | |
| | On-Site Resident | Adult/Child | Particulates from Surface Soil and Surface/Subsurface Soil [1] and Vapors from Soil | ECcancer | Exposure concentration for estimating cancer risk | Calculated | µg/m$^3$ | -- | **Non-Mutagenic Constituents** |
| | | | | ECnoncancer | Exposure concentration (chronic exposure) for estimating non-cancer HQ | Calculated | µg/m$^3$ | -- | ECcancer = (CA x ET x EF x EDr) / AT-C |
| | | | | CA | Exposure Point Concentration - Air | Modeled from soil | µg/m$^3$ | See Intake Equations | ECnoncancer (adult) = (CA x ET x EF x EDa) / AT-Na<br>ECnoncancer (child) = (CA x ET x EF x EDc) / AT-Nc |
| | | | | CS | Exposure Point Concentration - Soil | Based on soil sampling data | mg/kg | -- | |
| | | | | PEF | Particulate Emission Factor | 1.36E+09 | m$^3$/kg | USEPA, 2002 | **Where:** |
| | | | | ET | Exposure Time - adult/child resident | 3 | hour/day | USEPA, 2011, Table 16-26; mean value for time spent doing outdoor recreational activities in the Northeast Region of US. | CA = (CS / PEF) x CF (particulates) |
| | | | | EF | Exposure Frequency - adult/child resident | 350 | days/year | USEPA, 2014a (USEPA 1991) | CA = (CS / VF) x CF (vapors) |
| | | | | EDa | Exposure Duration - adult | 20 | years | USEPA, 2014a (Resident Exposure of 26 years (USEPA, 2011; Table 16-108; 90th percentile for current residence time) minus Resident Duration for child (6 years)). | |
| | | | | EDc | Exposure Duration - child | 6 | years | USEPA, 2014a (USEPA, 1991) | |

**Table F-6 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Future |
| Medium: | Soil |
| Exposure Medium: | Air |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| | On-Site Resident | Adult/Child | Particulates from Surface Soil and Surface/Subsurface Soil [1] and Vapors from Soil | $ED_{6-16}$ | Exposure Duration, 6-16 years | 10 | years | USEPA, 2005. Mutagenic calculations. | **Mutagenic Constituents** |
| | | | | $ADAF_{6-16}$ | Age depend. adjust. factor, 6-16 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ED_{16-26}$ | Exposure Duration, 16-26 years | 10 | years | USEPA, 2005. Mutagenic calculations. | ECcancer (adult) = [(CA x ET x EF x $ED_{6-16}$ x $ADAF_{6-16}$) + (CA x ET x EF x $ED_{16-26}$ x $ADAF_{16-26}$)] / AT-C |
| | | | | $ADAF_{16-26}$ | Age depend. adjust. factor, 16-26 years | 1 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ED_{0-2}$ | Exposure Duration. 0-2 years | 2 | years | USEPA, 2005. Mutagenic calculations. | ECcancer (child) = [(CA x ET x EF x $ED_{0-2}$ x $ADAF_{0-2}$) + (CA x ET x EF x $ED_{2-6}$ x $ADAF_{2-6}$)] / AT-C |
| | | | | $ADAF_{0-2}$ | Age depend. adjust. factor, 0-2 years | 10 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ED_{2-6}$ | Exposure Duration, 2-6 years | 4 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{2-6}$ | Age depend. adjust. factor, 2-6 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | **Where:** |
| | | | | EDr | Exposure Duration - resident (adult/child) | 26 | years | USEPA, 2014a (USEPA 2011, Table 16-108; 90th percentile for current residence time). | CA = (CS / PEF) x CF (particulates)<br>CA = (CS / VF) x CF (vapors) |
| | | | | CF | Conversion Factor | 1000 | µg/mg | -- | |
| | | | | AT-C | Averaging Time, carcinogens | 613,200 | hours | 70 [lifetime in years] x 365 day/year x 24 hours/day | |
| | | | | AT-Na | Averaging Time, noncarcinogens (Adult) | 175,200 | hours | EDa x 365 day/year x 24 hours/day | Mutagenic ECcancer = ECcancer (adult) + ECcancer (child) |
| | | | | AT-Nc | Averaging Time, noncarcinogens (Child) | 52,560 | hours | $ED_c$ x 365 day/year x 24 hours/day | |

Notes:
(1) Assumes a future excavation re-deposits mixed surface/subsurface soil as surface soil.

References:


USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors". June 1991.

USEPA, 1997. Exposure Factors Handbook. August 1997

USEPA, 2002. Supplemental Guidance for Development of Soil Screening Levels for Superfund Sites, Office of Emergency and Remedial Response, OSWER Directive 9355.4-24. December 2002.

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USEPA, 2014a. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February.

**Table F-7 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Future |
| Medium: | Groundwater |
| Exposure Medium: | Groundwater |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| Ingestion | Construction Workers | Adult | Shallow Groundwater | DI | Daily Intake | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CGW | Exposure Point Concentration - Groundwater | Based on groundwater sampling data | mg/L | -- | Daily Intake (mg/kg-day) for carcinogens = (CGW x IRGW x EF x ED) / (BW x AT-C) |
| | | | | IRGW | Incidental Ingestion Rate, groundwater | 0.02 | L/day | VDEQ, 2014 (Assumes 4 hours/day of exposure to groundwater) | |
| | | | | EF | Exposure Frequency | 250 | days/year | USEPA, 2002 | |
| | | | | ED | Exposure Duration | 0.5 | years | Assumes construction for one-half year | |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | Daily Intake (mg/kg-day) for noncarcinogens = (CGW x IRGW x EF x ED) / (BW x AT-N) |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 182.5 | days | ED x 365 days/year | |
| | Resident | Adult/Child | Groundwater | DI | Daily Intake | Calculated | mg/kg-day | -- | **Non-Mutagenic Constituents** |
| | | | | CGW | Exposure Point Concentration - Groundwater | Based on groundwater sampling data | mg/L | -- | Daily Intake (mg/kg-day) for carcinogens = (CGW x IRGWa x EFa x EDa) / (BWa x AT-C) + (CGW x IRGWc x EFc x EDc) / (BWc x AT-C) |
| | | | | IRGWa | Ingestion Rate, groundwater - adult | 2.5 | L/day | USEPA, 2014a (USEPA, 2011, Table 3-33; 90th percentile of consumer-only ingestion of drinking water (>= 21 years)) | |
| | | | | IRGWc | Ingestion Rate, groundwater - child | 0.78 | L/day | USEPA, 2014a (USEPA, 2011, Tables 3-15 and 3-33;weighted average of 90th percentile of consumer-only ingestion of drinking water (birth to < 6 years)) | Daily Intake (mg/kg-day) for noncarcinogens (adult) = (CGW x IRGWa x EFa x EDa) / (BWa x AT-Na) |
| | | | | EFa | Exposure Frequency - adult | 350 | days/year | USEPA, 2014a (USEPA 1991) | |
| | | | | EFc | Exposure Frequency - child | 350 | days/year | USEPA, 2014a (USEPA 1991) | Daily Intake (mg/kg-day) for noncarcinogens (child) = (CGW x IRGWc x EFc x EDc) / (BWc x AT-Nc) |
| | | | | EDa | Exposure Duration - adult | 20 | years | USEPA, 2014a (Resident Exposure of 26 years (USEPA, 2011; Table 16-108; 90th percentile for current residence time) minus Resident Duration for child (6 years)). | |
| | | | | $ED_{6-16}$ | Exposure Duration, 6-16 years | 10 | years | USEPA, 2005. Mutagenic calculations. | **Mutagenic Constituents** |
| | | | | $ADAF_{6-16}$ | Age depend. adjust. factor, 6-16 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ED_{16-26}$ | Exposure Duration, 16-26 years | 10 | years | USEPA, 2005. Mutagenic calculations. | Daily Intake (mg/kg-day) for mutagenic carcinogens (adult) = (CGW x IRGWa x EFa x $ED_{6-16}$ x $ADAF_{6-16}$) + (CGW x IRGWa x EFa x $ED_{16-26}$ x $ADAF_{16-26}$) / (BWa x AT-C) |
| | | | | $ADAF_{16-26}$ | Age depend. adjust. factor, 16-26 years | 1 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | EDc | Exposure Duration - child | 6 | years | USEPA, 2014a (USEPA, 1991) | |
| | | | | $ED_{0-2}$ | Exposure Duration. 0-2 years | 2 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{0-2}$ | Age depend. adjust. factor, 0-2 years | 10 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ED_{2-6}$ | Exposure Duration, 2-6 years | 4 | years | USEPA, 2005. Mutagenic calculations. | Daily Intake (mg/kg-day) for mutagenic carcinogens (child) = (CGW x IRGWc x EFc x $ED_{0-2}$ x $ADAF_{0-2}$) + (CGW x IRGWc x EFc x $ED_{2-6}$ x $ADAF_{2-6}$) / (BWc x AT-C) |
| | | | | $ADAF_{2-6}$ | Age depend. adjust. factor, 2-6 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | BWa | Body Weight - adult | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | **Where:** |
| | | | | BWc | Body Weight - child | 15 | kg | USEPA, 2014a (USEPA, 2011; Table 8-1; weighted average of mean body weights (birth to <6 years)) | Daily Intake (DI) (mg/kg-day) for mutagenic carcinogens = [DI (adult) + DI (child)] |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-Na | Averaging Time, noncarcinogens - adult | 7,300 | days | EDa x 365 days/year | |
| | | | | AT-Nc | Averaging Time, noncarcinogens - child | 2,190 | days | $ED_c$ x 365 days/year | |

**Table F-7 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Future |
| Medium: | Groundwater |
| Exposure Medium: | Groundwater |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| Dermal | Construction Workers | Adult | Shallow Groundwater | DAD | Dermally Absorbed Dose | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CGW | Exposure Point Concentration - Groundwater | Based on groundwater sampling data | mg/L | -- | Dermally Absorbed Dose (mg/kg-day) for carcinogens = |
| | | | | FA | Fraction Absorbed Water | Chemical-specific | unitless | USEPA, 2004 | (DA-event x EV x ED x EF x SA) / (BW x AT-C) |
| | | | | Kp | Dermal Permeability Coefficient | Chemical-specific | cm/hr | USEPA, 2004 | |
| | | | | SA | Body Area Available for Contact | 3,527 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Tables 7-12 and 7-13; Weighted average of mean values for head, hands, and forearms (male and female, 21+years)). Assume receptor is wearing water-proof work boots. | Dermally Absorbed Dose (mg/kg-day) for non-carcinogens = (DA-event x EV x ED x EF x SA) / (BW x AT-N) |
| | | | | tau-event | Lag Time per Event | Chemical-specific | hours/event | USEPA, 2004 | **Where:** |
| | | | | t-event | Event Duration | 4 | hours/event | VDEQ, 2014 (Assumes 4 hours/day of exposure to groundwater) | For organic compounds in which t-event is less than or equal to t-tau: |
| | | | | B | Ratio of Kp of a Compound through the Stratum Corneum Relative to Its Kp across the Viable Epidermis | Chemical-specific | unitless | USEPA, 2004 | DA-event (Absorbed Dose per Event [mg/$cm^2$-event] ) = 2 x FA x Kp x CGW x CF x SQRT([6 x tau-event x t-event] / π) |
| | | | | EV | Event Frequency | 1 | event/day | USEPA, 2004 | |
| | | | | EF | Exposure Frequency | 250 | days/year | USEPA, 2002 | |
| | | | | ED | Exposure Duration | 0.5 | years | Assumes construction for one-half year duration | For organics where t-event is greater than t-tau: |
| | | | | CF | Conversion Factor | 0.001 | $L/cm^3$ | -- | DA-event = FA x Kp x CGW x CF x {[t-event/(1+B)] + 2 x tau-event x [ (1 + 3B + $3B^2$) / $(1 + B)^2$ ] } |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | For inorganic compounds, |
| | | | | AT-N | Averaging Time, noncarcinogens | 182.5 | days | ED x 365 days/year | DA-event = Kp x CGW x CF x t-event |
| | Off-Site Resident | Adult/Child | Groundwater | DAD | Dermally Absorbed Dose | Calculated | mg/kg-day | -- | **Non-Mutagenic Constituents** |
| | | | | CGW | Exposure Point Concentration - Groundwater | Based on groundwater sampling data | mg/L | -- | Dermally Absorbed Dose (mg/kg-day) for carcinogens = (DA-eventa x EV x EFa x EDa x SAa) / (BWa x AT-C) + (DA-eventc x EV x EFc x EDc x SAc) / (BWc x AT-C) |
| | | | | FA | Fraction Absorbed Water | Chemical-specific | unitless | USEPA, 2004 | |
| | | | | Kp | Dermal Permeability Coefficient | Chemical-specific | cm/hr | USEPA, 2004 | |
| | | | | SAa | Body Area Available for Contact -adult | 19,652 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Table 7-9; weighted average of mean values for male and female adults, 21-78). | Dermally Absorbed Dose (mg/kg-day) for noncarcinogens (adult) = (DA-eventa x EV x EFa x EDa x SAa) / (BWa x AT-Na) |
| | | | | SAc | Body Area Available for Contact - child | 6,365 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Table 7-9; weighted average of mean values for male and female children <6 years). | Dermally Absorbed Dose (mg/kg-day) for noncarcinogens (child) = (DA-eventc x EV x EFc x EDc x SAc) / (BWc x AT-Nc) |
| | | | | tau-event | Lag Time per Event | Chemical-specific | hours/event | USEPA, 2004 | |
| | | | | t-eventa | Event Duration - adult | 0.71 | hours/event | USEPA, 2014a (USEPA, 2011; Tables 16-30 and 14-31; weighted average of adult (21 to 78) 90th percentile of time spent bathing/showering in a day, divided by mean number of baths/showers taken in a day) | **Where:** For organic compounds in which t-event is less than or equal to t-tau: DA-event (Absorbed Dose per Event [mg/cm2-event] ) = 2 x FA x Kp x CGW x CF x SQRT([6 x tau-event x t-event] / π) |
| | | | | t-eventc | Event Duration - child | 0.54 | hours/event | USEPA, 2014a (USEPA, 2011; Tables 16-28; weighted average of 90th percentile time spent bathing (birth to < 6 years) | |
| | | | | B | Ratio of Kp of a Compound through the Stratum Corneum Relative to Its Kp across the Viable Epidermis | Chemical-specific | unitless | USEPA, 2004 | For organics where t-event is greater than t-tau: |
| | | | | EV | Event Frequency | 1 | event/day | USEPA, 2004 | DA-event = FA x Kp x CGW x CF x {[t-event/(1+B)] + 2 x tau-event x [ (1 + 3B + $3B^2$) / $(1 + B)^2$ ] } |
| | | | | EFa | Exposure Frequency - adult | 350 | days/year | USEPA, 2014a (USEPA, 1991) | |
| | | | | EFc | Exposure Frequency - child | 350 | days/year | USEPA, 2014a (USEPA, 1991) | |
| | | | | EDa | Exposure Duration - adult | 20 | years | USEPA, 2014a (Resident Exposure of 26 years (USEPA, 2011; Table 16-108; 90th percentile for current residence time) minus Resident Duration for child (6 years)). | For inorganic compounds, DA-event = Kp x CGW x CF x t-event |
| | | | | $ED_{6-16}$ | Exposure Duration, 6-16 years | 10 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{6-16}$ | Age depend. adjust. factor, 6-16 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $SA_{6-16}$ | Skin surface area for contact, 6-16 years | 13,350 | $cm^2$ | USEPA, 2011; Table 7-9; weighted average of mean values for male and female adults, 6-16. | |
| | | | | $ED_{16-26}$ | Exposure Duration, 16-26 years | 10 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{16-26}$ | Age depend. adjust. factor, 16-26 years | 1 | unitless | USEPA, 2005. Mutagenic calculations. | |

**Table F-7 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Future |
| Medium: | Groundwater |
| Exposure Medium: | Groundwater |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| | Off-Site Resident | Adult/Child | Groundwater | $SA_{16-26}$ | Skin surface area for contact , 16-26 years | 19,652 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Table 7-9; weighted average of mean values for male and female adults, 21-78). | **Mutagenic Constituents** |
| | | | | EDc | Exposure Duration - child | 6 | years | USEPA, 2014a (USEPA, 1991) | Dermally Absorbed Dose (DAD) (mg/kg/day) for mutagenic carcinogens (adult) = |
| | | | | $ED_{0-2}$ | Exposure Duration. 0-2 years | 2 | years | USEPA, 2005. Mutagenic calculations. | [(DA-event x EV x EFa x $SA_{6-16}$ x $ED_{6-16}$ x $ADAF_{6-16}$) + (DA-event x EV x EFa x $SA_{16-26}$ x $ED_{16-26}$ x $ADAF_{16-26}$)] / (BWa x AT-C) |
| | | | | $ADAF_{0-2}$ | Age depend. adjust. factor, 0-2 years | 10 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $SA_{0-2}$ | Skin surface area for contact, 0-2 years | 4,646 | $cm^2$ | USEPA, 2011; Table 7-9; weighted average of mean values for male and female children, birth to <2 years. | Dermally Absorbed Dose (DAD) (mg/kg/day) for mutagenic carcinogens (child) = |
| | | | | $ED_{2-6}$ | Exposure Duration, 2-6 years | 4 | years | USEPA, 2005. Mutagenic calculations. | [(DA-event x EV x EFc x $SA_{0-2}$ x $ED_{0-2}$ x $ADAF_{0-2}$) + (DA-event x EV x EFc x $SA_{2-6}$ x $ED_{2-6}$ x $ADAF_{2-6}$)] / (BWc x AT-C) |
| | | | | $ADAF_{2-6}$ | Age depend. adjust. factor, 2-6 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $SA_{2-6}$ | Skin surface area for contact, 2-6 years | 6,365 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Table 7-9; weighted average of mean values for male and female children <6 years). | **Where:** |
| | | | | CF | Conversion Factor | 0.001 | $L/cm^3$ | -- | DAD (mg/kg/day) for mutagenic carcinogens = [DAD (adult) + DAD (child)] |
| | | | | BWa | Body Weight - adult | 80 | kg | USEPA, 2014 (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | BWc | Body Weight - child | 15 | kg | USEPA, 2014a (USEPA, 2011; Table 8-1; weighted average of mean body weights (birth to <6 years)) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-Na | Averaging Time, noncarcinogens - adult | 7,300 | days | EDa x 365 days/year | |
| | | | | AT-Nc | Averaging Time, noncarcinogens - child | 2,190 | days | $ED_c$ x 365 days/year | |

References:


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USEPA, 2014a. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February.

VDEQ, 2009. Virginia Department of Environmental Quality Voluntary Remediation Program (VRP), Risk Assessment Guidance. Section 3.3.2 Exposure Factors. http://www.deq.state.va.us/vrprisk/raguide.html.

**Table F-8 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Future |
| Medium: | Groundwater |
| Exposure Medium: | Air |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| Inhalation | Construction Worker | Adult | Vapors from Volatilization of Groundwater in Excavation Trench | ECcancer | Exposure Concentration for estimating risk | Calculated | $\mu g/m^3$ | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | ECnoncancer | Exposure concentration for estimating subchronic exposures for non-cancer HQ | Calculated | $\mu g/m^3$ | -- | ECcancer = (CA x ET x EF x ED) / AT-C |
| | | | | CA | Exposure Point Concentration - Air | Modeled from groundwater | $\mu g/m^3$ | -- | ECnoncancer = (CA x ET x EF x ED) / AT-N |
| | | | | CGW | Exposure Point Concentration - Groundwater | Based on groundwater sampling data | mg/L | -- | **Where:** |
| | | | | VF | Volatilization Factor (Groundwater to Air) | Chemical-specific | $L/m^3$ | VDEQ, 2014 (Trench Model) | CA = CGW x CF x VF |
| | | | | CF | Conversion Factor | 1000 | ug/mg | -- | |
| | | | | ET | Exposure Time | 4 | hour/day | VDEQ, 2014 (Assumes 4 hours/day of exposure to groundwater) | |
| | | | | EF | Exposure Frequency | 250 | days/year | USEPA, 2002 | |
| | | | | ED | Exposure Duration | 0.5 | years | Assumes construction for one-half year duration | |
| | | | | AT-C | Averaging Time, carcinogens | 613,200 | hours | 70 [lifetime in years] x 365 day/year x 24 hour/day | |
| | | | | AT-N | Averaging Time, noncarcinogens | 4,380 | hours | ED x 365 day/year x 24 hour/day | |
| | Off-Site Resident | Adult | Vapors from Volatilization of Groundwater Potable Use (Shower/Bath) | ECcancer | Exposure Concentration for estimating risk | Calculated | $\mu g/m^3$ | -- | **Non-Mutagenic Constituents** |
| | | | | ECnoncancer | Exposure concentration for estimating non-cancer HQ | Calculated | $\mu g/m^3$ | -- | ECcancer = [(CA x ETa x EF x EDa) + (CA x ETc x EF x EDc)] / AT-C |
| | | | | CA | Exposure Concentration - Air | Modeled from groundwater | $\mu g/m^3$ | -- | |
| | | | | ETa | Exposure Frequency | 0.71 | hour/day | USEPA, 2014a (USEPA, 1991) | |
| | | | | ETc | Exposure Frequency | 0.54 | hour/day | USEPA, 2014a (USEPA, 2011; Table 16-28; weighted average of 90th percentile time spent bathing (birth to < years)). | ECnoncancer (adult) = (CA x ETa x EF x EDa) / AT-Na<br>ECnoncancer (child) = (CA x ETc x EF x EDc) / AT-Nc |
| | | | | EF | Exposure Frequency | 350 | days/year | USEPA, 2014a (USEPA, 1991) | **Mutagenic Constituents** |
| | | | | EDr | Exposure Duration | 26 | years | USEPA, 2014a (Resident Exposure of 26 years | ECcancer (adult) = |
| | | | | EDa | Exposure Duration | 20 | years | USEPA, 2014a (USEPA 2011, Table 16-108; 90th percentile for current residence time). | $((CA \times ETa \times EF \times ED_{6\text{-}16} \times ADAF_{6\text{-}16}) + (CA \times ETa \times EF \times ED_{16\text{-}26} \times ADAF_{16\text{-}26})) / AT\text{-}C$ |
| | | | | EDc | Exposure Duration - child | 6 | years | USEPA, 2014a (USEPA, 1991) | |
| | | | | $ED_{6\text{-}16}$ | Exposure Duration, 6-16 years | 10 | years | USEPA, 2005. Mutagenic calculations. | ECcancer (child) = |
| | | | | $ADAF_{6\text{-}16}$ | Age depend. adjust. factor, 6-16 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | $((CA \times ETc \times EF \times ED_{0\text{-}2} \times ADAF_{0\text{-}2}) + (CA \times ETc \times EF \times ED_{2\text{-}6} \times ADAF_{2\text{-}6})) / AT\text{-}C$ |
| | | | | $ED_{16\text{-}26}$ | Exposure Duration, 16-26 years | 10 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{16\text{-}26}$ | Age depend. adjust. factor, 16-26 years | 1 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ED_{0\text{-}2}$ | Exposure Duration. 0-2 years | 2 | years | USEPA, 2005. Mutagenic calculations. | **Where:** |
| | | | | $ADAF_{0\text{-}2}$ | Age depend. adjust. factor, 0-2 years | 10 | unitless | USEPA, 2005. Mutagenic calculations. | ECcancer = [ECcancer (adult) + ECcancer (child)] |
| | | | | $ED_{2\text{-}6}$ | Exposure Duration, 2-6 years | 4 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{2\text{-}6}$ | Age depend. adjust. factor, 2-6 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | CA = concentration in shower air is calculated using USEPA Region III modified Foster-Chrostowski model. |
| | | | | AT-Na | Averaging Time, noncarcinogens (Adult) | 7,300 | days | EDa x 365 days/year | |
| | | | | AT-Nc | Averaging Time, noncarcinogens (Child) | 2,190 | days | EDc x 365 day/year | |


References:
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USEPA, 2002. Supplemental Guidance for Development of Soil Screening Levels for Superfund Sites, Office of Emergency and Remedial Response, OSWER Directive 9355.4-24. December 2002.

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VDEQ, 2009. Virginia Department of Environmental Quality Voluntary Remediation Program (VRP), Risk Assessment Guidance. Section 3.3.2 Exposure Factors. http://www.deq.state.va.us/vrprisk/raguide.html.

**Table F-9 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Future |
| Medium: | Sediment |
| Exposure Medium: | Sediment |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| Incidental Ingestion | Outdoor Worker | Adult | Sediment | DI | Daily Intake | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CSD | Exposure Point Concentration in Sediment | Based on sediment sampling data | mg/kg | -- | Daily Intake (mg/kg-day) for carcinogens = (CSD x IRsediment x FI x EF x ED x CF) / (BW x AT-C) |
| | | | | IRsediment | Ingestion Rate, sediment | 100 | mg/day | USEPA, 2014a (USEPA, 1991; same as adult resident soil ingestion rate) | |
| | | | | FI | Fraction Ingested from Source | 1 | unitless | USEPA, 1989 (all of the sediment contacted is presumed to be contaminated) | Daily Intake (mg/kg-day) for noncarcinogens = (CSD x IRsediment x FI x EF x ED x CF) / (BW x AT-N) |
| | | | | EF | Exposure Frequency | 225 | days/year | USEPA, 2014a (USEPA 1991) | |
| | | | | ED | Exposure Duration | 25 | years | USEPA, 2014a (USEPA 1991) | |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 9,125 | days | ED x 365 days/year | |
| | Construction Worker | Adult | Sediment | DI | Daily Intake | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CSD | Exposure Point Concentration in Soil | Based on soil sampling data | mg/kg | -- | Daily Intake (mg/kg-day) for carcinogens = (CSD x IRsediment x FI x EF x ED x CF) / (BW x AT-C) |
| | | | | IRsediment | Ingestion Rate, sediment | 330 | mg/day | USEPA, 2002 | |
| | | | | FI | Fraction Ingested from Source | 1 | unitless | USEPA, 1989 (all of the soil contacted is presumed to be contaminated) | |
| | | | | EF | Exposure Frequency | 250 | days/year | USEPA, 2002 | Daily Intake (mg/kg-day) for noncarcinogens = (CSD x IRsediment x FI x EF x ED x CF) / (BW x AT-N) |
| | | | | ED | Exposure Duration | 0.5 | years | Assumes construction for one-half year duration | |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 182.5 | days | ED x 365 days/year | |
| | On-Site Resident | Adult/Child | Sediment | DI | Daily Intake | Calculated | mg/kg-day | -- | **Non-Mutagenic Constituents** |
| | | | | CSD | Exposure Point Concentration in Sediment | Based on sediment sampling data | mg/kg | -- | Daily Intake (mg/kg-day) for carcinogens = (CSD x IRsedimenta x FI x EFa x EDa x CF) / (BWa x AT-C) + (CSD x IRsedimentc x FI x EFc x EDc x CF) / (BWc x AT-C) |
| | | | | IRsedimenta | Ingestion Rate, sediment - adult | 100 | mg/day | USEPA, 2014a (USEPA, 1991; assumed same as soil) | |
| | | | | IRsedimentc | Ingestion Rate, sediment - child | 200 | mg/day | USEPA, 2014a (USEPA, 2011; Table 5-1; "upper-bound values" accounting for both soil and dust ingestion) (Assumed same as soil) | Daily Intake (mg/kg-day) for noncarcinogens = (CSD x IRsedimenta x FI x EFa x EDa x CF) / (BWa x AT-Na) |
| | | | | FI | Fraction Ingested from Source | 1 | unitless | USEPA, 1989 (all of the sediment contacted is presumed to be contaminated) | |
| | | | | EFa | Exposure Frequency - adult | 176 (1) | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | Daily Intake (mg/kg-day) for noncarcinogens = (CSD x IRsedimentc x FI x EFc x EDc x CF) / (BWc x AT-Nc) |
| | | | | EFc | Exposure Frequency - child | 176 (1) | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | |
| | | | | EDa | Exposure Duration - adult | 20 | years | USEPA, 2014a (Resident Exposure of 26 years (USEPA, 2011; Table 16-108; 90th percentile for current residence time) minus Resident Duration for child (6 years)). | |
| | | | | EDc | Exposure Duration - child | 6 | years | USEPA, 2014a (USEPA, 1991) | |

**Table F-9 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Future |
| Medium: | Sediment |
| Exposure Medium: | Sediment |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| | On-Site Resident | Adult/Child | Sediment | $ED_{6-16}$ | Exposure Duration, 6-16 years | 10 | years | USEPA, 2005. Mutagenic calculations. | **Mutagenic Constituents** |
| | | | | $ADAF_{6-16}$ | Age depend. adjust. factor, 6-16 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | Daily Intake (mg/kg-day) for mutagenic carcinogens (adult) = |
| | | | | $ED_{16-26}$ | Exposure Duration, 16-26 years | 10 | years | USEPA, 2005. Mutagenic calculations. | [(CSD x IRsedimenta x FI x EFa x $ED_{6-16}$ x $ADAF_{6-16}$ x CF) + (CSD x |
| | | | | $ADAF_{16-26}$ | Age depend. adjust. factor, 16-26 years | 1 | unitless | USEPA, 2005. Mutagenic calculations. | IRsedimenta x FI x EFa x $ED_{16-26}$ x $ADAF_{16-26}$ x CF)] / (BWa x AT-C) |
| | | | | $ED_{0-2}$ | Exposure Duration. 0-2 years | 2 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{0-2}$ | Age depend. adjust. factor, 0-2 years | 10 | unitless | USEPA, 2005. Mutagenic calculations. | Daily Intake (mg/kg-day) for mutagenic carcinogens (child) = |
| | | | | $ED_{2-6}$ | Exposure Duration, 2-6 years | 4 | years | USEPA, 2005. Mutagenic calculations. | [(CSD x IRsedimentc x FI x EFc x $ED_{0-2}$ x $ADAF_{0-2}$ x CF) + (CSD x |
| | | | | $ADAF_{2-6}$ | Age depend. adjust. factor, 2-6 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | IRsedimentc x FI x EFc x $ED_{2-6}$ x $ADAF_{2-6}$ x CF)] / (BWc x AT-C) |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | **Where:** |
| | | | | BWa | Body Weight - adult | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | Daily Intake (DI) for mutagenic carcinogens (mg/kg-day) = [DI (adult) + DI (child)] |
| | | | | BWc | Body Weight -child | 15 | kg | USEPA, 2014a (USEPA, 2011; Table 8-1; weighted average of mean body weights (birth to <6 years)) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-Na | Averaging Time, noncarcinogens (Adult) | 7,300 | days | EDa x 365 days/year | |
| | | | | AT-Nc | Averaging Time, noncarcinogens (Child) | 2,190 | days | EDc x 365 days/year | |
| Dermal | Outdoor Worker | Adult | Sediment | DAD | Dermally Absorbed Dose | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CSD | Exposure Point Concentration in Sediment | Based on sediment sampling data | mg/kg | -- | Dermally Absorbed Dose (mg/kg-day) for carcinogens = (DA-event x EV x EF x ED x SA) / (BW x AT-C) |
| | | | | SA | Skin surface area for contact | 3,527 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Tables 7-12 and 7-13; Weighted average of mean values for head, hands, and forearms (male and female, 21+years)) | Dermally Absorbed Dose (mg/kg-day) for carcinogens = (DA-event x EV x EF x ED x SA) / (BW x AT-N) |
| | | | | AF | Sediment-to-skin adherence factor | 0.12 | $mg/cm^2$-event | USEPA, 2014a (USEPA, 2011; Table 7-20 and Section 7.2.2; arithmetic mean of weighted average of body part-specific (hands, forearms, and face) mean adherence factors for adult commercial/industrial activities) | **Where:** Absorbed Dose per Event (DA-event) ($mg/cm^2$-event) = CSD x AF x ABS x CF |
| | | | | ABS | Sediment Absorption Factor | Chemical-specific | unitless | USEPA, 2004 (Exhibit 3-4) | |
| | | | | EV | Event Frequency | 1 | events/day | USEPA, 2004 | |
| | | | | EF | Exposure Frequency | 225 | days/year | USEPA, 2014a (USEPA 1991) | |
| | | | | ED | Exposure Duration | 25 | years | USEPA, 2014a (USEPA 1991) | |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 9125 | days | ED x 365 days/year | |
| | Construction Worker | Adult | Sediment | DAD | Dermally Absorbed Dose | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CSD | Exposure Point Concentration in Soil | Based on soil sampling data | mg/kg | -- | |
| | | | | SA | Skin surface area for contact | 3,527 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Tables 7-12 and 7-13; Weighted average of mean values for head, hands, and forearms (male and female, 21+years)) | Dermally Absorbed Dose (mg/kg-day) for carcinogens = (DA-event x EV x EF x ED x SA) / (BW x AT-C) |
| | | | | AF | Soil-to-skin adherence factor | 0.3 | $mg/cm^2$-event | USEPA, 2004 | Dermally Absorbed Dose (mg/kg-day) for noncarcinogens = (DA-event x EV x EF x ED x SA) / (BW x AT-N) |
| | | | | ABS | Soil Absorption Factor | Chemical-specific | unitless | USEPA, 2004 (Exhibit 3-4) | |
| | | | | EV | Event Frequency | 1 | events/day | USEPA, 2002 | |
| | | | | EF | Exposure Frequency | 250 | days/year | USEPA, 2002 | |

**Table F-9 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Future |
| Medium: | Sediment |
| Exposure Medium: | Sediment |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| | Construction Worker | Adult | Sediment | ED | Exposure Duration | 0.5 | years | Assumes construction for one-half year duration | **Where:**<br>Absorbed Dose per Event (DA-event) (mg/cm$^2$-event) =<br>CSD x AF x ABS x CF |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 182.5 | days | ED x 365 days/year | |
| | On-Site Resident | Adult/Child | Sediment | DAD | Dermally Absorbed Dose | Calculated | mg/kg-day | -- | **Non-Mutagenic Constituents**<br>Dermally Absorbed Dose (mg/kg-day) for carcinogens =<br>(DA-event x EV x EFa x EDa x SAa) / (BWa x AT-C) +<br>(DA-event x EV x EFc x EDc x SAc) / (BWc x AT-C) |
| | | | | CSD | Exposure Point Concentration in Sediment | Based on sediment sampling data | mg/kg | -- | |
| | | | | SAa | Skin surface area for contact -adult | 6,032 | cm$^2$ | USEPA, 2014a (USEPA, 2011; Tables 7-12 and 7-13; weighted average of mean values for head, hands, forearms, and lower legs (male and female, 21+years)) | |
| | | | | SAc | Skin surface area for contact - child | 2,373 | cm$^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Tables 7-2 and 7-8; weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, birth to < 6 years) (forearm and lower leg-specific data used when available, ratios for nearest available age group used elsewhere)). | Dermally Absorbed Dose (mg/kg-day) for noncarcinogens (adult) =<br>(DA-eventa x EV x EFa x EDa x SAa) / (BWa x AT-Na)<br>**Where:**<br>Absorbed Dose per Event (DA-eventa) (mg/cm$^2$-event) =<br>CSD x AFa x ABS x CF |
| | | | | AFa | Sediment-to-skin adherence factor -adult | 0.07 | mg/cm$^2$-event | USEPA, 2014a (USEPA, 2004) (Assumed same as soil) | |
| | | | | AFc | Sediment-to-skin adherence factor - child | 0.2 | mg/cm$^2$-event | USEPA, 2014a (USEPA, 2004) (Assumed same as soil) | Dermally Absorbed Dose (mg/kg-day) for noncarcinogens (child) =<br>(DA-eventc x EV x EFc x EDc x SAc) / (BWc x AT-Nc) |
| | | | | ABS | Sediment Absorption Factor | Chemical-specific | unitless | USEPA, 2004 (Exhibit 3-4) | |
| | | | | EV | Event Frequency | 1 | events/day | USEPA, 2014a (USEPA, 2004, Exhibit 3-5) - assumed same as soil | **Where:** |
| | | | | EFa | Exposure Frequency - adult | 176 (1) | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | Absorbed Dose per Event (DA-eventc) (mg/cm$^2$-event) =<br>CSD x AFc x ABS x CF |
| | | | | EFc | Exposure Frequency - child | 176 (1) | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | |
| | | | | EDa | Exposure Duration - adult | 20 | years | USEPA, 2014a (Resident Exposure of 26 years (USEPA, 2011; Table 16-108; 90th percentile for current residence time) minus Resident Duration for child (6 years)). | |
| | | | | EDc | Exposure Duration - child | 6 | years | USEPA, 2014a (USEPA, 1991) | |

**Table F-9 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Future |
| Medium: | Sediment |
| Exposure Medium: | Sediment |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| | On-Site Resident | Adult/Child | Sediment | $ED_{6-16}$ | Exposure Duration, 6-16 years | 10 | years | USEPA, 2005. Mutagenic calculations. | **Mutagenic Constituents** |
| | | | | $ADAF_{6-16}$ | Age depend. adjust. factor, 6-16 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | Dermally Absorbed Dose (mg/kg-day) for mutagenic carcinogens (adult) = [(DA-event x EV x EFa x $ED_{6-16}$ x $ADAF_{6-16}$ x $SA_{6-16}$) + (DA-event x EV x EFa x $ED_{16-26}$ x $ADAF_{16-26}$ x $SA_{16-26}$)] / (BWa x AT-C) |
| | | | | $SA_{6-16}$ | Skin surface area for contact, 6-16 years | 3,749 | $cm^2$ | USEPA 2011; Tables 7-2; weighted average of mean values for head, hands, forearms, and lower legs (male and female, 6 to <16 years). | |
| | | | | $ED_{16-26}$ | Exposure Duration, 16-26 years | 10 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{16-26}$ | Age depend. adjust. factor, 16-26 years | 1 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $SA_{16-26}$ | Skin surface area for contact , 16-26 years | 6,032 | $cm^2$ | USEPA, 2014a (USEPA, 2011; Tables 7-12 and 7-13; weighted average of mean values for head, hands, forearms, and lower legs (male and female, 21+years)) | **Where:** Absorbed Dose per Event (DA-event) ($mg/cm^2$-event) = CSD x AFa x ABS x CF |
| | | | | $ED_{0-2}$ | Exposure Duration. 0-2 years | 2 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{0-2}$ | Age depend. adjust. factor, 0-2 years | 10 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $SA_{0-2}$ | Skin surface area for contact, 0-2 years | 1,741 | $cm^2$ | USEPA, 2011; Tables 7-2; Weighted average of mean values for head, hands, forearms, and lower legs (male and female, birth to <2 years). | Dermally Absorbed Dose (mg/kg-day) for mutagenic carcinogens (child) = [(DA-event x EV x EFc x $ED_{0-2}$ x $ADAF_{0-2}$ x $SA_{0-2}$) + (DA-event x EV x EFc x $ED_{2-6}$ x $ADAF_{2-6}$ x $SA_{2-6}$)] / (BWc x AT-C) |
| | | | | $ED_{2-6}$ | Exposure Duration, 2-6 years | 4 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{2-6}$ | Age depend. adjust. factor, 2-6 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | **Where:** |
| | | | | $SA_{2-6}$ | Skin surface area for contact, 2-6 years | 2,373 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Tables 7-2 and 7-8; weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, birth to < 6 years) (forearm and lower leg-specific data used when available, ratios for nearest available age group used elsewhere)). | Absorbed Dose per Event (DA-event) ($mg/cm^2$-event) = CSD x AFc x ABS x CF |
| | | | | CF | Conversion Factor | 1.0E-06 | kg/mg | -- | |
| | | | | BWa | Body Weight - adult | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | Dermally Absorbed Dose (DAD) (mg/kg-day) for mutagenic carcinogens = [DAD (adult) + DAD (child)] |
| | | | | BWc | Body Weight -child | 15 | kg | USEPA, 2014a (USEPA, 2011; Table 8-1; weighted average of mean body weights (birth to <6 years)) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-Na | Averaging Time, noncarcinogens (Adult) | 7,300 | days | EDa x 365 days/year | |
| | | | | AT-Nc | Averaging Time, noncarcinogens (Child) | 2,190 | days | $ED_c$ x 365 days/year | |

Notes:
(1) Potentially to be revised based on site specific information.

References:


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USEPA, 2011. Exposure Factors Handbook: 2011 Edition. EPA/ 600/ R-090/052F, September 2011.

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**Table F-10 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Future |
| Medium: | Surface Water |
| Exposure Medium: | Surface Water |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| Incidental Ingestion | Outdoor Worker | Adult | Surface Water | DI | Daily Intake | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CSW | Exposure Point Concentration - Surface Water | Based on surface water sampling data | mg/L | -- | Daily Intake (mg/kg-day) for carcinogens = (CSW x IRSW x EF x ED) / (BW x AT-C) |
| | | | | IRSW | Ingestion Rate, surface water | 0.02 | L/day | Ingestion rate of 0.005 L/hr during wading (VDEQ, 2014) and assumes 4 hours/day exposure to surface water. | |
| | | | | EF | Exposure Frequency | 225 | days/year | USEPA, 2014a (USEPA 1991) | Daily Intake (mg/kg-day) for noncarcinogens = (CSW x IRSW x EF x ED) / (BW x AT-N) |
| | | | | ED | Exposure Duration | 25 | years | USEPA, 2014a (USEPA 1991) | |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 9,125 | days | ED (10 years) x 365 days/year | |
| | Construction Worker | Adult | Surface Water | DI | Daily Intake | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CSW | Exposure Point Concentration - Surface Water | Based on surface water sampling data | mg/L | -- | Daily Intake (mg/kg-day) for carcinogens = (CSW x IRSW x EF x ED) / (BW x AT-C) |
| | | | | IRSW | Ingestion Rate, surface water | 0.02 | L/day | Ingestion rate of 0.005 L/hr during wading (VDEQ, 2014) and assumes 4 hours/day exposure to surface water. | |
| | | | | EF | Exposure Frequency | 250 | days/year | USEPA, 2002 | Daily Intake (mg/kg-day) for noncarcinogens = (CSW x IRSW x EF x ED) / (BW x AT-N) |
| | | | | ED | Exposure Duration | 0.5 | years | Assumes construction for one-half year duration | |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 182.5 | days | ED x 365 days/year | |
| | On-Site Resident | Adult/Child | Surface Water | DI | Daily Intake | Calculated | mg/kg-day | -- | **Non-Mutagenic Constituents** |
| | | | | CSW | Exposure Point Concentration - Surface Water | Based on surface water sampling data | mg/L | -- | Daily Intake (mg/kg-day) for carcinogens = (CSW x IRSWa x EFa x EDa) / (BWa x AT-C) + (CSW x IRSWc x EFc x EDc) / (BWc x AT-C) |
| | | | | IRSWa | Ingestion Rate, surface water - adult | 0.015 | L/day | Ingestion rate of 0.005 L/hr during wading (VDEQ, 2014) and assumes 3 hours/day exposure to surface water (USEPA, 2011; Table 16-26). | |
| | | | | IRSWc | Ingestion Rate, surface water - child | 0.015 | L/day | | |
| | | | | EFa | Exposure Frequency - adult | 176 (1) | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | Daily Intake (mg/kg-day) for noncarcinogens (adult) = (CSW x IRSWa x EFa x EDa) / (BWa x AT-Na) |
| | | | | EFc | Exposure Frequency - child | 176 (1) | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | Daily Intake (mg/kg-day) for noncarcinogens (child) = (CSW x IRSWc x EFc x EDc) / (BWc x AT-Nc) |
| | | | | EDa | Exposure Duration -adult | 20 | years | USEPA, 2014a (Resident Exposure of 26 years (USEPA, 2011; Table 16-108; 90th percentile for current residence time) minus Resident Duration for child (6 years)). | |
| | | | | $ED_{6-16}$ | Exposure Duration, 6-16 years | 10 | years | USEPA, 2005. Mutagenic calculations. | **Mutagenic Constituents** |
| | | | | $ADAF_{6-16}$ | Age depend. adjust. factor, 6-16 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ED_{16-26}$ | Exposure Duration, 16-26 years | 10 | years | USEPA, 2005. Mutagenic calculations. | Daily Intake (mg/kg-day) for mutagenic carcinogens (adult) = (CSW x IRSWa x EFa x $ED_{6-16}$ x $ADAF_{6-16}$) + (CSW x IRSWa x EFa x $ED_{16-26}$ x $ADAF_{16-26}$) / (BWa x AT-C) |
| | | | | $ADAF_{16-26}$ | Age depend. adjust. factor, 16-26 years | 1 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | EDc | Exposure Duration - child | 6 | years | USEPA, 2014a (USEPA, 1991) | |
| | | | | $ED_{0-2}$ | Exposure Duration. 0-2 years | 2 | years | USEPA, 2005. Mutagenic calculations. | Daily Intake (mg/kg-day) for mutagenic carcinogens (child) = (CSW x IRSWc x EFc x $ED_{0-2}$ x $ADAF_{0-2}$) + (CSW x IRSWc x EFc x $ED_{2-6}$ x $ADAF_{2-6}$) / (BWc x AT-C) |
| | | | | $ADAF_{0-2}$ | Age depend. adjust. factor, 0-2 years | 10 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ED_{2-6}$ | Exposure Duration, 2-6 years | 4 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{2-6}$ | Age depend. adjust. factor, 2-6 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | **Where:** Daily Intake (DI) (mg/kg-day) for mutagenic carcinogens = [DI (adult) + DI (child)] |
| | | | | BWa | Body Weight - adult | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | BWc | Body Weight - child | 15 | kg | USEPA, 2014a (USEPA, 2011; Table 8-1; weighted average of mean body weights (birth to <6 years)) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-Na | Averaging Time, noncarcinogens (Adult) | 7,300 | days | EDa x 365 days/year | |
| | | | | AT-Nc | Averaging Time, noncarcinogens (Child) | 2,190 | days | EDc x 365 day/year | |

**Table F-10 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Future |
| Medium: | Surface Water |
| Exposure Medium: | Surface Water |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| Dermal | Outdoor Worker | Adult | Surface Water | DAD | Dermally Absorbed Dose | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CSW | Exposure Point Concentration - Surface Water | Based on surface water sampling data | mg/L | -- | Dermally Absorbed Dose (mg/kg-day) for carcinogens = (DA-event x EV x EF x ED x SA) / (BW x AT-C) |
| | | | | FA | Fraction Absorbed Water | Chemical-specific | unitless | USEPA, 2004 | |
| | | | | Kp | Dermal Permeability Coefficient | Chemical-specific | cm/hr | USEPA, 2004 | Dermally Absorbed Dose (mg/kg-day) for noncarcinogens = (DA-event x EV x EF x ED x SA) / (BW x AT-N) |
| | | | | SA | Body Area Available for Contact | 3,527 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Tables 7-12 and 7-13; Weighted average of mean values for head, hands, and forearms (male and female, 21+years)). Assume receptor is wearing water-proof work boots. | |
| | | | | tau-event | Lag Time per Event | Chemical-specific | hours/event | USEPA, 2004 | **Where:** |
| | | | | t-event | Event Duration | 4 | hours/event | Assumes 4 hrs/day exposure to surface water | For organic compounds in which t-event is less than or equal to t-tau: |
| | | | | B | Ratio of Kp of a Compound through the Stratum Corneum Relative to Its Kp across the Viable Epidermis | Chemical-specific | unitless | USEPA, 2004 | DA-event (Absorbed Dose per Event [$mg/cm^2$-event] ) = 2 x FA x Kp x CSW x CF x SQRT([6 x tau-event x t-event] / π) |
| | | | | EV | Event Frequency | 1 | event/day | USEPA, 2004 | |
| | | | | EF | Exposure Frequency | 225 | days/year | USEPA, 2014a (USEPA 1991) | For organics where t-event is greater than t-tau: |
| | | | | ED | Exposure Duration | 25 | years | USEPA, 2014a (USEPA 1991) | DA-event = FA x Kp x CSW x CF x {[t-event/(1+B)] + 2 x tau-event x [ (1 + 3B + $3B^2$) / (1 + $B)^2$ ] } |
| | | | | CF | Conversion Factor | 0.001 | $L/cm^3$ | -- | |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | For inorganic compounds, DA-event = Kp x CSW x CF x t-event |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 9,125 | days | ED x 365 days/year | |
| | Construction Worker | Adult | Surface Water | DAD | Dermally Absorbed Dose | Calculated | mg/kg-day | -- | **Mutagenic and Non-Mutagenic Constituents** |
| | | | | CSW | Exposure Point Concentration - Surface Water | Based on surface water sampling data | mg/L | -- | Dermally Absorbed Dose (mg/kg-day) for carcinogens = (DA-event x EV x EF x ED x SA) / (BW x AT-C) |
| | | | | FA | Fraction Absorbed Water | Chemical-specific | unitless | USEPA, 2004 | |
| | | | | Kp | Dermal Permeability Coefficient | Chemical-specific | cm/hr | USEPA, 2004 | Dermally Absorbed Dose (mg/kg-day) for noncarcinogens = (DA-event x EV x EF x ED x SA) / (BW x AT-N) |
| | | | | SA | Body Area Available for Contact | 3,527 | $cm^2$ | USEPA, 2014a and 2015 (USEPA, 2011; Tables 7-12 and 7-13; Weighted average of mean values for head, hands, and forearms (male and female, 21+years)). Assume receptor is wearing water-proof work boots. | |
| | | | | tau-event | Lag Time per Event | Chemical-specific | hours/event | USEPA, 2004 | **Where:** |
| | | | | t-event | Event Duration | 4 | hours/event | Assumes 4 hrs/day exposure to surface water | For organic compounds in which t-event is less than or equal to t-tau: |
| | | | | B | Ratio of Kp of a Compound through the Stratum Corneum Relative to Its Kp across the Viable Epidermis | Chemical-specific | unitless | USEPA, 2004 | DA-event (Absorbed Dose per Event [$mg/cm^2$-event] ) = 2 x FA x Kp x CSW x CF x SQRT([6 x tau-event x t-event] / π) |
| | | | | EV | Event Frequency | 1 | event/day | USEPA, 2004 | |
| | | | | EF | Exposure Frequency | 250 | days/year | USEPA, 2002 | For organics where t-event is greater than t-tau: |
| | | | | ED | Exposure Duration | 0.5 | years | Assumes construction for one-half year duration | DA-event = FA x Kp x CSW x CF x {[t-event/(1+B)] + 2 x tau-event x [ (1 + 3B + $3B^2$) / (1 + $B)^2$ ] } |
| | | | | CF | Conversion Factor | 0.001 | $L/cm^3$ | -- | |
| | | | | BW | Body Weight | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | For inorganic compounds, DA-event = Kp x CSW x CF x t-event |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-N | Averaging Time, noncarcinogens | 182.5 | days | ED x 365 days/year | |
| | On-Site Resident | Adult/Child | Surface Water | DAD | Dermally Absorbed Dose | Calculated | mg/kg-day | -- | **Non-Mutagenic Constituents** |
| | | | | CSW | Exposure Point Concentration - Surface Water | Based on surface water sampling data | mg/L | -- | Dermally Absorbed Dose (mg/kg-day) for carcinogens = (DA-eventa x EV x EFa x EDa x SAa) / (BWa x AT-C) + (DA-eventc x EV x EFc x EDc x SAc) / (BWc x AT-C) |
| | | | | FA | Fraction Absorbed Water | Chemical-specific | unitless | USEPA, 2004 | |
| | | | | Kp | Dermal Permeability Coefficient | Chemical-specific | cm/hr | USEPA, 2004 | |
| | | | | SAa | Body Area Available for Contact -adult | 7,327 | $cm^2$ | USEPA, 2011; Table 7-2; weighted average of mean values for head, hands, forearms, legs, and feet (male and female, 21+years) | Dermally Absorbed Dose (mg/kg-day) for noncarcinogens (adult) = (DA-eventa x EV x EFa x EDa x SAa) / (BWa x AT-Na) |
| | | | | SAc | Body Area Available for Contact - child | 2,583 | $cm^2$ | USEPA, 2011; Table 7-2; weighted average of mean values for head, hands, arms, legs, and feet (male and female, 2 to <6 years). | Dermally Absorbed Dose (mg/kg-day) for noncarcinogens (child) = (DA-eventc x EV x EFc x EDc x SAc) / (BWc x AT-Nc) |
| | | | | tau-event | Lag Time per Event | Chemical-specific | hours/event | USEPA, 2004 | |

**Table F-10 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Future |
| Medium: | Surface Water |
| Exposure Medium: | Surface Water |

| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| | | | | t-eventa | Event Duration - adult | 3 | hours/event | USEPA, 2011, Table 16-26; mean value for time spent doing outdoor recreational activities in the Northeast Region of US. | **Where:** |
| | | | | t-eventc | Event Duration - child | 3 | hours/event | | For organic compounds in which t-event is less than or equal to t-tau: |
| | | | | B | Ratio of Kp of a Compound through the Stratum Corneum Relative to Its Kp across the Viable Epidermis | Chemical-specific | unitless | USEPA, 2004 | DA-event (Absorbed Dose per Event [mg/cm$^2$-event] ) = 2 x FA x Kp x CSW x CF x SQRT([6 x tau-event x t-event] / π) |
| | | | | EV | Event Frequency | 1 | event/day | USEPA, 2004 | |
| | | | | EFa | Exposure Frequency - adult | 176 (1) | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | For organics where t-event is greater than t-tau: |
| | | | | EFc | Exposure Frequency - child | 176 (1) | days/year | Site-specific assumption (12 weeks (winter) at 2 day/week: 38 weeks (non-winter) at 4 days/week) | DA-event = FA x Kp x CSW x CF x {[t-event/(1+B)] + 2 x tau-event x [ (1 + 3B + 3B$^2$) / (1 + B)$^2$ ] } |
| | | | | EDa | Exposure Duration - adult | 20 | years | USEPA, 2014a (Resident Exposure of 26 years (USEPA, 2011; Table 16-108; 90th percentile for current residence time) minus Resident Duration for child (6 years)). | For inorganic compounds, DA-event = Kp x CSW x CF x t-event |
| | | | | EDc | Exposure Duration - child | 6 | years | USEPA, 2014a (USEPA, 1991) | |
| | | | | $ED_{6-16}$ | Exposure Duration, 6-16 years | 10 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{6-16}$ | Age depend. adjust. factor, 6-16 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | **Mutagenic Constituents** |
| | | | | $SA_{6-16}$ | Skin surface area for contact, 6-16 years | 4,639 | cm$^2$ | USEPA, 2011; Tables 7-2; weighted average of mean values for head, hands, forearms, lower legs, and feet (male and female, 6 to <16 years). | Dermally Absorbed Dose (DAD) (mg/kg/day) for mutagenic carcinogens (adult) = |
| | | | | $ED_{16-26}$ | Exposure Duration, 16-26 years | 10 | years | USEPA, 2005. Mutagenic calculations. | [(DA-event x EV x EFa x $SA_{6-16}$ x $ED_{6-16}$ x $ADAF_{6-16}$) + (DA-event x EV x EFa x $SA_{16-26}$ x $ED_{16-26}$ x $ADAF_{16-26}$)] / (BWa x AT-C) |
| | | | | $ADAF_{16-26}$ | Age depend. adjust. factor, 16-26 years | 1 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $SA_{16-26}$ | Skin surface area for contact , 16-26 years | 7,327 | cm$^2$ | USEPA, 2011; Table 7-2; weighted average of mean values for head, hands, forearms, legs, and feet (male and female, 21+years) | Dermally Absorbed Dose (DAD) (mg/kg/day) for mutagenic carcinogens (child) = |
| | | | | $ED_{0-2}$ | Exposure Duration. 0-2 years | 2 | years | USEPA, 2005. Mutagenic calculations. | [(DA-event x EV x EFc x $SA_{0-2}$ x $ED_{0-2}$ x $ADAF_{0-2}$) + (DA-event x EV x EFc x $SA_{2-6}$ x $ED_{2-6}$ x $ADAF_{2-6}$)] / (BWc x AT-C) |
| | | | | $ADAF_{0-2}$ | Age depend. adjust. factor, 0-2 years | 10 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $SA_{0-2}$ | Skin surface area for contact, 0-2 years | 2,035 | cm$^2$ | USEPA, 2011; Table 7-2; weighted average of mean values for head, hands, forearms, legs, and feet (male and female, birth to <2 years). | **Where:** |
| | | | | $ED_{2-6}$ | Exposure Duration, 2-6 years | 4 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{2-6}$ | Age depend. adjust. factor, 2-6 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | DAD (mg/kg/day) for mutagenic carcinogens = [DAD (adult) + DAD (child)] |
| | | | | $SA_{2-6}$ | Skin surface area for contact, 2-6 years | 2,583 | cm$^2$ | USEPA, 2011; Table 7-2; weighted average of mean values for head, hands, arms, legs, and feet (male and female, 2 to <6 years). | |
| | | | | CF | Conversion Factor | 0.001 | L/cm$^3$ | -- | |
| | | | | BWa | Body Weight - adult | 80 | kg | USEPA, 2014a (USEPA, 2011; Table 8-3; weighted mean values for adults 21 – 78) | |
| | | | | BWc | Body Weight - child | 15 | kg | USEPA, 2014a (USEPA, 2011; Table 8-1; weighted average of mean body weights (birth to <6 years)) | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-Na | Averaging Time, noncarcinogens (Adult) | 7,300 | days | EDa x 365 days/year | |
| | | | | AT-Nc | Averaging Time, noncarcinogens (Child) | 2,190 | days | EDc x 365 day/year | |

Notes:
(1) Potentially to be revised based on site specific information.

References:

USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors". June 1991.
USEPA, 2004. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment), Final, July 2004.
USEPA, 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum, EPA, Washington, DC. 20460, EPA/630/R-03/003F. March.
USEPA, 2011. Exposure Factors Handbook: 2011 Edition. EPA/ 600/ R-090/052F, September 2011.
USEPA, 2014a. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February.
VDEQ, 2014. Virginia Department of Environmental Quality Voluntary Remediation Program (VRP), Risk Assessment Guidance. Section 3.3.2 Exposure Factors.
http://www.deq.virginia.gov/Programs/LandProtectionRevitalization/RemediationProgram/VoluntaryRemediationProgram/VRPRiskAssessmentGuidance/Guidance.aspx

**Table F-11 (RAGS Part D Table 4)**
**Values Used For Daily Intake Calculations**
**Human Health Risk Assessment**
**Former Camp Hero Park, Montauk, New York**

| | |
|---|---|
| Scenario Timeframe: | Future |
| Medium: | Groundwater Contamination |
| Exposure Medium: | Indoor Air |

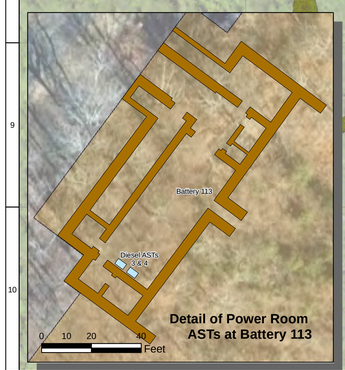
| Exposure Route | Receptor Population | Receptor Age | Exposure Point | Parameter Code | Parameter Definition | Value | Units | Rationale/Reference | Intake Equation/Model Name |
|---|---|---|---|---|---|---|---|---|---|
| Inhalation | On-Site and Off-Site Resident | Adult/Child | Vapors in Indoor Air from Subsurface Vapor Intrusion from Groundwater | ECcancer | Exposure concentration for estimating cancer risk | Calculated | $\mu g/m^3$ | -- | **Non-Mutagenic Constituents** |
| | | | | ECnoncancer | Exposure concentration (chronic exposure) for estimating non-cancer HQ | Calculated | $\mu g/m^3$ | -- | ECcancer = (CA x ET x EF x EDr) / AT-C |
| | | | | CA | Exposure Point Concentration - Indoor Air | Modeled from groundwater sampling | $\mu g/m^3$ | 2004 Johnson and Ettinger Model | ECnoncancer (adult) = (CA x ET x EF x EDa) / AT-Na |
| | | | | ET | Exposure Time | 24 | hour/day | USEPA, 2014a (Assumes whole day) | ECnoncancer (child) = (CA x ET x EF x EDc) / AT-Nc |
| | | | | EF | Exposure Frequency | 350 | days/year | USEPA, 2014a (USEPA 1991) | |
| | | | | EDr | Exposure Duration | 26 | years | USEPA, 2014a (Resident Exposure of 26 years | **Mutagenic Constituents** |
| | | | | EDa | Exposure Duration | 20 | years | USEPA, 2014a (USEPA 2011, Table 16-108; 90th percentile for current residence time). | ECcancer (adult) = |
| | | | | $ED_{6-16}$ | Exposure Duration, 6-16 years | 10 | years | USEPA, 2005. Mutagenic calculations. | $((CA \times ET \times EF \times ED_{6-16} \times ADAF_{6-16}) + (CA \times ET \times EF \times ED_{16-26} \times ADAF_{16-26})) / AT\text{-}C$ |
| | | | | $ADAF_{6-16}$ | Age depend. adjust. factor, 6-16 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ED_{16-26}$ | Exposure Duration, 16-26 years | 10 | years | USEPA, 2005. Mutagenic calculations. | ECcancer (child) = |
| | | | | $ADAF_{16-26}$ | Age depend. adjust. factor, 16-26 years | 1 | unitless | USEPA, 2005. Mutagenic calculations. | $((CA \times ET \times EF \times ED_{0-2} \times ADAF_{0-2}) + (CA \times ET \times EF \times ED_{2-6} \times ADAF_{2-6})) / AT\text{-}C$ |
| | | | | EDc | Exposure Duration - child | 6 | years | USEPA, 2014a (USEPA, 1991) | |
| | | | | $ED_{0-2}$ | Exposure Duration. 0-2 years | 2 | years | USEPA, 2005. Mutagenic calculations. | **Where:** |
| | | | | $ADAF_{0-2}$ | Age depend. adjust. factor, 0-2 years | 10 | unitless | USEPA, 2005. Mutagenic calculations. | ECcancer = [ECcancer (adult) + ECcancer (child)] |
| | | | | $ED_{2-6}$ | Exposure Duration, 2-6 years | 4 | years | USEPA, 2005. Mutagenic calculations. | |
| | | | | $ADAF_{2-6}$ | Age depend. adjust. factor, 2-6 years | 3 | unitless | USEPA, 2005. Mutagenic calculations. | |
| | | | | AT-C | Averaging Time, carcinogens | 25,550 | days | 70 [lifetime in years] x 365 day/year | |
| | | | | AT-Na | Averaging Time, noncarcinogens (Adult) | 7,300 | days | EDa x 365 days/year | |
| | | | | AT-Nc | Averaging Time, noncarcinogens (Child) | 2,190 | days | EDc x 365 day/year | |

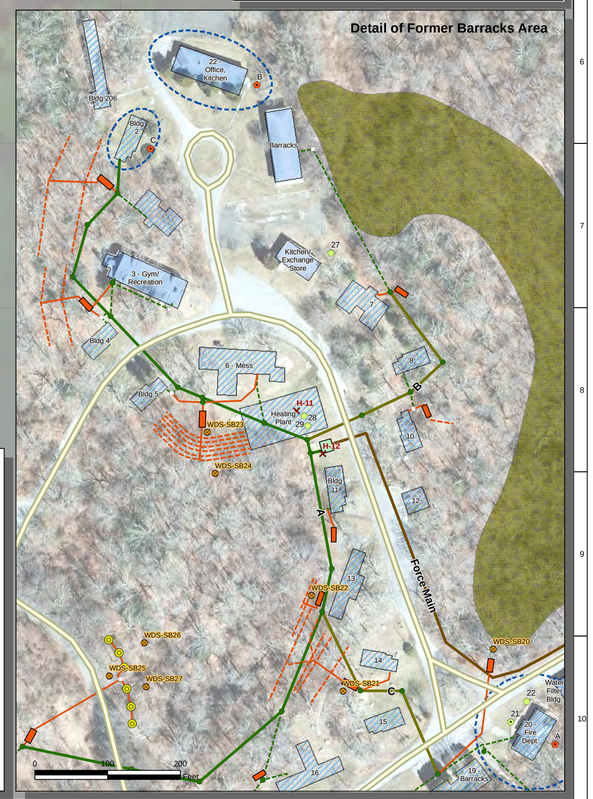

References:
USEPA, 1991. Human Health Evaluation Manual, Supplemental Guidance: "Standard Default Exposure Factors". June 1991.
USEPA, 2005. Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens. Risk Assessment Forum, EPA, Washington, DC. 20460, EPA/630/R-03/003F. March.
USEPA, 2014a. Human Health Evaluation Manual, Supplemental Guidance: Update of Standard Default Exposure Factors. OSWER Directive 9200.1-120. February.

**FWS Wetlands 2014**

- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond; Lake

| Area of Concern | Description/Reason for Concern |
|---|---|
| Battery 113 | Oil Staining, HazMats |
| Building 203 | Possible Ethylene glycol release |
| Building 2010 | Pb in Soil |
| Building F100C | Pb in Soil |
| AST 35/H-13 | Tank associated with reported spill |
| Fuel Pump House/Distribution Line for AST-35 | Potential fuel release (AST-35) |
| Building 20 (Tank A) | Suspected former tank |
| Building 22 (Tank B) | Suspected former tank |
| Building 2 (Tank C) | Suspected former tank |
| Building 104R (Tank D) | Suspected former tank |
| Building 3001 (Tank E) | Suspected former tank |
| Pump House (Tank F) | Suspected former tank |
| Pump House (Tank G) | Suspected former tank |
| Battery 112 | Oil Staining - PCBs |
| Building 107 | Electrical Substation - PCBs |
| Building 201 | Main Radar Tower - PCBs |
| Abandoned Waste Disposal Systems | Hazardous Material Disposal |
| Motor Pool | Hydraulic Lift, Ordinance Repair, Cesspool |
| Engineering Field Office | Ordinance Repair |
| H-1 | Drums |
| H-2 | Drums |
| H-3 | Drums |
| H-4 | Construction Debris |
| H-5 | Debris |
| H-6 | Construction Debris |
| H-7 | Boilers |
| H-8 | Boilers |
| H-9 | Boilers |
| H-11 | Former Power Plant |
| H-12 | Sewage Ejector Station |
| H-14 | Coal Storage Area |
| H-15 | Coal Storage Area |
| H-16 | Sewage Treatment Area |
| H-17 | Open Pits |
| H-18 | Drums |
| H-19 | 550 gal Storage Tank |
| H-20 | Drums |
| H-21 | Open Pits |
| H-22 | Drums |
| Battery 216 | Possible Debris |
| Plotting Room 113 | Possible Debris |
| Camp Hero State Park Bluffs | Debris |




- Water Well
- Sanitary Sewer Geoprobe Location
- Background Sample Location
- AOCs from Cashin Report
- AST (closed)
- UST (closed)
- AST to be Investigated
- UST to be Investigated
- AST (in use)
- UST (in use)
- Streams
- AGC Sites
- Hills
- State Park Bluffs

**Buildings**

- Bunker or Battery
- Former Building
- Existing Building
- Geophysics Area

**Primary Sanitary Sewer Lines**

- A
- B
- C
- D
- E
- F
- G
- H
- J
- Force Main
- Secondary Sewer Line
- Septic Lines
- Drain Tilefields
- Septic Tank
- Other
- Manhole
- Box (cleanout or other)
- Cesspool




Surface water features obtained from National Hydrography Dataset (NHD) Dates of publication vary.

2013 NAIP Aerial Imagery obtained from the USDA Geospatial Data Gateway, a service of the US Department of Agriculture.

Wetlands shapes from U. S. Fish and Wildlife Service. 2015. National Wetlands Inventory website. http://www.fws.gov/wetlands/

Coordinate System: NAD 1983 StatePlane New York Long Island FIPS 3104 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

N W E S

0 85 170 340 Feet

1 inch = 175 feet


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# Site Map

Camp Hero Remedial Investigation Work Plan

| PROJECT NO | APPROVED BY | DATE | Figure 1-2 |
|---|---|---|---|
| 60443903 | DDS | May 2016 | |

9/12/2016 12,100 \\USCHLIFP002\Data\Library\Gisprojects\Projects\Camp_Hero\Maps\Workplan\Fig 1-2 SiteMap.mxd

**FWS Wetlands 2014**

- Estuarine and Marine Wetland
- Freshwater Emergent Wetland
- Freshwater Forested/Shrub Wetland
- Freshwater Pond or Lake

| Area of Concern | Description/Reason for Concern |
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| Building 203 | Possible Ethylene glycol release |
| Building 2010 | Pb in Soil |
| Building F100C | Pb in Soil |
| AST 35/H-13 | Tank associated with reported spill |
| Fuel Pump House/Distribution Line for AST-35 | Potential fuel release (AST-35) |
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| Building 22 (Tank B) | Suspected former tank |
| Building 2 (Tank C) | Suspected former tank |
| Building 104R (Tank D) | Suspected former tank |
| Building 3001 (Tank E) | Suspected former tank |
| Pump House (Tank F) | Suspected former tank |
| Pump House (Tank G) | Suspected former tank |
| Battery 112 | Oil Staining - PCBs |
| Building 107 | Electrical Substation - PCBs |
| Building 201 | Main Radar Tower - PCBs |
| Abandoned Waste Disposal Systems | Hazardous Material Disposal |
| Motor Pool | Hydraulic Lift, Ordinance Repair, Cesspool |
| Engineering Field Office | Ordinance Repair |
| H-1 | Drums |
| H-2 | Drums |
| H-3 | Drums |
| H-4 | Construction Debris |
| H-5 | Debris |
| H-6 | Construction Debris |
| H-7 | Boilers |
| H-8 | Boilers |
| H-9 | Boilers |
| H-11 | Former Power Plant |
| H-12 | Sewage Ejector Station |
| H-14 | Coal Storage Area |
| H-15 | Coal Storage Area |
| H-16 | Sewage Treatment Area |
| H-17 | Open Pits |
| H-18 | Drums |
| H-19 | 550 gal Storage Tank |
| H-20 | Drums |
| H-21 | Open Pits |
| H-22 | Drums |
| Battery 216 | Possible Debris |
| Plotting Room 113 | Possible Debris |
| Camp Hero State Park Bluffs | Debris |

Northern tilefield extent is estimated. It extends off historic drawings.

**Detail of Former Barracks Area**

**Detail of Power Room ASTs at Battery 113**

- Water Well
- Sanitary Sewer Geoprobe Location
- Background Sample Location
- AOCs from Cashin Report

**Storage Tanks**

- AST (closed)
- UST (closed)
- AST to be Investigated
- UST to be Investigated
- AST (in use)
- UST (in use)
- 10-ft. Contour
- Streams
- Local Road
- Abandoned Road
- Hills
- State Park Bluffs

**Buildings**

- Bunker or Battery
- Former Building
- Existing Building
- Geophysics Area

- Manhole
- Box (cleanout or other)
- Cesspool

**Sanitary Sewer Lines**

- other
- A
- B
- C
- D
- E
- F
- G
- H
- J
- Force Main
- Secondary Sewer Line
- Septic Lines
- Drain Tilefields
- Septic Tank
- Other

Surface water features obtained from National Hydrography Dataset (NHD) Dates of publication vary.

2013 NAIP Aerial Imagery obtained from the USDA Geospatial Data Gateway, a service of the US Department of Agriculture.

Wetlands shapes from U. S. Fish and Wildlife Service. 2015. National Wetlands Inventory website. http://www.fws.gov/wetlands/

MAP LOCATION

Contour Interval = 10 feet

Coordinate System: NAD 1983 StatePlane New York Long Island FIPS 3104 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

1 inch = 170 feet

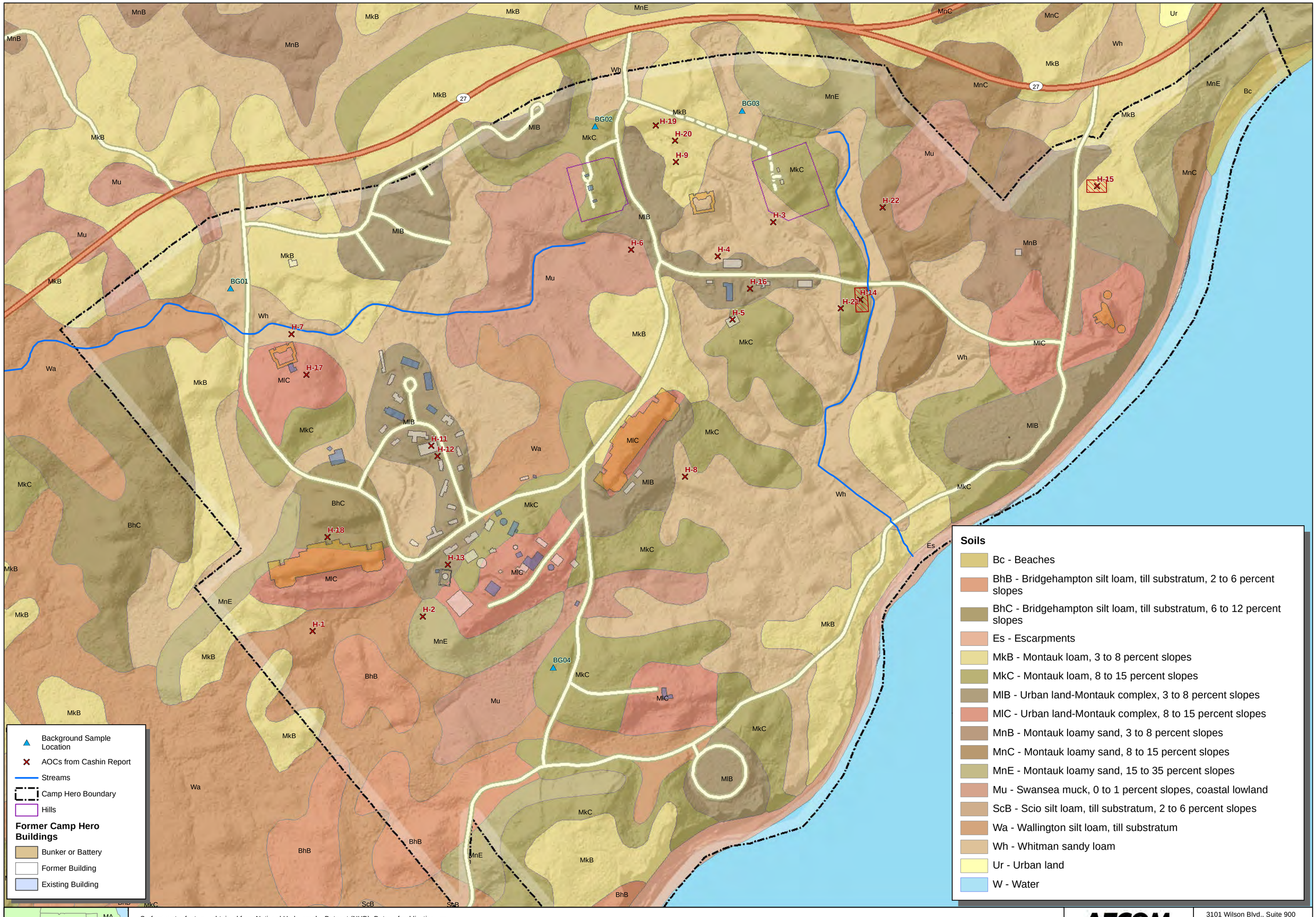
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# Site Topography

Camp Hero Remedial Investigation Work Plan

| Project No. | Designed By | Date | Figure |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 1-2** |

9/26/2016 12:040 \\USCHL1FP002\Data\Library\Gisprojects\Projects\Camp_Hero\Maps\Workplan\Fig 3-2 Topography.mxd







MAP LOCATION

Surface water features obtained from National Hydrography Dataset (NHD) Dates of publication vary.

SSURGO Soils data obtained from U.S. Department of Agriculture, NRCS Service Center

Coordinate System: NAD 1983 StatePlane New York Long Island FIPS 3104 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

0 85 170 340 Feet

1 inch = 350 feet

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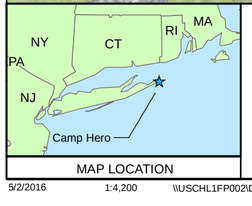
# Soils Map of Camp Hero

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 3-3** |

5/12/2016 1:4,200 \\USCHL1FP002\Data\Library\Gisprojects\Projects\Camp_Hero\Maps\Workplan\Fig 3-3 Soils.mxd




MAP LOCATION

Surface water features obtained from National Hydrography Dataset (NHD) Dates of publication vary.

Significant Natural Communities features represent occurrences of rare or high-quality natural communities (ecological communities), as recorded by the New York Natural Heritage Program. Features obtained from the New York State GIS Clearinghouse.

Coordinate System: NAD 1983 StatePlane New York Long Island FIPS 3104 Feet
Projection: Lambert Conformal Conic
Datum: North American 1983

N W E S

0 175 350 700 Feet

1 inch = 350 feet

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# Significant Natural Communities

Camp Hero Remedial Investigation Work Plan

| PROJECT NO. | PREPARED BY: | DATE: | |
|---|---|---|---|
| 60443903 | DDS | May 2016 | **Figure 3-4** |

5/2/2016 1:4,200 \\USCHL1FP002\Data\Library\Gisprojects\Projects\Camp_Hero\Maps\Workplan\Fig 3-4 Significant Communities.mxd