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FINAL UNIFORM FEDERAL POLICY SAMPLING AND ANALYSIS PLAN STUMP NECK ANNEX SOLID WASTE MANAGEMENT UNIT 14 (SWMU 14) PILOT STUDY NSWC INDIAN HEAD MD
03/01/2015
CH2M HILL

SAP Worksheet #1—Title and Approval Page

Final

Uniform Federal Policy-Sampling and Analysis Plan Stump Neck Annex SWMU 14 Pilot Study

Naval Support Facility Indian Head
Indian Head, Maryland

Contract Task Order JU40

March 2015

Prepared for:

Department of the Navy
Naval Facilities Engineering Command
Washington

Prepared under:

Contract N62470-08-D-1000
CTO-JU40

Prepared by:

CH2MHILL

Chantilly, Virginia

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SAP Worksheet #1—Title and Approval Page (continued)

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Pre-Draft UFP-SAP signed 7 November 2014 by Judith A. Solomon
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NAVFAC Atlantic QA Officer

Other Approval Signatures:

Joseph Rail (by direction)

Allison Cantu
NAVFAC Washington Remedial Project Manager

Robert Thomson

Robert Thomson
EPA Region III Remedial Project Manager

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Executive Summary

Introduction

CH2M HILL has been contracted by the Department of the Navy (Navy), Naval Facilities Engineering Command (NAVFAC) Washington to conduct a pilot study at Stump Neck Annex Solid Waste Management Unit 14 (Stump Neck SWMU 14) - Photographic Lab Septic Tank System, at Naval Support Facility Indian Head, Indian Head, Maryland (Figure 1). This Uniform Federal Policy-Sampling (UFP) and Analysis Plan (SAP) is designed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended by the Superfund Amendments and Reauthorization Act of 1986. CH2M HILL prepared this document under the NAVFAC Washington Comprehensive Long-Term Environmental Action, Navy Contract N62470-11-D-8012, Contract Task Order JU40, for submittal to NAVFAC Washington, the U.S. Environmental Protection Agency (EPA) Region III, and the Maryland Department of the Environment.

Background Information

Stump Neck SWMU 14 is located in the Stump Neck Annex and is approximately 300 feet south of the Potomac River. The site is a topographically flat area atop a small hill and covers approximately 2.4 acres. The site consists of a photographic laboratory (Building 22SN), x-ray facility (Building 2009), and two abandoned-in-place septic tanks with discharge lines and drain fields (Figure 2). The original septic system was constructed in approximately 1968 (A.T. Kearney, Inc., 1990). Photographic development waste chemicals containing silver, hydroquinone, and sodium thiosulfate were periodically discharged to the septic system until it was abandoned in place in the early 1990s (A.T. Kearney, Inc., 1990). The newer septic system, constructed in the early 1990s, was used until buildings 22SN and 2009 were connected to the facility’s sanitary system in 2002. Photographic chemicals are no longer discharged to the septic system.

Environmental sampling was conducted between 2005 and 2008 as part of a Site Screening Process investigation to identify the potential contaminants in subsurface soil and groundwater (CH2M HILL, 2009). Analytical results were evaluated and compared against human health and ecological screening criteria and facility background concentrations. Based on the results of the human health and ecological screening processes, further investigations were recommended to characterize the extent of cobalt contamination in groundwater. Subsurface soil was not recommended for further investigation because the risk screening results suggested that exposure to subsurface soil does not pose unacceptable human health or ecological risks. Based on the results of the Site Screening Process the Indian Head Installation Restoration Team recommended that the groundwater and surface soil be further investigated. A Remedial Investigation (RI) was conducted in 2011 and 2012 to define the nature and extent of metals constituents in the shallow groundwater, in the surface soil in the vicinity of the septic system drain fields, and in the surface soil in the low- lying area downgradient of the site. The RI concluded that potentially unacceptable risks from cobalt are associated with future industrial and hypothetical residential use of the site through exposure to or use of groundwater as a potable water supply, and recommended that a Feasibility Study (FS) be conducted to evaluate remedial alternatives to address elevated levels of cobalt in groundwater at SWMU 14. The RI further concluded that because there is limited habitat for ecological receptors and there were no human health risks associated with surface soil, no further action was recommended for the surface soil.

A draft FS report was initiated in early 2013. Several remedial technologies were selected for evaluation that could potentially address the cobalt in groundwater, including monitored natural attenuation and *in situ* chemical precipitation (as cobalt sulfide). However, several uncertainties regarding site conditions and the potential effectiveness of the remedies were identified. These uncertainties included the current distribution of cobalt in the groundwater, the amount of chemical reagents required for effective treatment, and timeframe for any remedy to decrease the cobalt concentration to the target cleanup goal (39.6 micrograms per liter [µg/L]). Through discussions with the Indian Head Installation Restoration Team, the remedial alternative considered most likely to be selected as the final remedy is *in situ* chemical precipitation of cobalt in areas where cobalt concentrations exceed 400 µg/L. However, additional data are needed to refine the understanding of the plume and aquifer characteristics, the effectiveness of the proposed treatment method, and cost. This UFP-SAP addresses field testing of *in situ* chemical precipitation of cobalt to reduce cobalt concentrations in groundwater and uncertainties to refine the FS assumptions.

The *in situ* chemical precipitation process to be pilot-tested involves precipitation of cobalt as cobalt sulfide, a mineral with low solubility. Sulfide will be generated *in situ* by injecting an organic substrate and sulfate. Microbial activity, driven by the fermentation of the organic substrate, will convert the sulfate to sulfide, which will react with dissolved cobalt to form cobalt sulfide, resulting in lower cobalt concentrations in groundwater.

Objectives of Proposed Investigation

The objectives of this pilot study are:

- Assess the current geochemical conditions and cobalt distribution in the shallow groundwater to refine the 400-µg/L cobalt isoconcentration boundary
- Evaluate the effects of organic carbon substrate and sulfate on shallow groundwater geochemistry and cobalt plume
- Evaluate the potential for natural attenuation
- Determine whether substrate and sulfate injection will be effective as a full-scale remedy at SWMU 14
- Demonstrate whether metals are mobilized as a result of substrate and sulfate injection
- Collect field data for design parameters such as:
  - Organic carbon substrate and sulfate loading (amount to cost-effectively reduce cobalt)
  - Effective porosity of the aquifer

These objectives will be accomplished through the following field activities:

- Installation of an estimated eight permanent monitoring wells and three injection wells
- Establishment of baseline conditions before implementing the injection action, consisting of collection and analyses of groundwater from an estimated 20 wells (9 existing permanent monitoring wells, 8 new permanent monitoring wells, and 3 injection wells)
- Injection of organic carbon substrate and sulfate into three injection wells
- Short-term performance monitoring on a monthly basis for an estimated nine months after injection;, consisting of collection and analyses of groundwater from an estimated three permanent monitoring wells near the injection wells

In accordance with the scoping session held on June 12, 2014 with EPA, analysis will include full target analyte list of target analyte list metals as well as geochemical parameters. EPA noted that full suite analysis for metals is a standard requirement for injectates because as they may change the geochemistry of the groundwater and mobilize other metals.

CH2M HILL prepared this UFP-SAP in accordance with the Navy's UFP-SAP policy guidance to ensure that environmental data collected are scientifically sound, of known and documented quality, and suitable for intended uses. The laboratory information cited in this UFP-SAP is specific to Environmental Conservation Laboratories, Inc. (ENCO) in Orlando, Florida. ENCO was selected based on a competitive selection process and will support all laboratory needs for this project. If additional laboratory services are necessary to meet the project objectives, revised UFP-SAP worksheets will be submitted to the Navy and regulatory agencies for approval and appended to this UFP-SAP.

UFP-SAP Outline

This UFP-SAP contains 37 worksheets, which are grouped into four areas:

- Project Management (worksheets #1–#16)
- Measurements/Data Acquisition (worksheets #17–#30)
- Assessment Oversight (worksheets #31–#33)
- Data Review (worksheets #34–#37)

The tables are embedded within the worksheets and the figures are provided at the end of the document. Field standard operating procedures are provided in Appendix A, and the Department of Defense Environmental Laboratory Accreditation Program letter for ENCO is provided in Appendix B. Upon approval of this UFP-SAP by the Navy and the regulators, the field activities described herein will take place.

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SAP Worksheets

Appendices

Figures

Acronyms and Abbreviations

°C	degrees Celsius
%R	percent recovery
µg/L	micrograms per liter
AM	Activity Manager
AQM	Activity Quality Manager
bgs	below ground surface
CA	corrective action
CAS	Chemical Abstract Service
CCV	continuing calibration verification
CLEAN	Comprehensive Long-Term Environmental Action, Navy
COC	constituent of concern
CoC	chain of custody
CSM	conceptual site model
DL	detection limit
DO	dissolved oxygen
DoD	Department of Defense
DoD QSM	Department of Defense Quality Systems Manual
DQI	data quality indicator
DQO	data quality objective
ELAP	Environmental Laboratory Accreditation Program
ENCO	Environmental Conservation Laboratories, Inc.
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
FTL	Field Team Leader
GPS	global positioning system
H&S	health and safety
HDPE	high-density polyethylene
HHRA	human health risk assessment
ICAL	initial calibration
ICP-MS	inductively coupled plasma mass spectrometer
ICS	interference check solutions
ICV	initial calibration verification
ID	identification
IDW	investigation-derived waste
IHIRT	Indian Head Installation Restoration Team
IR	Installation Restoration
IS	internal standards
LCS	laboratory control sample
LOD	limit of detection
LOQ	limit of quantitation

MCL	Maximum Contaminant Level
MDE	Maryland Department of the Environment
MEE	methane, ethane, ethene
mg/L	milligrams per liter
mL	milliliter(s)
MS/MSD	matrix spike/matrix spike duplicate
MMYY	month and year
N/A	not applicable
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NSFIH	Naval Support Facility Indian Head
ORP	oxidation reduction potential
PAL	project action limit
PM	Project Manager
POC	point of contact
PPE	personal protective equipment
PQL	project quantitation limit
PVC	polyvinyl chloride
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
RI	Remedial Investigation
RL	reporting limit
RPD	relative percent difference
RPM	Remedial Project Manager
RSD	relative standard deviation
RSL	Regional Screening Level
RT	retention time
SAP	Sampling and Analysis Plan
SERA	screening-level ecological risk assessment
SOP	standard operating procedure
SWMU	Solid Waste Management Unit
TAL	target analyte list
TBD	to be determined
TOC	total organic carbon
UFP	Uniform Federal Policy
VOA	volatile organic analyte

SAP Worksheet #2—SAP Identifying Information

Site Name/Number: Photographic Lab Septic Tank System/Stump Neck Annex Solid Waste Management Unit 14 (Stump Neck SWMU 14)

Site Number: SWMU 14

Operable Unit: Not Applicable (N/A)

Contractor Name: CH2M HILL

Contract Number: N62470-8-D-1000, Contract Task Order JU40

Contract Title: Comprehensive Long-Term Environmental Action, Navy (CLEAN) 1000

1. **This Uniform Federal Policy (UFP)-Sampling and Analysis Plan (SAP) was prepared in accordance with the requirements of:**

   Uniform Federal Policy for Quality Assurance Project Plans: Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs. Part 1: UFP-QAPP Manual. *505-B-04-900A*. March. (EPA, Intergovernmental Data Quality Task Force, 2005)

   Guidance for Quality Assurance Project Plans. 240-R-02-009. (EPA, 2002)

   Guidance on Systematic Planning Using the Data Quality Objectives Process. EPA QA/G-4 (EPA, 2006)

2. **Identify regulatory program:**

   Comprehensive Environmental Response, Compensation, and Liability Act of 1980

3. **This SAP is specific to:**

   This is a project-specific SAP for pilot study activities at Stump Neck SWMU 14.

4. **Dates of scoping sessions:**

Scoping Session	Date
Initial Scoping Session (Indian Head Tier I)	April 23, 2014

5. **Dates and titles of SAP documents written for previous site work that are relevant to the current investigation:**

Title	Date
Final Site Screening Process Work Plan for Sites 19, 26, and 27; Wetland Area Adjacent to Site 45; and Stump Neck SWMUs 14 and 30	April 2005
Final Uniform Federal Policy – Sampling and Analysis Plan for Stump Neck Annex SWMU 14 Remedial Investigation	June 2012

6. **Organizational partners (stakeholders) and connection with lead organization:**

   - Maryland Department of the Environment (MDE) – regulatory stakeholder
   - EPA Region III – regulatory stakeholder

7. **Lead organization (see Worksheet #7 for detailed list of data users)**:

   Navy – Lead Agency

SAP Worksheet #2—SAP Identifying Information (continued)

8. If any required UFP-SAP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted elements and provide an explanation for their exclusion below:

All UFP-SAP elements required for this project are described herein on the 37 UFP-SAP worksheets. Therefore, the crosswalk table is not necessary for this project.

SAP Worksheet #3—Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number (Optional)	E-mail Address or Mailing Address
Allison Cantu	Remedial Project Manager (RPM)	Naval Facilities Engineering Command (NAVFAC) Washington	202-685-8056	allison.cantu@navy.mil
Nicholas Carros	Installation Restoration (IR) Program Project Manager	Naval Support Facility Indian Head (NSFIH)	301-744-2263	nicholas.carros@navy.mil
Bob Thomson	RPM	EPA Region III	215-814-3357	Thomson.Bob@epa.gov
Curtis DeTore	RPM	MDE	410-537-3791	curtis.detore@maryland.gov
Margaret Kasim	Activity Manager/Project Manager (AM/PM)	CH2M HILL	703-376-5154	margaret.kasim@ch2m.com
Stacy Bogdanski	Project Manager (PM)	CH2M HILL	703-376-5082	stacy.bogdanski@ch2m.com
Juan Acaron	Project Chemist	CH2M HILL	352-384-7002	Juan.Acaron@ch2m.com
To be determined (TBD)	Field Team Leader (FTL)	CH2M HILL	TBD	TBD
TBD	Field Staff	CH2M HILL	TBD	TBD
Herb Kelly	Data Validator	CH2M HILL	352-384-7100	Herb.Kelly@ch2m.com
Marcia Colon	PM	Environmental Conservation Laboratories, Inc. (ENCO)	407-826-5314	mcolon@encolabs.com
Lori Mangrum	Quality Assurance (QA) Officer	ENCO	407-826-5314	lmangrum@encollabs.com

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SAP Worksheet #4—Project Personnel Sign-Off Sheet

The personnel listed below acknowledge their receipt, acceptance, and approval for the listed sections of this UFP-SAP for pilot study activities at Stump Neck SWMU 14, NSFIH, Indian Head, Maryland. The signed version of this document becomes a part of the Administrative Record for the NSFIH, and a copy will be maintained in CH2M HILL's project file.

Name	Organization-Title-Role	Telephone Number	Signature/email receipt	Date SAP Read	SAP Section Reviewed
Janna Staszak	CH2M HILL – CLEAN Program UFP-SAP Reviewer	757-671-6256			
Anita Dodson	CH2M HILL – CLEAN Program Chemist	757-671-6218			
Juan Acaron	CH2M HILL – Project Chemist	352-384-7002			
TBD	CH2M HILL – FTL	TBD			
TBD	CH2M HILL – Field Team Member	TBD			
Marcia Colon	ENCO – PM	407-826-5314			
Lori Mangrum	ENCO – QA Officer	407-826-5314			
Herb Kelly	CH2M HILL – Data Validator	352-384-7100			

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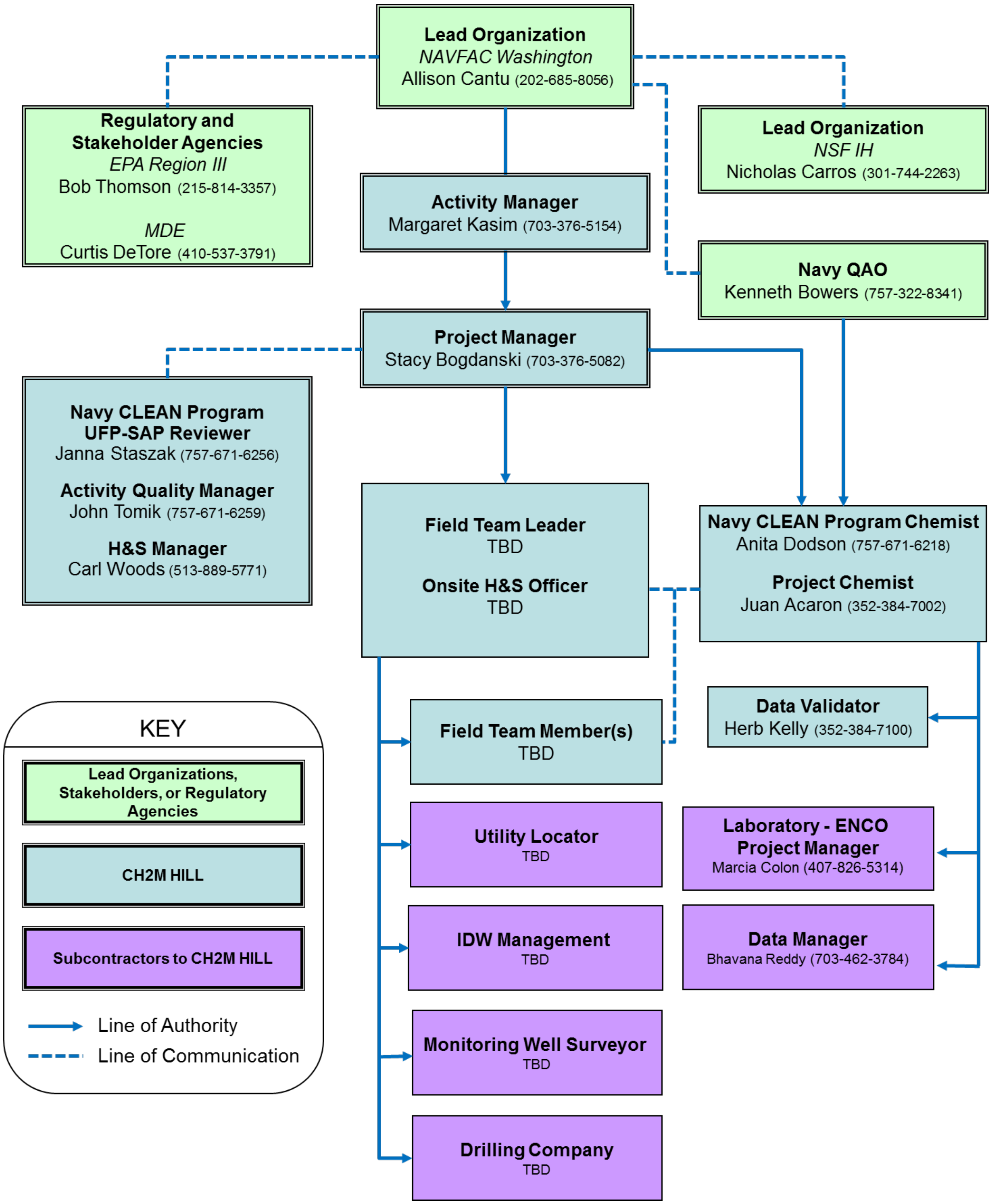
SAP Worksheet #5—Project Organizational Chart



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SAP Worksheet #6—Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure
Communication with Navy (lead agency)	Navy RPM	Allison Cantu	202-685-8056 Alision.Cantu@navy.mil	• Primary point of contact (POC) for Navy • Delegates communication to other internal or external POCs • Notifies EPA and MDE via email within 24 hours of field changes affecting the scope or implementation of the design • Participates in the onboard review discussion • Navy will have 21 calendar days for UFP-SAP review
Communication with NSF-IH	NSFIH	Nicholas Carros	301-744-2263 Nicholas.Carros@navy.mil	• Primary POC for NSFIH • Delegates communication to other internal or external POCs • Participates in the onboard review discussion • If field issues occur that affect the mission of the facility, the IR Program PM or his designee should be notified immediately
Communication with EPA (regulatory agency)	RPM	Robert Thomson	215-814-3357 Thomson.Bob@epa.gov	• Primary POC for EPA • Delegates communication to other internal or external POCs • Has 30 days for UFP-SAP review. • Participates in the onboard review discussion. • Upon notification of field changes, EPA will have up to 24 hours to approve or comment on the field changes
Communication with MDE (regulatory agency)	RPM	Curtis DeTore	410-537-3791 Curtis.detore@maryland.gov	• Primary POC for MDE • Delegates communication to other internal or external POCs • Has 30 days for UFP-SAP review • Participates in the onboard review discussion • Upon notification of field changes, MDE will have up to 24 hours to approve or comment on the field changes
Communication regarding overall project status and implementation and primary POC with Navy RPM, EPA, and MDE	AM	Margaret Kasim	703-376-5154 Margaret.Kasim@ch2m.com	• Forwards all relevant information and materials about the project to Allison Cantu (NAVFAC Washington), John Burchette (EPA), and Curtis DeTore (MDE) • Oversees the overall project status
Technical communications for project implementation and data interpretation	Activity Quality Manager (AQM)	John Tomik	352-335-5877 John.Tomik@ch2m.com	• To be contacted regarding questions/issues encountered in the field, input on data interpretation, as needed • Reviews the data as necessary prior to partnering team discussion
Communications regarding project management and implementation of all project phases, and primary POC with Navy RPM	PM	Stacy Bogdanski	703-376-5082 stacy.bogdanski@ch2m.com	• Forwards all information and materials about the project to Navy RPM on a daily basis • If field changes occur during field activities, PM will work with the Navy RPM to communicate field changes to the team via email within 24 hours • Tracks and coordinates project status as needed • In the case of serious laboratory issues, PM will communicate with the Navy RPM

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure
Data tracking from collection through upload to database Management of analytical lab subcontractor and data validation. Analytical corrective actions (CAs)/ release of analytical data	CH2M HILL Project Chemist	Juan Acaron	352-384-7002 juan.acaron@ch2m.com	• In collaboration with FTL, develops any CAs for field and analytical issues and reports to the PM within 4 hours • Tracks data from sample collection through upload to the database, ensuring Work Plan requirements are met by laboratory and field personnel • POC for laboratory quality assurance/quality control (QA/QC) officer • Reports lab issues to the PM within 4 hours • Analytical laboratory CAs will be identified by, or brought to the attention of, the Project Chemist on a daily basis and reported to the PM within 4 hours • Facilitates resolution on a same-day basis after consulting with the PM and AQM and the Navy Chemist (if changes in the UFP-SAP are warranted) to ensure UFP-SAP requirements are met by the laboratory • Approves release of analytical data after validation is completed and approved by the Project Chemist within 7 days • Communicates with subcontractor laboratory(ies) and data validator by phone, followed up with e-mail to document decisions and actions • Informs PM, RPM, and Navy Chemist of any laboratory issues that would cause negative impacts to project delivery or would cause the project data quality objectives (DQOs) to not be met.
UFP-SAP implementation in the field	CH2M HILL FTL	TBD	TBD	• Documents deviations from the Work Plan in the field logbook and notifies PM immediately • Executes Work Plan deviations only after PM approval • Facilitates CH2M HILL's internal communication (PM to field team members) • Coordinates schedules and field activities with driller, utility locator, and investigation-derived waste (IDW) subcontractors • Communicates with subcontractors by phone, followed up with e-mail to document decisions and actions • Implements project health and safety (H&S) requirements • Reports H&S near misses and incidents to the PM immediately by phone • Provides daily progress reports/updates to the CH2M HILL PM by phone or email
H&S	Onsite H&S Officer	TBD	TBD	• Responsible for the adherence of team members to the site safety requirements described in the H&S Plan • Reports H&S incidents and near losses to PM
Reporting lab data quality issues	Laboratory PM	Marcia Colon	407-826-5314 mcolon@encolabs.com	• Report all QA/QC issues with project field samples to the Project Chemist as soon as identified, not to exceed 24 hours

SAP Worksheet #7—Personnel Responsibilities Table

Name	Title/Role	Organizational Affiliation	Responsibilities
Allison Cantu	Navy RPM	NAVFAC Washington	Manages all NSFIH IR Program activities
Nicholas Carros	IR Program Manager	NSFIH	NSFIH Base contact, reviews and provides input for NSFIH on development of the Stump Neck SWMU 14 activities, and coordinates with NAVFAC and contractors
Robert Thomson	RPM	EPA Region III	Reviews and provides input for EPA on development of the Stump Neck SWMU 14 Remedial Investigation (RI)
Curtis DeTore	RPM	MDE	Reviews and provides input for MDE on the Stump Neck SWMU 14 RI
Margaret Kasim	AM	CH2M HILL	Oversees overall project status for all projects implemented at NSFIH
Stacy Bogdanski	PM	CH2M HILL	Manages Stump Neck SWMU 14 project, oversees all project activities, and is responsible for all aspects of the work performed under this UFP-SAP.
John Tomik	AQM	CH2M HILL	Provides overall technical QC of the field investigation design and implementation; responsible for audits, CA, checks of QA performance
Janna Staszak	CLEAN Program UFP- SAP Reviewer	CH2M HILL	Program-level review of UFP-SAP
Anita Dodson	CLEAN Program Chemist	CH2M HILL	Provides SAP delivery support and program-level review of UFP- SAP
Dean Williamson	Project Technologist	CH2M HILL	Provides technical support, and senior technical oversight of the field investigation design and implementation.
Juan Acaron	Project Chemist	CH2M HILL	Coordinates laboratory and data validation subcontracts and oversees performance of laboratory and data validation. Provides sample tracking, data management, and communication with laboratory.
Carl Woods	H&S Officer	CH2M HILL	Develops and approves project H&S Plan
TBD	FTL	CH2M HILL	Supervises field implementation of the UFP-SAP
Marcia Colon	Laboratory PM	ENCO	Manages sample tracking and maintains good communication with Project Chemist
Lori Mangrum	Laboratory QA officer	ENCO	Responsible for audits, CAs, checks of QA performance within the laboratory
Herb Kelly	Data Validator	CH2M HILL	Provides internal data validation of analytical laboratory data.

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SAP Worksheet #8—Special Personnel Training Requirements Table

No special training requirements are needed for the completion of the work associated with this UFP-SAP.

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SAP Worksheet #9-1—Project Scoping Session 1 Participants Sheet

Project Name: Stump Neck SWMU 14 Pilot Study **Projected Date(s) of Sampling:** 2015 **Project Manager:** Jennifer Myers/CH2M HILL			**Site Name:** Stump Neck SWMU 14 **Site Location:** NSFIH, Indian Head, Maryland	
Date of Session: April 23, 2014 **Scoping Session Purpose:** Scoping session				
Name	**Title**	**Affiliation**	**Phone Number**	**E-mail Address**
Allison Cantu	Navy RPM	NAVFAC Washington	202-685-8056	Allison.Cantu@navy.mil
Nate Delong	Navy RPM	NAVFAC Washington	202-685-3279	Nathan.delong@navy.mil
Nicholas Carros	IR Program PM	NSFIH	301-744-2263	Nicholas.carros@navy.mil
John Burchette	RPM	EPA Region III	215-814-3378	Burchette.John@epa.gov
Curtis DeTore	RPM	MDE	410-537-3791	Curtis.Detore@maryland.gov
Margaret Kasim	AM	CH2M HILL	703-376-5154	Margaret.Kasim@ch2m.com
Jennifer Myers	PM	CH2M HILL	703-376-5203	Jennifer.Myers@ch2m.com
Dean Williamson	Senior Technologist	CH2M HILL	352-384-7204	Dean.Williamson@ch2m.com
John Tomik	AQM	CH2M HILL	757-671-6259	John.Tomik@ch2m.com

The goal of this scoping session was to discuss and concur on the sampling and analysis approach to be presented in a UFP-SAP for Stump Neck SWMU 14 pilot study. CH2M HILL presented a summary of the site history, the conceptual site model (CSM), site layout, and investigation rationale for the Stump Neck SWMU 14 pilot study. The RI was finalized in March 2014, and the draft Feasibility Study (FS) report has been completed, but not submitted to the Indian Head Installation Restoration Team (IHIRT). The Team was informed that based on the FS, the remedy most likely to be chosen will be *in situ* chemical precipitation in the area where cobalt concentration are greater than or equal to 400 micrograms per liter (µg/L). However, additional data are needed to refine the assumptions used in the understanding of the plume and aquifer characteristics, treatment effectiveness, and cost.

The following investigation objectives were proposed during the meeting:

- Assess the current geochemical condition and cobalt distribution in the shallow groundwater
- Evaluate the effects of organic carbon substrate and sulfate on shallow groundwater geochemistry and cobalt plume
- Determine whether substrate and sulfate (in the form of either sodium or magnesium sulfate) injection will be effective as a full-scale remedy at SWMU 14

The Team agreed to the proposed objectives with no changes.

The environmental questions and sampling approach to accomplish the objectives were presented to the Team. Below are the questions, sampling approach, and Team discussions:

What are the current geochemical conditions and cobalt distribution in the shallow groundwater? *To answer that question, 8 monitoring and 3 injection wells will be installed; 20 wells will be sampled (9 existing, 8 monitoring and 3 injection) for total and dissolved cobalt; and a subset of 12 wells will be analyzed for geochemical parameters nitrate, sulfate, total organic carbon (TOC), sulfide, chloride, alkalinity, ferrous iron and dissolved methane, ethane, ethene (MEE), plus field parameters to establish baseline concentrations.*

SAP Worksheet #9-1—Project Scoping Session 1 Participants Sheet (continued)

New monitoring wells will be located within the center of the ≥ 400 µg/L area to better define the plume, and the injection points will be located in the area of highest concentration.

Team discussion and resolution – The Team agreed with the sampling approach with no changes.

How does the injection of organic carbon substrate and sulfate modify the cobalt distribution and geochemistry of groundwater? *To answer that question the reagents will be injected into three injection wells; three monitoring wells near the injection wells will be analyzed monthly for cobalt(total and dissolved), nitrate, sulfate, sulfide, TOC, chloride, alkalinity, ferrous iron, MEE, and field parameters for up to 8 months; results will be evaluated and modeled.*

Team discussion and resolution – Allison asked what the rationale is for nine months of monthly sampling. Dean responded that the target duration of up to nine months was selected for the pilot test based on previous experience using organic substrates and injections of this type. He further explained that nine months is the high end of the time range in which we will expect to see a reduction in the cobalt concentrations. Sampling every month for nine months may not be required, but it will depend on results observed as the test progresses.

John Burchette requested that arsenic and manganese be added to the list of compounds for analysis because they are susceptible to mobilization under the reducing conditions that are necessary to precipitate cobalt. A discussion ensued on the justification for analyzing the samples for full target analyte list (TAL) metals versus the current select list, which is based on the results of the RI completed at this site. Margaret mentioned that there is justification to add metals that are redox- sensitive, but not all metals. She pointed out that the rationale for including all metals will be documented in the UFP-SAP and may be questioned by the Navy Chemist if it does not warrant merit. John will check with Mindi to see what other metals, if any, EPA would like to have analyzed. John Burchette will provide a final list of metals to monitor before drafting the SAP. The SAP will reflect the analytes that EPA requests.

Will the injectates be effective for full- scale use? *Nine months following the injection, a final sampling event will be conducted, during which 17 monitoring wells will be sampled for cobalt (total and dissolved) and a subset of 9 monitoring wells will be analyzed for the geochemistry parameters. Results will be compared to baseline results. If concentrations near the injection points are significantly decreased and the desired geochemistry changes are achieved in the aquifer, the alternative will be considered effective*; *if concentrations near the injection points are not significantly decreased and the desired geochemistry changes are not achieved in the aquifer, the alternative will be considered ineffective and additional remedial alternatives be considered.*

Allison asked what data would indicate that "desired geochemical changes are achieved." Dean summarized the desired parameters that would indicate reducing conditions had been achieved: reduction in oxidation reduction potential (ORP), dissolved oxygen (DO), and sulfate concentrations, increases in ferrous iron and methane, and detection of sulfide. Allison asked if cold weather would affect the injection or microbiological activities. Dean explained that groundwater temperatures are not strongly affected by cold weather; however, freezing conditions can affect concentrated substrates, such as emulsified vegetable oil, if they are allowed to freeze. Jennifer said that the injection activities would be planned for early spring to avoid freezing temperatures.

The schedule was proposed for the investigation to begin in early 2015 following approval of the SAP.

Action Items

John Burchette is to provide list of metals to be analyzed so that the SAP can reflect the full list before going to the Navy Chemist for review. Although a date was not agreed to, it is recommended that the list be provided to CH2M HILL by May 20, 2014.

SAP Worksheet #9-2—Project Scoping Session 2 Participants Sheet

Project Name: Stump Neck SWMU 14 Pilot Study **Projected Date(s) of Sampling:** 2015 **Project Manager:** Jennifer Myers/CH2M HILL			**Site Name:** Stump Neck SWMU 14 **Site Location:** NSFIH, Indian Head, Maryland	
Date of Session: June 12, 2014 **Scoping Session Purpose:** Sampling parameters				
Allison Cantu	Navy RPM	NAVFAC Washington	202-685-8056	Alision.Cantu@navy.mil
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Margaret indicated that the goal of the call was to gain consensus on the sampling parameters for the SWMU 14 pilot study. She further added that the Navy/CH2M HILL do not believe that full metals analysis is necessary because only cobalt was identified as a constituent of concern (COC) in the RI, and because experience at other sites has shown that the metals that can be expected to be mobilized are those that are redox-sensitive, such as iron, manganese and arsenic. Margaret referred to the supporting literature that was sent to the team via email earlier in the day. Mindi indicated that she had not had a chance to review the supporting documentation. She stated that full suite analysis for metals is a standard requirement in the case of injectates that may change the geochemistry of the groundwater. She stated that it is necessary to collect one initial round for full suite metals analysis following the injection to determine if changes in the geochemistry cause changes in the concentrations of other metals. She further added that it may be possible to remove some or all metals from the analytical list following review of the data.

The Team agreed to complete full TAL metals analysis. The Team further agreed to evaluate the data following the first post-injection event and potentially reduce the analyte list. However, the Team could not agree on the criteria to be used in reducing the analyte list. Therefore, the criteria cannot be incorporated into this SAP.

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SAP Worksheet #10—Conceptual Site Model

This worksheet presents the CSM for SWMU 14. The CSM is depicted on Figure 3.

Base Location and Description

NSFIH is a Navy facility in northwestern Charles County, Maryland, approximately 25 miles southwest of Washington, DC. The facility consists of two tracts of land: the Main Installation on the Cornwallis Neck Peninsula and the Stump Neck Annex across Mattawoman Creek (Figure 1). The Main Installation covers approximately 2,500 acres and is bounded by the Potomac River to the northwest, west, and south; Mattawoman Creek to the south and east; and the town of Indian Head to the northeast. Included as part of the Main Installation are Marsh Island and Thoroughfare Island in Mattawoman Creek. The Stump Neck Annex covers approximately 1,084 acres and is bounded by Mattawoman Creek to the northeast, the Potomac River to the north and west, and Chicamuxen Creek to the south.

Site Description and History

Stump Neck SWMU 14 is in the northern portion of Stump Neck Annex, approximately 300 feet south of the Potomac River (Figure 2). The site is a topographically flat area atop a small hill and covers approximately 2.4 acres. The site consists of a photographic laboratory (Building 22SN), x-ray facility (Building 2009), and two abandoned-in-place septic tanks with discharge lines and drain fields. The original septic system was constructed in approximately 1968 (A.T. Kearney, Inc., 1990). Photographic development waste chemicals containing silver, hydroquinone, and sodium thiosulfate were periodically discharged to the septic system until it was abandoned in place in the early 1990s (A.T. Kearney, Inc., 1990). The newer septic system, constructed in the early 1990s, was used until buildings 22SN and 2009 were connected to the facility’s sanitary system in 2002. The photographic laboratory is currently vacant and neither of the septic systems at the site is in use. Photographic chemicals are no longer discharged to the septic system.

Cobalt has been identified as a contaminant in shallow groundwater at this site and is considered to be associated with the use of the original septic system; however, the specific use of cobalt at the site has not been documented even though cobalt-containing compounds are commonly used in imaging (CH2M HILL, 2014). A draft FS report, initiated in early 2013, selected several remedial technologies for evaluation that could potentially address the cobalt in groundwater, including monitored natural attenuation and *in situ* chemical precipitation (as cobalt sulfide). However, several uncertainties regarding site conditions and the potential effectiveness of the remedies were identified. These uncertainties included the current distribution of cobalt in the groundwater, longer-term concentration trends, the amount of chemical reagents required for effective treatment, and the timeframe for either remedy to decrease the cobalt concentration to the target cleanup goal (39.6 µg/L). Through discussions with the IHIRT, the remedial alternative considered most likely to be selected as the final remedy is *in situ* chemical precipitation of cobalt in areas where cobalt concentrations exceed 400 µg/L. However, additional data are needed to refine the understanding of the plume and aquifer characteristics, the effectiveness of the proposed treatment method, and cost. This UFP-SAP addresses field testing of *in situ* chemical precipitation of cobalt to reduce cobalt concentrations in groundwater and uncertainties to refine the FS assumptions and gathers site-wide data to evaluate geochemical conditions and contaminant trends to evaluate a potential for natural attenuation.

The *in situ* chemical precipitation process to be pilot-tested involves precipitation of cobalt as cobalt sulfide, a mineral with low solubility. Sulfide will be generated *in situ* by injecting an organic substrate and sulfate. Microbial activity, driven by the fermentation of the organic substrate, will convert the sulfate to sulfide, which will react with dissolved cobalt to form cobalt sulfide, resulting in lower cobalt concentrations in groundwater.

SAP Worksheet #10—Conceptual Site Model (continued)

Geology, Hydrogeology and Hydrology

Soil at Stump Neck SWMU 14 consists of fluvial silts and clayey sands and gravel from the ground surface to an approximate depth of 31 feet below ground surface (bgs). The sand and gravel layer is underlain by lean clay from an approximate depth of 31 feet to depths greater than 34 feet bgs, but the thickness is unknown because its full depth was not penetrated. Shallow groundwater occurs between 20 and 30 feet bgs within the silt and clayey sands. The water-bearing zone does not extend beyond the hill because the silt and clayey sand unit pinches out. Shallow groundwater appears to flow north towards Mattawoman Creek; however, elevation of the clay confining layer is higher than the elevation of creek, preventing direct discharge of groundwater to the creek. Overland flow from the site is to the adjacent Potomac River.

Nature and Extent of Contamination

Based on the RI (CH2M HILL, 2014), cobalt is the only COC in the shallow groundwater. The highest concentrations of cobalt were detected in the vicinity of the original (circa 1968) septic drain field, indicating that cobalt within the groundwater is likely a result of releases from the original septic system; however, the specific use of cobalt is unknown. During the RI, cobalt was found to exceed the background concentration of 39.6 µg/L at every monitoring well location except IU14MW04, IU14MW09, and IU14MW11. The area exceeding background covers approximately 2 acres. The highest concentrations of cobalt occur in and around monitoring well IU14MW01 and west across the site to monitoring well IU14MW08. The average and maximum dissolved concentrations are 226 µg/L and 632 µg/L, respectively. The average and maximum total concentrations are 228 µg/L and 595 µg/L, respectively. Figure 4 shows the extent of cobalt in groundwater.

Summary of Site Risks

The human health risk assessment (HHRA) and screening-level ecological risk assessment (SERA) conducted as part of the RI concluded the following:

- Surface soil – There are no unacceptable HHRA or SERA risks posed by contamination in the surface soil.
- Subsurface soil – There are no unacceptable HHRA or SERA risks posed by contamination in the subsurface soil.
- Groundwater – The HHRA concluded that there are potentially unacceptable risks to future hypothetical adult and child residents and future industrial workers using shallow groundwater as a potable water supply due to the presence of cobalt. The SERA concluded that there are no unacceptable risks to ecological receptors from exposure to cobalt.

Current and Future Land Use

Currently Stump Neck SWMU 14 is within the confines of Stump Neck Annex and public access is restricted. Navy and Department of Defense (DoD) personnel do have access to the area; however, the site itself is surrounded by a fence to deter trespassers. At this time, the future use of this site is not expected to change.

SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements

This section presents the problem statement and project quality objectives for the pilot study at Stump Neck SWMU 14 in the format specified by the UFP-SAP guidance.

Problem Definition:

A draft FS report was initiated in early 2013. Several remedial technologies were identified that could potentially address the cobalt in groundwater, including monitored natural attenuation and *in situ* chemical precipitation (as cobalt sulfide). Through discussions with the IHIRT, the remedial alternative considered most likely to be selected as the final remedy is *in situ* chemical precipitation of cobalt in areas where cobalt concentrations exceed 400 µg/L. However, several uncertainties regarding site conditions and the potential effectiveness of the remedies were also identified—the distribution of cobalt in the groundwater, long-term concentration trends, aquifer characteristics (such as effective porosity), the dose of organic carbon substrate and sulfate required, and the effects of the remedy on the groundwater geochemistry (that is, will the remedy cause other metals to dissolve in the groundwater). Additional data are needed to refine the understanding of the plume and aquifer characteristics, the effectiveness of the proposed treatment method, and cost.

Environmental Questions to be Answered and Types of Data Needed to Answer Them

1. What are the current geochemical conditions and cobalt distribution in the shallow groundwater?

Eight monitoring wells will be installed within the ≥ 400-µg/L area to better define the plume, and the three injection wells will be installed in the area of highest concentrations (Figure 4). Twenty wells will be sampled (nine existing monitoring, eight new monitoring, and three new injection) for total and dissolved TAL metals with mercury, and a subset of 12 wells (9 monitoring and 3 injection) will be analyzed for geochemical parameters nitrate, sulfate, TOC, sulfide, chloride, alkalinity, ferrous iron and dissolved MEE, plus field parameters to establish baseline concentrations.

2. How does the injection of organic carbon substrate and sulfate modify the cobalt distribution and geochemistry of groundwater?

An organic carbon substrate and sulfate reagent will be injected into three injection wells (Figure 4). Groundwater samples will be collected monthly from three monitoring wells near the injection wells and analyzed initially for TAL metals with mercury (total and dissolved), nitrate, sulfate, sulfide, TOC, chloride, alkalinity, ferrous iron, MEE, and field parameters for up to 8 months for performance monitoring.

4. Do the site-wide geochemical condition and changes in the cobalt distribution in the shallow groundwater over time indicate natural attenuation is occurring at the site?

Nine months following the injection, a final sampling event will be conducted. All site monitoring wells (17) will be sampled for cobalt (total and dissolved); a subset of 9 wells will also be analyzed for the geochemistry parameters.

Who will use the data?

The data will be used by the IHIRT (Navy, EPA Region III, MDE) to make decisions about the path forward for the site. CH2M HILL will use the data in the FS, which will document the field activities and; analytical results, and will refine the assumptions used in the understanding of the plume characteristics and treatability, remedy timeframe, and cost.

Within each organization, the data may be used by hydrogeologists, technologists, and/or PMs. Other technical disciplines within each organization may use the data as well. Chemists will use the data to evaluate overall data quality with respect to subcontracted laboratories. Geologists, hydrogeologists, and technologists may use the data to gain better understanding of groundwater conditions. Engineers may use the data in designing remedial systems in the future, if necessary.

SAP Worksheet #11— Project Quality Objectives/ Systematic Planning Process Statements (continued)

What are the Project Action Limits (PALs)?

The PAL for cobalt, the site COC in the shallow groundwater, is the site remediation goal, which is the background concentration of 39.6 µg/L. The PALs for the other metals, which are not COCs, are the basewide background concentrations (Tetra Tech NUS, 2002), Regional Screening Levels (RSLs), or federal Maximum Contaminant Levels (MCLs), whichever is higher. Field parameters (DO, ORP, pH, temperature, specific conductivity, and turbidity), and other geochemical parameters (such as ferrous iron, alkalinity, sulfate, sulfide, MEE, and chloride) do not have PALs because they do not have a “critical” level upon which decisions will be made. However, the relative values and the changes in the values over time will be used to assess the shallow groundwater conditions before and after treatment and will be used in the overall evaluation of cobalt concentration reduction.

What will the data be used for?

The data will be used to answer the environmental questions listed above.

How “good” must the data be to support the environmental decision?

The data will be of the quality and quantity required to meet the project objective of refining the 400-µg/L cobalt isoconcentration boundary; evaluating the effects of organic carbon substrate and sulfate on the geochemistry of the groundwater, cobalt plume, and natural attenuation parameters; and assessing the dose of organic carbon substrate and sulfate to use. Additional information associated with the precision, bias, sensitivity, representativeness, and comparability of the data is provided in this worksheet and in worksheets #12, #15, #19, #20, #24, and #28.

How will data be used when the laboratory-specific limits of detection (LODs) are greater than the PALs?

Worksheet #15 presents analytical methodology and limits. Some LODs are greater than their respective PALs. Although this information was considered when planning the analytical protocol for the site and may lead to some uncertainty, it does not prevent conclusions from being drawn with respect to the objectives of the pilot study for the following reasons:

(1) The LOD for cobalt, the site COC in the shallow groundwater is not greater than the PAL.

(2) Even though some non-COC LODs are greater than the respective PAL, detection limits (DLs) are closer to and in most cases less than the applicable PALs. The laboratory instrumentation would report a constituent if detected at a concentration greater than its detection limit; such a result would be qualified as estimated when less than the limit of quantitation (LOQ).

(3) For nickel and silver, the DL is greater than the PAL. For these analytes, there exists the potential for a detection greater than the PAL but less than the DL, which would be screened out (reported as non-detect at the LOD) because it cannot be distinguished from noise. Non-detects will be treated as non-exceedances. Any detection (greater than the DL) is treated as an exceedance and is qualified as estimated if less than the LOQ. Although this results in uncertainty, the impact would not be significant because nickel and silver are not site COCs. In addition, the PALs (which are the RSLs) are purely risk-based and do not consider current instrumentation capability. Furthermore, the objective does not require the demonstration of the absence of nickel and silver at less than the RSL.

How much data should be collected (number of samples for each analytical group, matrix, and concentration)?

Detailed information on data collection is provided in Worksheet #17. The quantities and types of QA/QC samples are detailed in Worksheet #20.

SAP Worksheet #11— Project Quality Objectives/ Systematic Planning Process Statements (continued)

Where, when, and how should the data be collected/generated?

- Detailed information on when the data will be collected is provided in Worksheet #16.
- Detailed information on where and how the data will be collected is provided in worksheets #14 and #17.
- All sampling will be performed in general accordance with the procedures described in the NSFIH master plans (TetraTech, 2009) and the standard operating procedures (SOPs) listed on Worksheet #21 and provided in Appendix A.

Where, when, and how should the data be collected/generated?

- Detailed information on when the data will be collected is provided in Worksheet #16.
- Detailed information on where and how the data will be collected is provided in worksheets #14 and #17.
- All sampling will be performed in general accordance with the procedures described in the NSFIH master plans (TetraTech, 2009) and the SOPs listed on Worksheet #21 and provided in Appendix A.

Who will collect and generate the data? How will the data be reported?

- The CH2M HILL field team will collect the samples during the field sampling event.
- The samples will be shipped via overnight courier to ENCO.
- All chemical data generated will be submitted to CH2M HILL. Once received and reviewed by CH2M HILL, all chemical data will be validated internally.
- Field data and field observations will also be collected by CH2M HILL during the field sampling event. These data are qualitative and semi-quantitative (screening) in nature and, therefore, will not undergo validation.
- All chemical and field data will be presented in the FS, which will be submitted to the Navy as a preliminary draft for review before distribution to EPA and MDE for review and approval. The final approved report will be placed in the Administrative Record and will be publicly available.
- **How will the data be archived?**

Data will be archived in accordance with CLEAN contractual requirements. The data will be loaded into the Naval Installation Restoration Information Solution database. At the end of the project, paper copies of archived laboratory data and validation reports will be returned to the Navy.

List the Project Quality Objectives in the form of if/then qualitative and quantitative statements.

- Quantifiable analytical results will be the primary basis for project decisions. The LOQ, defined as the minimum concentrations or quantity of a target analyte that can be reported with accurate quantitation, will be the metric to define whether an analytical result it quantifiable. **If** the analysis of samples shows that analytes are undetected or detected below the PALs, **then** it will be assumed that the concentrations of these constituents require no action.
- If concentrations of cobalt are decreased, and the desired geochemistry changes are achieved within the *in situ* pilot test area, then *in situ* chemical precipitation will be considered an effective remedy.
- If cobalt concentrations within the *in situ* pilot test area are not decreased and the desired geochemistry changes are not achieved; and the approach is not considered cost-effective in the FS, then *in situ* chemical precipitation will be considered ineffective and additional remedial alternatives will be considered.

SAP Worksheet #11— Project Quality Objectives/ Systematic Planning Process Statements (continued)

- If concentrations of other (non-COC) metals do not exceed the PALs, then this treatment approach will be concluded to not result in metals mobilization.
- If concentrations of cobalt are decreasing over time, and the geochemistry conditions necessary to support natural attenuation are present, then it will be assumed that natural attenuation of cobalt is occurring.

SAP Worksheet #12-1—Measurement Performance Criteria Table - Field QC Samples

Matrix: Groundwater
Analytical Group: METAL and FMETAL[3]
Concentration Level: Low (SW-846 6020A, 7470A, 9014)

QC Sample[2]	Analytical Group[1]	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Field Duplicate	METAL and FMETAL	One per 10 discrete field samples	Precision	%RPD ≤20%	S & A
Equipment Rinsate Blank		One per day of sampling for decontaminated equipment One per lot for disposable equipment	Bias / Contamination	Same as method blank. Refer to Worksheet 28	S
Temperature Blank		One per cooler	Accuracy / Representativeness	≤ 6 °C	S

Notes:

[1] If information varies within an analytical group, separate by individual analyte.

[2] Matrix spike/matrix spike duplicate (MS/MSD) is described on Worksheet #28.

[3] Cyanide is not part of the FMETAL analysis group.

RPD –relative percent difference

°C – degrees Celsius

SAP Worksheet #12-2—Measurement Performance Criteria Table - Field QC Samples

Matrix: Groundwater
Analytical Group: WCHEM (MEE, Sulfide, TOC, Alkalinity, Chloride, Nitrate, and Sulfate)
Concentration Level: Low (RSK-175, SM4500-S2-E, SW-846 9060A, EPA 310.2, EPA 300)

QC Sample	Analytical Group[1]	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A) or both (S&A)
Temperature Blank	WCHEM	One per cooler	Accuracy / Representativeness	≤ 6 °C	S

Notes:
[1] If information varies within an analytical group, separate by individual analyte.

SAP 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
Groundwater	CH2M HILL, Site Screening Process Investigation Report for Sites 19, 26, and 27; Wetland Area Adjacent to Site 45; and Stump Neck SWMUs 14 and 30	CH2M HILL, Groundwater, 2005, 2007, 2008,	Data will be used to assist the placement of sample locations and evaluating cobalt concentration trends.	The older data may not be indicative of current site conditions because the data were collected in 2005 and 2007.
Groundwater	CH2M HILL, Remedial Investigation Report Stump Neck Annex – SWMU 14	CH2M HILL, Groundwater, 2005, 2007, 2008, 2011, 2012	Data will be used to assist the placement of sample locations and evaluating cobalt concentration trends.	The older data may not be indicative of current site conditions because the data were collected in 2005 and 2007.

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SAP Worksheet #14—Summary of Project Tasks

Project Logistics

In general, work will be performed by workers in Level D personal protective equipment (PPE), which consists of hard hat, safety glasses, safety-toed boots, and hearing protection. Optional PPE includes the use of Tyvek coveralls. Upgrades to higher levels of PPE are discussed in the H&S Plan, provided as Appendix C.

Sampling activities are expected to be performed during normal working hours, except under specific arrangement with NSFIH for after-hours or weekend activities.

Pre-Mobilization Tasks

- Procure subcontractors
- Schedule field and support staff and conduct field kickoff meeting
- Obtain comprehensive work approval process from NSFIH

Field Investigation Tasks

Applicable project sampling SOPs for project tasks outlined in this section are listed in Worksheet #21 and presented in Appendix A.

Third-Party Utility Clearance

CH2M HILL will identify and mark the locations of the new monitoring wells using a global positioning system (GPS) in accordance with SOP A.1. CH2M HILL will coordinate utility clearance with Miss Utility of Maryland and NSFIH. A third-party utility clearance subcontractor (TBD) will conduct utility clearance for a 15-foot radius around each borehole location, if possible, so that boreholes can be easily relocated if refusal is encountered at a proposed location. Clearance will be performed before conducting any intrusive work, in accordance with SOP A.2.

Well Installation

The locations of the eight monitoring wells (IU14MW12 through IU14MW19), and three injection wells (IU14UIW01 through IU14UIW01U) are shown in Figure 4. Justification for the selection and locations of these wells is provided in Worksheet #17. With support from a drilling subcontractor (TBD), CH2M HILL will install eight permanent monitoring wells and three injection wells using hollow stem auger methods (SOP A.3) to the top of the confining layer, approximately 30 feet bgs. Each borehole will be logged in accordance with SOP A.6 for lithologic characterization. Field screening will be conducted using a photoionization detector as the boreholes are advanced in accordance with SOP A.4.

Monitoring wells and injection wells will be installed using a 4.25-inch inside diameter hollow-stem auger drilling methods. Each well will be constructed of 2-inch inner diameter Schedule-40 polyvinyl chloride (PVC) pipe and installed at a maximum depth of 30 feet. Actual depths of monitoring wells and injection wells may be changed in accordance with field observations made by the field geologist during well installation activities. The monitoring well screens will be machine-slotted, 0.010-inch PVC. Injection well screens will be circumslot (that is, continuous slot, also sometimes called wire-wrapped), 0.010-inch PVC in 5-foot lengths. Injection wells will be completed with a female threaded adapter to accommodate the injection manifold connection.

A silica sand filter pack will be placed around the annular space of the well screen from the bottom of the boring and extending to a depth of 2 feet above the top of the screen. A 2-foot bentonite layer will be placed above the top of the sand pack. After the bentonite has been hydrated, a cement–bentonite grout will be placed in the remaining annular space. The monitoring wells will be completed as a stickup with a steel cover. A locking watertight cap will be placed on the PVC pipe and the wells will be clearly marked.

SAP Worksheet #14—Summary of Project Tasks (continued)

Well Development

Following installation, each well will be developed by the drilling subcontractor using a submersible pump in accordance with SOP A.3. Each monitoring well will be developed using a combination of surging and pumping throughout the well screen. During monitoring well development, CH2M HILL will measure water quality parameters, including pH, ORP, temperature, conductivity, turbidity, and DO with a Horiba U-22 water quality meter or similar water quality meter. The water quality parameters will be recorded in the field notebook approximately every 5 minutes. In addition, the water quality meter will be calibrated daily (at a minimum) and the calibration documented in the field notebook. At least three well volumes of water will be removed, in addition to the amount of water added during the installation process. Development will continue until the water is relatively clear and free of sediment or until 2 hours of development have passed, whichever comes first. Development information, including turbidity, pH, specific conductivity, temperature, and gallons removed will be recorded in the field logbook.

Surveying

All newly installed wells will be horizontally and vertically located by a Maryland-licensed surveyor in accordance with SOP A.5. The surveyor will provide coordinates of all horizontal points X, Y, to the nearest 0.5 foot and vertical point Z to the nearest 0.01 foot (0.1 foot for unpaved ground surface elevations). Well locations (northing, easting, elevation) will be loaded into the geographic information system database.

Groundwater Sampling

All groundwater samples will be collected following low-flow sampling in accordance with SOP A.6. Before well purging for sample collection, water levels will be measured in each. Groundwater samples will be collected by placing the sample intake in the middle of the screen interval. Each well will be purged using low-flow techniques and field parameters (pH, specific conductivity, turbidity, DO, ORP, and temperature) will be monitored until the well has been sufficiently purged in accordance with SOP A.7. Data will be recorded in the log book in accordance with the SOP A.8. DO and ferrous iron will be field-verified using CHEMetrics and Hach test kits, respectively.

If the recharge rate of the well is so low that the well goes dry despite a flow rate of 0.1 liter per minute, purging will stop and the well allowed to recharge. Sampling will be conducted once at least one well volume has been removed. Appropriate QA/QC samples will be collected as specified in Worksheet #20. Equipment blanks and field blanks will be prepared in accordance with SOP A.9. The samples will be placed in coolers and sent to the lab under chain of custody (CoC) in accordance with SOPs A.10 and A.11. The monitoring program is summarized in the text and table below.

- Baseline sampling event: Collect groundwater samples from all 20 wells at the site (17 monitoring and 3 injection) and analyze for total and dissolved TAL metals and mercury. A subset of 12 wells will also be analyzed for geochemical parameters (nitrate, sulfate, TOC, sulfide, chloride, alkalinity, ferrous iron and dissolved MEE), as outlined in Worksheet #19.
- Post-injection monthly sampling events (Month 1 through Month 8): Collect groundwater samples from three wells near the injection wells and analyze for total and dissolved TAL metals and geochemical parameters, similar to baseline sampling and as outlined in Worksheet #19.
- 9-month post-injection sampling event: Collect groundwater samples from 17 monitoring wells and analyze for TAL metals (total and dissolved). A subset of 9 monitoring wells will also be analyzed for geochemical parameters, similar to baseline sampling and as outlined in Worksheet #19.

SAP Worksheet #14—Summary of Project Tasks (continued)

Analyte	Baseline Number of wells to be sampled	Monthly Post-Injection (8 months) Number of wells to be sampled	9-month Post-Injection Number of wells to be sampled
Total TAL Metals (and mercury)	20	3	17
Dissolved TAL Metals (and mercury)	20	3	17
TOC	12	3	9
Sulfate	12	3	9
Sulfide	12	3	9
Nitrate	12	3	9
Chloride	12	3	9
MEE	12	3	9
Alkalinity	12	3	9

Injection Activities

Injection of the organic substrate and sulfate into the aquifer is expected to be accomplished using a small field trailer equipped with a mixing tank for mixing the reagents with water, a small centrifugal pump for injecting the injectate, hoses for conveying the injectate to the injection wells, and appropriate valves, pressure gauges, and flow meters for managing the injection process. It is expected that relatively low injection pressure (less than 20 pounds per square inch) will be needed to accomplish the injection. The volume of injectate for each injection well is expected to be on the order of 1,500 to 2,000 gallons.

Equipment Decontamination

All non-disposable sampling equipment will be decontaminated before sampling activities at each location in accordance with SOP A.12, referenced in Worksheet #21.

Heavy equipment such as drill rig equipment (augers, rods or split spoons) will be steam-cleaned before use at each new monitoring well location. A decontamination pad will be set up onsite to prevent runoff of the decontamination water and to allow easy collection of decontamination fluids into a 55-gallon drum and treatment as IDW.

IDW Handling

IDW soil, purge water, and decontamination rinse water will be placed in 55-gallon drums and sampled for waste characterization parameters in accordance with SOPs A.13 and A.14, referenced in Worksheet #21.

Documentation

Detailed field observations will be recorded in a field notebook in accordance with SOP A.8, referenced in Worksheet #21.

Analytical Tasks

- The laboratory will maintain, test, inspect, and calibrate analytical instruments (worksheets #24 and #25).
- The laboratory will process and prepare samples for analysis.
- The laboratory will analyze environmental samples for various groups of parameters, as shown on Worksheet #18.

SAP Worksheet #14—Summary of Project Tasks (continued)

- The laboratory will provide all sample results in a Level IV data package, which includes all laboratory QC forms and raw data. Please refer to Worksheet #29.
- Although all sample results will be reported in Level IV data packages, only 10 percent of the definitive data will be undergo Level IV data validation (i.e. recalculation of results). Refer to worksheets #34–#36 for more information.

Quality Control

- SOPs for field activities (Appendix A) and laboratory activities being performed.
- QC samples will be collected as described on Worksheet #20.

Secondary Data

Secondary data (Worksheet #13) provided by CH2M HILL has been incorporated into the site history narrative, and will be used for risk assessment and risk management purposes, as appropriate.

Data Management

Appendix A provides guidance on data management steps, such as data requirements and format for field log books and information on CoC procedures. The CH2M HILL Project Chemist is responsible for data tracking and storage and will coordinate archiving and retrieval of data. In addition, a data validator will receive all analytical data from the laboratory and will validate the definitive data before its use by the Navy. All screening data will be checked by the Project Chemist before it is used. See worksheets #34–36 for more information. All validated analytical data will be loaded into the Naval Installation Restoration Information System database.

Procedures for Recording Data, including Guidelines for Recording and Correcting Data

- Field data will be recorded in field logbooks.
- Project Assessment/Audit: Worksheets #31 and #32
- Data Validation: Worksheets #35 and #36
- Data Usability Assessment: Worksheet #37

SAP Worksheet #15-1—Reference Limits and Evaluation Table

Analytical Group: METAL and FMETAL

Matrix: Aqueous

Analyte	CAS No.	RSLs Tap Water Adjusted, May 2014 (µg/L)	MCL Values (µg/L)	95% Upper Tolerance Limit-Background Value (µg/L)	Selected PAL[2] (µg/L)	PQL Goal[3] (µg/L)	Laboratory Specific Limits (µg/L)			Accuracy Control Limit (%R)[4]		Precision Control Limit (% RPD)
							LOQs	LODs	DLs			
Aluminum	7429-90-5	2000	NC[1]	286,545,198	286,545,198	1000	45	25	6.8	84	117	20
Antimony	7440-36-0	0.78	6	NC[1]	6	0.39	2	0.44	0.11	85	117	20
Arsenic	7440-38-2	0.052	10	NC[1]	10	0.026	15	10	0.61	84	116	20
Barium	7440-39-3	380	2000	254	2000	127	10	8	2	86	114	20
Beryllium	7440-41-7	2.5	4	NC[1]	4	1.25	0.8	0.37	0.094	83	121	20
Cadmium	7440-43-9	0.92	5	2.8	5	0.46	8	4	0.11	87	115	20
Calcium	7440-70-2	NC[1]	NC[1]	599,450	599,450	299,725	1750	1200	36	87	118	20
Chromium	7440-47-3	0.035	100	20.9	1000	0.018	5	3	0.45	85	116	20
Cobalt	7440-48-4	0.6	NC[1]	39.6	39.6	19.8	1	0.84	0.21	86	115	20
Copper	7440-50-8	80	1300	22.4	1300	11.2	1.5	0.88	0.22	85	118	20
Cyanide	57-12-5	0.15	200	NC[1]	200	0.075	0.026	0.016	0.0053	83	116	20
Iron	7439-89-6	1400	NC[1]	57,199	57,199	700	25	15	3.8	87	118	20
Lead	7439-92-1	15	15	NC[1]	15	7.5	1	0.6	0.16	88	115	20
Magnesium	7439-95-4	NC[1]	NC[1]	31,254	31,254	15,627	200	120	30	83	118	20
Manganese	7439-96-5	43	NC[1]	28,160	28,160	21.5	2	1.28	0.32	87	115	20
Mercury	7439-97-6	0.57	2	0.13	2	0.065	0.200	0.069	0.023	82	119	20
Nickel	7440-02-0	39	NC[1]	39	39	19. 5	3500	1750	48	87	115	20
Potassium	7440-09-7	NC[1]	NC[1]	83,058	83,058	41,529	4	2.6	0.65	80	120	20
Selenium	7782-49-2	10	50	NC[1]	50	5	0.225	0.116	0.029	85	116	20
Silver	7440-22-4	9.4	NC[1]	NC[1]	9.4	4.7	200	120	32	85	117	20
Sodium	7440-23-5	NC[1]	NC[1]	79,585	79,585	39792.5	0.4	0.23	0.058	82	116	20

SAP Worksheet #15-1—Reference Limits and Evaluation Table (continued)

Analytical Group: METAL and FMETAL

Matrix: Aqueous

Analyte	CAS No.	RSLs Tap Water Adjusted, May 2014 (µg/L)	MCL Values (µg/L)	95% Upper Tolerance Limit-Background Value (µg/L)	Selected PAL[2] (µg/L)	PQL Goal[3] (µg/L)	Laboratory Specific Limits (µg/L)			Accuracy Control Limit (%R)[4]		Precision Control Limit (% RPD)
							LOQs	LODs	DLs			
Thallium	7440-28-0	0.02	2	NC[1]	2	0.01	5	1.56	0.39	86	115	20
Vanadium	7440-62-2	8.6	NC[1]	24.1	24.1	4.3	1	0.8	0.2	86	115	20
Zinc	7440-66-6	600	NC[1]	45.2	600	22.6	10	6.4	1.6	83	119	20

Notes:

[1] NC: No screening level for this compound. Ca, Mg, K, and Na are nutrients.

[2] The PAL for cobalt is 39.6 µg/L and all other constituent PALs are the greater of the RSL, MCL or background values.

[3] To be most conservative, the Project Quantitation Limit (PQL) goal is 1/2 the lesser of RSLs, MCL, and background values.

[4] DoD Quality Systems Manual ([4]DoD QSM) v. 4.2 is the basis for LCS and MS/MSD limits.

Shading indicates cells where the LOD is greater than the PQL goal. Refer to Worksheet #11 section "**How will data be used...**

DoD QSM v. 5.0 does not provide limits for this compound. In-house limits used.

%R - percent recovery

CAS - Chemical Abstract Service

LCS - laboratory control sample

SAP Worksheet #15-2—Reference Limits and Evaluation Table

Analytical Group: WCHEM

Matrix: Groundwater

Analyte	CAS No.[2]	PQL Goal[1] (mg/L)	Laboratory Specific Limits (mg/L)			Accuracy Control Limit (%R)[4]		Precision Control Limit (% RPD)
			LOQs	LODs	DLs			
TOC	TOC	1	1	0.64	0.32	84	115	21
Chloride	16887-00-6	5	5	1	0.3	87	111	15
Sulfate	14808-79-8	5	5	0.3	0.07	87	112	15
Sulfide	18496-25-8	1	1	1	0.45	84	106	10
Nitrate	14797-55-8	1	1	0.2	0.05	88	111	15
Alkalinity	471-34-1	11	11	5.7	1.9	90	110	10
Methane	74-82-8	0.001	0.001	0.000964	0.00044	73	125	30
Ethane	74-84-0	0.002	0.002	0.00196	0.000471	73	133	30
Ethene	74-85-1	0.003	0.003	0.00271	0.00062	74	131	30

Notes:

[1] There are no screening levels or project action limits applicable to WCHEM data. The PQL goal (µg/L) is the laboratory-specific LOQ.

[2] These CAS numbers are contractor-specific

mg/L – milligrams per liter

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SAP Worksheet #16—Project Schedule/Timeline

Pre-Draft UFP-SAP to Navy Chemist	September 2014
Draft UFP-SAP to IHIRT	November 2014
Final UFP-SAP	March 2015
Well Install and Baseline Sampling	Summer 2015
Monthly Monitoring	Summer 2015 though Spring 2016
Results Memo	Summer 2016

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SAP Worksheet #17—Sampling Rationale

Matrix	Depth of Samples	Analysis	Method	Maximum Number of Samples	Rationale	Sampling Strategy
Groundwater	Center of screen interval	TAL Metals (Total and Dissolved, w/Mercury) Sulfate Sulfide MEE Ferrous Iron pH TOC Hardness Cyanide Chloride, Nitrate Alkalinity	6020A (7470A) 2 EPA 300 SM 4500-S2-E RSK-175 9060A 9014 EPA 300 EPA 310.2	91	Eight monitoring wells and three injection wells will be installed at the locations shown on Figure 4. Monitoring well locations were selected to refine the 400-µg/L cobalt isoconcentration boundary. Injection wells will be located in the area of highest cobalt concentrations. Baseline: Twenty wells will be sampled (17 monitoring and 3 injection) for TAL metals with mercury, and a subset of 12 wells (9 monitoring and 3 injection) will be analyzed for geochemical parameters nitrate, sulfate, TOC, sulfide, chloride, alkalinity, ferrous iron and dissolved MEE, plus field parameters to establish baseline concentrations Post-injection monthly sampling: Three monitoring wells will be sampled to evaluate the effects of organic carbon substrate and sulfate on shallow groundwater geochemistry and cobalt concentrations within the injection area. 9-month post-injection sampling: The baseline event will be repeated (without the three injection wells) to assess the post-injection long-term geochemical and cobalt distribution trends in the shallow groundwater and refine the 400-µg/L cobalt isoconcentration boundary post-injection.	Monitoring wells will be purged before sampling. Samples will be collected using low-flow groundwater sampling techniques.

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SAP Worksheet #18—Sampling Locations and Methods/Standard Operating Procedure (SOP) Requirements Table

Sampling Location/ID Number	Matrix	Depth (units)	Analytical Group (See Worksheet #19)	Number of Samples (identify field duplicates)	Sampling (Field) SOP Reference (see Appendix A)
IU14MW01/IU14MW01MMYY	Groundwater	Center of screened interval	TAL Metals (including Cyanide and Mercury) TAL Dissolved Metals (including Mercury) MEE Sulfate Chloride Nitrate Sulfide TOC Alkalinity	1	A.6
IU14MW01/IU14MW01PMMYY				1 (duplicate)	
IU14MW03/IU14MW03MMYY				1	
IU14MW04/IU14MW04MMYY				1	
IU14MW05/IU14MW05MMYY				1	
IU14MW06/IU14MW06MMYY				1	
IU14MW07/IU14MW07MMYY				1	
IU14MW08/IU14MW08MMYY				1	
IU14MW09/IU14MW09MMYY				1	
IU14MW10/IU14MW10MMYY				1	
IU14MW11/IU14MW11MMYY				1 (duplicate)	
IU14MW12/IU14MW12MMYY				1	
IU14MW13/IU14MW13MMYY				1	
IU14MW14/IU14MW14MMYY				1	
IU14MW15/IU14MW15MMYY				1	
IU14MW16/IU14MW16MMYY				1	
IU14MW17/IU14MW17MMYY				1	
IU14IW01/IU14IW01MMYY				1	
IU14IW02/IU14IW02MMYY				1	
IU14IW03/IU14IW03MMYY				1	

Notes:
ID: identification
MMYY: Month and Year

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SAP Worksheet #19—Analytical SOP Requirements Table

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference[1]	Containers (number, size, and type)	Sample Volume[2] (units)	Preservation Requirements (chemical, temperature, light-protected)	Maximum Holding Time[3] (preparation / analysis)
GW	METAL	SW-846 3005A, 6020A, 7470A/MET-03, MET-15	1 of 250mL HDPE	100mL	HNO3 to pH<2 Cool to <6 °C	180 days/ 28 days (Hg)
		SW-846 9014 /WETS-027	1 of 250mL HDPE	150mL	Ascorbic Acid + NaOH to pH > 12, Cool to <6 °C	14 days
	FMETAL	SW-846 3005A, 6020A, 7470A/MET-03, MET-15	1 of 250mL HDPE	100mL	HNO3 to pH<2 Cool to <6 °C	180 days/ 28 days (Hg)
	WCHEM (MEE)	RSK-175 / VGC-11	2 of 40mL VOA Vials	40mL	Cool to <6 °C	7 days
	WCHEM (Alkalinity)	EPA 310.2 / WETS-047	1 of 250mL HDPE	50mL	Cool to <6 °C	28 days
	WCHEM (Chloride, Sulfate, Nitrate)	EPA 300.0 / WETS-092		20mL		14 days
	WCHEM (Sulfide)	SM 4500-S^{2}-E /WETS-061	1 of 250mL HDPE	250mL	ZnAc+NaOH to pH >12, Cool to 6 ° C	7 days
	WCHEM (TOC)	SW-846 9060A / WETS-66	2 of 40mL VOA Vials	40mL	H2SO4 to pH<2, Cool to 6 °C	28 days

Notes:

[1] Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

[2] Provide the minimum sample volume or mass requirement if it differs from the container volume.

[3] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

HDPE - high-density polyethylene

mL - milliliter(s)

VOA - volatile organic analyte

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SAP Worksheet #20—Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Sampling Locations[2]	No. of Field Duplicates	No. of Field Triplicates	No. of MS/MSDs[1]	No. of Field Blanks[3]	No. of Equip. Blanks[3]	No. of VOA Trip Blanks[3]	Total No. of Samples to Lab
Event 1 (May 2015)									
GW	METAL (including Hg and CN)	20	2		2		4		30
	FMETAL (including Hg)	20	2		2		4		30
	WCHEM (Alk, Cl, NO3, SO4, S2, MEE, TOC)	12							12
Event 2-9 (November 2015 - August 2016)									
GW	METAL (including Hg and CN)	3	1		1		1		6
	FMETAL (including Hg)	3	1		1		1		6
	WCHEM (Alk, Cl, NO3, SO4, S2, MEE, TOC)	3							3
Event 10 (September 2016)									
GW	METAL (including Hg and CN)	17	2		2		4		27
	FMETAL (including Hg)	17	2		2		4		27
	WCHEM (Alk, Cl, NO3, SO4, S2, MEE, TOC)	9							9

Notes:

[1] Although the MS/MSD is not typically considered a field QC, it is included here because location determination is often established in the field.

[2] If samples will be collected at different depths at the same location, count each discrete sampling depth as a separate sampling location or station.

[3] The number of equipment blanks, field blanks, and trip blanks is based on a fundamental assumption of the number of sampling days each event will require.

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SAP Worksheet #21—Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work?	Comments
Appendix A.1	Global Positioning System; August 2013	CH2M HILL	GPS unit	No	
Appendix A.2	Locating and Clearing Underground Utilities; August 2013	CH2M HILL	Subcontractor-supplied	No	
Appendix A.3	General Guidance for Monitoring Well Installation; August 2013	CH2M HILL	Subcontractor-supplied	No	
Appendix A.4	Logging of Soil Borings; August 2013	CH2M HILL	Pen, field book, soil color chart	No	
Appendix A.5	Civil Surveying; August 2013	CH2M HILL	GPS unit	No	
Appendix A.6	Groundwater Sampling from Monitoring Wells; August 2013	CH2M HILL	Groundwater sampling pumps and tubing, Horiba U-22	No	
Appendix A.7	Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, Oxidation Reduction Potential, and Temperature Using the Horiba® U-22 with Flow-through Cell; August 2013	CH2M HILL	Horiba U-22	No	
Appendix A.8	Preparing Field Log Books; August 2013	CH2M HILL	N/A	No	
Appendix A.9	Equipment Blank and Field Blank Preparation; August 2013	CH2M HILL	Deionized water, blank liquid	No	
Appendix A.10	Packaging and Shipping Procedures for Low- Concentration Samples; August 2013	CH2M HILL	Lab-supplied coolers	No	
Appendix A.11	Chain-of-Custody; August 2013	CH2M HILL	N/A	No	
Appendix A.12	Decontamination of Personnel and Equipment; April 2014	CH2M HILL	For cleansing reusable samplers	No	
Appendix A.13	Sampling Contents of Tanks and Drums; August 2013	CH2M HILL	Subcontractor-supplied	No	
Appendix A.14	Disposal of Waste Fluids and Solids; August 2013	CH2M HILL	55-gallon steel drums, labeling equipment	No	

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SAP Worksheet #22—Field Equipment Calibration, Maintenance, Testing, and Inspection Table

Field Equipment	Calibration Activity	Maintenance Activity	Testing/ Inspection Activity	Frequency	Acceptance Criteria	CA	Resp. Person	SOP Reference	Comments
Water quality meter	Calibration of pH, dissolved oxygen and conductivity probes	N/A	Visual Inspection	Daily	Parameter specific per model/instruction manual	Manufacturer technical support for calibration errors	FTL	A.7	
Horiba U-22	Calibrate probe using Horiba U-22 Auto-Calibration Standard Solution	Check mechanical and electronic parts, verify system continuity, check battery, and clean probes. Calibration check.	Visual Inspection	Daily before use, at the end of the day, and when unstable readings occur.	Stable readings after 3 minutes pH reads 4.0 +/- 3°/0 conductivity reads 4.49 +/- 3% turbidity reads 0 +/- 3%	Clean probe with deionized water and calibrate again. Do not use this instrument if unable to calibrate properly.	FTL	A.7	
Groundwater sampling pumps and tubing	N/A	N/A	Inspect pumps, tubing and air/ sample line quick-connects	Regularly	Maintained in good working order per manufacturer's recommendations	Replace items	FTL	A.6	

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SAP Worksheet #23—Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and / or Number	Date Last Revisited if not Revised	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to QSM	Modified for Project Work?[1] (y/n)
LOGINS-03	RECEIVING SAMPLES (Rev. 11, Effective 07/31/2012)	6/11/2014	NA	NA	NA	ENCO	No	No
ADMIN-14	WASTE DISPOSAL AND CHARACTERIZATION (Rev. 6, 09/16/2011)	05/20/2014	NA	NA	NA	ENCO	No	No
VGC-11	Analysis of Dissolved Gases by Headspace GC/TCD/FID (Rev. 6, 04/13/2014)	NA	Screening	GW / WCHEM	Gas Chromatograph (GC)	ENCO	No	No
MET-03	Mercury in Waters by Digestion/CVAA (Rev.7, 04/22/2014)	NA	Definitive	GW / METAL, FMETAL	Cold-Vapor Atomic Absorption (CVAA)	ENCO	No	No
Met-15	Metals Analysis by ICP-MS (Rev. 7, 05/15/2014)	NA	Definitive	GW / METAL, FMETAL	Inductively Coupled Plasma Mass Spectrometer (ICP-MS)	ENCO	No	No
EXMT-12	Acid Digestion of Aqueous Samples & Extracts for Analysis by ICP or ICP-MS (Rev.7, 02/20/2014)	NA	NA	GW / METAL, FMETAL	NA	ENCO	No	No
WETS-061	Sulfide (Titrimetric), (Rev. 8/02/20/2014)	NA	Screening	GW / WCHEM	NA	ENCO	No	No
WETS-066	Total and Dissolved Organic Carbon by Combustion-Infrared Method using the Tekmar Apollo 9000 TOC Combustion Analyzer (Rev. 5, 04/15/2013)	4/22/2014	Screening	GW / WCHEM	TOC Analyzer	ENCO	No	No
WETS-092	Ion Chromatography (Rev. 3, 04/05/2013)	3/31/2014	Screening	GW / WCHEM	Ion Chromatograph (IC)	ENCO	No	No
WETS-047	Alkalinity (Methyl Orange, Automated); EPA Method 310.2 (Rev. 2, 06/21/11)	6/21/2014	Screening	GW / WCHEM	NA	ENCO	No	No
WETS-027	Colorimetric Determination of Total Cyanides (Rev. 12, 09/01/2013)	NA	Definitive	GW / METAL	NA	ENCO	No	No

Notes:

This worksheet was prepared 07/15/2014

[1] If yes, then specify the modification that has been made. Note that any analytical SOP modification made relative to project specific needs must be reviewed and approved by the Navy QA Officer.

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SAP Worksheet #24—Analytical Instrument Calibration Table

Instrument[3]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA[2]	SOP Reference[1]
ICP-MS (Metals)	Linear Dynamic Range or High-level Check Standard	At initial set-up and checked every 6 months with a high standard at the upper limit of the range.	Within +/- 10% of true value.	Dilute samples within the calibration range, or re-establish/verify the Linear Dynamic Range	Analyst	MET-15
	Tuning	Prior to initial calibration (ICAL).	Mass calibration ≤ 0.1 atomic mass unit from the true value; resolution < 0.9 atomic mass unit full width at 10% peak height. For stability, relative standard deviation (RSD) ≤ 5% for at least four replicate analyses.	Retune instrument then reanalyze tuning solutions.		
	ICAL for all analytes	Daily ICAL prior to sample analysis.	If more than one calibration standard is used, r^2≥ 0.995.	Correct problem, then repeat ICAL.		
	Second source calibration verification	Once after each ICAL, prior to beginning a sample run.	Value of second source for all analytes within ± 10% of true value.	Verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.		
	Continuing Calibration Verification (CCV)	After every 10 field samples and at the end of the analysis sequence.	All analytes within ± 10% of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.		
	Low-Level Calibration Check Standard (Low-Level Initial Calibration Verification [ICV])	Daily	All reported analytes within ± 10% of the true value.	Correct problem and repeat ICAL.		
	Internal Standards (IS)	Every field samples, standard and QC sample.	IS intensity in the samples within 30-120% of the intensity of the IS in the ICAL blank.	Terminate analysis, locate and correct problem, reanalyze interference check solutions (ICS), reanalyze all samples.		
CVAA (Mercury)	ICAL - minimum 5 standards and a calibration blank	ICAL Daily prior to sample analysis.	Correlation coefficient >0.995; accepted if the second-source calibration verification passes.	Correct problem, then repeat ICAL.	Analyst	MET-03
	Second-source Calibration Verification	Once per ICAL, prior to beginning a sample run.	Less than 10% difference from expected concentration for all target analytes.	Correct problem, then repeat. If still fails, repeat initial calibration.		
	CCV	Following second-source calibration verification, after every 10 samples and the end of the sequence.	Within +/- 20% of true value.	Correct problem, then repeat. If still fails, repeat ICAL. Re-analyze all samples since the last successful calibration verification.		
	Calibration blank	Daily after ICAL and every 10 samples.	No analytes detected > LOD.	Correct problem, re-prep and reanalyze calibration blank. Re-analyze all samples following the last acceptable calibration blank.		
IC (Ions)	ICAL for all analytes.	ICAL prior to sample analysis.	r2 ≥ 0.99.	Correct problem then repeat ICAL.	Analyst	WETS-092
	Retention Time (RT) window position establishment	One per multipoint calibration	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA		
	RT window width	At method set-up and after major maintenance (e.g. column change).	RT width is ± 3 times the standard deviation for each analyte RT over a 24 hour period.	NA		
	ICV	Once after each ICAL, analysis of a second source standard prior to sample analysis.	All reported analytes within established RT windows. All analytes within ± 10% of true value.	Correct problem. Rerun ICV. If that fails, repeat ICAL.		
	CCV	Before sample analysis; after every 10 field samples; and at the end of the analysis sequence.	All project analytes within established RT windows. Within ± 10% of true value.	Recalibrate, and reanalyze all affected samples since the last acceptable CCV; or Immediately analyze two additional consecutive CCVs. If both pass, samples may be reported without reanalysis. If either fails, take CA corrective action(s) and re-calibrate; then reanalyze all affected samples since the last acceptable CCV.		
TOC Analyzer	ICAL, minimum of five standards and a calibration blank	Annually, ICAL prior to sample analysis.	Coefficient of determination at least 0.995	Correct problem then repeat ICAL.	Analyst	WETS-066
	Second source calibration verification	Once after each ICAL.	All analytes within ± 15% of true value and RTs within appropriate windows	Verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.		
	CCV	After every 10 field samples and at the end of the analysis sequence.	All analytes within ± 15% of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.		

SAP Worksheet #24—Analytical Instrument Calibration Table (continued)

Instrument[3]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA[2]	SOP Reference[1]
GC (MEE)	ICAL for all analytes	Daily ICAL prior to sample analysis.	Calculate response factor for each standard, compute average response factor and percent RSD. RSD <20%. Optionally, a linear regression curve may be fit if the correlation coefficient > 0.990.	Correct problem then repeat ICAL.	Analyst	VGC-11
	Second -source calibration verification	Once after each ICAL.	All project analytes within ± 25% of true value.	Verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.		
	CCV	Before any samples in sequences that don't include initial calibrations, after every 24 hours, and at the end of the sequence.	All project analytes within ± 20% of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.		
Cyanide Analyzer	ICAL - six standards and a calibration blank	Daily ICAL prior to sample analysis.	r ≥ 0.995	Correct problem, then repeat ICAL.	Analyst	WETS-027
	Distilled Standards (one high and one low)	Once per ICAL.	Within ± 15% of true value.	Correct problem, then repeat distilled standards.		
	Second-source calibration verification	Once after each ICAL, prior to beginning a sample run.	Within ± 15% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		

Notes:

[1] Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

[2] Name or title of responsible person may be used.

[3] DoD QSM v. 4.2 is the basis for specifications on this table. Specifications are based on the analytical method that will be performed.

SAP 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[2]	SOP Reference[1]
ICP-MS	Clean, inspect, change cones	Monitor internal standard (ISTD) counts for variation	Instrument performance and sensitivity	As needed	Monitor ISTD counts for variation	Re-calibrate	Analyst	MET-15
	Clean, inspect, change spray chamber, injector, torch					Replace windings, re-calibrate and re-analyze		
	Replace pump windings							
CVAA (Mercury)	Replace disposables, flush lines	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	MET -03
	Clean lens				Method blank pass criteria			
	Replace pump tubing	Flow Rate Check		As needed	Monitor flow rate for variation	Replace windings, recalibrate and re-analyze		
IC (Ions)	Fill eluent bottles and Fill reservoir water bottle.	N/A	Visual	Weekly or as needed	N/A	Fill bottle as needed	Analyst	WETS-092
	Check back pressure is below 2,300 pounds per square inch.	N/A	Visual	Weekly or as needed	N/A	clean or replace guard column and frit		
	Check IC for leaks.	N/A	visual check for liquid or pressure fluctuation	Weekly or as needed	N/A	fix leak		
TOC ANALYZER	Inspect/Clean TOC syringe.	N/A	Visual	Monthly	N/A	Clean as needed	Analyst	WETS-066
	Inspect Permeation Dryer.	N/A	Visual	Monthly	N/A	Replace if humidity observed		
	Test fittings on 8 port valve	N/A	Visual check for leaks	Monthly	N/A	Replace or tight fittings as needed		
	Replace Injection Line.	N/A	Peak shape and uniformity between injection replicas	As needed	CCV pass criteria	Replace line		
	Replace Corrosive Scrubber (Tin and Copper).	N/A	Color discoloration	As needed	CCV pass criteria	Replace Tin and Copper		
	Replace/wash and condition Catalyst and Combustion Tube	N/A	CCV passing	As needed	CCV pass criteria	Replace and condition.		
GC-FID (MEE)	Injection port maintenance	N/A	Evaluate baseline and peak shapes	As needed	Analyst judgment of excessive tailing or baseline fluctuation	Clip the guard column, replace the injection port liner, replace the gold seal, clean the injection port, and replace the injection port septum.	Analyst	VGC-11
Cyanide Analyzer	Clean sample cell before use	Turn on instrument and wait 15 minutes to warm-up	Visual	Before each run	Calibrate by zeroing; blank and CCV pass criteria	Recalibrate instrument	Analyst	WETS-27

Notes:

[1] Specify the appropriate reference letter or number from the Analytical SOP References table (Worksheet #23).

[2] Name or title of responsible person may be used.

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SAP Worksheet #26—Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): FTL (TBD)/CH2M HILL
Sample Packaging (Personnel/Organization): Sample Processor or Field Team Member (TBD)/CH2M HILL
Coordination of Shipment (Personnel/Organization): Sample Processor or Field Team Member (TBD)/CH2M HILL
Type of Shipment/Carrier: Overnight/FedEx
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Receipt Personnel/ ENCO
Sample Custody and Storage (Personnel/Organization): Sample Receipt Personnel/ ENCO
Sample Preparation (Personnel/Organization): Extractions Personnel/ ENCO
Sample Determinative Analysis (Personnel/Organization): Analyst/ ENCO
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): 90 days
Sample Extract/Digestate Storage (No. of days from extraction/digestion): Extracts may be disposed of 90 days after extraction.
Biological Sample Storage (No. of days from sample collection): N/A
SAMPLE DISPOSAL
Personnel/Organization: Environmental Health and Safety Office/ ENCO
Number of Days from Analysis: Samples may be disposed of 90 days after report mail date

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SAP Worksheet #27—Sample Custody Requirements Table

Sample Labeling

Sample labels will include, at a minimum, client name, site, sample ID, date/time collected, analysis group or method, preservative, and sampler's initials. Labels will be taped to the jar to ensure that they do not separate.

1. Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):

Samples will be collected by field team members under the supervision of the FTL. As samples are collected, they will be placed into containers and labeled, as outlined above. Samples will be cushioned with packaging material and placed into coolers containing enough ice to keep the samples below 4 °C until they are received by the laboratory. The chain of custody (CoC) will also be placed into the cooler. Coolers will be shipped to the laboratory via FedEx, with the airbill number indicated on the CoC (to relinquish custody). Upon delivery, the laboratory will log in each cooler and report the status of the samples.

2. Laboratory Sample Custody Procedures (receipt of samples, archiving, and disposal):

See the laboratories' sample handling SOPs: LOGINS-03 for details on sample handling.

3. Sample Identification Procedures:

Upon opening the cooler, the receiving clerk signs the CoC and then takes the temperature using the temperature blank (if absent, then a sample container or infrared thermometer is used). The sample containers in the cooler are unpacked and checked against the client's CoC and any discrepancies or breakage are noted on the CoC. Next, if any water samples require preservative, the clerk will check the pH values to see if they are in the acceptable pH range. The clerk will deliver the CoC (and any other paperwork, such as temperature or pH QA notice, to the PM for Laboratory Information Management Systems entry and client contact (if needed).

The field logbook will identify the sample ID with the location, depth, date/time collected, and the parameters requested. The laboratory will assign each field sample a laboratory sample ID based on information in the CoC. The laboratory will send sample log-in forms to the Project Chemist to check sample IDs and parameters are correct.

4. Chain-of-Custody Procedures:

CoCs will include, at a minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information. Sample information will include sample ID, date/time collected, number and type of containers, preservative information, analysis method, and comments. The CoC will also have the sampler's name and signature. The CoC will link location of the sample from the field logbook to the laboratory receipt of the sample. The laboratory will use the sample information to populate the Laboratory Information Management System database for each sample.

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SAP Worksheet #28-1—Laboratory QC Samples Table

Matrix: Groundwater
Analytical Group: METAL, FMETAL
Analytical Method/ SOP Reference: SW-846 6020A, 7470A, and 9014 /MET-15, MET-03, and WETS-27

QC Sample[1]	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
METALs and FMETALs by SW-846 6020A						
Method Blank	One per preparatory batch.	No analytes detected > 1/2 LOQ. Blank result must not otherwise affect sample results.	Correct problem; then repeat. If the method blank still fails; redigest and analyze all affected samples.	Analyst, Laboratory Supervisor	Bias/Contamination	Same as Method / SOP QC Acceptance Limits.
LCS		Refer to Worksheet #15.	LCS is re-analyzed. If still fails, samples, along with QC, are re-prepped and re-analyzed. Client will be contacted for guidance about whether to re-prep samples. In the absence of client-specific requirements, flag the data.		Precision and Accuracy/Bias	
MS		Same as LCS.	Perform a dilution test and/or post spike to evaluate matrix effects.		Precision and Accuracy/Bias	
MSD		Same as LCS and refer to Worksheet #15 for MS/MSD RPD.			Precision and Accuracy/Bias	
Dilution Test		Recovery within ±10% of true value.	Perform post spike.		Precision and Accuracy/Bias	
Post Spike	When dilution test fails or analyte concentration for all samples < 50x LOD.	Recovery within ±25% of true value.	If dilution test recovers outside of QC acceptance limits but post spike meets QC acceptance criteria, matrix effects are not confirmed, reprep and reanalyze sample.		Precision and Accuracy/Bias	
IS	Spiked in every sample.	IS intensity within 30-120% of intensity of IS in ICAL.	Re-analyze sample at 5x dilution with the addition of appropriate amounts of IS.		Precision and Accuracy	
Mercury and Filtered Mercury by SW-846 7470A						
Method Blank	One per preparatory batch.	No analytes detected > 1/2 LOQ. Blank result must not otherwise affect sample results.	Correct problem; then repeat. If the method blank still fails; re-prep and re-analyze all samples processed with contaminated blank.	Analyst, Laboratory Supervisor	Bias/Contamination	Same as Method / SOP QC Acceptance Limits.
LCS		Refer to Worksheet #15.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch.		Precision and Accuracy/Bias	
MS		Same as LCS.	Examine the project DQOs. In absence of project specific instruction, flag the data.		Precision and Accuracy/Bias	
MSD		Same as LCS and refer to Worksheet #15 for MS/MSD RPD.	Examine the project-specific DQOs, Contact the client as to additional measures to be taken.		Precision and Accuracy/Bias	
Cyanide[2] by SW-846 9014						
Method Blank	One per preparatory batch.	No analytes detected > ½ RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct problem; then repeat. If the method blank still fails; redigest and analyze all affected samples.	Analyst, Laboratory Supervisor	Bias/Contamination	Same as Method / QC Acceptance Limits.

SAP Worksheet #28-1—Laboratory QC Samples Table (continued)

Matrix: Groundwater

Analytical Group: METAL, FMETAL

Analytical Method/ SOP Reference: SW-846 6020A, 7470A, and 9014 /MET-15, MET-03, and WETS-27

QC Sample[1]	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
LCS		Refer to Worksheet #15.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes. If reanalysis cannot be performed, data must be qualified and explained in the case narrative.		Precision and Accuracy/Bias	
MS		Same as LCS.	In absence of client-specific requirements, flag the data.		Precision and Accuracy/Bias	
MSD		Same as LCS and RPD ≤ 20%.				

Notes:

[1] DoD QSM v. 4.2 is the basis for specifications on this table.

[2] Cyanide is not part of the FMETAL analysis group.

RL - reporting limit

SAP Worksheet #28-2—Laboratory QC Samples Table

Matrix: Groundwater

Analytical Group: WCHEM

Analytical Method/ SOP Reference: SW-846 9060A, EPA 310.2, EPA 300.0, SM 4500 S-2E, and RSK-175 / WETS-066, WETS-004, WETS-092, WETS-061, and VGC-11

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
TOC by SW-846 9060A						
Method Blank	One per preparatory batch	No target analytes > 1/2 LOQ	Correct problem; then repeat. If the method blank still fails; repeat initial calibration.	Analyst, Laboratory Supervisor	Bias/ contamination	Same as Method / SOP QC Acceptance Limits.
LCS		85-115%	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. Client will be contact for guidance about whether to re-prep samples. In the absence of client- specific requirements, flag the data.		Precision and Accuracy/Bias	
MS/MSD		85-115%	In the absence of client-specific requirements, flag the data		Precision and Accuracy/Bias	
Alkalinity by EPA 310.2						
Method Blank	One per preparatory blank	No target analytes > 1/2 LOQ	Correct problem; then repeat. If the method blank still fails; repeat initial calibration.	Analyst, Laboratory Supervisor	Bias/ contamination	Same as Method / SOP QC Acceptance Limits.
LCS		90-110%	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. Client will be contact for guidance about whether to re-prep samples. In the absence of client- specific requirements, flag the data.		Precision and Accuracy/Bias	
MS/MSD		90-110%	In the absence of client-specific requirements, flag the data		Precision and Accuracy/Bias	
Nitrate, Sulfate, and Chloride by EPA 300.0						
Method Blank	One per preparatory blank	No target analytes > 1/2 LOQ	Correct problem; then repeat. If the method blank still fails; repeat ICAL.	Analyst, Laboratory Supervisor	Bias/ contamination	Same as Method / SOP QC Acceptance Limits.
LCS		90-110%	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. Client will be contact for guidance about whether to re-prep samples. In the absence of client- specific requirements, flag the data.		Precision and Accuracy/Bias	
MS/MSD		90-110%	In the absence of client-specific requirements, flag the data		Precision and Accuracy/Bias	
Sulfide by SM 4500 S-2E						
Method Blank	One per preparatory blank	No target analytes > 1/2 LOQ	Correct problem; then repeat. If the method blank still fails; repeat ICAL	Analyst, Laboratory Supervisor	Bias/ contamination	Same as Method / SOP QC Acceptance Limits.
LCS		84-106%	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. Client will be contact for guidance about whether to re-prep samples. In the absence of client-specific requirements, flag the data.		Precision and Accuracy/Bias	
MS/MSD		84-106%	In the absence of client-specific requirements, flag the data		Precision and Accuracy/Bias	

SAP Worksheet #28-2—Laboratory QC Samples Table (continued)

Matrix: Groundwater

Analytical Group: WCHEM

Analytical Method/ SOP Reference: SW-846 9060A, EPA 310.2, EPA 300.0, SM 4500 S-2E, and RSK-175 / WETS-066, WETS-004, WETS-092, WETS-061, and VGC-11

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	Measurement Performance Criteria
MEE by RSK-175						
Method Blank	One per preparatory batch	No target analytes > 1/2 LOQ; no common laboratory contaminants > LOQ	Correct problem. If required, re-prep and re-analyze method blank and all samples processed with the contaminated blank.	Analyst, Laboratory Supervisor	Bias/ contamination	Same as Method / SOP QC Acceptance Limits.
LCS	One per preparatory batch	See Worksheet #15	LCS is reanalyzed. If still fails, samples along with QC, are re-prepped and re-analyzed. In the absence of client-specific requirements, flag the data.	Analyst, Laboratory Supervisor	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits.
MS/MSD	One per preparatory batch	Same as LCS, see Worksheet #15 for RPD	In the absence of client-specific requirements, flag the data	Analyst, Laboratory Supervisor	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits.
Surrogate	One per preparatory batch	Trimethylacetic Acid 80% - 124%	Re-prep and re-analyze sample unless objective evidence of suspected or confirmed sample matrix effects are available. If insufficient sample exists for reanalysis, client will be contacted for instructions. In the absence of client instruction, data will be qualified.	Analyst, Laboratory Supervisor	Precision and Accuracy/Bias	Same as Method / SOP QC Acceptance Limits.
ICS	At the beginning of an analytical run.	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spike analytes) ICS-AB: Within ±20% of true value.	Terminate analysis; locate and correct problem; reanalyze ICS; reanalyze all samples. If corrective action fails, apply Q-flag to all results for specific analyte(s) in al samples associated with the ICS.	Analyst, Laboratory Supervisor	Accuracy/Bias	

Notes:

[1] The analytical methods are the basis for the specifications in this table.

SAP Worksheet #29—Project Documents and Records Table

Document	Where Maintained
Field Notebooks	Electronic .pdf copies in the project file. Hardcopy (bound notebook) in the project file. Archived at project closeout.
CoC Records	Electronic .pdf copies in the project file. Hardcopy in the data validation report. Archived at project closeout.
Airbills	Hardcopy in the project file. Archived at project closeout.
Telephone Logs	Hardcopy in the project file. Archived at project closeout.
CA Forms	Electronic .pdf copies in the project file. Hardcopy in the project file. Archived at project closeout.
Photoionization detector / flame ionization detector readings	Recorded in Field Notebook. Stored in Data Warehouse
Water quality parameters collected during groundwater sampling	Recorded in Field Notebook. Stored in Data Warehouse
Organic vapor monitor readings	Recorded in Field Notebook. Stored in Data Warehouse
Various field measurements	Recorded in Field Notebook.
All field equipment calibration information	Recorded in Field Notebook.
Pertinent telephone conversations	Recorded in Field Notebook.
Field equipment maintenance records	Inspected by Field Team Leader. Not maintained.
Sample Receipt, Custody, and Tracking Records	Electronic .pdf copies in the project file. Hardcopy in the full data package.
Standard Traceability Logs	Hardcopy in the full data package. Archived at project closeout.
Equipment Calibration Logs	Hardcopy in the full data package. Archived at project closeout.
Sample Prep Logs	Hardcopy in the full data package. Archived at project closeout.
Run Logs	Hardcopy in the full data package. Archived at project closeout.
Equipment Maintenance, Testing, and Inspection Logs	Kept on file at the laboratory. Not maintained.
Reported Field Sample Results	Electronic .pdf copies in the project file. Hardcopy in the data package. Archived at project closeout.
Reported Results for Standards, QC Checks, and QC Samples	Hardcopy in the full data package. Archived at project closeout.
Instrument Printouts (raw data) for Field Samples, Standards, QC Checks, and QC Samples	Hardcopy in the full data package. Archived at project closeout.
Data Package Completeness Checklists	Hardcopy in the data validation report. Archived at project closeout.

SAP Worksheet #29—Project Documents and Records Table (continued)

Document	Where Maintained
Sample Disposal Records	Maintained by the laboratory.
Extraction/Clean-up Records	Maintained by the laboratory.
Raw Data	Hardcopy in the full data package. Archived at project closeout.
Field Sampling Audit Checklists	Hardcopy in the project file. Archived at project closeout.
Fixed Laboratory Audit Checklists	If completed, hardcopy in the project file. Archived at project closeout.
Data Validation Reports	Electronic .pdf copies in the project file. Hardcopy stored with the data package. Archived at project closeout.

In general, documents are stored at a CH2M HILL project office until they are archived.

<u>CH2M HILL Project Office:</u>

Jennifer Myers/CH2M HILL

5701 Cleveland Street
Suite 200
Virginia Beach, VA 23462

(757) 671-6215

Hardcopy deliverables such as logbooks, CoCs, etc., will be archived indefinitely at Iron Mountain:

<u>Iron Mountain Headquarters</u>

745 Atlantic Avenue
Boston, MA 02111

(800) 899-IRON

Following project completion, hardcopy deliverables, including CoCs, raw data, and data validation reports, will be archived indefinitely at the Washington National Records Center:

<u>Washington National Records Center</u>

4205 Suitland Road
Suitland, Maryland 20746-8001

(301) 778-1550

SAP Worksheet #30—Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID Number	Analytical Method	Data Package Turnaround Time	Laboratory / Organization[1] (name and address, contact person, and telephone number)	Backup Laboratory / Organization (name and address, contact person, and telephone number)
GW	METAL	Refer to Worksheet #18	METALs by SW-846 6020A	28 Calendar-day TAT	ENCO 10775 Central Port Drive Orlando, FL 32824 Ms. Marcia Colon (407) 826-5314	TBD
			Mercury by SW-846 7470A Cyanide by SW-846 9014			
	FMETAL		FMETALs by SW-846 6020A			
			Filtered Mercury by SW-846 7470A			
	WCHEM		Sulfide by SM 4500 S-2E Total Organic Carbon by SW-846 9060A Alkalinity by EPA 310.2 Methane, Ethane, Ethene by RSK-175 Nitrate, Sulfate, Chloride by EPA 300.0			

Notes:

[1] If the laboratory is not known at time of SAP submission, put "TBD" in the column as a placeholder.

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SAP Worksheet #31—Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (Title and Organizational Affiliation)	Person(s) Responsible for Responding to Assessment Findings (Title and Organizational Affiliation)	Person(s) Responsible for Identifying and Implementing CAs (Title and Organizational Affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (Title and Organizational Affiliation)
Field Performance Audit	Once during sampling activities	Internal	CH2M HILL	TBD FTL CH2M HILL	Jennifer Myers PM CH2M HILL	Jennifer Myers PM CH2M HILL	John Tomik Activity Quality Manager CH2M HILL
Offsite Laboratory Technical Systems Audit	Laboratory must have current DoD Environmental Laboratory Accreditation Program (ELAP) certification that will identify the period of performance. The laboratory must be re-evaluated before expiration of period of performance. If DoD ELAP is not yet applicable to the DoD program at the time of sampling, then the laboratory must hold a current Naval Facilities Engineering Service Center evaluation letter.	External	DoD ELAP Accrediting Body (TBD)	DoD ELAP Accrediting Body (TBD)	Lori Mangrum Laboratory QA Officer	Lori Mangrum Laboratory QA Officer	Anita Dodson Program Chemist CH2M HILL

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SAP Worksheet #32—Assessment Findings and CA Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response (Name, Title, Org.)	Time Frame for Response
Field Performance Audit	Checklist and written audit report	Jennifer Myers PM, CH2M HILL	Within 1 week of audit	Memorandum	TBD FTL CH2M HILL John Tomik AQM CH2M HILL	Within 1 week of receipt of CA Form
Offsite Laboratory Technical Systems Audit	Written audit report	Lori Mangrum Laboratory QA Officer ENCO	Within 2 months of audit	Memorandum	DoD ELAP Accrediting Body (TBD)	Within 2 months of receipt of initial notification

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Worksheet #32-1—Laboratory Corrective Action Form

Person initiating corrective action ______________________________ **Date** ______________

Description of problem and when identified: ______________________________

Cause of problem, if known or suspected: ______________________________

Sequence of Corrective Action (CA): (including date implemented, action planned and personnel/data affected)

CA implemented by: ______________________________ **Date** ______________

CA initially approved by: ______________________________ **Date** ______________

Follow-up date: ______________________________

Final CA approved by: ______________________________ **Date** ______________

Information copies to:

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SAP Worksheet #32-2—Field Performance Audit Checklist

Project Responsibilities

Project No.: ______________________________ Date: ______________________________

Project Location: ______________________________ Signature: ______________________________

Team Members

Yes No 1) Is the approved work plan being followed?

Comments ______________________________

Yes No 2) Was a briefing held for project participants?

Comments ______________________________

Yes No 3) Were additional instructions given to project participants?

Comments ______________________________

Sample Collection

Yes No 1) Is there a written list of sampling locations and descriptions?

Comments ______________________________

Yes No 2) Are samples collected as stated in the Master SOPs?

Comments ______________________________

Yes No 3) Are samples collected in the type of containers specified in the work plan?

Comments ______________________________

Yes No 4) Are samples preserved as specified in the work plan?

Comments ______________________________

Yes No 5) Are the number, frequency, and type of samples collected as specified in the work plan?

Comments ______________________________

Worksheet #32-2—Field Performance Audit Checklist (continued)

Yes No 6) Are QA checks performed as specified in the work plan??

Comments ____

____

Yes No 7) Are photographs taken and documented?

Comments ____

____

Document Control

Yes No 1) Have any accountable documents been lost?

Comments ____

____

Yes No 2) Have any accountable documents been voided?

Comments ____

____

Yes No 3) Have any accountable documents been disposed of?

Comments ____

____

Yes No 4) Are the samples identified with sample tags?

Comments ____

____

Yes No 5) Are blank and duplicate samples properly identified?

Comments ____

____

Yes No 6) Are samples listed on a chain-of-custody record?

Comments ____

____

Yes No 7) Is chain of custody documented and maintained?

Comments ____

____

SAP Worksheet #33—QA Management Reports Table

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and Organizational Affiliation)	Report Recipient(s) (Title and Organizational Affiliation)
Data Usability Assessment Report	Once after all data are generated and validated	Submitted with final reports	TBD CH2M HILL	Included in Technical Memorandum. See **Worksheet #3** for distribution list.

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SAP Worksheet #34-36–Data Verification and Validation (Steps I and IIa/IIb) Process Table

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Step I			
Field Notebooks	Field notebooks will be reviewed internally and placed into the project file for archival at project closeout.	Internal	FTL (TBD)/CH2M HILL
CoCs and Shipping Forms	CoC forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the CoC will be initialed by the reviewer, a copy of the CoC retained in the site file, and the original and remaining copies taped inside the cooler for shipment.	Internal / External	FTL (TBD)/CH2M HILL Project Chemist: Juan Acaron/CH2M HILL
Sample Condition upon Receipt	Any discrepancies, missing, or broken containers will be communicated to the Project Chemist in the form of laboratory logins.	External	Project Chemist: Juan Acaron/CH2M HILL
Documentation of Laboratory Method Deviations	Laboratory method deviations will be discussed and approved by the Project Chemist. Documentation will be incorporated into the case narrative that becomes part of the final hardcopy data package.	Internal / External	Project Chemist: Juan Acaron/CH2M HILL
Electronic Data Deliverables	Electronic data deliverables will be compared against hardcopy laboratory results (10% check).	External	Project Chemist: Juan Acaron/CH2M HILL
Case Narrative	Case narratives will be reviewed by the data validator during the data validation process. This is verification that they were generated and are applicable to the data packages.	External	Data Validator: Herb Kelly/CH2M HILL
Laboratory Data	All laboratory data packages will be verified internally by the laboratory performing the work for completeness and technical accuracy prior to submittal.	Internal	Laboratory QA Officer (ENCO)
Laboratory Data	The data will be verified for completeness by the Project Chemist.	External	Project Chemist: Juan Acaron/CH2M HILL
Audit Reports	Upon report completion, a copy of all audit reports will be placed in the site file. If corrective actions are required, a copy of the documented corrective action taken will be attached to the appropriate audit report in the QA site file. Periodically, and at the completion of site work, site file audit reports and corrective action forms will be reviewed internally to ensure that all appropriate actions have been taken and that corrective action reports are attached. If corrective actions have not been taken, the project manager will be notified to ensure action is taken.	Internal	PM: Jennifer Myers/CH2M HILL Project Chemist: Juan Acaron/CH2M HILL
CA Reports	CA reports will be reviewed by the Project Chemist or PM and placed into the project file for archival at project closeout.	External	PM: Jennifer Myers/CH2M HILL Project Chemist: Juan Acaron/CH2M HILL
Step IIa			
Laboratory Methods	Ensure the laboratory analyzed samples using the correct methods.	External	Project Chemist: Juan Acaron/CH2M HILL

SAP Worksheet #34-36–Data Verification and Validation (Steps I and IIa/IIb) Process Table (continued)

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
TALs	Ensure the laboratory reported all analytes from each analysis group as described in Worksheet #15.	External	Project Chemist: Juan Acaron/CH2M HILL
RLs	Ensure the laboratory met the project-designated reporting limits RLs as described in Worksheet #15. If RLs were not met, the reason will be identified and documented.	External	Project Chemist: Juan Acaron/CH2M HILL
Laboratory SOPs	Ensure that approved analytical laboratory SOPs were followed.	External	Data Validator: Herb Kelly/CH2M HILL
Step IIb			
Sample Chronology	Holding times from collection to extraction or analysis and from extraction to analysis will be considered by the data validator during the data validation process.	External	Data Validator: Herb Kelly/CH2M HILL
Raw Data	10 percent review of raw data to confirm laboratory calculations.	External	Data Validator: Herb Kelly/CH2M HILL
Onsite Screening	All non-analytical field data will be reviewed against SAP requirements for completeness and accuracy based on the field calibration records.	Internal	FTL (TBD) /CH2M HILL
Documentation of Method QC Results	Establish that all required QC samples were run and met limits.	External	Data Validator: Herb Kelly/CH2M HILL
Documentation of field QC Sample Results	Establish that all required SAP QC samples were run and met limits.	Internal	Project Chemist: Juan Acaron/CH2M HILL Data Validator: Herb Kelly/CH2M HILL
Step IIb: Analytical Data Validation			
METAL or FMETAL	Analytical methods and laboratory SOPs, as presented in this UFP-SAP, will be used to evaluate compliance against QA/QC criteria. QA/QC criteria for field QC samples are presented in Worksheet #12; TALs , LOQs, LODs, DLs, and limits for precision and accuracy are presented in Worksheet #15; QA/QC criteria for calibrations are presented in Worksheet #24; and QA/QC criteria for laboratory QC samples are presented in Worksheet #28. Data may be qualified if QA/QC exceedances have occurred. Data qualifiers will be those presented in *EPA Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analyses* (EPA Region III, April 1993). Guidance from EPA *Contract Laboratory Program National Functional Guidelines for Inorganic Data Review* (EPA, Rev. Final, October, 2004) may also be applicable.	External	Data Validator: Herb Kelly/CH2M HILL
WCHEM	WCHEM and GRAINSIZE are subject to the verification and validation procedures specified in worksheets #34 and #35. The case narratives will be read, any issues will be investigated, and the impact (if any) on data quality or data usability will be discussed with the project team.	External	Project Chemist: Juan Acaron/CH2M HILL

SAP Worksheet #37—Usability Assessment

The following is a summary of the usability assessment process and procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:

- The data will be evaluated by the Project Chemist to see if the project required LODs listed in **Worksheet #15** were achieved for non-detected constituents.
- If verification and validation are not acceptable, the data will be qualified by the validator. The data may be qualified for minor QC deviations that do not affect the data usability—for example, "attributable to blank contamination" (B), estimated (J), estimated, biased high (K), estimated, biased low (L), non-detect, estimated LOD (UJ), non-detect, LOD biased low (UL), or the data may be rejected (R-Flag) for major QC deviations affecting data usability. The use and implications of estimated data will be discussed in the project report. Rejected data will not be used. The impact of data qualified as rejected because of analytical deficiencies will be discussed with the IHIRT and will be evaluated to determine the need for any CAs. Depending on the analytical deficiency and the intended use of the data, the IHIRT may or may not agree that the data are of sufficient quality to support project decisions.
- Completeness is defined as the percentage of measurements that are not rejected compared to the total number of measurements made. The objective of the overall completeness goal for this project is set at 95 percent.
- For statistical comparisons and risk assessment calculations, non-detect values will be represented by a concentration equal to one-half the sample-specific LOQ. Where duplicates are collected, the greater of the two concentrations will be used for risk evaluation and nature and extent evaluations.
- The site data will not be evaluated for outliers. It is anticipated that the site data will have significant variations based on localized sources.
- Analytical data will be checked by the Project Chemist, who will ensure that they are accurately transferred to the electronic project database and geographic information system.
- Laboratory and field precision, as computed from duplicate samples, will be compared by the data validator. These computations will be based on calculation of RPD = (Difference of two results)/(average of two results) *100 percent. Laboratory and field duplicate precision are addressed in worksheets #28 and #12, respectively.
- Deviations from the procedures outlined in this UFP-SAP will be reviewed by the Project Chemist and the PM to assess whether the deviations were significant enough to compromise the attainment of project objectives.

The following evaluative procedures will be used to assess overall measurement error associated with the project:

- The PM and the data users will reconcile the validated data with the method performance criteria to assess whether sufficient data of acceptable quality are available for decision making. A series of evaluations and statistical analyses will be performed to estimate the data characteristics. The statistical evaluations will include, for each target constituent or group: maximum concentration, minimum concentration, number of samples with non-detected results, number of samples with positive results, and the proportion of samples with detected and non-detected results.
- If a significant deviation occurs between lab and field precision (using the method described above), the data validator will notify the Project Chemist. The cause will be investigated, described, and interpreted for its impact on decision making. The expectation is that laboratory precision values (RPDs) will be no greater than RPDs for field duplicates of the same matrix.

SAP Worksheet #37—Usability Assessment (continued)

- If significant biases are detected (represented by low or high MS, LCS, or surrogate recoveries), the data validator will qualify the data. The Project Chemist will describe the impact of the data qualification on the quality and usability of the data for making decisions. The tendency will be to emphasize low biases more than high biases unless biased results are near action levels. Low biases will be emphasized more because they are likely to represent an inability to detect compounds that are present at the site and, on a percentage basis, generally represent a greater proportion of the reported values.

The following personnel are responsible for performing the usability assessment:

- CH2M HILL PM, Project Chemist, and other CH2M HILL team members will compile project data and make recommendations pertaining to the usability of the data. The data will be provided to the IHIRT for discussion and review, and the project team as a whole will weigh in on the usability of the data.

The following documentation will be generated during the usability assessment and will be presented to identify trends, relationships (correlations), and anomalies:

- The data will be presented in tabular format in the RI report. Data qualifications such as "attributable to blank contamination" (B), estimation (J, K, L, UJ, UL) or rejection (R) will be applied. Written documentation will be provided to support any non-compliance, or rejected data results. The project report will identify and describe the data usability limitations and suggest CAs.
- A description of the precision and bias evaluations described above will be included in the RI report. This will include a summary with supporting documentation. Significant deviations or deficiencies will be conveyed to the Navy RPM for consideration.

References

A.T. Kearney, Inc. 1990. *RCRA Facility Assessment Report of the U.S. Naval Explosive Ordnance Disposal Technology Center, Stump Neck Annex, Indian Head, Maryland.*

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U.S. Environmental Protection Agency (EPA). Intergovernmental Data Quality Task Force, 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs Part 1: UFP-QAPP Manual*. *505-B-04-900A*. March.

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U.S. Environmental Protection Agency (EPA). 2002. *Guidance for Quality Assurance Project Plans*, 240-R-02-009. December.

U.S. Environmental Protection Agency (EPA). 1993. *EPA Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analysis*.

Tetra Tech NUS, Inc. 2002. *Final Background Soil Investigation Report for Indian Head and Stump Neck Annex, Naval Surface Warfare Center, Indian Head, Maryland.*

Tetra Tech NUS, Inc. 2009. *Master Plans for Installation Restoration Program Environmental Investigations at Naval District Washington, Indian Head, Indian Head, Maryland*. June.

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Figures

R:\USNAVFACENGCOM405450\INDIANHEAD\MAPFILES\417366_SWMU14_PILOTSTUDY\FIGURE 1 - FACILITY LOCATION.MXD BMAILHES 8/28/2014 9:13:29 AM

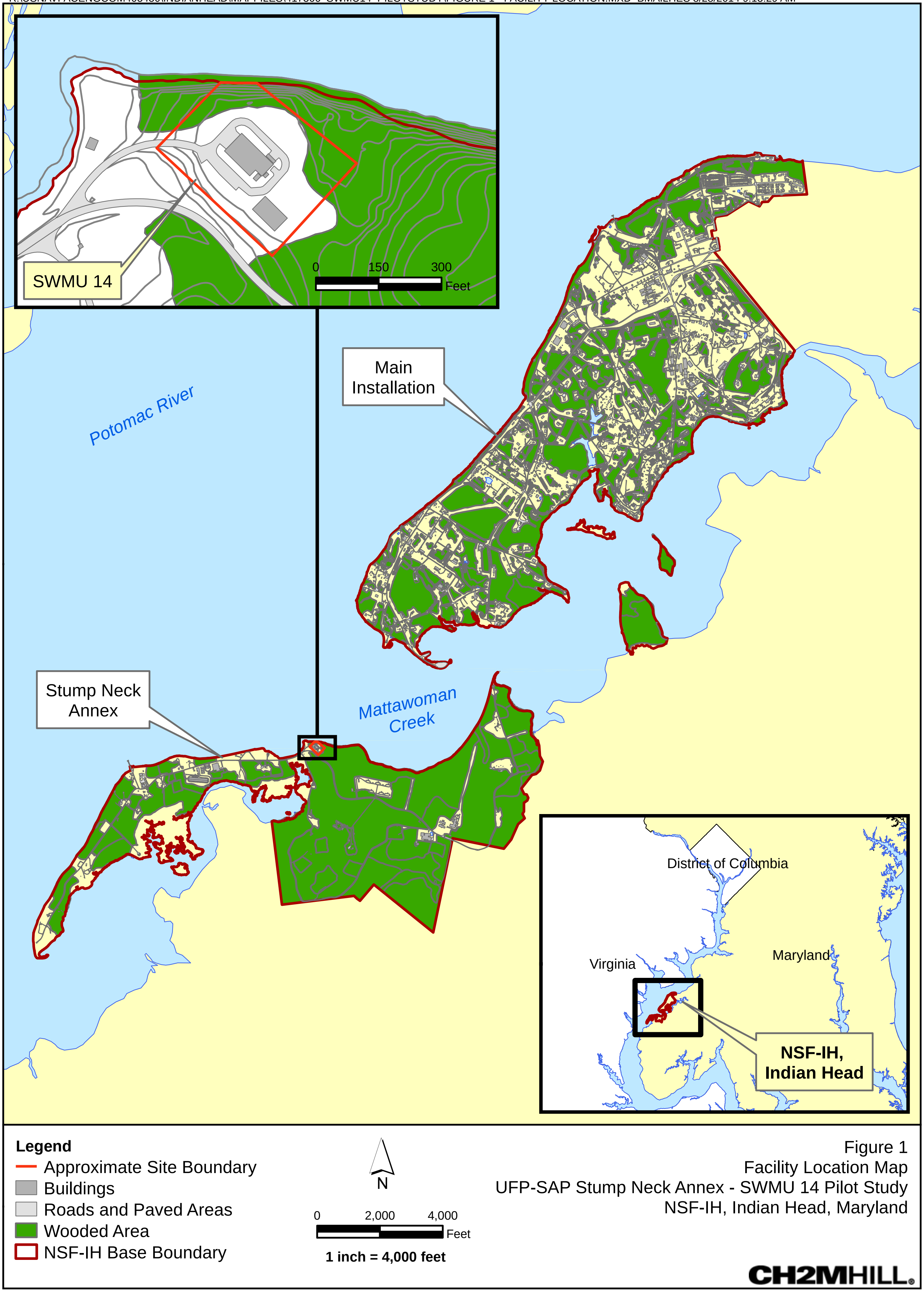
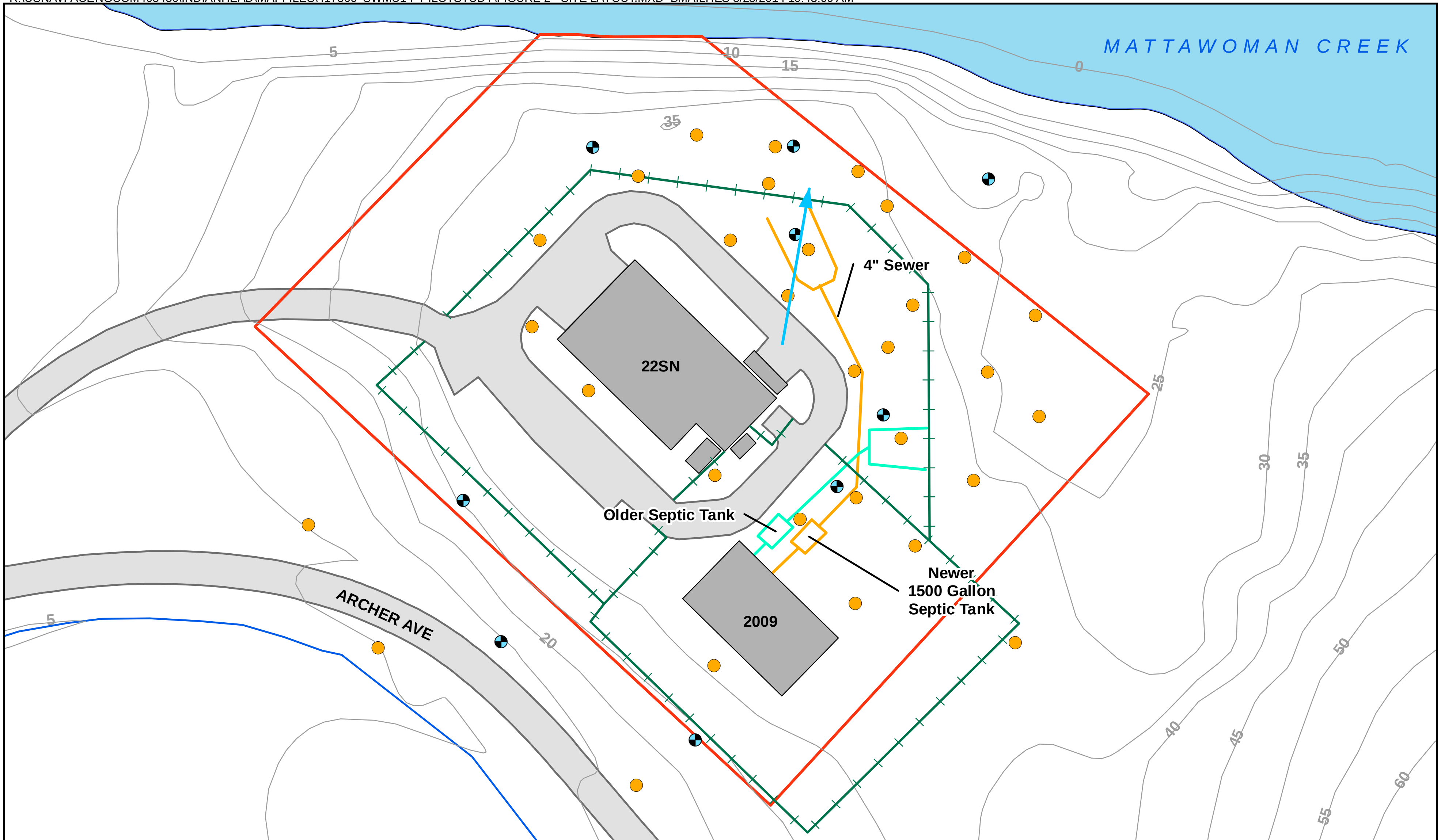


Figure 1
Facility Location Map
UFP-SAP Stump Neck Annex - SWMU 14 Pilot Study
NSF-IH, Indian Head, Maryland

CH2MHILL.

R:\USNAVFACENGCOM405450\INDIANHEAD\MAPFILES\417366_SWMU14_PILOTSTUDY\FIGURE 2 - SITE LAYOUT.MXD BMAILHES 8/28/2014 10:43:09 AM



Legend
- DPT Groundwater Sample Locations
- Monitoring Well Location
- Approximate Site Boundary
- Elevation Contour (5 foot interval)
- Fence Line
- Streams
- Buildings
- Roads and Paved Areas
- Groundwater Flow Direction

Figure 2
Site Layout
UFP-SAP Stump Neck Annex - SWMU 14 Pilot Study
NSF-IH, Indian Head, Maryland

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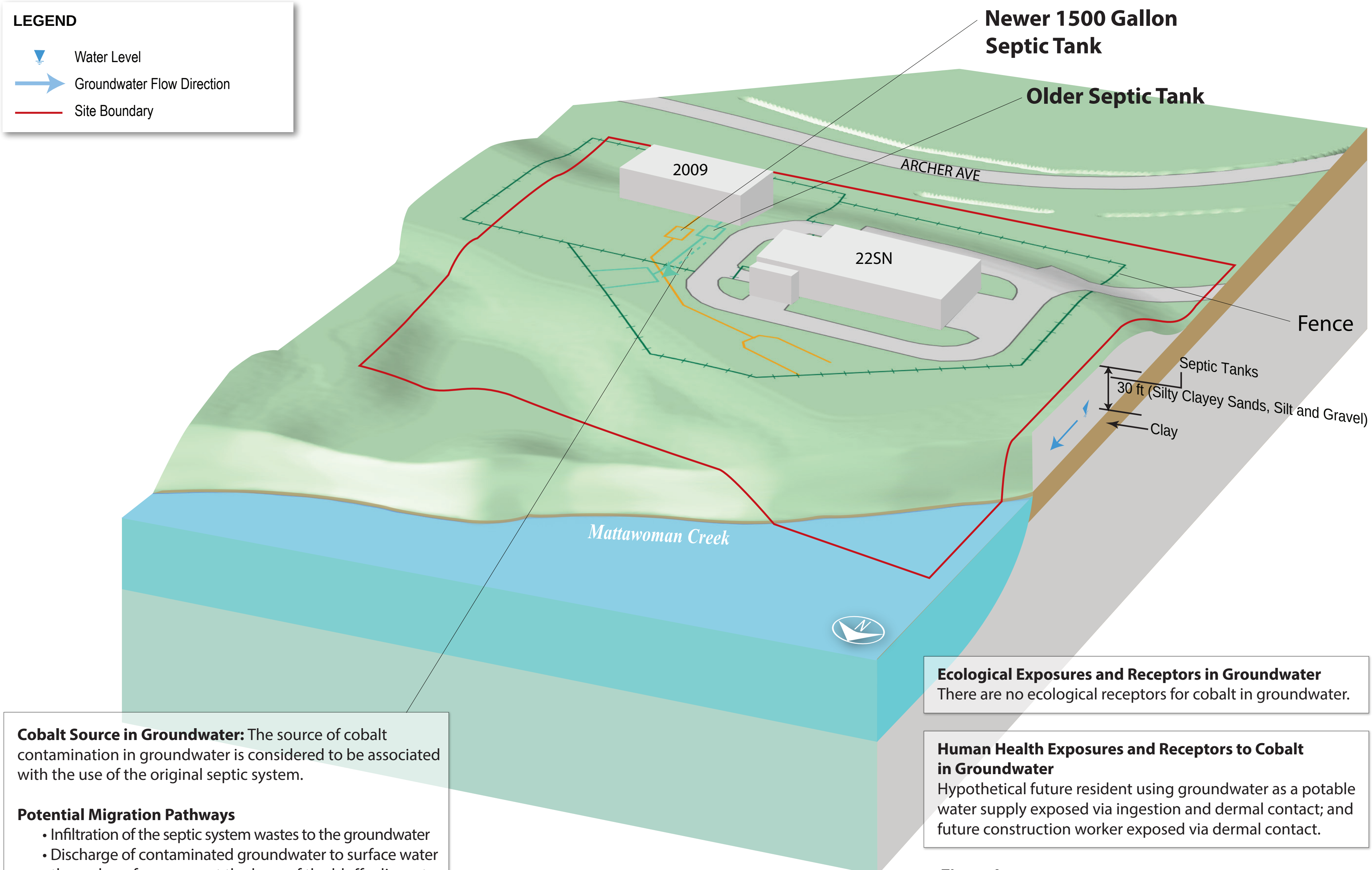


Cobalt Source in Groundwater: The source of cobalt contamination in groundwater is considered to be associated with the use of the original septic system.

Potential Migration Pathways

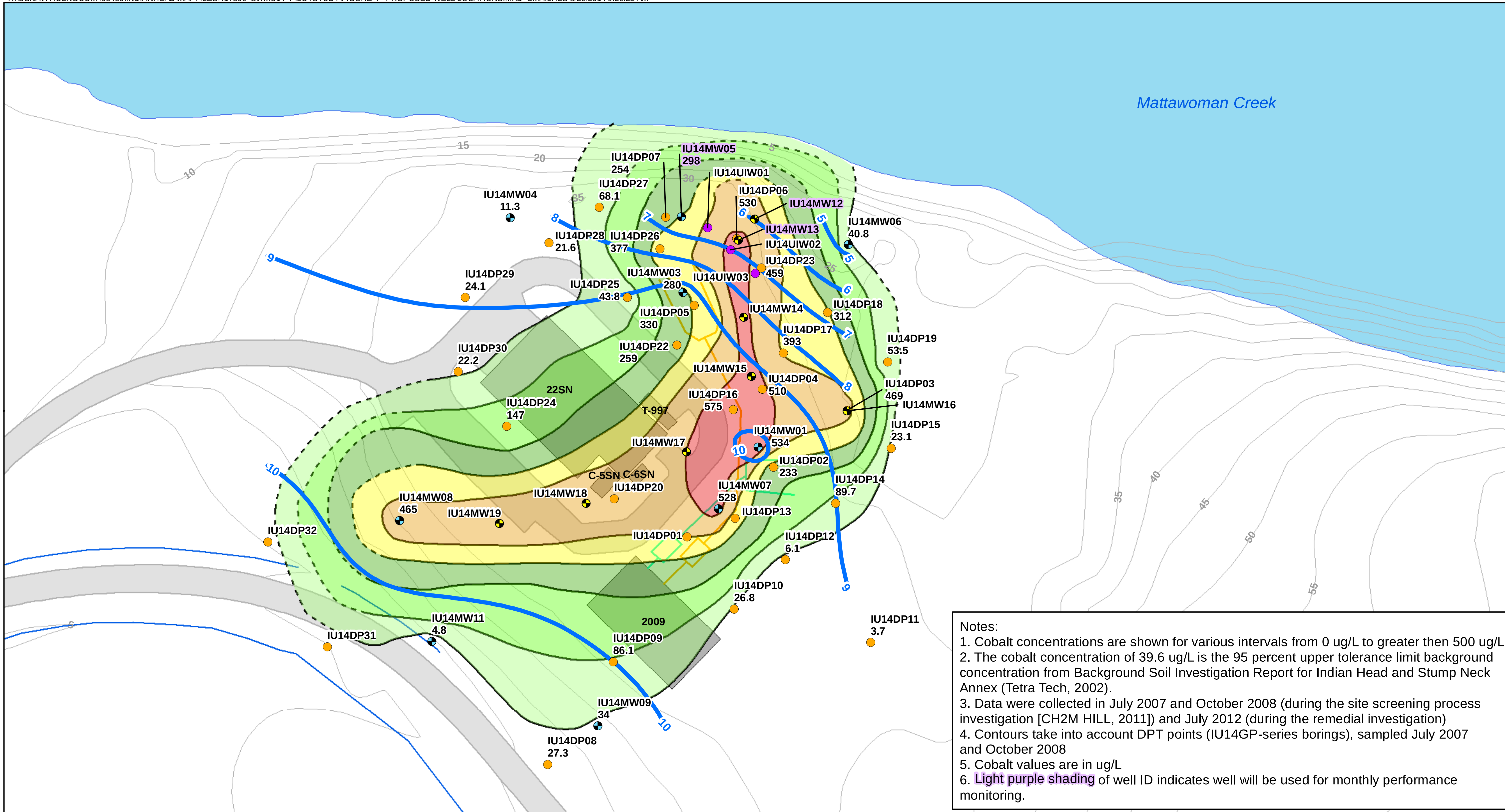
- Infiltration of the septic system wastes to the groundwater
- Discharge of contaminated groundwater to surface water through surface seeps at the base of the bluff adjacent to the river
- Discharge of contaminated groundwater to the river through the groundwater/surface water transition zone

Ecological Exposures and Receptors in Groundwater
There are no ecological receptors for cobalt in groundwater.

Human Health Exposures and Receptors to Cobalt in Groundwater
Hypothetical future resident using groundwater as a potable water supply exposed via ingestion and dermal contact; and future construction worker exposed via dermal contact.

Figure 3
Conceptual Site Model
UFP-SAP Stump Neck Annex - SWMU 14
Pilot Study
NSF-IH, Indian Head, Maryland

R:\USNAVFACENGCOM405450\INDIANHEAD\MAPFILES\417366_SWMU14_PILOTSTUDY\FIGURE 4 - PROPOSED WELL LOCATIONS.MXD BMAILHES 8/29/2014 9:26:22 AM



Notes:
1. Cobalt concentrations are shown for various intervals from 0 ug/L to greater then 500 ug/L
2. The cobalt concentration of 39.6 ug/L is the 95 percent upper tolerance limit background concentration from Background Soil Investigation Report for Indian Head and Stump Neck Annex (Tetra Tech, 2002).
3. Data were collected in July 2007 and October 2008 (during the site screening process investigation [CH2M HILL, 2011]) and July 2012 (during the remedial investigation)
4. Contours take into account DPT points (IU14GP-series borings), sampled July 2007 and October 2008
5. Cobalt values are in ug/L
6. Light purple shading of well ID indicates well will be used for monthly performance monitoring.

Legend

- Proposed Monitoring Well Locations
- Existing Monitoring Well Locations
- Proposed Injection Well Locations
- DPT Groundwater Sample Locations
- Potentiometric Contour
- Streams
- Elevation Contour (5-foot interval)
- Older 4-inch Sewer Line
- Newer 4-inch Sewer Line
- Cobalt Isoconcentration Line (dashed where inferred)
- Buildings
- Roads and Paved Areas

Cobalt Isoconcentrations (ug/L)

- 39.7 - 100
- 100.1 - 200
- 200.1 - 300
- 300.1 - 400
- 400.1 - 500
- > 500.1

N

0 30 60 Feet

Figure 4
Proposed Well Locations
UFP-SAP Stump Neck Annex - SWMU 14 Pilot Study
NSF-IH, Indian Head, Maryland

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Appendix A
Field Standard Operating Procedures

STANDARD OPERATING PROCEDURE

Global Positioning System

I. Purpose

The procedure describes the calibration, operation, and functions associated with a Trimble® Pro XRS GPS Unit with a TSC-1 Asset Surveyor for datalogging. GPS signal information is differentially corrected to sub-meter accuracy on a continual basis using a second satellite signal broadcast from OmniSTAR satellite subscription service. The procedure applies to all field data collection activities.

II. Scope

This procedure provides information regarding the field operation and general maintenance of a Trimble® Pro XRS GPS Unit with a TSC-1 Asset Surveyor for datalogging. The information contained herein presents the operation procedures for this equipment. Review of the equipment's instruction manual is a necessity for more detailed descriptions pertaining to the operation and maintenance of the equipment.

III. Definitions

GPS: Global Positioning System - A system of 24 satellites developed and operated by the US DOD. Continuous 3D coordinate information is broadcast free of charge on a worldwide basis enabling precise positional location. Three standard categories of positional accuracy are generally used:

1. Uncorrected Signal - accuracy +/-10 meters - a single satellite transmission is used
2. Differentially Corrected Signal - accuracy +/- <1 meter - additional positional transmissions are recorded simultaneously and used to triangulate coordinate position.
3. Carrier Phase Signal- accuracy +/- <1 centimeter - requires a second receiver and additional software. Both receivers need to be equipped to receive Carrier Phase signals.

IV. Procedures and Guidelines

The procedure for calibration, operation, and maintenance of the GPS unit is outlined below. Daily calibration and battery recharging is typical operating procedure; frequencies other than daily shall be noted in the logbook and reason for increased frequency recorded. If using a different instrument, the operation manual supplied by the manufacturer should be consulted for instructions.

The procedures described below include additional features pre-programmed into the GPS datalogger to aid the data collection process.

A. Calibration

1. Check to ensure that the datalogger and antenna cables are properly connected to the receiver and that the batteries are securely connected.

2. Turn the datalogger unit on by pressing the green **On** key in the bottom left corner. The datalogger will perform a self-calibration. Wait to ensure that the antenna is receiving a sufficient number of satellite signals (usually a minimum of 3).

3. Once the datalogger receives a satellite signal then it is ready for operation.

B. Operations for surveying coordinates of a location

1. The datalogger and GPS receiver are ready for use after the initial self-calibration.

2. Field data may be immediately recorded in the datalogger.

3. The first screen view is the 'Main Menu'. Use the round keypad to select 'Data Collection' and press the **Enter** key.

4. Use the round keypad to select either 'Create new file' or 'Open existing file' and press the **Enter** key. It is not necessary to create a new file at each new location; however, it may be useful to create a new file at the beginning of each day.

5. If a new file is created then the GPS unit will automatically assign it a file name. The file name may be changed if desired. Press the enter key after the file name is assigned. If opening an existing file then use the round keypad to scroll through existing file names.

6. The next screen is 'Antenna options'. Press the **Enter** key to move to the next screen.

7. Select the type of activity to be performed. At the beginning of each day 'Sample Site Detail' should be completed. This allows the operator to enter each field team member, weather, objectives, health and safety meetings, etc. Once the 'Sample Site Detail' is completed then data entry activities may begin including well purging, water level elevations, and sample collection

8. The datalogger prompts the operator when a data field is required and by using the round key pad, numeric, alphanumeric, enter, and escape keys, the operator can perform electronic data capture on the GPS datalogger.

9. Once all information pertaining to an individual site has been recorded, press enter to complete data entry. If GPS signal is obstructed (tree canopy, building height, etc) user may choose to remain in same location until satellite transmission clears the obstruction. This usually takes only a few moments. Data may still be captured and recorded electronically even if GPS signal is insufficient for positioning.

10. To shut down, press the **Escape** key to return to the 'Main Menu'. The unit can be turned off by pressing the green key in the left hand corner. The datalogger should only be turned off when the 'Main Menu' screen is displayed.

11. All data from the datalogger should be downloaded into Trimble Pathfinder Office software on a PC a minimum of once daily. It is recommended that data is downloaded twice daily. Data may be viewed and mapped using Pathfinder Office or exported to

other software. Export file formats support standard ASCII text, generic database .dbf and most GIS and CAD software.

C. Operations for locating a point using coordinates/reacquiring a previously surveyed location

1. The datalogger and GPS receiver are ready for use after the initial self-calibration.
2. Use the Trimble Pathfinder software to load the data file containing the coordinates for each desired location ("programmed location").
3. The first screen view is the 'Main Menu'. Use the keypad to select 'Navigation' and press the **Enter** key.
4. Use the round keypad to select 'Open existing file' to open the file loaded in Step 2 above.
5. Select the location to be reacquired from the screen and press the enter key.
6. A circle with an arrow will appear. As you begin walking, the arrow will point in the direction of the programmed location. Walk in the direction indicated by the arrow.
7. Once you are within 10-feet of the location being reacquired, the GPS unit will display a circle (representing the programmed location) and an "X" (representing the GPS unit). Continue to walk in the direction of the circle until the "X" is centered in the circle. Once the "X" is centered, you are standing at the programmed location.
8. To shut down, press the **Escape** key to return to the 'Main Menu'. The unit can be turned off by pressing the green key in the left hand corner. The datalogger should only be turned off when the 'Main Menu' screen is displayed.

D. Preventive Maintenance

The antenna and datalogger are weatherproof. It is recommended that the receiver remain in the provided backpack carrier. Care should be taken not to crease, pinch or bend the antenna cable. Data should be downloaded from the datalogger a minimum of once daily, twice daily is preferred. At the end of each day the receiver batteries should be recharged. For technical assistance call the rental company through which you acquired the Trimble® unit. Guidance is also provided in the manual and at http://www.trimble.com.

STANDARD OPERATING PROCEDURE

Locating and Clearing Underground Utilities

I. Purpose

The purpose of this SOP is to provide general guidelines and specific procedures that must be followed on Navy CLEAN projects for locating underground utilities and clearing dig locations in order to maximize our ability to avoid hitting underground utilities and to minimize liabilities to CH2M HILL and its subcontractors and health and safety risks to our project staff.

This SOP shall be used by Activity Managers and Project Managers to, in-turn, develop Activity-specific and project-specific utility location procedures. The activity and project-specific procedures will become part of work plans and project instructions and will be used to prepare scopes of work (SOWs) for the procurement of utility location subcontractors to meet the needs of individual projects.

This SOP also identifies the types of utility locating services that are available from subcontractors and the various tools that are used to locate utilities, and discusses when each type of service and tool may or may not be applicable.

II. Scope

Depending on the Navy/Marine Activity we typically find ourselves in one of two scenarios:

Scenario 1

The Activity provides utility locating (or dig clearance) services through the public works department or similar organization, or has a contract with an outside utility clearance service. Some of these services are provided in the form of dig permits which are required before you can dig or drill. In other cases no official permit is required and the process is somewhat vague.

Scenario 2

The Activity does not get involved in any utility locating processes aside from possibly providing the most recent utility maps, and relies on CH2M HILL to clear the dig locations.

Table 1 provides an up to date summary of which scenarios apply to the various primary Activities served under the Navy CLEAN program.

Scenario 1 is preferred because under this scenario the Navy tends to assume the responsibility if the location is improperly cleared, a utility is struck, and property damage results. However, our experience has been that the clearance services provided by the Navy do not meet the standards that we consider to be adequate, in that they often simply rely on available base maps to mark utilities and do not verify locations using field geophysics. And if they do use locating tools, they do not provide adequate documentation or marking to confirm that a location has been cleared. So while the Navy's process may protect us from liability for property damage, it does not adequately protect our staff and subcontractors from health risks nor does it compensate us for down time, should a utility be hit.

Therefore, regardless of what services the Navy provides, in most cases we still need to supplement this effort with clearance services from our own third party utility location subcontractor following the procedures and guideline outlined in Section IV of this SOP. The cost implications of providing this service will range from $500 to several $1,000 depending on the size of the project.

The scope of services that we ask our subcontractors to provide can involve utility marking/mapping or the clearing of individual dig locations. In the former we ask our subs to mark all utilities within a "site" and often ask them to prepare a map based on their work. In the later, we ask them to clear (identify if there are any utilities within) a certain radius of a proposed dig/drill location.

The appropriate requested scope of services for a project will depend on the project. Clearing individual boreholes is often less expensive and allows the sub to concentrate their efforts on a limited area. However if the scope of the investigation is fluid (all borehole locations are not predetermined) it may be best to mark and map an entire site or keep the subcontractor on call.

Clearance of individual dig locations should be done to a minimum 20 foot radius around the location.

An example SOW for a utility subcontractor procurement is provided in Attachment A.

III. Services and Equipment

This section provides a general description of the services available to help us locate subsurface utilities and describes the types of equipment that these services may (or may not) use to perform their work. It identifies the capabilities of each type of equipment to help the PM specify what they should require from our utility location subs.

Services

The services that are available to us for identifying and marking underground utilities are:

- The local public/private utility-run service such as Miss Utility
- Utility location subcontractors (hired by us)

Attachment B provides a detailed description of each type of organization. It also provides contact numbers and web sites for the various Miss-Utility-type organizations in the areas where we do work for the Navy and contacts and services provided by several subcontractors that we have used or spoken to in the past.

Equipment

Attachment C provides a summary of the various types of equipment used for subsurface utility location. It describes the capabilities and limitations of each in order to help the PM determine if the equipment being used by a subcontractor is adequate.

It is important to make the potential subcontractors aware of the possible types of utilities (and utility materials) that are at the site, and to have them explain in their bid what types of equipment they will use to locate utilities /clear dig locations, and what the limitations of these equipment are.

A list of in-house experts that can be used to help you evaluate bids or answer questions you may have is provided in **Appendix C.**

IV. Procedures and Guidelines

This section presents specific procedures to be followed for the utility location work to be conducted by CH2M HILL and our subcontractors. In addition, a PM will have to follow the procedures required by the Activity to obtain their approvals, clearances and dig permits where necessary. These "dig permit" requirements vary by Activity and must be added to the project-specific SOP, or project instructions. It is preferable that the Activity perform their clearance processes before we follow up with our clearance work.

Activity Notification and Dig Permit Procedures

Identify Activity-specific permit and/or procedural requirements for excavation and drilling activities. Contact the Base Civil Engineer and obtain the appropriate form to begin the clearance process.

Activity Specific: To be provided by Activity or Project Manager

CH2M HILL Utility Clearance Procedures

Do not begin subsurface construction activities (e.g., trenching, excavation, drilling, etc.) until a check for underground utilities and similar obstructions has been conducted by CH2M HILL as a follow-up to the services provided by the Navy. The use of as-built drawings and utility company searches must be supplemented with a geophysical or other survey by a qualified, independent survey contractor (subcontracted to CH2M HILL) to identify additional and undiscovered buried utilities.

Examples of the type of geophysical technologies include (these are further described in Attachment C):

- **Ground Penetrating Radar (GPR),** which can detect pipes, including gas pipes, tanks, conduits, cables etc, both metallic and non-metallic at depths up to 30 feet depending on equipment. Sensitivity for both minimum object size and maximum depth detectable depends on equipment selected, soil conditions, etc.
- **Radio Frequency (RF),** involves inducing an RF signal in the pipe or cable and using a receiver to trace it. Some electric and telephone lines emit RF naturally and can be detected without an induced signal. This method requires knowing where the conductive utility can be accessed to induce RF field if necessary.

- **Dual RF**, a modified version of RF detection using multiple frequencies to enhance sensitivity but with similar limitations to RF
- **Ferromagnetic Detectors**, are metal detectors that will detect ferrous and non-ferrous utilities. Sensitivity is limited, e.g. a 100 mm iron disk to a depth of about one meter or a 25 mm steel paper clip to a depth of about 20 cm.
- **Electronic markers,** are emerging technologies that impart a unique electronic signature to materials such as polyethylene pipe to facilitate location and tracing after installation. Promising for future installations but not of help for most existing utilities already in place.

The following procedures shall be used to identify and mark underground utilities during subsurface construction activities on the project:

- Contact utility companies or the state/regional utility protection service (such as Miss Utility) at least two (2) working days prior to intrusive activities to advise of the proposed work, and ask them to establish the location of the utility underground installations prior to the start of actual excavation: this is a law. These services will only mark the location of public-utility-owned lines and not Navy-owned utilities. In many cases there will not be any public-utility-owned lines on the Activity. There may also be Base-access issues to overcome.
- Procure and schedule the independent survey.
- The survey contractor shall determine the most appropriate geophysical technique or combinations of techniques to identify the buried utilities on the project site, based on the survey contractor's experience and expertise, types of utilities anticipated to be present and specific site conditions. ***The types of utilities must be provided to the bidding subcontractors in the SOW and procedures to be used must be specified by the bidder in their bid. It is extremely helpful to provide the sub with utility maps, with the caveat that all utilities are not necessarily depicted.***
- The survey subcontractor shall employ the same geophysical techniques used to identify the buried utilities, to survey the proposed path of subsurface investigation/construction work to confirm no buried utilities are present.
- Obtain utility clearances for subsurface work on both public and private property.
- Clearances provided by both the "Miss Utility" service and the CH2M HILL-subcontracted service are to be in writing, signed by the party conducting the clearance. The Miss Utility service will have standard notification forms/letters which typically simply state that they have been to the site and have done their work. The CH2M HILL subcontractor shall be required to fill out the form provided in Attachment D (this can be modified for a particular project) indicating that each dig/drill location has been addressed. ***This documentation requirement (with a copy of the form) needs to be provided in the subcontractor SOW.***
- Marking shall be done using the color coding presented in Attachment E. The type of material used for marking must be approved by the Activity prior to marking. Some base commanders have particular issues with persistent spray paint on their

sidewalks and streets. ***Any particular marking requirements need to be provided in the subcontractor SOW.***

- Protect and preserve the markings of approximate locations of facilities until the markings are no longer required for safe and proper excavations. If the markings of utility locations are destroyed or removed before excavation commences or is completed, the Project Manager must notify the utility company or utility protection service to inform them that the markings have been destroyed.
- Perform a field check prior to drilling/digging (preferably while the utility location sub is still at the site) to see if field utility markings coincide with locations on utility maps. Look for fire hydrants, valves, manholes, light poles, lighted signs, etc to see if they coincide with utilities identified by the subcontractor.
- Underground utility locations must be physically verified (or dig locations must be physically cleared) by hand digging using wood or fiberglass-handled tools, air knifing, or by some other acceptable means approved by CH2M HILL, when the dig location (e.g. mechanical drilling, excavating) is expected to be within 5 feet of a marked underground system. Hand clearance shall be done to a depth of four feet unless a utility cross-section is available that indicates the utility is at a greater depth. In that event, the hand clearance shall proceed until the documented depth of the utility is reached.
- Conduct a site briefing for employees at the start of the intrusive work regarding the hazards associated with working near the utilities and the means by which the operation will maintain a safe working environment. Detail the method used to isolate the utility and the hazards presented by breaching the isolation.
- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon during drilling or change in color, texture or density during excavation that could indicate the ground has been previously disturbed).

IV. Attachments

A- Example SOW for Utility Location Subcontractor Procurement
B - Services Available for Identifying and Marking Underground Utilities
C – Equipment Used for Identifying Underground Utilities
D – Utility Clearance Documentation Form
E – Utility Marking Color Codes

Attachment A–Example SOW for Subcontracting Underground Utilities Locating Services

CTO-XXX

Scope of Work

Subsurface Utility Locating

Site XX

Navy Activity

City, State

A licensed and insured utility locator will be subcontracted to identify and mark out subsurface utilities for an environmental investigation/remediation project at Site XX of <<insert name of base, city, and state>>. The subcontractor will need to be available beginning at <<insert time>> on <<insert date>>. It is estimated that the work can be completed within XX days.

Proposed Scope of Work

The subcontractor will identify and mark all subsurface utilities (CHOOSE 1) that lie within a radius of 20 feet of each of XX sampling locations at Site XX shown on the attached Figure 1; (OR) that lie within the bounds of Site XX as delineated on the attached Figure 1. (If multiple sites are to be cleared, provide maps of each site with sample locations or clearance boundaries clearly delineated and a scale provided.)

Utilities will be identified using all reasonably available as-built drawings, electronic locating devices, and any other means necessary to maintain the safety of drilling and sampling personnel and the protection of the base infrastructure. The location of utilities identified from as-built drawings or other maps must be verified in the field prior to marking.

Base utility drawings for the Site(s) (CHOOSE 1) can be found at <<insert specific department and address or phone number on the base>> and should be reviewed by the subcontractor and referenced as part of the utility locating. (OR), will be provided to the subcontractor by CH2M HILL upon the award of the subcontract. (OR), are not available. Utility drawings shall not be considered definitive and must be field verified.

Field verification will include detection using nonintrusive subsurface detection equipment (magnetometers, GPR, etc) as well as opening manhole covers to verify pipe directions. As part of the bid, the Subcontractor shall provide a list of the various subsurface investigation tools they propose to have available and use at the site and what the limitations are of each tool.

A CH2M HILL representative shall be present to coordinate utility clearance activities and identify points and features to be cleared.

Field Marking and Documentation

All utilities located within **(CHOOSE 1)** ***a 20-ft radius of the XX proposed soil boring locations*** **(OR)** ***within the boundary of the site(s)*** as identified on the attached figure(s) will be marked using **paint** ***(some Bases such as the WNY may have restrictions on the use of permanent paint)*** and/or pin flags color coded to indicate electricity, gas, water, steam, telephone, TV cable, fiber optic, sewer, etc. The color coding shall match the industry standard as described on the attached form. In addition, the ***Buried Utility Location Tracking Form*** (attached) will be completed by the Subcontractor based upon what is identified in the field during the utility locating and submitted back to CH2M HILL (field staff or project manager) within 24 hours of completing the utility locating activities.

(OPTIONAL) ***The subcontractor shall also provide a map (or hand sketch) of the identified utilities to the Engineer within XX days of field demobilization. The map shall include coordinates or ties from fixed surface features to each identified subsurface utility.***

Bid Sheet/Payment Units

The subcontractor will bid on a time and materials basis for time spent on site and researching utility maps. Mobilization (including daily travel to the site) should be bid as a lump sum, as well as the preparation of the AHA and any required mapping. The per diem line item should be used if the field crew will require overnight accommodations at the project site.

Health and Safety Requirements

The utility locating subcontractor is to provide and assume responsibility for an adequate corporate Health and Safety Plan for onsite personnel. Standard personal safety equipment including: hard hat, safety glasses, steel-toed boots, gloves are recommended for all project activities. Specific health and safety requirements will be established by the Subcontractor for each project. The health and safety requirements will be subject to the review of CH2M HILL.

The subcontractor shall also prepare and provide to the Engineer, at least 48 hours prior to mobilization, an acceptable Activity Hazard Analysis (AHA) using the attached AHA form or similar.

It is also required that all subcontractor personnel who will be on site attend the daily 15-minute health and safety tailgate meeting at the start of each day in the field.

Subcontractor personnel showing indications of being under the influence of alcohol or illegal drugs will be sent off the job site and their employers will be notified. Subcontractor personnel under the influence of prescription or over-the-counter medication that may impair their ability to operate equipment will not be permitted to do so. It is expected that the subcontractor will assign them other work and provide a capable replacement (if necessary) to operate the equipment to continue work.

Security

The work will be performed on US Navy property. CH2M HILL will identify the Subcontractor personnel who will perform the work to the appropriate Navy facility point-of-contact, and will identify the Navy point-of-contact to the Subcontractor crew. The Subcontractor bears final responsibility for coordinating access of his personnel onto Navy property to perform required work. This responsibility includes arranging logistics and providing to CH2M HILL, in advance or at time of entry as specified, any required identification information for the Subcontractor personnel. Specifically, the following information should be submitted with the bid package for all personnel that will perform the work in question (this information is required to obtain a base pass):

- Name
- Birth Place
- Birth Date
- Social Security Number
- Drivers License State and Number
- Citizenship

Please be advised that no weapons, alcohol, or drugs will be permitted on the Navy facility at any time. If any such items are found, they will be confiscated, and the Subcontractor will be dismissed.

Quality Assurance

The Subcontractor will be licensed and insured to operate in the State of <<state>> and will comply with all applicable federal, state, county and local laws and regulations. The subcontractor will maintain, calibrate, and operate all electronic locating instruments in accordance with the manufacturer's recommendations. Additionally, the Subcontractor shall make all reasonable efforts to review as-built engineering drawings maintained by Base personnel, and shall notify the CH2M HILL Project Manager in writing (email is acceptable) whenever such documentation was not available or could not be reviewed.

Subcontractor Standby Time

At certain periods during the utility locating activities, the Subcontractor's personnel may be asked to stop work and standby when work may normally occur. During such times, the Subcontractor will cease activities until directed by the CH2M HILL representative to resume operations. Subcontractor standby time also will include potential delays caused by the CH2M HILL representative not arriving at the site by the agreed-upon meeting time for start of the work day. Standby will be paid to the

Subcontractor at the hourly rate specified in the Subcontractor's Bid Form attached to these specifications.

Cumulative Subcontractor standby will be accrued in increments no shorter than 15 minutes (i.e., an individual standby episode of less than 15 minutes is not chargeable).

During periods for which standby time is paid, the surveying equipment will not be demobilized and the team will remain at the site. At the conclusion of each day, the daily logs for the Subcontractor and CH2M HILL representative will indicate the amount of standby time incurred by the Subcontractor, if any. Payment will be made only for standby time recorded on CH2M HILL's daily logs.

Down Time

Should equipment furnished by the Subcontractor malfunction, preventing the effective and efficient prosecution of the work, or inclement weather conditions prevent safe and effective work from occurring, down time will be indicated in the Subcontractor's and CH2M Hill representative's daily logs. No payment will be made for down time.

Schedule

It is anticipated that the subsurface utility locating activities will occur on <<insert date>>. It is estimated that the above scope will be completed within XXX days.

Attachment B–Services Available for Identifying and Marking Underground Utilities

The services that are available to us for identifying and marking underground utilities are:

- The Activity's PWC (or similar organization)
- The local public/private utility -run service such as Miss Utility
- Utility location subcontractors (hired by CH2M HILL)

Each are discussed below.

Navy Public Works Department

A Public Works Department (PWD) is usually present at each Activity. The PWD is responsible for maintaining the public works at the base including management of utilities. In many cases, the PWD has a written permit process in place to identify and mark-out the locations of Navy-owned utilities [Note: The PWD is usually NOT responsible for the locations/mark-outs of non-Navy owned, public utilities (e.g., Washington Gas, Virginia Power, municipal water and sewer, etc.). Therefore, it is likely that we will have to contact other organizations besides the PWD in order to identify non-Navy owned, public utilities].

At some Activities, there may not be a PWD, the PWD may not have a written permit process in place, or the PWD may not take responsibility for utility locating and mark-outs. In these cases, the PWD should still be contacted since it is likely that they will have the best understanding of the utility locations at the Activity (i.e., engineering drawings, institutional knowledge, etc.). Subsequently, the PWD should be brought into a cooperative arrangement (if possible) with the other services employed in utility locating and mark-out in order to have the most comprehensive assessment performed.

At all Activities we should have a contact (name and phone number), and preferably an established relationship, with PWD, either directly or through the NAVFAC Atlantic, Midlant, or Washington NTR or Activity Environmental Office that we can work with and contact in the event of problems.

Miss Utility or "One Call" Services for Public Utility Mark-outs

Miss Utility or "One Call" service centers are information exchange centers for excavators, contractors and property owners planning any kind of excavation or digging. The "One Call" center notifies participating public utilities of the upcoming excavation work so they can locate and mark their underground utilities in advance to prevent possible damage to underground utility lines, injury, property damage and service outages. In some instances, such with southeastern Virginia bases, the Navy has entered into agreement with Ms. Utilities and is part of the response process for Miss Utilities. Generally, a minimum of 48 hours is required for the public utility mark-outs to be performed. The "One Call" services are free to the public. Note that the "One Call" centers only coordinate with participating public utilities. There may be some public utilities that do NOT participate in the "One Call" center which may need to be contacted separately. For example, in Washington, DC, the Miss Utility "One Call" center does not locate and mark public sewer and water lines. Therefore, the municipal water and sewer authority must be contacted separately to have the sewer and water lines marked out. The AM should contact the appropriate one-call center to determine their scope of services.

For the Mid-Atlantic region, the following "One Call" service centers are available.

Name	Phone	Website	Comments
Miss Utility of DELMARVA	800-257-7777	www.missutility.net	Public utility mark-outs in Delaware, Maryland, Washington, DC, and Northern Virginia
Miss Utility of Southern Virginia (One Call)	800-552-7001	not available	Public utility mark-outs in Southern Virginia
Miss Utility of Virginia	800-257-7777 800-552-7007	www.missutilityofvirginia.com	General information on public utility mark-outs in Virginia, with links to Miss Utility of DELMARVA and Miss Utility of Southern Virginia (One Call)
Miss Utility of West Virginia, Inc	800-245-4848	none	Call to determine what utilities they work with in West Virginia
North Carolina One Call Center	800-632-4949	www.ncocc.org/ncocc/default.htm	Public Utility Markouts in North Carolina

Private Subcontractors

1. Utility-locating support is required at some level for most all CH2M HILL field projects in "clearing" proposed subsurface boring locations on the project site. Utility location and sample clearance can include a comprehensive effort of GIS map interpretation, professional land surveying, field locating, and geophysical surveying. Since we can usually provide our own GIS-related services for projects and our professional land surveying services are normally procured separately, utility-locating subcontractors will normally only be required for some level of geophysical surveying support in the field. This level of geophysical surveying support can range widely from a simple electromagnetic (EM) survey over a known utility line, to a blind geophysical effort, including a ground-penetrating radar (GPR) survey and/or a comprehensive EM survey to delineate and characterize all unknown subsurface anomalies.

   The level of service required from the subcontractor will vary depending on the nature of the site. At sites where utility locations are well defined on the maps and recent construction is limited, CH2M HILL may be confident with a limited effort from a traditional utility-locating subcontractor providing a simple EM survey. At sites where utility locations are not well defined, where recent constructions may have altered utility locations, or the nature of the site makes utility location difficult, CH2M HILL will require the services of a comprehensive geophysical surveying subcontractor, with a wide range of GPR and EM services available for use on an "as-needed" basis. Typical costs for geophysical surveying subcontractors will range from approximately $200 per day for a simple EM effort (usually one crew member and one instrument) to approximately $1,500 per day for a comprehensive geophysical surveying effort (usually a two-person crew and multiple instruments). Comprehensive geophysical surveying efforts may also include field data interpretation (and subsequent report preparation) and non-destructive excavation to field-verify utility depths and locations.

The following table provides a list of recommended geophysical surveying support subcontractors that can be used for utility-locating services:

Company Name and Address	Contact Name and Phone Number	Equipment[1]					Other Services[2]		
		1	2	3	4	5	A	B	C
US Radar, Inc.* PO Box 319 Matawan, NJ 07747	Ron LaBarca 732-566-2035			4					
Utilities Search, Inc.*	Jim Davis 703-369-5758	4				4	4	4	4
So Deep, Inc.* 8397 Euclid Avenue Manassas Park, VA 20111	703-361-6005	4					4	4	4
Accurate Locating, Inc. 1327 Ashton Rd., Suite 101 Hanover, MD 21076	Ken Shipley 410-850-0280	4	4						
NAEVA Geophysics, Inc. P.O. Box 7325 Charlottesville, VA 22906	Alan Mazurowski 434-978-3187	4	4	4	4	4	4	4	4
Earth Resources Technology. Inc. 8106 Stayton Rd. Jessup, MD 20794	Peter Li 240-554-0161	4	4	4	4	4	4	4	
Geophex, Ltd 605 Mercury Street Raleigh, NC 27603	I. J. Won 919-839-8515	4	4	4	4	4	4	4	4

Notes:

*Companies denoted with an asterisk have demonstrated reluctance to assume responsibility for damage to underground utilities or an inability to accommodate the insurance requirements that CH2M HILL requests for this type of work at many Navy sites.

[1]Equipment types are:

1. Simple electromagnetic instruments, usually hand-held
2. Other, more innovative, electromagnetic instruments, including larger instruments for more area coverage
3. Ground-penetrating radar systems of all kinds
4. Audio-frequency detectors of all kinds
5. Radio-frequency detectors of all kinds

[2]Other services include:

A. Data interpretation and/or report preparation to provide a permanent record of the geophysical survey results and a professional interpretation of the findings, including expected accuracy and precision.
B. Non-destructive excavation to field-verify the depths, locations, and types of subsurface utilities.
C. Concrete/asphalt coring and pavement/surface restoration.

Attachment C–Equipment Used for Identifying Underground Utilities

This attachment provides a summary of the various types of equipment used for subsurface utility location. It describes the capabilities and limitations of each in order to help the AM and PM determine if the equipment being proposed by a subcontractor or Navy is adequate. A list of in-house experts that can be used to answer questions you may have is provided below.

CH2M HILL In-house Utility Location Experts

Tamir Klaff/WDC

Home Office Phone – 703-669-9611

Electromagnetic Induction (EMI) Methods

EMI instruments, in general, induce an electromagnetic field into the ground (the primary field) and then record the response (the secondary field), if any. Lateral changes in subsurface conductivity, such as caused by the presence of buried metal or by significant soil variations, cause changes in the secondary field recorded by the instrument and thus enable detection and mapping of the subsurface features. It should be noted that EMI only works for electrically conductive materials--plastic or PVC pipes are generally not detected with EMI. Water and gas lines are commonly plastic, although most new lines include a copper "locator" strip on the top of the PVC to allow for detection with EMI.

EMI technology encompasses a wide range of instruments, each with inherent strengths and weaknesses for particular applications. One major division of EMI is between "time-domain" and "frequency-domain" instruments that differ in the aspect of the secondary field they detect. Another difference in EMI instruments is the operating frequency they use to transmit the primary field. Audio- and radio-frequencies are often used for utility detection, although other frequencies are also used. Consideration of the type of utility expected, surface features that could interfere with detection, and the "congestion" of utilities in an area, should be made when choosing a particular EMI instrument for a particular site.

One common EMI tool used for utility location is a handheld unit that can be used to quickly scan an area for utilities and allows for marking locations in "real time". This method is most commonly used by "dig-safe" contractors marking out known utilities prior to excavation. It should be noted that this method works best when a signal (the primary field) can be placed directly onto the line (i.e., by clamping or otherwise connecting to the end of the line visible at the surface, or for larger utilities such as sewers, by running a transmitter through the utility). These types of tools also have a limited capability to scan an area for unknown utilities. Usually this requires having enough area to separate a hand held transmitter at least a hundred feet from the receiver. Whether hunting for unknown, or confirming known, utilities, this method will only detect continuous lengths of metallic conductors.

In addition to the handheld EMI units, larger, more powerful EMI tools are available that provide more comprehensive detection and mapping of subsurface features. Generally, data with these methods are collected on a regular grid in the investigation area, and are then analyzed to locate linear anomalies that can be interpreted as utilities. These methods will usually detect *all* subsurface metal (above a minimum size), including pieces of abandoned utilities. In addition, in some situations, backfill can be detected against native soils giving information on trenching and possible utility location. Drawbacks to these methods are that the secondary signals from utilities are often swamped (i.e., undetectable) close to buildings and other cultural features, and that the subsurface at heavily built-up sites may be too complicated to confidently interpret completely.

Hand-held metal detectors (treasure-finders) are usually based on EMI technology. They can be used to locate shallow buried metal associated with utilities (e.g., junctions, manholes, metallic locators). Advantages of these tools is the ease of use and real-time marking of anomalies. Drawbacks include limited depths of investigations and no data storage capacity.

Ground Penetrating Radar (GPR)

GPR systems transmit radio and microwave frequency (e.g., 80 megaHertz to 1,000 megaHertz) waves into the ground and then record reflections of those waves coming back to the surface. Reflections of the radar waves typically occur at lithologic changes, subsurface discontinuities, and subsurface structures. Plastic and PVC pipes can sometimes be detected in GPR data, especially if they are shallow, large, and full of a contrasting material such as air in a wet soil, or water in a dry soil. GPR data are usually collected in regular patterns over an area and then analyzed for linear anomalies that can be interpreted as utilities. GPR is usually very accurate in x-y location of utilities, and can be calibrated at a site to give very accurate depth information as well. A significant drawback to GPR is that depth of investigation is highly dependant on background soil conductivity, and it will not work on all sites. It is not uncommon to get only 1-2 feet of penetration with the signal in damp, clayey environments. Another drawback to GPR is that sites containing significant fill material (e.g., concrete rubble, scrap metal, garbage) will result in complicated anomalies that are difficult or impossible to interpret.

Magnetic Field Methods

Magnetic field methods rely on detecting changes to the earth's magnetic field caused by ferrous metal objects. This method is usually more sensitive to magnetic metal (i.e., deeper detection) than EMI methods. A drawback to this method is it is more susceptible to being swamped by surface features such as fences and cars. In addition, procedures must usually be implemented that account for natural variations in the earth's background field as it changes throughout the day. One common use of the method is to measure and analyze the gradient of the magnetic field, which eliminates most of the drawbacks to the method. It should be noted this method only detects ferrous metal, primarily iron and steel for utility location applications. Some utility detector combine magnetic and EMI methods into a single hand-held unit.

Optical Methods

Down the hole cameras may be useful in visually reviewing a pipe for empty conduits and/or vaults.

Attachment D–Utility Clearance Documentation Form

Attachment E–Utility Marking Color Codes

The following is the standard color code used by industry to mark various types of utilities and other features at a construction site.

White – Proposed excavations and borings

Pink – Temporary survey markings

Red – Electrical power lines, cables, conduits and lighting cables

Yellow – Gas, oil, steam, petroleum or gaseous materials

Orange – Communication, alarm or signal lines, cables, or conduits

Blue – Potable water

Purple – Reclaimed water, irrigation and slurry lines

Green – Sewer and storm drain lines

STANDARD OPERATING PROCEDURE

General Guidance for Monitoring Well Installation

I. Purpose

To provide site personnel with a review of the well installation procedures that will be performed. These procedures are to be considered general guidelines only and are in no way intended to supplement or replace the contractual specifications in the driller's subcontract.

II. Scope

Monitoring well installations are planned for shallow and/or deep unconsolidated aquifers and/or for bedrock aquifers. The SOPs *Installation of Shallow Monitoring Wells, Installation of Surface-Cased Monitoring Wells, Installation of Bedrock Monitoring Wells,* and *Installation of Monitoring Wells Using Sonic Drilling* provide more specifics.

III. Equipment and Materials

1. Drilling rig (hollow stem auger, sonic, air hammer, air rotary, or mud rotary)
2. Well-construction materials (i.e., surface casing, screens, riser, casing, caps, bottom plugs, centering guides, sand, bentonite, grout, and surface-finish materials)
3. Development equipment

IV. Procedures and Guidelines

1. Wells will be installed in accordance with standard EPA procedures. Note that USEPA Region III requires any well penetrating a confining layer to be double-cased.
2. The threaded connections will be water-tight.
3. Well screens generally will be constructed of 10-slot or 20-slot Schedule 40 PVC and will be 5 to 10 feet in length depending on saturated thickness of unconsolidated sediments. The exact slot size and length will be determined by the field team supervisor. Stainless steel may be required under certain contaminant conditions.
4. Stick-up wells will be surrounded by four concrete-filled guard posts at least 2 inches in diameter.

5. A record of the finished well construction will be compiled.

6. All soils and liquids generated during well installations will be drummed for proper disposal.

Monitoring Well Installation

- 2″ monitoring wells in unconsolidated materials will be installed in at least 6-inch-diameter boreholes to accommodate well completion materials in designated locations.

- All monitoring wells penetrating a confining layer will be surface-cased from the ground surface to approximately 5 feet into the confining layer. Exceptions to this may be allowed under certain circumstances (e.g., evidence of significant natural gaps in the confining layer).

- Monitoring wells in unconsolidated materials will be constructed of 2-inch-diameter, factory manufactured, flush-jointed, Schedule 40 PVC (or stainless steel) screen with threaded bottom plug and riser.

- Screens will be filter packed with a properly sized and graded, thoroughly washed, sound, durable, well-rounded basalt or siliceous sand. When using hollow-stem augers, the filter pack will be installed by slowly pouring the sand into the annular space while simultaneously raising the augers and using a weighted tape to sound for the sand surface. For rotary-drilled wells, the height of the sand pack also will be sounded with a weighted tape.

- The primary filter sand pack (typically Morie #00 or DSI #1 for a 10-slot screen) will extend from 1 to 2 feet below the base to 2 feet above the top of the screen; filter pack will be allowed to settle before final measurement is taken. For wells deeper than 30 feet, the filter pack will be placed using a tremie pipe and flowing water.

- A secondary filter sand pack (typically a fine sand seal) 1-foot thick may be placed above the primary sand pack.

- Annular well seals will consist of 2 feet of pelletized, chip, or granular bentonite clay placed above the filter pack. If necessary the pellets will be hydrated using potable water. For wells installed using hollow-stem augers, the bentonite will be poured into the annular space while slowly raising the augers and sounding for the top of the bentonite with a weighted tape. A high-solids bentonite slurry using powdered bentonite introduced with a side-discharging tremie pipe will be used for the bentonite seals in wells greater than 30 feet deep. For rotary-drilled wells, the height of the well seal also will be sounded with a weighted tape. High-solids slurries will have solids content of at least 20 percent.

- The top of the annular seal will be measured after the bentonite seal has been allowed to hydrate and before the grout is applied. The seal will be allowed to hydrate for at least 30 minutes before work in the well continues.

- The annular space above the bentonite seal will be filled to grade with a bentonite-cement slurry grout mixture.
- The grout mixture consists of 6 to 8 gallons of water per 94-pound bag of Portland cement; 3 to 6 pounds of bentonite added per bag of cement to reduce shrinkage.
- The grout mix will be carefully applied to avoid disturbing the bentonite seal; the method of grout placement must force grout from the top of the bentonite seal to ground surface.
- After allowing the grout to settle and set up overnight, additional grout will be added to maintain grade.
- A protective steel casing equipped with keyed alike locking caps will be grouted in place for each new well; the casing will extend at least 2 feet above grade and 3 feet below grade, and will be painted a bright color.

Well Development

- New monitoring wells will be developed after the well has been completely installed and the grout has hardened (at least 24 hours)
- The well will be developed by surging and pumping.
- Equipment placed in the well will be decontaminated before use.
- If information is available, begin developing in the least-contaminated well first.
- Development will include surging the well by either abruptly stopping flow and allowing water in the well column to fall back into the well or through the use of a surge block that is slightly smaller in diameter than the well casing inner diameter.
- Pipes and pumps must not be fitted with foot valves or other devices that might inhibit the return flow of water to the well.
- Surging should continue throughout the development process.
- The air-lift method may be used to pump materials out of the well. The air compressor will be fitted with filters to remove all oil and the air lift hose used will be made of inert materials.
- Well development will continue until the water produced is free of turbidity, sand, and silt. A Horiba-U22 meter, YSI meter with separate Hanna turbidity meter, or equivalent should be used to determine when the turbidity is low and parameters have stabilized.
- Development water will be considered hazardous and placed in sealed 55-gallon U.S. DOT approved steel drums. CH2M HILL will label and date the drums as pending analysis, and transport the drums to a designated site for storage.

V. Attachments

None.

VI. Key Check and Items

- Ensure that all equipment is properly decontaminated as needed.
- Only new, sealed materials (e.g., screens, risers, and sand) will be used in constructing the well.
- Care shall be taken when making downhole measurements to ensure that proper heights of sand, seal, and grout are achieved.

STANDARD OPERATING PROCEDURE

Logging of Soil Borings

I. Purpose and Scope

This SOP provides guidance to obtain accurate and consistent descriptions of soil characteristics during soil-sampling operations. The characterization is based on visual examination and manual tests, not on laboratory determinations.

II. Equipment and Materials

- Indelible pens
- Tape measure or ruler
- Field logbook
- Spatula
- HCL, 10 percent solution
- Squirt bottle with water
- Rock- or soil-color chart (e.g., Munsell)
- Grain-size chart
- Hand lens
- Unified Soil Classification System (USCS) index charts and tables to help with soil classification (attached)

III. Procedures and Guidelines

This section covers several aspects of soil characterization: instructions for completing the CH2M HILL soil boring log Form D1586 (attached), field classification of soil, and standard penetration test procedures.

A. Instructions for Completing Soil Boring Logs

Soil boring logs will be completed in the field log books or on separate soil boring log sheets. Information collected will be consistent with that required for Form D1586 (attached), a standard CH2M HILL form (attached), or an equivalent form that supplies the same information.

The information collected in the field to perform the soil characterization is described below.

Field personnel should review completed logs for accuracy, clarity, and thoroughness of detail. Samples also should be checked to see that information is correctly recorded on both jar lids and labels and on the log sheets.

B. Heading Information

Boring/Well Number. Enter the boring/well number. A numbering system should be chosen that does not conflict with information recorded for previous exploratory work done at the site. Number the sheets consecutively for each boring.

Location. If station, coordinates, mileposts, or similar project layout information is available, indicate the position of the boring to that system using modifiers such as "approximate" or "estimated" as appropriate.

Elevation. Elevation will be determined at the conclusion of field activities through a survey.

Drilling Contractor. Enter the name of the drilling company and the city and state where the company is based.

Drilling Method and Equipment. Identify the bit size and type, drilling fluid (if used), and method of drilling (e.g., rotary, hollow-stem auger). Information on the drilling equipment (e.g., CME 55, Mobile B61) also is noted.

Water Level and Date. Enter the depth below ground surface to the apparent water level in the borehole. The information should be recorded as a comment. If free water is not encountered during drilling or cannot be detected because of the drilling method, this information should be noted. Record date and time of day (for tides, river stage) of each water level measurement.

Date of Start and Finish. Enter the dates the boring was begun and completed. Time of day should be added if several borings are performed on the same day.

Logger. Enter the first and last name.

C. Technical Data

Depth Below Surface. Use a depth scale that is appropriate for the sample spacing and for the complexity of subsurface conditions.

Sample Interval. Note the depth at the top and bottom of the sample interval.

Sample Type and Number. Enter the sample type and number. SS-1 = split spoon, first sample. Number samples consecutively regardless of type. Enter a sample number even if no material was recovered in the sampler.

Sample Recovery. Enter the length to the nearest 0.1-foot of soil sample recovered from the sampler. Often, there will be some wash or caved material above the sample; do not include the wash material in the measurement. Record soil recovery in feet.

Standard Penetration Test Results. In this column, enter the number of blows required for each 6 inches of sampler penetration and the "N" value, which is the sum of the blows in the middle two 6-inch penetration intervals. A typical standard penetration test involving successive blow counts of 2, 3, 4, and 5 is recorded as 2-3-4-5 and (7). The standard penetration test is terminated if the sampler encounters refusal. Refusal is a penetration of less than 6 inches with a blow count of 50. A partial penetration of 50 blows for 4 inches is recorded as 50/4 inches. Penetration by the weight of the slide hammer only is recorded as "WOH."

Samples should be collected using a 140-pound hammer and 2-inch diameter split spoons. Samples may be collected using direct push sampling equipment. However, blow counts will not be available. A pocket penetrometer may be used instead to determine relative soil density of fine grained materials (silts and clays).

Sample also may be collected using a 300-pound hammer or 3-inch-diameter split-spoon samples at the site. However, use of either of these sample collection devices invalidates standard penetration test results and should be noted in the comments section of the log. The 300-pound hammer should only be used for collection of 3-inch-diameter split-spoon samples. Blow counts should be recorded for collection of samples using either a 3-inch split-spoon, or a 300-pound hammer. An "N" value need not be calculated.

Soil Description. The soil classification should follow the format described in the "Field Classification of Soil" subsection below.

Comments. Include all pertinent observations (changes in drilling fluid color, rod drops, drilling chatter, rod bounce as in driving on a cobble, damaged Shelby tubes, and equipment malfunctions). In addition, note if casing was used, the sizes and depths installed, and if drilling fluid was added or changed. You should instruct the driller to alert you to any significant changes in drilling (changes in material, occurrence of boulders, and loss of drilling fluid). Such information should be attributed to the driller and recorded in this column.

Specific information might include the following:

- The date and the time drilling began and ended each day
- The depth and size of casing and the method of installation
- The date, time, and depth of water level measurements
- Depth of rod chatter
- Depth and percentage of drilling fluid loss
- Depth of hole caving or heaving
- Depth of change in material
- Health and safety monitoring data
- Drilling interval through a boulder

D. Field Classification of Soil

This section presents the format for the field classification of soil. In general, the approach and format for classifying soils should conform to ASTM D 2488, Visual-Manual Procedure for Description and Identification of Soils (attached).

The Unified Soil Classification System is based on numerical values of certain soil properties that are measured by laboratory tests. It is possible, however, to estimate these values in the field with reasonable accuracy using visual-manual procedures (ASTM D 2488). In addition, some elements of a complete soil description, such as the presence of cobbles or boulders, changes in strata, and the relative proportions of soil types in a bedded deposit, can be obtained only in the field.

Soil descriptions should be precise and comprehensive without being verbose. The correct overall impression of the soil should not be distorted by excessive emphasis on insignificant details. In general, similarities rather than differences between consecutive samples should be stressed.

Soil descriptions must be recorded for every soil sample collected. The format and order for soil descriptions should be as follows:

1. Soil name (synonymous with ASTM D 2488 Group Name) with appropriate modifiers. Soil name should be in all capitals in the log, for example "POORLY-GRADED SAND."
2. Group symbol, in parentheses, for example, "(SP)."
3. Color, using Munsell color designation
4. Moisture content
5. Relative density or consistency
6. Soil structure, mineralogy, or other descriptors

This order follows, in general, the format described in ASTM D 2488.

E. Soil Name

The basic name of a soil should be the ASTM D 2488 Group Name on the basis of visual estimates of gradation and plasticity. The soil name should be capitalized.

Examples of acceptable soil names are illustrated by the following descriptions:

- A soil sample is visually estimated to contain 15 percent gravel, 55 percent sand, and 30 percent fines (passing No. 200 sieve). The fines are estimated as either low or highly plastic silt. This visual classification is SILTY SAND WITH GRAVEL, with a Group Symbol of (SM).
- Another soil sample has the following visual estimate: 10 percent gravel, 30 percent sand, and 60 percent fines (passing the No. 200 sieve). The fines are estimated as low plastic silt. This visual classification is SANDY SILT. The gravel portion is not included in the soil name because the gravel portion was estimated as less than 15 percent. The Group Symbol is (ML).

The gradation of coarse-grained soil (more than 50 percent retained on No. 200 sieve) is included in the specific soil name in accordance with ASTM D 2488. There is no need to further document the gradation. However, the maximum size and angularity or roundness of gravel and sand-sized particles should be recorded. For fine-grained soil (50 percent or more passing the No. 200 sieve), the name is modified by the appropriate plasticity/elasticity term in accordance with ASTM D 2488.

Interlayered soil should each be described starting with the predominant type. An introductory name, such as "Interlayered Sand and Silt," should be used. In addition, the relative proportion of each soil type should be indicated (see Table 1 for example).

Where helpful, the evaluation of plasticity/elasticity can be justified by describing results from any of the visual-manual procedures for identifying fine-grained soils, such as reaction to shaking, toughness of a soil thread, or dry strength as described in ASTM D 2488.

F. Group Symbol

The appropriate group symbol from ASTM D 2488 must be given after each soil name. The group symbol should be placed in parentheses to indicate that the classification has been estimated.

In accordance with ASTM D 2488, dual symbols (e.g., GP-GM or SW-SC) can be used to indicate that a soil is estimated to have about 10 percent fines. Borderline symbols (e.g., GM/SM or SW/SP) can be used to indicate that a soil sample has been identified as having properties that do not distinctly place the soil into a specific group. Generally, the group name assigned to a soil with a borderline symbol should be the group name for the first symbol. The use of a borderline symbol should not be used indiscriminately. Every effort should be made to first place the soil into a single group.

G. Color

The color of a soil must be given. The color description should be based on the Munsell system. The color name and the hue, value, and chroma should be given.

H. Moisture Content

The degree of moisture present in a soil sample should be defined as dry, moist, or wet. Moisture content can be estimated from the criteria listed on Table 2.

I. Relative Density or Consistency

Relative density of a coarse-grained (cohesionless) soil is based on N-values (ASTM D 1586 [attached]). If the presence of large gravel, disturbance of the sample, or non-standard sample collection makes determination of the in situ relative density or consistency difficult, then this item should be left out of the description and explained in the Comments column of the soil boring log.

Consistency of fine-grained (cohesive) soil is properly based on results of pocket penetrometer or torvane results. In the absence of this information, consistency can be estimated from N-values. Relationships for determining relative density or consistency of soil samples are given in Tables 3 and 4.

J. Soil Structure, Mineralogy, and Other Descriptors

Discontinuities and inclusions are important and should be described. Such features include joints or fissures, slickensides, bedding or laminations, veins, root holes, and wood debris.

Significant mineralogical information such as cementation, abundant mica, or unusual mineralogy should be described.

Other descriptors may include particle size range or percentages, particle angularity or shape, maximum particle size, hardness of large particles, plasticity of fines, dry strength, dilatancy, toughness, reaction to HCl, and staining, as well as other information such as organic debris, odor, or presence of free product.

K. Equipment and Calibration

Before starting the testing, the equipment should be inspected for compliance with the requirements of ASTM D 1586. The split-barrel sampler should measure 2-inch or 3-inch O.D., and should have a split tube at least 18 inches long. The minimum size sampler rod allowed is "A" rod (1-5/8-inch O.D.). A stiffer rod, such as an "N" rod (2-5/8-inch O.D.), is required for depths greater than 50 feet. The drive weight assembly should consist of a 140-pound or 300-pound hammer weight, a drive head, and a hammer guide that permits a free fall of 30 inches.

IV. Attachments

Soil Boring Log (Sample Soil Boring Log.xls)

CH2M HILL Form D1586 and a completed example (Soil_Log_Examp.pdf)

ASTM D 2488 *Standard Practice for Description and Identification of Soils (Visual-Manual Procedures)* (ASTM D2488.pdf)

ASTM 1586 *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils* (ASTM D1586.pdf)

Tables 1 through 4 (Tables 1-4.pdf)

V. Key Checks and Preventive Maintenance

- Check entries to the soil-boring log and field logbook in the field; because the samples will be disposed of at the end of fieldwork, confirmation and corrections cannot be made later.
- Check that sample numbers and intervals are properly specified.
- Check that drilling and sampling equipment is decontaminated using the procedures defined in SOP *Decontamination of Drilling Rigs and Equipment*.

CH2MHILL	PROJECT NUMBER	BORING NUMBER
	SOIL BORING LOG	

PROJECT : LOCATION :

ELEVATION : DRILLING CONTRACTOR :

DRILLING METHOD AND EQUIPMENT USED :

ATD WATER LEVEL : START : END : LOGGER :

DEPTH BELOW SURFACE (FT)	INTERVAL (FT)	RECOVERY (FT)	SAMPLE #/TYPE	STANDARD PENETRATION TEST RESULTS 6"-6"-6"-6" (N')	SOIL DESCRIPTION SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY, OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY.	USCS	COMMENTS DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS, AND INSTRUMENTATION. DRILLING ACTIONS/DRILLER COMMENTS PID Readings: Breathing Zone: Above Hole:

CH2M HILL

PROJECT NUMBER	BORING NUMBER	SHEET
DEN 22371.G5	BL-3	1 OF 3

SOIL BORING LOG

PROJECT Howard Ave Landslide LOCATION Howard & 24th Ave, Centennial, CO

ELEVATION 5136 Feet DRILLING CONTRACTOR Kendall Explorations, Ashcan, Colorado

DRILLING METHOD AND EQUIPMENT 4"-inch H.S. Augers, Mobil B-61 rotary drill rig

WATER LEVELS 3.2 Feet, 8/5/89 START August 4, 1989 FINISH August 8, 1989 LOGGER J.A. Michner

DEPTH BELOW SURFACE (FT)	SAMPLE: INTERVAL	SAMPLE: NUMBER AND TYPE	SAMPLE: RECOVERY (FT)	STANDARD PENETRATION TEST RESULTS 6"-6"-6" (N)	SOIL DESCRIPTION: SOIL NAME, USCS GROUP SYMBOL, COLOR, MOISTURE CONTENT, RELATIVE DENSITY OR CONSISTENCY, SOIL STRUCTURE, MINERALOGY	COMMENTS: DEPTH OF CASING, DRILLING RATE, DRILLING FLUID LOSS, TESTS AND INSTRUMENTATION
0	2.5				Surface material consist of 4 inches AC underlain by 6 inches of 3/4 inch minus base rock	Start Drilling @ 3:00
	2.5–4.0	1-S	1.5	2-3-4 (7)	POORLY-GRADED SAND WITH SILT, (SP-SM), fine, light brown, wet, loose	Driller notes water at 4 feet
5	5.0–6.5	2-S	0.9	WOH/12"-1	ORGANIC SILT, (OL), very dark, gray to black, wet, very soft; strong H_2S odor, many fine roots up to about 1/4 inch	Driller notes very soft drilling 4ft. dark grey, wet silty cuttings.
	8.0–10.0	3-ST	1.3	—	ORGANIC SILT, similar to 2-S, except includes fewer roots (by volume)	
10	10.0–11.5	4-S	1.3	2-2-2 (4)	SILT, (ML), very dark gray to black, wet, soft	water level @ 3.2 feet on 8/5/89 @ 0730
						Driller notes rough drilling action and chatter @ 13 ft
15	15.0–15.5	5-S	0.5	60/6"	SILTY GRAVEL, (GM), rounded gravel up to about 1 inch maximum observed size, wet, very dense	
20	20.0–21.0	6-S	1.0	12-50/6"	LEAN CLAY WITH SAND, (CL), medium to light green, moist, very stiff	Driller notes smoother, firm drilling @ 19 ft some angular rock chips @ bot tip of 6-S, poss boulders or rock
	23.0–23.1	7-S	0	50/1"	NO RECOVERY	Driller notes very hard, slow grinding, smooth drilling action from 21 to 23 ft, possibly bedrock
					END SOIL BORING @ 23.1 FEET SEE ROCK CORE LOG FOR CONTINUATION OF BL-3	

Figure 2
EXAMPLE OF COMPLETED LOG FORM

REV 11 89 FORM D1586

STANDARD OPERATING PROCEDURE

Civil Surveying

I. Purpose and Scope

The SOP describes survey procedures to be used on CLEAN projects. Modified third-order survey procedures will be used for most surveying. Geographic Positioning System techniques will be used for measurement of some horizontal coordinates.

II. Records and Definitions

All field notes should be kept in bound books. Each book should have an index. Each page of field notes should be numbered and dated and should show the initials of all crew members. The person taking field notes will be identified in the log. Information on weather (wind speed/wind direction, cloud cover, etc.) and on other site conditions should also be entered in the notes. Notes should also include instrument field identification number and environmental settings. Graphite pencils or waterproof ballpoint pens should be used. Erasing is not acceptable; use a single-strike-through and initial it. The notekeeping format should conform to the *Handbook of Survey Notekeeping* by William Pafford. A survey work drawing with grid lines and at the scale of the topographic map should be prepared for all survey field work. Field notebooks will be available on site.

The following terms are defined to clarify discussion in this SOP:

- North American Datum (NAD) -The standard geodetic datum on the North American continent.
- National Geodetic Vertical Datum (NGVD) - The vertical-control datum used (1929 or later) by the National Geodetic Survey for vertical control.
- Horizontal Control - Horizontal location of an object from surveyed corners or other features on permanent land monuments in the immediate site area. Will be based on North American Datum (NAD) 1983 and state plane grid systems.
- Vertical Control - Vertical location of an object compared to the adjacent ground surface.
- Bench Mark - Precisely determined elevation above or below sea level. May also have horizontal control (northing, easting) determined for location.

III. Surveying

Horizontal Survey

Horizontal angular measurements shall be made with a 20-second or better theodolite or transit. When using a 20-second instrument the horizontal angles shall be turned four times (two each direct and inverted) with the mean of the fourth angle being within 5 seconds of the mean of the second angle. When using a 10-second or better instrument the angles shall be doubled (once each direct and inverted), with the mean of the second angle within 5 seconds of the first angle. The minimum length of any traverse courses shall be 300 feet.

Distance measurements shall be made with a calibrated steel tape corrected for temperature and tension or a calibrated electronic distance meter (EDM). When using an EDM the parts per million (PPM), curvature and refraction corrections shall be made. Vertical angle measurements used for distance slope corrections shall be recorded to the nearest 20 seconds of arc deviation from the horizontal plane. Horizontal locations will be surveyed to within 0.05-foot of the true location.

Horizontal traverse stations shall be established and referenced for future use. All stations shall be described in the field notes with sufficient detail to facilitate their recovery at a later date. The station shall consist of a permanent mark scribed on facilities such as sidewalks, curbs, concrete slabs, or iron rod and cap.

The horizontal location will be referenced to NAD83 and the appropriate state plane grid system.

Some horizontal coordinates will be measured using Geographic Positioning System (GPS) equipment. This approach will be used in particular for determining the coordinates of surface-water and sediment sampling locations, and may be used also for determining the locations of piezometers and monitoring wells. The GPS survey will be performed by staff trained in the use of the equipment and will conform to guidance provided by the manufacturer.

Vertical Survey

When practical, vertical control will be referenced to the National Geodetic Vertical Datum (NGVD) of 1929, obtained from a permanent benchmark. If practical, level circuits should close on a known benchmark other than the starting benchmark. The following criteria shall be met in conducting the survey:

- Instruments shall be pegged weekly or after any time it is dropped or severely jolted.
- Foresight and backsight distances shall be reasonably balanced and shall not be greater than 250 feet in length.
- No side shot shall be used as a beginning or ending point in another level loop.
- Rod readings shall be made to 0.01-foot and estimated to 0.005-foot.
- Elevations shall be adjusted and recorded to 0.01-foot.

Temporary benchmarks (TBMs) shall be established and referenced for future use. All TBMs shall be described in the field notes with sufficient detail to facilitate their recovery at a later date. The TBMs shall consist of a permanent mark scribed on facilities such as sidewalks, curbs, concrete slabs, etc. or spikes set in the base of trees (not power poles), or tops of anchor bolts for transmission line towers, etc.

(Horizontal traverse stations will not be considered as a TBM, but may be used as a permanent turning point.)

Traverse Computations and Adjustments

Traverses will be closed and adjusted in the following manner:

- Step One—Coordinate closures will be computed using unadjusted bearings and unadjusted field distances.
- Step Two—Coordinate positions will be adjusted (if the traverse closes within the specified limits) using the compass rule.
- Step Three—Final adjusted coordinates will be labeled as "adjusted coordinates." Field coordinates should be specifically identified as such.
- Step Four—The direction and length of the unadjusted error of closure, the ratio of error, and the method of adjustment shall be printed with the final adjusted coordinates.

Level Circuit Computations and Adjustments

Level circuits will be closed and adjusted in the following manner:

- For a single circuit, elevations will be adjusted proportionally, provided the raw closure is within the prescribed limits for the circuit.
- In a level net where the elevation of a point is established by more than one circuit, the method of adjustment should consider the length of each circuit, the closure of each circuit, and the combined effect of all the separate circuit closures on the total net adjustments.

Piezometer and Monitoring-Well Surveys

Piezometer and monitoring-well locations will be surveyed only after the installation of the protective casing, which is set in concrete. The horizontal plane survey accuracy is ±0.05-foot and is measured to any point on the protective-casing cover. The vertical plane survey must be accurate to ±0.01-foot. The following two elevations will be measured at piezometers and monitoring wells:

- Top of the piezometer or well riser (not on the protective casing), preferably on the north side
- Ground surface, preferably on the north side of the well

If no notch or mark exists, the point at which the elevation was measured on the inner casing shall be described so that water-level measurements may be taken from the same location.

Grid Surveys

Selected soil boring locations may be located by the survey crew after the soil borings are complete. The selected borings will be staked in the field by the field team leader. The stake will be marked with the boring number for reference. The horizontal plane survey accuracy is $\pm$ 1 foot and is measured to any point on the ground surface immediately adjacent to the stake.

Exhibit A
STANDARDS FOR MODIFIED THIRD-ORDER PLANE SURVEYS

Traverse

Max Number of bearing courses between azimuth checks	30
Astronomical bearings: standard error of results	6"
Azimuth closure at azimuth checkpoint not to exceed	20" $\sqrt{N}$
Standard error of the mean for length measurements	1 in 50,000
Position closure per loop in feet before azimuth adjustment	1:10,000

Leveling

Levels error of closure per loop in feet	0.05 $\sqrt{M}$

N = the number of stations for carrying bearing
M = the distance in miles

STANDARD OPERATING PROCEDURE

Low-Flow Groundwater Sampling from Monitoring Wells – EPA Region I and III

I. Purpose and Scope

This SOP presents general guidelines for the collection of groundwater samples from monitoring wells using low-flow purging and sampling procedures. Operations manuals should be consulted for specific calibration and operating procedures.

II. Equipment and Materials

- Adjustable-rate positive-displacement pump, submersible pump, or peristaltic pump
- Horiba® U-22 or equivalent water quality meters to monitor pH, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (ORP), and temperature
- Flow-through cell with inlet/outlet ports for purged groundwater and watertight ports for each probe
- Generator or alternate power source depending on pump type
- Water-level indicator
- Disposable Teflon, Teflon-lined polyethylene tubing or polyethylene tubing for metals and other inorganics
- Plastic sheeting
- Well-construction information
- Calibrated container and stopwatch to determine flow rate
- Sample containers
- In-line disposable 0.45µm filters (QED® FF8100 or equivalent)
- Shipping supplies (labels, coolers, and ice)
- Field book

III. Procedures and Guidelines

A. Setup and Purging

1. Obtain information on well location, diameter(s), depth, and screen interval(s), and the method for disposal of purged water.
2. Calibrate instruments according to manufacturer's instructions.
3. The well number, site, date, and condition are recorded in the field logbook.

4. Plastic sheeting is placed on the ground, and the well is unlocked and opened. All decontaminated equipment to be used in sampling will be placed only on the plastic sheeting until after the sampling has been completed. To avoid cross-contamination, do not let any downhole equipment touch the ground.

5. All sampling equipment and any other equipment to be placed in the well is cleaned and decontaminated before sampling in accordance with SOP *Decontamination of Personnel and Equipment*.

6. Water level measurements are collected in accordance with the *Water Level Measurements* SOP. **Do not measure the depth to the bottom of the well at this time**; this reduces the possibility that any accumulated sediment in the well will be disturbed. Obtain depth to bottom information from well construction log.

7. Attach and secure the tubing to the low-flow pump. Lower the pump slowly into the well and set it at approximately the middle of the screen. Place the pump intake in the middle of the saturated screen length and should be at least two feet above the bottom of the well to avoid mobilization of any sediment present in the bottom.

8. Insert the measurement probes into the flow-through cell. The purged groundwater is directed through the cell, allowing measurements to be collected before the water contacts the atmosphere.

9. If using a generator, locate it 30 feet downwind from the well to avoid exhaust fumes contaminating the samples.

10. Start purging the well at 0.2 to 0.5 liters per minute. Avoid surging. Purging rates for more transmissive formations could be started at 0.5-liter to 1 liter per minute. The initial field parameters of pH, specific conductance, dissolved oxygen, ORP, turbidity, and temperature of water are measured and recorded in the field logbook.

11. The water level should be monitored during purging, and, ideally, the purge rate should equal the well recharge rate so that there is little or no drawdown in the well (i.e., less than 0.3-foot). The water level should stabilize for the specific purge rate. There should be at least 1 foot of water over the pump intake so there is no risk of the pump suction being broken, or entrainment of air in the sample. Record adjustments in the purge rate and changes in depth to water in the logbook. Purge rates should, if needed, be decreased to the minimum capabilities of the pump (0.1- to 0.2-liter per minute) to avoid affecting well drawdown.

12. During purging, the field parameters are measured frequently (every 5 minutes) until the parameters have stabilized. Field parameters are considered stable when measurements meet the following criteria:

    - pH: within 0.1 pH units

- Specific conductance: within 3 percent
- Dissolved oxygen: within 10 percent
- Turbidity: within 10 percent for values greater than 5 NTU; if 3 turbidity values are less than 5 NTU, consider the values as stabilized
- ORP: within 10 mV
- Temperature: within 3 percent

B. Sample Collection

Once purging is complete the well is ready to sample. The elapsed time between completion of purging and collection of the groundwater sample should be minimized. Typically, the sample is collected immediately after the well has been purged, but this is also dependent on well recovery.

Samples will be placed in sample containers that have been cleaned to laboratory standards and are preserved in accordance with the analytical method. The containers are typically pre-preserved, if required.

VOC samples are normally collected first and directly into pre-preserved sample containers.

During purging and sampling, the centrifugal/peristaltic pump tubing must remain filled with water to avoid aeration of the groundwater. It is recommended that ¼ or 3/8 inch inside diameter tubing be used to help insure that the sample tubing remains water filled. If the pump tubing is not completely filled to the sampling point, collect non-VOC dissolved gasses samples first, then increase flow rate slightly until water completely fills the tubing and collect the VOC/dissolved gases samples. Record new flow rate and drawdown depth.

The steps to be followed for sample collection are as follows:

1. The cap is removed from the sample bottle, and the bottle is tilted slightly.
2. The sample is slowly poured from the bailer or discharged from the pump so that it runs down the inside of the sample bottle with a minimum of splashing. The pumping rate should be reduced to approximately 100 ml per minute when sampling VOCs.
3. Inorganics, including metals, may be collected and preserved in the filtered form as well as the unfiltered form. Disposable in-line filters (0.45 micron filter), connected to the end of the sample tubing,, are typically used for field filtration. Samples are field filtered as the water is being placed into the sample container. If a bailer is used, filtration may be driven by a peristaltic pump.

4. Adequate space is left in the bottle to allow for expansion, except for VOC vials, which are filled to the top with a positive meniscus.

5. The bottle is capped and clearly labeled.

6. Immediately upon collection, all samples for chemical analysis are to be placed in a closed container on ice unless it is not possible to do so. Although unusual and uncommon, there may be instances where it is not possible to have containers with ice at the sample location. In these instances, the samples should be placed on ice as soon as practical and during the time between collection and placing the samples on ice, the samples should be kept as cool as possible.

7. Nondedicated equipment is cleaned and decontaminated in accordance with the *Decontamination of Personnel and Equipment* SOP.

The following information, at a minimum, will be recorded in the log book:

1. Sample identification (site name, location, and project number; sample name/number and location; sample type and matrix; time and date; sampler's identity)
2. Sample source and source description
3. Field observations and measurements (appearance, volatile screening, field chemistry, sampling method), volume of water purged prior to sampling, number of well volumes purged, and field parameter measurements
4. Sample disposition (preservative; laboratory name, date and time sent; laboratory sample number, chain-of-custody number, sample bottle lot number)
5. Additional remarks

C. Additional remarks

1. If the well goes dry during purging, wait until it recovers sufficiently to remove the required volumes to sample all parameters. It may be necessary to return periodically to the well but a particular sample (e.g., large amber bottles for semivolatile analysis) should be filled at one time rather than over the course of two or more visits to the well.

2. Disposable tubing is disposed of with PPE and other site trash.

IV. Attachments

White paper on reasons and rationale for low-flow sampling.

V. Key Checks and Preventative Maintenance

- The drawdown in the well should be minimized as much as possible (preferably no more than 0.5-foot to 1 foot) so that natural groundwater-flow conditions are maintained as closely as possible.
- The highest purging rate should not exceed 1 liter per minute. This is to keep the drawdown minimized.
- Stirring up of sediment in the well should be avoided so that turbidity containing adsorbed chemicals is not suspended in the well and taken in by the pump.
- Overheating of the pump should be avoided to minimize the potential for losing VOCs through volatilization.
- Keep the working space clean with plastic sheeting and good housekeeping.
- Maintain field equipment in accordance with the manufacturer's recommendations. This will include, but is not limited to:
    - Inspect sampling pump regularly and replace as warranted
    - Inspect quick-connects regularly and replace as warranted
    - Verify battery charge, calibration, and proper working order of field measurement equipment prior to initial mobilization and daily during field efforts

Attachment to the SOP on Low-Flow Sampling Groundwater Sampling from Monitoring Wells

White Paper on Low-Flow Sampling

EPA recommends low-flow sampling as a means of collecting groundwater samples in a way that minimizes the disturbance to the natural groundwater flow system and minimizes the introduction of contamination into the samples from extraneous sources. The following are details about these issues.

When a pump removes groundwater from the well at the same rate that groundwater enters the well through the screen, the natural groundwater-flow system around the well experiences a minimum of disturbance. Some disturbance is bound to occur because you are causing groundwater to flow to the well in a radial fashion that otherwise would have flowed past it. However, the resulting low-flow sample provides the most-representative indication we can get of groundwater quality in the immediate vicinity of the well.

Normally, when a well is pumped at an excessive rate that drops the water level in the well below the water level in the aquifer, the water cascades down the inside of the well screen when it enters the well. The turbulence from this cascading causes gases such as oxygen and carbon dioxide to mix with the water in concentrations that are not representative of the native groundwater and are higher than expected. This causes geochemical changes in the nature of the water that can change the concentrations of some analytes, particularly metals, in the groundwater sample, not mention it's effect on the dissolved oxygen levels that then will be measured in the flow-through cell. Such turbulence also may cause lower-than-expected concentrations of volatile organic compounds due to volatilization.

For wells in which the water level is above the top of the screen, the water up in the riser is out of the natural circulation of the groundwater and, therefore, can become stagnant. This stagnant water is no longer representative of natural groundwater quality because its pH, dissolved-oxygen content, and other geochemical characteristics change as it contacts the air in the riser. If we minimize the drawdown in the well when we pump, then we minimize the amount of this stagnant water that is brought down into the well screen and potentially into the pump. As a result, a more-representative sample is obtained.

Typically, wells contain some sediment in the bottom of the well, either as a residue from development that has settled out of the water column or that has sifted through the sand pack and screen since the well was installed. This sediment commonly has adsorbed on it such analytes as metals, SVOCs, and dioxins that normally would not be dissolved in the groundwater. If these sediments are picked up in the groundwater when the well is disturbed by excessive pumping, they can:

- Make filtering the samples for metals analysis more difficult
- Add unreasonably to the measured concentration of SVOCs and other organic compounds

The SOP for low-flow sampling has been modified recently and should be consulted for additional information about low-flow sampling and ways of dealing with wells in which the water level cannot be maintained at a constant level.

STANDARD OPERATING PROCEDURE

Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, ORP, and Temperature Using a Horiba or YSI Water Quality Parameter Meter with Flow-through Cell

I. Purpose and Scope

The purpose of this procedure is to provide a general guideline for using a water quality parameter meter (e.g., Horiba® or YSI) for field measurements of pH, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (ORP), and temperature of aqueous samples. The YSI instrument does not measure turbidity. A separate turbidity meter (i.e., Hanna Turbidity Meter) will need to be used in conjunction with the YSI meter. The operator's manual should be consulted for detailed operating procedures.

II. Equipment and Materials

- Water Quality Parameter Meter such as a Horiba® Water Quality Monitoring System or YSI with flow-though cell
- Auto-Calibration Standard Solution (provided by rental company)
- Distilled water in squirt bottle

III. Procedures and Guidelines

A. Parameters and Specifications:

Parameter	Range of measurement	Accuracy
pH	0 to 14 pH units	+/- 0.1 pH units
Specific conductance	0 to 9.99 S/m	+/- 3 % full scale
Turbidity	0 to 800 NTU	+/- 5 % full scale
Dissolved oxygen	0 to 19.99 mg/l	+/- 0.2 mg/l
Temperature	0 to 55 ^oC	+/- 1.0 ^oC
ORP	-999 to +999 mV	+/- 15 mV
Salinity	0 to 4 %	+/- 0.3 %

B. Calibration:

Prior to each day's use, clean the probe and flow-through cell using deionized water and calibrate using the Standard Solution.

Horiba Calibration procedure:

1. Fill a calibration beaker with standard solution to the recommended fill line.

2. Insert the probe into the beaker. All the parameter sensors will now be immersed in the standard solution except the D.O. sensor; the D.O. calibration is done using atmospheric air.

3. Turn power on and allow some time for the machine to warm-up prior to starting the calibration. When the initial readings appear to stabilize the instrument is ready to calibrate.

4. Press CAL key to put the unit in the calibration mode.

5. Press the ENT key to start automatic calibration. Wait a moment, and the upper cursor will gradually move across the four auto-calibration parameters one by one: pH, COND, TURB, and DO. When the calibration is complete, the readout will briefly show END. The instrument is now calibrated.

6. If the unit is calibrated properly the instrument readings, while immersed in the standard solution, will match the standard solution values provided on the solution container. The typical standard solution values are: pH = 4.0 +/- 3%, conductivity 4.49 mS/cm +/- 3%, and turbidity = 0 NTU +/- 3%.

7. Record the calibration data (e.g. time, instrument ID, solution lot number and expiration date, final calibrated readings, and solution temperature in the field logbook.

YSI Calibration procedure:

1. Press the **On/off** key to display the run screen

2. Press the **Escape** key to display the main menu screen

3. Use the arrow keys to highlight the **Calibrate**

4. Press the **Enter** key. The Calibrate screen is displayed

5. Choose the parameter to calibrate

A. Conductivity Calibration:

This procedure calibrates specific conductance (recommended), conductivity and salinity. Calibrating any one option automatically calibrates the other two.

1) Use the arrow keys to highlight the **Conductivity** selection
2) Press **Enter.** The Conductivity Calibration Selection Screen is displayed.
3) Use the arrow keys to highlight the Specific Conductance selection.
4) Press **Enter.** The Conductivity Calibration Entry Screen is displayed.

5) Place the correct amount of conductivity standard (see Instrument Manual) into a clean, dry or pre-rinsed transport/calibration cup.
6) Carefully immerse the sensor end of the probe module into the solution.
7) Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.

    NOTE: The sensor must be completely immersed past its vent hole. Using the recommended volumes from the Instrument Manual Calibration Volumes should ensure that the vent hole is covered.

8) Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

    NOTE: Do not over tighten as this could cause damage to the threaded portions.

9) Use the keypad to enter the calibration value of the standard you are using.

    NOTE: Be sure to enter the value in **mS/cm at 25°C**.

10) Press **Enter**. The Conductivity Calibration Screen is displayed.
11) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
12) Observe the reading under Specific Conductance. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
13) Press **Enter**. This returns you to the Conductivity Calibrate Selection Screen
14) Press **Escape** to return to the calibrate menu.
15) Rinse the probe module and sensors in tap or purified water and dry.

B. Dissolved Oxygen Calibration:

This procedure calibrates dissolved oxygen. Calibrating any one option (% or mg/L) automatically calibrates the other.

1) Go to the calibrate screen as described in Section

    NOTE: The instrument must be on for at least 20 minutes to polarize the DO sensor before calibrating.

2) Use the arrow keys to highlight the **Dissolved Oxygen** selection.
3) Press **Enter**. The dissolved oxygen calibration screen is displayed.
4) DO calibration in mg/L is carried out in a water sample which has a known concentration of dissolved oxygen (usually determined by a Winkler titration).
5) Use the arrow keys to highlight the **DO mg/L** selection.
6) Press **Enter**. The DO mg/L Entry Screen is displayed.
7) Place the probe module in water with a known DO concentration.

    NOTE: Be sure to completely immerse all the sensors.

8) Use the keypad to enter the known DO concentration of the water.
9) Press **Enter**. The Dissolved Oxygen mg/L Calibration Screen is displayed.
10) Stir the water with a stir bar, or by rapidly moving the probe module, to provide fresh sample to the DO sensor.
11) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

12) Observe the DO mg/L reading, when the reading is stable (shows no significant change for approximately 30 seconds), press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
13) Press **Enter**. This returns you to the DO calibration screen.
14) Press **Escape** to return to the calibrate menu.
15) Rinse the probe module and sensors in tap or purified water and dry.

C. *pH Calibration:*

1) Go to the calibrate screen.
2) Use the arrow keys to highlight the **pH** selection.
3) Press **Enter**. The pH calibration screen is displayed.
   - Select the **1-point** option only if you are adjusting a previous calibration. If a 2-point or 3-point calibration has been performed previously, you can adjust the calibration by carrying out a one point calibration. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select only one pH buffer.
   - Select the **2-point** option to calibrate the pH sensor using only two calibration standards. Use this option if the media being monitored is known to be either basic or acidic. For example, if the pH of a pond is known to vary between 5.5 and 7, a two-point calibration with pH 7 and pH 4 buffers is sufficient. A three point calibration with an additional pH 10 buffer will not increase the accuracy of this measurement since the pH is not within this higher range.
   - Select the **3-point** option to calibrate the pH sensor using three calibration solutions. In this procedure, the pH sensor is calibrated with a pH 7 buffer and two additional buffers. The 3-point calibration method assures maximum accuracy when the pH of the media to be monitored cannot be anticipated. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select a third pH buffer.
4) Use the arrow keys to highlight the **2-point** selection.
5) Press **Enter**. The pH Entry Screen is displayed.
6) Place the correct amount of pH buffer into a clean, dry or pre-rinsed transport/calibration cup.
   NOTE: For maximum accuracy, the pH buffers you choose should be within the same pH range as the water you are preparing to sample.
   NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the pH sensor with a small amount of buffer that can be discarded. Be certain that you avoid cross-contamination of buffers with other solutions.
7) Carefully immerse the sensor end of the probe module into the solution.
8) Gently rotate and/or move the probe module up and down to remove any bubbles from the pH sensor.
   NOTE: The sensor must be completely immersed. Using the recommended volumes from Table 6.1 Calibration Volumes, should ensure that the sensor is covered.

9) Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.
   NOTE: Do not over tighten as this could cause damage to the threaded portions.
10) Use the keypad to enter the calibration value of the buffer you are using **at the current temperature**.
   NOTE: pH vs. temperature values are printed on the labels of all YSI pH buffers.
11) Press **Enter**. The pH calibration screen is displayed.
12) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
13) Observe the reading under pH, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
14) Press **Enter**. This returns you to the Specified pH Calibration Screen.
15) Rinse the probe module, transport/calibration cup and sensors in tap or purified water and dry.
16) Repeat steps 6 through 13 above using a second pH buffer.
17) Press **Enter**. This returns you to the pH Calibration Screen.
18) Press **Escape** to return to the calibrate menu.
19) Rinse the probe module and sensors in tap or purified water and dry.

D. ORP Calibration:

1) Go to the calibrate screen.
2) Use the arrow keys to highlight the **ORP** selection.
3) Press **Enter**. The ORP calibration screen is displayed.
4) Place the correct amount of a known ORP solution into a clean, dry or pre-rinsed transport/calibration cup.
   NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the ORP sensor with a small amount of solution that can be discarded. Be certain that you avoid cross-contamination with other solutions.
5) Carefully immerse the sensor end of the probe module into the solution.
6) Gently rotate and/or move the probe module up and down to remove any bubbles from the ORP sensor.
   NOTE: The sensor must be completely immersed.
7) Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.
8) Use the keypad to enter the correct value of the calibration solution you are using at the current temperature.
9) Press **Enter**. The ORP calibration screen is displayed.
10) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
11) Observe the reading under ORP, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

12) Press **Enter**. This returns you to the Calibrate Screen.
13) Rinse the probe module and sensors in tap or purified water and dry.
    Record the calibration data (e.g. time, instrument ID, solution lot number and expiration date, final calibrated readings, and solution temperature in the field logbook.

C. Sample Measurement:

Horiba measurement procedure:

As water passes through the flow-through the flow cell, press MEAS to obtain reading; record data in a field notebook.

YSI measurement procedure:

As water passes through the flow-through the flow cell, the readings are displayed for each parameter. Record the water quality parameter data in a field notebook. In addition, the data is recorded in the YSI and can be downloaded to a computer following completion of the sampling event.

IV. Key Checks and Preventive Maintenance

- Calibrate meter
- Clean probe with deionized water when done
- Refer to operations manual for recommended maintenance and troubleshooting
- Check batteries, and have a replacement set on hand
- Due to the importance of obtaining these parameters, the field team should have a spare unit readily available in case of an equipment malfunction.

V. References

YSI 556 Multi Probe System Operator Manual

STANDARD OPERATING PROCEDURE

Preparing Field Log Books

I. Purpose

This SOP provides general guidelines for entering field data into log books during site investigation and remediation activities.

II. Scope

This is a general description of data requirements and format for field log books. Log books are needed to properly document all field activities in support of data evaluation and possible legal activities.

III. Equipment and Materials

- Log book
- Indelible pen

IV. Procedures and Guidelines

Properly completed field log books are a requirement for much of the work we perform under the Navy CLEAN contract. Log books are legal documents and, as such, must be prepared following specific procedures and must contain required information to ensure their integrity and legitimacy. This SOP describes the basic requirements for field log book entries.

A. PROCEDURES FOR COMPLETING FIELD LOG BOOKS

1. Field notes commonly are kept in bound, hard-cover logbooks used by surveyors and produced, for example, by Peninsular Publishing Company and Sesco, Inc. Pages should be water-resistant and notes should be taken only with water-proof, non-erasable permanent ink, such as that provided in Sanford Sharpie® permanent markers.
2. On the inside cover of the log book the following information should be included:
   - Company name and address
   - Log-holders name if log book was assigned specifically to that person
   - Activity or location
   - Project name

- Project manager's name
- Phone numbers of the company, supervisors, emergency response, etc.

3. All lines of all pages should be used to prevent later additions of text, which could later be questioned. Any line not used should be marked through with a line and initialed and dated. Any pages not used should be marked through with a line, the author's initials, the date, and the note "Intentionally Left Blank."

4. If errors are made in the log book, cross a single line through the error and enter the correct information. All corrections shall be initialed and dated by the personnel performing the correction. If possible, all corrections should be made by the individual who made the error.

5. Daily entries will be made chronologically.

6. Information will be recorded directly in the field log book during the work activity. Information will not be written on a separate sheet and then later transcribed into the log book.

7. Each page of the log book will have the date of the work and the note takers initials.

8. The final page of each day's notes will include the note-takers signature as well as the date.

9. Only information relevant to the subject project will be added to the log book.

10. The field notes will be copied and the copies sent to the Project Manager or designee in a timely manner (at least by the end of each week of work being performed).

B. INFORMATION TO BE INCLUDED IN FIELD LOG BOOKS

1. Entries into the log book should be as detailed and descriptive as possible so that a particular situation can be recalled without reliance on the collector's memory. Entries must be legible and complete.

2. General project information will be recorded at the beginning of each field project. This will include the project title, the project number, and project staff.

3. Scope: Describe the general scope of work to be performed each day.

4. Weather: Record the weather conditions and any significant changes in the weather during the day.

5. Tail Gate Safety Meetings: Record time and location of meeting, who was present, topics discussed, issues/problems/concerns identified, and corrective actions or adjustments made to address concerns/ problems, and other pertinent information.

6. Standard Health and Safety Procedures: Record level of personal protection being used (e.g., level D PPE), record air monitoring data on a regular basis and note where data were recording (e.g., reading in borehole, reading in breathing zone, etc). Also record other required health and safety procedures as specified in the project specific health and safety plan.

7. Instrument Calibration; Record calibration information for each piece of health and safety and field equipment.

8. Personnel: Record names of all personnel present during field activities and list their roles and their affiliation. Record when personnel and visitors enter and leave a project site and their level of personal protection.

9. Communications: Record communications with project manager, subcontractors, regulators, facility personnel, and others that impact performance of the project.

10. Time: Keep a running time log explaining field activities as they occur chronologically throughout the day.

11. Deviations from the Work Plan: Record any deviations from the work plan and document why these were required and any communications authorizing these deviations.

12. Heath and Safety Incidents: Record any health and safety incidents and immediately report any incidents to the Project Manager.

13. Subcontractor Information: Record name of company, record names and roles of subcontractor personnel, list type of equipment being used and general scope of work. List times of starting and stopping work and quantities of consumable equipment used if it is to be billed to the project.

14. Problems and Corrective Actions: Clearly describe any problems encountered during the field work and the corrective actions taken to address these problems.

15. Technical and Project Information: Describe the details of the work being performed. The technical information recorded will vary significantly between projects. The project work plan will describe the specific activities to be performed and may also list requirements for note taking. Discuss note-taking expectations with the Project Manager prior to beginning the field work.

16. Any conditions that might adversely affect the work or any data obtained (e.g., nearby construction that might have introduced excessive amounts of dust into the air).

17. Sampling Information; Specific information that will be relevant to most sampling jobs includes the following:

- Description of the general sampling area – site name, buildings and streets in the area, etc.
- Station/Location identifier
- Description of the sample location – estimate location in comparison to two fixed points – draw a diagram in the field log book indicating sample location relative to these fixed points – include distances in feet.
- Sample matrix and type
- Sample date and time
- Sample identifier
- Draw a box around the sample ID so that it stands out in the field notes
- Information on how the sample was collected – distinguish between "grab," "composite," and "discrete" samples
- Number and type of sample containers collected
- Record of any field measurements taken (i.e. pH, turbidity, dissolved oxygen, and temperature, and conductivity)
- Parameters to be analyzed for, if appropriate
- Descriptions of soil samples and drilling cuttings can be entered in depth sequence, along with PID readings and other observations. Include any unusual appearances of the samples.

C. SUGGESTED FORMAT FOR RECORDING FIELD DATA

1. Use the left side border to record times and the remainder of the page to record information (see attached example).
2. Use tables to record sampling information and field data from multiple samples.
3. Sketch sampling locations and other pertinent information.
4. Sketch well construction diagrams.

V. Attachments

Example field notes.

47 MAY 12, 2003 EXAMPLE

0715 ARRIVE ON SITE AT XYZ SITE.
CH2M HILL STAFF:
John Smith : FIELD TEAM LEADER
Bob Builder: SITE SAFETY COORD.
WEATHER: OVERCAST + Cool, 45°F
CHANCE OF LATE SHOWERS
SCOPE: • Collect GROUNDWATER
SAMPLES for LTM work at SITE 14
• SUPERVISE SURVEY CREW
At SITE 17
0725 BB ~~Cal JS~~ JS Calibrates
PID: 101 ppm/100 ppm ok
PID Model #, SERIAL #
0730 BB Calibrates HORIBA METER
Model #, SERIAL #
→ List calibration Results
0738 Survey crew ARRIVES on Site
→ List NAMES
0745 BB Holds H+S Talk on Slips,
Trips, Falls, Ticks + Air Monitoring
JS + Survey Crew ATTEND
No H+S ISSUES IDENTIFIED as
concerns. All work is in "Level D."
0755 JS Conducts site-wide Air Monitoring
All readings = 0.0 ppm in

JS
5-12-03

MAY 12, 2003 EXAMPLE 48

SITE 14 LTM
BREATHING ZONE (BZ)
0805 Mobilize to well MW-22 to
SAMPLE, surveyors setting up
At SITE 17
0815 PM (PAUL PAPER PUSHER) calls AND
informs JS to collect GW sample
At well MW-44 today for 24 hour
TAT ANALYSIS OF VOC'S
0820 Purging MW-22
→ RECORD WATER QUALITY DATA

JS
5-12-03

0843 Collect SAMPLE At MW-22 for
total TAL Metals AND VOC's. No
Dissolved Metals Needed per PM
0905 JS + BB Mobilize to SITE 17 to
show surveyors wells to Survey.
0942 Mobilize to well MW-22 to
Collect SAMPLE...
0950 CAN not Access well MW-22
due to BASE OPERATIONS; Contact
PAUL PAPERPUSHER AND he stated
he will check on GAINING ACCESS
with BASE contact.
0955 Mobilize to well MW-19

JS
5.12.03

STANDARD OPERATING PROCEDURE

Equipment Blank and Field Blank Preparation

I. Purpose

To prepare blanks to determine whether decontamination procedures are adequate and whether any cross-contamination is occurring during sampling due to contaminated air and dust.

II. Scope

The general protocols for preparing the blanks are outlined. The actual equipment to be rinsed will depend on the requirements of the specific sampling procedure.

III. Equipment and Materials

- Blank liquid (use ASTM Type II or lab grade water)
- Millipore™ deionized water
- Sample bottles as appropriate
- Gloves
- Preservatives as appropriate

IV. Procedures and Guidelines

A. Decontaminate all sampling equipment that has come in contact with sample according to SOP *Decontamination of Personnel and Equipment.*

B. To collect an equipment blank for volatile analysis from the surfaces of sampling equipment other than pumps, pour blank water over one piece of equipment and into two 40-ml vials until there is a positive meniscus, then seal the vials. Note the sample number and associated piece of equipment in the field notebook as well as the type and lot number of the water used.

For non-volatiles analyses, one aliquot is to be used for equipment. For example, if a pan and trowel are used, place trowel in pan and pour blank fluid in pan such that pan and trowel surfaces which contacted the sample are contacted by the blank fluid. Pour blank fluid from pan into appropriate sample bottles.

Do not let the blank fluid come in contact with any equipment that has not been decontaminated.

C. When collecting an equipment blank from a pump, run an extra gallon of deionized water through the pump while collecting the pump outflow into appropriate containers. Make sure the flow rate is low when sampling VOCs. If a Grundfos Redi-Flo2 pump with disposable tubing is used, remove the disposable tubing after sampling but before decon. When decon is complete, put a 3- to 5-foot segment of new tubing onto the pump to collect the equipment blank.

D. To collect a field blank, slowly pour ASTM Type II or lab grade water directly into sample containers.

E. Document and ship samples in accordance with the procedures for other samples.

F. Collect next field sample.

V. Attachments

None.

VI. Key Checks and Items

- Wear gloves.
- Do not use any non-decontaminated equipment to prepare blank.
- Use ASTM-Type II or lab grade water.

STANDARD OPERATING PROCEDURE

Packaging and Shipping Procedures for Low-Concentration Samples

I. Purpose and Scope

The purpose of this guideline is to describe the packaging and shipping of low-concentration samples of various media to a laboratory for analysis.

II. Scope

The guideline only discusses the packaging and shipping of samples that are anticipated to have low concentrations of chemical constituents. Whether or not samples should be classified as low-concentration or otherwise will depend upon the site history, observation of the samples in the field, odor, and photoionization-detector readings.

If the site is known to have produced high-concentration samples in the past or the sampler suspects that high concentrations of contaminants might be present in the samples, then the sampler should conservatively assume that the samples cannot be classified as low-concentration. Samples that are anticipated to have medium to high concentrations of constituents should be packaged and shipped accordingly.

If warranted, procedures for dangerous-goods shipping may be implemented. Dangerous goods and hazardous materials pose an unreasonable risk to health, safety, or property during transportation without special handling. As a result only employees who are trained under CH2M HILL Dangerous Goods Shipping course may ship or transport dangerous goods. Employees should utilize the HAZMAT ShipRight tool on the Virtual Office and/or contact a designated CH2M HILL HazMat advisor with questions.

III. Equipment and Materials

- Coolers
- Clear tape
- "This Side Up" labels
- "Fragile" labels
- Vermiculite
- Ziplock bags or bubble wrap
- Ice
- Chain-of-Custody form (completed)
- Custody seals

IV. Procedures and Guidelines

Low-Concentration Samples

A. Prepare coolers for shipment:

- Tape drains shut.
- Affix "This Side Up" labels on all four sides and "Fragile" labels on at least two sides of each cooler.
- Place mailing label with laboratory address on top of coolers.
- Fill bottom of coolers with about 3 inches of vermiculite or absorbent pads.

B. Arrange decontaminated sample containers in groups by sample number. Consolidate VOC samples into one cooler to minimize the need for trip blanks.

C. Affix appropriate adhesive sample labels to each container. Protect with clear label protection tape.

D. Seal each sample bottle within a separate ziplock plastic bag or bubble wrap, if available. Tape the bag around bottle. Sample label should be visible through the bag.

E. Arrange sample bottles in coolers so that they do not touch.

F. If ice is required to preserve the samples, cubes should be repackaged in zip-lock bags and placed on and around the containers.

G. Fill remaining spaces with vermiculite or absorbent pads.

H. Complete and sign chain-of-custody form (or obtain signature) and indicate the time and date it was relinquished to Federal Express or the courier.

J Close lid and latch.

K. Carefully peel custody seals from backings and place intact over lid openings (right front and left back). Cover seals with clear protection tape.

L. Tape cooler shut on both ends, making several complete revolutions with strapping tape. Cover custody seals with tape to avoid seals being able to be peeled from the cooler.

M. Relinquish to Federal Express or to a courier arranged with the laboratory. Place airbill receipt inside the mailing envelope and send to the sample documentation coordinator along with the other documentation.

Medium- and High-Concentration Samples:

Medium- and high-concentration samples are packaged using the same techniques used to package low-concentration samples, with potential additional restrictions. If applicable, the sample handler must refer to instructions associated with the shipping of dangerous goods for the necessary procedures for shipping by Federal Express or other overnight carrier. If warranted, procedures for dangerous-goods shipping may be implemented. Dangerous goods and hazardous materials pose an unreasonable risk to health, safety, or property during transportation without special handling. As a result only employees who are trained under CH2M HILL Dangerous Goods Shipping course may ship or transport dangerous goods. Employees should utilize the HAZMAT ShipRight tool on the Virtual Office and/or contact a designated CH2M HILL HazMat advisor with questions.

V. Attachments

None.

VI. Key Checks and Items

- Be sure laboratory address is correct on the mailing label
- Pack sample bottles carefully, with adequate vermiculite or other packaging and without allowing bottles to touch
- Be sure there is adequate ice
- Include chain-of-custody form
- Include custody seals

STANDARD OPERATING PROCEDURE

Chain-of-Custody

I Purpose

The purpose of this SOP is to provide information on chain-of-custody procedures to be used under the CLEAN Program.

II Scope

This procedure describes the steps necessary for transferring samples through the use of Chain-of-Custody Records. A Chain-of-Custody Record is required, without exception, for the tracking and recording of samples collected for on-site or off-site analysis (chemical or geotechnical) during program activities (except wellhead samples taken for measurement of field parameters). Use of the Chain-of-Custody Record Form creates an accurate written record that can be used to trace the possession and handling of the sample from the moment of its collection through analysis. This procedure identifies the necessary custody records and describes their completion. This procedure does not take precedence over region specific or site-specific requirements for chain-of-custody.

III Definitions

Chain-of-Custody Record Form - A Chain-of-Custody Record Form is a printed two-part form that accompanies a sample or group of samples as custody of the sample(s) is transferred from one custodian to another custodian. One copy of the form must be retained in the project file.

Custodian - The person responsible for the custody of samples at a particular time, until custody is transferred to another person (and so documented), who then becomes custodian. A sample is under one's custody if:

- It is in one's actual possession.
- It is in one's view, after being in one's physical possession.
- It was in one's physical possession and then he/she locked it up to prevent tampering.
- It is in a designated and identified secure area.

Sample - A sample is physical evidence collected from a facility or the environment, which is representative of conditions at the point and time that it was collected.

IV. Procedures

The term "chain-of-custody" refers to procedures which ensure that evidence presented in a court of law is valid. The chain-of-custody procedures track the evidence from the time and place it is first obtained to the courtroom, as well as providing security for the evidence as it is moved and/or passed from the custody of one individual to another.

Chain-of-custody procedures, recordkeeping, and documentation are an important part of the management control of samples. Regulatory agencies must be able to provide the chain-of-possession and custody of any samples that are offered for evidence, or that form the basis of analytical test results introduced as evidence. Written procedures must be available and followed whenever evidence samples are collected, transferred, stored, analyzed, or destroyed.

Sample Identification

The method of identification of a sample depends on the type of measurement or analysis performed. When *in situ* measurements are made, the data are recorded directly in bound logbooks or other field data records with identifying information.

Information which shall be recorded in the field logbook, when in-situ measurements or samples for laboratory analysis are collected, includes:

- Field Sampler(s),
- Contract Task Order (CTO) Number,
- Project Sample Number,
- Sample location or sampling station number,
- Date and time of sample collection and/or measurement,
- Field observations,
- Equipment used to collect samples and measurements, and
- Calibration data for equipment used

Measurements and observations shall be recorded using waterproof ink.

Sample Label

Samples, other than for *in situ* measurements, are removed and transported from the sample location to a laboratory or other location for analysis. Before removal, however, a sample is often divided into portions, depending upon the analyses to be performed. Each portion is preserved in accordance with the Sampling and Analysis Plan. Each sample container is identified by a sample label (see Attachment A). Sample labels are provided, along with sample containers, by the analytical laboratory. The information recorded on the sample label includes:

- Project - CTO Number.

- Station Location - The unique sample number identifying this sample.

- Date - A six-digit number indicating the day, month, and year of sample collection (e.g., 08/21/12).

- Time - A four-digit number indicating the 24-hour time of collection (for example: 0954 is 9:54 a.m., and 1629 is 4:29 p.m.).
- Medium - Water, soil, sediment, sludge, waste, etc.
- Sample Type - Grab or composite.
- Preservation - Type and quantity of preservation added.
- Analysis - VOA, BNAs, PCBs, pesticides, metals, cyanide, other.
- Sampled By - Printed name of the sampler.
- Remarks - Any pertinent additional information.

Using only the work assignment number of the sample label maintains the anonymity of sites. This may be necessary, even to the extent of preventing the laboratory performing the analysis from knowing the identity of the site (e.g., if the laboratory is part of an organization that has performed previous work on the site). The field team should always follow the sample ID system prepared by the project EIS and reviewed by the Project Manager.

Chain-of-Custody Procedures

After collection, separation, identification, and preservation, the sample is maintained under chain-of-custody procedures until it is in the custody of the analytical laboratory and has been stored or disposed.

Field Custody Procedures

- Samples are collected as described in the site Sampling and Analysis Plan. Care must be taken to record precisely the sample location and to ensure that the sample number on the label matches the Chain-of-Custody Record exactly.

- A Chain-of-Custody Record will be prepared for each individual cooler shipped and will include ***only*** the samples contained within that particular cooler. The Chain-of-Custody Record for that cooler will then be sealed in a zip-log bag and placed in the cooler prior to sealing. This ensures that the laboratory properly attributes trip blanks with the correct cooler and allows for easier tracking should a cooler become lost during transit.

- The person undertaking the actual sampling in the field is responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

- When photographs are taken of the sampling as part of the documentation procedure, the name of the photographer, date, time, site location, and site description are entered sequentially in the site logbook as photos are taken. Once downloaded to the server or developed, the electronic files or photographic prints shall be serially numbered, corresponding to the logbook descriptions; photographic prints will be stored in the project files. To identify sample locations in photographs, an easily read sign with the appropriate sample location number should be included.

- Sample labels shall be completed for each sample, using waterproof ink unless prohibited by weather conditions (e.g., a logbook notation would explain that a pencil was used to fill out the sample label if the pen would not function in freezing weather.)

Transfer of Custody and Shipment

Samples are accompanied by a Chain-of-Custody Record Form. **A Chain-of-Custody Record Form must be completed for each cooler and should include only the samples contained within that cooler**. A Chain-of-Custody Record Form example is shown in Attachment B. When transferring the possession of samples, the individuals relinquishing and receiving will sign, date, and note the time on the Record. This Record documents sample custody transfer from the sampler, often through another person, to the analyst in the laboratory. The Chain-of-Custody Record is filled out as given below:

- Enter header information (CTO number, samplers, and project name).

- Enter sample specific information (sample number, media, sample analysis required and analytical method grab or composite, number and type of sample containers, and date/time sample was collected).

- Sign, date, and enter the time under "Relinquished by" entry.

- Have the person receiving the sample sign the "Received by" entry. If shipping samples by a common carrier, print the carrier to be used in this space (i.e., Federal Express).

- If a carrier is used, enter the airbill number under "Remarks," in the bottom right corner;

- Place the original (top, signed copy) of the Chain-of-Custody Record Form in a plastic zipper-type bag or other appropriate sample-shipping package. Retain the copy with field records.

- Sign and date the custody seal, a 1-inch by 3-inch white paper label with black lettering and an adhesive backing. Attachment C is an example of a custody seal. The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field. Custody seals shall be provided by the analytical laboratory.

- Place the seal across the shipping container opening (front and back) so that it would be broken if the container were to be opened.

- Complete other carrier-required shipping papers.

The custody record is completed using waterproof ink. Any corrections are made by drawing a line through and initialing and dating the change, then entering the correct information. Erasures are not permitted.

Common carriers will usually not accept responsibility for handling Chain-of-Custody Record Forms; this necessitates packing the record in the shipping container (enclosed with other documentation in a plastic zipper-type bag). As long as custody forms are sealed inside the shipping container and the custody seals are intact, commercial carriers are not required to sign the custody form.

The laboratory representative who accepts the incoming sample shipment signs and dates the Chain-of-Custody Record, completing the sample transfer process. It is then the laboratory's responsibility to maintain internal logbooks and custody records throughout sample preparation and analysis.

V Quality Assurance Records

Once samples have been packaged and shipped, the Chain-of-Custody copy and airbill receipt become part of the quality assurance record.

VI Attachments

A. Sample Label
B. Chain of Custody Form
C. Custody Seal

VII References

USEPA. *User's Guide to the Contract Laboratory Program*. Office of Emergency and Remedial Response, Washington, D.C. (EPA/540/P-91/002), January 1991.

Attachment A

Example Sample Label

Quality Analytical Laboratories, Inc.
2567 Fairlane Drive
Montgomery, Alabama 36116
PH. (334)271-2440

Client
Sample No.
Location
Analysis
Preservative HCL
Date By

CEIMIC CORPORATION
10 Dean Knauss Drive, Narragansett, R.I. 02882 • (401) 782-8900

SITE NAME	DATE
ANALYSIS	TIME
	PRESERVATIVE

SAMPLE TYPE

☐ Grab ☐ Composite ☐ Other

COLLECTED BY:

Attachment B

Example Chain-of-Custody Record

CH2M HILL
APPLIED SCIENCES LABORATORY

CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CH2M Hill Project #	Purchase Order #	# OF CONTAINERS	LAB TEST CODES	SHADED AREA– FOR LAB USE ONLY	
☐☐☐☐☐☐☐☐.☐☐.☐☐				Lab 1 #	Lab 2 #
Project Name				Quote #	Kit Request #
Company Name CH2M HILL Office			ANALYSES REQUESTED	Project #	
Project Manager & Phone # Mr. [ ] Ms. [ ] Dr. [ ]	Report Copy to:				
Requested Completion Date:	Sampling Requirements: SDWA ☐ NPDES ☐ RCRA ☐ OTHER ____ / Sample Disposal: Dispose ☐ Return ☐			No. of Samples	Page of
				Login	LIMS Ver

Sampling Date	Sampling Time	Type COMP	Type GRAB	Matrix WATER	Matrix SOIL	Matrix AIR	CLIENT SAMPLE ID (9 CHARACTERS)	# OF CONTAINERS	ANALYSES REQUESTED	REMARKS	LAB 1 ID	LAB 2 ID

Sampled By & Title (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time
Received By (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time
Received By (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time
Received By (Please sign and print name)	Date/Time	Shipped Via UPS BUS Fed-Ex Hand Other ____	Shipping #
Work Authorized By (Please sign and print name)	Remarks		

QC Level: 1 2 3 Other: ____	
COC Rec	ICE
Ana Req	TEMP
Cust Seal	Ph

Instructions and Agreement Provisions on Reverse Side

DISTRIBUTION: Original - LAB, Yellow - LAB, Pink - Client
REV 3/94 FORM 340

Attachment C

Example Custody Seal

CH2M HILL

CUSTODY SEAL

Date

Signature

STANDARD OPERATING PROCEDURE

Decontamination of Personnel and Equipment

I. Purpose

To provide general guidelines for the decontamination of personnel, sampling equipment, and monitoring equipment used in potentially contaminated environments.

II. Scope

This is a general description of decontamination procedures.

III. Equipment and Materials

- Demonstrated analyte-free, deionized ("DI") water (specifically, ASTM Type II water or lab-grade DI water)
- Potable water; must be from a municipal water supplier, otherwise an analysis must be run for appropriate volatile and semivolatile organic compounds and inorganic chemicals (e.g., Target Compound List and Target Analyte List chemicals)
- 2.5% (W/W) Liquinox® and water solution
- Concentrated (V/V) pesticide grade isopropanol (DO NOT USE ACETONE)
- Large plastic pails or tubs for Liquinox® and water, scrub brushes, squirt bottles for Liquinox® solution, methanol and water, plastic bags and sheets
- DOT approved 55-gallon drum for disposal of waste
- Personal Protective Equipment as specified by the Health and Safety Plan
- Decontamination pad and steam cleaner/high pressure cleaner for large equipment

IV. Procedures and Guidelines

A. PERSONNEL DECONTAMINATION

To be performed after completion of tasks whenever potential for contamination exists, and upon leaving the exclusion zone.

1. Wash boots in Liquinox® solution, then rinse with water. If disposable latex booties are worn over boots in the work area, rinse with Liquinox® solution, remove, and discard into DOT-approved 55-gallon drum.

2. Wash outer gloves in Liquinox® solution, rinse, remove, and discard into DOT-approved 55-gallon drum.

3. Remove disposable coveralls (“Tyveks”) and discard into DOT-approved 55-gallon drum.

4. Remove respirator (if worn).

5. Remove inner gloves and discard.

6. At the end of the work day, shower entire body, including hair, either at the work site or at home.

7. Sanitize respirator if worn.

B. SAMPLING EQUIPMENT DECONTAMINATION—GROUNDWATER SAMPLING PUMPS

Sampling pumps are decontaminated after each use as follows.

1. Don phthalate-free gloves.

2. Spread plastic on the ground to keep equipment from touching the ground

3. Turn off pump after sampling. Remove pump from well and remove and dispose of tubing. Place pump in decontamination tube.

4. Turn pump back on and pump 1 gallon of Liquinox® solution through the sampling pump.

5. Rinse with 1 gallon of 10% isopropanol solution pumped through the pump. (DO NOT USE ACETONE). (Optional)

6. Rinse with 1 gallon of tap water.

7. Rinse with 1 gallon of deionized water.

8. Keep decontaminated pump in decontamination tube or remove and wrap in aluminum foil or clean plastic sheeting.

9. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.

10. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in either DOT-approved 55-gallon drums or with solid waste in garbage bags, dependent on Facility/project requirements.

C. SAMPLING EQUIPMENT DECONTAMINATION—OTHER EQUIPMENT

Reusable sampling equipment is decontaminated after each use as follows.

1. Don phthalate-free gloves.
2. Before entering the potentially contaminated zone, wrap soil contact points in aluminum foil (shiny side out).
3. Rinse and scrub with potable water.
4. Wash all equipment surfaces that contacted the potentially contaminated soil/water with Liquinox® solution.
5. Rinse with potable water.
6. Rinse with distilled or potable water and isopropanol solution (DO NOT USE ACETONE). (Optional)
7. Air dry.
8. Rinse with deionized water.
9. Completely air dry and wrap exposed areas with aluminum foil (shiny side out) for transport and handling if equipment will not be used immediately.
10. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.
11. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums or with solid waste in garbage bags, dependent on Facility/project requirements.

D. HEALTH AND SAFETY MONITORING EQUIPMENT DECONTAMINATION

1. Before use, wrap soil contact points in plastic to reduce need for subsequent cleaning.
2. Wipe all surfaces that had possible contact with contaminated materials with a paper towel wet with Liquinox® solution, then a towel wet with methanol solution, and finally three times with a towel wet with distilled water. Dispose of all used paper towels in a DOT-approved 55-gallon drum or with solid waste in garbage bags, dependent on Facility/project requirements.

E. SAMPLE CONTAINER DECONTAMINATION

The outsides of sample bottles or containers filled in the field may need to be decontaminated before being packed for shipment or handled by personnel without hand protection. The procedure is:

1. Wipe container with a paper towel dampened with Liquinox®

solution or immerse in the solution AFTER THE CONTAINERS HAVE BEEN SEALED. Repeat the above steps using potable water.

2. Dispose of all used paper towels in a DOT-approved 55-gallon drum or with solid waste in garbage bags, dependent on Facility/project requirements.

F. HEAVY EQUIPMENT AND TOOLS

Heavy equipment such as drilling rigs, drilling rods/tools, and the backhoe will be decontaminated upon arrival at the site and between locations as follows:

1. Set up a decontamination pad in area designated by the Facility

2. Steam clean heavy equipment until no visible signs of dirt are observed. This may require wire or stiff brushes to dislodge dirt from some areas.

V. Attachments

None.

VI. Key Checks and Items

- Clean with solutions of Liquinox®, Liquinox® solution (optional), and distilled water.
- Do not use acetone for decontamination.
- Drum all contaminated rinsate and materials.
- Decontaminate filled sample bottles before relinquishing them to anyone.

STANDARD OPERATING PROCEDURE

Sampling Contents of Tanks and Drums

I. Scope and Application

This procedure provides an overview approach and guidelines for the routine sampling of drums and tanks. Its purpose is to describe standard procedures and precautions which are applied in sampling drums and tanks. Procedures for opening drums with the individual instruments are included in Attachment D.

The samples obtained may be used to obtain physical chemical or radiological data. The resulting data may be qualitative or quantitative in nature, and are appropriate for use in preliminary surveys as well as confirmatory sampling.

II. Summary of Methods

Drums are generally sampled by means of sampling tubes such as glass sample tubes or COLIWASA samplers. In either case, the sampling tube is manually inserted into the waste material. A sample of the drum contents is withdrawn by the sampling device. Should a drum contain bottom sludge, a glass tube will be used to retrieve a sample of this as well.

Storage tank and tank trailers, because of their greater depths, require sampling devices that can be lowered from the top, filled at a particular depth, then withdrawn. Such devices are a COLIWASA, a Kemmerer depth sampler, or a Bacon Bomb. Where samples of bottom sludge are desired, a gravity corer can be utilized. This heavy tube with a tapered nose piece will penetrate the sludge as it free falls through the tank.

III. Comments

The sampling of tanks, containers, and drums present unique problems not associated with environmental samples. Containers of this sort are generally closed except for small access ports, manways, or hatches on the larger vessels, or taps and bungs on smaller drums. The physical size, shape, construction material, and location of access limit the types of equipment and methods of collection that can be used.

When liquids are contained in sealed vessels, gas vapor pressure can build up, sludges can settle out, and density layerings (stratification) can develop. Bulging drums may be under pressure and extreme caution should be exercised. The potential exists for explosive reactions or the release of noxious gases when containers are opened. All vessels should be opened with extreme caution. Check the HSP for the level of personnel protection to be worn. A preliminary sampling of any headspace gases is warranted. As a minimum, a preliminary check with a Multi RAE or equivalent may be of aid in selecting a sampling method.

In most cases it is impossible to observe the contents of these sealed or partially sealed vessels. Since some layering or stratification is likely in any solution left undisturbed over time, a sample must be taken that represents the entire depth of the vessel.

IV. Required Equipment and Apparatus

A. **Health and safety equipment/materials**: As listed in the site safety plan.

B. **Sampling equipment**: COLIWASA, glass sample tubes, Kemmerer depth sampler, Bacon Bomb, gravity corer.

C. **Tools**: Rubber mallet, bung wrench, speed wrench with socket, etc., (all non-sparking), paint marker.

D. **Heavy equipment**: Backhoe equipped with explosion shield, drum grappler, and 3-foot copper-beryllium (non-sparking) spike with 6-inch collar (to puncture top of drums for sampling, if necessary).

E. **Sample Containers**: As specified in the field sampling plan.

V. Procedures

A. Drums

NOTE: DO NOT open more than one drum at a time. Each drum must be handled and sampled as a separate entity to reduce vapors in the sampling area.

1. Drums will be sampled on an area-by-area basis. Drums will be sampled after they have been placed in overpack drums but before they are transferred from the excavation to the onsite storage area.
2. Record, in logbook, all pertinent information from visual inspection of drum (e.g., physical condition, leaks, bulges, and labels). Label each drum with a unique identifying number.
3. If possible, stage drums for easy access.
4. If necessary, attach ground strap to drums and grounding point.
5. Remove any standing material (water, etc.) from container top.
6. Using non-sparking tools, carefully remove the bung or lid while monitoring air quality with appropriate instruments. If necessary (and as a last resort), the non-sparking spike affixed to the backhoe can also be used to puncture the drum for sampling. See Attachment D for method of drum opening. Record air-quality monitoring results.

7. When sampling a previously sealed vessel, a check should be made for the presence of bottom sludge. This is accomplished by measuring the depth to apparent bottom, then comparing it to the known interior depth.

8. Agitation to disrupt the layers and rehomogenize the sample is physically difficult and almost always undesirable. If the vessel is greater than 3 feet in depth (say, a 55-gallon drum), the appropriate sampling method is to slowly lower the sampling device (i.e., suction line of peristaltic pump, glass tube) in known increments of length. Discrete samples can be collected from various depths, then combined or analyzed separately. If the depth of the vessel is greater than the lift capacity of the pump, an at-depth water sampler, such as the Kemmerer or Bacon Bomb type, may be required.

9. Extract a representative sample from the drum using a glass rod, COLIWASA, Bacon Bomb, Kemmerer bottle, or gravity corer (See Attachments). Ensure that the entire depth of material is penetrated. Depending on the size of the opening of the drum, three to four takes should be collected from random locations across the drum surface, to ensure a representative sample. Any observed stratification must be recorded in logbook, including number and thickness of the layers and a conceptualized sketch.

10. Record a visual description of the sample (e.g., liquid, solid, color, viscosity, and percent layers).

11. When possible, sampling equipment (like glass tubes) should be expendable and be left inside the drum for disposal with drum contents, once sampling is completed.

12. Place lid, bung, cap, etc., back in place on drum. Tighten hand tight. If necessary, the sampling port can be sealed using a cork.

13. Wipe up spilled material with lab wipes. Wipe off sample containers.

14. Mark the drum with a unique sample identification number and date using a paint marker.

15. Samples will be handled as high hazard samples. Samples will be placed in containers defined according to the analytical needs, wiped clean, and then packed in paint cans for shipping. Packaging, labeling, and preparation for shipment procedures will follow procedures as specified in the field sampling plan.

B. Underground Storage Tanks

1. A sampling team of at least two people is required for sampling—one will collect samples, the other will relay required equipment and implements.

2. Sampling team will locate a sampling port on the tank. Personnel should be wearing appropriate protective clothing at this time and carrying sampling gear.

3. Do not attempt to climb down into tank. Sampling MUST BE accomplished from the top.

4. Collect a sample from the upper, middle, and lower section of the tank contents with one of the recommended sampling devices.

5. If compositing is necessary, ship samples to laboratory in separate containers for laboratory compositing.

6. Samples will be handled as hazardous. Samples will be placed in appropriate containers and packed with ice in a cooler. Packaging, labeling, and preparation for shipment will follow procedures specified in the field sampling plan.

C. Tank Trailers or Above-Ground Storage Tanks

1. A sampling team of two is required. One will collect samples, the other will relay required equipment and implements.

2. Samples will be collected through the manhole (hatch) on top of the tanker or the fill port. Do not open valves at the bottom. Before opening the hatch, check for a pressure gauge or release valve. Open the release valve slowly to bring the tank to atmospheric pressure.

3. If tank pressure is too great, or venting releases large amounts of toxic gas, discontinue venting and sampling immediately. Measure vented gas with organic vapor analyzer and explosimeter.

4. If no release valve exists, slowly loosen hatch cover bolts to relieve pressure in the tank. (Again, stop if pressure is too great.)

5. Once pressure in tank has been relieved, open the hatch and withdraw sample using one of the recommended sampling devices.

6. Sample each trailer compartment.

7. If compositing is necessary, ship samples to laboratory in separate containers for laboratory compositing.

8. Samples will be handled as hazardous. Samples will be placed in appropriate containers and packed with ice in a cooler. Packaging, labeling, and preparation for shipment will follow procedures specified in the field sampling plan.

D. Refer to Attachment B for procedures for sampling with appropriate devices as follows:

<u>Drum</u>

Glass tube – Procedure 1

COLIWASA	—	Procedure 2

Storage Tank and Tank Trailer

COLIWASA	—	Procedure 2
Bacon Bomb	—	Procedure 3
Gravity Corer (for bottom sludge)	—	Procedure 4

VI. Contamination Control

Sampling tools, instruments, and equipment will be protected from sources of contamination prior to use and decontaminated after use as specified in SOP *Decontamination of Personnel and Equipment*. Liquids and materials from decontamination operations will be handled in accordance with the waste management plan. Sample containers will be protected from sources of contamination. Sampling personnel shall wear chemical resistant gloves when handling any samples. Gloves will be decontaminated or disposed of between samples.

VIII. Attachments

A. Collection of Liquid-Containerized Wastes Using Glass Tubes

B. Sampling Containerized Wastes Using the Composite Liquid Waste Sample (COLIWASA)

C. Sampling Containerized Wastes Using the Bacon Bomb Sampler

D. Gravity Corer for sampling Sludges in Large Containers

E. Construction of a Typical COLIWASA

F. Drum Opening Techniques and Equipment

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Test Method for Evaluating Solid Waste, SW-846, Volume II, Field Methods, Second Edition, U.S. Environmental Protection Agency, Washington, D.C., 1982.

U.S. Environmental Protection Agency, *Characterization of Hazardous Waste Sites – A Method Manual: Volume II, Available Sampling Methods*, USEPA Environmental Monitoring Systems Laboratory, Las Vegas, EPA-600/4-84-076, December, 1984.

Environmental Surveillance Procedures, Quality Control Program, Martin Marietta Energy Systems, ESH/Sub/87-21706/1, Oak Ridge, TN, September 1988.

X. Field Checklist

- _______ Sampling Instruments
- _______ Tools
- _______ Rubber Mallet
- _______ Logbook
- _______ Safety Glasses or Monogoggles
- _______ Safety Shoes
- _______ Ice/Cooler, as required
- _______ Custody Seals, as required
- _______ Chain-of-Custody Forms
- _______ Drum Labels, as required
- _______ Paint Marker, if drum sampling
- _______ Black Indelible Pen
- _______ Monitoring Instruments
- _____ Labels
- _____ Sampling and Analysis Plan
- _____ Health and Safety Plan
- _____ Decontamination Equipment
- _____ Lab Wipes
- _____ Lab Spatulas or Stainless Steel Spoons
- _____ Chemical Preservatives, as required
- _____ Appropriate Containers for Waste and Equipment
- _____ Duct Tape
- _____ Plastic Sheeting

Attachment A
Collection of Liquid-Containerized Wastes Using Glass Tubes

Discussion

Liquid samples from opened containers (i.e., 55-gallon drums) are collected using lengths of glass tubing. The glass tubes are normally 122 centimeters long and 6 to 16 millimeters inside diameter. Larger diameter tubes may be used for more viscous fluids if sampling with the small diameter tube is not adequate. The tubing is broken and discarded in the container after the sample has been collected, eliminating difficult cleanup and disposal problems. This method should not be attempted with less than a two-person sampling team.

Uses

This method provides for a quick, relatively inexpensive means of collecting concentrated containerized wastes. The major disadvantage is from potential sample loss that is especially prevalent when sampling low-viscosity fluids. Splashing can also be a problem and proper protective clothing should always be worn.

Note: A flexible tube with an aspirator attached is an alternative method to the glass tube, and allows various levels to be sampled discretely.

Procedures for Use

1. Remove cover from sample container.
2. Insert glass tubing almost to the bottom of the container. Tubing should be of sufficient length so that at least 30 centimeters extend above the top of the container.
3. Allow the waste in the drum to reach its natural level in the tube.
4. Cap the top of the tube with a safety-gloved thumb or a stopper.
5. Carefully remove the capped tube from the drum. If the tube has passed through more than one layer, the boundary should be apparent in the glass tube.
6. Insert the bottom, uncapped end into the sample container.
7. Partially release the thumb or stopper on the top of the tube and allow the sample to slowly flow into the sample container. If separation of phases is desired, cap off tube before the bottom phase has completely emptied. It may be advisable to have an extra container for “waste,” so that the fluid on either side of the phase boundary can be directed into a separate container, allowing collection of pure phase liquids in the sample containers. The liquid remaining after the boundary fluid is removed is collected in yet a third container. NOTE: It is not necessary to put phases in separate containers if analysis of separate phases is not desired.
8. Repeat steps 2 through 6 if more volume is needed to fill the sample container.

9. Remove the tube from the sample container and replace the tube in the drum, breaking it, if necessary, in order to dispose of it in the drum.

<u>Optional Method</u> (if sample of bottom sludge is desired)

1. Remove the cover from the container opening.
2. Insert glass tubing slowly almost to the bottom of the container. Tubing should be of sufficient length so that at least 30 cm extends above the top of the container.
3. Allow the waste in the drum to reach its natural level in the tube.
4. Gently push the tube towards the bottom of the drum into the sludge layer. Do not force it.
5. Cap the top of the tube with a safety-gloved thumb or stopper.
6. Carefully remove the capped tube from the drum and insert the uncapped end into the sample container.
7. Release the thumb or stopper on the top of the tube and allow the sample container to fill to approximately 90 percent of its capacity. If necessary, the sludge plug in the bottom of the tube can be dislodged with the aid of the stainless steel laboratory spatula.
8. Repeat if more volume is needed to fill sample container and recap the tube.

<u>Note:</u>

1. If a reaction is observed when the glass tube is inserted (violent agitation, smoke, light, etc.), the investigators should leave the area immediately.
2. If the glass tube becomes cloudy or smoky after insertion into the drum, the presence of hydrofluoric acid maybe indicated, and a comparable length of rigid plastic tubing should be used to collect the sample.
3. When a solid is encountered in a drum (either layer or bottom sludge) the optional method described above may be used to collect a core of the material, or the material may be collected with a disposable scoop attached to a length of wooden or plastic rod.

Attachment B
Sampling Containerized Wastes using the Composite Liquid Waste Sampler (COLIWASA)

Discussion

The COLIWASA is a much-cited sampler designed to permit representative sampling of multiphase wastes from drums and other containerized wastes. The sampler is commercially available or can be easily fabricated from a variety of materials, including PVC, glass, or Teflon. In its usual configuration it consists of a 152 cm by 4 cm (inside diameter) section of tubing with a neoprene stopper at one end attached by a rod running the length of the tube to a locking mechanism at the other end. Manipulation of the locking mechanism opens and closes the sampler by raising and lowering the neoprene stopper. See Attachment E: Construction of a COLIWASA.

Uses

The COLIWASA is primarily used to sample containerized liquids. The PVC COLIWASA is reported to be able to sample most containerized liquid wastes except for those containing ketones, nitrobenzene, dimethylforamide, mesityloxide, and tetrahydrofuran. A glass COLIWASA is able to handle all wastes unable to be sampled with the plastic unit except strong alkali and hydrofluoric acid solutions. Due to the unknown nature of many containerized wastes, it would therefore be advisable to eliminate the use of PVC materials and use samplers composed of glass or Teflon.

The major drawback associated with using a COLIWASA is concern for decontamination and costs. The sampler is difficult, if not impossible, to decontaminate in the field, and its high cost in relation to alternative procedures (glass tubes) makes it an impractical throwaway item. It still has applications, however, especially in instances where a true representation of a multiphase waste is absolutely necessary.

Procedures for Use

1. Check to make sure the sampler is functioning properly. Adjust the locking mechanism, if present, to make sure the neoprene rubber stopper provides a tight closure.

2. Put the sampler in the open position by placing the stopper rod handle in the T-position and pushing the rod down until the handle sits against the sampler's locking block.

3. Slowly lower the sampler into the liquid waste. Lower the sampler at a rate that permits the levels of the liquid inside and outside the sampler tube to be about the same. If the level of the liquid in the sample tube is lower than that outside the sampler, the sampling rate is too fast and will result in a non-representative sample.

4. When the sampler stopper hits the bottom of the waste container, push the sampler tube downward against the stopper to close the sampler. Lock the sampler in the

closed position by turning the T-handle until it is upright and one end rests tightly on the locking block.

5. Slowly withdraw the sampler from the waste container with one hand while wiping the sampler tube with a laboratory wipe with the other hand. A phase boundary, if present, can be observed through the tube.

6. Carefully discharge the sample into a suitable sample container by slowly pulling the lower end of the T-handle away from the locking block while the lower end of the sampler is positioned in a sample container.

7. Unscrew the T-handle of the sampler and disengage the locking block.

Attachment C
Sampling Containerized Wastes using the Bacon Bomb Sampler

Discussion

The Bacon Bomb is designed for the withdrawal of samples from various levels within a storage tank. It consists of a cylindrical body with an internal tapered plunger that acts as a valve to admit the sample. A line attached to the top of the plunger is used to open and close the valve. A removable cover provides a point of attachment for the sample line and has a locking mechanism to keep the plunger closed after sampling. The Bacon Bomb is usually constructed of chrome-plated brass and bronze with a rubber O-ring acting as the plunger-sealing surface. Stainless steel versions are also available. The volumemetric capacity is 8, 16, or 32 oz (237, 473, or 946 ml).

<u>Uses</u>

The Bacon Bomb is a heavy sampler suited best for viscous materials held in large storage tanks or in lagoons. If a more non-reactive sampler is needed, the stainless steel version would be used, or any of the samplers could be coated with Teflon.

<u>Procedures for Use</u>

1. Attach the sample line and the plunger line to the sampler.
2. Measure and then mark the sampling line at the desired depth.
3. Gradually lower the sampler by the sample line until the desired level is reached.
4. When the desired level is reached, pull up on the plunger line and allow the sampler to fill for a sufficient length of time before releasing the plunger line to seal off the sampler.
5. Retrieve the sampler by the sample line, being careful not to pull up on the plunger line, thereby accidentally opening the bottom valve.
6. Wipe off the exterior of the sampler body.
7. Position the sampler over the sample container and release its contents by pulling up on the plunger line.

Attachment D
Gravity Corer for Sampling Sludges in Large Containers

Discussion

A gravity corer is a metal tube with a replaceable tapered nosepiece on the bottom and a ball or other type of check valve on the top. The check valve allows water to pass through the corer on descent but prevents a washout during recovery. The tapered nosepiece facilitates cutting and reduces core disturbance during penetration. Most corers are constructed of brass or steel and many can accept plastic liners and additional weights.

Uses

Corers are capable of collecting samples of most sludges and sediments. They collect essentially undisturbed samples that represent the strata profile that may develop in sediments and sludges during variations in the deposition process. Depending on the density of the substrate and the weight of the corer, penetration to depths of 75 cm (30 in.) can be attained. Exercise care when using gravity corers in vessels or lagoons that have liners because penetration depths could exceed those of the substrate; this could result in damage to the liner material.

Procedures for Use

1. Attach a precleaned corer to the required length of sample line. Solid braided 5-mm (3/16-in.) nylon line is sufficient; however, 20-mm (3/4-in.) nylon is easier to grasp during hand hoisting. An additional weight can be attached to the outside of the corer if necessary.
2. Secure the free end of the line to a fixed support to prevent accidental loss of the corer.
3. Allow corer to free fall through the liquid to the bottom.
4. Retrieve corer with a smooth, continuous, up-lifting motion. Do not bump corer because this may result in some sample loss.
5. Remove nosepiece from corer and slide sample out of corer into stainless steel or Teflon pan (preferred).
6. Transfer sample into appropriate sample bottle with a stainless steel lab spoon or laboratory spatula.

Attachment E
Construction of a Typical COLIWASA

The sampling tube consists of a 1.52-m (5-ft) by 4.13-cm (1-5/8 in) I.D. translucent plastic pipe, usually polyvinyl chloride (PVC) or borosilicate glass plumbing tube. The closure-locking mechanism consists of a short-length, channeled aluminum bar attached to the sampler's stopper rod by an adjustable swivel. The aluminum bar serves both as a T-handle and lock for the samplers' closure system. When the sampler is in the open position, the handle is placed in the T-position and pushed down against the locking block. This manipulation pushes out the neoprene stopper and opens at the sampling tube. In the closed position, the handle is rotated until one leg of the T is squarely perpendicular against the locking block. This tightly seats the neoprene stopper against the bottom opening of he sampling tube and positively locks the sampler in the closed position. The closure tension can be adjusted by shortening or lengthening the stopper rod by screwing it in or out of the T-handle swivel. The closure system of the sampler consists of a sharply tapered neoprene stopper attached to a 0.95-cm (3/8-in) O.D. rod, usually PVC. The upper end of the stopper rod is connected to the swivel of the aluminum T-handle. The sharply tapered neoprene stopper can be fabricated according to specifications by plastic-products manufacturers at an extremely high price, or it can be made in-house by grinding down the inexpensive stopper with a shop grinder.

COLIWASA samplers are typically made out of plastic or glass. The plastic type consists of translucent plastic (usually PVC) sampling tube. The glass COLIWASA uses borosilicate glass plumbing pipe as the sampling tube and a Teflon plastic stopper rod. For purpose of multiphase sampling, clear plastic or glass is desirable in order to observe the profile of the multiphase liquid.

The sampler is assembled as follows:

a. Attach the swivel to the T-handle with the 3.18-cm (1-1/4 in) long bolt and secure with the 0.48-cm (3/16-in) National Coarse (NC) washer and lock nut.

b. Attach the PFTE stopper to one end of the stopper rod and secure with the 0.95-cm (3/8-in) washer and lock nut.

c. Install the stopper and stopper rod assembly in the sampling tube.

d. Secure the locking block sleeve on the block with glue or screw. This block can also be fashioned by shaping a solid plastic rod on a lathe to the required dimension.

e. Position the locking block on top of the sampling tube such that the sleeveless portion of the block fits inside the tube, the sleeve sits against the top end of the tube, and the upper end of the stopper rod slips though the center hole of the block.

f. Attach the upper end of the stopper rod to the swivel of the T-handle.

g. Place the sampler in the close position and adjust the tension on the stopper by screwing the T-handle in or out.

Attachment F
Drum Opening Techniques and Equipment [1]

I. Introduction

The opening of closed drums prior to sampling entails considerable risk if not done with the proper techniques, tools, and safety equipment. The potential for vapor exposure, skin exposure due to splash or spraying, or even explosion resulting from sparks produced by friction of the tools against the drum, necessitate caution when opening any closed container. Both manual drum opening and remote drum opening will be discussed in the following paragraphs. When drums are opened manually risks are greater than when opened remotely; for this reason, the remote opening of drums is advised whenever possible.

Prior to sampling, the drums should be staged to allow easy access. Also, any standing water or other material should be removed from the container top so that the representative nature of the sample is not compromised when the container is opened. There is also the possibility of encountering a water-reactive substance.

II. Manual Drum Opening

A. Bung Wrench

A common method for opening drums manually is using a universal bung wrench. These wrenches have fittings made to remove nearly all commonly encountered bungs. They are usually constructed of cast iron, brass, or a bronze-beryllium (a non-sparking alloy formulated to reduce the likelihood of sparks). The use of bung wrenches marked “NON SPARKING” is encouraged. However, the use of a “NON SPARKING” wrench does not completely eliminate the possibility of spark being produced. Such a wrench only prevents a spark caused by wrench-to-bung friction, but it cannot prevent sparking between the threads on the drum and the bung.

A simple tool to use, the fitting on the bung wrench matching the bung to be removed is inserted into the bung and the tool is turned counterclockwise to remove the bung. Since the contents of some drums may be under pressure (especially, when the ambient temperature is high), the bung should be turned very slowly. If any hissing is heard, the person opening the drum should back off and wait for the hissing to stop. Since drums under pressure can spray out liquids when opened, the wearing of appropriate eye and skin protection in addition to respiratory protection is critical.

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[1] Taken from EPA Training Course: “Sampling for Hazardous Materials,” U.S. Environmental Protection Agency, Office of Emergency and Remedial Response Support Division, March 24, 1987.

B. Drum Deheader

One means by which a drum can be opened manually when a bung is not removable with a bung wrench is by using a drum deheader. This tool is constructed of forged steel with an alloy steel blade and is designed to cut the lid of a drum off or part way off by means of a scissors-like cutting action. A limitation of this device is that it can be attached only to closed head drums (i.e., DOT Specification 17E and 17F drums); drums with removable heads must be opened by other means.

Drums are opened with a drum deheader by first positioning the cutting edge just inside the top chime and then tightening the adjustment screw so that the deheader is held against the side of the drum. Moving the handle of the deheader up and down while sliding the deheader along the chime will enable the entire top to be rapidly cut off if so desired. If the top chime of a drum has been damaged or badly dented it may not be possible to cut the entire top off. Since there is always the possibility that a drum may be under pressure, the initial cut should be made very slowly to allow for the gradual release of any built-up pressure. A safer technique would be to employ a remote pressure release method prior to using the deheader.

C. Hand Pick or Spike

When a drum must be opened and neither a bung wrench nor a drum deheader is suitable, then it can be opened for sampling by using a hand pick, pickaxe, or spike. These tools are usually constructed of brass or a non-sparking alloy with a sharpened point that can penetrate the drum lid or head when the tool is swung. The hand picks or pickaxes that are most commonly used are commercially available, whereas the spikes are generally uniquely fabricated 4- foot long poles with a pointed end. Often the drum lid or head must be hit with a great deal of force in order to penetrate it. Because of this, the potential for splash or spraying is greater than with other opening methods and therefore this method of drum opening is not recommended, particularly when opening drums containing liquids. Some spikes used for drum opening have been modified by the addition of a circular splash plate near the penetrating end. This plate acts as a shield and reduces the amount of splash in the direction of the person using the spike. Even with this shield, good splash gear is essential.

Since drums, some of which may be under pressure, cannot be opened slowly with these tools, “sprayers” may result and appropriate safety measures must be taken. The pick or spike should be decontaminated after each drum is opened to avoid cross contamination and/or adverse chemical reaction from incompatible materials.

III. Remote Opening

A. Backhoe Spike

The most common means used to open drums remotely for sampling is the use of a metal spike attached or welded to a backhoe bucket. In addition to being very efficient, this method can greatly reduce the likelihood of personnel exposure.

Drums should be "staged," or placed in rows with adequate aisle space to allow ease in backhoe maneuvering. Once staged, the drums can be quickly opened by punching a hole in the drum head or lid with the spike.

The spike should be decontaminated after each drum is opened to prevent cross contamination. Even though some splash or spray may occur when this method is used, the operator of the backhoe can be protected by mounting a large shatter-resistant shield in front of the operator's cage. This, combined with the normal sampling safety gear, should be sufficient to protect the operator. Additional respiratory protection can be afforded by providing the operator with an on-board airline system. The hole in the drum can be sealed with a cork.

B. Hydraulic Devices

Recently, remotely operated hydraulic devices have been fabricated to open drums remotely. One such device is discussed here. This device uses hydraulic pressure to pierce through the wall of a drum. It consists of a manually operated pump that pressurizes oil through a length of hydraulic line. A piercing device with a metal point is attached to the end of this line and is pushed into the drum by the hydraulic pressure. The piercing device can be attached so that a hole for sampling can be made in either the side or the head/lid of the drum. Some of the metal piercers are hollow or tube-like so that they can be left in place, if desired, and serve as a permanent tap or sampling port. The piercer is designed to establish a tight seal after penetrating the container.

C. Pneumatic Devices

Pneumatically-operated devices utilizing compressed air have been designed to remove drum bungs remotely. A pneumatic bung remover consists of a compressed air supply (usually SCBA cylinders) that is controlled by a heavy-duty, 2-stage regulator. A high pressure air line of desired length delivers compressed air to a pneumatic drill that is adapted to turn a bung fitting (preferably, a bronze-beryllium alloy) selected to fit the bung to be removed. An adjustable bracketing system has been designed to position and align the pneumatic drill over the bung. This bracketing system must be attached to the drum before the drill can be operated. Once the bung has been loosened, the bracketing system must be removed before the drum can be sampled. This attachment and removal procedure is time-consuming and is the major drawback of this device. This remote bung opener does not permit the slow venting of the container, and therefore appropriate precautions must be taken. It also requires the container to be upright and relatively level. Bungs that are rusted shut cannot be removed with this device.

IV. Summary

The opening of closed containers is one of the most hazardous site activities. Maximum efforts would be made to ensure the safety of the sampling team. Proper protective equipment and a general wariness of the possible dangers will minimize the risk inherent to sampling operations. Employing proper drum opening techniques and equipment will also safeguard personnel. The use of remote sampling equipment whenever feasible is highly recommended.

STANDARD OPERATING PROCEDURE

Disposal of Waste Fluids and Solids

I. Purpose and Scope

This SOP describes the procedures used to dispose of hazardous fluid and solid materials generated as a result of the site operations. This SOP does not provide guidance on the details of Department of Transportation regulations pertaining to the transport of hazardous wastes; the appropriate Code of Federal Regulations (49 CFR 171 through 177) should be referenced. Also, the site investigation-derived waste management plan should be consulted for additional information and should take precedence over this SOP.

II. Equipment and Materials

A. Fluids

- DOT-approved 55-gallon steel drums or Baker® Tanks
- Tools for securing drum lids
- Funnel for transferring liquid into drum
- Labels
- Paint Pens
- Marking pen for appropriate labels
- Seals for 55-gallon steel drums

B. Solids

- DOT-approved 55-gallon steel drums or rolloffs
- Tools for securing drum lids
- Paint Pens
- Plastic sheets
- Labels
- Marking pen for appropriate labels

III. Procedures and Guidelines

A. Methodology

Clean, empty drums or rolloffs or Baker® Tanks will be brought to the site by the drilling subcontractor for soil and groundwater collection and storage. The empty drums will be located at the field staging area and moved to drilling locations as required. The drums will be filled with the drilling and well installation wastes, capped, sealed, and moved to the onsite drum storage area by the drilling subcontractor. The full drums will separate types of wastes by media. The drums will be labeled as they are filled in the field and labels indicating that the contents are pending analysis affixed.

The drum contents will be sampled to determine the disposal requirements of the drilling wastes. The drum sampling will be accomplished through the collection and submittal of composite samples, one sample per 10 drums (check with disposal facility to determine sample frequency) containing the same media. Similar compositing will be performed in each rolloff to obtain a representative sample. The compositing of the sample will be accomplished by collecting a specific volume of the material in each drum into a large sample container. When samples from each of the drums being sampled in a single compositing are collected, the sample will be submitted for TCLP, ignitability, corrosivity, and reactivity analysis. The analysis will be used to determine if drilling wastes are covered by land disposal restrictions.

If rolloffs are used, compositing and sampling of soil will comply with applicable state and federal regulations.

B. Labels

Drums and other containers used for storing wastes from drilling operations will be labeled when accumulation in the container begins. Labels will include the following minimum information:

- Container number
- Container contents
- Origin (source area including individuals wells, piezometers, and soil borings)
- Date that accumulation began
- Date that accumulation ended
- Generator Contact Information
- When laboratory results are received, drum labels will be completed or revised to indicate the hazardous waste constituents in compliance with Title 40 of the Code of Federal Regulations, Part 262, Subpart C if the results indicate hazardous waste or labeled as non-hazardous if applicable.

C. Fluids

Drilling fluids generated during soil boring and groundwater discharged during development and purging of the monitoring wells will be collected in 55-gallon, closed-top drums. When a drum is filled, the bung will be secured tightly. Fluids may also be transferred to Baker® Tanks after being temporarily contained in drums to minimize the amount of drums used.

When development and purging is completed, the water will be tested for appropriate hazardous waste constituents. Compositing and sampling of fluids will comply with applicable state and federal regulations.

D. Solids

The soil cuttings from well and boring drilling will constitute a large portion of the solids to be disposed of.

The solid waste stream also will include plastic sheeting used for decontamination pads, Tyveks, disposable sampling materials, and any other disposable material used during the field operations that appears to be contaminated. These materials will be placed in designated drums.

E. Storage and Disposal

The wastes generated at the site at individual locations will be transported to the drum storage area by the drilling services subcontractor. Drums should be stored on pallets on plastic sheeting with a short berm wall (hay bales or 2 x 4 planks or equivalent) to capture small spills.

Waste solid materials that contain hazardous constituents will be disposed of at an offsite location in a manner consistent with applicable solid waste, hazardous waste, and water quality regulations. Transport and disposal will be performed by a commercial firm under subcontract.

The liquid wastes meeting acceptable levels of discharge contamination may be disposed of through the sanitary sewer system at the site. However, prior to disposal to the sanitary sewer system, approval and contract arrangements will be made with the appropriate authorities. Wastes exceeding acceptable levels for disposal through the sanitary sewer system will be disposed of through contract with a commercial transport and disposal firm.

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

- Check that representative samples of the containerized materials are obtained.
- Be sure that all state and federal regulations are considered when classifying waste for disposal.

Appendix B
Laboratory DoD ELAP Accreditation Letters

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

ENVIRONMENTAL CONSERVATION LABORATORIES – JACKSONVILLE
4810 Executive Park Court, Suite 111
Jacksonville, FL 32216
Denise K. Stern Phone: 904 296 3007
Email address: dstern@encolabs.com

ENVIRONMENTAL

Valid To: April 30, 2016 Certificate Number: 3000.02

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:

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste (Solid)	Air
Isopropyl alcohol (2-Propanol)	EPA 8015C	EPA 8015C	ENCO VGCMS-07
4-Ethyltoluene	---------------------------	---------------------------	ENCO VGCMS-07
Cyclohexane	EPA 8260B	EPA 8260B	ENCO VGCMS-07
1,1,1-Trichloroethane	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
1,1,2,2-Tetrachloroethane	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 8260B	EPA 8260B	EPA TO-14A
1,1,2-Trichloroethane	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
1,1-Dichloroethane	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
1,1-Dichloroethylene	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
1,2-Dichloro-1,1,2,2-tetrafluoroethane	---------------------------	---------------------------	EPA TO-14A
1,3-Butadiene	---------------------------	---------------------------	EPA TO-15
1,4-Dioxane	EPA 8260B	EPA 8260B	EPA TO-15
2,2,4-Trimethylpentane	---------------------------	---------------------------	EPA TO-15
Benzyl chloride	---------------------------	---------------------------	EPA TO-15
n-Hexane	---------------------------	---------------------------	EPA TO-15
2-Hydroxy isobutyric acid	ENCO VGC-13	---------------------------	---------------------------
Acetic acid	ENCO VGC-13	---------------------------	---------------------------
Butyric acid (Butanoic acid)	ENCO VGC-13	---------------------------	---------------------------
Hexanoic acid	ENCO VGC-13	---------------------------	---------------------------
Isohexanoic acid (4-methyl-pentanoic acid)	ENCO VGC-13	---------------------------	---------------------------
Isopentanoic acid (3-methyl-butanoic acid)	ENCO VGC-13	---------------------------	---------------------------
Lactic acid	ENCO VGC-13	---------------------------	---------------------------

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste (Solid)	Air
Lactic acid/ HIBA (2-Hydroxyisobutyric acid)	ENCO VGC-13	---------------------------	---------------------------
Pentanoic acid	ENCO VGC-13	---------------------------	---------------------------
Propionic acid (Propanoic acid)	ENCO VGC-13	---------------------------	---------------------------
Pyruvic acid	ENCO VGC-13	---------------------------	---------------------------
Propylene glycol	EPA 8015C	EPA 8015C	---------------------------
Diethylene glycol	EPA 8015C	EPA 8015C	---------------------------
Ethyl acetate	EPA 8015C	EPA 8015C	ENCO VGCMS-07
Ethylene glycol	EPA 8015C	EPA 8015C	---------------------------
Triethylene glycol	EPA 8015C	EPA 8015C	---------------------------
Diesel range organics (DRO)	EPA 8015C	EPA 8015C	---------------------------
Gasoline range organics (GRO)	EPA 8015C	EPA 8015C	---------------------------
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8015C/8260B	EPA 8260B/8015C	---------------------------
Methanol	EPA 8015C	EPA 8015C	---------------------------
n-Butyl alcohol	EPA 8015C	---------------------------	---------------------------
n-Propanol	EPA 8015C	EPA 8015C	---------------------------
1,2-Dibromo-3-chloropropane (DBCP)	8260B	EPA 8260B	---------------------------
1,2-Dibromoethane (EDB, Ethylene dibromide)	8260B	EPA 8260B	EPA TO-14A/TO-15
1,2-Dichlorobenzene	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
1,2-Dichloroethane	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
1,2-Dichloropropane	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
1,3-Dichlorobenzene	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
1,4-Dichlorobenzene	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
2-Chloroethyl vinyl ether	EPA 624/8260B	EPA 8260B	---------------------------
Acrolein (Propenal)	EPA 624/8260B	EPA 8260B	---------------------------
Acrylonitrile	EPA 624/8260B	EPA 8260B	---------------------------
Benzene	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
Bromodichloromethane	EPA 624/8260B	EPA 8260B	ENCO VGCMS-07
Bromoform	EPA 624/8260B	EPA 8260B	EPA TO-15
Carbon tetrachloride	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
Chlorobenzene	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
Chloroethane	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
Chloroform	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
cis-1,3-Dichloropropene	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
Dibromochloromethane	EPA 624/8260B	EPA 8260B	ENCO VGCMS-07
Ethylbenzene	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
Methyl bromide (Bromomethane)	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
Methyl chloride (Chloromethane)	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
Methylene chloride	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
Tetrachloroethylene	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
Toluene	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
trans-1,2-Dichloroethylene	EPA 624/8260B	EPA 8260B	EPA TO-15
trans-1,3-Dichloropropylene	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
Trichloroethene	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
Trichlorofluoromethane	EPA 624/8260B	EPA 8260B	EPA-TO-14A

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste (Solid)	Air
Vinyl chloride	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
Xylene (total)	EPA 624/8260B	EPA 8260B	EPA TO-14A/TO-15
1,1,1,2-Tetrachloroethane	EPA 8260B	EPA 8260B	---------------------------
1,1-Dichloropropene	EPA 8260B	EPA 8260B	---------------------------
1,2,3-Trichlorobenzene	EPA 8260B	EPA 8260B	---------------------------
1,2,3-Trichloropropane	EPA 8260B	EPA 8260B	---------------------------
1,2,4-Trichlorobenzene	EPA 8260B	EPA 8260B	EPA TO-14A/TO-15
1,2,4-Trimethylbenzene	EPA 8260B	EPA 8260B	EPA TO-14A
1,3,5-Trimethylbenzene	EPA 8260B	EPA 8260B	EPA TO-14A
1,3-Dichloropropane	EPA 8260B	EPA 8260B	---------------------------
2,2-Dichloropropane	EPA 8260B	EPA 8260B	---------------------------
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260B/8015C	EPA 8260B/8015C	EPA TO-15
2-Chlorotoluene	EPA 8260B	EPA 8260B	---------------------------
2-Hexanone	EPA 8260B	EPA 8260B/8015C	ENCO VGCMS-07
4-Chlorotoluene	EPA 8260B	EPA 8260B	---------------------------
4-Methyl-2-pentanone (MIBK)	EPA 8260B/8015C	EPA 8260B/8015C	EPA TO-15
Acetone	EPA 8260B	EPA 8260B	ENCO VGCMS-07
Acetonitrile	EPA 8260B	EPA 8260B	---------------------------
Allyl chloride (3-Chloropropene)	EPA 8260B	EPA 8260B	EPA TO-15
Bromobenzene	EPA 8260B	EPA 8260B	---------------------------
Bromochloromethane	EPA 8260B	EPA 8260B	---------------------------
Carbon disulfide	EPA 8260B	EPA 8260B	EPA TO-15
Chloroprene	EPA 8260B	EPA 8260B	---------------------------
cis-1,2-Dichloroethylene	EPA 8260B	EPA 8260B	EPA TO-14A/TO-15
Dibromomethane	EPA 8260B	EPA 8260B	---------------------------
Dichlorodifluoromethane	EPA 8260B	EPA 8260B	EPA TO-14A
Diethyl ether	EPA 8260B	EPA 8260B	---------------------------
Ethanol	EPA 8260B/8015C	EPA 8260B/8015C	---------------------------
Ethyl methacrylate	EPA 8260B	EPA 8260B	---------------------------
Hexachlorobutadiene	EPA 8260B	EPA 8260B	EPA TO-14A/TO-15
Iodomethane (Methyl iodine)	EPA 8260B	EPA 8260B	---------------------------
Isopropylbenzene	EPA 8260B	EPA 8260B	EPA TO-15
Isopropyl ether	EPA 8260B	EPA 8260B	---------------------------
Methacrylonitrile	EPA 8260B	EPA 8260B	---------------------------
Methyl Acetate	EPA 8260B	EPA 8260B	---------------------------
Methyl Cyclohexane	EPA 8260B	EPA 8260B	---------------------------
Methyl methacrylate	EPA 8260B	EPA 8260B	---------------------------
Methyl tert-butyl ether (MTBE)	EPA 8260B	EPA 8260B	EPA TO-15
m.p-Xylene	EPA 8260B	EPA 8260B	EPA TO-14A/TO-15
Naphthalene	EPA 8260B	EPA 8260B	---------------------------
n-Butyl benzene	EPA 8260B	EPA 8260B	---------------------------
n-Propyl benzene	EPA 8260B	EPA 8260B	---------------------------
o-Xylene	EPA 8260B	EPA 8260B	EPA TO-14A/TO-15
p-Isopropyltoluene	EPA 8260B	EPA 8260B	---------------------------
Propionitrile (Ethyl cyanide)	EPA 8260B	EPA 8260B	---------------------------
sec-Butylbenzene	EPA 8260B	EPA 8260B	---------------------------
Styrene	EPA 8260B	EPA 8260B	EPA TO-14A/TO-15
tert-Amyl alcohol	EPA 8260B	EPA 8260B	---------------------------

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste (Solid)	Air
tert-Amyl methyl ether	EPA 8260B	EPA 8260B	---------------------------
tert-Butyl alcohol	EPA 8260B	EPA 8260B	---------------------------
tert-Butylbenzene	EPA 8260B	EPA 8260B	---------------------------
tert-Butyl ethyl ether	EPA 8260B	EPA 8260B	---------------------------
trans-1,4-Dichloro-2-butene	EPA 8260B	EPA 8260B	---------------------------
Vinyl acetate	EPA 8260B	EPA 8260B	EPA TO-15
Total coliforms	SM9222B-1997	---------------------------	---------------------------
Fecal coliforms	SM9222D-1997	---------------------------	---------------------------
Aluminum	EPA 200.7/6010C	EPA 6010C	---------------------------
Antimony	EPA 200.7/6010C	EPA 6010C	---------------------------
Arsenic	EPA 200.7/6010C	EPA 6010C	---------------------------
Barium	EPA 200.7/6010C	EPA 6010C	---------------------------
Beryllium	EPA 200.7/6010C	EPA 6010C	---------------------------
Boron	EPA 200.7/6010C	EPA 6010C	---------------------------
Cadmium	EPA 200.7/6010C	EPA 6010C	---------------------------
Calcium	EPA 200.7/6010C	EPA 6010C	---------------------------
Chromium	EPA 200.7/6010C	EPA 6010C	---------------------------
Cobalt	EPA 200.7/6010C	EPA 6010C	---------------------------
Copper	EPA 200.7/6010C	EPA 6010C	---------------------------
Hardness (calc.)	SM2340B-1997	---------------------------	---------------------------
Iron	EPA 200.7/6010C, SM3500-Fe B-1997	EPA 6010C	---------------------------
Lead	EPA 200.7/6010C	EPA 6010C	---------------------------
Lithium	EPA 200.7/6010C	EPA 6010C	---------------------------
Magnesium	EPA 200.7/6010C	EPA 6010C	---------------------------
Manganese	EPA 200.7/6010C	EPA 6010C	---------------------------
Molybdenum	EPA 200.7/6010C	EPA 6010C	---------------------------
Nickel	EPA 200.7/6010C	EPA 6010C	---------------------------
Potassium	EPA 200.7/6010C	EPA 6010C	---------------------------
Selenium	EPA 200.7/6010C	EPA 6010C	---------------------------
Silica as SiO_2	EPA 200.7/6010C	---------------------------	---------------------------
Silver	EPA 200.7/6010C	EPA 6010C	---------------------------
Sodium	EPA 200.7/6010C	EPA 6010C	---------------------------
Strontium	EPA 200.7/6010C	EPA 6010C	---------------------------
Thallium	EPA 200.7/6010C	EPA 6010C	---------------------------
Tin	EPA 200.7/6010C	EPA 6010C	---------------------------
Titanium	EPA 200.7/6010C	EPA 6010C	---------------------------
Vanadium	EPA 200.7/6010C	EPA 6010C	---------------------------
Zinc	EPA 200.7/6010C	EPA 6010C	---------------------------
Mercury	EPA 245.1/7470A	EPA 7471B	---------------------------
Sulfate	ASTM D516-90	---------------------------	---------------------------
Ignitability	EPA 1010A	EPA 1010A/1030	---------------------------
Conductivity	EPA 120.1, SM2510B-1997	---------------------------	---------------------------
Turbidity	EPA 180.1, SM2130B-2001	---------------------------	---------------------------
Orthophosphate as P	EPA 365.3	---------------------------	---------------------------
Color	SM2120B-2001	---------------------------	---------------------------
Alkalinity as CaC03	SM2320B-1997	---------------------------	---------------------------
Hardness	SM2340C-1997	---------------------------	---------------------------
Residue-nonfilterable (TSS)	SM2540D-1997	---------------------------	---------------------------
Residue-total	SM2540B-1997	---------------------------	---------------------------
Residue-filterable (TDS)	SM2540C-1997	---------------------------	---------------------------

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste (Solid)	Air
Chromium VI	SM3500-Cr B-2001 /UV-VIS SM 3500-Cr B-2009	---------------------------	---------------------------
Chloride	SM4500-Cl-C-1997	---------------------------	---------------------------
Total residual chlorine	SM4500-Cl-G-2000	---------------------------	---------------------------
pH	SM4500-H+-B-2000, EPA 9040C	EPA 9040C/9045D	---------------------------
Corrosivity (pH)	---------------------------	EPA 9040C	---------------------------
Paint Filter Liquids Test	---------------------------	EPA 9095B	---------------------------
Nitrite	SM4500-NO2 B-2000	---------------------------	---------------------------
Biochemical oxygen demand	SM5210B-2001	---------------------------	---------------------------
Carbonaceous BOD (CBOD)	SM5210B-2001	---------------------------	---------------------------
Chemical oxygen demand	SM5220D-1997, EPA 410.4	---------------------------	---------------------------
Total Organic Carbon	SM5310B-2000, EPA 9060A	---------------------------	---------------------------
Total Petroleum Hydrocarbons (TPH)	FL-PRO	FL-PRO	---------------------------
Oil & Grease (HEM)	EPA 1664A/1664B	EPA 9071B	---------------------------
Total Petroleum Hydrocarbons (TPH) (HEM-SGT)	EPA 1664A/1664B	---------------------------	---------------------------
Carbon dioxide	RSK-175	---------------------------	---------------------------
Ethane	RSK-175	---------------------------	---------------------------
Ethylene	RSK-175	---------------------------	---------------------------
Methane	RSK-175	---------------------------	---------------------------
C9-C18 Aliphatic Hydrocarbons	MAEPH	MAEPH	---------------------------
C19-C36 Aliphatic Hydrocarbons	MAEPH	MAEPH	---------------------------
C11-C22 Aromatic Hydrocarbons	MAEPH	MAEPH	---------------------------
C5-C8 Aliphatic Hydrocarbons	MAVPH	MAVPH	---------------------------
C9-C12 Aliphatic Hydrocarbons	MAVPH	MAVPH	---------------------------
C9-C10 Aromatic Hydrocarbons	MAVPH	MAVPH	---------------------------
Toxicity Characteristic Leaching Procedure (TCLP)	EPA 1311	EPA 1311	---------------------------
Synthetic Precipitation Leaching Procedure (SPLP)	EPA 1312	EPA 1312	---------------------------

Analytical method	Prep Method			
	Soil	Water	Air	Waste
EPA 8260B	EPA 5035	EPA 5030B	------------------	EPA 5035
EPA 624	------------------	EPA 5030B	------------------	------------------
EPA 625*	------------------	EPA 3510C	------------------	------------------
EPA 8270D*	EPA 3545A	EPA 3510C	------------------	EPA 3580A
EPA 200.7	------------------	EPA 200.7	------------------	------------------
EPA 6010C	EPA 3050B	EPA 3005A	------------------	EPA 3050B
EPA 608*	------------------	EPA 3510C	------------------	------------------
EPA 8081B*	EPA 3545A	EPA 3510C	------------------	EPA 3580A

Analytical method	Prep Method			
	Soil	Water	Air	Waste
EPA 8082A*	EPA 3545A, 3540C	EPA 3510C	------------------	EPA 3580A
EPA 9071B	EPA 3540C	------------------	------------------	EPA 3540C
MA VPH, May 2004 Revision 1.1	EPA 5035	EPA 5030B	------------------	------------------
MA EPH, May 2004 Revision 1.1	EPA 3545A	EPA 3510C	------------------	------------------
FLPRO	EPA 3545A	EPA 3510C	------------------	------------------
8015C – GRO	EPA 5035	EPA 5030B	------------------	------------------
8015C – DRO	EPA 3545A	EPA 3510C	------------------	------------------
TO14A	------------------	------------------	TO14A	------------------
TO15	------------------	------------------	TO15	------------------
SPLP	EPA 1312	EPA 1312	------------------	EPA 1312
TCLP	EPA 1311	EPA 1311	------------------	EPA 1311

*Determinative step performed at Orlando lab (Certificate number 3000.01).

American Association for Laboratory Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

ENVIRONMENTAL CONSERVATION LABORATORIES - JACKSONVILLE

Jacksonville, FL

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 2003 NELAC Chapter 5 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 7th day of May 2014.

President & CEO
For the Accreditation Council
Certificate Number 3000.02
Valid to April 30, 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

ENVIRONMENTAL CONSERVATION LABORATORIES – ORLANDO
10775 Central Port Drive
Orlando, FL 32824
Neil Christiana Phone: 407 826 5314
nchristiana@encolabs.com

ENVIRONMENTAL

Valid To: March 31, 2016 Certificate Number: 3000.01

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

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Metals		
Aluminum	EPA 6020A/200.8	EPA 6020A
Antimony	EPA 6020A/200.8	EPA 6020A
Arsenic	EPA 6020A/200.8	EPA 6020A
Barium	EPA 6020A/200.8	EPA 6020A
Beryllium	EPA 6020A/200.8	EPA 6020A
Cadmium	EPA 6020A/200.8	EPA 6020A
Calcium	EPA 6020A/200.8	EPA 6020A
Chromium	EPA 6020A/200.8	EPA 6020A
Cobalt	EPA 6020A/200.8	EPA 6020A
Copper	EPA 6020A/200.8	EPA 6020A
Hardness	SM 2340 B-1997	----------------------------------
Iron	EPA 6020A/200.8	EPA 6020A
Lead	EPA 6020A/200.8	EPA 6020A
Magnesium	EPA 6020A/200.8	EPA 6020A
Manganese	EPA 6020A/200.8	EPA 6020A
Mercury	EPA 245.1/7470A	EPA 7471B
Molybdenum	EPA 6020A/200.8	EPA 6020A
Nickel	EPA 6020A/200.8	EPA 6020A
Potassium	EPA 6020A/200.8	EPA 6020A
Selenium	EPA 6020A/200.8	EPA 6020A
Silver	EPA 6020A/200.8	EPA 6020A
Sodium	EPA 6020A/200.8	EPA 6020A
Thallium	EPA 6020A/200.8	EPA 6020A
Tin	EPA 6020A/200.8	EPA 6020A
Titanium	EPA 6020A/200.8	EPA 6020A

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Vanadium	EPA 6020A/200.8	EPA 6020A
Zinc	EPA 6020A/200.8	EPA 6020A
Microbiology		
Total Coliforms	SM 9222B -1997	----------------------------------
Fecal Coliforms	SM 9222D-1997	----------------------------------
General Chemistry		
Acidity, as $CaCO_3$	EPA 305.1/SM 2310 B (4A) -1997	----------------------------------
Alkalinity as $CaCO_3$	EPA 310.1/SM 2320 B -1997	EPA 310.1/SM 2320 B-1997
Alkalinity as $CaCO_3$	EPA 310.2	EPA 310.2
Biochemical Oxygen Demand	EPA 405.1/SM 5210 B-2001	----------------------------------
Bromide	EPA 300.0/9056A	EPA 9056A
Carbonaceous BOD (CBOD)	SM 5210 B-2001	----------------------------------
Chemical oxygen demand	EPA 410.4/SM5220 D-1997	----------------------------------
Chloride	EPA 300.0/9056A	EPA 9056A
Chromium VI	EPA 7196/ SM 3500-Cr B-2001	EPA 7196
Conductivity	EPA 120.1	----------------------------------
Cyanide	SM 4500-CN E-1999	EPA 9014
Cyanide, Reactive	----------------------------------	SW-846 7.3.3
Ferric Iron (Calculated)	SM 3500-Fe B-1997	----------------------------------
Ferrous Iron	SM 3500-Fe B-1997	----------------------------------
Fluoride	EPA 300.0/9056A	EPA 9056A
Hardness	EPA 130.2/SM 2340 C-1997	----------------------------------
Kjeldahl Nitrogen -Total	EPA 351.2	EPA 351.2
Nitrate as N	EPA 300.0/353.1/9056A	EPA 353.1/9056A
Nitrate-Nitrite	EPA 300.0/353.1/9056A	EPA 353.1/9056A
Nitrite as N	EPA 300.0/354.1/9056A/ SM 4500-NO_2 B-2000	EPA 9056A/ SM 4500-NO_2 B-2000
Orthophosphate as P	EPA 365.1	----------------------------------
Orthophosphate as P	EPA 365.3	----------------------------------
pH	EPA 150.1/9040C/SM 4500-H^+-B-2000	EPA 9045D
Phosphorus, total	EPA 365.4	EPA 365.4
Residue-Filterable (TDS)	SM 2540 C-1997	----------------------------------
Residue-Nonfilterable (TSS)	SM 2540 D-1997	----------------------------------
Residue-total	SM 2540 B-1997/SM 2540 G-1997/ EPA 160.3	SM 2540G-1997/EPA 160.3
Residue-volatile	EPA 160.4	EPA 160.4
Sulfate	EPA 300.0/9056A	EPA 9056A
Sulfide	EPA 376.1/SM 4500-S F-2000	EPA 9030B/9034
Sulfide, Reactive	----------------------------------	SW-846 7.3.4
Surfactants -MBAS	SM 5540 C-2000	----------------------------------
Total Nitrate-Nitrite	EPA 9056 A/SM 4500-NO_3 H-2000	EPA 9056 A/SM 4500-$N0_3$ H-2000
Total Cyanide	EPA 9014	EPA 9014
Total Nitrogen	TKN + Total nitrate-nitrite	TKN + Total nitrate-nitrite
Total Organic Carbon	EPA 9060A/SM 5310B-2000	TOC Walkley Black
Total Phenolics	EPA 420.1/EPA 9065	EPA 9065
Total, Fixed, and Volatile residue	SM 2540 G-1997	SM 2540 G-1997
Turbidity	EPA 180.1	----------------------------------
Extractable Organics		

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Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
1,2,4-Trichlorobenzene	EPA 8270D/625	EPA 8270D
1,2,4,5-Tetrachlorobenzene	EPA 8270D/625	EPA 8270D
1,2-Dichlorobenzene	EPA 8270D/625	EPA 8270D
1,2-Diphenylhydrazine as Azobenzene	EPA 8270D/625	EPA 8270D
1,3-Dichlorobenzene	EPA 8270D/625	EPA 8270D
1,4-Dichlorobenzene	EPA 8270D/625	EPA 8270D
1- Methylnaphthalene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
2,3,4,6-Tetrachlorophenol	EPA 8270D/625	EPA 8270D
2,4,5-Trichlorophenol	EPA 8270D/625	EPA 8270D
2,4,6-Trichlorophenol	EPA 8270D/625	EPA 8270D
2,4-Dichlorophenol	EPA 8270D/625	EPA 8270D
2,4-Dimethylphenol	EPA 8270D/625	EPA 8270D
2,4-Dinitrophenol	EPA 8270D/625	EPA 8270D
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270D/625/Scan-Sim	EPA 8270D
2,6-Dichlorophenol	EPA 8270D/625	EPA 8270D
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270D/625	EPA 8270D
2-Chloronaphthalene	EPA 8270D/625	EPA 8270D
2-Chlorophenol	EPA 8270D/625	EPA 8270D
2·Methyl-4,6-dinitrophenol	EPA 8270D/625	EPA 8270D
2-Methylnaphthalene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
2-Methylphenol (o-Cresol)	EPA 8270D/625	EPA 8270D
2-Nitroaniline	EPA 8270D/625	EPA 8270D
2-Nitrophenol	EPA 8270D/625	EPA 8270D
3,3'-Dichlorobenzidine	EPA 8270D/625	EPA 8270D
3/4-Methylphenols (m/p-Cresols)	EPA 8270D/625	EPA 8270D
3-Nitroaniline	EPA 8270D/625	EPA 8270D
4-Bromophenyl Phenyl Ether	EPA 8270D/625	EPA 8270D
4-Chloro-3-methylphenol	EPA 8270D/625	EPA 8270D
4-Chloroaniline	EPA 8270D/625	EPA 8270D
4-Chlorophenyl Phenyl Ether	EPA 8270D/625	EPA 8270D
4-Nitrophenol	EPA 8270D/625	EPA 8270D
Acenaphthene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
Acenaphthylene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
4-Melhylphenol (p-Cresol)	EPA 8270D/625	EPA 8270D
4-Nitroaniline	EPA 8270D/625	EPA 8270D
Acetophenone	EPA 8270D/625	EPA 8270D
Anthracene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
Atrazine	EPA 8270D/625	EPA 8270D
Benzaldehyde	EPA 8270D/625	EPA 8270D
Benzidine	EPA 8270D/625	EPA 8270D
Benzo(a)anthracene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
Benzo(a)pyrene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
Benzo(b)fluoranthene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
Benzo(g,h,i)perylene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
Benzo(k)fluoranthene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
Benzyl alcohol	EPA 8270D/625	EPA 8270D
1,1-Biphenyl	EPA 8270D/625	EPA 8270D
bis(2-Chloroethoxy) Methane	EPA 8270D/625	EPA 8270D
bis(2-Chloroethyl) Ether	EPA 8270D/625	EPA 8270D
bis(2-Chloroisopropyl)Ether (2,2'-Oxybis(1-Chloropropane))	EPA 8270D/625	EPA 8270D

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270D/625	EPA 8270D
Butyl benzyl phthalate	EPA 8270D/625	EPA 8270D
Caprolactam	EPA 8270D/625	EPA 8270D
Carbazole	EPA 8270D/625	EPA 8270D
Chrysene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
Dibenz(a,h)anthracene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
Dibenzofuran	EPA 8270D/625	EPA 8270D
Dibenzo(a,h)pyrene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
Diethyl Phthalate	EPA 8270D/625	EPA 8270D
Dimethyl Phthalate	EPA 8270D/625/Scan-Sim	EPA 8270D
Di-n-butyl Phthalate	EPA 8270D/625	EPA 8270D
Di-n-octyl Phthalate	EPA 8270D/625	EPA 8270D
Fluoranthene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
Fluorene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
Hexachlorobenzene	EPA 8270D/625/Scan-Sim	EPA 8270D
Hexachlorobutadiene	EPA 8270D/625/Scan-Sim	EPA 8270D
Hexachlorocyclopentadiene	EPA 8270D/625	EPA 8270D
Hexachloroethane	EPA 8270D/625	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
Isodrin	EPA 8270D/625	EPA 8270D
Isophorone	EPA 8270D/625	EPA 8270D
Naphthalene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
Nitrobenzene	EPA 8270D/625	EPA 8270D
n-Nitrosodimethylamine	EPA 8270D/625	EPA 8270D
n-Nitrosodi-n-propylamine	EPA 8270D/625	EPA 8270D
n-Nitrosodiphenylamine	EPA 8270D/625	EPA 8270D
n-Nitrosopyrrolidine	EPA 8270D/625	EPA 8270D
Pentachlorophenol	EPA 8270D/625/Scan-Sim	EPA 8270D
Phenanthrene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
Phenol	EPA 8270D/625	EPA 8270D
Pyrene	EPA 8270D/625/Scan-Sim	EPA 8270D/Scan-Sim
Pyridine	EPA 8270D/625	EPA 8270D
Total Petroleum Hydrocarbons (TPH)	FL·PRO	FL·PRO
Volatile Organics		
1,1,1,2-Tetrachloroethane	EPA 8260B/624	EPA 8260B
1,1,1-Trichloroethane	EPA 8260B/624	EPA 8260B
1,1,2,2-Tetrachloroethane	EPA 8260B/624	EPA 8260B
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 8260B/624	EPA 8260B
1,1,2-Trichloroethane	EPA 8260B/624	EPA 8260B
1,1-Dichloroethane	EPA 8260B/624	EPA 8260B
1,1-Dichloroethene	EPA 8260B/624	EPA 8260B
1,1-Dichloropropene	EPA 8260B/624	EPA 8260B
1,2,3-Trichlorobenzene	EPA8260B/624	EPA 8260B
1,2,3-Trichloropropane	EPA 8260B/624	EPA 8260B
1,2,4-Trichlorobenzene	EPA 8260B/624	EPA 8260B
1,2,4-Trimethylbenzene	EPA 8260B/624	EPA 8260B
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504.1/8011/8260B	EPA 8260B
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 504.1/8011/8260B	EPA 8260B
1,2-Dichlorobenzene	EPA 8260B/624	EPA 8260B

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Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
1,2-Dichloroethane	EPA 8260B/624	EPA 8260B
1,2-Dichloropropane	EPA 8260B/624	EPA 8260B
1,3,5-Trimethylbenzene	EPA 8260B/624	EPA 8260B
1,3-Dichlorobenzene	EPA 8260B/624	EPA 8260B
1,3-Dichloropropane	EPA 8260B/624	EPA 8260B
1,4-Dichlorobenzene	EPA 8260B/624	EPA 8260B
1,4-Dioxane (1,4-Diethylencoxide)	EPA 8260B/8260C/SIM/624	EPA 8260B/8260C SIM
2,2-Dichloropropane	EPA 8260B/624	EPA 8260B
2-Butanone (Methyl Ethyl Ketone, MEK)	EPA 8260B/624	EPA 8260B
2-Chloroethyl Vinyl Ether	EPA 8260B/624	EPA 8260B
2-Chlorotoluene	EPA 8260B/624	EPA 8260B
2-Hexanone	EPA 8260B/624	EPA 8260B
4-Chlorotoluene	EPA 8260B/624	EPA 8260B
4-Methyl-2-pentanone (MIBK)	EPA 8260B/624	EPA 8260B
Acetone	EPA 8260B/624	EPA 8260B
Acetonitrile	EPA 8260B/624	EPA 8260B
Acrolein (Propenal)	EPA 8260B/624	EPA 8260B
Acrylonitrile	EPA 8260B/624	EPA 8260B
Allyl chloride (3-Chloropropene)	EPA 8260B/624	EPA 8260B
Benzene	EPA 8260B/624	EPA 8260B
Bromobenzene	EPA 8260B/624	EPA 8260B
Bromochloromethane	EPA 8260B/624	EPA 8260B
Bromodichloromethane	EPA 8260B/624	EPA 8260B
Bromoform	EPA 8260B/624	EPA 8260B
Carbon tetrachloride	EPA 8260B/624	EPA 8260B
Carbon disulfide	EPA 8260B/624	EPA 8260B
Chlorobenzene	EPA 8260B/624	EPA 8260B
Chloroethane	EPA 8260B/624	EPA 8260B
Chloroform	EPA 8260B/624	EPA 8260B
Chloroprene	EPA 8260B/624	EPA 8260B
cis-1,2-Dichloroethene	EPA 8260B/624	EPA 8260B
cis-1,3-Dichloropropene	EPA 8260B/624	EPA 8260B
Cyclohexane	EPA 8260B/624	EPA 8260B
Dibromochloromethane	EPA 8260B/624	EPA 8260B
Dibromomethane	EPA 8260B/624	EPA 8260B
Dichlorodifluoromethane	EPA 8260B/624	EPA 8260B
Ethyl Methacrylate	EPA 8260B/624	EPA 8260B
Hexachlorobutadiene	EPA 8260B/624	EPA 8260B
Ethylbenzene	EPA 8260B/624	EPA 8260B
Iodomethane (Methyl Iodide)	EPA 8260B/624	EPA 8260B
Isobutyl Alcohol (2-Methyl-l-propanol)	EPA 8260B/624	EPA 8260B
Isopropylbenzene	EPA 8260B/624	EPA 8260B
m+p-Xylenes	EPA 8260B/624	EPA 8260B
Methacrylonitrile	EPA 8260B/624	EPA 8260B
Methyl Acetate	EPA 8260B/624	EPA 8260B
Methyl Bromide (Bromomethane)	EPA 8260B/624	EPA 8260B
Methyl Chloride (Chloromethane)	EPA 8260B/624	EPA 8260B
Methyl Methacrylate	EPA 8260B/624	EPA 8260B
Methyl Tert-Butyl Ether (MTBE)	EPA 8260B/624	EPA 8260B
Methylcyclohexane	EPA 8260B/624	EPA 8260B

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Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Methylene Chloride	EPA 8260B/624	EPA 8260B
Naphthalene	EPA 8260B/624	EPA 8260B
n-Butylbenzene	EPA 8260B/624	EPA 8260B
n-Propylbenzene	EPA 8260B/624	EPA 8260B
o-Xylene	EPA 8260B/624	EPA 8260B
p-Isopropyltoluene	EPA 8260B/624	EPA 8260B
Propionitrile (Ethyl cyanide)	EPA 8260B/624	EPA 8260B
sec-Butylbenzene	EPA 8260B/624	EPA 8260B
Styrene	EPA 8260B/624	EPA 8260B
tert-Butylbenzene	EPA 8260B/624	EPA 8260B
Tetrachloroethene (Perchloroethylene)	EPA 8260B/624	EPA 8260B
Toluene	EPA 8260B/624	EPA 8260B
trans-1,2-Dichloroethene	EPA 8260B/624	EPA 8260B
trans-1,3-Dichloropropene	EPA 8260B/624	EPA 8260B
trans-1,4-Dichloro-2-butene	EPA 8260B/624	EPA 8260B
Trichloroethene (Trichloroethylene)	EPA 8260B/624	EPA 8260B
Trichlorofluoromethane	EPA 8260B/624	EPA 8260B
Vinyl Acetate	EPA 8260B/624	EPA 8260B
Vinyl Chloride	EPA 8260B/624	EPA 8260B
Xylene (total)	EPA 8260B/624	EPA 8260B
Pesticides-Herbicides-PCBs		
2,4,5-T	EPA 8151A/615	EPA 8151A
2,4-D	EPA 8151A/615	EPA 8151A
2,4-DB	EPA 8151A/615	EPA 8151A
3,5-Dichlorobenzoic acid	EPA 8151A/615	EPA 8151A
4.4'-DDD	EPA 8081B/608	EPA 8081B
4.4'-DDE	EPA 8081B/608	EPA 8081B
4,4'·DDT	EPA 8081B/608	EPA 8081B
4-Nitrophenol	EPA 8151A/615	EPA 8151A
Acifluorfen	EPA 8151A/615	EPA 8151A
Aldrin	EPA 8081B/608	EPA 8081B
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
alpha-Chlordane	EPA 8081B/608	EPA 8081B
Aroclor-1016(PCB-1016)	EPA 8082A/608	EPA 8082A
Aroclor-1221 (PCB-1221)	EPA 8082A/608	EPA 8082A
Aroclor-1232 (PCB-1232)	EPA 8082A/608	EPA 8082A
Aroclor-1242 (PCB-1242)	EPA 8082A/608	EPA 8082A
Aroclor-1248 (PCB-1248)	EPA 8082A/608	EPA 8082A
Aroclor-1254 (PCB-1254)	EPA 8082A/608	EPA 8082A
Aroclor-1260 (PCB-1260)	EPA 8082A/608	EPA 8082A
Aroclor-1262 (PCB-1262)	EPA 8082A/608	EPA 8082A
Aroclor-1268 (PCB-1268)	EPA 8082A/608	EPA 8082A
Azinphos-methyl (Guthion)	EPA 8141B	EPA 8141B
Bentazon	EPA 8151A/615	EPA 8151A
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
Bolstar (Sulprofos)	EPA 8141B	EPA 8141B
Chloramben	EPA 8151A/615	EPA 8151A
Chlordane (tech.)	EPA 8081B/608	EPA 8081B

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Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Chlorpyrifos	EPA 8141B	EPA 8141B
Coumaphos	EPA 8141B	EPA 8141B
Dacthal (DCPA)	EPA 8151A/615	EPA 8151A
Dalapon	EPA 8151A/615	EPA 8151A
delta-BHC	EPA 8081B/608	EPA 8081B
Demeton, Total	EPA 8141B	EPA 8141B
Diazinon	EPA 8141B	EPA 8141B
Dicamba	EPA 8151A/615	EPA 8151A
Dichlorofenthion	EPA 8141B	EPA 8141B
Dichloroprop (Dichlorprop)	EPA 8151A/615	EPA 8151A
Dichlorovos (DDVP, Dichlorvos)	EPA 8141B	EPA 8141B
Dieldrin	EPA 8081B/608	EPA 8081B
Dimethoate	EPA 8141B	EPA 8141B
Dinoseb (2-sec-buty1-4 ,6-dinilrophenol, DNB P)	EPA 8151A/615	EPA 8151A
Disulfoton	EPA 8141B	EPA 8141B
Endosulfan I	EPA 8081B/608	EPA 8081B
Endosulfan II	EPA 8081B/608	EPA 8081B
Endosulfan Sulfate	EPA 8081B/608	EPA 8081B
Endrin	EPA 8081B/608	EPA 8081B
Endrin Aldehyde	EPA 8081B/608	EPA 8081B
Endrin Ketone	EPA 8081B/608	EPA 8081B
EPN	EPA 8141B	EPA 8141B
Ethion	EPA 8141B	EPA 8141B
Ethoprop	EPA 8141B	EPA 8141B
Fensulfothion	EPA 8141B	EPA 8141B
Fenthion	EPA 8141B	EPA 8141B
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
gamma-Chlordane	EPA 8081B/608	EPA 8081B
Heptachlor	EPA 8081B/608	EPA 8081B
Heptachlor Epoxide	EPA 8081B/608	EPA 8081B
Isodrin	EPA 8081B/608	EPA 8081B
Malathion	EPA 8141B	EPA 8141B
MCPA	EPA 8151A/615	EPA 8151A
MCPP	EPA 8151A/615	EPA 8151A
Merphos	EPA 8141B	EPA 8141B
Methoxychlor	EPA 8081B/608	EPA 8081B
Methyl Parathion (Parathion Methyl)	EPA 8141B	EPA 8141B
Mevinphos	EPA 8141B	EPA 8141B
Mirex	EPA 8081B/608	EPA 8081B
Monocrotophos	EPA 8141B	EPA 8141B
Naled	EPA 8141B	EPA 8141B
Parathion, Ethyl	EPA 8141B	EPA 8141B
Pentachlorophenol	EPA 8151A/615	EPA 8151A
Phorate	EPA 8141B	EPA 8141B
Picloram	EPA 8151A/615	EPA 8151A
Ronnel	EPA 8141B	EPA 8141B
Silvex (2,4,5-TP)	EPA 8151A/615	EPA 8151A
Stirofos	EPA 8141B	EPA 8141B
Sulfotepp	EPA 8141B	EPA 8141B

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Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Tetraethyl Pyrophosphate (TEPP)	EPA 8141B	EPA 8141B
Tokuthion (Prothiophos)	EPA 8141B	EPA 8141B
Toxaphene (Chlorinated camphene)	EPA 8081B/608	EPA 8081B

Preparation Methods

Fraction	Analytical Method	Preparation Method
Cyanide	EPA 9014/SM 4500-CN E-1999	EPA 9010C
TX	EPA 9056A	EPA 5050
Metal Water Prep	EPA 6020A/200.8	EPA 3005A
Metals Soil Prep	EPA 6020A	EPA 3050B
Metals TCLP prep	EPA 6020A/200.8	EPA 3010A
Extractable Organics and Pesticides Water Prep	EPA 8270D/625/8081B/8082A/608/ 8141B	EPA 3510C
Extractable Organics and Pesticides Waste Prep	EPA 8270D/625/8081B/8082A/608/ 8141B	EPA 3580A
Extractable Organics and Pesticides Soil Prep	EPA 8270D/625/8081B/8082A/608/ 8141B	EPA 3550C
Extractable Organics and Pesticides Soil Prep	EPA 8151A	EPA 8151A
Organics Water and Mid-level Soil Prep	EPA 8260B/624	EPA 5030B
Organics Low-level Soil Prep	EPA 8260B/624	EPA 5035
Soil/Water Leachate	Wets	ENCO WETS-88
SPLP	Wets, Organics, and Metals (6020A/8081B/8082A/8141B/8151A/ 8260B/8270D/7470A/7471B/9014)	EPA 1312
TCLP	Wets, Organics, and Metals (6020A/8081B/8082A/8141B/8151A/ 8260B/8270D/7470A/7471B/9014)	EPA 1311
Extractable Organics	EPA 8270D PAH SIM	EPA 3511

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American Association for Laboratory Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

ENVIRONMENTAL CONSERVATION LABORATORIES - ORLANDO

Orlando, FL

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 Chapter 5 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).

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION CORPORATE SEAL 1978 DISTRICT OF COLUMBIA A2LA

Presented this 9th day of April 2014.

President & CEO
For the Accreditation Council
Certificate Number 3000.01
Valid to March 31, 2016

For the tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

Appendix C
Health and Safety Plan

Accident Prevention Plan
Revision 1

SWMU 14 Pilot Study

Naval Support Facility Indian Head

Indian Head, Maryland

Contract Task Order JU40

February 2015

Prepared for

Department of the Navy
Naval Facilities Engineering Command, Washington

CH2MHILL®

15010 Conference Center Drive, Suite 200
Chantilly, Virginia 20151

Contents

Appendix

Acronyms and Abbreviations

AHA	activity hazard analysis
APP	Accident Prevention Plan
CFR	*Code of Federal Regulations*
CO/COR	Contracting Officer/Representative
CPR	cardiopulmonary resuscitation
EAP	Employee Assistance Program
EMR	Experience Modification Rate
HAZWOPER	Hazardous Waste Operations and Emergency Response
HSM	Health and Safety Manager
IARC	International Agency for Research on Cancer
IIPP	Injury and Illness Prevention Program
MSDS	Material Safety Data Sheet
OSHA	Occupational Safety and Health Administration
PPE	personal protective equipment
SSHO	Site Safety Health Officer
SSHP	Site Safety and Health Plan
USACE	U.S. Army Corps of Engineers

SECTION 1

Signature Page

Accident Prevention Plan (APP)
SWMU 14 Pilot Study
Indian Head, Maryland

Date February 2015

Plan Preparer:	Name: Stephen Brand Phone Number: 757-671-6211	Date: 02-06-15
Plan Approval Project Manager:	Name: CH2M HILL Program/Project Manager Phone:	Date:
Plan Concurrence:	Name: Mark Orman, CSP CH2M HILL Program Health and Safety Manager Phone:	Date: 11 Feb 2014

SECTION 2

Background Information

This APP has been developed to protect and guide the personnel conducting monitoring well installation, development, and sampling as well as emulsified vegetable oil injections. The site covered in this investigation Stump Neck, SWMU 14, in Indian Head Maryland, covering approximately 2.4 acre. This APP has been prepared to meet applicable requirements of the U.S. Army Corps of Engineers (USACE) Safety and Health Requirements Manual EM 385-1-1 (USACE 2011), 29 *Code of Federal Regulations* (CFR) 1910.1200 Hazard Communication Standard, Hazardous Waste Operations or emergency response as required by 29 CFR 1910.120 and 29 CFR 1926.65, and the corporate safety and health policies of CH2M HILL, Inc. This APP has been constructed to directly track with the EM 385-1-1 2011 Appendix A "Minimum Basic Outline for Accident Prevention Plan."

Various portions of this work shall also be conducted under non-hazardous waste site protocols. The site safety and health plan (SSHP) for this project is included as Appendix A.

2.1 Contractor

CH2M HILL, Inc.

2.2 Contract Number

N62470-08-D-1000

2.3 Project Name

Stump Neck, SWMU 14 Pilot Study

2.4 Project Description and Location

This APP presents the hazards known or anticipated to be present at Stump Neck, SWMU 14, Indian Head, Maryland. Tasks included under this HSP will be conducted on site. Stump Neck SWMU 14 is located in the Stump Neck Annex and is approximately 300 feet south of the Potomac River. The approximate area of Stump Neck SWMU 14 is 2.4 acres. The site consists of a photographic laboratory (Building 22SN), X-ray facility (Building 2009), and the associated two septic tanks, discharge lines, and drain fields. For additional information see section 3.2 of the SSHP. The plan also outlines the health and safety procedures that will be used to install, develop and sample groundwater monitoring wells at this site, as well as inject emulsified vegetable oil. The work is expected to commence in the spring of 2015. This project-specific APP will be used by CH2M HILL and its subcontractors to identify and mitigate task-specific hazards and to select appropriate health and safety protective measures.

Onsite personnel must review the APP and sign an agreement to comply with its provisions prior to commencing onsite work. The APP and attached SSHP are considered operational documents that are subject to revisions in response to various site-specific conditions that may be encountered. However, the documents may be modified or updated only with the approval of the health and safety manager (HSM) and project manager.

2.5 Contractor Accident Experience

CH2M HILL's exceptional safety performance greatly exceeds the industry average. Our injury and illness rates and our Experience Modification Rate (EMR) have averaged 0.68 over the past 5 years.

Following are examples of our achievements:

- An EMR of less than 1.0 over the past 5 years, which is the average accident injury experience for the industry, with a 2013 EMR of 0.63 (or 63 percent) of the industry average (NAICS 54133).

Category	2009	2010	2011	2012	2013
Employee Hours	14,675,508	12,842,086	10,704,063	9,759,106	9,636,525
Experience Modification Rate (EMR)	0.72	0.71	0.66	0.69	0.63
Fatalities	0	0	0	0	0
Recordable Incidents	20	9	13	12	13
Recordable Incident Rate	0.27	0.14	0.24	0.25	0.27
Recordable Incident Rate Average	1.2	1.0	1.0	0.8	0.8
Lost Workday (LWD) Incidents (DART)	3	1	3	0	2
LWD Incident Rate (DART)	0.04	0.02	0.06	0.0	0.04

2.6 Work Requiring Activity Hazard Analysis

The planned field tasks requiring activity hazard analyses (AHAs) are as follows:

- 01 General Oversight (surveying, utility clearance)
- 02 Oversight Drilling, MW installation and development
- 03 Subcontractor Drilling, installation, development, IDW management, and decon
- 04 EVO injection oversight
- 05 Subcontractor EVO injection
- 06 Groundwater sampling
- 07 Subcontractor IDW management and T&D

AHAs for each of the above field tasks are included in Appendix A.

SECTION 3

Statement of Safety and Health Policy and Compliance Procedures

CH2M HILL is committed to providing a safe and healthful workplace for employees. The conditions will be ensured through an aggressive and comprehensive worker safety and health program that is integrated with other site worker protection activities. We regard employee protection as a priority and are committed to developing, implementing, and improving safety and health practices that will afford optimal protection to employees and enable continuous improvement of the quality of worker protection performance. The safety and health of employees will take precedence whenever conflicts with production or other objectives arise.

Managers and supervisors are held accountable for worker safety and health. Accountability is achieved by assigning worker protection responsibilities, evaluating personnel performance, and holding personnel accountable for worker protection performance.

In addition to complying with this APP and their corporate safety and health program, persons working under the SSHP are encouraged to be active participants in their workplace safety and health activities, and to actively take advantage of the worker rights in a responsible manner, without reprisal.

CH2M HILL has embraced a philosophy for health safety and environment excellence. The primary driving force behind this commitment to health and safety is simple: employees are the company's most significant asset, and management values their safety, health, and welfare. Also, top management believes that all injuries are preventable. The safety culture empowers employees at all levels to accept ownership for safety and take whatever actions are necessary to eliminate injury. Our company is committed to world-class performance in health and safety and also understands that world-class performance in health and safety is a critical element in overall business success.

CH2M HILL is committed to the prevention of personal injuries, occupational illnesses, and damage to equipment and property in all of its operations; to the protection of the general public whenever it comes in contact with the Company's work; and to the prevention of pollution and environmental degradation.

Company management, field supervisors, and employees plan safety into each work task in order to prevent occupational injuries and illnesses. CH2M HILL management extends its full commitment to health and safety excellence.

3.1 Objective

The objective of the CH2M HILL program is to provide a place of employment free of all recognized hazards that are causing or will likely result in death or serious physical harm to our employees. The objective can be facilitated by developing and administering an overall health and safety program, which establishes written policies and procedures to serve as vehicles through which the program requirements will be implemented.

3.2 Purpose

The purpose of this project APP, in conjunction with the project-specific or program health and safety documents, is to define the policies, procedures, and requirements that must be implemented for the CH2M HILL program and to establish the requirements, responsibilities, and expectations for management, supervisors, employees, and subcontractors that may participate in the execution of the program projects. It is the intent of this APP to address applicable requirements set forth by 29 CFR 1910, 29 CFR 1926, EM 385 1-1, and CH2M HILL policies and procedures incorporated by reference herein.

3.3 Goals

The health and safety goal for this project and the overall goal for the CH2M HILL program are to eliminate workplace accidents, gain worker acceptance through cooperation and training, and provide our clients with a responsible, well-trained, safety-oriented work force.

CH2M HILL considers safety the highest priority during work at all project sites and in its business offices and has established a goal of zero incidents. CH2M HILL's program will be conducted in a manner that minimizes the probability of near misses, injury, illness, and equipment or property damage.

All management and employees are to strive to meet the project-specific health, safety, and environment goals outlined below. The team will be successful only if everyone makes a concerted effort to accomplish these goals. The goals allow the project to stay focused on optimizing the health and safety of all project personnel and, therefore, making the project a great success.

The project has established the following 11 specific goals and objectives:

1. Create an injury-free environment.
2. Have zero injuries or incidents.
3. Provide management leadership for health, safety, and environment by communicating performance expectations, reviewing and tracking performance, and leading by example.
4. Ensure effective implementation of the SSHP and APP through education, delegation, and teamwork.
5. Ensure 100-percent participation in training programs, personal protective equipment (PPE) use, and health, safety, and environment compliance.
6. Continuously improve safety performance.
7. Maintain free and open lines of communication.
8. Make a personal commitment to safety as a value.
9. Focus safety improvements on high-risk groups.
10. Continue strong employee involvement initiatives.
11. Achieve health and safety excellence.

3.4 Safe Work Policy

It is policy to perform work in the safest manner possible. Safety must never be compromised. To fulfill the requirements of this policy, an organized and effective safety program must be carried out at each location where work is performed.

CH2M HILL believes that all injuries are preventable, and is dedicated to the goal of a safe work environment. To achieve this goal, every employee on the project must assume responsibility for safety.

Every employee is empowered to:

- Conduct their work in a safe manner
- Stop work immediately to correct any unsafe condition that is encountered
- Take corrective actions so that work may proceed in a safe manner

Safety, occupational health, and environmental protection will not be sacrificed for production.

3.5 Standards of Conduct Violations

All individuals associated with this project must work injury-free and drug-free and must comply with the Standards of Conduct, the SSHP and APP, and the site safety requirements. Commonly accepted standards of conduct help maintain good relationships between people. They promote responsibility and self-development.

Misunderstandings, frictions, and disciplinary action can be avoided by refraining from thoughtless or wrongful acts. Violations of the standards of conduct would include, but not be limited to the following:

- Failure to perform work
- Inefficient performance, incompetence, or neglect of work
- Willful refusal to perform work as directed (insubordination)
- Negligence in observing safety regulations, poor housekeeping, or failure to report on-the-job injuries or unsafe conditions
- Unexcused or excessive absence or tardiness
- Unwillingness or inability to work in harmony with others
- Discourtesy, irritation, friction, or other conduct that creates disharmony
- Harassment or discrimination against another individual
- Failure to be prepared for work by wearing the appropriate construction clothing or PPE, or bringing the necessary tools
- Violation of any other commonly accepted reasonable rule of responsible personal conduct
- Violation of the safety and health requirements of their corporation’s policy or of this APP
- Unauthorized or illegal possession, use, or sale of alcohol or controlled substances on work premises, during working hours, while engaged in corporate activities, or in corporate vehicles
- Use or sale of firearms or explosives on work premises

See Appendix A of the SSHP, Section 1.0, for further details.

3.6 Intolerable Offenses

Certain employee conduct may be so intolerable as to justify removal from the project. Intolerable offenses and actions will include, but not be limited to, the following:

- Any manager, supervisor, foreman, or other person in charge of the work being performed who requires requests, asks, threatens with their job, allows, or condones employees to work in or around unsafe acts or conditions
- Any employee, supervisor, or manager who knowingly falsifies any investigative documents or testimony involving an investigation
- Any employee, supervisor, or manager who openly exhibits disregard, defiance, or disrespect for the safety program
- Any employee who violates established safety rules, regulations, or codes that endanger themselves or other employees
- Any and all parties involved in workplace violence, including physical encounters (fighting) or threats of violence, theft, or destruction of property
- Any employee, supervisor, or manager failing to comply with procedures contained in the subcontract, SSHP and APP, USACE EM 385-1-1 Manual, or local safety laws and regulations that create the potential for serious or costly consequences
- Any employee who commits repeated minor offenses and shows a lack of responsible effort to correct these offenses

3.7 Enforcement and Discipline

CH2M HILL's Enforcement and Discipline procedures, the Standards of Conduct, the Intolerable Offenses, and the Drug-Free Workplace policy will be thoroughly reviewed with each employee during the employee project orientation.

3.7.1 Intolerable Offenses

CH2M HILL practices zero tolerance for intolerable offenses. Individuals found participating in such offenses will be dealt with according to our policy and may be subjected to the following:

- Suspended from work for 3 days without pay
- Immediately discharged and not allowed to return

3.7.2 Other Violations

Other violations will be handled accordingly:

- First offense—employee will receive a written warning
- Second offense—employee will receive a 2-day suspension without pay
- Third offense—employee will be discharged

3.8 Subcontractor Default

If the subcontractor fails to comply with any of the requirements of the subcontract, SSHP and APP, or local safety laws and regulations, the prime contractor may issue a stop work order to the subcontractor. Thereupon, the subcontractor will immediately cease all work or portion of work that may be specifically designated in the stop work order until the prime contractor has concluded in writing that the subcontractor has corrected its failure of performance. No adjustments will be made to the subcontractor price or schedule as a result of any stop work orders being issued by the prime contractor. A stop work order will be given to the noncompliant subcontractor on the date of deficiency. If the subcontractor fails to correct the deficiencies noted in the stop work order within 3 working days following the written notice from the prime contractor, the prime contractor may, without prejudice to any other rights or remedies under the subcontract or at law or equity, suspend all further payments to subcontractor and/or terminate subcontractor's right to continue performance of the work.

3.9 Incentive Program

CH2M HILL will encourage all parties to implement a safety incentive program for the project that rewards workers for exhibiting exemplary safety behaviors. Actions that qualify are those that go above and beyond what is expected. Actions that will be rewarded include spotting and correcting a hazard, bringing a hazard to the attention of your foreman, telling your foreman about an incident, coming up with a safer way to get the work done, stopping a crew member from doing something unsafe, etc. The program will operate throughout the project, covering all craft workers. The incentive program will be communicated to all employees during the project employee orientation and project safety meetings.

3.10 Posting of Health and Safety Information

There will be a posting area, accessible by all workers onsite, and in clear view for the posting of site-specific health and safety information. The posted information will be protected from the environment and kept updated as project information changes.

SECTION 4

Responsibilities and Lines of Authorities

Section 4 identifies the personnel who have specific safety responsibilities on the project.

4.1 Personnel with Safety Responsibilities

Participating personnel are responsible for complying with safety procedures and for proactively making safety awareness part of their day-to-day conduct.

The following positions have specific corporate and project safety responsibilities:

- HSM
- Project manager
- Site safety health officer (SSHO)
- Other project field staff

Appendix A (the SSHP) lists the specific personnel that will fill the stated positions for this project. See Section 4 of Appendix A for details and lines of authority.

All work is conducted under a Behavior-based and loss prevention system program. AHAs are a vital part of this work, as well as using Pre-task Safety Planning. All staff members are accountable for their own health and safety, and have the authority to request a work stoppage when they feel unsafe behaviors, actions, or situations are occurring.

All work requiring a competent person per the Occupational Safety and Health Administration (OSHA) definition (29 CFR 1926.32(f)), will not be started until that competent person is designated and on site. *Competent person* means one who is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them.

For all general tasks, the SSHO is the competent person, unless otherwise noted for specific tasks.

SECTION 5
Subcontractors and Suppliers

Subcontractors and suppliers providing services onsite will be subject to the safety provisions of this APP and those included in Appendix A. See Section 4.3 of Appendix A for details. At this time, there are 5 subcontractors planned for use to fulfill this task order, surveying, utility clearance, drilling, EVO injection, and IDW management T&D.

CH2M HILL and any identified subcontractors shall conduct site work in accordance with this APP and associated documents. CH2M HILL shall address compliance with specific safety and health requirements, including those listed in Section 9, and through safety meetings at the start of each shift. The specific safety and health requirements and site conditions will be reviewed with field personnel during the meetings. All parties shall also comply with the requirements of their respective Injury and Illness Prevention Programs (IIPPs).

SECTION 6

Training

Site workers, supervisors, and managers will have training appropriate to their assigned duties and as specified in the SSHP and AHAs that are applicable to the work being performed. As specified in Section 4.0 of Appendix A, the SSHO (who will also conduct the project safety and health inspections), will meet the training and indoctrination requirements prescribed in this APP and Appendix A, as well as the Hazardous Waste Operations and Emergency Response (HAZWOPER) supervisory training. All employees engaging in hazardous waste operations or emergency response shall receive appropriate training as required by 29 CFR 1910.120 and 29 CFR 1926.65. At a minimum, the training shall have consisted of instruction in the topics outlined in 29 CFR 1910.120 and 29 CFR 1926.65. Since there are no tasks planned that require a competent person, competent-person-level training is not required. Personnel who have not met these training requirements shall not be allowed to engage in HAZWOPER activities.

Details of required training are specified in Section 15.0 of Appendix A.

All SSHO's (primary and alternates) will have completed 30-hour OSHA Construction Safety training, as well as all required internal training courses under CH2M HILL requirements. The courses include, but are limited to, First-aid/cardiopulmonary resuscitation (CPR), Fire Extinguisher, Blood Borne Pathogens, and many others.

The SSHO shall also serve as the project competent person for all general tasks not covered by a specialized subcontractor.

SECTION 7
Safety and Health Inspections

7.1 Inspection Details

The project SSHO (specifically identified in the attached SSHP) will provide onsite safety and health inspections for this project. The SSHO will meet the training and indoctrination requirements as prescribed in this APP and Appendix A, including HAZWOPER supervisory training, CPR, first-aid, and bloodborne pathogen awareness training. The SSHO will also have hands-on experience overseeing these types of tasks.

See Section 21.0 of Appendix A for further inspection details.

7.2 Recordkeeping

Project safety and health documentation will be maintained by the SSHO for CH2M HILL staff and verified for the respective contractors assigned to this task order. Records to be maintained (both in project files of each of the respective companies, and in the onsite field trailer) will include the following:

- HAZWOPER training certificates
- First-aid and CPR training certificates
- Documentation of medical surveillance
- Daily safety and health briefing acknowledgment forms
- Deficiency identification, correction, and follow-up documentation
- Accident reports and investigation records
- Respirator usage and fit training, as applicable
- Material Safety Data Sheet (MSDS) for sample preservatives

7.3 External Inspection/Certifications

External inspections or certifications will not be required for this work.

SECTION 8
Accident Reporting

The SSHO and HSM are responsible for all incidents reporting. Specific details are found in Section 22.0 of Appendix A.

Also, all significant accidents shall be reported as soon as possible, but not more than 24 hours afterwards to the Contracting Officer/Representative (CO/COR). The contractor shall thoroughly investigate the incident and submit the findings of the investigation along with appropriate corrective actions to the CO/COR in the prescribed format as soon as possible, but no later than 5 working days following the incident. Implement corrective actions as soon as reasonably possible.

The following occurrences require immediate accident notification:

- A fatal injury
- A permanent total disability
- A permanent partial disability
- The hospitalization of three or more people resulting from a single occurrence
- Property damage of $200,000 or more

SECTION 9

Plans Required By the EM 385-1-1 Safety Manual

Plans required by the EM 385-1-1 Safety Manual are presented in the following subsections. Plans and procedures that are not applicable to this project are indicated as such with the non-applicability rationale.

9.1 Layout Plan

Site layout is located at the end of section 3 in the SSHP. It will be provided prior to start of work to all staff.

9.2 Emergency Response Plans

Details are provided in Section 19.0 and 20.0 of Appendix A. Medical support for this project will be provided onsite and offsite. The plans fulfill the following:

- Procedures and tests (01.E.01)
- Spill plans (01.E.01, 06.A.02)
- Firefighting plan (01.E.01, Section 9)
- Posting of emergency telephone numbers (01.E.05)
- Medical support (section 03.A.02: 03.D)

9.2.1 Onsite Medical Support

When two or more field staff members are present onsite, at least two will have current certification in basic first-aid and CPR, along with bloodborne pathogens annual training. Unless injured, the SSHO will be the lead person to initiate any required first-aid until offsite medical support can be engaged.

Location and direction to medical support facilities shall be posted in a conspicuous location where temporary construction facilities or support are established at the project site. Where temporary construction facilities or a designated administrative/support office are not allowed or provided, the list shall be available for quick reference by the SSHO personnel executing site operations and its location shall also be made known to other site personnel.

In addition, the project shall be outfitted with first-aid kits of suitable size and quality (contents) to meet health and safety requirements for onsite first-aid and CPR response. Personal protective devices shall be provided such that universal precautions against bloodborne pathogens can be exercised while administering CPR or first-aid. Eye wash stations, either portable or stationary, will be available.

An effective means of communication to summon transportation of injured workers to medical treatment facilities must be evaluated and established prior to the start of field activities. Communication devices shall be tested in the area of use to assure functionality. When a medical facility or physician is not accessible within 5 minutes of an injury to a group of two or more employees for the treatment of injuries, at least two employees on each shift shall be qualified/certified to administer basic first-aid and CPR, along with bloodborne pathogens annual training. Unless injured, the SSHO/site safety coordinator will be the lead person to initiate any required first-aid until offsite medical support can be engaged.

It must be understood that for life-threatening emergencies, get or summon medical attention immediately.

During non-life-threatening emergencies, follow these procedures as appropriate:

- Notify appropriate emergency response authorities (for example, 911).
- The site supervisor or site safety coordinator will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Prevent further injury.

- Initiate first-aid and CPR where feasible and where worker "Universal Precautions" to bloodborne pathogens can be completed.
- Perform decontamination where feasible; lifesaving and first-aid or medical treatment take priority.
- Make certain that the injured person is accompanied to the emergency room.
- When contacting the medical consultant, give your name and telephone number, the name of the injured person, the extent of the injury or exposure, and the name and location of the medical facility where the injured person was taken.

9.2.2 Offsite Medical Support

In the event of a medical emergency or if follow up to basic first-aid is required, request emergency medical transport as opposed to transporting the injured person in a private or company vehicle where practical. The contact and location information for the nearest offsite medical support is presented below. A map indicating the travel route to the nearest medical facility with emergency care is presented in the SSHP.

Civista Medical Center	
701 East Charles Street, La Plata, MD	
Emergency #:	In case of emergency contact the base police, fire, and medical emergency dispatch at 301-744-4333**.**

9.2.3 Hospital Addresses and Route

Information on the nearest medical facility with emergency care is discussed in Section 19.0 of the SSHP.

9.3 Alcohol and Drug Abuse Prevention

*(*References: DFARS, Subpart 252.223-7004 and CH2M HILL SOP HSE-105, *Drug Free Workplace Program)*

In order to maintain a drug- and alcohol-free workplace, the respective parties have established a drug- and alcohol-free awareness program to educate employees on the following: (1) the danger of drug abuse and alcohol in the workplace; (2) the corporate drug- and alcohol-free workplace policy; (3) the availability of any drug and alcohol counseling, rehabilitation, and employee assistance programs; and (4) the penalties that may be imposed upon employees for drug abuse and alcohol violations and violations of the corporation's drug- and alcohol-free workplace. Such education includes the distribution of the drug- and alcohol-free workplace policy at the employment interview; a discussion of the drug- and alcohol-free workplace policy at the new employee orientation session; and inclusion of the company's drug- and alcohol-free workplace policy in the employee handbook and any other personnel policy publications.

9.3.1 CH2M HILL

The corporation has vital interests in ensuring a safe, healthy, and efficient working environment for our employees, their coworkers, and clients we serve. The unlawful or improper use of controlled substances or alcohol in the workplace presents a danger to everyone. In addition, as a federal contractor, we have a duty to comply with the requirement of the Drug-Free Workplace Act of 1988. For these reasons, we have established as a condition of employment and continued employment with the corporation the following drug- and alcohol-free workplace policy.

Employees are prohibited from reporting to work or working while using illegal or unauthorized substances. Employees are prohibited from reporting to work or working when the employee uses any drugs, except when the use is pursuant to a doctor's orders and the doctor has advised the employee that the substance does not adversely affect the employee's ability to safely perform his or her job duties. This does not include the authorized use of alcohol at corporate-sponsored functions or activities.

In addition, employees are prohibited from engaging in the unlawful or unauthorized manufacture, distribution, sale, or possession of illegal or unauthorized substances and alcohol in the workplace, including on client-paid time, on client premises, in client vehicles, or while engaged in client activities.

In accordance with the Drug-Free Workplace Act of 1988, employees must notify their supervisor of any criminal drug statute conviction for a violation occurring within the workplace within 5 days of such conviction.

Employment with the corporation is conditioned upon an employee's full compliance with the foregoing drug- and alcohol-free workplace policy. Any violation of this policy may result in disciplinary action, up to and including discharge. Furthermore, any employee who violates this policy who is subject to termination may be permitted in lieu of termination, at the corporation's sole discretion, to participate in and successfully complete an appropriate treatment, counseling, or rehabilitation program as recommended by a substance abuse professional as a condition of continued employment and in accordance with applicable federal, state, and local laws.

Consistent with its fair employment policy, the corporation maintains a policy of nondiscrimination and reasonable accommodation with respect to recovering addicts and alcoholics, and those having a medical history reflecting treatment for substance abuse conditions. We encourage employees to seek assistance before their drug and alcohol use renders them unable to perform their essential job functions or jeopardizes the health and safety of themselves or others. The corporation will attempt to assist its employees through referrals to rehabilitation, appropriate leaves of absence, and other measures consistent with the corporation's policies and applicable federal, state, or local laws.

The corporation further reserves the right to take any and all appropriate and lawful actions necessary to enforce this drug- and alcohol-free workplace policy, including, but not limited to, the inspection of corporation-issued lockers, desks, or other suspected areas of concealment. Employees are required to submit for "post accident" and "for cause" drug and alcohol screening following any incident. Random drug and/or alcohol screening is a requirement of CH2M HILL.

9.3.2 Subcontractor Management

The subcontractor must comply with the provisions of this program. As a minimum, the subcontractor must provide a written statement that their drug-free workplace program meets the minimum requirements outlined in CH2M HILL's program.

The prime contractor project manager and site safety coordinator can request to be provided copies of any subcontractor's employee's last negative screening results. The results cannot be over 12 months old.

It is the responsibility of subcontractors to transfer this plan to the lower-tiered subcontractors.

9.3.3 Prescription and Nonprescription Drugs

Employees using prescription or nonprescription drugs that could impair their functions on the project are required to notify the employer in advance of such drug use.

Failure to report prescription and nonprescription drugs as required above, illegally obtaining the substance, or use that is inconsistent with the prescription or label may be subject to disciplinary action.

The subcontractor is required to document that all of their employees have also been provided with a drug-free workplace and alcohol education program.

9.3.4 Employee Assistance Program

Employees may participate in CH2M HILL's Employee Assistance Program (EAP) immediately upon hire. The EAP helps eligible employees and their immediate families with a wide range of problems, including marriage and family problems; emotional problems; alcoholism and alcohol abuse; drug abuse and dependency; financial problems; compulsive gambling; and eating disorders. Employee conversations and records under the EAP are strictly confidential. The administrative cost of this program is fully paid by the company.

9.4 Site Sanitation Plan (Section 02)

The following constitutes the site sanitation plan for this project.

9.4.1 Drinking Water

A cooler containing an adequate supply of drinking water will be available at the site for the site workers and replenished each day. The cooler will be stored outside the exclusion zone on or near the field vehicles. Clean, disposable cups will be provided.

9.4.2 Toilets

All work on this site will be conducted by mobile crews with transportation readily available. Toilets are readily available in the visitors center and pass office near the site. EM 385-1-1, Section 02.E.01.

9.4.3 Washing Facilities

Access to washing facilities is available at the same location as the toilets.

Access to toilets is available on the facility.

However, toilet facilities on construction sites shall be provided as follows:

Minimum Toilet Facilities at Construction Sites

Number of Personnel	Number of Toilets
20 or fewer	One
20 or greater	One toilet seat and One urinal per 40 workers
Greater than 200	One toilet seat and One urinal per 50 workers

Note: The above requirements do not apply to mobile crews or to normally unattended work locations if employees working at these locations have transportation immediately available to nearby toilet facilities. Separate toilet rooms for each sex need not be provided if toilet rooms can only be occupied by one person at a time, can be locked from the inside, and contain at least one toilet seat.

Toilet facilities shall be constructed so that the occupants are protected against weather and falling objects; all cracks shall be sealed, and the door shall be tight-fitting, self-closing, and capable of being latched. Adequate ventilation shall be provided and all windows and vents shall be screened. Toilet facilities shall be constructed so that the interior is lighted.

Provisions for routinely servicing and cleaning all toilets and disposing of the sewage shall be established before placing toilet facilities into operation. The method of sewage disposal and the placement location selected shall be in accordance with federal, state, and local health regulations.

9.4.4 Washing Facilities

Access to washing facilities is available at the same location as the toilets.

Washing facilities shall be provided at toilet facilities and as needed to maintain healthful and sanitary conditions. Each washing facility shall be maintained in a sanitary condition and provided with water (either hot and cold running water or tepid running water), soap, and individual means of drying. If it is not practical to provide running water, hand sanitizers may be used as a substitute. Washing facilities shall be in close proximity to the worksite.

9.4.5 Food Service

No food service will be provided onsite. Site workers will either bring their food to the site to be consumed outside of the exclusion zone and only after proper decontamination, or will go offsite for food.

9.4.6 Waste Disposal

Any investigation-derived waste will be stored, profiled, and disposed of in accordance with the project work plan.

Nonhazardous waste materials and rubbish will be contained in a garbage bag and disposed of with regular site sanitary service disposal or at an offsite disposal facility.

9.4.7 Vermin Control

No enclosed spaces are being constructed for this project and waste materials will be securely stored and transported offsite to provide vermin control.

9.5 Access and Haul Road Plan (Section 4.B)

NOT APPLICABLE. No access or haul roads are being constructed for this work.

9.6 Respiratory Protection Plan (Section 05.G)

Not APPLICABLE. Exposure to respiratory hazards is not anticipated for the scope of work being performed under this APP. Tasks related to drilling, such as filter sand installation and grout mixing, where dust may be generated will be controlled by 1) minimizing generation, 2) engineering controls and staying upwind where feasible, and if the first two controls don't work, then 3) dust mask ppe. The plan will be updated if respiratory protection is required.

9.7 Health Hazard Control Plan (Section 06.A)

Safety and health hazards for performing work covered under this APP are identified through the preparation of AHAs (provided in Appendix A). Each AHA also indicates recommended controls for each identified potential safety/health hazard. Further hazards and controls are outlined in sections 7 through 11 of Appendix A.

Appropriate PPE shall be supplied and used at all times for this project. PPE selection is based on the selected hazard control measures specified in the AHAs and section 14 of Appendix A.

9.8 Hazard Communication Program

Chemical products may occasionally be stored and used on the project site, and/or stored on field vehicles. Examples of chemicals include hydrogen peroxide, gases used to calibrate sensing equipment, and lubricants. Other chemicals may be used as well. The chemicals may pose hazards, including flammability, corrosiveness, reactivity and incompatibility, and toxicity. Because of these potential hazards, special precautions must be taken including the following:

- Tracking and controlling hazardous chemical products received and stored
- A hazard evaluation of each chemical product, using such sources as SDSs
- Informing workers of the potential hazards through training, MSDSs, and appropriate labeling of containers
- Air monitoring in the case of potential respiratory hazards
- Design and implementation of engineering controls such as ventilation and source control
- Developing storage, handling, housekeeping, and decontamination procedures
- Assigning appropriate PPE such as eye and face protection, gloves, body protection, and respirators. Respirator usage by CH2M HILL or subcontractor employees will be in accordance with the employees' IIPP.
- Training personnel who will be handling chemicals on safe handling procedures, PPE, and emergency and spill cleanup procedures.

Hazardous substances that may be encountered in soil on the project site are not covered by this program. Appendix A, Section 12, addresses chemical and other hazard assessment and mitigation associated with site contaminants, including investigation and remediation of waste materials.

9.8.1 Chemicals Covered by this Project Program

For the purposes of this program, chemicals considered to be hazardous are those:

- Listed in the OSHA Permissible Exposure Limits.
- Included in the American Conference of Governmental Industrial Hygienists Threshold Limit Values for Chemical Substances (2007).
- Found to be suspected or confirmed carcinogens by the National Toxicology Program in the latest edition of the Annual Report on Carcinogens, or by the International Agency for Research on Cancer (IARC) in the latest edition of the IARC monographs.

Emulsified vegetable oil is expected to be used during field activities as part of this scope of work.

Exceptions to this policy, by OSHA definition, include consumer products that are used in a consumer fashion and pose no more of an exposure hazard than a consumer would face.

9.8.2 Training

Employees who work with or are potentially exposed to hazardous chemicals will receive initial training on the elements of this Hazard Communication Program, including the following:

- Content and requirements of this program and the OSHA Hazard Communication Standard
- The potential physical and toxic hazards of the chemicals used in their work location, and especially the hazards of non-routine tasks
- Chemical inventory and tracking procedures
- Location of this Hazard Communication Program, the chemical inventory, and the MSDSs
- How to read MSDSs
- Methods to detect the release of or exposure to chemicals in their area
- Content and interpretation of labels
- Safe use and handling of chemicals
- Required PPE
- Basic emergency procedures

Additional training will be provided annually, whenever a new chemical is added to the workplace, and when non-routine tasks are planned.

9.8.3 Labeling

The SSHO will ensure that hazardous chemicals brought onto the site are properly labeled with at least the following information, in English, as a minimum, and the language of non-English-speaking employees who may use the product, as appropriate. This labeling includes the following:

- The identity of the product and chemical components
- Appropriate hazard warnings
- Name and address of the manufacturer, importer, or other responsible party

Hazard warnings will also be transmitted in the form of the National Fire Prevention Agency or Hazardous Materials Information System color-coded warnings, which are ranked on a 0 to 4 scale. When chemicals are transferred to a portable container, labels containing chemical identification and hazard warnings must be affixed to the portable container.

9.8.4 Current Onsite Inventory (see attachments 2&3 of the SSHP)

Emulsified vegetable oil, pre-preserved sample bottles containing nitric acid, hydrochloric acid. YSI calibration standards, pH standards 4, 7, and 10.

9.9 Process Safety Management Plan (Section 06.B.04)

NOT APPLICABLE. This work does not include chemical management.

9.10 Lead Abatement Plan

NOT APPLICABLE. Lead is not known to be an exposure concern for this project.

9.11 Asbestos Hazard Control Plan

NOT APPLICABLE. Asbestos is not known to be an exposure concern for this project.

9.12 Radiation Safety Program (Section 06.E.03.a)

NOT APPLICABLE. Radiation hazards not anticipated for this work.

9.13 Abrasive Blasting (Section 06.H.01)

NOT APPLICABLE. This work does not involve abrasive blasting. Or see section 9.1 of the SSHP for specific details.

9.14 Heat/Cold Stress Monitoring Plan (Section 06.I.02)

See Sections 13.2.4 and 13.2.5 of Appendix A.

9.15 Crystalline Silica Monitoring Plan (Section 06.M)

The details of this plan and monitoring are covered in Section 9.4 of the SSHP. Small amounts of silica dust may be generated when mixing cement grout in small batches, and when adding filter sand to well boreholes. Dust is not anticipated to be generated during hollow stem auger drilling.

9.16 Night Operations Lighting Plan

NOT APPLICABLE. Work will not be conducted at night.

9.17 Fire Prevention Plan

See Section 8.6 of Appendix A for more details.

9.18 Wildland Fire Management Plan

NOT APPLICABLE. Wildland fires are not anticipated as a risk for this work.

9.19 Hazardous Energy Control Plan

NOT APPLICABLE. Servicing or maintenance on a system where the unexpected energizing, startup, or release of kinetic or stored energy that could cause injury or damage to occur is not part of this project.

9.20 Critical Lift Procedures

NOT APPLICABLE. No critical lifts will be performed under this scope of work.

9.21 Contingency Plan for Severe Weather

NOT APPLICABLE. Development of a severe weather contingency plan is related to marine operations and therefore does not apply to this scope of work. However, exterior fieldwork on this project will be suspended in the event of severe weather that could impact field activities. Such work suspension will be communicated immediately to the project manager.

This section is covered in detail of section 10.1 of the SSHP.

9.22 Float Plan (Section 19.F.04)

NOT APPLICABLE. This work is not over water or requiring use of a boat.

9.23 Fall Prevention and Protection Plan (Section 21.C)

NOT APPLICABLE. Fall protection is not required for this project. .

9.24 Demolition Plan (Engineering and Asbestos Surveys)

NOT APPLICABLE. This work does not involve demolition. However, if such work is required, it will be done by a subcontractor, and they will be required to submit a plan that complies with this section.

9.25 Excavation/Trenching Plan (Section 25.A.01)

NOT APPLICABLE. Not part of our scope of work.

9.26 Emergency Rescue (Tunneling) (Section 26.A)

NOT APPLICABLE. Tunneling and other underground construction is not necessary for this work.

9.27 Underground Construction Fire Prevention and Protection Plan

NOT APPLICABLE. Tunneling and other underground construction is not necessary for this work.

9.28 Compressed Air Plan

NOT APPLICABLE. Compressed air usage is not necessary for this work, except for calibration gases of very small amounts.

9.29 Formwork and Shoring Erection and Removal Plans

NOT APPLICABLE. This work does not involve forming or shoring.

9.30 Precast Concrete Plan (Section 27.D)

NOT APPLICABLE.

9.31 Jacking Plan (Lift) Slab Plans

NOT APPLICABLE. These plans are associated with concrete masonry work, which is not part of this project.

9.32 Steel Erection Plan

NOT APPLICABLE. This work does not involve steel erection.

9.33 Site Safety and Health Plan

An SSHP is attached to this APP as Appendix A. The SSHP meets the requirements for work on hazardous waste sites in accordance with 29 CFR 1910.120 and 29 CFR 1926.65.

Detailed site-specific hazards and controls are provided in Appendix A and AHAs.

9.34 Blasting Plan

NOT APPLICABLE. This work does not involve blasting.

9.35 Diving Plan

NOT APPLICABLE. This work does not involve diving.

9.36 Confined Space

NOT APPLICABLE. Entry or proximity to confined space is not required for this project.

SECTION 10

Risk Management Processes

The specific processes are addressed in multiple sections of Appendix A, depending on whether classified as physical, chemical, or other type (see Sections 7 through 15), as well as the task-specific AHAs included in Appendix A.

Appendix A
Site Safety and Health Plan

Site Safety and Health Plan rev 1

SWMU 14 Pilot Study
Naval Support Facility Indian Head
Indian Head, Maryland

Prepared for

Department of the Navy

Naval Facilities Engineering Command, Washington

February 2015

CH2MHILL®
15010 Conference Center Drive, Suite 200
Chantilly, Virginia 20151

Contents

Attachments

Acronyms and Abbreviations

AHA	activity hazard analysis
ANSI	American National Standards Institute
APP	Accident Prevention Plan
APR	Air Purifying Respirator
ATV	all-terrain vehicle
bpm	beats per minute
CFR	*Code of Federal Regulations*
CO	carbon monoxide
COC	contaminant of concern
CPR	cardiopulmonary resuscitation
CRZ	contamination reduction zone
dBA	decibel(s) (A-weighted scale)
DEET	N,N-diethylmetatoluamide
DOT	Department of Transportation
DPT	direct-push technology
EM	environmental manager
EOS	emulsified oil substrate
ERC	Emergency Response Coordinator
ESBG	Environmental Services Business Group
EVO	emulsified vegetable oil
EZ	exclusion zone
°F	degrees Fahrenheit
FID	flame ionization detector
GFCI	ground fault circuit interrupter
GW	groundwater
HAZWOPER	Hazardous Waste Operations and Emergency Response
HEPA	high-efficiency particulate air
HITS	Hours and Incident Tracking System
HRC	hydrogen release compound
HSE	health, safety, and environment
IRF	Incident Report Form
kV	kilovolt(s)
LEL	lower explosive limit

MEC	munitions and explosives of concern
$\mu g/m^3$	micrograms per cubic meter
MR	Munitions Response
MSA	Mine Safety Association
MSDS	Material Safety Data Sheet
NORM	Naturally Occurring Radiation Materials
ORE	Opportunity Risk Evaluation
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PEL	Permissible Exposure Limit established by OSHA
PFD	personal flotation device
PID	photoionization detector
PIM	potentially infectious material
PM	project manager
PPE	personal protective equipment
ppm	parts per million
PTSP	Pre-task Safety Plan
RCA	Root Cause Analysis
RHSM	responsible health and safety manager
RMSF	Rocky Mountain Spotted Fever
ROICC	Resident Officer in Charge of Construction
RPM	Remedial Project Manager
SB	soil boring
SBO	safe behavior observation
SCBA	self-contained breathing apparatus
SOP	standard operating procedure
SSD	Subslab Depressurization
SSHO	Site Safety & Health Officer
SSHP	Site Safety and Health Plan
STEL	short-term exposure limit
SZ	support zone
TCE	trichloroethylene
TLV	Threshold Limit Value
TWA	time-weighted average
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency

UV	ultraviolet
UXO	unexploded ordnance
WBGT	Wet Bulb Globe Thermometer

Approval

This site-Safety Health Plan (SSHP) has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions and identified scope(s) of work and must be amended if those conditions or scope(s) of work change.

By approving this SSHP, the responsible health and safety manager (RHSM) certifies that the personal protective equipment (PPE) has been selected based on the project-specific hazard assessment.

Date February 9, 2015

Plan Preparer:	Name: Stephen Brand Phone Number: 757-671-6211	Date: 02-09-2015
Plan Approval Project Manager:	Name: CH2M HILL Program/Project Manager Phone:	Date:
Plan Concurrence:	Mark Orman Name: Mark Orman, CSP CH2M HILL Program/Responsible Health and Safety Manager Phone:	Date: 11 Feb 2-15

Introduction

TargetZero_Horizontal_2011_FINAL.jpg

Health, Safety and Environment Policy Commitment

Protection of people and the environment is a CH2M HILL core value. It is our vision to create a culture that empowers employees to drive this value into all global operations and achieve excellence in health, safety, and environment (HSE) performance.

CH2M HILL deploys an integrated, enterprise-wide behavior based HSE management system to fulfill our mission and the expectations of our clients, staff, and communities based on the following principles:

- We require all management and supervisory personnel to provide the leadership and resources to inspire and empower our employees to take responsibility for their actions and for their fellow employees to prevent injuries, illnesses, and adverse environmental impacts, and create a safe, healthy, and environmentally-responsible workplace.
- We provide value to clients by tailoring HSE processes to customer needs and requiring CH2M HILL employees and subcontractors to deliver projects that identify HSE requirements and commit to compliance with applicable HSE laws and regulations, company standards, and external requirements.
- We are committed to pollution prevention in conjunction with our Sustainability Policy and by offering our clients sustainable solutions.
- We aspire to continually improve our performance and influence others to redefine world-class HSE excellence.
- We evaluate our design engineering and physical work environment to verify safe work conditions and practices are established, followed, and corrected as needed.
- We assess and continually improve our HSE program to achieve and maintain world-class performance by setting and reviewing objectives and targets, reporting performance metrics, and routinely evaluating our program.
- We expect all employees to embrace our Target Zero culture, share our core value for the protection of people and the environment, understand their obligations, actively participate, take responsibility, and "walk the talk" on and off the job.

The undersigned pledge our leadership, commitment, and accountability for making this Policy a reality at CH2M HILL.

Dated the 11th day of February, 2014

Jacqueline Hinman
Chief Executive Officer

JoAnn Shea
Interim Chief Financial Officer

John Madia
Chief Human Resources Officer

Gregory Nixon
Chief Legal Officer

Michael McKelvy
Chief Delivery Officer

Michael Szomjassy
Chief Operational Excellence Officer

1.1 CH2M HILL Policy and Commitment

1.1.1 Safe Work Policy

It is the policy of CH2M HILL to perform work in the safest manner possible. Safety must never be compromised. To fulfill the requirements of this policy, an organized and effective safety program must be carried out at each location where work is performed.

CH2M HILL believes that all injuries are preventable, and we are dedicated to the goal of a safe work environment. To achieve this goal, every employee on the project must assume responsibility for safety.

Every employee is empowered to:

- Conduct their work in a safe manner
- Stop work immediately to correct any unsafe condition that is encountered
- Take corrective actions so that work may proceed in a safe manner

Safety, occupational health, and environmental protection will not be sacrificed for production. These elements are integrated into quality control, cost reduction, and job performance, and are crucial to our success.

1.1.2 Health and Safety Commitment

CH2M HILL has embraced a philosophy for health and safety excellence. The primary driving force behind our commitment to health and safety is simple: employees are CH2M HILL's most significant asset and CH2M HILL management values their safety, health, and welfare. Also, top management believes that all injuries are preventable. CH2M HILL's safety culture empowers employees at all levels to accept ownership for safety and take whatever actions are necessary to eliminate injury. Our company is committed to world-class performance in health and safety and also understands that world-class performance in health and safety is a critical element in overall business success.

CH2M HILL is committed to the prevention of personal injuries, occupational illnesses, and damage to equipment and property in all of its operations; to the protection of the general public whenever it comes in contact with our work; and to the prevention of pollution and environmental degradation.

CH2M HILL's management, field supervisors, and employees plan safety into each work task in order to prevent occupational injuries and illnesses. The ultimate success of CH2M HILL's safety program depends on the full cooperation and participation of each employee.

CH2M HILL management extends its full commitment to health and safety excellence.

1.1.3 Project-specific Health, Safety, and the Environment Goals

All management and employees are to strive to meet the project-specific health, safety, and the environment (HSE) goals outlined below. The team will be successful only if everyone makes a concerted effort to accomplish these goals. The goals allow the project to stay focused on optimizing the health and safety of all project personnel and, therefore, making the project a great success.

The project has established the following 11 specific goals and objectives:

- Create an injury-free environment
- Have zero injuries or incidents
- Provide management leadership for HSE by communicating performance expectations, reviewing and tracking performance, and leading by example
- Ensure effective implementation of the SSHP through education, delegation, and teamwork
- Ensure 100 percent participation in HSE compliance
- Continuously improve our safety performance

- Maintain free and open lines of communication
- Make a personal commitment to safety as a value
- Focus safety improvements on high-risk groups
- Continue strong employee involvement initiatives
- Achieve health and safety excellence

SECTION 2

Applicability

This SSHP applies to the following:

- All CH2M HILL staff, including subcontractors and tiered subcontractors of CH2M HILL working on the site
- All visitors to the construction site in the custody of CH2M HILL, including visitors from the client, the government, the public, and other staff of any CH2M HILL company)

This SSHP does not apply to the third-party contractors, their workers, their subcontractors, their visitors, or any other persons not under the direct control or custody of CH2M HILL.

This SSHP defines the procedures and requirements for the health and safety of CH2M HILL staff and visitors when they are physically on the work site. The work site includes the project area (as defined by the contract documents) and the project offices, trailers, and facilities thereon.

This SSHP will be kept onsite during field activities and will be reviewed as necessary. The SSHP will be amended or revised as project activities or conditions change or when supplemental information becomes available.
The SSHP adopts, by reference, the Enterprise-wide Core Standards and standard operating procedures (SOPs), as appropriate. In addition, the SSHP may adopt procedures from the project work plan and any governing regulations. If there is a contradiction between this SSHP and any governing regulation, the more stringent and protective requirement will apply.

All CH2M HILL staff and subcontractors must sign the employee signoff form included in this document (Attachment 1) to acknowledge review of this document. Copies of the signature page will be maintained onsite by the site safety and health officer (SSHO).

SECTION 3

General Project Information

3.1 Project Information and Background

Project Number: 417366.WP.WP

Client: NAVFAC Atlantic

Project/Site Name: Indian Head SWMU 14 Pilot Study

Site Address: Indian Head, Maryland

CH2M HILL Project Manager: Stacy Bogdanski

CH2M HILL Office: WDC

DATE HSP Prepared: 02-09-2015

Date(s) of Site Work: Spring 2015 to Fall 2016

3.2 Site Background and Setting

NSF-IH is a Navy facility located in northwestern Charles County, Maryland, approximately 25 miles southwest of Washington, D.C. The facility consists of two tracts of land: the Main Area on the Cornwallis Neck Peninsula and the Stump Neck Annex across Mattawoman Creek from the Main Area.

The Main Area is approximately 2,500 acres and is bounded by the Potomac River to the northwest, west, and south; Mattawoman Creek to the south and east; and the town of Indian Head to the northeast. Included as part of the Main Area are Marsh Island and Thoroughfare Island in Mattawoman Creek. Elevations range from sea level to approximately 125 feet above mean sea level (amsl). The Stump Neck Annex is approximately 1,084 acres and is bounded by Mattawoman Creek to the northeast, the Potomac River to the northwest, and Chicamuxen Creek to the south-southwest. Elevations range from sea level to approximately 10 feet amsl. Both the Main Area and the Annex are on the National Priorities List, but they are separated by Mattawoman Creek (noncontiguous), have separate EPA identification numbers, and perform dissimilar operations.

Stump Neck SWMU 14 is located in the Stump Neck Annex and is approximately 300 feet south of the Potomac River. The approximate area of Stump Neck SWMU 14 is 2.4 acres. The site consists of a photographic laboratory (Building 22SN), X-ray facility (Building 2009), and the associated two septic tanks, discharge lines, and drain fields.

The original septic tank system was constructed in approximately 1968. Waste fixer from the Xray facility, which contains silver, was treated on-site for silver recovery and then released to the septic system with the wash water and developer. The septic effluent was chlorinated before discharging to the Potomac River.

Stump Neck SWMU 14 was inspected during the RCRA Facility Assessment (RFA) in 1990. Stump Neck SWMU 14 was included in a January 2002 Desk-Top Audit Decision Document (Tetra Tech NUS, Inc., 2002b), which was signed by Remedial Project Managers from NSF IH, Engineering Field Activity Chesapeake, and USEPA Region III and concurred with by MDE.

The decision reached during the desktop audit was that, due to lack of investigation data available, Stump Neck SWMU 14 should be retained as an area of concern pending additional investigation of the old drain field associated with Stump Neck SWMU 14.

Since 2002, Buildings 22SN and 2009 have been connected to a pipeline that conveys sanitary and process wastewater from the building to the NSF-IH wastewater treatment plant. Consequently, neither of the two septic systems at the site is in use. In 1999, the photographic laboratory was converted to a completely digital system and no longer discharges waste into the sanitary sewer system. The work area is presented in the Site Map below.

See Site Map for layout of work area.

3.3 Contractor Accident Experience

CH2M HILL's exceptional safety performance greatly exceeds the industry average. Our injury and illness rates and our experience modification rate have decreased dramatically over the past 5 years. See Section 2.5 of the APP for details on past 5 years of history.

3.4 Description of Tasks

All CH2M HILL and subcontractor employees engaging in hazardous waste operations (HAZWOPER) or emergency response will receive appropriate training as required by 29 *Code of Federal Regulations* (CFR) 1910.120 and 29 CFR 1926.65 (or if required by subcontract). Personnel who have not met these training requirements will not be allowed to engage in HAZWOPER or emergency response activities. See the following subsection for HAZWOPER-regulated tasks.

3.4.1 HAZWOPER-regulated Tasks

- Monitoring well drilling, installation, development.
- Emulsified vegetable oil and sodium sulfate salt treatment injections at < 10 psi
- Groundwater sampling
- IDW management and T&D

3.4.2 Non-HAZWOPER-regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state HAZWOPER regulations are not applicable. The following tasks do not involve exposure to safety or health hazards associated with the hazardous waste operations. HAZWOPER training or medical requirements do not apply for the following tasks:

Tasks	Controls
• Utility clearance	• Brief on hazards, limits of access, and emergency procedures.
• Surveying	• Post areas of contamination as appropriate.
	• Perform air sampling/monitoring as specified in this SSHP.

3.5 Tasks Requiring Activity Hazard Analysis

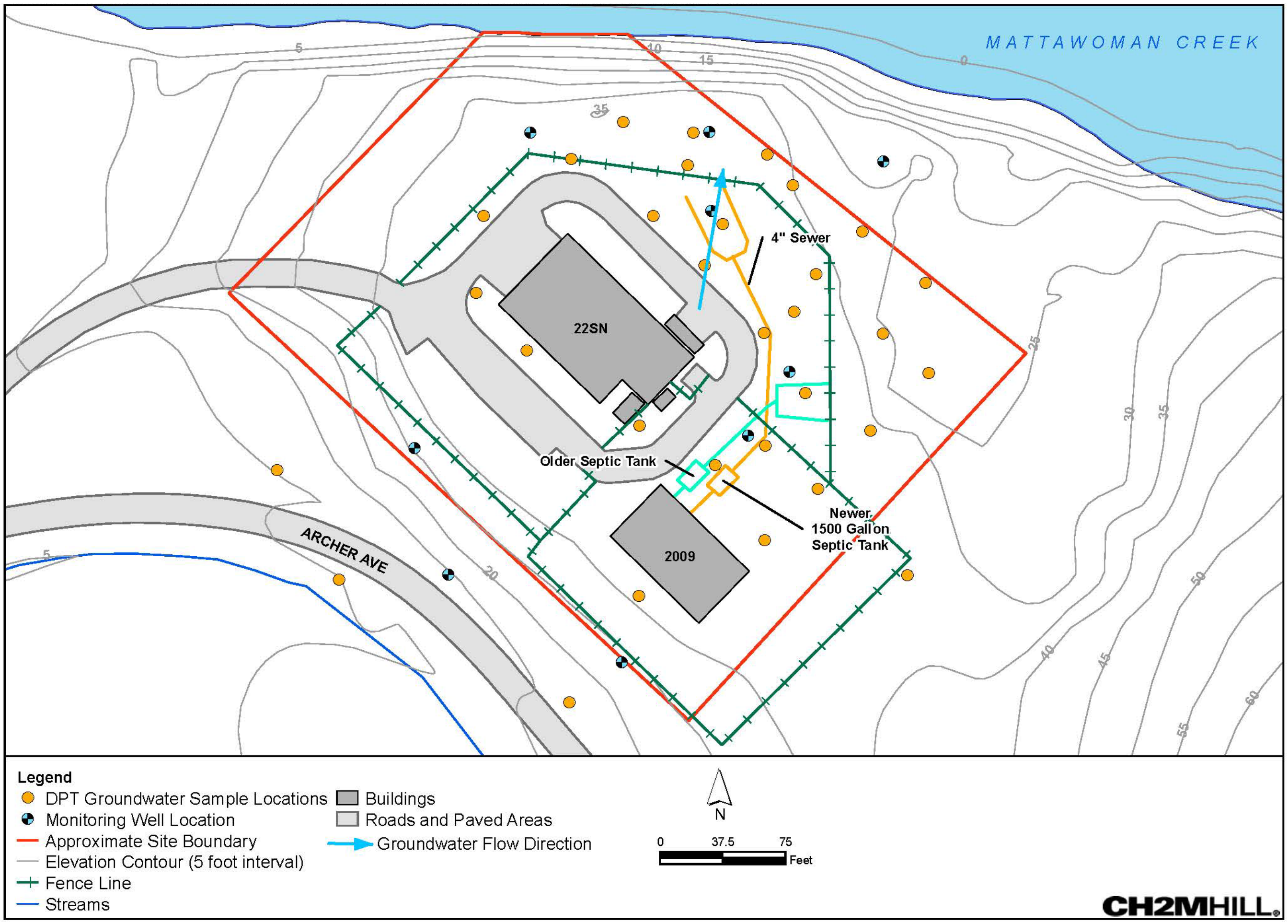
Activity hazard analyses (AHAs) are required for all definable work tasks. As the project gets closer to initiation of field operations, additional information such as identification of subcontractor, specific equipment and/or tools is obtained, the AHAs will be updated accordingly. The planned field tasks requiring AHAs are as follows:

- 01 General Oversight (surveying, utility clearance)
- 02 Oversight Drilling, MW installation and development
- 03 Subcontractor Drilling, installation, development, IDW management, and decon
- 04 EVO injection oversight
- 05 Subcontractor EVO injection
- 06 Groundwater sampling

- 07 Subcontractor IDW management and T&D

Refer to Section 7 for information regarding AHA preparation, training, and use for visual inspection and all other tasks associated with this project. The project AHAs for the hazardous work operations listed above are included in Attachment 10.

3.6 Site Map



SECTION 4

Project Organization and Responsibilities

4.1 Client

Contact Name: Allison Cantu
Phone: 202-685-8056
Facility Contact Name: Nick Carros
Phone: 301-744-2263

4.2 CH2M HILL

4.2.1 Project Manager

Project Manager Name: Stacy Bogdanski
CH2M HILL Office: WDC
Telephone Number: 703-376-5082
Cellular Number:703-727-6632

The project manager (PM) is responsible for providing adequate resources (budget and staff) for project-specific implementation of the HSE management process. The PM has overall management responsibility for the tasks in the following bulleted list. The PM may explicitly delegate specific tasks to other staff, as described in sections that follow, but retains ultimate responsibility for completion of the following in accordance with this document:

- Incorporate standard terms and conditions, and contract-specific HSE roles and responsibilities in contract and subcontract agreements (including flow-down requirements to lower-tier subcontractors).
- Select safe and competent subcontractors by:
  - Choosing potential subcontractors based on technical ability and HSE performance
  - Implementing the subcontractor prequalification process
  - Ensuring that acceptable certificates of insurance, including CH2M HILL as named additional insured, are secured as a condition of subcontract award
  - Ensuring HSE submittals, subcontract agreements, and appropriate site-specific safety procedures are in place and accepted prior field mobilization
- Ensure copies of training and medical monitoring records, and site-specific safety procedures are being maintained in the project file accessible to site personnel.
- Provide oversight of subcontractor HSE practices per the site-specific safety plans and procedures.
- Manage the site and interfacing with third parties in a manner consistent with the contract and subcontract agreements and the applicable standard of reasonable care.
- Ensure that the overall, job-specific, HSE goals are fully and continuously implemented.
- Provide visible support and motivation for HSE programs, rules, procedures, processes, and training, leading by example and encouraging CH2M HILL employees to take ownership of HSE issues.
- Intervene or stop work when an unsafe condition or behavior is observed, and/or when an environmentally compromising condition is encountered.
- Make available to and require CH2M HILL employees to complete required HSE training within established timelines and provide project numbers for such training.

- Consistently and even-handedly enforce HSE rules, procedures, and requirements at the office and/or on project work sites.
- Promptly report all work-related HSE incidents or near misses.
- Wear any required PPE.
- Ensure CH2M HILL employees complete required HSE training within established timelines.
- Conduct, cooperate, or assist with HSE incident investigations.
- Consult with the Human Resources Delivery Partner before taking any disciplinary action (other than verbal counseling) associated with CH2M HILL Policy 203 and/or HSE programs rules, procedures, processes, and training.

4.2.2 CH2M HILL Responsible Health and Safety Manager, CSP

RHSM Name: Mark Orman
CH2M HILL Office: KNV
Telephone Number: 865-560-2825
Cellular Number: 414-712-4138

The RHSM is responsible for the following:

- Review and evaluate subcontractor HSE performance using the pre-qualification process.
- Approve the SSHP and its revisions as well as AHA.
- Review and evaluate subcontractor site-specific safety procedures for adequacy prior to start of subcontractor's field operations.
- Support the oversight (or SSHO's direct oversight) of subcontractor and tiered subcontractor HSE practices.
- Permit upgrades and downgrades in respiratory protection after reviewing analytical data.
- Conduct audits as determined by project schedule and coordination with PM.
- Participate in incident investigations, lessons learned, and loss and near loss reporting.

4.2.3 CH2M HILL Project Environmental Manager

Environmental Manager Name: Hope Wilson
CH2M HILL Office: ATL
Telephone Number: 678-530-4226
Cellular Number:678-656-5411

The project environmental manager (EM) is responsible for the following:

- Provide environmental program support in areas such as training, auditing, planning, permit tracking, and subcontractor oversight as needed or as specified in the project environmental plan.
- Review and evaluate qualifications for subcontractors with a history of environmental noncompliance and for waste transportation and disposal subcontractors.
- Evaluate any spills, releases, or environmental permit incidents for appropriate follow-up actions, notifications, and recordkeeping requirements.
- Provide environmental compliance and environmental management expertise and advice to the project team as needed during the course of the project.

4.2.4 CH2M HILL Site Safety Health Officer

SSHO Name: Stacy Bogdanski
CH2M HILL Office: WDC

Telephone Number: 703-376-5082
Cellular Number:703-727-6632

The SSHO is responsible for verifying that the project is conducted in a safe manner including the following specific obligations:

- Conduct a health, safety, and environment orientation for all team members prior to entering the project work areas.
- Verify compliance with the requirements of this SSHP and applicable contractor SSHP, U.S. Army Corps of Engineers (USACE) EM 385-1-1 Manual, and federal, state, and local regulations.
- Verify this SSHP is current and amended when project activities or conditions change.
- Verify CH2M HILL site personnel and subcontractor personnel read the SSHP and sign the Employee Signoff Form, prior to commencing field activities.
- Verify CH2M HILL site personnel have completed any required specialty training (for example, fall protection, confined space entry, etc.) and medical surveillance as identified in this SSHP.
- Verify that project files include copies of subcontractor training and medical monitoring records, and accepted site-specific safety procedures prior to start of subcontractor’s field operations.
- Act as the project “Hazard Communication Coordinator,” and perform the responsibilities outlined in the SSHP.
- Act as the project “Emergency Response Coordinator,” and perform the responsibilities outlined in the SSHP.
- Act as the project competent person for general tasks not conducted by a specialized subcontractor.
- Post the Occupational Safety and Health Administration (OSHA) job-site poster—the poster is required at sites where project field offices, trailers, or equipment-storage boxes are established. If you work in a state with an OSHA state plan, make sure the state plan poster is posted, if required.
- Hold and/or verify that safety meetings are conducted and documented in the project file initially and as needed throughout the course of the project (as tasks or hazards change).
- Verify that project health and safety forms and permits are being used as outlined this SSHP.
- Perform oversight and assessments of subcontractor HSE practices per the site-specific safety plan, and verify that project activity self-assessment checklists are being used as outlined this SSHP.
- Coordinate with the RHSM regarding CH2M HILL and subcontractor operational performance, and third-party interfaces.
- Verify appropriate PPE use, availability, and training.
- Ensure that the overall, job-specific, HSE goals are fully and continuously implemented.
- Conduct accident investigations, including root cause analysis.
- Calibrate and conduct air monitoring in accordance with the SSHP, and maintain all air monitoring records in the project file.
- Maintain HSE records and documentation.
- Facilitate client, OSHA, or other government agency inspections, including accompanying the inspector and providing all necessary documentation and follow-up.
- Deliver field HSE training as-needed, based on project-specific hazards and activities.
- Consistently and even-handedly enforce HSE rules, procedures, and requirements at the office and/or on project work sites.

- Wear any required PPE.
- Conduct, cooperate, or assist with HSE incident investigations.
- Contact the PM and RHSM when standards of conduct or CH2M HILL Policy 203 has been violated by a CH2M HILL employee.
- Contact the RHSM and PM in the event of an incident.
- Contact the RHSM and project EM in the event of a spill or release immediately so evaluation of reportable quantity requirements and whether agency reporting is required.
- When an apparent imminent danger exists, immediately remove all affected CH2M HILL employees and subcontractors, notify subcontractor safety representative, stop affected work until adequate corrective measures are implemented, and notify the PM and RHSM as appropriate.
- Document all verbal health-and-safety-related communications in project field logbook, daily reports, or other records.

4.3 CH2M HILL Subcontractors

(Reference CH2M HILL SOP HSE-215, *Contracts and Subcontracts)*

Drilling Subcontractor: Parratt Wolff
Subcontractor Contact Name: Butch Stevens
Telephone: 800-627-7920

Surveying Subcontractor: ECLS
Subcontractor Contact Name: Shawn Rumberger
Telephone: 910-897-3257

Utility Clearance Subcontractor: Accumark
Subcontractor Contact Name: Valerie Mayhew
Telephone: 804-550-7740

IDW T&D Subcontractor: Capital Environmental
Subcontractor Contact Name: Terry Fort
Telephone: 540-777-6547

Subcontractors must comply with the following activities, and are responsible to for the following:

- Comply with all local, state, and federal safety standards.
- Comply with project and owner safety requirements.
- Actively participate in the project safety program and either hold or attend and participate in all required safety meetings.
- Provide a qualified safety representative to interface with CH2M HILL.
- Maintain safety equipment and PPE for their employees.
- Maintain and replace safety protection systems damaged or removed by the subcontractor's operations.
- Notify the SSHO of any accident, injury, or incident (including spills or releases) immediately, and submit reports to CH2M HILL within 24 hours.
- Install contractually required general conditions for safety (for example, handrail, fencing, fall protection systems, floor opening covers).
- Conduct and document weekly safety inspections of project-specific tasks and associated work areas.

- Conduct site-specific and job-specific training for all subcontractor employees, including review of the CH2M HILL SSHP, subcontractor health and safety plans, and subcontractor AHAs, and sign appropriate signoff forms.
- Determine and implement necessary controls and corrective actions to correct unsafe conditions.

The subcontractors listed above may be required to submit their own site-specific health and safety plan and other plans such as lead or asbestos abatement compliance plans. Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit their plans to CH2M HILL for review and acceptance before the start of fieldwork.

Subcontractors are also required to prepare AHAs before beginning each activity posing hazards to their personnel. The AHA will identify the principle steps of the activity, potential health and safety hazards for each step, and will recommended control measures for each identified hazard. In addition, a listing of the equipment to be used to perform the activity, inspection requirements, and training requirements for the safe operation of the equipment listed must be identified.

4.4 Employee Responsibilities

All personnel are assigned responsibility for safe and healthy operations. This concept is the foundation for involving all employees in identifying hazards and providing solutions. For any operation, individuals have full authority to stop work and initiate immediate corrective action or control. In addition, each worker has a right and responsibility to report unsafe conditions or practices. This right represents a significant facet of worker empowerment and program ownership. Through shared values and a belief that all accidents are preventable, our employees accept personal responsibility for working safely.

Each employee is responsible for the following performance objectives:

- Understanding and abiding by CH2M HILL and client HSE programs, rules, procedures, processes, and training, including any that are project-specific
- Completing all required HSE training made available and accessible within established timelines
- Always wearing any required personal protective equipment
- Intervening or stopping work for you or other CH2M HILL employees when an unsafe condition or behavior is encountered or observed, and/or when an environmentally compromising condition exists
- Promptly notifying a supervisor, PM, SSHO, or RHSM when an unsafe condition or behavior is observed, and/or when an environmentally compromising condition exists
- Promptly reporting a supervisor, PM, SSHO, or RHSM all work-related health, safety , and environmental incidents or near misses
- Attending required project HSE pre-task briefings and meeting prior to performing work
- Cooperating or assisting with HSE incident investigations

4.4.1 Employee Authority

Each employee on the project has the obligation and authority to shut down any perceived unsafe work and during employee orientation, each employee will be informed of their authority to do so.

4.5 Client Contractors

(Reference CH2M HILL SOP HSE-215, *Contracts, Subcontracts and HSE Management Practices*)

Contractor: None
Contact Name:
Telephone:
Contractor Task(s):

This SSHP does not cover contractors that are contracted directly to the client or the owner. CH2M HILL is not responsible for the health and safety or means and methods of the contractor's work, and we must never assume such responsibility through our actions (such as advising on health and safety issues). In addition to these instructions, CH2M HILL team members should review contractor safety plans so that we remain aware of appropriate precautions that apply to us. Self-assessment checklists are to be used by the site safety and health officer (SSHO) and CH2M HILL team members to review the contractor's performance only as it pertains to evaluating CH2M HILL exposure and safety. The RHSM is the only person who is authorized to comment on or approve contractor safety procedures.

Health-and-safety-related communications with contractors should be conducted as follows:

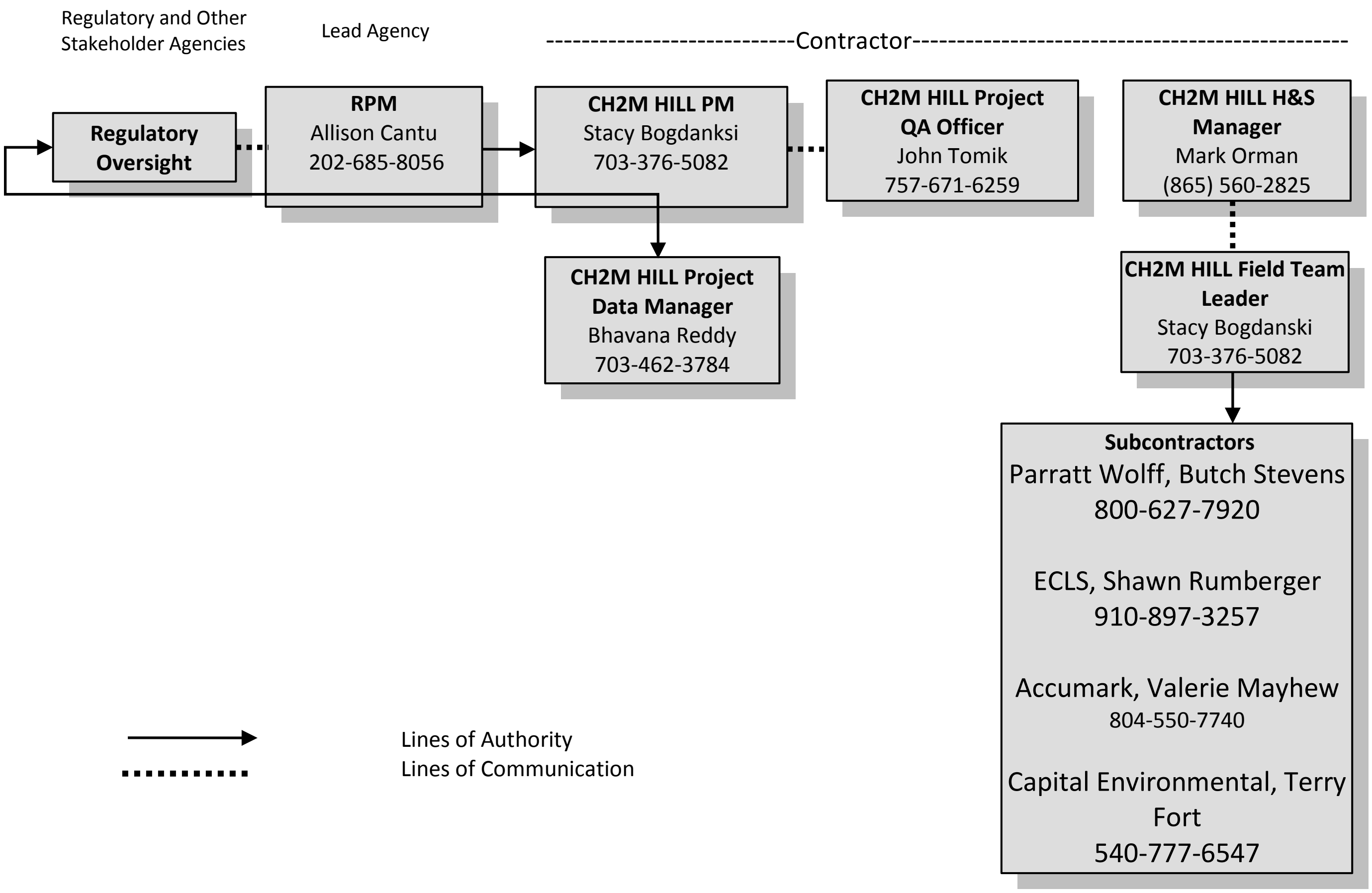
- Request the contractor to brief CH2M HILL team members on the precautions related to the contractor's work
- When an apparent contractor noncompliance or unsafe condition or practice poses a risk to CH2M HILL team members, conduct the following:
  - Notify the contractor safety representative
  - Request that the contractor determine and implement corrective actions
  - If necessary, stop affected CH2M HILL work until contractor corrects the condition or practice
  - Notify the client, PM, and RHSM as appropriate

If apparent, contractor noncompliance or unsafe conditions or practices are observed, inform the contractor safety representative (CH2M HILL's obligation is limited strictly to informing the contractor of the observation; the contractor is solely responsible for determining and implementing necessary controls and corrective actions).

If an apparent imminent danger is observed, immediately warn the contractor employee(s) in danger and notify the contractor safety representative (CH2M HILL's obligation is limited strictly to immediately warning the affected individual(s) and informing the contractor of the observation; the contractor is solely responsible for determining and implementing necessary controls and corrective actions).

All verbal health-and-safety-related communications will be documented in the project field logbook, daily reports, or other records.

4.6 Lines of Authority



SECTION 5
Standards of Conduct

All individuals associated with this project must work injury-free and drug-free and must comply with the following standards of conduct, the SSHP, and the safety requirements of CH2M HILL. Commonly accepted standards of conduct help maintain good relationships between people. They promote responsibility and self-development. Misunderstandings, frictions, and disciplinary action can be avoided by refraining from thoughtless or wrongful acts.

5.1 Standards of Conduct Violations

All individuals associated with this project are expected to behave in a professional manner. Violations of the standards of conduct would include, but not be limited to, the following:

- Failure to perform work
- Inefficient performance, incompetence, or neglect of work
- Willful refusal to perform work as directed (insubordination)
- Negligence in observing safety regulations, poor housekeeping, or failure to report on-the-job injuries or unsafe conditions
- Unexcused or excessive absence or tardiness
- Unwillingness or inability to work in harmony with others
- Discourtesy, irritation, friction, or other conduct that creates disharmony
- Harassment or discrimination against another individual
- Failure to be prepared for work by wearing the appropriate construction clothing or bringing the necessary tools
- Violation of any other commonly accepted reasonable rule of responsible personal conduct

5.2 Disciplinary Actions

The Environmental Services Business Group (ESBG) employees, employees working on ESBG projects, and subcontractor employees are subject to disciplinary action for not following HSE rules and requirements. Potential disciplinary action is equally applicable to all employees, including management and supervision. Disciplinary action may include denial of access to the worksite, warnings, reprimands, and other actions up to and including termination depending on the specific circumstances.

5.3 Subcontractor Safety Performance

CH2M HILL should continuously endeavor to observe subcontractors' safety performance and adherence to their plans and AHAs. This endeavor should be reasonable, and include observing for hazards or unsafe practices that are both readily observable and occur in common work areas. CH2M HILL is not responsible for exhaustive observation for hazards and unsafe practices. CH2M HILL oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

5.3.1 Observed Hazard Form

When apparent noncompliance or unsafe conditions or practices are observed, notify the subcontractor's supervisor or safety representative verbally, and document using the Observed Hazard Form, included as an attachment to this SSHP, and require corrective action.

If necessary, stop subcontractor's work using the Stop Work Order Form until corrective actions is implemented for observed serious hazards or conditions. Update the Observed Hazard Form to document corrective actions have been taken. The subcontractor is responsible for determining and implementing necessary controls and corrective actions.

5.3.2 Stop Work Order

CH2M HILL has the authority, as specified in the contract, and the responsibility to stop work in the event any CH2M HILL employee observes unsafe conditions or failure of the subcontractor to adhere to its safe work practices, or observes a condition or practice that may result in a release or violation of an environmental requirement. This authority and action does not in any way relieve the subcontractor of its responsibilities for the means and methods of the work or, therefore, of any corrective actions. Failure to comply with safe work practices can be the basis for restriction or removal of the subcontractor staff from the job site, termination of the subcontract, restriction from future work, or all three.

When an apparent imminent danger is observed, immediately stop work and alert all affected individuals. Remove all affected CH2M HILL employees and subcontractor staff from the danger, notify the subcontractor's supervisor or safety representative, and do not allow work to resume until adequate corrective measures are implemented. Notify the PM, contract administrator, and RHSM.

When repeated noncompliance or unsafe conditions are observed, notify the subcontractor's supervisor or safety representative and stop affected work by completing and delivering the Stop Work Order Form (attached to this SSHP) until adequate corrective measures are implemented. Consult the contract administrator to determine what the contract dictates for actions to pursue in event of subcontractor noncompliance including work stoppage, back charges, progress payments, removal of subcontractor manager, monetary penalties, or termination of subcontractor for cause.

5.4 Incentive Program

Each project is encouraged to implement a safety incentive program that rewards workers for exhibiting exemplary safety behaviors. Actions that qualify are those that go above and beyond what is expected. Actions that will be rewarded include spotting and correcting a hazard, bringing a hazard to the attention of your foreman, telling your foreman about an incident, coming up with a safer way to get the work done, or stopping a crew member from doing something unsafe. The program will operate throughout the project, covering all workers. The incentive program will be communicated to all employees during the project employee orientation and project safety meetings.

5.5 Reporting Unsafe Conditions/Practices

Responsibility for effective health and safety management extends to all levels of the project and requires good communication between employees, supervisors, and management. Accident prevention requires a proactive policy on near misses, close calls, unsafe conditions, and unsafe practices. All personnel must report any situation, practice, or condition which might jeopardize the safety of our projects. All unsafe conditions or unsafe practices will be corrected immediately. CH2M HILL has zero tolerance of unsafe conditions or unsafe practices.

No employee or supervisor will be disciplined for reporting unsafe conditions or practices. Individuals involved in reporting the unsafe conditions or practices will remain anonymous.

The following reporting procedures will be followed by all project employees:

- Upon detection of any unsafe condition or practice, the responsible employee will attempt to safely correct the condition.
- The unsafe condition or practice will be brought to the attention of the worker's direct supervisor, unless the unsafe condition or practice involves the employee's direct supervisor. If so, the SSHO needs to be notified at once by the responsible employee.

- Either the responsible employee or responsible employee's direct supervisor is responsible for immediately reporting the unsafe condition or practice to the SSHO.
- The SSHO will act promptly to correct the unsafe condition or practice.
- Details of the incident or situation will be recorded by the SSHO in the field logbook. If the subcontractor was involved, the Observed Hazard Form will be used.

SECTION 6

Safety Planning and Change Management

6.1 Daily Safety Meetings and Pre-task Safety Plans

Daily safety meetings are to be held with all project personnel in attendance to review the hazards posed and required HSE procedures and AHAs that apply for each day's project activities. The Pre-task Safety Plans (PTSPs) serve the same purpose as the general assembly safety meetings, but the PTSPs are held between the crew supervisor and their work crews to focus on hazards posed to individual work crews.

At the start of each day's activities, the crew supervisor completes the PTSP, provided as an attachment to this HSP, with input from the work crew, during their daily safety meeting. The day's tasks, personnel, tools, and equipment that will be used to perform the tasks listed, along with the hazards posed and required HSE procedures, in the HSP and AHA. The use of PTSPs promotes worker participation in the hazard recognition and control process while reinforcing the task-specific hazard and required HSE procedures with the crew each day.

6.2 Change Management

This HSP addresses all known activities and associated hazards. As work progresses, if significant changes are identified that could affect health and safety at the site, coordinate with the RHSM to determine whether an HSP update is necessary.

The following are examples of changes that may require a revision to the plan:

- Change in CH2M HILL staff
- New subcontractor to perform work
- New chemicals brought to site for use
- Change in scope or addition of new tasks
- Change in contaminants of concern (COCs) or change in concentrations of COCs
- New hazards or hazards not previously identified that are not addressed in this SSHP

6.3 Agency Inspection Guidance

(Reference CH2M HILL SOP HSE-201, *Agency Inspections and Communications*)

Agency inspections (for example, OSHA, the U.S. Environmental Protection Agency (USEPA), or other regulatory agencies) are on the rise. CH2M HILL implements safety and environmental programs in order to ensure safety to workers, the public, and the environment. This plan addresses things like labeling containers, completing the hazard communication training using the attachments to this SSHP, listing training requirements and PPE requirements, and addressing project-specific hazards. Field personnel need to contact the RHSM to update this plan if hazards are encountered that are not addressed.

SOP HSE-201 addresses agency inspections in detail, and the attached **Target Zero Bulletin on Agency Inspections** provides a good summary of the inspection process and what to do if an agency such as OSHA or USEPA shows up at the site. It is critical immediately notify the RHSM if an inspector arrives (and EM if it is environmental-related) because they can help facilitate and make additional notifications.

Review the Target Zero Bulletin and keep it with your Health and Safety Plan/Environmental Plan. Make it a topic at a safety meeting, and keep it readily available in the event of an inspection.

SECTION 7

Project Hazard Analysis and Health Hazard Control Program

(Reference: EM 385-1-1 Section 01.B.06)

The Health Hazard Control Program will be conducted by the use of the AHA process. Section 7 outlines the process that will be used by the SSHO onsite to determine the presence of hazardous environments or whether hazardous or toxic agents could be released into the work environment.

A health and safety risk analysis (Table 1) has been performed for each task. In the order listed below, the RHSM considers the various methods for mitigating the hazards. Employees are trained on this hierarchy of controls during their hazardous waste training and reminded of them throughout the execution of projects:

- Elimination of the hazards (use remote sampling methodology to avoid going into a confined space)
- Substitution (reduce exposure to vapors by using of a geoprobe instead of test pitting)
- Engineering controls (ventilate a confined space to improve air quality)
- Warnings (establish exclusion zones to keep untrained people away from hazardous waste work)
- Administrative controls (implement a work-rest schedule to reduce chance of heat stress)
- Use of PPE (use of respirators when action levels are exceeded)

The hazard controls and safe work practices are summarized in the following sections of this SSHP:

- General hazards and controls
- Project-specific hazards and controls
- Physical hazards and controls
- Biological hazards and controls
- Contaminants of concern

7.1 Activity Hazard Analysis

An AHA must be developed for each CH2M HILL job activity. The AHA should define the work tasks required to perform each activity, along with potential HSE hazards and recommended control measures for each hazard. A listing of the equipment to be used to perform the activity, inspection requirements to be performed, and training requirements for the safe operation of the equipment listed must be identified. Workers are briefed on the AHA before performing the work and their input is solicited prior to, during, and after the performance of work to further identify the hazards posed and control measures required. The AHA should identify the work tasks required to perform each activity, along with potential HSE hazards and recommended control measures for each hazard.

The hazard controls described in the following sections and applicable CH2M HILL core standards and SOPs should be used as a basis for preparing AHAs.

AHAs prepared for CH2M HILL activities and subcontractors are included as an attachment to this SSHP.

7.2 Subcontractor Activity Hazard Analysis

CH2M HILL subcontractors are required to provide AHAs specific to their scope of work on the project for acceptance by CH2M HILL. Each subcontractor will submit AHAs for its field activities, as defined in its scope of work, along with a project-specific safety plan and procedures. Additions or changes in field activities, equipment, tools, or material used to perform work or hazards not addressed in existing AHAs requires either a new AHA to be prepared or an existing AHA to be revised.

TABLE 1
General Activity Hazard Analysis

	Project Activity							
Potential Hazard	Utility Survey	Monitoring Well Drilling, Installation and Development	Surveying	EVO Treatment Injections	Groundwater Sampling	IDW Management and T&D		
Biological Hazards	X	X	X	X	X	X		
Chemical Hazard		X		X	X	X		
Chemical Injections (remediation)				X				
Crystalline Silica		X						
Drilling		X		X				
Drum Handling		X		X	X	X		
Drum Sampling		X		X	X	X		
Groundwater Sampling					X			
Hand & Power Tools	X	X	X	X	X	X		
Knife Use		X	X					
Lockout /Tagout/Hazardous Energy Controls				X				
Manual Lifting	X	X	X	X	X	X		
Methane (from injection activities)					X			
Noise		X		X				
Portable Generators		X			X			
Pressurized Lines/Equipment		X		X				
Pressure Washing Equipment/ Decontamination		X		X				
Temperature Extremes	X	X	X	X	X	X	X	X
Ultraviolet Light exposure (sunburn)	X	X	X	X	X	X	X	X
Utilities (underground/overhead)		X		X				

SECTION 8

General Hazards and Controls

Section 8 provides safe work practices and control measures used to reduce or eliminate potential hazards. It is a summarized list of requirements. Always consult the appropriate CH2M HILL SOP to ensure all requirements are implemented.

8.1 Bloodborne Pathogens

(Reference CH2M HILL SOP HSE-202, *Bloodborne Pathogens*)

Exposure to bloodborne pathogens may occur when rendering first-aid or cardiopulmonary resuscitation (CPR), or when coming into contact with landfill waste or waste streams containing potentially infectious material (PIM).

Employees trained in first-aid/CPR or those exposed to PIM must complete CH2M HILL's 1-hour bloodborne pathogens computer-based training module annually. When performing first-aid/CPR the following apply:

- Observe universal precautions to prevent contact with blood or other PIMs. Where differentiation between body fluid types is difficult or impossible, consider all body fluids to be potentially infectious materials.
- Always wash your hands and face with soap and running water after contacting PIMs. If washing facilities are unavailable, use an antiseptic cleanser with clean paper towels or moist towelettes.
- If necessary, decontaminate all potentially contaminated equipment and surfaces with chlorine bleach as soon as possible. Use one part chlorine bleach (5.25 percent sodium hypochlorite solution) diluted with 10 parts water for decontaminating equipment or surfaces after initially removing blood or other PIMs. Remove contaminated PPE as soon as possible before leaving a work area.

CH2M HILL will provide exposed employees with a confidential medical examination should an exposure to PIM occur. The examination includes the following procedures:

- Documenting the exposure.
- Testing the exposed employee's and the source individual's blood (with consent).
- Administering post-exposure prophylaxis.

8.2 Chemical Storage

The following are general guidelines for storing chemicals and other hazardous materials:

- Keep acids away from bases.
- Keep oxidizers (nitric acid, nitrates, peroxides, chlorates) and organics away from inorganic reducing agents (metals).
- Keep flammables and corrosives in appropriate storage cabinets.
- Do not store paper or other combustibles near flammables.
- Use secondary containment and lipped shelving that is secured.
- Have a fire suppression system available.

8.2.1 Storage of Flammable/Combustible Liquids

- Only approved containers and portable tanks shall be used for storage and handling of flammable and combustible liquids.
- Approved safety cans shall be used for the handling and use of flammable liquids in quantities of 5 gallons (19 liters) or less. Do not use plastic gas cans.

- For quantities of 1 gallon (3.78 liters) or less, the original container may be used for storage and use of flammable liquids.
- Flammable or combustible liquids shall not be stored in areas used for stairways or normally used for the passage of people.

8.2.2 Indoor Storage of Flammable/Combustible Liquids

- No more than 25 gallons (95 liters) of flammable or combustible liquids shall be stored in a room outside of an approved storage cabinet.
- Quantities of flammable and combustible liquids in excess of 25 gallons (95 liters) shall be stored in an acceptable or approved cabinet.
- Cabinets shall be conspicuously lettered: "FLAMMABLE: KEEP FIRE AWAY."
- Not more than 60 gallons (228 liters) of flammable or 120 gallons (456 liters) of combustible liquids shall be stored in any one storage cabinet. Not more than three such cabinets may be located in a single storage area.

8.2.3 Outside Storage of Flammable/Combustible Liquids

- Storage of containers (not more than 60 gallons [228 liters] each) shall not exceed 1,100 gallons (4,180 liters) in any one area. No area shall be within 20 feet (6.1 meters) of any building.
- Storage areas shall be graded to divert spills away from buildings and surrounded by an earthen dike.
- Storage areas may not be located near a storm drain. Overflow and spills must be diverted away from storm drains or surface waters.
- Storage areas shall be free from weeds, debris, and other combustible materials.
- Outdoor portable tanks shall be provided with emergency vent devices and shall not be closer than 20 feet (6.1 meters) to any building.
- Signs indicating no smoking shall be posted around the storage area.

8.2.4 Storage of Hazardous Waste

- All facilities storing ignitable and combustible liquids and hazardous wastes must be designed, constructed, maintained, and operated to minimize the possibility of a fire, explosion, or any release of hazardous constituents.
- Flammable wastes should be stored more than 50 feet from the property line.

8.2.5 Storage of Chemical Injection Chemicals/Materials

When chemical injection remediation technologies are being used at a site, the following storage guidelines must be followed:

- Some injection chemicals, such as strong oxidizers, may have stringent storage requirements per local or National Fire Codes. Verify that appropriate storage provisions are in place prior to starting work.

  NOTE: Counties and cities may have requirements specific to storing these chemicals. Also, storage and use of certain chemicals such as potassium permanganate and hydrogen peroxide may be subject to the new Chemical Facility Anti-Terrorism Standards of the Department of Homeland Security—the applicability depends on the chemical, quantity/concentration, and type of facility. Please contact the project EM to determine whether chemicals are subject to these standards.

- Injection chemicals must be stored in a designated, secured area with spill prevention capabilities. Review Material Safety Data Sheet (MSDS) or other information to determine potential incompatible materials. Incompatible materials shall not be stored together. Ensure all containers are labeled.

8.3 Driving Safety

(Reference CH2M HILL HSE Policy 205, Distracted Driving – Wireless Devices, Vehicle Safety Core Standard)

All CH2M HILL employees are prohibited from using wireless devices while operating a motor vehicle when conducting company business regardless of the location or vehicle ownership and whether or not during regular working hours.

All CH2M HILL contractors and subcontractors are prohibited from using wireless devices while operating a CH2M HILL- or CH2M HILL client-owned, leased, or rented motor vehicle, or while operating any other motor vehicle on the project site.

- Prohibited use includes the following:
  - Dialing or speed dialing
  - Using a hands-free or voice-recognition (blue tooth) device to dial or speed dial
  - Engaging in conversation or listening to a conversation using a wireless device
  - Checking e-mails or surfing the Internet using a wireless device
  - Texting or e-mailing (reading, sending, or screening) with a wireless device
  - Programming or entering coordinates into a global positioning system device (following directions by a global positioning system is permitted)
  - Using a wireless device for voice recording or dictation
- Employees, contractors, and subcontractors who need to use a wireless device must pull off the road to a safe location, with the vehicle securely stopped and emergency flashers on, or wait until they reach their destination.
- Avoid distractions from mobile phones, smartphones, voice recognition systems, PDAs, notebook, tablets (or similar devices), or laptops, by turning off or silencing the wireless devices before operating a motor vehicle.

Follow the guidelines below when operating a vehicle:

- Obey speed limits, and be aware of blind spots or other hazards associated with low visibility. Practice defensive driving techniques, such as leaving plenty of room between your vehicle and the one ahead of you.
- Do not drive while drowsy. Drowsiness can occur at any time, but is most likely after 18 hours or more without sleep.
- Maintain focus on driving. Eating, drinking, smoking, and adjusting controls can divert attention from the road. Take the time to park and perform these tasks when parked rather than while driving.
- Ensure vehicle drivers are familiar with the safe operation of vehicles of the type and size to be operated. Large vehicles such as full-size vans and pick-ups have different vision challenges and handling characteristics than smaller vehicles.

8.4 Electrical Safety

(Reference CH2M HILL SOP HSE-206, *Electrical Safety*)

Below are the hazard controls and safe work practices to follow when using electrical tools, extension cords, and/or other electrical-powered equipment or when exposed to electrical hazards. Ensure the requirements of the referenced SOP are followed:

- Only qualified personnel are permitted to work on unprotected energized electrical systems.
- Only authorized personnel are permitted to enter high-voltage areas.

- CH2M HILL employees who might from time to time work in an environment influenced by the presence of electrical energy must complete Awareness Level Electrical Safety Training located on the CH2M HILL Virtual Office.
- Do not tamper with electrical wiring and equipment unless qualified to do so. All electrical wiring and equipment must be considered energized until lockout/tagout procedures are implemented.
- Inspect electrical equipment, power tools, and extension cords for damage prior to use. Do not use defective electrical equipment; remove from service.
- CH2M HILL has selected Ground Fault Circuit Interrupters (GFCIs) as the standard method for protecting employees from the hazards associated with electric shock:
  - GFCIs shall be used on all 120-volt, single-phase 15- and 20-amphere receptacle outlets that are not part of the permanent wiring of the building or structure.
- An assured equipment grounding conductor program may be required under the following scenarios:
  - GFCIs cannot be used
  - Client requires such a program to be implemented
  - Business group decides to implement program in addition to GFCI protection
- Extension cords must be equipped with third-wire grounding. Cords passing through work areas must be covered, elevated, or protected from damage. Cords should not be routed through doorways unless protected from pinching. Cords should not be fastened with staples, hung from nails, or suspended with wire.
- Electrical power tools and equipment must be effectively grounded or double-insulated and Underwriters Laboratory approved.
- Operate and maintain electric power tools and equipment according to manufacturers' instructions.
- Maintain safe clearance distances between overhead power lines and any electrical conducting material unless the power lines have been de-energized and grounded, or where insulating barriers have been installed to prevent physical contact. Maintain at least 10 feet (3 meters) from overhead power lines for voltages of 50 kilovolts (kV) or less, and 10 feet (3 meters) plus 0.4 inch (1.0 centimeter) for every 1 kV over 50 kV.
- Temporary lights shall not be suspended by their electric cord unless designed for suspension. Lights shall be protected from accidental contact or breakage.
- Protect all electrical equipment, tools, switches, and outlets from environmental elements.

8.5 Field Vehicles

- Field vehicles may be personal vehicles, rental vehicles, fleet vehicles, or project vehicles.
- Maintain a first-aid kit, bloodborne pathogen kit, and fire extinguisher in the field vehicle at all times.
- Use a rotary beacon on vehicle if working adjacent to active roadway.
- Familiarize yourself with the following rental vehicle features prior to operating the vehicle:
  - Vision fields and blind spots
  - Vehicle size
  - Mirror adjustments
  - Seat adjustments
  - Cruise control features, if offered
  - Pre-program radio stations and global positioning system, if equipped
- Always wear seatbelt while operating vehicle.

- Adjust headrest to proper position.
- Tie down loose items if utilizing a van or pick-up truck.
- Close car doors slowly and carefully. Fingers can get pinched in doors.
- Park vehicle in a location where it can be accessed easily in the event of an emergency. If not possible, carry a phone.
- Have a designated place for storing the field vehicle keys when not in use.
- Ensure back-up alarms are functioning, if equipped. Before backing a vehicle, take a walk around the vehicle to identify obstructions or hazards. Use a spotter when necessary to back into or out of an area.
- See the Vehicle Accident Guidance attached to this SSHP, if a vehicle incident is experienced in a rental or fleet vehicle.

8.6 Fire Prevention

(Reference EM 385-1-1 Section 09.A.01, and CH2M HILL SOP HSE-403, *Hazardous Material Handling*)

Follow the fire prevention and control procedures listed in the following subsection.

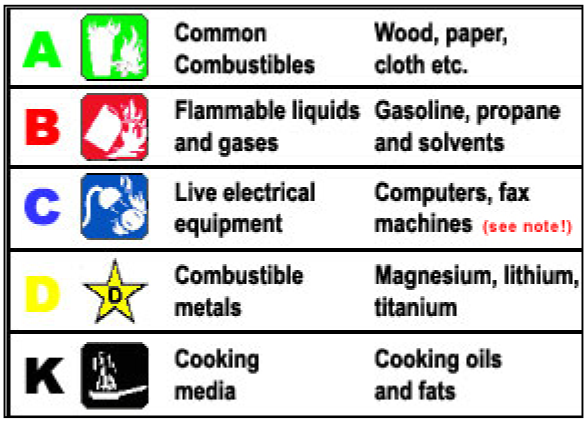
8.6.1 Fire Extinguishers and General Fire Prevention Practices

- Fire extinguishers shall be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 feet (30.5 meters). When 5 gallons (19 liters) or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 feet (15.2 meters). When 10 liters or more of a flammable or combustible liquid is being used, an extinguisher must be within 15 meters.
- Extinguishers must:
  - Be maintained in a fully charged and operable condition
  - Be visually inspected each month
  - Undergo a maintenance check each year
- The area in front of extinguishers mustbe kept clear.
- Post “Exit” signs over exiting doors, and post “Fire Extinguisher” signs over extinguisher locations.
- Combustible materials stored outside should be at least 10 feet (3 meters) from any building.
- Solvent waste and oily rags must be kept in a fire resistant, covered container until removed from the site.
- Keep areas neat. Housekeeping is important.
- A fire extinguisher, rated not less than 2A, shall be provided for each 280 square meters of a combustible building area, or major fraction thereof. Travel distance from any point of the protection area to the nearest fire extinguisher shall not exceed a horizontal distance of 50 feet or 15 meters.
- Flammable/combustible liquids must be kept in approved containers, and must be stored in an approved storage cabinet.

Fire extinguishers can represent an important segment of any overall fire protection program. However, their successful functioning depends upon the following conditions having been met:

- The extinguisher is properly located and in working order.
- The extinguisher is of proper type and for a fire which may occur.
- The fire is discovered while still small enough for the extinguisher to be effective.
- The fire is discovered by a person ready, willing, and able to use the extinguisher.

- Class C fires (see below for fire classifications) can be readily extinguished by quenching-cooling with water or a water-mixture agent. Class B fires are more effectively extinguished by an agent that blankets-smothers the fire through exclusion of oxygen surrounding the fire area. Those extinguishers containing bromochlorodifluoromethane, monobromotrifluoromethane, carbon dioxide, or dry chemical are generally best suited for extinguishing Class B fires. For Class C fires, the primary consideration in extinguishing this type of fire is the selection of nonconductive extinguishing agent to prevent dangerous electrical shock and possible death to user.
- Due to its corrosive nature, dry chemical is not recommended for use on computerized, electronic, or other equipment with extensive circuitry.
- The following chart defines/explains classes of fires:



A	Common Combustibles	Wood, paper, cloth etc.
B	Flammable liquids and gases	Gasoline, propane and solvents
C	Live electrical equipment	Computers, fax machines (see note!)
D	Combustible metals	Magnesium, lithium, titanium
K	Cooking media	Cooking oils and fats

Fires are classified into five groups:

- Class A: Class A fires involve common combustibles such as wood, paper, cloth, rubber, trash, and plastics. They are common in typical commercial and home settings, but can occur anywhere these types of materials are found.
- Class B: Class B fires involve flammable liquids, gases, solvents, oil, gasoline, paint, lacquers, tars, and other synthetic or oil-based products. Class B fires often spread rapidly and, unless properly secured, can reflash after the flames are extinguished.
- Class C: Class C fires involve energized electrical equipment, such as wiring, controls, motors, data processing panels, or appliances. They can be caused by a spark, power surge, or short circuit and typically occur in locations that are difficult to reach and see.
- Class D: Class D fires involve combustible metals such as magnesium and sodium. Combustible metal fires are unique industrial hazards that require special dry powder agents.

(NOTE: Although ABC and BC dry chemical extinguishers can control a fire involving electronic equipment, the National Fire Code specifically advises against dry-chemical extinguishers for fires involving computers or other delicate electronic equipment due to the potential damage from residues).

Fire fighting shall only be conducted by those trained and certified in this practice. The commonly accepted practice is the PASS method. This means, pull the pin, aim, squeeze the handle, and sweep the base of the fire area. The SSHO shall verify that at least two staff members are onsite that have the required training for use of fire extinguishers.

8.6.2 Dispensing of Flammable/Combustible Liquids

- Areas in which flammable or combustible liquids are dispensed in quantities greater than 5 gallons (22.7 liters) (shall be separated from other operations by at least 25 feet (7.6 meters).

- Drainage away from storm drains or surface waters or other means of containment shall be provided to control spills.
- Adequate natural or mechanical ventilation shall be provided to maintain the concentration of flammable vapor at or below 10 percent of the lower flammable limit.
- Dispensing of flammable liquids from one container to another shall be done only when containers are electrically interconnected (bonded).
- Dispensing flammable or combustible liquids by means of air pressure on the container or portable tanks is prohibited.
- Dispensing devices and nozzles for flammable liquids shall be of an approved type.

8.7 General Practices and Housekeeping

The following are general requirements applicable to all portions of the work:

- Site work should be performed during daylight hours whenever possible.
- Good housekeeping must be maintained at all times in all project work areas.
- Common paths of travel should be established and kept free from the accumulation of materials.
- Keep access to aisles, exits, ladders, stairways, scaffolding, and emergency equipment free from obstructions.
- Provide slip-resistant surfaces, ropes, or other devices to be used.
- Specific areas should be designated for the proper storage of materials.
- Tools, equipment, materials, and supplies shall be stored in an orderly manner.
- As work progresses, scrap and unessential materials must be neatly stored or removed from the work area.
- Containers should be provided for collecting trash and other debris and shall be removed at regular intervals.
- All spills shall be quickly cleaned up; oil and grease shall be cleaned from walking and working surfaces.
- Review the safety requirements of each job you are assigned to with your supervisor. You are not expected to perform a job that may result in injury or illness to yourself or to others.
- Familiarize yourself with, understand, and follow jobsite emergency procedures.
- Do not fight or horseplay while conducting the firm’s business.
- Do not use or possess firearms or other weapons while conducting the firm’s business.
- Report unsafe conditions or unsafe acts to your supervisor immediately.
- Report emergencies, occupational illnesses, injuries, vehicle accidents, and near misses immediately.
- Do not remove or make ineffective safeguards or safety devices attached to any piece of equipment.
- Report unsafe equipment, defective or frayed electrical cords, and unguarded machinery to your supervisor.
- Shut down and lock out machinery and equipment before cleaning, adjustment, or repair. Do not lubricate or repair moving parts of machinery while the parts are in motion.
- Do not run in the workplace.
- When ascending or descending stairways, use the handrail and take one step at a time.
- Do not apply compressed air to any person or clothing.
- Do not wear steel taps or shoes with metal exposed to the sole at any CH2M HILL project location.

- Do not wear finger rings, loose clothing, wristwatches, and other loose accessories when within arm's reach of moving machinery.
- Remove waste and debris from the workplace and dispose of in accordance with federal, state, and local regulations.
- Note the correct way to lift heavy objects (secure footing, firm grip, straight back, lift with legs), and get help if needed. Use mechanical lifting devices whenever possible.
- Check the work area to determine what problems or hazards may exist.

8.8 Hazard Communication

(Reference Section 01.B.06, EM 385-1-1 and CH2M HILL SOPs HSE-107, *Hazard Communication* and HSE-403, *Hazardous Material Handling*)

The hazard communication coordinator is to perform the following:

- Effective information and training on hazardous chemicals shall be given to project employees by their employer at the time of initial assignment and/or whenever a new physical or health hazard the employees have not been previously trained about is introduced into their work area.
- Complete an inventory of chemicals brought onsite by CH2M HILL using the chemical inventory form included as an attachment to this SSHP.
- Confirm that an inventory of chemicals brought onsite by CH2M HILL subcontractors is available.
- Request or confirm locations of MSDSs from the client, contractors, and subcontractors for chemicals to which CH2M HILL employees potentially are exposed.
- Before or as the chemicals arrive onsite, obtain an MSDS for each hazardous chemical and include on the chemical inventory sheet (attached to this SSHP) and add the MSDS to the MSDS attachment section of this plan.
- Label chemical containers with the chemical name and with hazard warnings, and store properly.
- Give employees required chemical-specific hazardous communication training using the chemical-specific training form included as an attachment to this SSHP.
- Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

8.9 Knife Use

Open-bladed knives (for example, box cutters, utility knives, pocket knives, machetes, and multi-purpose tools with fixed blades such as a Leatherman™) are prohibited at worksites, except where the following three conditions are met:

- The open-bladed knife is determined to be the best tool for the job.
- An approved AHA or written procedure is in place and covers the necessary safety precautions (work practices, PPE, and training).
- Knife users have been trained and follow the AHA.

8.10 Lighting

Lighting shall be evaluated when conducting work inside buildings, confined spaces, or other areas/instances where supplemental light may be needed (for example, work before sunrise or after sunset). A light meter can be used to evaluate the adequacy of lighting. The following are common requirements for lighting and the conditions/type of work being performed:

- While work is in progress outside construction, areas shall have at least 33 lux.
- Construction work conducted inside buildings should be provided with at least 55 lux light.
- The means of egress shall be illuminated with emergency and non-emergency lighting to provide a minimum 11 lux measured at the floor. Egress illumination shall be arranged so that the failure of any single lighting unit, including the burning out of an electric bulb, will not leave any area in total darkness.

8.11 Manual Lifting

(Reference CH2M HILL SOP HSE-112, *Manual Lifting*)

Back injuries are the leading cause of disabling work and most back injuries are the result of improper lifting techniques or overexertion. Use the following to mitigate the hazards associated with lifting:

- When possible, the task should be modified to minimize manual lifting hazards.
- Lifting of loads weighing more than 40 pounds (18 kilograms) shall be evaluated by the SC using the Lifting Evaluation Form contained in SOP HSE-112.
- Using mechanical lifting devices is the preferred means of lifting heavy objects such as forklifts; cranes, hoists, and rigging; hand trucks; and trolleys.
- Personnel shall seek assistance when performing manual lifting tasks that appear beyond their physical capabilities.
- In general, the following steps must be practiced when planning and performing manual lifts: Assess the situation before you lift; ensure good lifting and body positioning practices; and ensure good carrying and setting down practices.
- All CH2M HILL workers must have training in proper manual lifting training either through the New Employee Orientation or through Manual Lifting module located on the Virtual Office.

8.12 Personal Hygiene

Good hygiene is essential for personal health and to reduce the potential of cross-contamination when working on a hazardous waste site. Implement the following:

- Keep hands away from nose, mouth, and eyes during work.
- Keep areas of broken skin (chapped, burned, etc.) covered.
- Wash hands with soap and water prior to eating, smoking, or applying cosmetics.

8.13 Personal Security

Follow the guidelines below for personal security measures. The RHSM and Firm-Wide Security Office can be contacted if additional, specific measures are needed (such as evaluating the needs for security service).

8.13.1 General Safety and Security Guidelines

The CH2M HILL Corporate Security Department recommends the following guidelines for workers in the United States:

- Stay alert and be aware of your surroundings. Avoid pre-occupations with mobile devices, while in an unfamiliar area.
- Whenever possible, use the buddy system with another employee or client or subcontractor employee.
- Trust your intuition; if a situation appears strange or wrong, it probably is.
- Be confident in your walk or stride; do not give the appearance you are new in town.

- Avoid carrying and displaying large sums of cash.
- If you sense or see dangerous situations along your route, change your route and depart the area quickly. If you feel that you are being followed, go to the nearest police station or safe location and file a complaint with the police. Provide a description of the person, their vehicle, license plate number, and any other useful information.
- Only walk short distances that are safe and secure while visiting an unfamiliar city or location.
- Take host-approved transportation for long distances.
- "Fight or Flight?" Leaving the possible or dangerous area is always better than staying to fight.
- Always report suspicious activity to the nearest local law enforcement agency.
- Locate emergency exits in your hotel or where you are staying to ensure you know where to go in case of a fire or a natural or man-made disaster.
- Secure your electronic devices when left in your room or take them with you if you are not able to secure them properly.
- If you feel your life is in danger, call 911. Be sure to speak clearly, concisely, and give the dispatcher a good description of where you are physically located.

8.13.2 Operating or Riding in Vehicles

- When waiting for public transportation or a taxi, remain in a store or restaurant as long as possible before catching your ride and never wait by yourself in an isolated area.
- Approach your vehicle with keys firmly in your hand and ready to unlock the car.
- Quickly check your car before entering it to determine damage or presence of an intruder.
- Vulnerable times can be stopping to find your keys to enter your vehicle or stepping out of your vehicle in an isolated area. Be aware of your surroundings before you perform these activities.
- Always keep your doors locked during transit and when the vehicle is parked.
- Never leave your vehicle unlocked, even when performing a quick task such as checking in at a hotel, getting gas, or going picking up food.
- If confronted by an individual inside a vehicle pointing a weapon at you, run the opposite way from where the vehicle is facing and scream as loud as you can. This evasive action will probably cause the individual to drive away.
- If an individual in a passing car points at your tires or engine to indicate a malfunction, only pull over in a well-lit and populated gas or rest stop. Never pull over in an isolated or dimly lit area. You may have a malfunction or the passing motorist may be attempting to rob you.
- Always park your vehicle in a well-lit and secure area. If your vehicle is parked in a dimly lit or isolated area in a parking garage; ask an attendant or friend to accompany you to your vehicle.
- Secure your valuables in the trunk, or place them out of sight or cover them with a blanket or coat if there is no secure storage area in the vehicle. The would-be-perpetrator likes to see what to steal and not knowing what you have concealed will normally prevent a break in.

8.13.2.1 Riding in a Taxi

- Have your host or a designated travel agent suggest or reserve a reputable taxi service for you during your stay.
- Only use a taxi service that was vetted for safety and reliability.
- If possible, place luggage, laptop, and personal belongings inside the taxi.

- When you first enter the taxi, check the driver's photo identification card, normally located on the driver's visor, with the driver to ensure they match.

8.13.2.2 Walking

- If you experience automotive trouble, remain inside the locked vehicle and call for assistance.
- If you can't reach assistance through a mobile phone, only walk for help in a safe area facing the traffic.
- If while walking you are shadowed or followed by a vehicle, run back in the direction of your vehicle and enter the vehicle if possible. File a police report on the incident as soon as practicable.
- Be aware of your surroundings and those around you while walking, and do not be distracted by using electronic devices.
- Regularly change your route if you are walking to and from meetings or conferences, and choose only well-lit areas in which to walk at night.
- If walking long distances, identify a safe house, shop, store, or restaurant to duck into if confronted by a perpetrator.

8.13.2.3 Jogging or Running

- Always jog or run in an area that is safe, secure, and used for exercising.
- Avoid running along busy roads or highways.
- If you choose to venture out on a jog or run, check the route by vehicle prior to beginning to exercise.
- Let the host or a friend know when you leave, when you plan to return, and the route you will take during exercising.
- Take a photo identification and mobile phone with you for emergencies.
- Avoid physically over-extending yourself since reflexes and decision making ability can be impaired.

8.13.2.4 Clothing and Jewelry

- Dress to blend in with locals, maintain a low profile, and avoid drawing attention to yourself.
- Travel with inexpensive clothing and jewelry.
- Avoid wearing CH2M HILL distinctive clothing or using CH2M HILL logos on luggage or laptops.

8.13.2.5 Emergency Numbers and Information

- Leave your itinerary and emergency contact numbers where you can be reached with family members and only those that have a need to know.
- Pre-program emergency numbers in the mobile device you are traveling with.
- Carry a list of current medications and specific doses in your purse or wallet.
- Record medical emergency information on a document that can be readily available if you are unable to speak or unconscious.
- Have a photocopy of your driver's license, passport, and credit card information separately in case your wallet or purse is stolen.

8.14 Shipping and Transportation of Hazardous Materials

(Reference CH2M HILL SOP HSE-417, *Hazardous Materials Transportation*)

The U.S. Department of Transportation (DOT) has specific regulations governing shipping of hazardous materials (also called dangerous goods). Chemicals brought to the site might be defined as hazardous materials by the U.S. DOT. Hazardous wastes that may be shipped offsite are also defined as hazardous materials by U.S. DOT.

Other wastes may also be U.S. DOT hazardous materials. To confirm whether a material or a waste is a U.S. DOT hazardous material, check with the ESBG Waste Coordinator (Lisa Schwan/ATL), the project EM, or the CH2M HILL Dangerous Goods Shipping Coordinators (John Blasco/BAO or Rob Strehlow/MKW).

All staff who are involved in shipment of hazardous materials, including receiving hazardous materials, preparing profiles or manifests, packaging hazardous wastes, labeling, or transporting hazardous materials by road, are called HazMat employees (note CH2M HILL cannot transport hazardous wastes by public road). HazMat employees must receive CH2M HILL online training in shipping dangerous goods. CH2M HILL's online Dangerous Goods Shipping course can be found on the HSSE area of the Virtual Office.

All hazardous materials that are shipped (for example, by Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. If the material is a product that is being shipped (for example, calibration gas), use the HazMat ShipRight tool on the CH2M HILL Virtual Office (under Company Resources – Online Shipping). Contact the Dangerous Goods Shipping coordinators, the ESBG Waste Coordinator, or the project EM for additional information.

49 CFR 172 requires that all hazmat employees be aware of potential transportation security concerns. Hazardous materials security is addressed in CH2M HILL's Hazardous Materials SOP (HSE-403). The following points are provided as an overview of security measures to increase awareness of this important matter:

- It is essential that each employee understand the security risks involved with transporting hazardous materials.
- All transporters of hazardous materials must be prequalified by a contract administrator who evaluates the carrier's safety rating, security measures, and employee screening procedures.
- When shipping hazardous materials, check driver's credentials and ask about shipping details.
- When receiving a hazardous materials shipment, inspect packages for signs of tampering or damage to the contents. Verify the drivers and company information on the form with the driver.
- If there is suspicious or unusual behavior (for example, driver without credentials, evasive answers) or any discrepancies identified, do not offer or accept the shipment, and immediately notify the PM or the RHSM.

Employees responsible for shipping hazard materials must also review the CH2M HILL Transportation Security Plan (HSE-417 Appendix A).

8.15 Substance Abuse

(Reference CH2M HILL SOP HSE-105, *Drug-Free Workplace)*

Employees who work under the influence of controlled substances, drugs, or alcohol may prove to be dangerous or otherwise harmful to themselves, other employees, clients, the company, the company's assets and interests, or the public. CH2M HILL does not tolerate illegal drug use, or any use of drugs, controlled substances, or alcohol that impairs an employee's work performance or behavior.

Prohibitions onsite include the following:

- Use or possession of intoxicating beverages while performing CH2M HILL work.
- Abuse of prescription or nonprescription drugs.
- Use or possession of illegal drugs or drugs obtained illegally.
- Sale, purchase, or transfer of legal, illegal, or illegally obtained drugs.
- Arrival at work under the influence of legal or illegal drugs or alcohol.

Drug and/or alcohol testing is applicable under CH2M HILL Constructors, Inc., and munitions response projects performed in the United States. In addition, employees may be required to submit to drug and/or alcohol testing as required by clients. When required, the testing is performed in accordance with SOP HSE-105, Drug-Free

Workplace. Employees who are enrolled in drug or alcohol testing are required to complete annual training located on the CH2M HILL Virtual Office.

8.16 Unknown or Suspect Objects/Materials

If unknown or suspect objects/materials are encountered (that is, exposed or partially buried drums, biological waste, cylinders, munitions of explosive concern, and unexpected stained/discolored soil) are encountered during site operations, ongoing activities shall be immediately suspended. CH2M HILL or subcontractor personnel encountering unknown or suspect objects/materials shall adhere to the following:

- Secure the area and identify the location of the object/material to the extent possible, without causing bodily injury to yourself or others and without disturbing the object.
- Evacuate the work area.
- Immediately notify the PM/HSM of the encountered condition.
- Do not provide additional disturbance or otherwise handle the suspect object/material.

The site supervisor or SC shall contact the PM and the HSM to evaluate potential hazards associated with the specific situation encountered. The project team will then address the need for the use of special procedures, engineering controls, PPE, or specialized subcontract personnel to safely mitigate the situation.

SECTION 9

Project-specific Hazard Controls

Section 9 provides safe work practices and control measures used to reduce or eliminate potential hazards. The practices and controls are to be implemented by the party in control of either the work or the particular hazard. Each person onsite is required to abide by the hazard controls. Always consult the appropriate CH2M HILL SOP to ensure all requirements are implemented. CH2M HILL employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M HILL employees and subcontractors who do not understand any of these provisions should contact the RHSM for clarification.

9.1 Chainsaws

(Reference CH2M HILL SOP HSE-210, *Hand and Power Tools*)

Below are the hazard controls and safe work practices to follow when working around or operating chainsaws. Ensure the requirements in the referenced SOP are followed.

9.1.1 Equipment

Only chainsaws equipped with a spark arrestor and fully functioning chain brake or "safety chain" shall be used. The following safety equipment shall be readily available while operating a chainsaw:

- Chainsaw operator's manual
- Fully stocked first-aid kit
- Multipurpose fire extinguisher
- Grounded extension cord approved for outdoor use and GFCI for electrical-powered chainsaws
- Approved safety gasoline container and funnel or flexible nozzle for refueling gasoline-powered chainsaws
- Sledge hammer and non-metallic wedges when necessary to prevent pinching of the chain

9.1.2 PPE Requirements

The following personal protective equipment shall be worn while operating chainsaws:

- Safety glasses with side shields and face shield to prevent injury from wood chips, sawdust, or other flying objects.
- Hard hat with properly fitted suspension to prevent head injury from falling debris.
- Steel-toed safety shoes or boots to prevent foot injury from falling objects and accidental contact with the moving chain.
- Hearing protection to prevent permanent damage to hearing. Ear muffs or plugs will have a decibel noise reduction rating assigned to them. The higher the rating, the greater the protection offered.
- Non-leather, fabric work gloves to prevent hand injury from abrasions, splinters and cuts.
- Clothing that is well-fitted and free of loose edges that could become entangled in the saw.
- Protective chaps or leggings that cover the area from the groin to about 2 inches (5.08 centimeters) above the ankles should be used. These chaps are made from synthetic fabrics that are designed to prevent the running saw chain from coming in contact with your legs.

9.1.3 Safe Operation

The following safe operation guidelines shall be followed regardless of the purpose for using a chainsaw:

- Inspect the chainsaw prior to use.

- Chainsaws shall be held firmly with both hands, with thumbs and fingers encircling both chain saw handles.
- Stand slightly to the left side of the saw, out of the plane of the cutting chain and guide bar to reduce the risk of injury in the event of a kickback.
- Position saw so that it is between the waist and mid-chest level. Overreaching or cutting above the mid-chest height shall be avoided.
- Maintain a full throttle setting while cutting. Chainsaws are designed to be run at full speed.
- Always be aware of what is in the saw's downward path after the cut.
- Do not attempt to cut material that is larger than the guide bar of the saw.
- Avoid cuts that will cause the chainsaw to jam. Always cut into the compression wood first until the cut starts to close; then cut from the other side toward the compression cut.
- Use a non-metallic wedge to prevent the compression cut jamming on the blade.
- Chainsaws are designed to feed themselves into the wood and require only light pressure to cut efficiently. If extra force is required to keep cutting, the chain requires sharpening. Additional signs of a dull chain include a saw that is cutting crooked, results in fine sawdust instead of chips, or the smell of burnt wood. Do not use a dull chain.
- Bystanders and helpers shall be kept at a safe distance from operation.
- Do not operate a chainsaw when fatigued; take frequent breaks.
- Work slowly; don't rush.
- A fire extinguisher shall be present at all times when operating the chainsaw in forest or brushy areas.

9.1.4 Refueling the Engine

The fuel for gasoline-powered chainsaws shall be mixed in accordance with the manufacturer's recommendations as outlined in the chainsaw operator's manual. Fuel shall be stored and transported in an approved safety container. The following precautions should also be followed:

- The engine shall be shut off and allowed to cool before refueling; never refuel a hot engine.
- A fire extinguisher shall be present during fueling and refueling.
- Smoking around fueling or refueling operations shall be prohibited.
- A funnel or a flexible nozzle shall be used to avoid spilling fuel on the engine.

9.2 Chemical Injections

The remedial action objectives for this project will be facilitated via the subsurface injection of EVO by DPT. Where these chemical injection remediation technologies are engaged within the site target areas, the procedures and handling practices identified below must be implemented. Chemical/compound-specific hazards and controls associated with the DPT injection are discussed after these general bullets.

9.2.1 Pre-injection

1. Review the MSDSs for the materials which are expected to be utilized in the chemical injection processes for this contract task order and:
   - Document training in accordance with the Hazard Communication section of this plan.
   - Ensure that appropriate spill response materials are present (for example, absorbent media for oil, neutralizing agents for potassium permanganate, secondary containment for larger chemical tanks).
2. Evaluate potential for "daylighting" of chemical injection in the work area:

- Evaluation should identify known or potential pathways such as existing monitoring wells screened at the same depth interval as the planned injection, wells that were not properly abandoned, and utility corridors.
- Identify potential surface release areas such as nearby sensitive areas (for example, wetlands) storm drains, ditches, or streams, and ensure that mitigation measures are in place (for example, temporarily blocking storm sewer drains).
- Contact the project EM for assistance in identifying release scenarios and mitigation measures.

9.2.2 Injection Operations

- Operate and maintain pressure vessels, pumps and hosing in accordance with the manufacturer's recommendations.
- Do not exceed the rated pressure of the vessels and associated piping or hoses of the system.
- The system must be provided with a pressure relief valve/controller that safely reduces the system pressure to within the system rated pressure.
- The pressure relief valve must be rated at no more than 110 percent the rated pressure of the system and must be tested at regular intervals.
- Each vessel must be equipped with a functioning pressure gauge to monitor pressure.
- For PPE and air monitoring requirements, refer to the PPE section and Site Monitoring section of this plan. PPE shall be used to minimize potential exposure to identified site contaminants of concern and injection solutions during site injection operations. In addition, good personal hygiene practices and procedures must be practiced.
- Use face shields in combination with safety glasses or goggles when the potential for exposure to chemical splashes may exist.
- If repairs to injection delivery system components are necessary after the subsurface injection operations have been initiated, the injection lines must be relieved of pressure and drained before conducting repair work. See also the lockout/tagout section of this SSHP.
- EVO drums shall be moved using a drum "dolly" or other appropriate material handling equipment where the weight of the drum can be properly managed and secured during the movement.
- Empty EVO containers may require special preparation/rinsing prior to disposal. Verify requirements with the project Environmental Manager.
- Only qualified personnel, by prior training or experience, may operate the injection system delivery components/array(s).
- Appropriate spill response materials for all chemicals must be present at the job site. Only qualified (by training and previous experience) who have proper PPE and equipment available shall provide spill response operations.
- Station a portable eye wash in the immediate work area where chemical injections are occurring, along with wash facilities for hygienic practices and PPE decontamination.
- If PPE becomes saturated and may potentially impact work clothing, dermal surfaces, or mucous membranes, change PPE immediately.
- Verify the competency and integrity of the chemical injection hoses/piping and connection points
- Confirm hose/piping rated for 20 psi (injections at 10 psi).

- Verify that any cam-lock fitting on the injection hose/piping, well head, or direct-push technology (DPT) rods are structurally sound and free of defects. Where hoses are used, ensure fittings have been secured to the hose surface via mechanical banding equipment to prevent whipping.
- When injecting under pressure, stand at a sufficient distance (that is, around 20 feet) from the injection well head/point. Keep unessential project personnel away from the injection system, array, and well head(s) during injection operations.
- Remove/stow all unnecessary equipment and material in the area.
- The injection system/array must be monitored/attended at all times during the injection process and when not in use, components must be properly secured, de-energized, or stowed. If the system will operate without an attendant, plans for operating unattended must be in place an approved by the PM an HSM/EM.
- All pressured lines and fittings should be ‘tethered’ or otherwise secured to minimize whipping or ‘launching’ of lines in the event of an equipment failure. Any “quick connect” type fittings (compressed air or fluid) should be secured with appropriate pins, clips to prevent accidental disengagement of the fitting during operation.
- Inspect all equipment, hoses, pressure lines, and fittings daily and prior to pressurizing.

9.2.3 Chemical Storage

- Some injection chemicals, such as strong oxidizers, may have stringent storage requirements per local or National Fire Codes. Verify that appropriate storage provisions are in place prior to starting work.
- NOTE: Counties and cities may have requirements specific to storing these chemicals. Also, storage and use of certain chemicals such as potassium permanganate and hydrogen peroxide may be subject to the new Chemical Facility Anti-Terrorism Standards of the Department of Homeland Security—the applicability depends on the chemical, quantity/concentration, and type of facility. Please contact the project Environmental Manager to determine whether chemicals are subject to these standards.
- EVO must be stored in a designated, secured area with spill prevention capabilities. Review MSDS or other information to determine potential incompatible materials. Incompatible materials shall not be stored together. Ensure all containers are labeled.

9.2.4 Substrates That Create Reducing Conditions To Facilitate Bioremediation

Materials such as emulsified vegetable oil (EVO) or emulsified oil substrate (EOS), lactate, and cheese whey are commonly used as the electron donors or “fuel” during enhanced reductive dechlorination treatment. Enhanced reductive dechlorination can be an effective method for degrading various chlorinated solvents dissolved in groundwater.

Addition of these “electron donors” can also cause changes that need to be recognized and monitored, such as production of gases such as methane and hydrogen sulfide, and increases in carcinogenic byproducts, such as vinyl chloride, in groundwater or in the vadose zone. The gases or byproducts are not yet formed during the injection work, but are observed weeks following the injections as the biological process take place. The hazards must be considered during subsequent groundwater sampling activities. The air monitoring protocol and action levels, as well as required PPE, are discussed in later sections of this HSP.

Although EVO is food-grade material, MSDSs for the material must be kept onsite, as well as added to the chemical inventory, and specific training on hazards conducted and documented in the Attachments in this HSP.

The Clean Water Act requires a Spill Prevention, Control, and Countermeasures Plan for storage of more than 1,320 gallons of oil (including EVO and EOS) in greater than or equal to 55-gallon aboveground containers. Additionally, spill kits/materials capable of stopping the spread of a leak/spill must be available and accessible. Involve your EM for assistance to determine whether a plan is required, to prepare a Spill Prevention, Control, and Countermeasures Plan, or to plan for spill control if EVO or other oils will be used around a body of water.

The following hazards must be acknowledged and addressed in the injection AHA:

- Slips/falls resulting from spilled EVO/EOS
- Slips/trips/falls from hoses transporting EVO/EOS and water
- Pressure in the injection lines (less than 20 pounds per square inch)
- Potential for oil to spray on face/body if there's a breach or leak (refer to bullets above for mitigation measures)
- Hazards associated with the mixing and injection process such as electrical hazards associated with the pump, hand contact hazards during the mixing process, spills, etc.
- Other hazards applicable to the injection process.

9.3 Compressed Gas Cylinders

(Reference CH2M HILL SOP HSE-403, *Hazardous Materials Handling*)

The following are the hazard controls and safe work practices to follow when working around or using compressed gas cylinders. Ensure the requirements in the referenced SOP are followed.

- Cylinders and pressure-controlling apparatus shall be inspected for defects and leakage prior to use. Damaged or defective items shall not be used. If a cylinder is found to be defective, the gas distributor shall be notified and subsequent instructions followed. If a leak should develop at a fuse plug or other safety device, the cylinder shall be removed from the work area.
- Cylinders shall be labeled with the identity of the contents. Cylinders not labeled shall be sent back to the cylinder distributor. The color of the cylinder shall not be used exclusively to identify cylinder contents.
- Valve caps must be in place when cylinders are transported, moved, or stored.
- Cylinders must be secured in an upright position at all times.
- Cylinder valves must be closed when cylinders are not being used and when cylinders are being moved.
- Cylinders must be secured on a cradle, basket, or pallet when hoisted; they may not be hoisted by choker slings.
- Eye protection (safety glasses or goggles) shall be worn when using cylinders.
- Cylinders must be shielded from welding and cutting operations and positioned to avoid being struck or knocked over; contacting electrical circuits; or exposed to extreme heat sources.
- Cylinders inside buildings shall be stored in dry, well-ventilated locations at least 20 feet (6.1 meters) from highly combustible materials. Cylinders should be stored in definitely assigned places away from elevators, stairs, or gangways. Assigned storage areas shall be located where cylinders will not be knocked over or damaged.
- Oxygen cylinders in storage shall be separated from fuel gas cylinders or combustible materials by a minimum of 20 feet (6.1 meters) or by a noncombustible barrier at least 5 feet (1.5 meters) high, having a fire-resistance rating of at least 0.5 hour.
- Signs indicating no smoking shall be provided for storage areas containing flammable gas cylinders.
- Complete the self-assessment checklist for compressed gas cylinders are being used.

9.4 Crystalline Silica

(Reference CHM HILL SOP HSE-511, Crystalline Silica and USACE EM 385-1-1, section 06M)

CH2M HILL subcontractors shall control employee exposure to crystalline silica when exposures are at or above the ACGIH Threshold Limit Value (TLV) of 0.025 mg/m^3 by submitting for review and approval a crystalline silica exposure monitoring plan. The elements of an exposure monitoring plan include, but are not limited to the following:

- A bulk sample representative of the material to be demolished must be sent with the air monitoring sample media for analysis.
- Initial monitoring and personal air sampling must be conducted to determine the potential worker exposure to respirable crystalline silica.
- Real-time particulate monitors with a 10-micron respirable size fraction attachment may be used as part of the initial and ongoing monitoring plan to evaluate the potential worker exposure. This must include an action level established by their corporate or site health and safety professional and include actions required (for example, implement engineering, administrative controls, respiratory protection).

Other exposure control measures include the following :

- Maintaining surfaces as clean as practicable to minimize accumulation of crystalline silica-containing particulate material.
- Clean surfaces with a HEPA-filter vacuum or equivalent method.
- Implement dust suppression during tasks such as demolition, borehole grouting, and concrete coring.
- Restricting access to the work area where crystalline silica exposure may exist to only those authorized to perform work or enter the area.
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in these areas.
- Staff rotations to reduce exposures below the TWA.
- Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained from the competent person.

CH2M HILL personnel shall review the fact sheet included as an attachment to this SSHP.

9.5 Drilling Safety

(Reference CH2M HILL SOP HSE-204, *Drilling*)

The following are the hazard controls and safe work practices to follow when working around or performing drilling. Ensure the requirements in the referenced SOP are followed.

- The drill rig is not to be operated in inclement weather.
- The driller is to verify that the rig is properly leveled and stabilized before raising the mast.
- Personnel should be cleared from the sides and rear of the rig before the mast is raised.
- The driller is not to drive the rig with the mast in the raised position.
- The driller must check for overhead power lines before raising the mast. Maintain a minimum distance of 10 feet (3 meters) between mast and overhead lines (less than 50 kV) and an additional 0.4 inch for every 1 kV over 50 kV. Verify the voltage of nearby overhead power lines to determine the minimum distance.
- If the project site is suspected of munitions or explosives of concern (MEC) contamination, requirements of the *Explosives Usage and Munitions Response (MR)* SOP HSE-610 shall be followed. MECs include unexploded

ordnance (UXO), discarded military munitions, materials that present a potential explosive hazard, chemical warfare materials, munitions constituents, and contaminated soil or groundwater. Down-hole avoidance support may be required to prevent accidental contact with UXO. Safety requirements will be based on the risk assessment identified within the MR (safety) ORE.

- Personnel should stand clear before rig startup.
- The driller is to verify that the rig is in neutral when the operator is not at the controls.
- Become familiar with the hazards associated with the drilling method used (cable tool, air rotary, hollow-stem auger, etc.).
- Do not wear loose-fitting clothing, watches, etc., that could get caught in moving parts.
- Do not smoke or permit other spark-producing equipment around the drill rig.
- The drill rig must be equipped with a kill wire or switch, and personnel are to be informed of its location.
- Be aware and stand clear of heavy objects that are hoisted overhead.
- The driller is to verify that the rig is properly maintained in accordance with the drilling company's maintenance program.
- The driller is to verify that all machine guards are in place while the rig is in operation.
- The driller is responsible for housekeeping (maintaining a clean work area).
- The drill rig should be equipped with at least one fire extinguisher.
- If the drill rig comes into contact with electrical wires and becomes electrically energized, do not touch any part of the rig or any person in contact with the rig, and stay as far away as possible. Notify emergency personnel immediately.
- Use the drilling self-assessment checklist attached to this SSHP to evaluate drilling operations.

9.6 Drum and Portable Tank Handling

The following are the hazard controls and safe work practices to follow when overseeing the movement of drums or when handling drums:

- Ensure that personnel are trained in proper lifting and moving techniques to prevent back injuries.
- Ensure drum or tank bungs and lids are secured and are labeled prior to moving.
- Ensure that drums and tanks remain covered except when removing or adding material or waste. Covers and/or lids will be properly secured at the end of each workday.
- Provide equipment to keep the operator removed from the drums to lessen the likelihood of injury. Such equipment might include: a drum grappler attached to a hydraulic excavator; a small front-end loader, which can be either loaded manually or equipped with a bucket sling; a rough terrain forklift; Roller conveyor equipped with solid rollers; drum carts designed specifically for drum handling.
- Make sure the vehicle selected has sufficient rated load capacity to handle the anticipated loads, and make sure the vehicle can operate smoothly on the available road surface.
- Ensure there are appropriately designed Plexiglas cab shields on loaders, backhoes, etc., when handling drums containing potentially explosive materials.
- Equipment cabs should be supplied with fire extinguishers, and should be air-conditioned to increase operator efficiency.
- Supply operators with appropriate respiratory protective equipment when needed.

- Ensure that drums are secure and are not in the operator's view of the roadway.
- Prior to handling, all personnel should be warned about hazards of handling.
- Before moving anything, determine the most appropriate sequence in which the various drums, portable tanks, and other containers should be moved (for example small containers may have to be removed first to permit heavy equipment to enter and move the drums.
- Overpack drums and an adequate volume of absorbent should be kept near areas where minor spills may occur.
- Use containers or overpacks that are compatible with the waste or materials.
- Drums containing liquids or hazardous waste will be provided with secondary containment and may not be located near a storm water inlet or conveyance.
- Allow enough aisle space between drum pallets and between drums and other equipment that the drums can be easily accessed (at least 2 to 3 feet) by fire control equipment and similar equipment.
- Make sure that a spill kit is available in drum or tank storage areas (or where liquids are transferred from one vessel to another).

9.7 Drum Sampling Safety

Personnel are permitted to handle and/or sample drums containing certain types of waste (drilling waste, investigation-derived waste, and waste from known sources) only. Handling or sampling drums with unknown contents requires a plan revision or amendment approved by the RHSM. The following control measures will be taken when sampling drums:

- Minimize transportation of drums.
- Sample only labeled drums or drums from a known waste stream.
- Do not sample bulging or swollen drums. Contact the RHSM.
- If drums contain, or potentially contain, flammable materials, use non-sparking tools to open.
- Use the proper tools to open and seal drums.
- Reseal bung holes or plugs whenever possible.
- Avoid mixing incompatible drum contents;
- Sample drums without leaning over the drum opening.
- Transfer/sample the content of drums using a method that minimizes contact with material.
- Use the PPE and perform air monitoring as specified in the PPE and Site Monitoring sections of this SSHP.
- Take precautions to prevent contaminated media from contacting the floor or ground, such as having plastic under the sampling area, having a spill kit accessible during sampling activities.
- If transferring/sampling drums containing flammable or combustible liquids, drums and liquid transfer equipment should be grounded and bonded to reduce the potential of a static discharge.

9.8 Forklift Operations

(Reference CH2M HILL, SOP HSE-309, *Forklifts*)

The following are the hazard controls and safe work practices to follow when working around or operating forklifts. Ensure the requirements in the referenced SOP are followed.

- Forklift operators are prohibited from using any wireless device while operating forklifts.

- A rated lifting capacity must be posted in a location readily visible to the operator.
- A forklift truck must not be used to elevate employees unless a platform with guardrails, a back guard, and a kill switch is provided on the vehicle. When guardrails are not possible, fall arrest protection is required.
- The subcontractor operating the forklift must post and enforce a set of operating rules for forklift trucks.
- Only certified forklift operators shall operate forklifts.
- Stunt driving and horseplay are prohibited.
- Employees must not ride on the forks.
- Employees must never be permitted under the forks (unless forks are blocked).
- The driver must inspect the forklift once a shift and document this inspection.
- The operator must look in the direction of travel and must not move the vehicle until all persons are clear of the vehicle.
- Forks must be carried as low as possible.
- The operator must lower the forks, shut off the engine, and set the brakes (or block the wheels) before leaving the forklift operator's position unless maintenance or safety inspections require the forklift to be running.
- Trucks must be blocked and have brakes set when forklifts are driven onto their beds.
- Extreme care must be taken when tilting elevated loads.
- Every forklift must have operable brakes capable of safely stopping it when fully loaded.
- Forklifts must have parking brakes and an operable horn.
- When the operator is exposed to possible falling objects, industrial trucks must be equipped with overhead protection (canopy).
- If using certified CH2M HILL forklift operators—forklifts must be inspected and documented daily using the forklift inspection form.

9.9 Groundwater Sampling/Water Level Measurements

The following are the hazard controls and safe work practices to follow when personnel or subcontractors are performing groundwater sampling and/or water level measurements:

- Full coolers are heavy. Plan in advance to have two people available at the end of the sampling effort to load full coolers into vehicles. If two people won't be available use several smaller coolers instead of fewer large ones.
- Wear the appropriate PPE when sampling, including safety glasses, nitrile gloves, and steel-toe boots (see PPE section of this SSHP).
- Monitor headspace of wells prior to sampling to minimize any vapor inhalation (refer to the Site Monitoring section of this SSHP).
- Use caution when opening well lids. Wells may contain poisonous spiders and hornet or wasp nests.
- Use the appropriate lifting procedures (see CH2M HILL SOP HSE-112) when unloading equipment and sampling at each well.
- Avoid sharp edges on well casings.
- If dermal contact occurs with groundwater or the acid used in sample preservation, immediately wash all affected skin thoroughly with soap and water.

- Avoid eating and drinking onsite and during sampling.
- Use ear plugs during sampling if sampling involves a generator.
- Containerize all purge water and transport to the appropriate storage area.
- Use two people to transport full coolers/containers whenever possible. If two people are not available use a dolly to move coolers. If the coolers weigh more than 40 pounds Attachment 1 of the HSE-112, *Manual Lifting,* shall be completed by the SSHO. If the coolers weigh more than 50 pounds, they should never be lifted by one person.

9.10 Hand and Power Tools

(Reference CH2M HILL, SOP HSE-210, *Hand and Power Tools*)

The following are the hazard controls and safe work practices to follow when personnel or subcontractors are using hand and power tools. Ensure the requirements in the referenced SOP are followed:

- Tools shall be inspected prior to use and damaged tools will be tagged and removed from service.
- Hand tools will be used for their intended use and operated in accordance with manufacturer's instructions and design limitations.
- Maintain all hand and power tools in a safe condition.
- Use PPE (such as gloves, safety glasses, earplugs, and face shields) when exposed to a hazard from a tool.
- Do not carry or lower a power tool by its cord or hose.
- Portable power tools will be plugged into GFCI protected outlets.
- Portable power tools will be Underwriters Laboratories listed and have a three-wire grounded plug or be double insulated.
- Disconnect tools from energy sources when they are not in use, before servicing and cleaning them, and when changing accessories (such as blades, bits, and cutters).
- Safety guards on tools must remain installed while the tool is in use and must be promptly replaced after repair or maintenance has been performed.
- Store tools properly in a place where they will not be damaged or come in contact with hazardous materials.
- If a cordless tool is connected to its recharge unit, both pieces of equipment must conform strictly with electrical standards and manufacturer's specifications.
- Tools used in an explosive environment must be rated for work in that environment (that is, intrinsically safe, spark-proof, etc.).
- Working with manual and pistol-grip hand tools may involve highly repetitive movement, extended elevation, constrained postures, and/or awkward positioning of body members (for example, hand, wrist, arm, shoulder, neck, etc.). Consider alternative tool designs, improved posture, the selection of appropriate materials, changing work organization, and sequencing to prevent muscular, skeletal, repetitive motion, and cumulative trauma stressors.

9.10.1 Machine Guarding

- Ensure that all machine guards are in place to prevent contact with drive lines, belts, chains, pinch points, or any other sources of mechanical injury.
- Unplugging jammed equipment will only be performed when equipment has been shut down, all sources of energy have been isolated and equipment has been locked/tagged and tested.

- Maintenance and repair of equipment that results in the removal of guards or would otherwise put anyone at risk requires lockout of that equipment prior to work.

9.11 Lockout/Tagout Activities and Hazardous Energy Control Program

(Reference EM 385-1-1 Section 12.A.07 and CH2M HILL SOP HSE-310, *Lockout and Tagout*)

Lockout/tagout shall be performed whenever service or maintenance is necessary on equipment that could cause injury to personnel from the unexpected equipment energizing or start-up or unexpected release of stored energy. Energy sources requiring lockout/tagout may include electrical, pneumatic, kinetic, and potential.

If work on energized electrical systems is necessary—contact the RHSM. Specific training and procedures are required to be followed before any work on energized electrical systems can be performed and are NOT covered in this section. Energized electrical work is defined as work performed **on or near** energized electrical systems or equipment with exposed components operating at 50 volts or greater. Working near energized live parts is any activity inside a Limited Approach Boundary (anywhere from 3.5 feet to 24 feet [1 meter 7.3 meters] depending on voltage). Examples of energized electrical work include using a voltmeter to troubleshoot electrical systems and changing out controllers.

When lockout/tagout is necessary to perform maintenance/repair of a system, all the requirements of SOP HSE-310, Lockout and Tagout, shall be met including the following:

- When CH2M HILL controls the work, CH2M HILL must verify that subcontractors affected by the unexpected operation of equipment develop a written lockout/tagout program, provide training on lockout/tagout procedures and coordinate its program with other affected subcontractors. This may include compliance with the owner or facility lockout/tagout program.
- When CH2M HILL personnel are affected by the unexpected operation of equipment they must complete the electrical safety awareness module on the VO. Authorized personnel shall inform the affected personnel of the lockout/tagout. Affected personnel shall not tamper with lockout/tagout devices.
- Standard lockout/tagout procedures include the following six steps: (1) notify all personnel in the affected area of the lockout/tagout, (2) shut down the equipment using normal operating controls, (3) isolate all energy sources, (4) apply individual lock and tag to each energy isolating device, (5) relieve or restrain all potentially hazardous stored or residual energy, and (6) verify that isolation and de-energization of the equipment has been accomplished. Once verified that the equipment is at the zero energy state, work may begin.
- All safe guards must be put back in place, all affected personnel notified that lockout has been removed and controls positioned in the safe mode prior to lockout removal. Only the individual who applied the lock and tag may remove them.
- CH2M HILL authorized employees shall complete the lockout/tagout training module on the Virtual Office and either the electrical safety training module on the Virtual Office or 10-hour construction training. The authorized employee must also be trained and qualified on the system they are working on (for example, qualified electrician for working on electrical components of a system).
- When equipment-specific lockout/tagout procedures are not available or when existing procedures are determined to be insufficient, CH2M HILL authorized employees shall also complete the Equipment-Specific Lockout/Tagout Procedure Development Form, provided as an attachment to this SSHP, to create an equipment-specific lockout/tagout procedure.

9.12 Methane (as a Product of Injection Activities)

Methane is a colorless, odorless gas with a wide distribution in nature. Methane is created when organic matter decomposes (rots) without any oxygen present ("anaerobic" decomposition) and is common in landfills, marshes, septic systems, and sewers.

Methane may be produced as a by-product of the biological process when biological additives are used in a remediation process (such as when emulsified oil is injected to enhance dechlorination of contaminated groundwater).

Experience has shown that methane may be present in the well space following the injection of emulsified oil, once the biological process has had time to progress. This needs to be considered when returning to collect ground water samples. Although methane degrades Engineering controls shall be considered to bring the concentrations of methane down to an acceptable level in the breathing zone.

Methane is a "simple asphyxiant," which means that it can displace available oxygen. Methane is combustible and mixtures of methane with air are explosive within the range 5 to 15 percent by volume of methane (the lower and upper explosive limits). At room temperature, methane is lighter than air, so in an outdoor environment, it tends to dissipate.

Methane is not toxic when inhaled, but it can produce suffocation by reducing the concentration of oxygen inhaled. When exposed to concentrations high enough to displace oxygen, you may experience dizziness, deeper breathing, possible nausea, and eventual unconsciousness.

The primary danger is from fire and explosion, so ensure that you work in a well-ventilated area, and that there is no source of ignition present. Use spark-proof tools and intrinsically safe equipment, if necessary. If working in a confined space, make sure that appropriate controls are in place and follow an approved permit-required confined space entry plan.

9.13 Portable Generator Hazards

(Reference CH2M HILL SOP HSE-206, Electrical Safety)

- Portable generators are useful when temporary or remote electric power is needed, but they also can be hazardous. The primary hazards to avoid when using a generator are carbon monoxide (CO) poisoning from the toxic engine exhaust, electric shock or electrocution, and fire.
- NEVER use a generator indoors or in similar enclosed or partially-enclosed spaces. Generators can produce high levels of CO very quickly. When you use a portable generator, remember that you cannot smell or see CO. Even if you can't smell exhaust fumes, you may still be exposed to CO.
- If you start to feel sick, dizzy, or weak while using a generator, get to fresh air RIGHT AWAY. DO NOT DELAY. The CO from generators can rapidly lead to full incapacitation and death.
- If you experience serious symptoms, get medical attention immediately. Inform project staff that CO poisoning is suspected. If you experienced symptoms while indoors have someone call the fire department to determine when it is safe to re-enter the building.
- Follow the instructions that come with your generator. Locate the unit outdoors and away from doors, windows, and vents that could allow CO to come indoors.
- Ensure the generator is grounded in accordance with the manufacturer's operation manual.
- Keep the generator dry and do not use in rain or wet conditions. To protect from moisture, operate it on a dry surface under an open, canopy-like structure. Dry your hands if wet before touching the generator.
- Plug appliances directly into the generator. Or, use a heavy duty, outdoor-rated extension cord that is rated (in watts or amps) at least equal to the sum of the connected appliance loads. Check that the entire cord is free of cuts or tears and that the plug has all three prongs, especially a grounding pin.

- Most generators come with GFCI. Test the GFCIs daily to determine whether they are working.
- If the generator is not equipped with GFCI protected circuits plug a portable GFCI into the generator and plug appliances, tools, and lights into the portable GFCI.
- Never store fuel near the generator or near any sources of ignition.
- Before refueling the generator, turn it off and let it cool down. Gasoline spilled on hot engine parts could ignite.

9.14 Pressure Line/Vessel Systems

- Operate and maintain pressure vessels, pumps and hosing in accordance with the manufacturer's recommendations.
- Do not exceed the rated pressure of the vessels and hosing of the system.
- The system must be provided with a pressure relief valve/controller that safely reduces the system pressure to within the system rated pressure.
- The pressure relief valve must be rated at no more than 110 percent the rated pressure of the system and must be tested at regular intervals.
- Each vessel must be equipped with a functioning pressure gauge to monitor pressure.

9.15 Pressure Washing Operations

The following are the hazard controls and safe work practices to follow when working around or performing pressure washing:

- Only trained, authorized personnel may operate the high-pressure washer.
- Follow manufacturer's safety and operating instructions.
- Inspect pressure washer before use and confirm deadman trigger is fully operational
- The wand must always be pointed at the work area.
- The trigger should never be tied down
- Never point the wand at yourself or another worker.
- The wand must be at least 42 inches (1.1 meter) from the trigger to the tip and utilize greater than 10-degree tips.
- The operator must maintain good footing.
- Non-operators must remain a safe distance from the operator.
- No unauthorized attachment may be made to the unit.
- Do not modify the wand.
- All leaks or malfunctioning equipment must be repaired immediately or the unit taken out-of-service.
- Polycoated Tyvek or equivalent, 16-inch-high steel-toed rubber boots, safety glasses, hard hat with face shield, and inner and outer nitrile gloves will be worn, at a minimum.

9.16 Slips, Trips and Falls

9.16.1 General

- Institute and maintain good housekeeping practices.
- Designate foot traffic paths in and out of sites, when necessary, to ensure paths are kept free from slip, trip, and fall hazards or to deter personnel from taking "shortcuts" where slip, trip, hazards may be.
- Mitigate icy conditions by keeping foot traffic paths clear of ice and snow.
- Watch footing as you walk to avoid trip hazards, animal holes, or other obstacles, especially in tall grassy areas.

9.16.2 Muddy Conditions

- Muddy conditions present a slipping hazard. Use mats or other similar surface to work from if footing cannot be stabilized.
- Take shortened steps across muddy areas.
- Use a walking staff or other similar means to assist with balance.

9.16.3 Steep Slopes/Uneven Ground/Rock and Vertical Slopes

- Be aware that escarpments can slough. Avoid these areas.
- Exercise caution in relying on rocks and trees/tree stumps to support yourself—many times they are loose.
- Whenever possible, switchback your way up/down steep areas, and maintain a slow pace with firm footing.
- Employees walking in ditches, swales and other drainage structures adjacent to roads or across undeveloped land must use caution to prevent slips and falls which can result in twisted or sprained ankles, knees, and backs.
- Whenever possible observe the conditions from a flat surface and do not enter a steep ditch or side of a steep road bed.
- If steep terrain must be negotiated coordinate with RHSM to evaluate the need for ladders or ropes to provide stability.

9.17 Traffic Control

(Reference CH2M HILL SOP HSE-216, *Traffic Control*)

The following precautions must be taken when working around traffic, and in or near an area where traffic controls have been established by a sub contractor. Ensure the requirements in the referenced SOP are followed.

- Exercise caution when exiting traveled way or parking along street—avoid sudden stops, use flashers, etc.
- Park in a manner that will allow for safe exit from vehicle, and where practicable, park vehicle so that it can serve as a barrier.
- All staff working adjacent to traveled way or within work area must wear reflective/high-visibility safety vests.
- Eye protection should be worn to protect from flying debris.
- Remain aware of factors that influence traffic related hazards and required controls—sun glare, rain, wind, flash flooding, limited sight-distance, hills, curves, guardrails, width of shoulder (that is, breakdown lane), etc.
- Always remain aware of an escape route (for example, behind an established barrier, parked vehicle, guardrail, etc).
- Always pay attention to moving traffic—never assume drivers are looking out for you.
- Work as far from traveled way as possible to avoid creating confusion for drivers.
- When workers must face away from traffic, a “buddy system” should be used, where one worker is looking towards traffic.
- When working on highway projects, obtain a copy of the contractor’s traffic control plan.
- Work area should be protected by a physical barrier—such as a K-rail or Jersey barrier.
- Review traffic control devices to ensure that they are adequate to protect your work area. Traffic control devices should: (1) convey a clear meaning, (2) command respect of road users, and (3) give adequate time for proper traffic response. The adequacy of these devices are dependent on limited sight distance, proximity to ramps or intersections, restrictive width, duration of job, and traffic volume, speed, and proximity.

- Either a barrier or shadow vehicle should be positioned a considerable distance ahead of the work area. The vehicle should be equipped with a flashing arrow sign and truck-mounted crash cushion (TMCC). All vehicles within 40 feet (12.2 meters) of traffic should have an orange flashing hazard light atop the vehicle.
- Except on highways, flaggers should be used when (1) two-way traffic is reduced to using one common lane, (2) driver visibility is impaired or limited, (3) project vehicles enter or exit traffic in an unexpected manner, or (4) the use of a flagger enhances established traffic warning systems.
- Lookouts should be used when physical barriers are not available or practical. The lookout continually watches approaching traffic for signs of erratic driver behavior and warns workers.
- Vehicles should be parked at least 40 feet (12.2 meters) away from the work zone and traffic. Minimize the amount of time that you will have your back to oncoming traffic.
- Traffic control training module on the VO shall be completed when CH2M HILL workers who work in and around roadways and who exposed to public vehicular traffic.

9.18 Utilities (underground)

An assessment for underground utilities must be conducted where there is a potential to contact underground utilities or similar subsurface obstructions during intrusive activities. Intrusive activities include excavation, trenching, drilling, hand augering, soil sampling, or similar activities.

The assessment must be conducted <u>before any intrusive subsurface activity</u> and must include at least the following elements:

1. A background and records assessment of known utilities or other subsurface obstructions.
2. Contacting and using the designated local utility locating service.
3. Conducting an independent field survey to identify, locate, and mark potential underground utilities or subsurface obstructions. *Note: This is independent of, and in addition to, any utility survey conducted by the designated local utility locating service above.*
4. A visual survey of the area to validate the chosen location.

When any of these steps identifies an underground utility within 5 feet (1.5 meters) of intrusive work, then non-aggressive means must be used to physically locate the utility before a drill rig, backhoe, excavator or other aggressive method is used.

Aggressive methods are never allowed within 2 feet of an identified high-risk utility (see paragraph below).

Any deviation from these requirements must be approved by the RHSM and the PM.

9.18.1 Background and Records Assessment of Known Utilities

Identify any client- or location-specific permit and/or procedural requirements (for example, dig permit or intrusive work permit) for subsurface activities. For military installations, contact the Base Civil Engineer and obtain the appropriate form to begin the clearance process.

Obtain available utility diagrams and/or as-built drawings for the facility.

Review locations of possible subsurface utilities including sanitary and storm sewers, electrical lines, water supply lines, natural gas lines, fuel tanks and lines, communication lines, lighting protection systems, etc. Note: Use caution in relying on as-built drawings as they are rarely 100 percent accurate.

Request that a facility contact with knowledge of utility locations review and approve proposed locations of intrusive work.

9.18.2 Designated Local Utility Locating Service

Contact your designated local utility locating service (for example, Dig-Safe, Blue Stake, One Call) to identify and mark the location of utilities. Call 811 in the US or go to www.call811.com to identify the appropriate local service group. Contacting the local utility locating service is a legal requirement in most jurisdictions.

9.18.3 Independent Field Survey (Utility Locate)

The organization conducting the intrusive work (CH2M HILL or subcontractor) shall arrange for an independent field survey to identify, locate, and mark any potential subsurface utilities in the work area. This survey is in addition to any utility survey conducted by the designated local utility-locating service.

The independent field survey provider shall determine the most appropriate instrumentation/technique or combinations of instrumentation/techniques to identify subsurface utilities based on their experience and expertise, types of utilities anticipated to be present, and specific site conditions.

A CH2M HILL or subcontractor representative must be present during the independent field survey to observe the utility locate and verify that the work area and utilities have been properly identified and marked. If there is any question that the survey was not performed adequately or the individual was not qualified, then arrangements must be made to obtain a qualified utility locate service to re-survey the area. Obtain documentation of the survey and clearances in writing and signed by the party conducting the clearance. Maintain all documentation in the project file.

If the site owner (military installation or client) can provide the independent field survey, CH2M HILL or the subcontractor shall ensure that the survey includes:

- Physically walking the area to verify the work location and identify, locate, and mark underground utility locations.
- Having qualified staff available and instrumentation to conduct the locate.
- Agreeing to document the survey and clearances in writing.
- Should any of the above criteria not be met, CH2M HILL or subcontractor must arrange for an alternate independent utility locate service to perform the survey.
- The markings from utility surveys must be protected and preserved until the markings are no longer required. If the utility location markings are destroyed or removed before intrusive work commences or is completed, the PM, SC, or designee must notify the independent utility locate service or the designated local utility locating service to resurvey and remark the area.

9.18.4 Visual Assessment before and during Intrusive Activities

Perform a “360 degree” assessment. Walk the area and inspect for utility-related items such as valve caps, previous linear cuts, patchwork in pavement, hydrants, manholes, utility vaults, drains, and vent risers in and around the dig area.

The visual survey shall include all surface landmarks, including manholes, previous liner cuts, patchwork in pavement, pad-mounted transformers, utility poles with risers, storm sewer drains, utility vaults, and fire hydrants.

If any unanticipated items are found, conduct further research before initiating intrusive activities and implement any actions needed to avoid striking the utility or obstruction.

9.18.5 Subsurface Activities within 5 feet of an Underground Utility or if there is Uncertainty

When aggressive intrusive activities will be conducted within 5 feet (1.5 meters) of an underground utility or when there is uncertainty about utility locations, locations must be physically verified by non-aggressive means such as air or water knifing, hand digging, or human powered hand augering. Non-conductive tools must be used if electrical hazards may be present. If intrusive activities are within 5 feet (1.5 meters) and parallel to a marked existing utility, the utility location must be exposed and verified by non-aggressive methods every 100 feet (30.5 meters). Check to see if the utility can be isolated during intrusive work.

9.18.5.1 Intrusive Activities within 2 feet of an Underground Utility

Use non-aggressive methods (hand digging, vacuum excavation, etc.) to perform intrusive activities within 2 feet of a high-risk utility (that is, a utility that cannot be de-energized or would cause significant impacts to repair/replace). Hazardous utilities shall be de-energized whenever possible.

9.18.6 Spotter

A spotter shall be used to monitor for signs of utilities during advancement of intrusive work (for example, sudden change in advancement of auger or split spoon, presence of pea gravel or sand in soils, presence of concrete or other debris in soils, refusal of auger or excavating equipment). If any suspicious conditions are encountered, stop work immediately and contact the PM or RHSM to evaluate the situation. The spotter must have a method to alert an operator to stop the intrusive activity (for example, air horn, hand signals).

9.19 Utilities (overhead)

9.19.1 Proximity to Power Lines

It must be determined whether equipment operations including, positioning, and traveling will occur in proximity to power lines within 20 feet (6.1 meters) for line voltage up to 350 kV, and within 50 feet (15.2 meters) for line voltage between 350 kV to 1,000 kV. For power lines over 1,000 kV, the distance must be determined by the utility/operator or qualified registered professional engineer in electrical power transmission and distribution.

Operations adjacent to overhead power lines are PROHIBITED unless one of the following conditions is satisfied:

- Power has been shut off, positive means (such as lockout) have been taken to prevent the lines from being energized, lines have been tested to confirm the outage, and the utility company has provided a signed certification of the outage.
- The minimum clearance from energized overhead lines is as shown in the table below, or the equipment will be repositioned and blocked to ensure that no part, including cables, can come within the minimum clearances shown in the table.

Minimum Distances from Powerlines

Powerlines Nominal System Kv	Minimum Required Distance, Feet (Meters)
0-50	10 (3.0)
50-200	15 (4.6)
201-350	20 (6.1)
351-500	25 (7.6)
501-750	35 (10.7)
751-1000	45 (13.7)
Over 1000	Established by utility owner/operator or by a professional engineer in electrical power transmission/distribution

(These distances have been determined to eliminate the potential for arcing based on the line voltage.)

- The power line(s) has been isolated through the use of insulating blankets which have been properly placed by the utility. If insulating blankets are used, the utility will determine the minimum safe operating distance; get this determination in writing with the utility representative's signature.
- All inquiries regarding electric utilities must be made in writing and a written confirmation of the outage/isolation must be received by the PM prior to the start of work.

SECTION 10

Physical Hazards and Controls

Physical hazards include exposure to temperature extremes, sun, noise, and radiation. If you encounter a physical hazard that has not been identified in this plan, contact the RHSM so that a revision to this plan can be made.

10.1 Contingency Plan for Severe Weather

10.1.1 Inclement Weather

- Work may proceed in light rain—wear rain gear. However, no roof work can proceed during any storm event.
- Exposure to slips, trips, and falls is increased during rainy conditions.
- Take cover in a sheltered location during adverse weather conditions (high winds, heavy rain).
- Work shall cease and cover shall be taken in the event of lightning or tornado warnings.
- Identify "Take Shelter" areas before starting the project.
- Notify the PM and Client representative after shelter has been sought.

Adverse weather conditions requiring immediate suspension of fieldwork activities are defined as the following:

- Thunder or lightning. Thunderstorm watches or warning, as the situation warrants, will be used as an alert to potential electrical activity. Typically, a 30-minute stand-down occurs to allow the storm cell to pass the area. If lightning or thunder is observed within the stand down period, the 30-minute timeframe is extended until electrical activity ceases.
- Sustained wind gusts of 25 miles per hour for boating activities.
- Sustained wind speeds of 25miles per hour or wind gusts of 35 miles per hour for high-profile work where wind chill is not a factor, that is, greater than 60°F .
- Sustained wind speeds of 40 miles per hour or wind gusts of 45 miles per hour for non-high-profile work.
- Moderate rain and/or snow fall of 0.11 to 0.3 inch per hour during hoisting activities. Freezing rain is also cause for suspending hoist use.
- An equivalent wind chill factor of minus 24°F on the wind chill factor chart (see Section 10.4.2) will trigger systematic shut down of all non-emergency work activities.
- A tornado or hurricane warning for the general area or county will suffice in requiring a general work stoppage.
- If you are inadvertently caught outside in a thunder/lightning storm, move away from all metal structures.

10.2 Noise

(Reference CH2M HILL SOP HSE-108, *Hearing Conservation*)

CH2M HILL is required to control employee exposure to occupational noise levels of 85 decibels (dBA), A-weighted, and above by implementing a hearing conservation program that meets the requirements of the OSHA Occupational Noise Exposure standard, 29 CFR 1910.95. A noise assessment may be conducted by the RHSM or designee based on potential to emit noise above 85 dBA and also considering the frequency and duration of the task.

- Areas or equipment emitting noise at or above 90 dBA shall be evaluated to determine feasible engineering controls. When engineering controls are not feasible, administrative controls can be developed and appropriate hearing protection will be provided.
- Areas or equipment emitting noise levels at or above 85 dBA, hearing protection must be worn.

- Employees exposed to 85 dBA or a noise dose of 50 percent must participate in the hearing conservation program including initial and annual (as required) audiograms.
- The RHSM will evaluate appropriate controls measures and work practices for employees who have experienced a standard threshold shift in their hearing.
- Employees who are exposed at or above the action level of 85 dBA are required to complete the online Noise Training Module located on CH2M HILL's Virtual Office.
- Hearing protection will be maintained in a clean and reliable condition, inspected prior to use and after any occurrence to identify any deterioration or damage, and damaged or deteriorated hearing protection repaired or discarded.
- In work areas where actual or potential high noise levels are present at any time, hearing protection must be worn by employees working or walking through the area.
- Areas where tasks requiring hearing protection are taking place may become hearing protection required areas as long as that specific task is taking place.
- High noise areas requiring hearing protection should be posted or employees must be informed of the requirements in an equivalent manner and a copy of the OSHA standard 29 CFR 1910.95 shall be posted in the workplace.

10.3 Ultraviolet Radiation (sun exposure)

Health effects regarding ultraviolet (UV) radiation are confined to the skin and eyes. Overexposure can result in many skin conditions, including erythema (redness or sunburn), photoallergy (skin rash), phototoxicity (extreme sunburn acquired during short exposures to UV radiation while on certain medications), premature skin aging, and numerous types of skin cancer. Implement the following controls to avoid sunburn.

10.3.1 Limit Exposure Time

- Rotate staff so the same personnel are not exposed all of the time.
- Limit exposure time when UV radiation is at peak levels (approximately 2 hours before and after the sun is at its highest point in the sky).
- Avoid exposure to the sun, or take extra precautions when the UV index rating is high.

10.3.2 Provide Shade

- Take lunch and breaks in shaded areas.
- Create shade or shelter through the use of umbrellas, tents, and canopies.
- Fabrics such as canvas, sailcloth, awning material and synthetic shade cloth create good UV radiation protection.
- Check the UV protection of the materials before buying them. Seek protection levels of 95 percent or greater, and check the protection levels for different colors.

10.3.3 Clothing

- Reduce UV radiation damage by wearing proper clothing; for example, long sleeved shirts with collars, and long pants. The fabric should be closely woven and should not let light through.
- Head protection should be worn to protect the face, ears, and neck. Wide-brimmed hats with a neck flap or "Foreign Legion" style caps offer added protection.
- Wear UV-protective sunglasses or safety glasses. These should fit closely to the face. Wrap-around style glasses provide the best protection.

10.3.4 Sunscreen

- Apply sunscreen generously to all exposed skin surfaces at least 20 minutes before exposure, allowing time for it to adhere to the skin.
- Re-apply sunscreen at least every 2 hours, and more frequently when sweating or performing activities where sunscreen may be wiped off.
- Choose a sunscreen with a high sun protection factor. Most dermatologists advocate sun protection factor 30 or higher for significant sun exposure.
- Waterproof sunscreens should be selected for use in or near water, and by those who perspire sufficiently to wash off non-waterproof products.
- Check for expiration dates, because most sunscreens are only good for about 3 years. Store in a cool place out of the sun.
- No sunscreen provides 100 percent protection against UV radiation. Other precautions must be taken to avoid overexposure.

10.4 Temperature Extremes

(Reference CH2M HILL SOP HSE-211, *Heat and Cold Stress*)

Each employee is responsible for the following:

- Recognizing the symptoms of heat or cold stress.
- Taking appropriate precautionary measures to minimize their risk of exposure to temperature extremes (see following sections).
- Communicating any concerns regarding heat and cold stress to their supervisor or SC.

10.4.1 Heat

Heat-related illnesses are caused by more than just temperature and humidity factors.

Physical fitness influences a person's ability to perform work under heat loads. At a given level of work, the more fit a person is, the less the physiological strain, the lower the heart rate, the lower the body temperature (indicates less retrained body heat—a rise in internal temperature precipitates heat injury), and the more efficient the sweating mechanism.

Acclimatization is a gradual physiological adaptation that improves an individual's ability to tolerate heat stress. Acclimatization requires physical activity under heat-stress conditions similar to those anticipated for the work. With a recent history of heat-stress exposures of at least 2 continuous hours per day for 5 of the last 7 days to 10 of the last 14 days, a worker can be considered acclimatized. Its loss begins when the activity under those heat-stress conditions is discontinued, and a noticeable loss occurs after 4 days and may be completely lost in 3 to 4 weeks. Because acclimatization is to the level of the heat-stress exposure, a person will not be fully acclimatized to a sudden higher level, such as during a heat wave.

Dehydration reduces body water volume. This reduces the body's sweating capacity and directly affects its ability to dissipate excess heat.

The ability of a body to dissipate heat depends on the ratio of its surface area to its mass (surface area/weight). **Heat dissipation** is a function of surface area, while heat production depends on body mass. Therefore, overweight individuals (those with a low ratio) are more susceptible to heat-related illnesses because they produce more heat per unit of surface area than if they were thinner. Monitor these persons carefully if heat stress is likely.

When wearing **impermeable clothing**, the weight of an individual is not as important in determining the ability to dissipate excess heat because the primary heat dissipation mechanism, evaporation of sweat, is ineffective.

Symptoms and Treatment Of Heat Stress

	Heat Syncope	Heat Rash	Heat Cramps	Heat Exhaustion	Heat Stroke
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure.	Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours.	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure; oral temperature normal or low.	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature of 104°F or higher.
Treatment	Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.	Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.	Remove to cooler area. Rest lying down. Increase fluid intake.	Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.	Cool rapidly by soaking in cool–but not cold–water. Call ambulance, and get medical attention immediately!

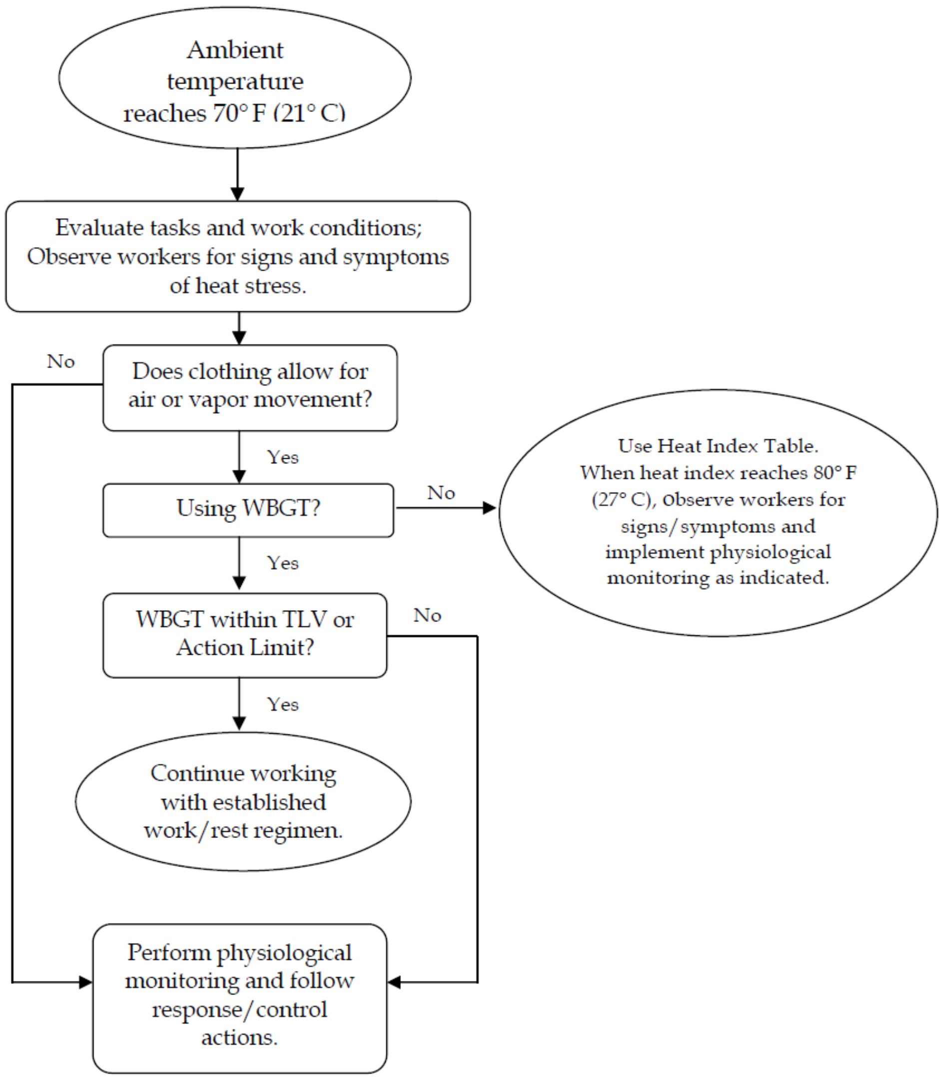
10.4.2 Precautions

- Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50°F (10 degrees Celsius) to 60°F (15.6 degrees Celsius) should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons (7.5 liters) per day. Remind employees to drink water throughout their work shift.
- Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.
- Acclimate to site work conditions by slowly increasing workloads; for example, do not begin site work with extremely demanding activities. Closely monitor employees during their first 14 days of work in the field.
- Supervisors and SCs must continually observe employees throughout the work shift for signs and symptoms of heat stress or illness. Employees must monitor themselves for heat stress as well as observe their coworkers.
- Effective communication must be maintained with employees throughout the work shift either by voice, observation, or electronic device.
- Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency.
- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.
- Avoid direct sun whenever possible, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods.
- Provide adequate shade to protect personnel against radiant heat (sun, flames, hot metal).
- Use portable fans for convection cooling or in extreme heat conditions, an air-conditioned rest area when needed.
- In hot weather, rotate shifts of workers.
- Maintain good hygiene standards by frequent changes of clothing and showering. Clothing should be permitted to dry during rest periods. Persons who notice skin problems should consult medical personnel.

- Brief employees initially before the project work begins and routinely as part of the daily safety briefing, on the signs and symptoms, of heat-relatedness illnesses, precautions to measures and emergency procedures to follow as described in this plan.
- Observe one another for signs of heat stress. PREVENTION and communication are key.

10.4.3 Thermal Stress Monitoring

Thermal Stress Monitoring Flow Chart



10.4.4 Thermal Stress Monitoring—Permeable or Impermeable Clothing

When **permeable work clothes** are worn (street clothes or clothing ensembles over street clothes), regularly observe workers for signs and symptoms of heat stress and implement physiological monitoring as indicated below. This should start when the heat index reaches 80°F (27 degrees Celsius) [see Heat Index Table below], or sooner if workers exhibit symptoms of heat stress indicated in the table above. The heat index values were devised for shady, light wind conditions; exposure to full sunshine can increase the values by up to 15°F (8 degrees Celsius). Also, strong winds, particularly with very hot, dry air, can be extremely hazardous.

When wearing **impermeable clothing** (for example, clothing doesn't allow for air or water vapor movement such as Tyvek), physiological monitoring as described below shall be conducted when the ambient temperature reaches 70°F (21 degrees Celsius) or sooner when climatic conditions may present greater risk of heat stress combined with wearing unique variations of impermeable clothing, or workers exhibit symptoms of heat stress.

Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	126	130					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Streuous Activity

Caution Extreme Caution Danger Extreme Danger

Heat Index	Possible Heat Disorders	Minimum Frequency of Physiological Monitoring
80°F - 90°F (27°C - 32°C)	Fatigue possible with prolonged exposure and/or physical activity	Conduct initial monitoring as baseline and observe workers for signs of heat stress and implement physiological monitoring if warranted.
90°F - 105°F (32°C - 41°C)	Sunstroke, heat cramps, or heat exhaustion possible with prolonged exposure and/or physical activity	Conduct initial monitoring as baseline, then at least every hour, or sooner, if signs of heat stress are observed.
105°F - 130°F (41°C - 54°C)	Sunstroke, heat cramps, or heat exhaustion likely, and heat stroke possible with prolonged exposure and/or physical activity.	Conduct initial monitoring as baseline, then every 30 minutes or sooner if signs of heat stress are observed.
130°F or Higher (54°C or Higher)	Heat/Sunstroke highly likely with continued exposure.	Conduct initial monitoring as baseline, then every 15 minutes or sooner if signs of heat stress are observed.
Source: National Weather Service		

10.4.4.1 Physiological Monitoring and Associated Actions

For employees wearing permeable clothing, follow the minimum frequency of physiological monitoring listed in the Heat Index Table.

For employees wearing impermeable clothing, physiological monitoring should begin initially at a 15-minute interval, then if the employee's heart rate or body temperature is within acceptable limits, conduct the subsequent physiological monitoring at 30 minutes, and follow the established regimen protocol below.

When physiological monitoring is required, use either radial pulse or aural temperature and follow actions below:

- The sustained heart rate during the work cycle should remain below 180 beats per minute (bpm) minus the individual's age (for example 180 – 35 year old person = 145 bpm). The sustained heart rate can be estimated by measuring the heart rate at the radial pulse for 30 seconds as quickly as possible prior to starting the rest period.
- The heart rate after one minute rest period should not exceed 120 bpm.
- If the heart rate is higher than 120 bpm after the FIRST minute into the rest period, the next work period should be shortened by 33 percent, while the length of the rest period stays the same.
- If the pulse rate still exceeds 120 bpm at the beginning of the next rest period, the following work cycle should be further shortened by 33 percent.
- Continue this procedure until the rate is maintained below 120 bpm after the FIRST minute into the rest period.

Alternately, the body temperature can be measured, either oral or aural (ear), before the workers have something to drink.

- If the oral or aural temperature exceeds 99.6°F (37.6 degrees Celsius) at the beginning of the rest period, the following work cycle should be shortened by 33 percent.
- Continue this procedure until the oral or aural (ear) temperature is maintained below 99.6°F (37.6 degrees Celsius). While an accurate indication of heat stress, oral temperature is difficult to measure in the field; however, a digital aural (aural) thermometer is easy to obtain and inexpensive to purchase.
- Use the form attached to this HSP to track workers' measurements and actions taken.

10.4.4.2 Procedures for when Heat Illness Symptoms are Experienced

- **Always** contact the RHSM when any heat illness related symptom is experienced so that controls can be evaluated and modified, if needed.
- In the case of cramps, reduce activity, increase fluid intake, move to shade until recovered.
- In the case of all other heat-related symptoms (fainting, heat rash, heat exhaustion), and if the worker is a CH2M HILL worker, contact the occupational physician at 1-866-893-2514 and immediate supervisor.
- In the case of heat stroke symptoms, call 911, have a designee give location and directions to ambulance service if needed, follow precautions under the emergency medical treatment of this HSP.
- Follow the Incident Notification, Reporting, and Investigation section of this HSP.

10.4.5 Cold

10.4.5.1 General

Low ambient temperatures increase the heat lost from the body to the environment by radiation and convection. In cases where the worker is standing on frozen ground, the heat loss is also due to conduction.

Wet skin and clothing, whether because of water or perspiration, may conduct heat away from the body through evaporative heat loss and conduction. Thus, the body cools suddenly when chemical protective clothing is removed if the clothing underneath is perspiration-soaked.

Movement of air across the skin reduces the insulating layer of still air just at the skin's surface. Reducing the insulating layer of air increases heat loss by convection.

Non-insulating materials in contact or near-contact with the skin, such as boots constructed with a metal toe or shank, conduct heat rapidly away from the body.

Certain common drugs, such as alcohol, caffeine, or nicotine, may exacerbate the effects of cold, especially on the extremities. The chemicals reduce the blood flow to peripheral parts of the body, which are already high-risk areas because of their large surface area to volume ratios. These substances may also aggravate an already hypothermic condition.

10.4.5.2 Precautions

- Be aware of the symptoms of cold-related disorders, and wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in wet weather.
- Consider monitoring the work conditions and adjusting the work schedule using guidelines developed by the U.S. Army (wind-chill index) and the National Safety Council.
- Wind-Chill Index (below) is used to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For those reasons, it should only be used as a guideline to warn workers when they are in a situation that can cause cold-related illnesses.
- Persons who experience initial signs of immersion foot, frostbite, and/or hypothermia should report it immediately to their supervisor/PM to avoid progression of cold-related illness.
- Observe one another for initial signs of cold-related disorders.
- Obtain and review weather forecast – be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation.

Symptoms and Treatment Of Cold Stress

	Immersion (Trench) Foot	Frostbite	Hypothermia
Signs and Symptoms	Feet discolored and painful; infection and swelling present.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Treatment	Seek medical treatment immediately.	Remove victim to a warm place. Re-warm area quickly in warm—but **not** hot—water. Have victim drink warm fluids, but **not** coffee or alcohol. Do not break blisters. Elevate the injured area, and get medical attention.	Remove victim to a warm place. Have victim drink warm fluids, but **not** coffee or alcohol. Get medical attention.

Wind Chill Chart

Temperature (°F)

Wind (mph)	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes; 10 minutes; 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

10.5 Radiological Hazards

Refer to CH2M HILL's Core Standard, Radiological Control and Radiological Controls Manual for additional requirements.

Hazards	Controls
None Known	None Required

SECTION 11
Biological Hazards and Controls

Biological hazards are everywhere and change with the region and season. During project planning stages, ask the site Point of Contact if there are insect or other biological hazards that have been noted at any of the work sites.

If you encounter a biological hazard that has not been identified in this plan, contact the RHSM so that a revision to this plan can be made. Whether it is contact with a poisonous plant, a poisonous snake, or a bug bite, do not take bites or stings lightly. If there is a chance of an allergic reaction or infection, or to seek medical advice on how to properly care for the injury, contact the occupational nurse at 1-866-893-2514.

11.1 Bees and Other Stinging Insects

Bees and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic.

Precautions include the following:

- Watch for and avoid nests.
- Keep exposed skin to a minimum.
- Carry a kit if you have had allergic reactions in the past, and inform your supervisor and/or a buddy. When working at a remote location, ensure that first-aid kits contain over-the-counter allergy and itch medication (for example, Benadryl, Claritin, etc.) as well as other over-the-counter medications that may not be available to aid in symptom treatment.
- If bees or other stinging insects are known to be present, determine whether additional protective clothing should be donned before entering/working in brushy areas.
- Before entering a heavily vegetated or brushy area, observe the area for several minutes to see if bees or other stinging insects may be present. If nests or individual insects are observed, retreat and inquire whether a specialist or a client service can be contacted to clear the area before work proceeds.
- Consider if heavy-weight clothing or Tyvek, or head netting would provide additional protection in areas where wasps/bees are known or suspected. Be aware of heat stress conditions that additional clothing may cause.
- Use insect repellent on clothing. Wear light-colored clothing and remove bright reflective safety-colored clothing if not working near a roadway as these may attract the wasps.
- Wear fragrance-free or lightly-scented sunscreen, and body lotions. Bees are attracted to sweet scents. Avoid using floral scented soaps, shampoos, or conditioners.
- Move slowly and calmly through vegetated areas and try to avoid major disturbance of vegetation as wasps/bees often react to aggressive movement.
- If you encounter a wasp, back away slowly and calmly, do not run or swat at the insect. Wait for it to leave, or gently move or brush it off gently with a piece of paper or other light object. Do not use your hand.

If you are stung, contact the occupational nurse at 1-866-893-2514, no matter how minor it may seem. If a stinger is present, remove it as soon as possible using something with a thin, hard edge (for example, credit card) to scrape the stinger out. Be sure to sanitize the object first with hand sanitizer, alcohol, or soap and water. Wash and disinfect the wound, cover it, and apply ice. Watch for an allergic reaction if you have never been stung before. Call 911 if the reaction is severe.

11.2 Feral Dogs

Avoid all dogs, both leashed and stray. Do not disturb a dog while it is sleeping, eating, or caring for puppies. If a dog approaches to sniff you, stay still. An aggressive dog has a tight mouth, flattened ears, and a direct stare. If you are threatened by a dog, remain calm, do not scream, and avoid eye contact. If you say anything, speak calmly and firmly. Do not turn and run, try to stay still until the dog leaves, or back away slowly until the dog is out of sight or you have reached safety (for example vehicle). If attacked, retreat to vehicle or attempt to place something between you and the dog. If you fall or are knocked to the ground, curl into a ball with your hands over your head and neck and protect your face. If bitten, contact the occupational nurse at 1-866-893-2514. Report the incident to the local authorities.

11.3 Fire Ants

There are several types of fire ants in the United States that can cause painful bites and allergic reactions. Fire ants aggressively defend their nests by stinging several times after climbing on their victims. Large ant mounds are easily visible, but there can be smaller mounds or nests with little "worked" soil that can be stepped on inadvertently. They can also be under rocks, wood, or other debris. Implement the following when fire ants are observed:

- Be aware of fire ants and take care not to stand on ant nests.
- Use insect repellents on clothing and footwear to temporarily discourage ants from climbing.
- Tuck pants into socks.

If stung, get away from the area on which you are standing, briskly brush off ants, and wash the affected area with soap. Call the occupational nurse.

11.4 Giant Hogweed

Giant hogweed is a noxious weed that has become established in New York, Pennsylvania, Ohio, Maryland, Oregon, Washington, Michigan, Virginia, Vermont, New Hampshire, Maine, and adjacent areas of Canada, but can be spread to surrounding areas.

Its sap, in combination with moisture and sunlight, can cause phytophotodermatitis—a serious skin inflammation and severe eye irritation leading to blindness. Contact between the skin and the sap of this plant occurs either through brushing against the bristles on the stem or breaking the stem or leaves. Eye exposure to the sap can occur during the breaking of the stems (during clearing/grubbing). Heat, sunlight, and moisture worsen the skin reaction.

Giant hogweed is a biennial or perennial that can grow up to 12 feet (approximately 3.5 meters) or more. Its hollow, ridged stems grow 2 to 4 inches (5 to 10 centimeters) in diameter and have dark reddish-purple blotches. Its large compound leaves can grow up to 5 feet (1.5 meters) wide. Its white flower heads can grow up to 2.5 feet (approximately 1 meter) in diameter.

Symptoms of exposure include initial itching and redness, then painful blisters form within 48 hours with the area becoming dark and pigmented. Long-term effects include scarring, sensitivity of the affected area to sunlight, and temporary or permanent blindness if it gets into the eyes.

As with all hazardous plants, recognition and avoidance is key. Do not touch any portion of the plant. Become familiar with the identity of the plants (see below). Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and cold water immediately. Keep exposed area away from sunlight for 48 hours. Contact the occupational nurse immediately.

11.5 Mosquito Bites

Due to the recent detection of the West Nile Virus in the southwestern United States, it is recommended that preventative measures be taken to reduce the probability of being bitten by mosquitoes whenever possible. Mosquitoes are believed to be the primary source for exposure to the West Nile Virus as well as several other types of encephalitis. The following guidelines should be followed to reduce the risk of these concerns for working in areas where mosquitoes are prevalent:

- Stay indoors at dawn, dusk, and in the early evening.
- Wear long-sleeved shirts and long pants whenever you are outdoors
- Spray clothing with repellents containing permethrin or N,N-diethyl-meta-toluamide (DEET) since mosquitoes may bite through thin clothing.
- Apply insect repellent sparingly to exposed skin. An effective repellent will contain 35 percent DEET. Repellents may irritate the eyes and mouth, so avoid applying repellent to the hands.
- Whenever you use an insecticide or insect repellent, be sure to read and follow the manufacturer's DIRECTIONS FOR USE, as printed on the product.

Vitamin B and "ultrasonic" devices are NOT effective in preventing mosquito bites.

11.5.1 Symptoms of Exposure to the West Nile Virus

Most infections are mild, and symptoms include fever, headache, and body aches, occasionally with skin rash and swollen lymph glands. More severe infection may be marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, paralysis, and, rarely, death.

The West Nile Virus incubation period is from 3 to 15 days.

Contact the project RHSM with questions, and immediately report any suspicious symptoms to your supervisor and PM, and contact the occupational nurse at 1-866-893-2514.

11.6 Poison Ivy, Poison Oak, and Poison Sumac

Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas. Shrubs are usually 12 to 30 inches high, or can also be a tree-climbing vine, with triple leaflets and short, smooth hair underneath. Plants are red and dark green in spring and summer, with yellowing leaves anytime especially in dry areas. Leaves may achieve bright reds in fall, but plants lose its (yellowed, then brown) leaves in winter, leaving toxic stems. All parts of the plant remain toxic throughout the seasons. These plants contain urushiol a colorless or pale yellow oil that oozes from any cut or crushed part of the plant, including the roots, stems and leaves and causes allergic skin reactions when contacted. The oil is active year round.

Become familiar with the identity of the plants (see images below). Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.

Poison Ivy

Poison Sumac

Poison Oak

Contamination with poison ivy, sumac, or oak can happen through several pathways, including the following:

- Direct skin contact with any part of the plant (even roots once aboveground foliage has been removed).
- Contact with clothing that has been contaminated with the oil.
- Contact from removing shoes that have been contaminated (shoes are coated with urushiol oil).
- Sitting in a vehicle that has become contaminated.
- Contact with any objects or tools that have become contaminated.
- Inhalation of particles generated by weed-whacking, chipping, and vegetation clearing.

If you must work on a site with poison ivy, sumac, or oak, the following precautions are necessary:

- Do not drive vehicles onto the site where it will come into contact with poison ivy, sumac, or oak. Vehicles that need to work in the area, such as drill rigs or heavy equipment must be washed as soon as possible after leaving the site.

- All tools used in the poison ivy, sumac, or oak area, including those used to cut back poison oak, surveying instruments used in the area, air monitoring equipment, or other test apparatus must be decontaminated before they are placed back into the site vehicle. If onsite decontamination is not possible, use plastic to wrap any tools or equipment until they can be decontaminated.

- PPE, including Tyvek coveralls, gloves, and boot covers must be worn. PPE must be placed into plastic bags and sealed if they are not disposed of immediately into a trash receptacle.

- As soon as possible following the work, shower to remove any potential contamination. Any body part with suspected or actual exposure should be washed with Zanfel, Tecnu, or other product designed for removing urushiol. If you do not have Zanfel or Tecnu, wash with cold water. Do not take a bath because the oils can form an invisible film on top of the water and contaminate your entire body upon exiting the bath.

- Tecnu may also be used to decontaminate equipment.

- Use IvyBlock or similar products to prevent poison oak, ivy, and sumac contamination. Check with the closest CH2M HILL warehouse to see if these products are available. Follow all directions for application.

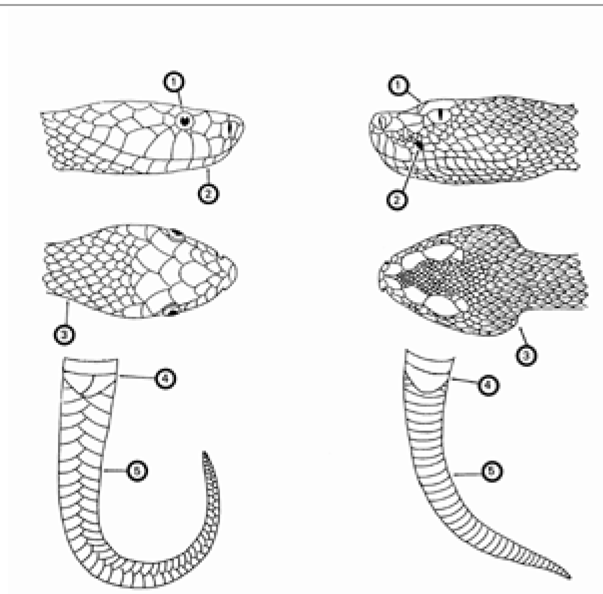
If you do come into contact with one of these poisonous plants and a reaction develops, contact your supervisor and the occupational nurse 1-866-893-2514.

11.7 Snakes

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Call the occupational nurse at 1-866-893-2514 immediately. Do not apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake: note color, size, patterns, and markings. The following is a guide to identifying poisonous snakes from non-poisonous snakes.

Identification of Poisonous Snakes

Major Identification Features Non-venomous Snake	Major Identification Features Venomous Snake
1. Round pupils 2. No sensing pit 3. Head slightly wider than neck 4. Divided anal plate 5. Double row of scales on the underside of the tail	1. Elliptical pupils 2. Sensing pit between eye and nostril 3. Head much wider than neck 4. Single anal plate 5. Single scales on the underside of the tail



11.8 Spiders—Brown Recluse and Widow

The Brown Recluse spider can be found most anywhere in the United States. It varies in size in shape, but the distinguishing mark is the violin shape on its body. They are typically non-aggressive. Keep an eye out for irregular, pattern-less webs that sometimes appear almost tubular built in a protected area such as in a crevice or between two rocks. The spider will retreat to this area of the web when threatened.

The Black Widow, Red Widow, and the Brown Widow are all poisonous. Most have globose, shiny abdomens that are predominantly black with red markings (although some may be pale or have lateral stripes), with moderately long, slender legs. The spiders are nocturnal and build a three-dimensional tangled web, often with a conical tent of dense silk in a corner where the spider hides during the day.

11.8.1 Hazard Controls

- Inspect or shake out any clothing, shoes, towels, or equipment before use.
- Wear protective clothing such as a long-sleeved shirt and long pants, hat, gloves, and boots when handling stacked or undisturbed piles of materials.
- Minimize the empty spaces between stacked materials.
- Remove and reduce debris and rubble from around the outdoor work areas.
- Trim or eliminate tall grasses from around outdoor work areas.
- Store apparel and outdoor equipment in tightly closed plastic bags.
- Keep your tetanus boosters up-to-date (every 10 years). Spider bites can become infected with tetanus spores.

If you think you have been bit by a poisonous spider, immediately call the occupational nurse at 1-866-893-2514 and follow the guidance below:

- Remain calm. Too much excitement or movement will increase the flow of venom into the blood.
- Apply a cool, wet cloth to the bite or cover the bite with a cloth and apply an ice bag to the bite.
- Elevate the bitten area, if possible.
- Do not apply a tourniquet, and do not try to remove venom.
- Try to positively identify the spider to confirm its type. If the spider has been killed, collect it in a plastic bag or jar for identification purposes. Do not try to capture a live spider—especially if you think it is a poisonous spider.

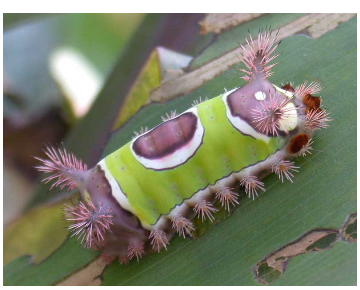
Black Widow

Red Widow

Brown Widow

Brown Recluse

11.9 Stinging Caterpillars



If you find a fuzzy or spiny caterpillar that inflicts a painful sting upon contact, you probably have found a stinging caterpillar. The intensity of the irritation, whether it is caused by “venomous” or “irritating” hairs or barbed hooks and/or sharp, hollow spines, will be dependent on the species of caterpillar and the individual’s sensitivity. Reaction ranges from mild, with local reddening, swelling, and itching, to rather severe depending on the susceptibility of the individual, the tenderness of the skin, and the place of contact, and may even require hospital care for unusually sensitive persons. Hypersensitive persons may experience symptoms and/or allergic reactions, for example, severe swelling, nausea, difficulty in breathing, and generalized systemic reaction.

Saddleback caterpillars are an example of a stinging caterpillar. They are prevalent along the east coast from Florida to Massachusetts. They are most active within August and September. Contact with this caterpillar may produce a rash and a high fever.

Stings usually occur when people brush against a caterpillar or attempt to remove it from their body or their clothing. Only a few of the many thousand caterpillars can sting.

Avoid handling any hairy caterpillars or material with which they have been in contact. Suitable protective clothing, including safety glasses and gloves, should always be worn if handling these insects are necessary. Remember, dead caterpillars can still cause painful stings. Most caterpillar infestations are usually short-lived and should be left undisturbed, unless they are causing a problem. All the moth larvae are leaf feeders. Infested shrubs and trees may be vacuumed or sprayed or dusted to reduce or eliminate the caterpillars. Contact the RHSM if caterpillars are abundant and cannot be avoided to determine if spraying foliage or removal of caterpillars is necessary.

If you are stung, call the occupational nurse at 1-866-893-2514. Applying tape, such as adhesive, duct, or cellophane transparent and pulling it off may be helpful in removing broken spines. Washing the affected skin thoroughly with soap and water may also help to remove insect hairs/spines and/or irritating venom. Prompt application of an ice pack and a baking soda poultice may help to reduce pain and prevent swelling.

11.10 Ticks

Every year employees are exposed to tick bites at work and at home putting them at risk of illness. Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to 0.25 inch (6.4 millimeters) in size.

In some geographic areas, exposure is not easily avoided. Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into boots; spray only outside of clothing with permethrin or permanone and spray skin with DEET only. Check yourself frequently for ticks.

Where site conditions (vegetation above knee height, tick-endemic area) or when tasks (having to sit or kneel in vegetation) diminish the effectiveness of the controls mentioned above, bug-out suits (check with your local or regional warehouse) or Tyvek shall be used. Bug-out suits are more breathable than Tyvek.

Take precautions to avoid exposure by including pre-planning measures for biological hazards prior to starting fieldwork. Avoid habitats where possible and reduce the abundance through habitat disruption or application of acracide. If the controls aren’t feasible, contact your local or regional warehouse for preventative equipment such as repellants, protective clothing, and tick-removal kits. Use the buddy system and perform tick inspections prior to entering the field vehicle. If ticks were not planned to be encountered and are observed, do not continue fieldwork until the controls can be implemented.

See tick fact sheet attached to this SSHP for further precautions and controls to implement when ticks are present. If bitten by a tick, follow the removal procedures found in the tick fact sheet, and call the occupational nurse at 1-866-893-2514.

Be aware of the symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme disease is a rash that might appear. The rash looks like a bull’s eye with a small welt in the center. RMSF is a rash of red spots under the skin 3 to 10 days after the tick bite. In both RMSF and Lyme disease, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, again contact the occupational nurse at 1-866-893-2514.

Be sure to complete an Incident Report (either use the Hours and Incident Tracking System [HITS] system on the Virtual Office) if you do come in contact with a tick.

SECTION 12
Contaminants of Concern

Table 12-1 summarizes the potential COCs and their occupational exposure limit and signs and symptoms of exposure. The table also includes the maximum concentration of each COC and the associated location and media that was sampled (groundwater, soil boring, surface soil). The concentrations were used to determine engineering and administrative controls described in the "Project-Specific Hazard Controls" section of this SSHP, as well as PPE and site monitoring requirements.

The data inserted in the table was gathered from the project data base.

TABLE 12-1
Contaminants of Concern

Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Cobalt (Metal, Dusts, and Fumes)	GW: 1110 µg/L SS 19.9 mg/kg SB: 15.8 mg/kg	0.05 mg/m^3	20 mg/m^3	Coughing, difficulty breathing, wheezing, decreased pulmonary function, diffuse nodule fibrosous, dermatitis, respiratory hypersensitivity, asthma	NA

Footnotes:

[a] Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), SS (Surface Soil), SL (Sludge), SW (Surface Water).

[b] Appropriate value of permissible exposure limit (PEL), recommended exposure limit (REL), or threshold limit value (TLV) listed.

[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.

[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

eV = electron volt
mg/m^3 = milligrams per cubic meter
µg/m^3 = micrograms per cubic meter
SB = soil boring

Potential Routes of Exposure		
Dermal: Contact with contaminated media. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of PPE.	**Inhalation:** Vapors and contaminated particulates. This route of exposure is minimized through use of engineering controls, administrative controls and proper use of respiratory protection when other forms of control do not reduce the potential for exposure.	**Other:** Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (for example, wash hands and face before drinking or smoking).

SECTION 13
Site Monitoring

(Reference CH2M HILL SOP HSE-207, *Exposure Monitoring for Airborne Chemical Hazards*)

When performing site monitoring, record all the information (for example, in a field logbook). Note date and time, describe monitoring location (for example, in breathing zone, at source), site location, and what the reading is. If any action levels are reached, note it in the field logbook, and note the action taken.

Exposure records (air sampling) must be preserved for the duration of employment, plus 30 years. Ensure that copies of the field logbook are maintained in the project file.

Copies of all project exposure records (for example, copies of field logbook pages where air monitoring readings are recorded and associated calibration) shall be sent to the regional safety program assistant for retention and maintained in the project files.

13.1 Direct Reading Monitoring Specifications

Instrument	Tasks	Action Levels[a]	Action to be Taken when Action Level reached	Frequency [b]	Calibration
Toxic Gas Monitor: MultiRAE Plus with 10.6 eV lamp (VOCs, O_2, LEL, CO, H_2S)	Drilling, GW sampling post injection	0-1 ppm 1-5 ppm >5 ppm	Level D Level C Stop work, contact RHSM	Initially and periodically during task	Daily
LEL on Multirae	Drilling, GW sampling post injection	0-10% :: >10% LEL:	No explosion hazard Explosion hazard; evacuate or vent	Initially and periodically during task	Daily
NOTE: The GEM 2000 (or equivalent) may be used for H_2S, methane LEL, and O_2 using the action levels listed above.					
Dust Monitor: Visual	All intrusive tasks	No visual dust Visual dust	Level D Engineering controls to suppress or Level C	Continuous	Zero Daily
Noise-Level Monitor [d]	Drilling	<85 dB(A) 85-120 dB(A) 120 dB(A)	No action required Hearing protection required Stop; re-evaluate	Initially and periodically during task	Daily

[a] Action levels apply to sustained breathing-zone measurements above background.
[b] The exact frequency of monitoring depends on field conditions and is to be determined by the SC; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate.
[c] If the measured percent of O_2 is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O_2 action levels apply only to ambient working atmospheres, and not to confined-space entry. More-stringent percent LEL and O_2 action levels are required for confined-space entry.
[d] Noise monitoring and audiometric testing also required.
VOC = volatile organic compound

13.2 Calibration Specifications

(Refer to the respective manufacturer's instructions for proper instrument-maintenance procedures)

Instrument	Gas	Span	Reading	Method
Sound Level Meter	Refer to Instrument Manual onsite,			
MultiRae or equivalent	H2S	CF = 25	25 ppm	0.5 lpm reg
	CO	CF = 50	50 ppm	T-tubing
	LEL	CF = 50	50 %	
	O2	CF = 20.9	20.9 %	
	100 ppm isobutylene	CF = 100	100 ppm	
GEM 2000 (or equivalent)	Methane, O_2	Various	Refer to Instrument Manual onsite,	

Calibrate air monitoring equipment daily (or prior to use) in accordance with the instrument's instructions. Document the calibration in the field logbook (or equivalent) and include the following information:

- Instrument name
- Serial Number
- Owner of instrument (for example, CH2M HILL, HAZCO)
- Calibration gas (including type and lot number)
- Type of regulator (for example, 1.5 lpm)
- Type of tubing (for example, direct or T-tubing)
- Ambient weather condition (for example, temperature and wind direction)
- Calibration/instrument readings
- Operator's name and signature
- Date and time

SECTION 14

Personal Protective Equipment

(Reference EM 385-1-1 Section 5, *Personal Protective and Safety Equipment*; CH2M HILL- SOP HSE-117, *Personal Protective Equipment*)

14.1 Required Personal Protective Equipment

PPE must be worn by employees when actual or potential hazards exist and engineering controls or administrative practices cannot adequately control the hazards.

A PPE assessment has been conducted by the RHSM based on project tasks (see PPE specifications below). Verification and certification of assigned PPE by task is completed by the RHSM that approved this plan. Below are items that need to be followed when using any form of PPE:

- Employees must be trained to properly wear and maintain the PPE.
- Employees must be trained in the limitations of the PPE.
- In work areas where actual or potential hazards are present at any time, PPE must be worn by employees working or walking through the area.
- Areas requiring PPE should be posted or employees must be informed of the requirements in an equivalent manner.
- PPE must be inspected prior to use and after any occurrence to identify any deterioration or damage.
- PPE must be maintained in a clean and reliable condition.
- Damaged PPE shall not be used and must either be repaired or discarded.
- PPE shall not be modified, tampered with, or repaired beyond routine maintenance.

The employer shall identify actual or potential hazards and the need for PPE. The following two conditions typically dictate the necessity for PPE: general hazards present in the work area, and hazards created by the tasks being performed. Some work areas have actual or potential hazards that can be present at any time, thereby potentially exposing any personnel working or walking through the area. Such areas should be posted as PPE-required areas, or personnel should be informed of the requirements in an equivalent manner. In addition, the actual task being performed may create a hazard and require personnel who perform this task to wear appropriate PPE. The areas where the tasks are taking place may become PPE-required areas as long as that specific task is taking place. Specific hazardous assessments are conducted through the AHA process, and thus AHAs become the daily tool for proper hazard assessment and mitigation. The following table should be used as a general minimum guideline, with the specific task AHA having the final required protocol for PPE. AHAs are a living document, and should reflect changing site conditions.

Table 41-1 outlines PPE to be used according to task, based on project-specific hazard assessment. If a task other than the tasks described in this table needs to be performed, contact the RHSM so this table can be updated.

TABLE 14-1
Project-specific Personal Protective Equipment Requirements[a]

Task	Level	Body	Head	Respirator [b]
General site work, surveying, utility location, IDW management, drilling, well installation, development, groundwater sampling	D	Work clothes; safety toed leather work boots [b] (client requirement, see note b) and gloves, surgical style nitrile gloves	Hardhat [b] Safety glasses with side shields [b] Ear protection [d]	None required
Work near vehicular traffic ways, drill rig or earth moving equipment.	All	Appropriate level of ANSI/ISEA 107-2010 high-visibility safety vests.	Work near vehicular traffic ways, drill rig or earth moving equipment.	
Equipment decontamination if using pressure washer	Modified D with splash protection	**Coveralls:** Polycoated Tyvek® or rain suit **Boots:** 16-inch-high steel-toed rubber boots **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [b] Splash shield [c] over safety glasses with side shields or splash goggles Ear protection [d]	None required.

Reasons for Upgrading or Downgrading Level of Protection (with approval of the RHSM)

Upgrade[f]	Downgrade
• Request from individual performing tasks. • Change in work tasks that will increase contact or potential contact with hazardous materials. • Occurrence or likely occurrence of gas or vapor emission. • Known or suspected presence of dermal hazards. • Instrument action levels in the "Site Monitoring" section exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decrease the hazard. • Change in work task that will reduce contact with hazardous materials.

[a] Modifications are as indicated. CH2M HILL will provide PPE only to CH2M HILL employees.
[b] Client requires hard hat, safety glasses, safety toe boots and high visibility vest or shirt on at all times when working on site.
[c] Hardhat and splash-shield areas are to be determined by the SC.
[d] Ear protection should be worn when conversations cannot be held at distances of 3 feet (1 meter) or less without shouting.
[e] See cartridge change-out schedule.
[f] Performing a task that requires an upgrade to a higher level of protection (for example, Level D to Level C) is permitted only when the PPE requirements have been approved by the RHSM, and an SC qualified at that level is present.

14.2 Respiratory Protection

(Reference Section 05.E.03, EM 385-1-1 and CH2M HILL SOP HSE-121, *Respiratory Protection*)

14.2.1 General

Respiratory protection is not anticipated to be required at this project site based on the current scope of work. If the parameters change, or unforeseen circumstances dictate the use of respiratory protection, the following guidelines will be adhered to.

14.2.2 Voluntary Usage

CH2M HILL has a regulatory-compliant Voluntary Usage Program for employees and workers who feel that they may want to wear a respirator, even when the situation and conditions do not require their use for protection. Any employee or worker can approach their supervisor or SSHO to have a respirator provided if so desired. Additional training and medical screening will be required to be performed in the event the user does want to wear a respirator.

14.2.3 Air Purifying Respirators

CH2M HILL employees and subcontractors will be required to use air-purifying respirators (APRs) under the following conditions and operations:

- Operations where the concentration of substance or vapor is known
- There is a filter available that is National Institute of Occupational Safety and Health/Mine Safety and Health Administration rated for the substance or material that poses the hazard

14.2.4 Filter Selection and Change Schedule

If, during the course of the project, the situation arises that would require the use of APRs, the site safety coordinator will contact CH2M HILL corporate Health and Safety to acquire the appropriate atmospheric monitoring equipment to determine the type of respirator cartridges needed. Once determined, a cartridge change schedule will be established based on the analytical data collected.

14.2.5 Fit Testing

All personnel required to wear either a self-contained breathing apparatus (SCBA) or APR during the project will be fit-tested in accordance with the CH2M HILL SOP. An operator seal check will be performed each time the respirator is placed on the operator's face for use.

Implement the following when using respiratory protection:

- Respirator users must have completed appropriate respirator training within the past 12 months. Level C training is required for the use of APRs, and Level B training is required for supplied-air respirators and SCBA use. Specific training is required for the use of powered air-purifying respirators.
- Respirator users must complete the respirator medical monitoring protocol and been approved for the specific type of respirator to be used.
- Tight-fitting facepiece respirator (negative or positive pressure) users must have passed an appropriate fit test within past 12 months.
- Respirator use shall be limited to those activities identified in this plan. If site conditions change and alter the effectiveness of the specified respiratory protection, the RHSM shall be notified to amend the written plan.
- Tight-fitting facepiece respirator users shall be clean-shaven and shall perform a user seal-check before each use.
- Canisters/cartridges shall be replaced according to the change-out schedule specified in this plan. Respirator users shall notify the SSHO or RHSM of any detection of vapor or gas breakthrough. The SSHO shall report any breakthrough events to the RHSM for schedule upgrade.
- Respirators in regular use shall be inspected before each use and during cleaning.
- Respirators in regular use shall be cleaned and disinfected as often as necessary to ensure they are maintained in a clean and sanitary condition.
- Respirators shall be properly stored to protect against contamination and deformation.
- Field repair of respirators shall be limited to routine maintenance. Defective respirators shall be removed from service.
- When breathing air is supplied by cylinder or compressor, the SSHO or RHSM shall verify the air meets Grade D air specifications.
- The SSHO or designee shall complete the Self-Assessment Checklist – Respiratory Protection included in as attachment to this plan to verify compliance with CH2M HILL's respiratory protection program.

Respirator Changeout Schedule

TABLE 14-2
Respirator Changeout Schedule

Contaminant	Changeout Schedule
Acrylonitrile	End-of-service life or end of shift (whichever occurs first)
Benzene	End-of-service life or end of shift (whichever occurs first)
Butadiene	After 4 hours for concentrations up to 5 ppm After 3 hours for concentrations between 5 and 10 ppm After 2 hours for concentrations between 10 and 25 ppm After 1 hour for concentrations up to 50 ppm
Formaldehyde	Cartridges: end-of-service life or after 3 hours (whichever occurs first) Canisters: end-of-service life or after 4 hours for concentrations up to 7.5 ppm (whichever occurs first) Industrial Canisters: end-of-service life or after 2 hours for concentrations up to 75 ppm (whichever occurs first)
Methylene Chloride	Canisters may only be used for emergency escape and must be replaced after use

SECTION 15

Worker Training and Qualification

15.1 CH2M HILL Worker Training

The intent of employee training program is to ensure that employees receive the appropriate level of training to conduct their work in a safe manner and to comply with applicable regulations. All employees are required to maintain the training qualification necessary to perform their assigned duties and job functions. (Reference CH2M HILL SOP HSE-110, *Training.*)

15.1.1 Hazardous Waste Operations Training

All employees engaging in HAZWOPER shall receive appropriate training as required by 29 CFR 1910.120 and 29 CFR 1926.65. At a minimum, the training shall have consisted of instruction in the topics outlined in 29 CFR 1910.120 and 29 CFR 1926.65. Personnel who have not met these training requirements shall not be allowed to engage in HAZWOPER activities.

15.1.1.1 Initial Training

General site workers engaged in hazardous waste operations shall, at the time of job assignment, have received a minimum of 40 hours of initial health and safety training for hazardous waste site operations, unless otherwise noted in the above-referenced standards.

Employees who may be exposed to health hazards or hazardous substances at treatment, storage, and disposal operations shall receive a minimum of 24 hours of initial training to enable the employee to perform their assigned duties and functions in a safe and healthful manner.

Employees engaged in emergency response operations shall be trained to the level of required competence in accordance with 29 CFR 1910.120.

15.1.1.2 Three-day Actual Field Experience

General site workers for hazardous waste operations shall have received 3 days of actual experience (on-the-job training) under the direct supervision of a trained, qualified supervisor, and shall be documented. If the field experience has not already been received and documented at a similar site, the supervised experience shall be accomplished and documented at the beginning of the assignment of the project.

15.1.1.3 Refresher Training

General site workers and treatment, storage, and disposal workers shall receive 8 hours of refresher training annually (within the previous 12-month period) to maintain qualifications for fieldwork. Employees engaged in emergency response operations shall receive annual refresher training of sufficient content and duration to maintain their competencies or shall demonstrate competency in the areas at least annually.

15.1.1.4 Eight-hour Supervisory Training

Onsite management or supervisors who will be directly responsible for, or supervise employees engaged in hazardous waste site operations, will have received at least 8 hours of additional specialized training in managing such operations. Employees designated as Safety Coordinator—Hazardous Waste are considered 8-hour HAZWOPER Site Safety Supervisor-trained.

15.1.2 First-aid/Cardiopulmonary Resuscitation

First-aid and CPR training consistent with the requirements of a nationally recognized organization such as the American Red Cross Association or National Safety Council shall be administered by a certified trainer. A minimum of two personnel per active field operation will have first-aid and CPR training. Bloodborne pathogen training located on CH2M HILL's Virtual Office is also required for those designated as first-aid/CPR trained.

15.1.3 Site Safety and Health Officer Training

SSHOs are trained to implement the HSE program on CH2M HILL field projects. A qualified SSHO is required to be identified in the SSHSP for CH2M HILL field projects. SSHOs must also meet the requirements of the worker category appropriate to the type of field project (construction or hazardous waste). In addition, the SSHOs shall have completed additional safety training required by the specific work activity on the project that qualifies them to implement the HSE program (for example, fall protection, excavation). All SSHO's shall also have completed 30-hour OSHA construction safety training, and have the requisite experience to oversee the tasks assigned. Furthermore, the SSHO shall have an understanding of the USACE EM385-1-1 Safety Manual.

15.1.4 Site-specific Training

Prior to commencement of field activities, all field personnel assigned to the project will have completed site-specific training that will address the contents of applicable HSPs, including the activities, procedures, monitoring, and equipment used in the site operations. Site-specific training will also include site and facility layout, potential hazards, risks associated with identified emergency response actions, and available emergency services. The training allows fieldworkers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and work operations for their particular activity.

15.1.5 Project-Specific Training Requirements

Project-specific training for this project includes the following:

- APP/SSHP, AHAs, crystalline silica fact sheet

15.2 Subcontractor Personnel Qualifications

All subcontractors will provide the RHSM with a list certifying the training and qualifications of competent persons and qualified operators for the following activities/equipment.

15.2.1 Competent Persons/Qualified Operators

- None

15.2.2 Activity/Equipment List

- Drill rig, ORC injection equipment, well development and sampling equipment, surveying equipment, utility location equipment, drum handling equipment.

15.3 Project Employee Orientation

Employees expecting to access the site are required to have the project employee orientation. The training will be provided by the SSC. The training provided to the employees in the employee orientation shall include the following:

- Review the SSHP and APP
- Present an overall site safety briefing (general site safety)
- Review employee responsibilities
- Review AHA policies and procedures
- Review emergency procedures and evacuation plan
- Review injury and incident reporting procedures
- Review reporting procedures for hazardous conditions and/or hazardous activities

15.4 Personal Protective Equipment Training

OSHA requires each PPE user to receive training on the proper care, maintenance, limitations, and instructions on how to wear and adjust PPE. The proper use of PPE will also be included in project safety briefings and toolbox meetings.

15.5 Safety Meetings and Toolbox Meetings

Safety meetings provide a method for maintaining safety awareness and providing safety-related information and training to employees. Safety meetings for project supervisory personnel and project employees shall be held at least daily, and include relevant information for on- and off-the-job safety.

15.6 Activity Hazard Analysis Training

Each supervisor will review task-specific AHAs with all workers assigned to perform that task prior to the beginning of that task anywhere on the job site. All workers will sign the AHA document signifying they have been trained and understand the task steps, hazards, and hazard controls to be used.

15.7 Safety Pre-task Planning and Training

Each day, the onsite supervisors shall hold informational safety training with each member of their crew. Information discussed and training performed shall pertain to current project activities and scope of work. The subcontractor is encouraged to use the time for employee input and task-specific training.

15.8 Vendor Training

Vendors that supply equipment to the project will be required to perform a training session to review and explain the safe operation procedures to the parties that will be using or operating the equipment.

15.9 Emergency Response Plan Training

Emergency Response Plan training will occur during the employee orientation and retraining will occur periodically in safety meetings. The Emergency Response Plan training will include evacuation alarms, site evacuation, designated evacuation assembly areas, and route to emergency medical facility. Emergency drills will be performed initially, but at least twice yearly. See Section 19 for the Emergency Preparedness procedures.

15.10 Conduct of Training

15.10.1 Instructor/Trainer Requirements

All personnel who will conduct training will have documented expertise in the areas of which they will be conducting the training, and knowledge of the regulatory and other requirements. They will also be listed as a competent person in that area by the employer or contractor.

15.10.2 Initial Training

All employees will have documentation of initial training required to perform their assigned duties with their assigned tools and equipment. If previous documentation or subcontractor certification is not available, then initial training will take place onsite prior to the employee commencing work.

15.10.3 Retraining

Retraining will be required under the following conditions:

- There is a change in operations or equipment capabilities.
- An employee is seen performing an unsafe act, or operating equipment or machinery in an unauthorized manner.
- There is an incident or accident on the job site.
- Anytime the regulatory requirements require refresher training due to time periods, such as HAZWOPER, etc.

15.10.4 Demonstrated Competency

For all training conducted for equipment, machinery, or hazardous activities, the trainer will document in writing that the individual has “demonstrated competency” in the areas required to perform their assigned tasks safely and in compliance with the regulatory and other guidance.

15.11 Documentation

All training shall be documented. Documentation and certificates verifying completion will be maintained onsite by the employer, and copies of the training documentation will be submitted to the Health and Safety Manager. Training documentation will be made available for review at all times.

SECTION 16

Medical Surveillance and Qualification

(Reference CH2M HILL SOP HSE-113, *Medical Surveillance*

All site workers participating in HAZWOPER will maintain an adequate medical surveillance program in accordance with 29 CFR 1910.120 or 29 CFR 1926.65 and other applicable OSHA standards. Documentation of employee medical qualification (for example, physician's written opinion) will be maintained in the project files and made available for inspection.

16.1 Hazardous Waste Operations and Emergency Response

CH2M HILL personnel expected to participate in onsite HAZWOPER tasks are required to have a current medical qualification for performing this work. Medical qualification shall consist of a qualified physician's written opinion regarding fitness for duty at a hazardous waste site, including any recommended limitations on the employee's assigned work. The physician's written opinion shall state whether the employee has any detected medical conditions that would place the employee at increased risk of material impairment of the employee's health from work in HAZWOPER, or from respirator use.

16.2 Job- or Site-specific Medical Surveillance

Due to the nature of hazards for a particular job or work site, specialized medical surveillance may be necessary. This surveillance could include biological monitoring for specific compounds, or specialized medical examinations.

Site-specific medical surveillance includes:

- None needed

16.3 Respirator User Qualification

Personnel required to wear respirators must have a current medical qualification to wear respirators. Medical qualification shall consist of a qualified physician's written opinion regarding the employee's ability to safely wear a respirator in accordance with 29 CFR 1910.134.

16.4 Hearing Conservation

Personnel working in hazardous waste operations or operations that fall under 29 CFR 1910.95 and exposed to noise levels in excess of the 85 dBA time-weighted average shall be included in a hearing-conservation program that includes annual audiometric testing.

Site Control Plan

17.1 Site Control Procedures

(Reference CH2M HILL SOP HSE-218, *Hazardous Waste Operations)*

Site control is established to prevent the spread of contamination throughout the site and to ensure that only authorized individuals are permitted into potentially hazardous areas.

The SSHO will implement site control procedures, including the following bulleted items:

- Establish support, contamination reduction, and exclusion zones. Delineate with flags or cones as appropriate. Support zone should be upwind of the site. Use access control at entry and exit from each work zone.
- Establish onsite communication consisting of the following:
  - Line-of-sight and hand signals
  - Air horn
  - Two-way radio or cellular telephone if available
- Establish offsite communication.
- Establish and maintain the "buddy system."

17.2 Remediation Work Area Zones

(Reference CH2M HILL SOP HSE-218 Hazardous Waste Operations)

A three-zone approach will be used to control areas where site contaminants exist. Access will be allowed only after verification of appropriate training and medical qualification. The three-zone approach shall include an exclusion zone (EZ), contamination reduction zone (CRZ), and a support zone (SZ). The three-zone approach is not required for construction work performed outside contaminated areas where control of site contamination is not a concern.

Specific work control zones shall be established as necessary during task planning. Site work zones should be modified in the field as necessary, based on such factors as equipment used, air monitoring results, environmental conditions, or alteration of work plans. The following guidelines shall be used for establishing and revising these preliminary zone designations.

17.2.1 Support Zone

The SZ is an uncontaminated area (trailers, offices, field vehicles, etc.) that will serve as the field support area for most operations. The SZ provides field team communications and staging for emergency response. Appropriate sanitary facilities and safety and emergency response equipment will be located in this zone. Potentially contaminated personnel/materials are not allowed in this zone. The only exception will be appropriately packaged and decontaminated materials, or personnel with medical emergencies that cannot be decontaminated.

17.2.2 Contamination Reduction Zone

The CRZ is established between the EZ and the SZ, upwind of the contaminated area where possible. The CRZ provides an area for decontamination of personnel, portable handheld equipment and tools, and heavy equipment. In addition, the CRZ serves as access for heavy equipment and emergency support services.

17.2.3 Exclusion Zone

The EZ is where activities take place that may involve exposure to site contaminants and/or hazardous materials or conditions. This zone shall be demarcated to prevent unauthorized entry. More than one EZ may be established if there are different levels of protection to be employed or different hazards that exist in the same work area.

The EZ shall be large enough to allow adequate space for the activity to be completed, including field personnel and equipment, as well as necessary emergency equipment.

The EZ shall be demarcated with some form of physical barrier or signage. The physical barrier or signage shall be placed so that it is visible to personnel approaching or working in the area. Barriers and boundary markers shall be removed when no longer needed.

17.2.4 Other Controlled Areas

Other work areas may need to be controlled due to the presence of an uncontrolled hazard, to warn workers of requirements, or to prevent unauthorized entry. Examples include general construction work areas, open excavations, high noise areas, vehicle access areas, and similar activities or limited access locations. The areas shall be clearly demarcated with physical barriers (fencing, cones, reinforced caution tape, or rope) as necessary and posted with appropriate signage.

SECTION 18

Decontamination

(Reference CH2M HILL SOP HSE-218, *Hazardous Waste Operations*)

Decontamination areas will be established for work in potentially contaminated areas to prevent the spread of contamination. Decontamination areas should be located upwind of the exclusion zone where possible and should consider any adjacent or nearby projects and personnel. The SC must establish and monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SC. The SC must ensure that procedures are established for disposing of materials generated on the site.

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SC should establish areas for eating, drinking, and smoking.

18.1 Contamination Prevention

Preventing or avoiding contamination of personnel, tools, and equipment will be considered in planning work activities at all field locations. Good contamination prevention and avoidance practices will assist in preventing worker exposure and result in a more efficient decontamination process. Procedures for contamination prevention and avoidance include the following:

- Do not walk through areas of obvious or known contamination.
- Do not directly handle or touch contaminated materials.
- Make sure there are no cuts or tears in PPE.
- Fasten all closures in suits and cover them with duct tape, if appropriate.
- Take particular care to protect any skin injuries.
- Stay upwind of airborne contamination, where possible.
- Do not eat or drink in contaminated work areas.
- Do not carry food, beverages, tobacco, or flame-producing equipment into contaminated work areas.
- Minimize the number of personnel and amount of equipment in contaminated areas to that necessary for accomplishing the work.
- Choose tools and equipment with nonporous exterior surfaces that can be easily cleaned and decontaminated.
- Cover monitoring and sampling equipment with clear plastic, leaving openings for the sampling ports, as necessary.
- Minimize the amount of tools and equipment necessary in contaminated areas.

18.2 Personnel and Equipment Decontamination

Personnel exiting an EZ must ensure that they are not spreading potential contamination into clean areas or increasing their potential for ingesting or inhaling potential contaminants. Personal decontamination may range from removing outer gloves as exiting the EZ, to proceeding through an outer layer doffing station, including a boot and glove wash and rinse, washing equipment, etc. Equipment that has come into contact with contaminated media must also be cleaned/decontaminated when it is brought out of the EZ.

18.3 Decontamination during Medical Emergencies

Standard personnel decontamination practices will be followed whenever possible. For emergency life-saving first-aid and/or medical treatment, normal decontamination procedures may need to be abbreviated or omitted. In this situation, site personnel shall accompany contaminated victims to advise emergency response personnel on potential contamination present and proper decontamination procedures.

Outer garments may be removed if they do not cause delays, interfere with treatment, or aggravate the problem. Protective clothing can be cut away. If the outer garments cannot be safely removed, a plastic barrier between the individual and clean surfaces should be used to help prevent contaminating the inside of ambulances or medical personnel. Outer garments can then be removed at the medical facility.

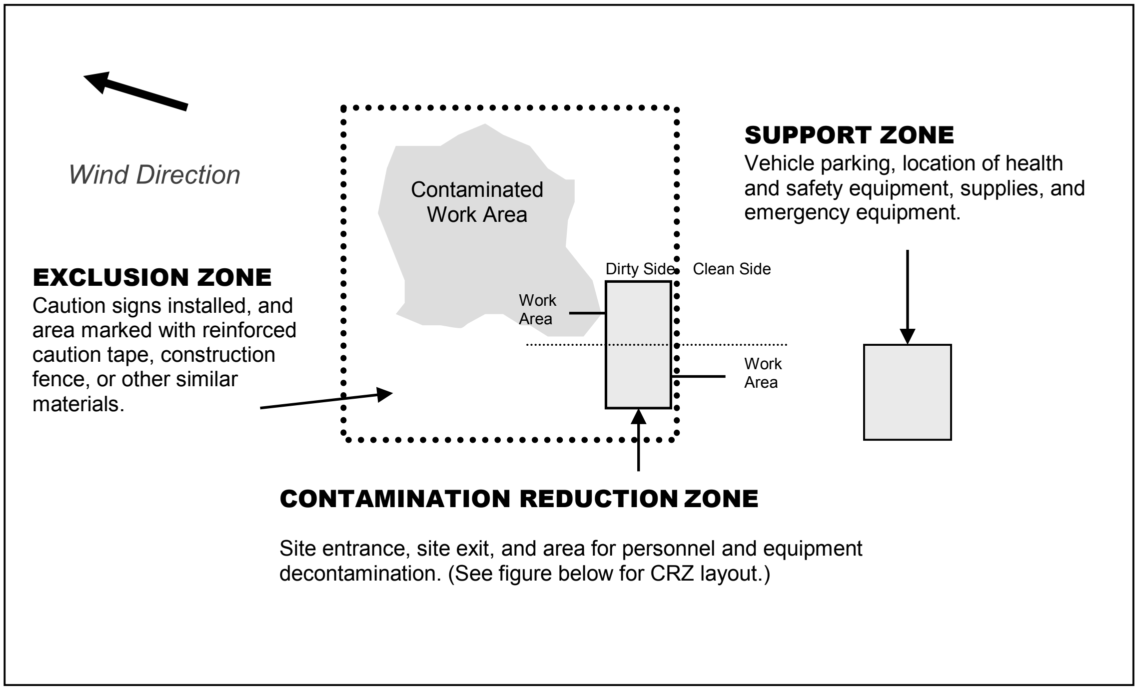
18.4 Waste Collection and Disposal

All contaminated material generated through the personnel and equipment decontamination processes (for example, contaminated disposable items, gross debris, liquids, and sludges) will be properly containerized, labeled, stored at a secure location, and disposed of in accordance with the project plans.

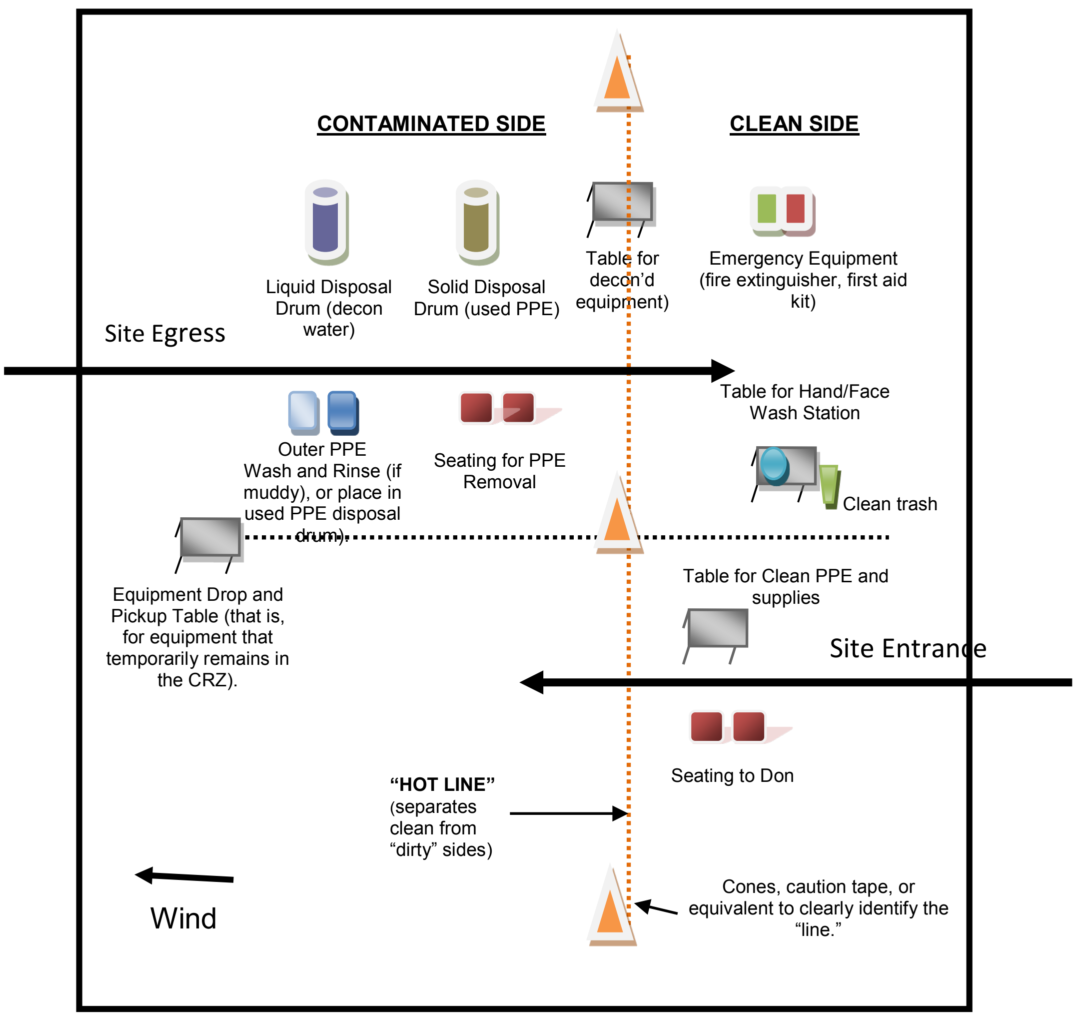
18.5 Diagram of Personnel-decontamination Line

The following figure illustrates a conceptual establishment of work zones, including the decontamination line. Work zones are to be modified by the SC to accommodate task-specific requirements.

Work Area—Set-up Appropriately Based On Wind Direction



Typical Contamination Reduction Zone



SECTION 19

Emergency Response Plan

(Reference CH2M HILL SOP HSE-106, *Emergency Planning*)

19.1 Pre-emergency Planning

The Emergency Response Coordinator (ERC), typically the SSHO or designee, performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with CH2M HILL onsite parties, the facility, and local emergency-service providers as appropriate. Pre-Emergency Planning activities performed by the ERC include the following:

- Review the facility emergency and contingency plans where applicable.
- Determine what onsite communication equipment is available (two-way radio and air horn).
- Determine what offsite communication equipment is needed (nearest telephone or cell phone).
- Confirm and post the "Emergency Contacts" page and route to the hospital located in this section in project trailer(s) and keep a copy in field vehicles along with evacuation routes and assembly areas. Communicate the information to onsite personnel and keep it updated.
- Field Trailers: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Review changed site conditions, onsite operations, and personnel availability in relation to emergency response procedures.
- Where appropriate and acceptable to the client, inform emergency room and ambulance and emergency response teams of anticipated types of site emergencies.
- Inventory and check site emergency equipment, supplies, and potable water.
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, and releases.
- Rehearse the emergency response plan before site activities begin. This may include a "tabletop" exercise or an actual drill depending on the nature and complexity of the project. Drills should take place periodically but no less than once a year.
- Brief new workers on the emergency response plan.
- The ERC will evaluate emergency response actions and initiate appropriate follow-up actions.

19.2 Emergency Equipment and Supplies

The ERC shall ensure the following emergency equipment is on the site. Verify and update the locations of this equipment as needed. The equipment will be inspected in accordance with manufacturer's recommendations. The inspection shall be documented in a field logbook or similar means to be kept in the project files.

Emergency Equipment and Supplies	Location
20 (or two 10) class A,B,C fire extinguisher	Drill rig, field vehicle
First-aid kit	Field vehicle
Eye wash	Field vehicle
Potable water	Field vehicle
Bloodborne-pathogen kit	Field vehicle
Additional equipment (specify): cell phone	SSC or field vehicle

19.3 Incident Response

In fires, explosions, or chemical releases, actions to be taken include the following:

- Notify appropriate response personnel. William Lindsay (301-744-2182) or Cathy Gardner (301-744-2181) of FEAD must be informed immediately of any injury or damage to government property. FEAD will conduct an investigation and file a report within 4 hours of the incident.
- Shut down CH2M HILL operations and evacuate the immediate work area.
- Account for personnel at the designated assembly area(s).
- Assess the need for site evacuation, and evacuate the site as warranted.
- Implement HSE-111, Incident Notification, Reporting and Investigation.
- Notify and submit reports to clients as required in contract. CH2MHILL and medical/occupational nurse must also be notified.

Small fires or spills posing minimal safety or health hazards may be controlled with onsite spill kits or fire extinguishers without evacuating the site. When in doubt evacuate. Follow the incident reporting procedures in the "Incident Notification, Reporting, and Investigation" section of this SSHP.

19.4 Emergency Medical Treatment

Emergency medical treatment is needed when there is a life-threatening injury (such as severe bleeding, loss of consciousness, breathing or heart has stopped). When in doubt, if an injury is life-threatening or not, treat it as needing emergency medical treatment.

- Notify 911 or other appropriate emergency response authorities as listed in the "Emergency Contacts" page located in this section.
- The ERC will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Prevent further injury, perform decontamination (if applicable) where feasible; lifesaving and first-aid or medical treatment takes priority.
- Initiate first-aid and CPR where feasible.
- Notify supervisor and if the injured person is a CH2M HILL employee, the supervisor will call the occupational nurse at 1-866-893-2514. Make other notifications as required by HSE SOP-111, *Incident Notification, Reporting and Investigation*.
- Make certain that the injured person is accompanied to the emergency room.
- Follow the Serious Incident Reporting process in HSE SOP-111, Incident Notification, Reporting, and Investigation, and complete incident report using the HITS system on the Virtual Office or if not feasible, use the hard copy forms provided as an attachment to this SSHP.
- Notify and submit reports to client as required in contract.

19.5 Evacuation

- Evacuation routes, assembly areas, and severe weather shelters (and alternative routes and assembly areas) are to be specified on the site map.
- Evacuation route(s) and assembly area(s) will be designated by the ERC or designee before work begins.
- Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation.
- The ERC and a "buddy" will remain on the site after the site has been evacuated (if safe) to assist local responders and advise them of the nature and location of the incident.

- The ERC will account for all personnel in the onsite assembly area.
- A designated person will account for personnel at alternate assembly area(s).
- The ERC will follow the incident reporting procedures in the "Incident Notification, Reporting, and Investigation" section of this HSP.

19.6 Evacuation Signals

Signal	Meaning
Grasping throat with hand	Emergency; help me.
Thumbs up	OK; understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

19.7 Firefighting Plan

(References: Section 01.E.01 & 06.A.02, EM 385-1-1 and CH2M HILL SOP HSE-208, *Fire Prevention*)

The decision on whether or not to try to extinguish a fire using available site personnel and equipment will be made by the SSC, and is based on whether the fire is small or large, and involves explosives or flammable liquids/gases.

19.7.1.1 Location of Fire Extinguishers

Fire extinguishers will be located around the project sites as required in the following places at a minimum:

- In each vehicle
- Near areas where flammable materials are stored or in use

All fire extinguishers will be kept clearly visible, marked, and placed where they are easily accessible.

19.8 Inclement Weather

Sudden inclement weather can rapidly encroach upon field personnel. Preparedness and caution are the best defenses. Field crew members performing work outdoors should carry clothing appropriate for inclement weather. Personnel are to take heed of the weather forecast for the day and pay attention for signs of changing weather that indicate an impending storm. Signs include towering thunderheads, darkening skies, or a sudden increase in wind. If stormy weather ensues, field personnel should discontinue work and seek shelter until the storm has passed.

Protective measures during a lightning storm include seeking shelter; avoiding projecting above the surrounding landscape (don't stand on a hilltop—seek low areas); staying away from open water, metal equipment, railroad tracks, wire fences, and metal pipes; and positioning people several yards apart. Some other general precautions include the following:

- Know where to go and how long it will take to get there. If possible, take refuge in a large building or vehicle. Do not go into a shed in an open area.
- The inclination to see trees as enormous umbrellas is the most frequent and most deadly mistake. Do not go under a large tree that is standing alone. Likewise, avoid poles, antennae, and towers.
- If the area is wide open, go to a valley or ravine, but be aware of flash flooding.
- If you are caught in a level open area during an electrical storm and you feel your hair stand on end, drop to your knees, bend forward and put your hands on your knees or crouch. The idea is to make yourself less

vulnerable by being as low to the ground as possible and taking up as little ground space as possible. Lying down is dangerous, since the wet earth can conduct electricity. Do not touch the ground with your hands.

- Do not use telephones during electrical storms, except in the case of emergency.

Remember that lightning may strike several miles from the parent cloud, so work should be stopped and restarted accordingly. The lightning safety recommendation is 30-30: Seek refuge when thunder sounds within 30 seconds after a lightning flash; and do not resume activity until 30 minutes after the last thunder clap.

High winds can cause unsafe conditions, and activities should be halted until wind dies down. High winds can also knock over trees, so walking through forested areas during high-wind situations should be avoided. If winds increase, seek shelter or evacuate the area. Proper body protection should be worn in case the winds hit suddenly, because body temperature can decrease rapidly.

19.8.1 Tornado Safety

Recognizing imminent tornado signs include seeing an unusually dark sky, possibly with some green or yellow clouds. You may hear a roaring or rumbling sound like a train, or a whistling sound like a jet. Large hail may also be falling. You may be able to see funnels, or they may be hidden by rain or hail.

Listen to your radio for tornado warnings during bad thunderstorms. If a tornado warning is issued, don't panic. Instead, listen and look. Quickly but calmly follow directions for getting to shelter.

Take cover. Indoors, you should go down into the basement and crouch down under the stairs, away from windows. Do not take an elevator. If you can't get to a basement, go into a closet or bathroom and pull a mattress over you or sit underneath a sturdy piece of furniture on the ground floor near the center of the building. Pull your knees up under you and protect your head with your hands.

A bad place to be in a tornado is in a building with a large freestanding roof such as a gymnasium, arena, auditorium, church, or shopping mall. If you are caught in such a building, take cover under something sturdy.

More than half of tornado deaths occur in mobile homes. If a tornado threatens, get out and go to a building with a good foundation, or lay down in a ditch away from vehicles and other objects.

If you are driving, get to a shelter, lie down in a ditch or seek cover up under the girders of an overpass or bridge. Stay as close to the ground as you can. Protect your head and duck from flying debris.

Stay away from metal and electrical equipment because lightning accompanies tornadoes.

If you have time before the tornado strikes, secure objects such as garbage cans and lawn furniture which can injure people. While most tornado damage is a result of the violent winds, most injuries and deaths actually result from flying debris.

Emergency Contacts

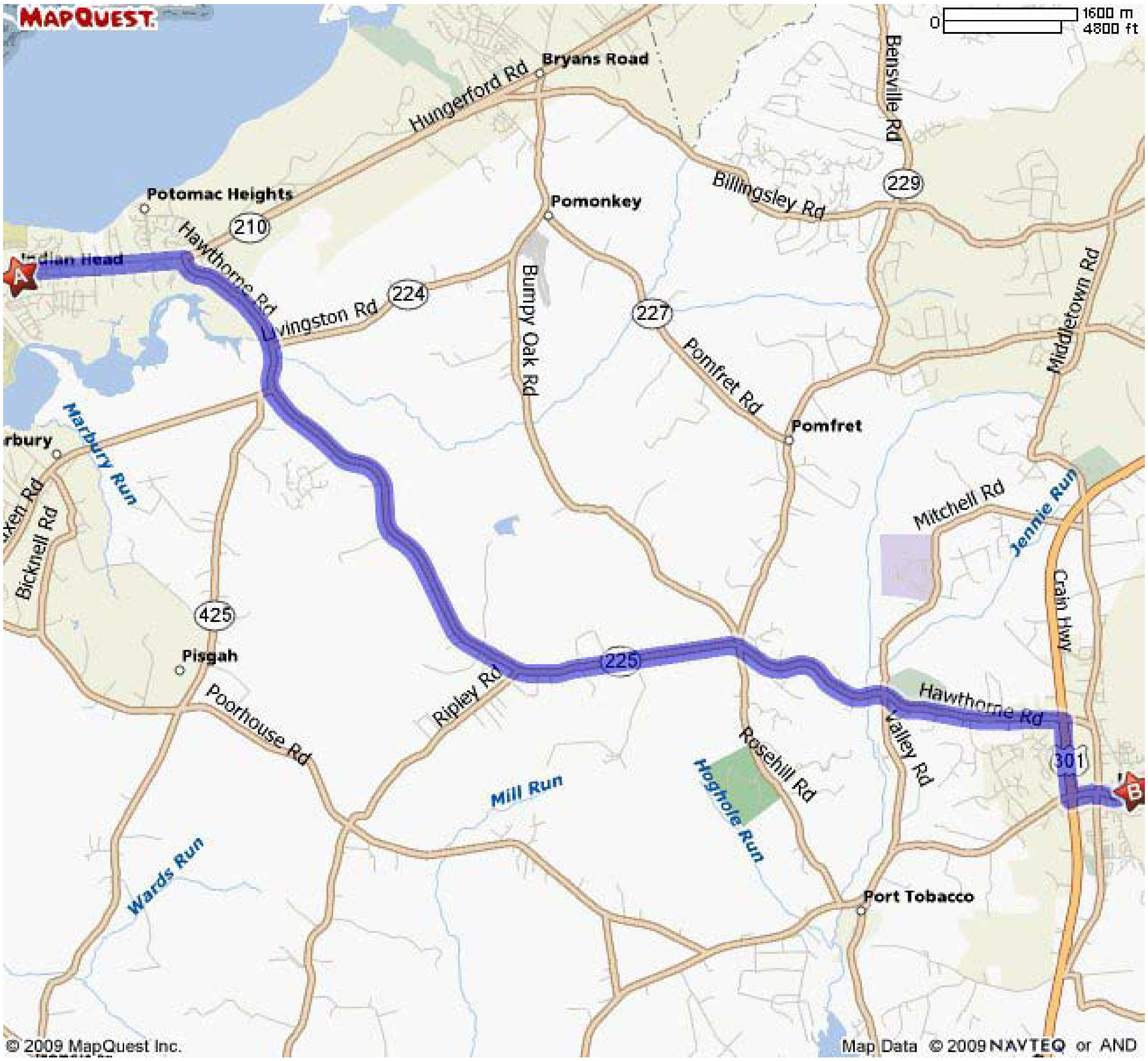
24-hour CH2M HILL Injury Reporting– 1-866-893-2514
24-hour CH2M HILL Serious Incident Reporting Contact – 720-286-4911

Medical Emergency – 911 **Facility Medical Response #:** 301-744-4333 (If in restricted area, use red call boxes-no cell phone usage in restricted area!) **Local Ambulance #: 911**	**CH2M HILL- Medical Consultant** WorkCare Dr. Peter Greaney M.D. 300 S. Harbor Blvd, Suite 600 Anaheim, CA 92805 800-455-6155/866-893-2514 714-978-7488
Fire/Spill Emergency – 911 Facility Fire Response #: 301-744-4333 (If in restricted area, use red call boxes-no cell phone usage in restricted area!) **Local Fire Dept #: 911**	**CH2M HILL Director – Health, Safety, Security & Environment** Andy Strickland/DEN 720-480-0685 (cell) or 720-286-2393 (office)
Security & Police – 911 Facility Security#: 301-744-4333 (If in restricted area, use red call boxes-no cell phone usage in restricted area!) **Local Police #: 911**	**CH2M HILL Responsible Health and Safety Manager (RHSM)** Name: Carl Woods Phone: (o) 513-889-5771, (c) 513-319-5771
Utilities Emergency Phone Numbers Contact Nick Carros, NSF-IH Phone 301-744-2263	**CH2M HILL Human Resources Department** Phone: Employee Connect toll-free number 1-877-586-4411 (U.S. and Canada)
CH2M HILL Project Manager Name: Jennifer Myers Phone: 703-376-5203	**CH2M HILL Worker's Compensation:** Contact Market HR dept. to have form completed or contact Jennifer Rindahl after hours: 720-891-5382
CH2M HILL SSHO Name: TBD Phone:	**Media Inquiries Corporate Strategic Communications** Name: John Corsi Phone: (720) 286-2087
CH2M HILL Project Environmental Manager Name: Hope Wilson Phone: (o) 678-530-4226, (c) 678-656-5411	**Automobile Accidents** Rental: Mary Ellegood-Oberts/DEN 720-286-2291 CH2M HILL owned vehicle: Linda George/DEN: 720-286-2057
Federal Express Dangerous Goods Shipping Phone: 800/238-5355	**CHEMTEL (hazardous material spills)** **Phone: 800/255-3924**
Facility Alarms: TBD on site arrival	Evacuation Assembly Area(s): TBD on site arrival
Facility/Site Evacuation Route(s): To be determined on site arrival	

Directions and MAP to Local Hospital

Local Hospital: Civista Medical Center 701 East Charles Street, La Plata, MD
Phone: 301-609-4000

Civista Medical Center, located at 701 East Charles Street, La Plata, MD
1. 0.0 Start on STRAUSS AV. N. Drive 0.9 miles
2. At 0.9 miles, drive onto HWY 210. Drive 0.7 miles
3. At 1.5 miles, TURN RIGHT on INDIAN HEAD LAPLATA RD. Drive 8.9 miles.
4. At 10.4 miles, drive onto HAWTHORNE DR. Drive 1.7 miles.
5. At 12.1 miles, TURN RIGHT on US 301. Drive 0.7 miles.
6. At 12.8 miles, TURN LEFT on CHARLES ST. Continue 0.6 miles to the hospital.



SECTION 20
Spill Containment Procedures

CH2M HILL and subcontractor personnel working at the project site shall be knowledgeable of the potential health, safety, and environmental concerns associated with petroleum and other substances that could potentially be released at the project site.

The following is a list of criteria that must be addressed in CH2M HILL's or the subcontractor's plans in the event of a spill or release. In the event of a large-quantity spill, notify emergency services. Personnel discovering a spill shall (only if safe to do so):

- Stop or contain the spill immediately (if possible) or note source. Shut off the source (for example, pump, treatment system) if possible. If unsafe conditions exist, then leave the area, call emergency services, inform nearby personnel, notify the site supervisors, and initiate incident reporting process. The SSHO shall be notified immediately.
- Extinguish sources of ignition (flames, sparks, hot surfaces, or cigarettes).
- Clear personnel from the spill location and barricade the area.
- Use available spill control equipment in an effort to ensure that fires, explosions, and releases do not occur, recur, or spread.
- Use sorbent materials to control the spill at the source.
- Construct a temporary containment dike of sorbent materials, cinder blocks, bricks or other suitable materials to help contain the spill.
- Attempt to identify the character, exact source, amount, and extent of the released materials. Identification of the spilled material should be made as soon as possible so that the appropriate cleanup procedure can be identified.
- Contact the RHSM and project EM in the event of a spill or release immediately so evaluation of reportable quantity requirements and whether agency reporting is required.
- Assess possible hazards to human health or the environment as a result of the release, fire or explosion.
- Follow incident notification, reporting, and investigation section of this plan.

SECTION 21

Inspections

21.1 Management Health, Safety, Security, and Environment Inspections

The Management Inspection Checklist (attached to this plan) is intended to facilitate PM leadership, provide an opportunity for PM's to mentor field staff on HSE and identify any big picture actions that need to be addressed. Observations that would improve global HSE program should also be included on the form. This checklist does NOT take the place of a formal HSE audit. The PM shall:

- Complete one checklist per month during fieldwork when visiting the site. The PM may delegate completion to the task lead, field team leader, or construction manager if the project is short duration and a visit is not planned for.
- Complete applicable sections of the checklist (can by typed or hand-written). Address issues with the field team, taking the opportunity to mentor staff by identifying the "root cause" of observation (for example, why are safe behavior observations not being completed, had this hazard been noted by any other team members?).
- Send completed form to Project Delivery Manager, Sector HSE Lead, and RHSM for tracking and review. Original should be kept in the project files.

21.2 Project Activity Self-assessment Checklists

In addition to the hazard controls specified in this document, Project Activity Self-assessment Checklists are contained as an attachment to this SSHP. The Project Activity Self–assessment Checklists are based upon minimum regulatory compliance and some site-specific requirements may be more stringent. The objective of the self-assessment process is to identify gaps in project safety performance, and prompt for corrective actions in addressing these gaps. The self-assessment checklists, including documented corrective actions, shall be made part of the permanent project records and maintained by the SSHO.

The self-assessment checklists will also be used by the SSHO in evaluating the subcontractors and any client contractors' compliance onsite.

The self-assessment checklists for the following tasks and exposures are required when the task or exposure is initiated and weekly thereafter while the task or exposure is taking place. The checklists shall be completed by the SSHO or other CH2M HILL representative and maintained in project files.

- Biological prevention
- Drilling
- Hand and Power Tools
- Lockout/Tagout
- Lifting

21.3 Safe Behavior Observations

Safe behavior observations (SBOs) are a tool to be used by supervisors to provide positive reinforcement for work practices performed correctly, while also identifying and eliminating deviations from safe work procedures that could result in a loss.

The SSHO or designee shall perform at least one SBO each week for any fieldwork performed by subcontractors or when there are at least two CH2M HILL personnel performing fieldwork.

The SSHO or designee shall complete the SBO form (attached to this SSHP) for the task/operation being observed and submit them weekly.

For federal projects, SBOs may be submitted electronically by e-mailing them to the address, “CH2M HILL ES FED Safe Behavior Observations,” when connected to the network or at CH2MHILLESFEDSafeBehaviorObservation@ch2m.com.

21.4 Deficiency Tracking System

21.4.1 Safe Behavior Observation Forms

All observed hazard forms will be completed onsite at the time of the observed hazard, or activity inspection. Both good behaviors and questionable or unsafe behaviors will be annotated on the form and discussed with the observed worker(s). Any unsafe behavior or acts observed will be documented in writing to the subcontractor’s project manager for action. All observed hazard forms will become a permanent part of the project files.

21.4.2 Self-assessment Checklists

Any item that is annotated with a “NO” must be explained on the last sheet of the checklist, and followed up for corrective action. The last page of each checklist has a column for recording the date the deficiency was corrected. The self-assessment checklists—once completed and signed by the inspector, reviewed with the applicable supervisor and/or employee, and signed by the project manager—will become a permanent record of inspection and part of the project files.

21.4.3 Open Deficiencies

All self-assessment checklists with open deficiencies or stop work orders will be the top priority for the SSC each work day to ensure they are corrected, any training accomplished, or the situation corrected to close out the deficiency. If the deficiency is not handled in a timely manner, the SSC will report the problem in writing to the prime contractor PM.

A copy of the Safety and Occupational Health deficiency tracking log shall be mounted on or be adjacent to the bulletin board or a notice on the bulletin board shall state the location where it may be accessed by all workers upon request. See Attachment 12 for the form.

SECTION 22

Incident Notification, Reporting, and Investigation

(Reference CH2M HILL SOP HSE-111, *Incident Notification, Reporting and Investigation*)

22.1 General Information

This section applies to the following:

- All injuries involving employees, third parties, or members of the public
- Damage to property or equipment
- Interruptions to work or public service (hitting a utility)
- Incidents that attract negative media coverage
- Near misses
- Spills, leaks, or regulatory violations
- Motor vehicle accidents

Documentation, including incident reports, investigation, analysis, and corrective measure taken shall be kept by the SSHO and maintained onsite for the duration of the project.

22.2 Section Definitions

Incident: An incident is an event that causes or could have caused undesired consequences. An incident may be caused by natural forces, employees, subcontractors, or third parties in any location associated with CH2M HILL operations, including offices, warehouses, project sites, private property, or public spaces. Incidents include the following:

- Injury or illness to a CH2M HILL employee or subcontractor employee, or member of the public
- Property damage
- Spill or release
- Environmental requirement or permit violation
- A "near-miss"
- Other (for example, fire, explosion, bomb threat, workplace violence, threats)

Accident: An incident involving actual loss through injury, damage to assets, or environmental harm

Near Miss: A near-miss occurs when an intervening factor prevented an injury or illness, property damage, spill or release, permit violation, or other event from occurring. Examples of near-miss situations include the following: a hard hat or other PPE prevented an injury; secondary containment or emergency shutoff prevented a spill; or an alert coworker prevented an incident.

Serious Incident: A Serious Incident must be immediately reported to senior management includes the following:

- Work-related death, or life threatening injury or illness of a CH2M HILL employee, subcontractor, or member of the public
- Kidnap/missing person
- Acts or threats of terrorism
- Event that involves a fire, explosion, or property damage that requires a site evacuation or is estimated to result in greater than $ 500,000 in damage
- Spill or release of hazardous materials or substances that involves a significant threat of imminent harm to site workers, neighboring facilities, the community, or the environment

22.3 Reporting Requirements

All employees and subcontractors' employees shall immediately report any incident (including "near misses," as defined in the section above) in which they are involved or witness to their supervisor.

The CH2M HILL or Subcontractor supervisor, upon receiving an incident report, shall inform his immediate superior and the CH2M HILL SSHO.

The SSHO shall immediately report the following information to the RHSM and PM by phone and e-mail:

- Project Name and Site Manager
- Date and time of incident
- Description of incident
- Extent of known injuries or damage
- Level of medical attention
- Preliminary root cause/corrective actions

If the incident was an environmental permit issue (potential permit noncompliance, other situation that result in a notice of violation) or a spill or release, contact the Project EM immediately so evaluation of reportable quantity requirements and whether agency reporting is required;

The CH2M HILL team shall comply with all applicable statutory incident reporting requirements such as those to OSHA, the police, or state federal environmental agency.

Be aware that many OSHA-designated states require reporting to the area OSHA office if one person is admitted to the hospital (for example, California and Washington); whereas, federal OSHA requires it if three or more are admitted.

22.4 HITS System and Incident Report Form

CH2M HILL maintains a HITS entry and/or IRF for all work-related injuries and illnesses sustained by its employees in accordance with recordkeeping and insurance requirements. A HITS entry and/or IRF will also be maintained for other incidents (property damage, fire, or explosion, spill, release, potential violation, and near misses) as part of our loss prevention and risk reduction initiative.

The SSHO shall complete an entry into the HITS database system located on CH2M HILL's Virtual Office (or if Virtual Office is not available, use the hard copy Incident Report Form and Root Cause Analysis Form and forward it to the RHSM) within 24 hours and finalize those forms within 3 calendar days.

22.5 Injury Management/Return-to-Work (for U.S./Puerto Rico-based CH2M HILL Staff Only)

(Reference CH2M HILL, SOP HSSE-124, Injury Management/Return-to-Work)

22.5.1 Background

The Injury Management Program has been established to provide orderly, effective, and timely medical treatment and return-to-work transition for an employee who sustains a work-related injury or illness. It also provides guidance and assistance with obtaining appropriate treatment to aid recovery, keep supervisors informed of employee status, and to quickly report and investigate work-related injury/illnesses to prevent recurrence.

To implement the Injury Management/Return-to-Work Program successfully, supervisors and/or SC should:

- Ensure employees are informed of the Injury Management/Return-to-Work Program.
- Become familiar with the Notification Process (detailed below).
- Post the Injury Management/Return-to-Work Notification Poster.

22.5.2 The Injury Management/Return-to-Work Notification Process:

- Employee informs their supervisor.
- Employee calls the Injury Management Program toll free number 1-866-893-2514 immediately and speaks with the Occupational Injury Nurse. This number is operable 24 hours per day, 7 days a week.
- Supervisor ensures employee immediately calls the Injury Management Program number. Supervisor makes the call with the injured worker or for the injured worker, if needed.
- Nurse assists employee with obtaining appropriate medical treatment, as necessary, schedules clinic visit for employee (calls ahead, and assists with any necessary follow up treatment). The supervisor or SC accompanies the employee if a clinic visit is necessary to ensure that employees receive appropriate and timely care.
- Supervisor or SC completes the HITS entry or Incident Report Form immediately (within 24 hours) and forwards it to the PM and RHSM.
- Nurse notifies appropriate CH2M HILL staff by e-mail (supervisor, Health & Safety, Human Resources, Workers' Compensation).
- Nurse communicates and coordinates with and for employee on treatment through recovery.
- Supervisor ensures suitable duties are identified and available for injured or ill workers who are determined to be medically fit to return to work on transitional duty (temporary and progressive).
- Supervisor ensures medical limitations prescribed (if any) by physician are followed until the worker is released to full duty.

22.6 Serious Incident Reporting Requirements

(Reference CH2M HILL SOP HSE-111, *Incident Reporting, Notification and Investigation*)

The serious incident reporting requirements ensures timely notification and allows for positive control over flow of information so that the incident is handled effectively, efficiently, and in conjunction with appropriate corporate entities. This standard notification process integrates Health, Safety, Security, and Environment and Firm-Wide Security Operations requirements for the consistent reporting of and managing of serious events throughout our operations.

22.6.1 Serious Incident Determination

The following are general criteria for determining whether an incident on CH2M HILL owned or managed facilities or program sites is considered serious and must be immediately reported up to Group President level through the reporting/notification process:

- Work-related death, or life threatening injury or illness of a CH2M HILL employee, subcontractor, or member of the public
- Kidnap or missing person
- Acts or threats of terrorism
- Event that involves a fire, explosion, or property damage that requires a site evacuation or is estimated to result in greater than $ 500,000 in damage
- Spill or release of hazardous materials or substances that involves a significant threat of imminent harm to site workers, neighboring facilities, the community, or the environment

22.6.2 Serious Incident Reporting

If an incident meets the "Serious Incident" criteria, the PM is to immediately contact the Crisis Manager at 720-286-4911, then follow the standard incident reporting procedure.

For all serious incidents this standard reporting process is implemented immediately so as to ultimately achieve notification to the Business Group President within 2 hours of incident onset or discovery, and notification to appropriate corporate Crisis Management Support Team.

Major accidents include any occupational hazard exposure or physical injury that requires more than basic first-aid (physical injury/exposure) or fire, explosion, or property damage exceeding $200,000. Major accidents require immediate notification of appropriate personnel as discussed below and must be done within 24 hours to the Contracting Officer/Representative.

In the event of an injury that constitutes an OSHA-recordable incident, the SSHO will notify the Navy Remedial Project Manager (RPM), Navy Resident Officer in Charge of Construction (ROICC), PM, Compliance Safety and Health Officer, and HSM as soon as practical after the incident. The reporting form shall be Contractor Safety Incident Report, found in Attachment 13.

ESBG US Operations
Incident Reporting Flow Diagram

Direct Reporting Responsibility

Informational Reporting

Incident:
- Injury or illness
- Hazardous substance exposure
- Damage to property
- Fire or explosion
- Spill, release, potential

If incident is an **injury** to US or Puerto Rico based CH2M HILL personnel contact the Occupational Health Nurse

The Ops Leader is responsible for completing the Incident Report Form (IRF) in **HITS** when there is an injury to a CH2M HILL employee. The PM, CM or SC is responsible for completing the IRF for all other incidents. ***The IRF/HITS must be completed within 24***

Incident
Ensure that Emergency Responders have been notified

Third Party – Incidents outside of our contractual obligations do not need to be communicated, unless they are serious and/or may affect CH2M HILL. The RHSM will

Employee or Subcontractor

Supervisor – Construction Manager - Safety Coordinator
Provide immediate notification by phone and email to PM and

Serious Incident:
- Work related death, or life threatening injury or illness of a CH2M HILL employee, subcontractor, or member of the public
- Kidnap/missing person
- Acts or threats of terrorism
- Event that involves a fire, explosion, or property damage that requires a site evacuation or is estimated to result in greater than $ 500,000 US in damage.

CRISIS MANAGER:
If the incident meets the "**Serious Incident"** criteria, contact the Crisis Manager **(720.286.4911)**

Responsible HSM (RHSM)
Immediately notify the Sector OR Client Program HSE Manager, immediately notify the Responsible Environmental Manager (EM) for spills, NOVs, and permit issues, and direct the incident investigation.

Client Program HSE Manager
Notify Sector HSM, and coordinate communication and incident investigations.

Immediate notification to the Sector HSM is not

Project Manager
Provide notification to the Sector OR Program Project Delivery (PD) or Operations (Ops) Manager or designee. Notification is based on program or sector specific criteria.

Sector or Program PD/Ops Manager
Notify Client Program Manager OR Sector Director, provide guidance and follow the incident through to resolution.

Client Program Manager
Notify Sector Director; provide decision-

Sector HSE Manager
Coordinate communication, direct significant

HSSE Director
Provide decision-making assistance or direction for incident resolution.

Sector Director
Provide decision-making assistance or direction for incident resolution.

ES US Operations Director/ Executive Leadership Team
Provide decision-making assistance, direction for incident resolution, and make higher level notifications as

Post-emergency incident communications regarding serious incidents at a CH2M HILL office or project (regardless of the party involved) shall be considered sensitive in nature and must be

22.7 Incident Root Cause Analysis

The accident analysis is essential if all causes of the incident are to be identified for the correct remedial actions to be taken to prevent the same and similar type of incident from recurring. Root Cause Analysis (RCA) shall be completed for all recordable injuries, property damage incidents in excess of $5000.00 (US), environmental permit violations, spills and releases that are required to be reported to regulatory agencies, and any other incident, including near misses where they RHSM or PM determines an RCA is appropriate. The RHSM/ Responsible Environmental Manager is responsible for ensuring it is completed and results entered in the incident report form in HITS. RCA's must be completed using a team that includes, at least the RHSM or designee, the involved party(ies), a responsible operations representative (for example, PM, construction manager, crew supervisor, etc.) and an independent management representative not associated with the incident.

The Root Cause Analysis Form must be completed for all Loss Incidents and Near Loss Incidents. The form must be submitted to the investigation team for review.

For minor losses or near losses, the information may be gathered by the supervisor or other personnel immediately following the loss. Based on the complexity of the situation, the information may be all that is necessary to enable the investigation team to analyze the loss, determine the root cause, and develop recommendations. More complex situations may require the investigation team to revisit the loss site or re-interview key witnesses to obtain answers to questions that may arise during the investigation process.

Photographs or videotapes of the scene and damaged equipment should be taken from all sides and from various distances. The point is especially important when the investigation team will not be able to review the loss scene.

The investigation team must follow the Root Cause Analysis Flow Chart (see Attachment 4 of the SOP) to assist in identifying the root cause(s) of a loss. Any loss may have one or more root causes and contributing factors. The root cause is the primary or immediate cause of the incident, while a contributing factor is a condition or event that contributes to the incident happening, but is not the primary cause of the incident. Root causes and contributing factors that relate to the person involved in the loss, his or her peers, or the supervisor should be referred to as "personal factors." Causes that pertain to the system within which the loss or injury occurred should be referred to as "job factors."

Personal factors include the following:

- Lack of skill or knowledge
- Correct way takes more time and/or requires more effort
- Short-cutting standard procedures is positively reinforced or tolerated
- Person thinks there is no personal benefit to always doing the job according to standards

Job Factors include the following:

- Lack of or inadequate operational procedures or work standards
- Inadequate communication of expectations regarding procedures or standards
- Inadequate tools or equipment

The root cause(s) could be any one or a combination of these seven possibilities or some other uncontrollable factor. In the vast majority of losses, the root cause is very much related to one or more of these seven factors. Uncontrollable factors should be used rarely and only after a thorough review eliminates all seven other factors.

22.7.1 Corrective Actions

Include all corrective actions taken or those that should be taken to prevent recurrence of the incident. Include the specific actions to be taken, the employer and personnel responsible for implementing the actions, and a timeframe for completion. Be sure the corrective actions address the causes.

Once the investigation report has been completed, the PM shall hold a review meeting to discuss the incident and provide recommendations. The responsible supervisors shall be assigned to carry out the recommendations, and shall inform the SSHO upon successful implementation of all recommended actions.

- Evaluation and follow-up of the IRF will be completed by the type of incident by the RHSM or EM.
- Incident investigations must be initiated and completed as soon as possible but no later than 72 hours after the incident.

SECTION 23

Records and Reports

An organized project filing system is essential for good documentation and recordkeeping. The following are some of the many benefits to an organized filing system:

- Other CH2M HILL employees can easily and quickly find documents
- Records are readily available for review
- Records may be needed during OSHA investigations, audits, or other legal matters
- Records may be needed on short notice in case of an accident, illness, or other emergency
- Systematic recordkeeping aids in overall project organization

The project filing system shall be established at the beginning of the project and maintained throughout all phases of construction and archived in accordance with CH2M HILL's Records Retention Policy. The information contained in the filing system shall be updated regularly and/or as specified in this document. The PM and SC are responsible for collecting documentation, including subcontractor documentation, and maintaining a complete and organized filing system.

Below are examples of records that must be maintained as the project progresses:

- Exposure records includes air monitoring data (including calibration records), MSDSs, and exposure modeling results
- Physical hazard exposure records include noise, ionizing radiation, non-ionizing radiation, vibration, and lasers exposure assessments and measurements
- Respiratory fit test records
- Training records
- Incident reports, investigations and associated back-up information such as agency notifications, calculations, and corrective actions taken
- Federal or state agency inspection records
- Other Records:
  - Ergonomic evaluations
  - HSE audits and assessments
  - Project-specific HSE plans
  - Confined space entry permits
  - Equipment inspections
  - Equipment maintenance
  - Emergency equipment inspection records
  - SBOs
  - Self-assessment checklists
- The RHSM shall coordinate with the PM or designee to ensure that final project-specific HSE records described in this section, including negative exposure determinations, are maintained with the project files in accordance with the CH2M HILL records retention schedule, or forwarded to the Medical Surveillance Program Administrator, as appropriate. Records retention requirements are detailed in the Recordkeeping and Access to Records SOP, HSE-119.

Health and Safety Plan Employee Signoff Form

EMPLOYEE SIGNOFF FORM

Health and Safety Plan

The CH2M HILL project employees and subcontractors listed below have been provided with a copy of this HSP, have read and understood it, and agree to abide by its provisions.

Project Name: **Project Number:**

EMPLOYEE NAME (Please print)	**EMPLOYEE SIGNATURE**	**COMPANY**	**DATE**

Chemical Inventory/Register Form

CH2MHILL

CHEMICAL INVENTORY/REGISTER FORM

Refer to SOP HSE-107, Attachment 1, for instructions on completing this form.

Location:

HCC:

☐ Office ☐ Warehouse ☐ Laboratory ☐ Project:

Project No.:

Regulated Product	Location	Container labeled (✓if yes)	MSDS available (✓if yes)

MSDS for the listed products will be maintained at:

CH2M HILL Health and Safety Plan

Attachment 3

Chemical-specific Training Form

CH2MHILL®

CHEMICAL-SPECIFIC TRAINING FORM

Refer to SOP HSE-107 Attachment 1 for instructions on completing this form.

Location:	Project # :
HCC:	Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

The HCC shall use the product MSDS to provide the following information concerning each of the products listed above.

- ☐ Physical and health hazards
- ☐ Control measures that can be used to provide protection (including appropriate work practices, emergency procedures, and personal protective equipment to be used)
- ☐ Methods and observations used to detect the presence or release of the regulated product in the workplace (including periodic monitoring, continuous monitoring devices, visual appearance or odor of regulated product when being released, etc.)

Training participants shall have the opportunity to ask questions concerning these products and, upon completion of this training, will understand the product hazards and appropriate control measures available for their protection.

Copies of MSDSs, chemical inventories, and CH2M HILL's written hazard communication program shall be made available for employee review in the facility/project hazard communication file.

CH2M HILL Health and Safety Plan
Attachment 4

Project Activity Self-assessment Checklists/Permits/Forms

Heat stress physiological monitoring form
Biological prevention
Drilling
Hand and Power Tools
Lockout/Tagout
Manual Lifting

HEAT STRESS PHYSIOLOGICAL MONITORING FORM	
Project:	
Date:	Company:

1. Take and record measurement of temperature or pulse at the frequency indicated in the safety plan.
2. Follow the Physiological Monitoring Protocol in the safety plan.
3. Never continue work if your body temperature is more than 100.4° F/38° C, or if you are experiencing sudden and severe fatigue, nausea, dizziness, or lightheadedness.

Employee:
Describe action taken below if measurements are exceeded:

Time								
Temp								
Pulse								

Employee:
Describe action taken below if measurements are exceeded:

Time								
Temp								
Pulse								

Employee:
Describe action taken below if measurements are exceeded:

Time								
Temp								
Pulse								

Employee:
Describe action taken below if measurements are exceeded:

Time								
Temp								
Pulse								

Employee:
Describe action taken below if measurements are exceeded:

Time								
Temp								
Pulse								

CH2M HILL Health and Safety Plan

Attachment 5

Key Target Zero Program Elements

(blank forms for field use)

Activity Hazard Analysis EM 385 format

Pre-Task Safety Plans

Safe Behavior Observation

Incident Report and Investigation

(use electronic form when possible)

HITS

Lessons Learned Template

Field Change Request Form

FCR tracking log

Activity Hazard Analysis (AHA)

ACTIVITY/WORK TASK:		Overall Risk Assessment Code (RAC) (Use highest code)					
	SIGNATURES	Activity #		AHA #			
PWD/OICC/ROICC OFFICE		**Risk Assessment Code (RAC) Matrix**					
NAME & DATE ACCEPTED BY GDA:							
CONTRACT NUMBER:		**Severity**	**Probability**				
TASK ORDER/DELIVERY #:							
PRIME CONTRACTOR:			Frequent	Likely	Occasional	Seldom	Unlikely
SUBCONTRACTOR:							
DATE OF PREPARATORY MEETING:		Catastrophic	E	E	H	H	M
DATE OF INITIAL INSPECTION:		Critical	E	H	H	M	L
CONTRACTOR COMPETENT PERSON:		Marginal	H	M	M	L	L
SITE SAFETY and HEALTH OFFICER		Negligible	M	L	L	L	L
ACCEPTANCE BY GOVERNMENT DESIGNATED AUTHORITY (GDA)		Review each **"Hazard"** with identified safety **"Controls"** and determine (RAC)					
E = EXTREMELY HIGH (PWO/OICC/ROICC)		Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" .Place the highest RAC at the top of AHA. This is the overall risk assessment code for this activity					
H = HIGH RISK (FEAD DIRECTOR)		**"Severity"** is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible after controls are in place					
M = MODERATE RISK (CM or ET or PAR)							
L = LOW RISK (ET or PAR)		**"Probability"** is the likelihood to cause an incident, near miss, or accident did occur and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely after controls are put in place.					

Job Steps	Hazards	Controls	RAC

Job Steps	Hazards	Controls	RAC

Equipment to be Used	Training Requirements and Competent or Qualified Personnel name(s)	Inspection Requirements	RAC

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements

Instructions for completing Contractor Activity Hazard Analysis

1. Activity/Work Task – Insert work/task this AHA is written for that is excavation, scaffold building, foundation preparation.
2. PWO/OICC/ROICC – Insert name of Public Works Office, Officer In Charge of Construction Office or Resident Officer in Charge of Construction (PWD/OICC/ROICC
3. Enter name & date AHA accepted by Government Designated Authority (GDA)
4. Enter contract number
5. Enter Task order or Delivery order number
6. Enter Prime Contractors name
7. Enter Subcontractors name
8. Enter date preparatory meeting was held
9. Enter date initial inspection was performed
10. Enter name of contractor competent person onsite for this activity
11. Enter name of Prime Contractor Site Safety and Health Officer
12. Level of government person responsible for accepting the AHA, progressive signatures as level of risk increases.
13. Overall Risk Assessment code is highest code assigned to any Job step after Hazards are assessed and Controls have been assigned
14. Schedule number is activity number from production daily reports
15. AHA number is the sequential number of all AHA's for this contract.
16. Job steps is the complete sequence of work, not general statements to complete the entire activity
17. Hazards is the known safety risks associated with completing the task
18. Controls is the safety measures in place to reduce the hazard to the lowest level possible
19. Risk Assessment code is where Severity and Probability intersect, place that letter E, H, M, or L in the RAC column
20. List all equipment to be used to complete this activity that is crane, backhoe, vehicle, all heavy equipment
21. List the training requirements required by EM 385, Safety Spec 01356 or OSHA that apply to this task.
List competent person(s) required for specific tasks in EM 385
List qualified person(s) required for specific tasks in EM 385
List CPR/First Aid training and qualification dates
22. List all inspection requirements of EM 385, Governmental Safety Requirements Specifications or OSHA 29 CFR 1926

Pre-task Safety Plan (PTSP) and Safety Meeting Sign-in Sheet

Project:____________________________ Location: ________________ Date:_________________

Supervisor: __________________________________ Job Activity:____

____

Attendees: Print Name Sign Name

____
____
____
____
____
____
____

List Tasks and verify that applicable AHAs have been reviewed:

____
____
____

Tools/Equipment Required for Tasks (ladders, scaffolds, fall protection, cranes/rigging, heavy equipment, power tools):

____
____
____

Potential Health and Safety Hazards, including chemical, physical, safety, biological and environmental (check all that apply):

__ Chemical burns/contact	__ Trench, excavations, cave-ins	__ Ergonomics
__ Pressurized lines/equipment	__ Overexertion	__ Chemical splash
__ Thermal burns	__ Pinch points	__ Poisonous plants/insects
__ Electrical	__ Cuts/abrasions	__ Eye hazards/flying projectile
__ Weather conditions	__ Spills	__ Inhalation hazard
__ Heights/fall > 6 feet	__ Overhead Electrical hazards	__ Heat/cold stress
__ Noise	__ Elevated loads	__ Water/drowning hazard
__ Explosion/fire	__ Slips, trip and falls	__ Heavy equipment
__ Radiation	__ Manual lifting	__ Aerial lifts/platforms
__ Confined space entry	__ Welding/cutting	__ Demolition
__Underground Utilities	__ Security	__ Poor communications

Other Potential Hazards (Describe):

____
____
____

Hazard Control Measures (Check All That Apply):

PPE
__ Thermal/lined
__ Eye
__ Dermal/hand
__ Hearing
__ Respiratory
__ Reflective vests
__ Flotation device
__ Hard Hat
__ Safety-Toed Boots

Protective Systems
__ Sloping
__ Shoring
__ Trench box
__ Barricades
__ Competent person
__ Locate buried utilities
__ Daily inspections
__ Entry Permits/notification

Fire Protection
__ Fire extinguishers
__ Fire watch
__ Non-spark tools
__ Grounding/bonding
__ Intrinsically safe equipment

Electrical
__ Lockout/tagout
__ Grounded
__ Panels covered
__ GFCI/extension cords
__ Power tools/cord inspected
__ Overhead line clearance
__ Underground utils ID'd

Fall Protection
__ Harness/lanyards
__ Adequate anchorage
__ Guardrail system
__ Covered opening
__ Fixed barricades
__ Warning system

Air Monitoring
__ PID/FID
__ Detector tubes
__ Radiation
__ Personnel sampling
__ LEL/O2
__ No visible dust
__ Other

Proper Equipment
__ Aerial lift/ladders/scaffolds
__ Forklift/heavy equipment
__ Backup alarms
__ Hand/power tools
__ Crane with current inspection
__ Proper rigging
__ Operator qualified

Welding & Cutting
__ Cylinders secured/capped
__ Cylinders separated/upright
__ Flash-back arrestors
__ No cylinders in confined space entry
__ Flame retardant clothing
__ Appropriate goggles

Confined Space Entry
__ Isolation
__ Air monitoring
__ Trained personnel
__ Permit completed
__ Rescue

Medical/ER
__ First-aid kit
__ Eye wash
__ First-aid-CPR trained personnel
__ Route to hospital

Heat/Cold Stress
__ Work/rest regime
__ Rest area
__ Liquids available
__ Monitoring
__ Training

Vehicle/Traffic
__ Traffic control
__ Barricades
__ Flags
__ Signs

Permits
__ Hot work
__ Confined space
__ Lockout/tagout
__ Excavation
__ Demolition
__ Energized work

Demolition
__ Pre-demolition survey
__ Structure condition
__ Isolate area/utilities
__ Competent person
__ Hazmat present

Inspections:
__ Ladders/aerial lifts
__ Lanyards/harness
__ Scaffolds
__ Heavy equipment
__ Drill rigs/geoprobe rigs
__ Cranes and rigging
__ Utilities marked

Training:
__ Hazwaste (current)
__ Construction
__ Competent person
__ Task-specific
__ First-aid/CPR
__ Confined Space
__ Hazcom

Underground Utilities
__Dig alert called
__3rd Party locater
__As-builts reviewed
__Interview site staff
__Client review
__soft locate necessary?

Incident Communications
__Work stops until cleared by TM/CM
__Immediate calls to TM/CM
__Client notification
__24 hour notification setup
__Clear communications

AHA' s
__reviewed and approved by HSM
__onsite and current
__applicable for this day's work
__Communication and incident processes included?

Field Notes (including observations from prior day, etc.):
____
____
____

Name (Print): ________________________________
Signature:________________________________ Date:__________________

CH2MHILL®

Safe Behavior Observation Form

☐ Federal ☐ Commercial (check one)
☐ International

☐ Construction or ☐ Consulting (check one)

Project Number (required):	Client/Program:
Project Name:	Observer: Date:
Position/Title of worker observed:	Background Information/ comments:
Task/Observation Observed:	

- ❖ Identify and reinforce safe work practices/behaviors
- ❖ Identify and improve on at-risk practices/acts
- ❖ Identify and improve on practices, conditions, controls, and compliance that eliminate or reduce hazards
- ❖ Proactive PM support facilitates eliminating/reducing hazards (do you have what you need?)
- ❖ Positive, corrective, cooperative, collaborative feedback/recommendations

Actions & Behaviors	Safe	At-Risk	Observations/Comments
Current & accurate Pre-Task Planning/Briefing (Project safety plan, STAC, AHA, PTSP, tailgate briefing, etc., as needed)			**Positive Observations/Safe Work Practices:**
Properly trained/qualified/experienced			
Tools/equipment available and adequate			
Proper use of tools			**Questionable Activity/Unsafe Condition Observed:**
Barricades/work zone control			
Housekeeping			
Communication			
Work Approach/Habits			
Attitude			
Focus/attentiveness			**Observer's Corrective Actions/Comments:**
Pace			
Uncomfortable/unsafe position			
Inconvenient/unsafe location			
Position/Line of fire			
Apparel (hair, loose clothing, jewelry)			
Repetitive motion			**Observed Worker's Corrective Actions/Comments:**
Other…			

For ES Federal Sector projects please email completed forms to: CH2M HILL ES FED Safe Behavior Observation

HITS Incident Report Hardcopy (Phase 1 – Initial Entry)

Phase 1 – Initial Entry

Type of Incident (May select more than one)

☐ Injury/Illness ☐ Spill/Release ☐ Near Miss
☐ Property Damage ☐ Environment/Permit ☐ Other

General Information Section

Preparer's Name: ______________________ **Preparer's Phone Number:** ______________________
Date of Incident: ______________ **Time of Incident**: ____________ AM / PM
What Business Group is accountable for this incident: ______________________
What Business Group SubGroup is accountable for this incident: ______________________
What CH2M HILL Company is accountable for this incident: ______________________
Where did the Incident occur?

☐ United States, Geographic Region: ______________________
☐ Canada, Province/Territory: ______________________
☐ International, County: ______________________

Location of Incident?

☐ Company Premises, CH2M HILL Office (use 3 letter office code if available): ______________________
☐ Project, Project name: ______________________
☐ In Transit
Traveling from: ______________________
Traveling to: ______________________
☐ At Home
☐ Other, Specify: ______________________

Describe the incident: ______________________
____
____

Describe how this event could have been prevented: ______________________
____

Provide Witness Information:

Name: ______________________ Phone: ______________________
Name: ______________________ Phone: ______________________
Name: ______________________ Phone: ______________________

Personnel Notified of Incident (Provide name, date and time):

CH2M HILL Personnel:
____

Client Personnel:
____

Additional Comments:
____
____

Injury/Ilness Section **[Complete only if Injury/Illness Incident type selected]**

Who was injured?

☐ CH2M HILL Employee or CH2M HILL Temp Employee
☐ Subcontractor to CH2M HILL (Non-LLC Joint Venture Project)
☐ LLC Joint Venture Partner Employee
☐ LLC Joint Venture Project Subcontractor/Contractor
☐ Other

Name of Injured: ______________________ **Job Title:** ______________________
Employer Name: ______________________ **Supervisor of Employee:** ______________________

Complete for CH2M HILL Employee Injuries

Business Group of Injured Employee: ______________________
Has the employee called the Injury Management Administrator (1-866-893-2514)?

☐ Yes ☐ No ☐ Not Sure

Has the injured employee's supervisor been notified of this incident?

☐ Yes ☐ No ☐ Not Sure

Complete for Non-CH2M HILL Employee Injuries

Has the project SSHO been notified of this incident?

☐ Yes ☐ No ☐ Not Sure

Project Safety Coordinator: ______________________________

Body Part Affected: ______________________________

Injury/Illness (Result): ______________________________

Describe treatment provided (if medication provided, identify whether over-the-counter or prescription): ______________________________

____

Describe any work restriction prescribed (include dates and number of days): ______________________________

____

Physician/Health Care Provider Information

Name: ______________________________ Phone: ______________

Was treatment provided away from the worksite?

☐ No

☐ Yes

Facility Name:

____

Address:

____

City: ______________________________ Phone Number:

____

Was injured treated in an emergency room?

☐ No ☐ Yes

Was injured hospitalized overnight as an in-patient?

☐ No ☐ Yes

General Information Environmental Section **[Complete only if Environment/Permit or Spill/Release Incident type selected]**

Who had control of the area during the incident?

☐ CH2M HILL, Company: ______________________________

☐ Subcontractor, Company: ______________________________

☐ Joint Venture Partner/Contractor/Subcontractor, Company: ______________________________

☐ Other, Company: ______________________________

Relationship to CH2M HILL: ______________________________

Property Damage Section **[Complete only if Property Damage Incident type selected]**

Property Damaged: ______________________________

Property Owner:

____

Damage Description: ______________________________

Estimated US Dollar Amount: ______________________________

Spill or Release Section **[Complete only if Spill/Release Incident type selected]**

Substance: ______________________________

Estimated Quantity: ______________________________

Did the spill/release move off the property?: ______________________________

Spill/Release From: ______________________________

Spill/Release To: ______________________________

Environment/Permit Section **[Complete only if Environment/Permit Incident type selected]**

Describe Environmental or Permit Issue: ______________________________

Permit Type: ______________________________

Permitted Level or Criteria (for example, discharge limit):

____

Permit Name and Number (for example, NPDES No. ST1234):

____

Substance and Estimated Quantity: ______________________________

Duration of Permit Exceedance: ______________________________

HSSE

Lessons Learned

[Date] ESBG LL-11-xx

Subject	**[Insert Descriptive Name of Lessons Learned]**
CH2M HILL Project?	[Yes or No]
Situation	[Describe incident or situation that occurred in general terms. Try to be brief and avoid unnecessary details such as names of people or projects, business groups, divisions, dates, location, etc.]
Lessons Learned (Recommendations and Comments)	• Bullet out any lessons learned, recommendations or other important "take away" information that would benefit others. Tie the recommendations to the incident or event, and avoid including information that is not directly tied to the event.
Submitted By	[Name/Office Location/Phone]
Additional Information Contact	[Name/Office Location/Phone]
Keywords/Categories	[Insert any keywords or incident categories that would aid in a search for this lessons learned]

Send completed Lessons Learned to the ESBG HSSE Director for posting and distribution. Please include a recommended distribution list.

CH2MHILL

Health and Safety Field Change Request (FCR)

Date of Change:		
FCR No. (assigned by RHSM):		
Applicable Health and Safety Plan Title:		
Project Number:	**Project Name & Location:**	
Subject of Change:		
Recommended Change:		
Reason for Change:		
Submitted by:	**Company**: CH2M HILL	**Date:**
Review & Acceptance:		
Project Manager:	**Date:**	
Health & Safety Mgr:	**Date:**	

Distribution:

1.	2.	3.	4.
5.	6.	7.	8.

File Copies: Project File

Project Health and Safety Field Change Request Log

Indian Head SWMU 14 Pilot Test

FCR Number	Description of changes	Date of issue
	.	

CH2M HILL Health and Safety Plan

Attachment 6

Fact Sheets

Tick Fact Sheet

Vehicle Accident Guidance

Crystalline Silica

Working Alone

Tick-Borne Pathogens—A Fact Sheet

Most of us have heard of Lyme disease or Rocky Mountain Spotted Fever (RMSF), but there are actually six known tick-borne pathogens that present a significant field hazard. In some areas, these account for more than half of our serious field incidents. The following procedures should be applied during any field activity—even in places that are predominantly paved with bordering vegetation.

Hazard Recognition

An important step in controlling tick-related hazards is understanding how to identify ticks, their habitats, their geographical locations, and signs and symptoms of tick-borne illnesses.

Tick Identification

The following are the five varieties of hard-bodied ticks that have been associated with tick-borne pathogens:

- Deer (Black Legged) Tick (eastern and pacific varieties)
- Lone Star Tick
- Dog Tick
- Rocky Mountain Wood Tick

The varieties and their geographical locations are illustrated on the following page.

Tick Habitat

In eastern states, ticks are associated with deciduous forest and habitat containing leaf litter. Leaf litter provides a moist cover from wind, snow, and other elements. In the north-central states, is generally found in heavily wooded areas often surrounded by broad tracts of land cleared for agriculture.

On the Pacific Coast, the bacteria are transmitted to humans by the western black-legged (deer) tick and habitats are more diverse. In this region, ticks have been found in habitats with forest, north coastal scrub, high brush, and open grasslands. Coastal tick populations thrive in areas of high rainfall, but ticks are also found at inland locations.

Illnesses and Signs and Symptoms

There are six known tick-borne pathogens that cause human illness in the United States. The pathogens may be transmitted during a tick bite—normally hours after attachment. The following are the illnesses, presented in approximate order of most common to least:

- Lyme (bacteria)
- RMSF (bacteria)
- Ehrlichiosis (bacteria)
- STARI (Southern Tick-Associated Rash Illness) (bacteria)
- Tularemia (Rabbit Fever) (bacteria)
- Babesia (protozoan parasite)

Symptoms will vary based on the illness, and may develop in infected individuals typically between 3 and 30 days after transmission. Some infected individuals will not become ill or may develop only mild symptoms. These illnesses present with some or all of the following signs & symptoms: fever, headache, muscle aches, stiff neck, joint aches, nausea, vomiting, abdominal pain, diarrhea, malaise, weakness, small solid, ring-like, or spotted rashes. The bite site may be red, swollen, or develop ulceration or lesions. For Lyme disease, the bite area will sometimes resemble a target pattern. A variety of long-term symptoms may result if the illness is left untreated, including debilitating effects and death.

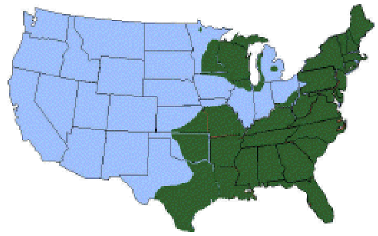
Deer Tick

From Left: adult female, adult male, nymph, and larvae Deer Tick (centimeter scale)

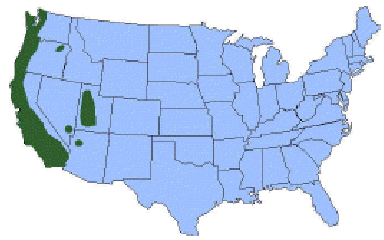
Lone Star Tick

Dog Tick

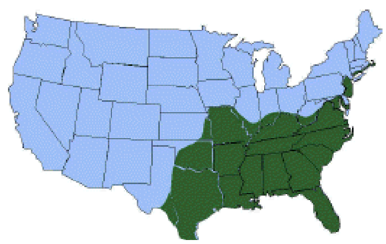
Rocky Mountain Wood Tick



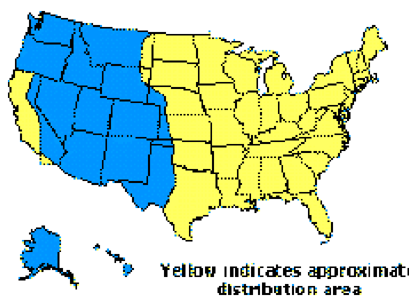
Distribution of Deer Tick (dark green)

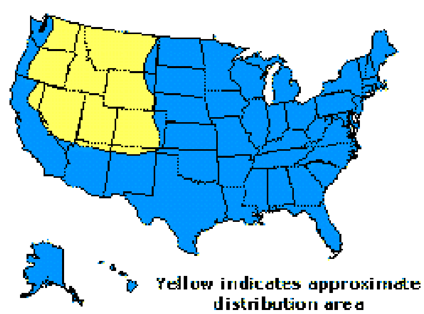


Distribution of Pacific Deer Tick (dark green)



Distribution of Lone Star Tick (Green)





Hazard Control

The methods for controlling exposure to ticks include, in order of most- to least-preferred:

- Avoiding tick habitats and ceasing operations in heavily infested areas
- Reducing tick abundance through habitat disruption or application of acracide
- Personal protection through use of repellants and protective clothing
- Frequent tick inspections and proper hygiene

Vaccinations are not available and preventative antibiotic treatment after a bite is generally not recommended.

Avoidance and Reduction of Ticks

To the extent practical, tick habitats should be avoided. In areas with significant tick infestation, consider stopping work and withdrawing from area until adequate tick population control can be achieved. Stopping and withdrawing should be considered as seriously as entering an area without proper energy control or with elevated airborne contaminants—tick-borne pathogens present risk of serious illness!

In areas where significant population density or infestation exists, tick reduction should be considered. Tick reduction can be achieved by disrupting tick habitats and/or direct population reduction through the use of tick-toxic pesticides (Damminix, Dursban, Sevin, etc.).

Habitat disruption may include only simple vegetative maintenance such as removing leaf litter and trimming grass and brush. Tick populations can be reduced by between 72 and 100 percent when leaf litter alone is removed. In more heavily infested areas, habitat disruption may include grubbing, tree trimming or removal, and pesticide application (Damminix, Dursban, Sevin, etc.). This approach is practical in smaller, localized areas or perimeter areas that require occasional access. Habitat controls are to be implemented with appropriate health and safety controls, in compliance with applicable environmental requirements, and may be best left to the property owner or tenant or to a licensed pesticide vendor. Caution should be exercised when using chemical repellents or pesticides in or around areas where environmental or industrial media samples will be collected for analysis.

Personal Protection

After other prevention and controls are implemented, personal protection is still necessary to control exposure to ticks. Personal protection must include all of the following steps:

- So that ticks may be easily seen, wear light-colored clothing. Full-body new Tyvek (paper-like disposable coveralls) may also be used
- To prevent ticks from getting underneath clothing tuck pant legs into socks or tape to boots
- Wear long-sleeved shirts, a hat, and high boots
- Apply DEET repellent to exposed skin or clothing per product label
- Apply permethrin repellent to the outside of boots and clothing before wearing, per product label
- Frequently check for ticks and remove from clothing
- At the end of the day, search your entire body for ticks (particularly groin, armpits, neck, and head) and shower
- To prevent pathogen transmission through mucous membranes or broken/cut skin, wash or disinfect hands, and/or wear surgical-style nitrile gloves any time ticks are handled

Pregnant individuals and individuals using prescription medications should consult with their physician and/or pharmacists before using chemical repellents. Because human health effects may not be fully known, use of chemical repellents should be kept to a minimum frequency and quantity. Always follow manufacturers' use instructions and precautions. Wash hands after handling, applying, or removing protective gear and clothing. Avoid situations such as hand-to-face contact, eating, drinking, and smoking when applying or using repellents.

Remove and wash clothes per repellent product label. Chemical repellents should not be used on infants and children.

Vaccinations are generally not available for tick-borne pathogens. Although production of the LYMErix™ Lyme disease vaccination has been ceased, vaccination may still be considered under specific circumstances and with concurrence from the consulting physician.

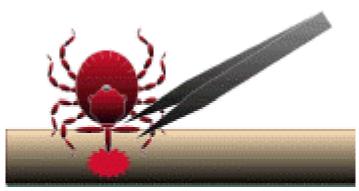
Tick Check

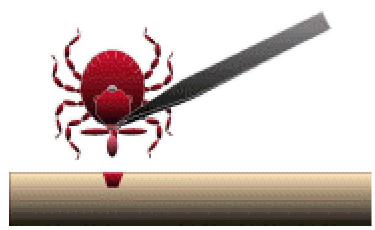
A tick check should be performed after field survey before entering the field vehicle (you do not want to infest your field vehicle with ticks). Have your field partner check your back; the backs of your legs, arms, and neck; and your hairline. Shake off clothing as thorough as possible before entering the vehicle. Once the field day is complete, repeat this procedure and perform a thorough self check.

If a tick has embedded itself into the skin, remove the tick as described below.

Tick Removal

1. Use the tick removal kit obtained through the CH2M HILL Milwaukee warehouse, or a fine-tipped tweezers or shield your fingers with a tissue, paper towel, or nitrile gloves.
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 healthcare provider if infection occurs.





3. Avoid squeezing, crushing, or puncturing the body of the tick because its fluids (saliva, hemolymph, gut contents) may contain infectious organisms. Releasing these organisms to the outside of the tick's body or into the bite area may increase the chance of infectious organism transmission.
4. Do not handle the tick with bare hands because infectious agents may enter through mucous membranes or breaks in the skin. This precaution is particularly directed to individuals who remove ticks from domestic animals with unprotected fingers. Children, elderly persons, and immunocompromised persons may be at greater risk of infection and should avoid this procedure.
5. After removing the tick, thoroughly disinfect the bite site and wash your hands with soap and water.
6. Should you wish to save the tick for identification, place it in a plastic bag, with the date of the tick bite, and place in your freezer. It may e used at a later date to assist a physician with making an accurate diagnosis (if you become ill).

Note: Folklore remedies such as 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, increasing the chances of transmitting the pathogen. These methods of tick removal should be avoided. In addition, a number of tick removal devices have been marketed, but none are better than a plain set of fine tipped tweezers.

First-aid and Medical Treatment

Tick bites should always be treated with first-aid. Clean and wash hands and disinfect the bite site after removing embedded tick. Individuals previously infected with Lyme disease does not confer immunity—re-infection from future tick bites can occur even after a person has contracted a tick-borne disease.

The employee should contact the Injury Management/Return To Work provider (IMRTW), WorkCare using the toll-free number 866-893-2514 to report the tick bite. WorkCare will follow-up with each CH2M Hill employee who reports a tick bite and is at risk of developing Lyme disease by monitoring for symptoms up to 45 days, and will refer the employee to a medical provider for evaluation and treatment as necessary.

2015 Vehicle Accident Guidance—E&N Business Group

Remember that if you a **renting** a non-CH2M HILL owned vehicle (short-term rental) in the U.S., you should carry the insurance card from the state where your driver's license is issued.

If you operate a **fleet vehicle**, carry the insurance card where the vehicle is registered.

For ALL Vehicles if you are in an accident:

1. If you are injured, call 911 for emergency medical treatment or 1-866-893-2514 to contact the CH2M HILL Occupational Nurse/Physician for minor injuries. If you feel you have not been injured, contact the RHSM for guidance on whether calling the CH2M HILL Occupation Nurse/Physician is applicable.

2. **Call the Police--**For any vehicle accident/damage, it is recommended that the local police (or site security/emergency services if working on a client site that provides such services) be called to determine if a report needs to be filed. In some instances, a report may not be required (during accident alerts, or in public parking lots). Document that the authorities were called and follow up with any guidance they give you. State requirements vary. If a report is filed, obtain a copy.

3. Notify Supervisor, (and PM/RHSM if working on a project site)

4. Complete a HITS report on the VO.

Additional Steps

To report an auto accident, and before a claim can be taken by telephonic reporting, have available your name (the company name alone is no longer accepted, a driver's name must be provided even for fender benders), location of accident and your office address if different than the accident location, business group and project number. A claim cannot be taken without your name, address, business group and your project number. By location the state where the accident occurred, and which office you are aligned to, i.e., accident occurs in Idaho, but you are out of the Denver office. Advise the claim recorder the accident occurred in ID, but that your office location is Denver. This will assist the claim intake person in identifying location coding for the claims.

Auto accidents involve two different sections of an Auto policy:

1) Liability to others due to Bodily Injury and Property Damage
2) Physical Damage - Comprehensive and Collision - damage to the vehicle CH employee is driving

CH2M Hill has Liability coverage for any auto - our policy will respond on either a primary or excess basis.

Refer to the table below for additional notifications to make based on the type of accident experienced and vehicle being used.

Liability - Bodily Injury or Property Damage to Others

Scenario	Which Coverage Responds	What to do if in an accident
CH2M Hill fleet, pool or project vehicle - long term lease - lower 48	CH2M Hill - Primary	Contact Broadspire (1-800-753-6737); Mary Ellegood-Oberts/DEN (720-286-2291); Linda George/DEN (720-286-2057)
CH2M Hill fleet, pool or project vehicle - long term lease - Alaska (North Slope)	CH2M Hill - Primary	Mary Ellegood-Oberts/DEN (720-286-2291)
Client vehicle driven by CH2M Hill employee	Client's auto policy unless client has made CH2M Hill responsible for vehicle	Contact Broadspire (1-800-753-6737); Mary Ellegood-Oberts/DEN (720-286-2291); contact client
Short term lease (30 days or less)	Rental car company if rented through Enterprise, Budget or Hertz; CH2M Hill excess	Contact Broadspire (1-800-753-6737); Contact local branch of rental car company where vehicle leased (ERAC includes 24 hour roadside assistance) and Mary Ellegood-Oberts/DEN (720-286-2291)

Short term lease (30 days or less)	CH2M Hill - Primary if rented through company other than our national agreements; $100,000 deductible	Contact Broadspire (1-800-753-6737); Contact rental car company and Mary Ellegood-Oberts/DEN (720-286-2291)
Personal vehicle used on business	Employee's personal auto policy; CH2M Hill on an excess basis	Contact personal auto insurance company; contact Mary Ellegood-Oberts/DEN (720-286-2291)

Physical Damage - damage to vehicle CH employee was driving

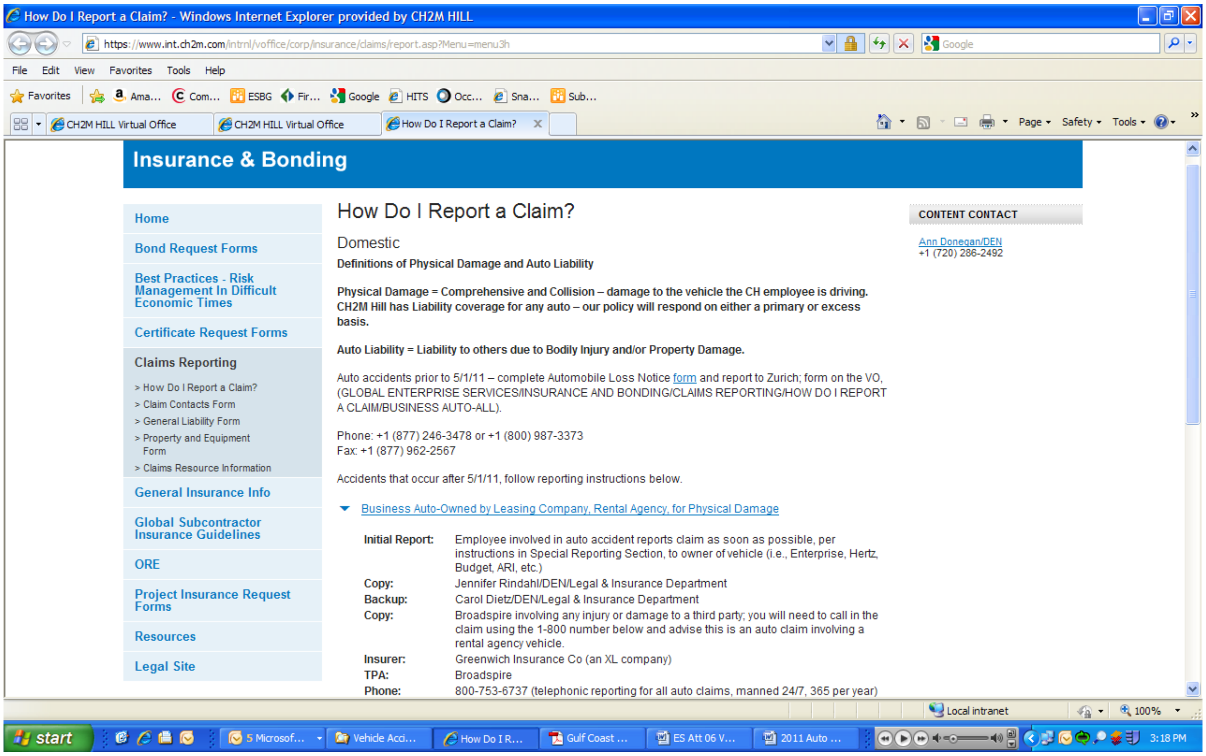
Scenario	Which Coverage Responds	What to do if in an accident
CH2M Hill fleet, pool or project vehicle - long term lease - lower 48	CH2M Hill ONLY if vehicle is scheduled on policy - $5,000 deductible	Contact Broadspire (1-800-753-6737); Mary Ellegood-Oberts/DEN (720-286-2291); Linda George/DEN (720-286-2057)
CH2M Hill fleet, pool or project vehicle - long term lease - Alaska (North Slope)	CH2M Hill Equipment Schedule if scheduled on policy	Contact Mary Ellegood-Oberts/DEN (720-286-2291)
CH2M Hill fleet, pool or project vehicle - long term lease	ARI if physical damage coverage purchased - $500 deductible	Contact Mary Ellegood-Oberts/DEN (720-286-2291); call ARI at 1-800-221-1645 give them Client Code and ARI fleet vehicle number; and notify Linda George/DEN - Fleet Coordinator - 720-286-2057
Client vehicle CH2M Hill Employee is driving	Client's auto policy unless client has made CH2M Hill contractually responsible for vehicle	Contact Mary Ellegood-Oberts/DEN (720-286-2291); contact client; contact Broadspire (1-800-753-6737)
Short term lease (30 days or less) using corporate VISA	VISA if corporate credit card used and vehicle is not a pickup, truck, cargo van or used off-road	Contact VISA - 1-800-847-2911 or http://www.visa.com/eclaim
Short term lease (30 days or less) through Enterprise (ERAC) and vehicle is used off-road and physical damage coverage included when vehicle leased	ERAC up to $3,000 in damage; CH2M Hill's coverage is excess	Notify Rental Car Company; contact Mary Ellegood-Oberts/DEN (720-286-2291) if damage over $5,000
Short term lease (30 days or less) did **not** use corporate VISA Personal vehicle used on business	CH2M Hill - $5,000 deductible (project responsibility) CH will reimburse the amount of the deductible carried on the employee's policy up to $500 whichever is less	Contact Broadspire (1-800-753-6737); Contact Mary Ellegood-Oberts/DEN (720-286-2291); contact VISA - 1-800-847-2911 or http://www.visa.com/eclaim Contact Mary Ellegood-Oberts/DEN (720-286-2291); contact client; contact Broadspire (1-800-753-6737)

Details for reporting a claim on the CH2M Hill VO are accessed by going to the VO home page and clicking:

GLOBAL ENTERPRISE SERVICES/INSURANCE & BONDING/CLAIMS REPORTING

HOW DO I REPORT A CLAIM TAB or access the following URL:

https://www.int.ch2m.com/intrnl/voffice/corp/insurance/claims/report.asp?Menu=menu3h



For Personally Owned Vehicles (POVs):

CH2M HILL does not provide auto insurance for POVs, it is responsibility of the owner. If you are in a vehicle accident conducting company business, contact the police as above, supervisor, and 911 or CH2M HILL's occupational nurse/physician as stated above. Complete a HITS report. Contact Mary Ellegood-Oberts/DEN for assistance for meeting personal insurance deductibles (up to $500) with proof of insurance and deductible.

If using your POV for extended project use, notify the PM to make sure a rental car is not needed. Check your insurance policy for guidance on using the POV for business use.

Additional Resources:

[Claims Resource Manual]()

CH2MHILL

Crystalline Silica Fact Sheet

Uses and Occurrences

Silica is a naturally occurring element in rocks and soil existing in an amorphous or crystalline state. Amorphous is characterized by a large scale random arrangement of silicon and oxygen atoms abundant in naturally-occurring forms such as diatomaceous earth (skeletal remains of marine organisms), and vitreous silica or volcanic glass. Crystalline silica is characterized by a large scale, repeating pattern of silicon and oxygen atoms occurring in three primary mineralogical forms, polymorphs quartz, christobolite, and tridymite.

Crystalline silica is a natural constituent of the earth's crust and is a basic component of sand, concrete, brick, asphalt, granite, and some blasting grit. Employees may be exposed to the health hazards associated with crystalline silica when they are performing any of the following activities:

- Abrasive blasting
- Jack-hammering
- Concrete crushing
- Pneumatic Hammering
- Rock drilling
- Mixing of concrete or grout
- Concrete drilling
- Concrete grinding
- Sawing concrete, concrete blocks, or bricks
- Chipping or scarifying concrete
- Rock crushing (Note that quartz is the most common form of crystalline silica.)
- Moving or dumping piles of concrete, rock, or sand
- Housekeeping activities (shoveling, sweeping, vacuuming, etc.)
- Demolition involving any of these materials

If a material or product contains crystalline silica in quantities greater than 0.1% there should be a Material Safety Data Sheet (MSDS) for it, and the product must have a label that identifies it contains silica. Even materials containing small amounts of crystalline silica may be hazardous if they are used in ways that produce high dust concentrations. Concrete contains Portland Cement with silica and rock that contains silica.

Physical Characteristics

Appearance: White or tan sand, granular, crushed or ground

Odor: None

Flammable: None

Flash Point: None

Flammable Range: None

Specific gravity: 2.65

Stability: Stable

Incompatibilities: Contact with powerful oxidizing agents, such as fluorine, chlorine trifluoride, and oxygen difluoride, may cause fires

Melting Point: 1710°C or 3110°F

Boiling Point: 2230°C or 4046°F

Potential Health Effects

Inhalation:

- Silicosis: Respirable crystalline silica (quartz) can cause silicosis, a fibrosis (scarring) of the lungs. Silicosis may be progressive; it may lead to disability and death.
- Lung Cancer: Crystalline silica (quartz) inhaled from occupational sources is classified as carcinogenic to humans.
- Tuberculosis: Silicosis increases the risk of tuberculosis.
- Autoimmune and Chronic Kidney Diseases: Some studies show excess numbers of cases of scleroderma, connective tissue disorders, lupus, rheumatoid arthritis, chronic kidney diseases and end-stage kidney disease in workers exposed to respirable crystalline silica.
- Non-Malignant Respiratory Diseases (other than silicosis): Some studies show an increased incidence in chronic bronchitis and emphysema in workers exposed to respirable crystalline silica.

Eye Contact: Crystalline silica (quartz) may cause abrasion of the cornea.

Skin Contact: Not applicable. **Ingestion:** Not applicable.

Chronic Effects: The adverse health effects -- silicosis, lung cancer, autoimmune and chronic kidney diseases, tuberculosis, and non-malignant respiratory diseases-- are chronic effects.

Signs and Symptoms of Exposure: Generally, there are no signs or symptoms of exposure to crystalline silica (quartz).

Medical Conditions Generally Aggravated by Exposure: The condition of individuals with lung disease (e.g., bronchitis, emphysema, chronic obstructive pulmonary disease) can be aggravated by exposure.

Modes of Exposure

Inhalation: Dusts

Skin Absorption: None

Ingestion: Dusts

Exposure Limits – Respirable Crystalline Silica

TLV	25 μg/m^3
NIOSH	50 μg/m^3
OSHA PEL	10 mg/m^3
	2+ % respirable quartz in sample

PPE

Eye:	Safety glasses;
Skin:	Chemical protective gloves and body protection
Respiratory:	Air-purifying respirators with P-100 cartridges, or supplied-air respirators, depending on the exposure, and a PAPR if requested by the worker

First Aid

Inhalation:	Move to fresh air; seek medical attention promptly
Skin:	Quick drenching with water; wash skin with soap and water; seek medical attention promptly
Eyes	Flush with water for 15 minutes, lifting the lower and upper lids occasionally; seek medical attention promptly
Ingestion :	Seek medical attention promptly

WORKING ALONE PROTOCOL
CALL-IN CONTACT FORM

Date of site work:_______________ Expected start time:______________
Name of CH2M HILL employee in the field:_____________________________________
Name of CH2M HILL employee responsible to receive contact:
Client Emergency Contact (if any):
CH2M HILL employee's contact numbers:
  Radio #__________________________
  Cell Phone #______________________
Address and Location of work:____
Directions/Map:

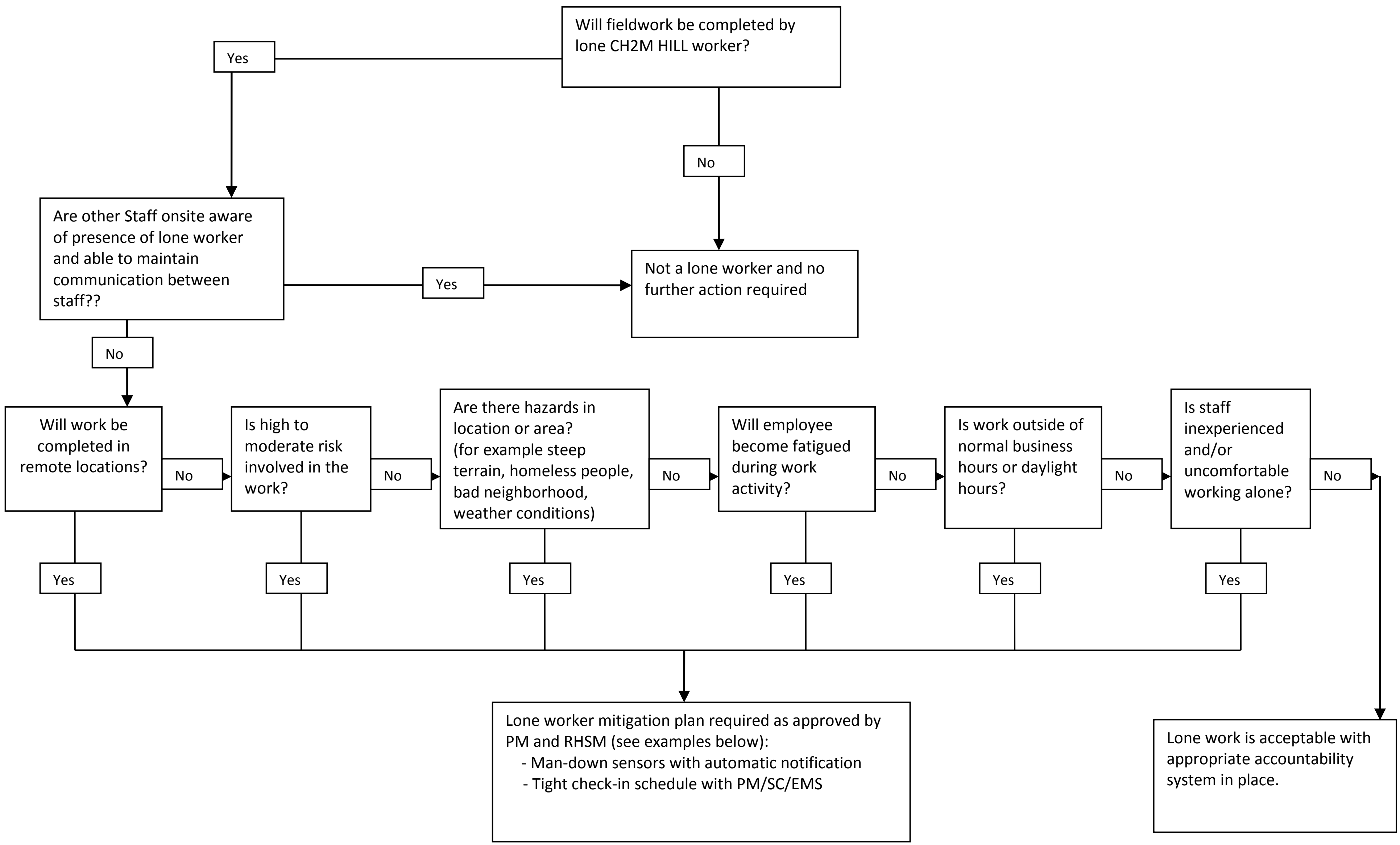
Planned Activity:____
Specified Frequency and time for call in:____

Time	Verified	Location

If lone worker fails to call in at specified frequency/time:

1. Call worker's radio and cell to determine if an emergency exists.
2. If no reply, immediately call client security/emergency service if there is one at the site.
3. If there is no client security, call Emergency Services (911). Inform the dispatcher there is a lone worker that cannot be contacted and there may be an emergency onsite. Provide the lone worker's name, their last known location, and your contact information.
4. After Emergency Services have been contacted, call the other emergency contacts, PM, and Responsible Health and Safety Manager.

Lone Worker Protocol



Observed Hazard Form

CH2MHILL

OBSERVED HAZARD FORM

Name/Company of Observer (*optional*):

Date reported:____________________

Time reported:______________________

Contractor/s performing unsafe act or creating unsafe condition:

1. ____

2. ____

3. ____

Unsafe Act or Condition:

____
____
____
____
____
____
____
____
____

Location of Unsafe Act or Condition:

Corrective Actions Taken: Date: ____________

____
____
____
____
____

Project Safety Committee Evaluation: Date: ____________

____
____
____
____

Stop Work Order Form

CH2MHILL

Stop Work Order

REPORT PREPARED BY:

Name:	**Title:**	**Signature:**	**Date:**

ISSUE OF NONPERFORMANCE:

Description:	Date of Nonperformance:
	_________________

SUBCONTRACTOR SIGNATURE OF NOTIFICATION:

Name:	**Title:**	**Signature:**	**Date:**

**** Corrective action is to be taken immediately. Note below the action taken, sign and return to CCI.* Work may not resume until authorization is granted by CH2M HILL Constructors, Inc. Representative,***

SUBCONTRACTOR'S CORRECTIVE ACTION

Description:	Date of Nonperformance:
	_________________

SUBCONTRACTOR SIGNATURE OF CORRECTION

Name:	**Title:**	**Signature:**	**Date:**

Agency Inspection Target Zero Bulletin

Environmental Services Business Group

TARGET ZERO BULLETIN

Subject: HSSE Agency Inspections (OSHA, EPA, DOT, State Health Department)

Do you know what YOU would do if an agency inspector arrived at your site unannounced?

Recently, a State Occupational Safety and Health Administration (OSHA) inspector made an unannounced visit to one of our Federal project sites. OSHA, U.S. Environmental Protection Agency (EPA), and authorized state or local agencies have authority to inspect any facility that is subject to health, safety, and environmental legislation. Inspections may be announced or unannounced. This particular inspector indicated that the project was targeted for an inspection because the work was funded by the American Recovery and Reinvestment Act (ARRA).

Enterprise Standard Operating Procedure (SOP) HSE-201, *Agency Inspections and Communications,* describes the responsibilities, procedures, and requirements associated with inspections conducted by external regulatory agencies, as well as the methods for communicating information to key individuals. This Target Zero Bulletin is a brief summary of what to do in the event of an agency inspection at your site. Refer to the SOP for more specific guidance.

Notification of Inspections

- If the inspection is an announced regulatory agency inspection, the Project Manager (PM) should notify the Responsible Health and Safety Manager (RHSM) and Responsible Environmental Manager (REM) well in advance of the inspection.
- If an unannounced agency inspector visits one of our projects, Field personnel must immediately notify the project Emergency Response Coordinator (ERC). Typically the ERC is the Safety Coordinator (SC).
- The ERC must immediately notify the RHSM/REM, as appropriate, of unannounced inspections, or designate someone to call the RHSM/REM. The RHSM/REMs can provide guidance to the field staff and PM.

Inspector Credential Verification

- Upon arrival, the ERC must request the inspector to provide official credentials. Record the inspector's name and office phone number or obtain the inspector's business card.
- The inspector shall sign the visitors log and be given a site-specific health, safety, and environmental protection briefing.
- The inspector shall meet any site access requirements associated with security clearances, specialized training, and medical monitoring. The CH2M HILL representative shall verify that the inspector possesses these requirements; access will only be granted to those areas where appropriate access requirements are met. Some inspectors have the authority to gain access to any work area at any time, such as an inspector with a search warrant. In these cases, we can stop work operations as necessary to protect the safety of the inspector(s).

Opening Conference

- The CH2M HILL Project Manager, ERC, RHSM, or REM, and the inspector shall determine attendees for the opening conference. The RHSM (for OSHA and other worker health and safety inspections) or REM (for environmental inspections) shall join the opening conference via conference call.
- The inspector shall inform CH2M HILL of the purpose of the inspection and provide a copy of the complaint, if applicable.
- The inspector shall outline the scope of the inspection, including employee interviews conducted in private, physical inspection of the workplace and records, possible referrals, discrimination complaints, and the closing conference(s).

Requests for OSHA Logs

- An OSHA inspector may request to review the project OSHA Injury/Illness log, better known as the OSHA 300 Log. Contact your RHSM for assistance in obtaining the OSHA 300 Log.
- Field projects with a continuous duration of one year or longer are considered to be separate establishments and are required to maintain an OSHA 300 log specific to the project. The project OSHA 300 log should be maintained onsite and kept current.
- Recordable injuries and illnesses sustained on field projects less than one year in duration are maintained on the CH2M HILL office log where the injured employee is based.

The Inspection

- The scope of the inspection shall be limited to that indicated by the inspector in the opening conference. The inspector shall be escorted to relevant areas only. The ERC or other designated by the RHSM or REM must accompany the inspector during the inspection.
- Ensure that the inspection is limited to the scope that the inspector disclosed during the opening conference. The ERC should always take notes which identify: areas inspected, machinery or equipment and materials examined, employees or other persons interviewed, and photographs taken by the inspector.
- The inspector will observe safety, health, and environmental conditions and practices and document the inspection process. The inspector may also take photos and instrument readings, examine records, collect air samples, measure noise levels, survey existing engineering controls, and monitor employee exposure to toxic vapors, gases, and dusts.
- CH2M HILL should gather duplicate information (photographs, readings, samples) in the same manner and condition as the inspector. If the equipment needed to take duplicate samples is not onsite, ask the inspector if the sampling can wait until the equipment is available. If samples are taken, request a description of the tests that the agency intends to perform on the samples and request results as soon as they are available.
- Employees may be questioned during the inspection tour. The employee can refuse to speak to an inspector, can speak to the inspector with a company representative (including management) present, or can speak to the inspector privately. It is CH2M HILL policy that employees who wish to speak to the inspector are not discriminated against, intimidated, or otherwise mistreated for exercising their rights during compliance inspections.
- Copies of documents should not be provided to the inspector without the approval of the RHSM or REM or Legal Insurance Department (LID). **DO NOT** voluntarily release documents. Respond only to inspection team requests.
- During the course of the inspection, the inspector may point out violations. For each violation, the CH2M HILL representative should ask the inspector to discuss possible corrective action. Where possible, violations detected by the inspector should be corrected immediately and noted by the inspector as corrected.
- For those items which cannot be corrected immediately, an action plan shall be formulated for timely correction. In any instance, employees exposed to hazards shall be removed from the area.

Closing Conference

After the inspection, a closing conference is normally held as follows:

- The CH2M HILL PM, ERC, RHSM or REM shall be involved via conference call in the closing conference, at a minimum;
- The inspector shall describe the apparent violations found during the inspection and other pertinent issues as deemed necessary by the inspector. CH2M HILL shall be advised of their rights to participate in any subsequent conferences, meetings or discussions. Any unusual circumstances noted during the closing conference shall be documented by the ERC;

- The inspector shall discuss violations observed during the inspection and indicate for which violations a citation and a proposed penalty may be issued or recommended;
- The ERC shall request receipts for all samples and approved documents photocopied by the inspector, request a photocopy of the inspector's photograph log, and request a copy of the final inspection report; and
- Any documentation from an agency inspection must be transmitted immediately to the RHSM or REM, and LID.

Unannounced regulatory agency inspections may happen at any time on our projects -

Get your RHSM/REM and PM involved immediately if an Inspector arrives.

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 10

Completed CH2M HILL AHAs

Activity Hazard Analysis (AHA)

ACTIVITY/WORK TASK:	Drilling Oversight	Overall Risk Assessment Code (RAC) (Use highest code)					M
SWMU14 Pilot Test, Indian Head	SIGNATURES	Activity #			AHA #		
PWD/OICC/ROICC OFFICE		**Risk Assessment Code (RAC) Matrix**					
NAME & DATE ACCEPTED BY GDA:							
CONTRACT NUMBER:		**Severity**	**Probability**				
TASK ORDER/DELIVERY #:							
PRIME CONTRACTOR:			Frequent	Likely	Occasional	Seldom	Unlikely
SUBCONTRACTOR:							
DATE OF PREPARATORY MEETING:		Catastrophic	E	E	H	H	M
DATE AND NAME OF REVIEWER	2-13-15 Mark Orman	Critical	E	H	H	M	L
CONTRACTOR COMPETENT PERSON:		Marginal	H	M	M	L	L
SITE SAFETY and HEALTH OFFICER		Negligible	M	L	L	L	L
ACCEPTANCE BY GOVERNMENT DESIGNATED AUTHORITY (GDA)		Review each **"Hazard"** with identified safety **"Controls"** and determine (RAC)					
E = EXTREMELY HIGH (PWO/OICC/ROICC)		Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" .Place the highest RAC at the top of AHA. This is the overall risk assessment code for this activity					
H = HIGH RISK (FEAD DIRECTOR)		**"Severity"** is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible after controls are in place					
M = MODERATE RISK (CM or ET or PAR)							
L = LOW RISK (ET or PAR)		**"Probability"** is the likelihood to cause an incident, near miss, or accident did occur and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely after controls are put in place.					

Job Steps	Hazards	Controls	RAC
Preparing for activities outdoors	1. Warm/Hot weather/sun exposure, dehydration 2. Biological Hazards (Insects/Ticks-Lime Disease, Bees and Wasps, gnats) 3. Severe Weather/Evacuation	1. Keep exposed skin covered or use sun block, drink plenty of water 2. Follow temperature extremes section of HSP. Acclimatize to hot weather work. 3. Be conscious of your individual tolerance to work in hot weather and monitor yourself and co-workers for signs and symptoms of heat stress. 4. Stay hydrated, take breaks as needed in vehicle to cool down. 5. Wear light colored long sleeved shirt at pants, tuck pant legs into socks, check for ticks at least daily, Use insect repellant containing DEET. 6. Follow the biological hazard precautions, guidelines, and fact sheets in the HSP for, ticks, snakes, hazardous plants, etc. 7. Take time to review where the closest structure that can be used when severe weather occurs. Listen to	L

Preparing for activities outdoors (continued)		weather reports and plan for severe weather. Designate an emergency evacuation assembly area and evacuation routes. Keep a copy of the Emergency **8.** Contact page from the HSP accessible.	
Mobilizing to location	1. Vehicle Break-down. 2. High foot and vehicle traffic on site. 3. Restricted access areas/unauthorized personnel. 4. Slips/trips/falls at system/well location.	1. Perform a visual of inspection of vehicle prior to use, including looking underneath the vehicle. 2. Follow all posted speed limits and follow traffic patterns/haul routes. 3. Always wear your seatbelt. 4. Drive Defensively. 5. Use a spotter to maneuver in tight areas. 6. Be aware of all restricted areas and obey rules regarding access to those areas. In general, avoid restricted areas whenever possible. 7. Perform a visual inspection of the site, identify and remove potential trip hazards, verify walkways are clear and necessary equipment and safety supplies are readily available 8. Use a buddy when necessary to haul equipment and supplies 9. Ensure a spill kit, eye-wash, unit and fire extinguisher are at the location.	**M**
Observation of drilling	Slips, trips, and falls	1. Inspect area for tripping hazards - mark/remove obstructions 2. Wear safety-toed boots with good tread. 3. Use good housekeeping practices, keeping the work area clear of potential tripping hazards.	**L**
	Fire/explosion/Spills	1. Contractor to have spill materials and fire extinguisher in the area. 2. Keep ignition sources away from the work area. 3. No smoking in the area.	**L**
	Noise, flying debris, and entanglement with equipment.	1. Personnel conducting oversight duties shall wear hearing protection if it is not possible to communicate with another person standing next to you using your normal voice. 2. Personnel shall maintain a safe distance from the drilling equipment. 3. Personnel shall wear eye protection and hard hats at all times when drilling operations are being conducted. 4. Personnel shall not wear loose fitting clothing to avoid the potential for entanglement. 5. Operator should be verifying equipment condition daily before work start using equipment specific checklist, demonstrate emergency stop switch operability.	**M**

		6. Be aware; stand clear of heavy objects that are hoisted overhead.	
	Underground/overhead utilities	1. Have all sampling locations cleared by a licensed utility locator prior to beginning work. 2. Ensure that all overhead utility lines are at least 10 feet away. 3. If an obstruction is encountered, suspend work and determine what it is. If it cannot be determined, contact the RHSM/client.	**L**
	Strains from manually moving materials, equipment, and drums.	1. Personnel shall be directed to use proper lifting techniques such as keeping back straight, lifting with legs, limiting twisting, and getting help in moving bulky/heavy materials and equipment. 2. Mechanical equipment shall be used as much as possible to minimize manual lifting. 3. Follow controls in the HSP and SOP HSE-121, Lifting	**L**
	Exposure to site contaminants	1. Contractor to set up work zones, perform air monitoring, wear PPE, and perform equipment/personal decontamination in accordance with contractor's HSP. 2. PPE includes minimum PPE (hard hat, safety-toed boots, safety glasses with side shields) 3. Perform monitoring using a calibrated PID, or ensure contractor is performing air monitoring as specified in their HSP. Follow protocol in HSP. 4. Properly remove PPE and wash hands and face, no smoking, drinking, eating in the EZ or CRZ. **5.** Buddy system will be used when entering the EZ.	**L**
	Traffic Hazards	1. Wear high visibility traffic vests near heavy equipment or traffic. 2. Contractor to utilize traffic control equipment (cones, delineators, etc.) to route traffic around work area as needed.	**M**

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements
1. Hand and power tools, if needed 2. Fire Extinguisher (present in area) 3. Eye Wash (present in area) 4. First Aid Kit (present in area) 5. PPE: Client requires hard hat, safety glasses, safety toe boots, high visibility vest or shirt at all times while on site	1. Inspect all vehicles, equipment, tools, and PPE prior to each use (remove from service any defective equipment) 2. Use applicable Self-Assessment Checklists in HSP.	1. OSHA 40-hour HAZWOPER initial training and current refresher. 2. Training on CH2M HILL and Contractor's HSP and applicable AHAs. 3. Qualified CH2M HILL Safety Coordinator-HW. 4. Hazard Communication training (see hazard communication section of HSP) for any chemicals brought onsite.

PRINT NAME **SIGNATURE**

Supervisor Name: ____________________ ____________________________ **Date/Time:**________________________________

Safety Officer Name: ____________________ ____________________________ **Date/Time:**________________________________

Employee Name(s): ____________________ ____________________________ **Date/Time:**________________________________

____________________ ____________________________ **Date/Time:**________________________________

____________________ ____________________________ **Date/Time:**________________________________

____________________ ____________________________ **Date/Time:**________________________________

____________________ ____________________________ **Date/Time:**________________________________

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Date/Time:

Date/Time:

Date/Time:

Date/Time:

Date/Time:

Date/Time:

Date/Time:

Activity Hazard Analysis (AHA)

ACTIVITY/WORK TASK:	GW MW sampling, decon, IDW	Overall Risk Assessment Code (RAC) (Use highest code)					L
	SIGNATURES	Activity #				AHA #	
PWD/OICC/ROICC OFFICE		**Risk Assessment Code (RAC) Matrix**					
NAME & DATE ACCEPTED BY GDA:							
CONTRACT NUMBER:		**Severity**	**Probability**				
TASK ORDER/DELIVERY #:							
PRIME CONTRACTOR:			Frequent	Likely	Occasional	Seldom	Unlikely
SUBCONTRACTOR:							
DATE OF PREPARATORY MEETING:		Catastrophic	E	E	H	H	M
DATE AND NAME OF REVIEWER	2-13-15 Mark Orman	Critical	E	H	H	M	L
CONTRACTOR COMPETENT PERSON:		Marginal	H	M	M	L	L
SITE SAFETY and HEALTH OFFICER		Negligible	M	L	L	L	L
ACCEPTANCE BY GOVERNMENT DESIGNATED AUTHORITY (GDA)		Review each **"Hazard"** with identified safety **"Controls"** and determine (RAC)					
E = EXTREMELY HIGH (PWO/OICC/ROICC)		Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" .Place the highest RAC at the top of AHA. This is the overall risk assessment code for this activity					
H = HIGH RISK (FEAD DIRECTOR)		**"Severity"** is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible after controls are in place					
M = MODERATE RISK (CM or ET or PAR)							
L = LOW RISK (ET or PAR)		**"Probability"** is the likelihood to cause an incident, near miss, or accident did occur and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely after controls are put in place.					

Job Steps	Hazards	Controls	RAC
General site hazards	1. Slips/trips/falls 2. Loading heavy equipment/pinch points back strain 3. Shifting loads/pinch points 4. Fueling vehicles 5. Accidents driving to, from and on site. 6. List accidents/near misses that have happened on this site before. Discuss them with field staff. 7. Lack of understanding of local, site specific hazards. 8. Traffic hazards in high traffic areas.	1. Watch for slippery steps, watch footing. Keep working area clear of trip hazards. Maintain good housekeeping at site. Control cords, tubing, equipment. During cold months maintain site to keep ice off walking areas, steps and ladders. 2. Use partner, and if necessary a dolly or other mechanical lifting/transportation device, lift w/ legs. Evaluate heavy lifts prior to lifting. 3. Tie down loads securely with rope, bungee cords, load bars. Visualize what load would do in an accident, and prevent injuries from load shifting. 4. Perform vehicle walk-arounds to inspect for safety issues and observe obstacles to backing out of parking spot. 5. Radios and cell phones turned off when fueling. No cell phone use while driving.	L

	9. Construction equipment hazards in construction areas.	6. watch for other contractors 7. Get briefing from PM or someone very familiar with the site if possible, and discuss any site specific hazards, and how to mitigate them. Make sure PTSP contains emergency assembly point, emergency procedures and site specific hazards. Daily tailgate meeting required. Daily pre-use inspection of all tools. 8. If working near roadways or in parking lots or areas where there is likelihood of vehicular traffic, wear orange safety vest, follow traffic safety plan in HASP. 9. Avoid areas where construction equipment is working. Make eye contact with equipment operator prior to entering swing radius.	
Unpacking/prepping botleware/coolers	Cuts from broken bottles, acid/base burns from leaking preservative, lifting hazards	Visually evaluate condition of material prior to handling. Use caution when unpacking glass bottleware, wear cut resistant gloves if broken glass is seen or heard. Use acid resistant gloves when unpacking pre-preserved containers. Use appropriate lifting techniques. Follow lifting SOP. Review preservative MSDS and have emergency eyewash in immediate area.	**L**
Drive to closest access point for site.	Auto accident, Drivers driving unsafely for the road conditions. Local road conditions Traffic issues Striking equipment, wells Back strain/sprain.	<u>Drive very defensively.</u> Obey the speed limit, and drive slowly and defensively along roads. (discuss any road conditions that are specific issues here-pedestrians, specific road conditions, local driving habits, traffic issues). Defensive driving habits are a must. Manage time so as to prevent the need to rush to destinations. No high speed driving to get to FedEx on time. Watch out for other drivers driving erratically. No cell phone use while driving. If you can't safely drive up to the well, drive the nearest safe point, and carry in equipment in evenly distributed, light loads. Follow heavy lifting self evaluation and check sheet to avoid lifting overly heavy items.	**L**
Walking in to well sites, carrying in gear	Trip hazards from uneven surfaces. Strains from heavy lifting.	Watch out for trip hazards, vines and low stumps of previously cut vegetation under current ground cover vegetation. Watch out for ruts, holes and uneven terrain. Wear sturdy, breathable boots with good ankle support and	**L**

		very sturdy soles. Carry light evenly distributed loads to avoid lifting overly heavy loads. Keep work area free of clutter and trip hazards.	
	Poisonous and irritating plants.	Poison Ivy and Poison Oak Be able to recognize the plants and avoid. Use barrier creams and PPE as necessary (if is likely you will come in contact with the plants).	**L**
	Heat/cold	Heat: Follow SAHP guidelines for heat stress (pulse monitoring). Drink plenty of fluids. Take breaks as necessary. Watch yourself and your co-worker for signs of heat stress. Make sure to carry sufficient drinking water and sports drinks with you. Keep a cooler in the car with cool water bottles and sports drinks. Wear a hat with a broad brim. Stay out of the sun when possible. Use pop up pavilion or shade tarp where necessary. Cold: Follow SAHP guidelines, dress appropriately, take breaks to warm up in vehicle or trailer.	**L**
	Sunburn Inclement weather	Wear a hat and sun screen. Wear long sleeve shirts and long pants. Use sunscreen every morning before the sun gets hot re-apply sunscreen regularly. Stop work in heavy rain or high winds.; Stop work in lightning or thunder storms; Seek shelter in a building or rubber tired vehicle. Work will not re-start until 30 minutes after the last lightning strike or thunder clap .	**L**
	Tick borne pathogens, Mosquito borne pathogens Bees/Wasps	If ticks are possible in the groundwater sampling area in which you are working, read “Tick-Borne Pathogens” in HSP. The methods for controlling exposure to ticks include, in order of most- to least-preferred: • Avoiding tick habitats and ceasing operations in heavily infested areas • Reducing tick abundance through habitat disruption or application of acracide • Personal protection through use of repellants and protective clothing combined with • Frequent tick inspections and proper hygiene Use insecticide with Deet on clothing to prevent mosquito bites. Wear long sleeved shirts if necessary and long	**L**

		pants. • Check for bees/wasp/spider nests before reaching into/behind any objects. Always wear leather gloves when reaching into areas. • Report all bites stings to your supervisor or SC. Inform supervisor if you are allergic to bees.	
Accessing and opening well	1. Over tightened bolts, rusty locks/slipping causing cuts/abrasions to hands. 2. PID readings > 5ppm 3. Contact with potentially contaminated water. 4. Bee/Wasps nests. 5. Spiders/spider nests	1. Know the limitations of all hand tools. Use socket wrenches and bolt cutters, as necessary, to remove old, rusty locks. Wear work gloves over nitriles when working with tools. 2. Allow well to vent, if readings continue over 0.5 ppm then recap and advise management. 3. Wear nitrile gloves 4. Use caution if bees/wasps in well. 5. Check for spider and spider nests in well. Do not proceed until bees/wasp/spider nests are addressed or removed.	**L**
Water level measurement	1. Winding of meter/repetitive motion, probe recoiling too quickly striking personnel, leaning over well	1. Share physical aspects of job with partner. Take turns to avoid repetition. 2. Recoil meter slowly as the probe reaches meter 3. If cable begins to rapidly 'free wheel'. Do not try to stop it, let it go.	**L**
Sample Collection	1. Pinch points 2. Sampler preservatives/vapors released once water is added or splashing of preservative on skin 3. Shock if sampling with generator powered equipment 4. gas bottle hazards from inert gas drive pumps 5. Lifting hazards from car batteries for battery run equipment. Acid burns from battery	1. Watch hands and fingers when attaching sample ports. 2. Hold sample containers away from face and downwind when filling. Wear proper PPE per HSP. 3. Make sure generator is well grounded with ground rod, and equipment on GFCIs. 4. Gas bottles should be chained upright when not in use, and firmly secured when transported. Do not transport bottle with gages attached. Leave bottle secured upright when in use. 5. Use safe lifting techniques when lifting batteries, watch pinch points, check route prior to traveling with the load. Wear nitrile gloves and safety	**L**

		glasses/goggles. Ensure battery is correctly connected when replacing battery	
Fueling generator	Spills Contact with fuel	Ensure spill kit is available. Wear proper ppe (gloves, safety glasses/faceshield). Do not leave nozzle during fueling. Portable containers will be metal with spark arrestor and be properly labeled and stored.	**L**
Site Breakdown	1. Moving drums of purge water, hazards of heavy lifting and pinch points, muscle strain/sprain	1. Use partner to move pails/carboys from ground to vehicle 2. Safety glasses and nitrile gloves/leather or cut resistant work gloves 3. Do not rush. 4. Limit loads to safe weights 5. Use proper lifting technique Feet shoulder width apart, one leg slightly in front of the other. Bend at the knees, not the back Position objects to be carried close to the body Secure a firm grip Lift with legs Avoid twisting at the waist	**L**
Dealing with electrical batteries	Lifting hazard, contact with acids, shock.	Use proper PPE (chemical resistant gloves, goggles) when cleaning/inspecting/charging auto batteries. Charge batteries in open, well ventilated area. Use proper lifting techniques.	**L**
Equipment decon	Exposure to decon solutions (methanol, isopropanol, nitric, etc.)	1 Safety glasses and nitrile gloves. Wear chemical goggles if there is a splash potential.	**L**
Cutting tubing and plastic sheeting	Cuts from knife	Use tubing cutter to cut tubing, follow knife policy/Knife use AHA. (knife should be used only if there is no other tool for the job). Wear cut resistant gloves.	**L**

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements
First aid kit with ice pack, sting wipes.	First aid/CPR for SSC OSHA 40, 8-hour refresher Vinyl chloride training Hazcom	Make sure first aid supplies haven't expired, and that chemical ice pack hasn't gone off by itself.
PPE, safety glasses, steel toe boots, nitrile gloves. Client requires hard hat, safety glasses, safety toe boots, high visibility vest or shirt at all times while on site.		Inspect PPE before use
Fire extinguisher	Fire extinguisher training	Inspect monthly internally, document on tag, and have licensed inspection yearly with replacement tag.

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Safety Officer Name:	____________________	___________________________	**Date/Time:**______________________________
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Activity Hazard Analysis (AHA)

<table>
<tr><td>ACTIVITY/WORK TASK:</td><td>Inject emulsified vegetable oil (EVO) containing sodium sulfate salt.</td><td colspan="5">Overall Risk Assessment Code (RAC) (Use highest code)</td><td>M</td></tr>
<tr><td></td><td>SIGNATURES</td><td>Activity #</td><td colspan="2"></td><td colspan="2">AHA #</td><td></td></tr>
<tr><td>PWD/OICC/ROICC OFFICE</td><td></td><td colspan="6" rowspan="2">Risk Assessment Code (RAC) Matrix</td></tr>
<tr><td>NAME & DATE ACCEPTED BY GDA:</td><td></td></tr>
<tr><td>CONTRACT NUMBER:</td><td></td><td rowspan="4">Severity</td><td colspan="5" rowspan="2">Probability</td></tr>
<tr><td>TASK ORDER/DELIVERY #:</td><td></td></tr>
<tr><td>PRIME CONTRACTOR:</td><td></td><td rowspan="2">Frequent</td><td rowspan="2">Likely</td><td rowspan="2">Occasional</td><td rowspan="2">Seldom</td><td rowspan="2">Unlikely</td></tr>
<tr><td>SUBCONTRACTOR:</td><td></td></tr>
<tr><td>DATE OF PREPARATORY MEETING:</td><td></td><td>Catastrophic</td><td>E</td><td>E</td><td>H</td><td>H</td><td>M</td></tr>
<tr><td>DATE AND NAME OF REVIEWER</td><td>2-13-15 Mark Orman</td><td>Critical</td><td>E</td><td>H</td><td>H</td><td>M</td><td>L</td></tr>
<tr><td>CONTRACTOR COMPETENT PERSON:</td><td></td><td>Marginal</td><td>H</td><td>M</td><td>M</td><td>L</td><td>L</td></tr>
<tr><td>SITE SAFETY and HEALTH OFFICER</td><td></td><td>Negligible</td><td>M</td><td>L</td><td>L</td><td>L</td><td>L</td></tr>
<tr><td colspan="2">ACCEPTANCE BY GOVERNMENT DESIGNATED AUTHORITY (GDA)</td><td colspan="6">Review each "Hazard" with identified safety "Controls" and determine (RAC)</td></tr>
<tr><td>E = EXTREMELY HIGH (PWO/OICC/ROICC)</td><td></td><td colspan="6">Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" .Place the highest RAC at the top of AHA. This is the overall risk assessment code for this activity</td></tr>
<tr><td>H = HIGH RISK (FEAD DIRECTOR)</td><td></td><td colspan="6" rowspan="2">"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible after controls are in place</td></tr>
<tr><td>M = MODERATE RISK (CM or ET or PAR)</td><td></td></tr>
<tr><td>L = LOW RISK (ET or PAR)</td><td></td><td colspan="6">"Probability" is the likelihood to cause an incident, near miss, or accident did occur and identified as: Frequent, Likely, Occasional, Seldom, or Unlikely after controls are put in place.</td></tr>
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<table>
<tr><th>Job Steps</th><th>Hazards</th><th>Controls</th><th>RAC</th></tr>
<tr><td>General Conditions (applies to Mobilization/Demobilization, and injection of EVO solution)</td><td>Inclement weather</td><td>1. Sudden inclement weather can rapidly encroach upon field personnel. Preparedness and caution are the best defenses. Carry clothing appropriate for inclement weather. Realize ice and snow can adversely affect driving conditions, and plan accordingly.
2. Check and take heed of the weather forecast for the day prior to start of work and pay attention for signs of changing weather that indicate an impending storm. Signs include towering thunderheads, darkening skies, or a sudden increase in wind or sudden change in temperature. If stormy weather ensues, field personnel should discontinue work and seek shelter until the storm has passed.
3. Avoid working during thunderstorms.
4. If caught in one, seek shelter.</td><td>L</td></tr>
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		5. Avoid lone trees as shelter and open, bare areas. 6. If caught in open area, away from shelter, place feet close together and crouch down as small as possible, without lying on the ground. 7. Ground strikes are known to be initiated by “leaders”, or charges, from the earth making a connection to the charge in the clouds. This may cause your hair to stand up, immediately crouch as described above. 8. Avoid low lying areas such as washes after rain as they can flood. 9. Take time to review where the closest structure that can be used when severe weather occurs and what route will be used to get there. Listen to weather reports and plan for severe weather. Designate an emergency evacuation assembly area and evacuation routes for non-weather related emergencies (fire, etc.). Keep a copy of the Emergency Contact page from the HSP accessible. 10. Remember that lightning may strike several miles from the parent cloud, so work should be stopped and restarted accordingly. The lightning safety recommendation is 30-30: Seek refuge when thunder sounds within 30 seconds after a lightning flash; and do not resume activity until 30 minutes after the last thunder clap.	
	Auto accidents	1. Inspect the vehicle prior to departure. 2. If driving a rental car, become familiar with the safe operation of vehicles of the type and size to be operated. Large vehicles such as full size vans and pick-ups have different vision challenges and handling characteristics than smaller vehicles. 3. Drivers shall not use cellular phones, or other two-way communication devices while driving (including hands-free devices). Pull over and park the car to make or take phone calls, text, or e-mail. 4. Be sure to take adequate rest breaks when driving, especially on long distance trips. 5. Obey speed limits; be aware of blind spots or other hazards associated with low visibility. Practice defensive driving techniques, such as leaving plenty of room between your vehicle and the one ahead of you. 6. Do no drive while drowsy. Drowsiness can occur at any time, but is most likely after 18 hours or more without sleep.	**M**

		7. Maintain focus on driving. Eating, drinking, smoking, adjusting controls can divert attention from the road. Take the time to park and perform these tasks when parked rather than while driving. 8. If vehicle is malfunctioning, don't pull over off the road suddenly. Give the traffic behind you notice that you are pulling off. 9. Park as far from traffic as possible, use caution when exiting vehicle. 10. Always wear seatbelt in vehicle, regardless of length of drive. 11. Use vehicle flashers if moving slower than normal traffic. 12. Pull off the road, put the car in park and turn on flashers before talking on a mobile phone, even with a hands-free device. 13. Apply Get Out and Look (GOAL) when returning to the vehicle to prevent property damage and injury by looking for obstructions, personnel or other items. Back slowly and use a spotter when view is obstructed. It is preferable to park in a spot that you can pull forward out of, less preferable to back into a parking spot so you can pull straight out of it, and least preferable to drive into a parking spot that you have to back out of.	
	Biologicals: Ticks Bees and wasps, mosquitos Poison ivy/oak	Ticks: 1. Wear light colored long sleeve shirts and pants. Use repellent on exposed skin (with at least 35% DEET) if ticks/other biting insects are suspected in the area. Whenever you use an insecticide or insect repellent, be sure to read and follow the manufacturer's directions for us, as printed on the product. Tape bottoms of pant legs or tuck pants into socks. Use permethrin on shirts, pants and socks, as per application instructions prior to donning clothing. 2. Wear protective clothing such as Tyvek or Bug-out suits if ticks are abundant in addition to controls above. 3. Have tick removal kits accessible. Use the buddy system and perform tick inspections prior to entering the field vehicle. If ticks were not planned to be encountered and are observed, do not continue field work until these controls can be implemented. 4. See Tick Fact Sheet attached to the HSP for further precautions and controls to implement when ticks are	**L**

		present. Follow Navy CLEAN tick protocol. If bitten by a tick, follow the removal procedures found in the tick fact sheet, call the occupational nurse at 1-866-893-2514. 5. Try to avoid high grass or the boundary between woods and fields where ticks congregate. 6. Do a careful tick check at the end of the day. 7. Watch for and avoid stinging insects. If stung, leave the area to avoid further stings. If stinger still remains, remove quickly. Contact occupational nurse and PM. 8. All tools used in the poison ivy, sumac or oak area, must be decontaminated before they are placed back into the site vehicle. If on-site decontamination is not possible, use plastic to wrap any tools or equipment until they can be decontaminated. 9. Personal protective equipment, including Tyvek coveralls, gloves, and boot covers must be worn if poison ivy/oak cannot be avoided. PPE must be placed into plastic bags and sealed if they are not disposed immediately into a trash receptacle. 10. As soon as possible following the work, shower to remove any potential contamination. Any body part with suspected or actual exposure should be washed with Zanfel, Tecnu or other product designed for removing urushiol. If you do not have Zanfel or Tecnu wash with cold water. Do not take a bath, as the oils can form and invisible film on top of the water and contaminate your entire body upon exiting the bath. 11. Tecnu may also be used to decontaminate equipment. 12. Use IvyBlock or similar products to prevent poison oak, ivy and sumac contamination. Check with the closest CH2M HILL warehouse to see if these products are available. Follow all directions for application. 13. If you do come into contact with one of these poisonous plants and a reaction develops, contact your supervisor and the occupational nurse 1-866-893-2514.	
	Heat stress	1. Follow SAHP guidelines for heat stress. Drink plenty of fluids. Take breaks as necessary. Watch yourself and your co-worker for signs of heat stress. Make sure to carry sufficient drinking water and sports drinks with you. Keep a cooler in the car with cool water bottles and sports drinks.	**L**

		2. Use physiological monitoring as required by HSP, and document results on physiological monitoring forms.	
	Cold	1. Be prepared for all types of weather by having cold weather gear (including rain gear) in the field vehicle as weather in the mountains can change rapidly. Dress in layers. 2. Obtain and review daily weather forecast and adjust work schedule based on work conditions (and driving conditions). 3. Observe one another for signs of cold-related disorders (see HSP for review of signs and symptoms). 4. Stay hydrated. Drink 16 ounces of water before beginning work. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours. 5. Take regular breaks in a warm shelter for cold weather. 6. Follow the cold stress monitoring requirements outlined in the HASP. 7. Follow Wind Chill Chart to assist with work warming regiment determination and frostbite avoidance. 8. Persons who experience signs of cold stress should contact the PM and RHSM. Call the occupational nurse first if symptoms are severe at 1-866-893-2514.	**L**
	Hazardous Material Safety - Personnel Exposure	1. CH2M HILL requires all on-site personnel to have 40 hour Hazwoper and current 8 hour refresher training. 2. CH2M HILL requires all personnel to participate in an annual Physical/Medical program. 3. All site personnel must review and sign the HASP, the handbook and attend pre-work safety meetings to discuss job hazards. 4. CH2M HILL requires all personnel on-site to wear proper PPE which includes steel-toe boots, safety glasses, hard hat with chin strap and nitrile gloves.	**L**
	Physical Hazards Present in all Phases of this Project: 1. Eye injury 2. Hearing damage 3. Foot injury 4. Hand injury 5. Back injury	1. Protective eyewear with side shields that meet the ANSI Z-87.1 standard shall be worn at all times. Safety glasses/spoggles, and splash shield or safety glasses and chemical goggles when injecting and operating injection equipment. 2. Hearing protection shall be worn when noise levels exceed 85dBA. 3. Sturdy, leather safety-toed footwear shall be required.	**L**

	6. Slip/Trip hazards 7. Pressurized equipment 8. Head injuries	4. Use appropriate gloves for the job. Nitriles for protection from EVO injection materials, heavy work gloves as necessary for abrasion protection. 5. Employees should be instructed in safe lifting techniques. Back straight, bend at knees, load close to body, lift smoothly, and do not twist. Do not lift loads over 40 lbs 6. Basic maintenance requirements shall apply to the project site. Cords, tubing and hoses are used throughout the technology. Employees shall be reminded at daily safety meetings to carefully observe while walking. 7. Employees will avoid pressurized equipment unless they are trained to operate it. 8. All site personnel shall wear hard hat with chin strap.	
	Activities involving working near electrical tools or equipment:: Electrical shock from unsafe: 1. Electric Equipment 2. Portable electric tools 3. Extension Cords	1. Electrical tools/equipment shall be inspected for damage or wear prior to use. 2. Portable electric tools/equipment that are unsafe due to faulty plugs, damaged cords, or other reason shall be removed from service. 3. A Ground Fault Circuit Interrupter (GFCI) device shall be used with all cord and plug-connected equipment 4. Extension cords that have faulty plugs, damaged insulation, ground plug removed, or are unsafe in any way shall be removed from service. 5. Cords shall be protected from damage from sharp edges, projections, pinch points (doorways), and vehicular traffic. 6. Cords shall be suspended with a nonconductive support (rope, plastic ties, etc.). 7. Cords shall be inspected prior to, during, and after each use.	**L**
	Material Handling – includes movement or transport of materials, supplies and equipment to the work site: 1. Injuries resulting from manually lifting materials 2. Injury to head, feet, hands due to crushing, pinching, being caught between, striking against and being struck by objects	1. Totes of EVO with premixed sodium sulfate will be spotted on-site by supplier (oversight by CH2MHILL required). Alternately, tanker truck of EVO may be supplied. 2. Prior to chemicals arriving on site, train workers on the hazards associated with site chemicals. All employees working with chemicals will review the MSDS sheets prior to arrival of chemicals. List chemicals on the chemical inventory of the HASP and review chemical properties and hazards and sign chemical training sheet in HASP. Establish site controls.	**L**

	3. Injury to eyes from airborne particulates, flying debris and chemical exposure 4. Slips, trips, and falls 5. Traffic	3. Review emergency response procedures from the Health and Safety Plan and stage supplies. Verify eyewash stations and safety shower are functional. 4. Ensure containers are labeled to identify the chemical contents, and the associated hazards. 5. Spill containment materials shall be readily available to contain a spill and prevent chemical mixing and/or migration off-site. 6. Employees should be instructed in safe lifting techniques. Back straight, head up, eyes on the horizon, bend at knees, load close to body, lift smoothly, and do not twist. If tilting EVO totes is necessary, to drain all remaining EVO, wait till it is clearly drained to under 40 lbs load before tilting, or get assistance or use mechanical assistance. 7. Utilize material handling devices such as hand trucks. 8. Manual lifts of over 40 pounds require two people. Employees are encouraged to get help for any lift that appears excessive. 9. Wear at all times: steel-toed leather work boots. Leather gloves or heavy duty grip gloves shall be worn 10. when handling materials with rough, sharp, or slippery surfaces. 11. Protective eyewear with side shields that meet the ANSI Z-87.1 standard shall be worn at all times. If work conditions warrant (operation of injection piping system), full face shield with safety glasses/spoggles, or chemical goggles over safety glasses must be worn. 12. To the greatest extent possible, keep walking/working surfaces free of clutter, debris, and congestion. Brief personnel on hazards of wet, muddy soil hazards and traversing uneven grades. Spilled EVO can cause slip hazard. Keep soles of boots free of EVO to prevent slips. 13. Exercise caution and obey traffic regulations while transporting materials over roadways.	
	Sudden pressure release-hit by hose or piping, or sprayed by chemical.	1. Keep injection pressure at under 10 psi. 2. When injection system is constructed, train all personnel who will operate it on specific safe operations of system as designed. 3. Confirm operations prevent pressure being trapped in system after system shut off, that could be unintentionally released during a coupling disconnection.	**L**

		4. Confirm pumping will not take place against a closed valve such that dangerous pressures could be created, and that sufficient pressure gages are designed into system to safely manage pressures generated. 5. ‘Only qualified, trained operator to run injection 6. system. 7. All personnel not directly involved in operation of injection system must stay outside operational area of injection system. 8. Spill cleanup supplies must be available on site.	
Overseeing/collecting field parameters during the injections	1. General Hazards 2. Slips/trips, pressure releases	1. Stated above 2. Equipment shall be inspected prior to use. 3. Defective equipment shall be tagged and removed from service. 4. Equipment shall be used only for their intended purpose. 5. Wear appropriate PPE while using the equipment (this equipment includes YSI, water level meter, PID, and bailers). 6. Maintain good housekeeping to avoid slips/trips and falls. 7. Keep head and face away from well when releasing pressure cap in case of buildup of pressure.	**L**
Clean site/demobilize	Traffic. Nuisance or safety hazards left on site.	Use buddy system as necessary to remove traffic control. Leave site clean of refuse and debris. Safely leave the site and drive according to state rules of the road.	**L**

Equipment to be Used	Training Requirements/Competent or Qualified Personnel name(s)	Inspection Requirements
1. Hand and power tools 2. Fire extinguisher(s) 3. Portable eye wash 4. First Aid/Bloodborne pathogen/CPR kit 5. Support vehicles 6. PPE: Client requires hard hat, safety glasses, safety toe boots, high visibility vest or shirt at all times while on site.	1. Inspection of all equipment and tools prior to each use 2. Visual Inspections of work area daily 3. Use of applicable project self-assessment checklists 4. Inspect vehicles prior to operation 5. Inspect fire extinguisher monthly as per H&S plan, and document on tag, and have it inspected by a licensed professional yearly.	1. Hazard Communication training, as appropriate 2. Training on CH2M HILL HSP and applicable AHAs 3. Documented training on MSDSs for any chemicals used. 4. Qualified SSC 5. Training on operational safety of specific injection system as constructed for all personnel who will operate system.

	PRINT NAME	SIGNATURE	
Supervisor Name:	____________________	__________________________	**Date/Time:**______________________________
Safety Officer Name:	____________________	__________________________	**Date/Time:**______________________________
Employee Name(s):	____________________	__________________________	**Date/Time:**______________________________
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Material Safety Data Sheets/SDSs