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FINAL SAMPLING AND ANALYSIS PLAN FOR SITE 13 REMEDIAL INVESTIGATION ALLEGANY BALLISTICS LABORATORY NIROP ROCKET CENTER WV

04/01/2011

CH2M HILL

SAP Worksheet #1—Title and Approval Page

Final

Uniform Federal Policy Sampling and Analysis Plan

Site 13 Remedial Investigation
Allegany Ballistics Laboratory
Rocket Center, West Virginia

Contract Task Order WE08

April 2011

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN 1000 Program
Contract N62470-08-D-1000

Prepared by

CH2MHILL

Chantilly, Virginia

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

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Other Approval Signatures:

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Ji-Sun Yi/EPA Remedial Project Manager/EPA Region 3/Date

Thomas Bass/WVDEP Remedial Project Manager/Date

Executive Summary

Introduction

This document presents the Sampling and Analysis Plan (SAP) developed using the framework of the Navy's Uniform Federal Policy (UFP) for a Remedial Investigation at Site 13 of Allegany Ballistics Laboratory (ABL) located in Rocket Center, West Virginia. CH2M HILL prepared this document under the Department of the Navy, Naval Facilities Engineering Command (NAVFAC), Mid-Atlantic Division, Comprehensive Long-Term Environmental Action Navy (CLEAN) 1000 Contract N62470-08-D-1000, Contract Task Order WE08, for submittal to NAVFAC Mid-Atlantic; the United States Environmental Protection Agency (EPA) Region III; and the West Virginia Department of Environmental Protection (WVDEP).

Site 13 Background

Site 13, formerly known as the Range Road Area, is located in the southeastern portion of the developed section of Plant 1 (**Figure 1**). Currently, the site topography is relatively flat and consists of grassed areas and asphalt roadways. Site 13 is currently undeveloped and future land use is expected to remain the same. Groundwater at Site 13 is not used as a potable drinking water source, nor is it expected to be used as a potable drinking water source in the future. Groundwater flow direction in the underlying shallow alluvial aquifer is east-northeast as indicated by the direction of horizontal migration of a groundwater plume of trichloroethene (TCE) identified in 2005. TCE was initially discovered when concentrations of TCE less than 1,500 µg/L were found in surface water at an outfall to the Plant 1 drainage ditch system (SWMU 27A) during sampling required by the facility's National Pollutant Discharge Elimination System (NPDES) permit. Additional surface water sampling conducted during the Phase III Investigation traced the probable source of TCE in the drainage ditch system to the area near the intersection of H Street and Range Road (CH2M HILL, 2005).

A full-scale pilot study is currently ongoing at Site 13 to enhance the degradation of the TCE contamination in the alluvial aquifer groundwater. The pilot study is enhanced bioremediation and uses a subsurface injectate of an emulsified oil substrate to biostimulate existing bacteria in an effort to reduce TCE concentrations to below its maximum contaminant level (MCL). One round of postinjection sampling was performed in August 2009.

Groundwater in the alluvial aquifer at Site 13 is being evaluated independent of this UFP SAP. The alluvial groundwater data will be evaluated together with the data generated for other site media in the forthcoming RI report for Site 13.

Remedial Investigation

The objectives of this RI are to (1) evaluate the nature and extent of contamination associated with Site 13 in the bedrock aquifer and drainage ditch; (2) determine whether the contaminant levels (if present) pose a potentially unacceptable risk (by comparing them to

EPA-adjusted residential regional screening levels (RSLs) for groundwater, surface water, and sediment, and ecological-risk-based screening levels for surface water, pore water, and sediment); and (3) determine whether the contaminant levels (if present) will be sufficiently addressed by the pilot study.

Surface Water, Pore Water, and Sediment Sampling

When the alluvial groundwater is high enough to intersect the nearby drainage ditch (as evidenced by monthly water level measurements), pore water and surface water samples will be collected using passive diffusion bags and grab-sampling techniques, respectively. The temporary sample locations are shown in **Figure 2** and detailed in **Worksheet #18**.

Following this initial round of sampling, quarterly monitoring of surface water, pore water, and sediment will continue for 1 year. Two additional sample locations will be determined based on pore water concentration to coincide with the intersection of the plume and ditch as well as the three predetermined locations downgradient of the plume, as shown in **Figure 2**. Aqueous samples will be analyzed for VOCs, sediment samples will be analyzed for VOCs and TOC, as detailed in **Worksheet #14**. Sampling protocols will follow the SOPs found in **Appendix A**. Appropriate QA/QC samples will be collected, as specified in **Worksheet # 20**. The decision points and actions in **Figure 7** will be used to determine if contaminants are present.

Bedrock Groundwater Sampling

Monitoring wells will be installed in order to evaluate conditions within the bedrock aquifer. Three bedrock monitoring wells will be installed immediately outside of the alluvial TCE plume boundary as shown in **Figure 2** and detailed in **Worksheet #18**. Samples will be collected from each well quarterly for 1 year and analyzed for TCL VOCs and monitored natural attenuation parameters, as detailed in **Worksheet #14.** Sampling protocols will follow the SOPs found in **Appendix A**. Appropriate QA/QC samples will be collected as specified on **Worksheet # 20.** Groundwater sample results will be compared to Project Action Limits (PALs) as detailed in **Worksheet #15**.

Report Presentation

This SAP details the procedures necessary to complete the above-described Remedial Investigation and has been completed under contract number N62470-08-D-1000, Contract Task Order WE08, in accordance with the Navy's Uniform Federal Policy (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 SAP is specific to Microbac Laboratories. If additional laboratory services are requested that require modification to the existing SAP, revised SAP worksheets will be submitted to the Navy and regulatory agencies for approval.

This SAP consists of the 37 worksheets specific to the UFP-SAP. All tables are embedded within the worksheets. All figures are presented at the end of the document. The field standard operating procedures (SOPs) are provided in **Appendix A**, the project specific Health and Safety Plan (HSP) is provided in **Appendix B,** the site-specific laboratory SOPs are provided in **Appendix C,** and data management documentation is provided in **Appendix D**.

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A Field Standard Operating Procedures
B Health and Safety Plan
C Laboratory Standard Operating Procedures
D Data Management Plan

Acronyms and Abbreviations

ABL	Allegany Ballistics Laboratory
AM	Activity Manager
AQM	Activity Quality Manager
ATK	ATK Tactical Systems Company, LLC
AVS/SEM	acid-volatile sulfide/simultaneous extracted metals
BTAG	Biological Technical Assistance Group
CA	Corrective Action
CCV	Continuing Calibration Verification
CDN	Composite Drainage Net
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLEAN	Comprehensive Long-Term Environmental Action, Navy
CoC	chain of custody
COC	contaminant of concern
COPC	constituent of potential concern
CS	Confirmation Study
CSM	conceptual site model
CTO	contract task order
CVAA	Cold Vapor Atomic Absorption
DC	direct current
DFTPP	decafluorotriphenylphosphine
DNR	Department of Natural Resources
DO	dissolved oxygen
DQI	data quality indicator
DQO	data quality objective
DV	data validator
Eh	oxidation reduction potential
EIS	Environmental Information Specialist
EPA	Environmental Protection Agency
ERA	Ecological Risk Assessment
EW	extraction well
FEL	Fort Environmental Laboratories
FFA	Federal Facilities Agreement
FMC	flexible membrane cap
FTL	field team leader
GC/MS	gas chromatograph/mass spectrometer
gpm	gallons per minute
GW	groundwater

GWTP	groundwater treatment plant
H&S	health and safety
HAZWOPER	Hazardous Waste and Operations
HD	Hester-Dendy
HHRA	Human Health Risk Assessment
HI	Hazard Index
IAS	Initial Assessment Study
ICAL	initial calibration
ICB	initial calibration blank
ICP	inductively coupled plasma
ICV	initial calibration verification
IDW	investigation-derived waste
IS	Internal Standard
LC	Low Concentration
LC/MS	Liquid Chromatograph/Mass Spectrometer
LEL	Lower Explosive Limit
LTM	Long Term Monitoring
MCL	Maximum Contaminant Level
MDL	Method Detection Limit
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSL	Mean Sea Level
MW	Monitoring Well
NAVFAC	U.S. Naval Facilities Engineering Command
NAVSEA	Naval Sea Systems Command
NIRIS	Naval Integrated Risk Information System
NTR	Navy Technical Representative
O&M	Operations and Maintenance
OU	Operable Unit
PAL	Project Action Limits
PDB	passive diffusion bag
PID	photoionization detector
PM	Project Manager
PPE	personal protective equipment
PQO	Project Quality Objective
PQL	Project Quantitation Limit
PRB	permeable reactive barrier
PW	pore water
PWA	Production Well "A"
QA	quality assurance
QAPP	Quality Assurance Project Plan
QC	quality control
QL	quantitation limit

RAO	Remedial Action Objective
RBP	Rapid Bioassessment Protocol
RCRA	Resource, Conservation, and Recovery Act
RI	Remedial Investigation
ROD	Record of Decision
RPD	relative percent difference
RPM	Remedial Project Manager
RPP	rigid porous polyethylene
SAP	Sampling and Analysis Plan
SD	sediment
SOP	standard operating procedure
SSC-HW	Site Safety Coordinator-Hazardous Waste
SVOC	semivolatile organic compound
SW	surface water
TAL	Target Analyte List
TBD	to be determined
TCE	Trichloroethene
TCL	Target Compound List
TIC	total inorganic carbon
TOC	total organic carbon
TP	test pit
UFP	Uniform Federal Policy
USC	United States Code
VOC	volatile organic compound
WVDEP	West Virginia Department of Environmental Protection

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SAP Worksheet #2—SAP Identifying Information

Site Name/Number: Site 13
Contractor Name: CH2M HILL
Contract Number: N62470-08-D-1000
Contract Title: CLEAN Program 1000
Work Assignment Number: Contract Task Order WE08

1. **SAP requirements:** This SAP was prepared in accordance with the requirements of the Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP) (EPA, 2005) and EPA Guidance for Quality Assurance Project Plans, EPA QA/G-5, QAMS (EPA, 2002).
2. **Regulatory programs:** CERCLA
3. **Type of SAP:** This is a project-specific SAP for Site 13
4. **Dates of scoping session:**

Scoping Session	Date
CH2M HILL Internal Scoping Session	June 5, 2009
ABL Partnering Team Meetings	June 9 and 10, 2009
ABL Partnering Team Meetings	July 14 and 15, 2009
ABL Partnering Team Meetings	December 8, 2009
CH2M HILL Internal Scoping Session	January 12, 2010

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

Title	Date
Work Plan Addendum for a Pilot Study at the Range Road Area	CH2M HILL, 2008a

6. **Organizational partners (stakeholders) and connection with lead organization:** EPA and WVDEP—Federal Facilities Agreement (FFA) Signatory Parties and Support Agencies
7. **Lead organization:** United States Navy (Navy**)**
8. **Applicable SAP elements:** All the required SAP elements are included in this SAP; therefore, a crosswalk table is not necessary for this project. The health and safety plan is provided in **Appendix B**.

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SAP Worksheet #3—Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
Bill Fraser	Navy Technical Representative (NTR)	NAVFAC Atlantic	(757) 445-6637	William.G.Fraser@navy.mil
Janice Nielsen	Chemist/QA Officer	NAVFAC Atlantic	(757) 322-8339	Janice.Nielsen@navy.mil
John Aubert	NTR	NAVSEA	(951) 970-7511	RWAJOHN81@aol.com
Ji-Sun Yi	Remedial Project Manager (RPM)	EPA Region III	(215) 814-3377	Yi.ji-sun@epa.gov
Tom Bass	RPM	WVDEP	(304) 926-0449	Thomas.I.Bass@wv.gov
Steve Glennie	Activity Manager (AM)	CH2M HILL	(703) 376-5122	Steven.Glennie@ch2m.com
Jennifer Myers	Project Manager (PM)	CH2M HILL	(703) 376-5203	Jennifer.Myers@ch2m.com
Brett Doerr	Senior Consultant/Activity Quality Manager (AQM)	CH2M HILL	(757) 671-6219	Brett.Doerr@ch2m.com
Mark Orman	Health and Safety (H&S) Officer	CH2M HILL	(414) 847-0597	Mark.Orman@ch2m.com
Roni Warren	Human Health Risk Assessor	CH2M HILL	(814) 364-2454	Roni.Warren@ch2m.com
William Kappleman	Ecological Risk Assessor	CH2M HILL	(703) 376-5152	William.Kappleman@ch2m.com
Megan Morrison	Project Chemist	CH2M HILL	(703) 376-5053	Megan.Morrison@ch2m.com
Hillary Ott	Environmental Information Specialist (EIS)	CH2M HILL	(703) 376-5111	Hillary.Ott @ch2m.com
TBD	Field Team Leader (FTL) or Member	CH2M HILL		
TBD	Field Team Leader or Member	CH2M HILL		
Kathy Albertson	Project Manager	Microbac Laboratories	1-800-373-4071	kalbertson@microbac.com
Ward Dickens	Senior Chemist/ Data Validator	CH2M HILL	(352) 384-7049	ward.dickens@ch2m.com
TBD	Project Manager	Drilling Company		
TBD	Project Manager	IDW Management		

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SAP Worksheet #4—Project Personnel Sign-Off Sheet

Name	Organization/Title/Role	Telephone Number	Signature/ E-mail Receipt	SAP Section Reviewed	Date SAP Read
Anita Dodson	CH2M HILL/Navy CLEAN Program Chemist	(757) 671-6218			
Megan Morrison	CH2M HILL/Project Chemist	(703) 376-5053			
Hillary Ott	CH2M HILL/Project EIS	(703) 376-5165			
Mark Orman	CH2M HILL/Health and Safety Officer	(414) 847-0597			
TBD	CH2M HILL/Field Team Leader				
TBD	CH2M HILL/Field Team Member				
Roni Warren	CH2M HILL/Human Health Risk Assessor	(814) 364-2454			
William Kappleman	CH2M HILL/Ecological Risk Assessor	(703) 376-5152			
Kathy Albertson	Microbac Laboratories	1-800-373-4071			
Ward Dickens	CH2M HILL/ Senior Chemist and Data Validator	(352) 384-7049			

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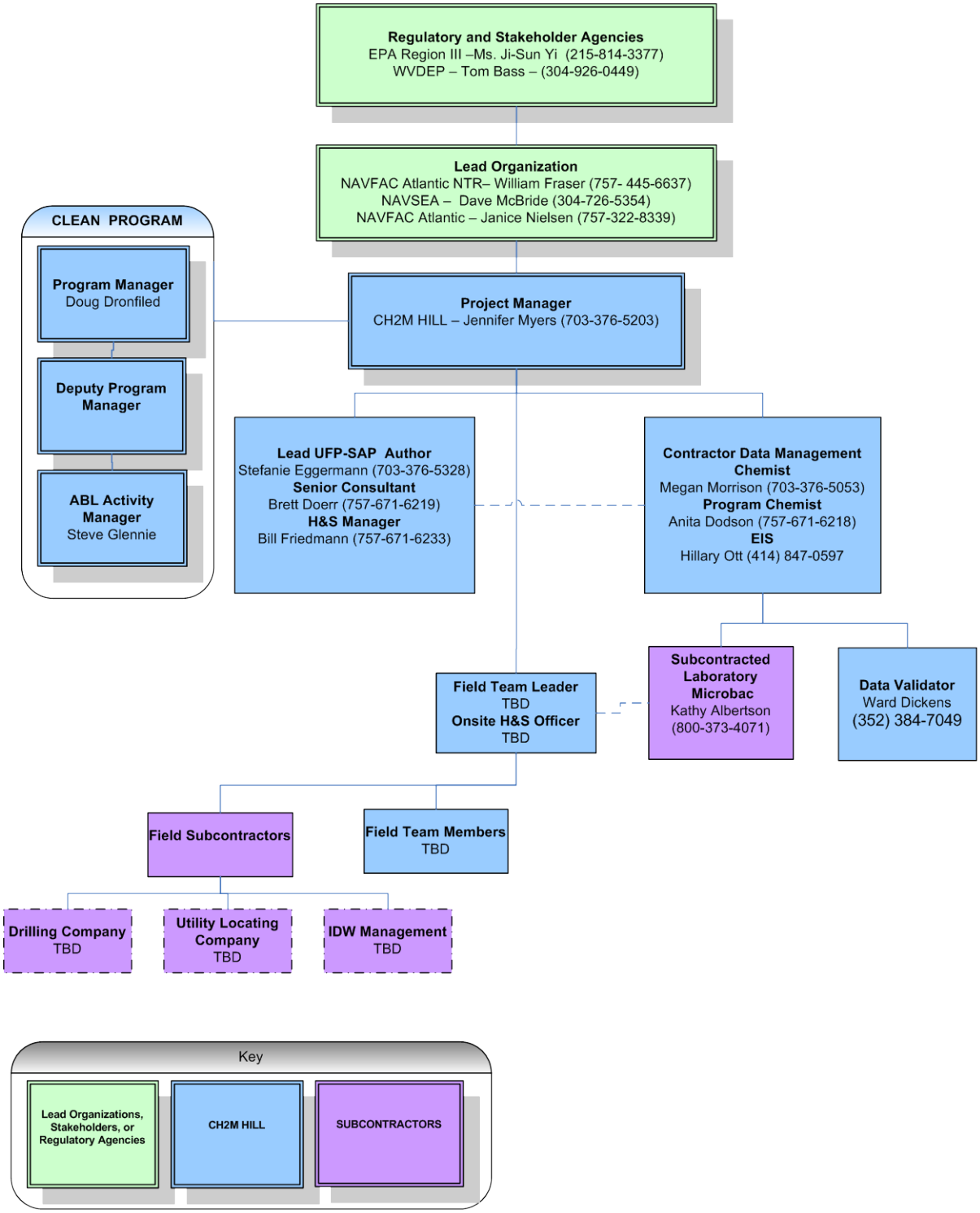
SAP Worksheet #5—Project Organizational Chart



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SAP Worksheet #6—Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Phone Number/E-mail	Procedure
Communication with Navy (lead agency)	Navy NTR	William Fraser	William.G.Fraser@navy.mil	• Primary contact for Navy; can delegate communication to other internal or external points of contact • Primary contact for stakeholder agency managers • Has 21 days for SAP review.
Communication with EPA	EPA RPM	Ji-Sun Yi	Yi.ji-sun@epa.gov	• Primary contact for EPA; can delegate communication to other internal or external points of contact • Has 60 days for SAP review. • Navy RPM will notify EPA via email within 24 hours for field changes affecting the scope or implementation of the SAP.
Communication with WVDEP	WVDEP RPM	Tom Bass	Thomas.l.bass@wv.gov	• Primary contact for WVDEP; can delegate communication to other internal or external points of contact • Has 60 days for SAP review. • Navy RPM will notify WVDEP via email within 24 hours for field changes affecting the scope or implementation of the SAP.
Communication with CH2M HILL regarding Navy chemistry standards as applied to this UFP-SAP	Navy Chemist	Janice Nielsen	Janice.Nielsen@navy.mil	• Primary contact for Navy to CH2M HILL program chemist • Has 21 days for SAP review
Communication regarding overall project status and implementation and primary point of contact with Navy NTR, EPA, and WVDEP	CH2M HILL AM	Steve Glennie	Steven.Glennie@ch2m.com	• Primary contacts for CH2M HILL to Navy, EPA, and WVDEP; can delegate communication to other points of contact within CH2M HILL • Forwards information and materials about the project to Navy RPM, EPA, and WVDEP as needed

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure
Communications regarding project management and implementation of all project phases, and primary point of contact with Activity Manager	CH2M HILL PM	Jennifer Myers	Jennifer.Myers@ch2m.com	• Oversees the overall project status • Will be informed of project status by CH2M HILL project staff • If field changes occur, works with Navy RPM to communicate changes to EPA and WVDEP within 24 hours • Communicates field results to team during partnering team meetings
SAP implementation in the field	CH2M HILL FTL	TBD	TBD	• Secondary contact for CH2M HILL to Navy for all ABL activities • Facilitates CH2M HILL's internal communication (PM to field team members) • Implements project health and safety requirements • Reports health and safety near misses and incidents to the PM immediately by phone • Provides daily progress reports/updates to the CH2M HILL PM by phone or email
SAP field changes/field progress reports	CH2M HILL FTL	TBD	TBD	• Documents field activities and work plan deviations (made with the approval of AM, PM, and/or AQM) in field logbooks • Communicates deviations to PM on a daily basis and prior to conducting any actions that may be affected by such communications
Field staff discussion and inquiry regarding HHRA	CH2M HILL Human Health Risk Assessor	Roni Warren	Roni.Warren@ch2m.com	• Primary point of contact for field team before, during and after investigation for human health risk concerns • Communicates back to PM, AQM, Data Manager, and EIS as needed

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure
Field staff discussion and inquiry regarding ecological risk assessment (ERA)	CH2M HILL Ecological Risk Assessor	William Kappleman	William.Kappleman@ch2m.com	• Primary point of contact for field team before, during and after investigation for ecological risk concerns • Communicates back to PM, AQM, Data Manager, and EIS as needed
Data tracking from field collection to database upload	CH2M HILL EIS	Hillary Ott	Hillary.Ott@ch2m.com	• Tracks data from sample collection through database upload • Primary contact for laboratories' project managers • Reports lab issues to the PM and project chemist by phone or email within 4 business hours
Field corrective actions (CAs)	CH2M HILL FTL	FTL	TBD	• Field and analytical issues requiring corrective action will be identified by the FTL and brought to the attention of the PM, who in turn will notify the AQM before any decisions on action are made • Communications and decisions should be made on a daily basis and prior to conducting any actions that may be affected by such communications/decisions • Communications with AQM shall be by in-person or phone, followed up with e-mail to document decisions and actions
Management of analytical lab and data validation sub contractors. Analytical corrective actions/release of analytical data.	CH2M HILL Project Chemist	Megan Morrison	Megan.Morrison@ch2m.com	• Analytical laboratory corrective actions will be identified by, or brought to the attention of, the project chemist on a daily basis. • Facilitates resolution on a same-day basis after consulting with the PM and AQM and the Navy chemist (if changes in the SAP are warranted) to ensure SAP requirements are met by the laboratory. • Communicates with subs by phone, followed up with e-mail to document decisions and actions
Reporting lab data quality issues	Microbac Laboratories Project Manager and CH2M HILL Data Validator	Kathy Albertson Ward Dickens	kalbertson@microbac.com ward.dickens@ch2m.com	• Report analytical laboratory corrective actions to the CH2M HILL project chemist and/or EIS on a same-day basis • CH2M HILL project chemist facilitates resolution after consulting with the PM and AQM and the Navy chemist (if changes in the SAP are warranted) to ensure SAP requirements are met by the laboratory. • Communications shall be by phone, followed up with e-mail to document decisions and actions.

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SAP Worksheet #7—Personnel Responsibilities Table

Name	Title/Role	Organizational Affiliation	Responsibilities
William Fraser	RPM	NAVFAC Atlantic	Manages all ABL Installation Restoration Program (IR Program) activities
Janice Nielsen	Navy Chemist	NAVFAC Atlantic	Perform lead agency review of UFP-SAP
John Aubert	Navy Technical Reviewer	NAVSEA	Reviews SAP
Ji-Sun Yi	RPM	EPA Region III	Reviews SAP and provides input for the EPA
Tom Bass	RPM	WVDEP	Reviews SAP and provides input for the WVDEP
Steve Glennie	AM	CH2M HILL	Oversees overall project status for all projects implemented at ABL
Jennifer Myers	PM	CH2M HILL	Manages production of UFP-SAP. Manages project, oversees all project activities, and is responsible for all aspects of the work performed under this SAP
Brett Doerr	Senior Consultant-AQM	CH2M HILL	Provides overall technical quality control of the field investigation design and implementation; responsible for audits, corrective action, checks of QA performance. Provides SAP delivery support and QA oversight
Anita Dodson	Navy CLEAN Program Chemist	CH2M HILL	Program-level review of UFP-SAP
Stefanie Eggermann	Lead Author	CH2M HILL	Writes nonchemistry sections of the SAP; prepares attachments; coordinate with GIS, senior consultants, and publications; assists PM in planning and coordinating
Roni Warren	Human Health Risk Assessor	CH2M HILL	Provides human health risk assessment oversight
William Kappleman	Ecological Risk Assessor	CH2M HILL	Provides ecological risk assessment oversight
Megan Morrison	Project Chemist	CH2M HILL	Coordinates laboratory and data validation subcontracts and oversees performance of laboratory and data validation. Writes/coordinates chemistry-specific UFP-SAP worksheets
Hillary Ott	EIS	CH2M HILL	Provides sample tracking, data management, and communication with laboratory

SAP Worksheet #7—Personnel Responsibilities Table (continued)

Name	Title/Role	Organizational Affiliation	Responsibilities
Mark Orman	Health and Safety Officer	CH2M HILL	Develops and approves project health and safety plans
TBD	Field Team Leader	CH2M HILL	Supervises field implementation of the SAP
Kathy Albertson	Laboratory PM	Microbac Laboratories	Manages sample tracking and maintains good communication with project chemist and EIS
Ward Dickens	Data Validator	CH2M HILL	Responsible for validation of environmental data
TBD	Drilling Company Lead	TBD	Performs drilling tasks
TBD	IDW Management PM	TBD	Manages the disposal of IDW

SAP Worksheet #8—Special Personnel Training Requirements Table

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/Organizational Affiliation	Location of Training Records/Certificates
Surface water, sediment, pore water, and groundwater sampling	Hazardous Waste and Operations (HAZWOPER) 40-hour Training, 8 hour annual refreshers as applicable	Registered training organization	Organization-specific	FTL (TBD), field team members (TBD), site safety coordinator (TBD), onsite subcontractors (TBD), Navy and agency representatives	Field team leader, field team members, and site safety coordinator from CH2M HILL; onsite subcontractors TBD; onsite visitors from Navy, EPA, and WVDEP	CH2M HILL, Navy, regulatory agency, or subcontractor Human Resources Department
Surface water, sediment, pore water, and groundwater sampling	CPR/First Aid Trained, Site safety coordinator-hazardous waste (SSC-HW)	Registered training organization	Organization-specific	Site safety coordinator	Onsite site safety coordinator from CH2M HILL	CH2M HILL Human Resources Department

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

Project Name: Site 13 Remedial Investigation [1] **Projected Date(s) of Sampling:** Spring 2010 **Project Manager:** Jennifer Myers	**Site Name:** Site 13 **Site Location:** Allegany Ballistics Laboratory, WV

Date of Session: June 5, 2009

Scoping Session Purpose: Internal scoping session

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Brett Doerr	Senior Consultant	CH2M HILL/VBO	757.671.6219	Brett.Doerr@ch2m.com	Provide input on CSM, DQOs, and SAP worksheets; senior review of SAP
Steven Glennie	Activity Manager	CH2M HILL/WDC	703.376.5122	Steven.Glennie@ch2m.com	Provide final review of SAP prior to publication
William Kappleman	Sr. Ecological Risk Assessor	CH2M HILL/WDC	703.376.5152	William.Kappleman@ch2m.com	Provide guidance on ecological risk screening
Jennifer Myers	Interim Project Manager	CH2M HILL/WDC	703.376.5203	Jennifer.Myers@ch2m.com	Prepare project instructions; manage project goals, budget, and schedule. Review SAP prior to Sr. review and provide final review prior to publication
Carol Peterson	Lead Author (former)	CH2M HILL/VBO	757.671.6275	Carol.Peterson@ch2m.com	Write nonchemistry sections of SAP, prepare attachments, and coordinate with GIS, Sr. consultants, and publications
Roni Warren	Sr. Human Health Risk Assessor	CH2M HILL/WDC	814.364.2454	Roni.Warren@ch2m.com	Provide guidance on human health risk screening

[1] Project began under the assumption that there would be an interim ROD and-long term monitoring; however, ultimate team consensus was that the more traditional CERCLA process would be followed starting with a remedial investigation.

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

Comments:

The purpose of the meeting was to hold an internal scoping session to discuss UFP-SAP draft Worksheets 9, 10, 11, and 17 and to determine key elements to discuss at the external scoping session during the June 2009 partnering meeting. Elements of discussion are to determine if the draft UFP-SAP follows the Navy guidelines and if Data Quality Objectives (DQOs) are in accordance with the Guidance on Systematic Planning Using the Data Quality Objectives Process (EPA QA/G-4).

Action Items:

None

Consensus Decisions:

Draft talking points of Worksheets 9, 10, 11, and 17 were created based on the meeting discussion. Key discussion items were identified for the June 2009 external scoping session to be held during the partnering meeting.

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

Project Name: Site 13 Remedial Investigation **Projected Date(s) of Sampling:** Spring-2010 **Project Manager:** Jennifer Myers	**Site Name:** Site 13 **Site Location:** Allegany Ballistics Laboratory, WV

Date of Session: June 9-10, 2009

Scoping Session Purpose: Discuss the investigation overview and conceptual site model for the site and obtain concurrence on the sampling approach for the long term monitoring.

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Michael Helbling	Navy Technical Representative (NTR)	NAVFAC Atlantic	757.445.6637	Michael.helbling@navy.mil	Manages all ABL Installation Restoration Program (IR Program) activities
John Aubert	NTR	NAVSEA	951.970.7511	RWAJOHN81@aol.com	Reviews SAP
Ji-Sun Yi	Remedial Project Manager (RPM)	EPA Region III	215.814.3377	Yi.ji-sun@epa.gov	Reviews and provides input for EPA on development and modification of the Site 13 LTM program
Tom Bass	RPM	WVDEP	304.926.0449	Thomas.l.bass@wv.gov	Reviews and provides input for WVDEP on development and modification of the Site 13 LTM program
Steven Glennie	Activity Manager	CH2M HILL/WDC	703.376.5122	Steven.Glennie@ch2m.com	Provide final review of SAP prior to publication
Brett Doerr	Senior Consultant	CH2M HILL/VBO	757.671.6219	Brett.Doerr@ch2m.com	Provide input on CSM, DQOs, and SAP worksheets; senior review of SAP
Sankalpa Bajpai	Associate Scientist	CH2M HILL/WDC	703.376.5094	Sankalpa.Bajpai@ch2m.com	Meeting-minutes taker
Don Martin	Environmental Technician	WVDEP (Tier II)	304.926.0449	Donald.W.Martin@wv.gov	Reviews and provides input for WVDEP on development and modification of the Site 13 LTM program

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

Comments:

The Partnering Team attended a scoping session for the UFP SAP on June 9 and 10, 2009. The overview of the investigation and conceptual site model for the site was discussed during the meeting. The goals of the meeting were to present talking points for discussion and obtain concurrence on the sampling approach for remedial investigation.

The scoping session is documented in the Partnering meeting minutes. These minutes include the problem statement, project objectives, environmental questions, project quality objectives, and sampling approaches discussed.

Action Items:

CH2M HILL will prepare a bulleted memo containing a technical synopsis of the proposed investigation for the EPA.

Consensus Decisions:

Based on the discussions at the session, the Partnering team tentatively agreed that an interim Record of Decision (ROD) will be prepared using the August 2009 analytical data from the pilot study. The EPA stated that there may be an issue with the EPA Regional Counsel with this approach. CH2M HILL agreed to prepare a bulleted memo containing a technical synopsis of the project for the EPA so that the RPM could use this as a basis for verbal discussion with the Regional Counsel to determine if this is an acceptable a path forward.

SAP Worksheet #9-3—Project Scoping Session

Project Name: Site 13 Remedial Investigation **Projected Date(s) of Sampling:** Spring 2010 **Project Manager:** Jennifer Myers	**Site Name:** Site 13 **Site Location:** Allegany Ballistics Laboratory, WV

Date of Session: July 14-15, 2009

Scoping Session Purpose: Obtain concurrence on the sampling approach for the long term monitoring

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Michael Helbling	Navy Technical Representative (NTR)	NAVFAC Atlantic	757.445.6637	Michael.helbling@navy.mil	Manages all ABL Installation Restoration Program (IR Program) activities
John Aubert	NTR	NAVSEA	951.970.7511	RWAJOHN81@aol.com	Reviews SAP
Ji-Sun Yi	Remedial Project Manager (RPM)	EPA Region III	215.814.3377	Yi.ji-sun@epa.gov	Reviews and provides input for EPA on development and modification of the Site 13 LTM program
Tom Bass	RPM	WVDEP	304.926.0449	Thomas.l.bass@wv.gov	Reviews and provides input for WVDEP on development and modification of the Site 13 LTM program
Steven Glennie	Activity Manager	CH2M HILL/WDC	703.376.5122	Steven.Glennie@ch2m.com	Provide final review of SAP prior to publication
Brett Doerr	Senior Consultant	CH2M HILL/VBO	757.671.6219	Brett.Doerr@ch2m.com	Provide input on CSM, DQOs, and SAP worksheets; senior review of SAP
Sankalpa Bajpai	Associate Scientist	CH2M HILL/WDC	703.376.5094	Sankalpa.Bajpai@ch2m.com	Meeting minute taker
Tim Reisch	ABL Tier II Representative	NAVFAC Mid-Atlantic	757.445.6682	timothy.reisch@navy.mil	Provide managerial guidance
Dawn Hayes	NAVFAC Technical Consultant	NAVFAC Atlantic	757.322.4792	Dawn.Hayes@navy.mil	Provide technical guidance

SAP Worksheet #9-3—Project Scoping Session (continued)

Comments:

The Partnering Team attended a second scoping session for the UFP SAP on July 14 and 15, 2009. The goal of this discussion was to obtain concurrence on whether or not an interim ROD should be prepared using data from the pilot study.

The scoping session is documented in the Partnering meeting minutes. These minutes include various sampling approaches discussed.

Action Items:

Obtain a copy of the ROD for NAS Oceana for discussion of Site 13 during the August Partnering Meeting. The report contains examples of contingency technology for bedrock treatment.

Consensus Decisions:

Based on the discussions at the session, the Partnering team agreed to use current data to complete the RI and follow with an FFS, PRAP, and ROD. A UFP-SAP for long-term monitoring will be developed concurrent with the RI and installation of bedrock wells. If additional contamination is discovered during the bedrock long term monitoring, an Explanation of Significant Difference document can be prepared to amend the ROD. It was noted that surface water-sediment will need to be worked into the ROD as well.

SAP Worksheet #9-4—Project Scoping Session

Project Name: Site 13 Remedial Investigation **Projected Date(s) of Sampling:** Spring 2010 **Project Manager:** Jennifer Myers	**Site Name:** Site 13 **Site Location:** Allegany Ballistics Laboratory, WV

Date of Session: October 27, 2009

Scoping Session Purpose: Obtain concurrence on the sampling approach for Long Term Monitoring.

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Michael Helbling	Navy Technical Representative (NTR)	NAVFAC Atlantic	757.445.6637	Michael.helbling@navy.mil	Manages all ABL Installation Restoration Program (IR Program) activities
William Fraser	Navy Technical Representative (NTR)	NAVFAC Atlantic	(757) 445-6637	william.g.fraser@navy.mil	Will be replacing Michael Helbling as ABL NTR
John Aubert	NTR	NAVSEA	951.970.7511	RWAJOHN81@aol.com	Reviews SAP
Ji-Sun Yi	Remedial Project Manager (RPM)	EPA Region III	215.814.3377	Yi.ji-sun@epa.gov	Reviews and provides input for EPA on development and modification of the Site 13 LTM program
Tom Bass	RPM	WVDEP	304.926.0449	Thomas.l.bass@wv.gov	Reviews and provides input for WVDEP on development and modification of the Site 13 LTM program
Steven Glennie	Activity Manager	CH2M HILL/WDC	703.376.5122	Steven.Glennie@ch2m.com	Provide final review of SAP prior to publication
Brett Doerr	Senior Consultant	CH2M HILL/VBO	757.671.6219	Brett.Doerr@ch2m.com	Provide input on CSM, DQOs, and SAP worksheets; s review of SAP
Sankalpa Bajpai	Associate Scientist	CH2M HILL/WDC	703.376.5094	Sankalpa.Bajpai@ch2m.com	Meeting minute taker
Bruce Beach	Tier II Representative	EPA Region III	215.814.3364	Beach.bruce@epa.govmailto:	Provide managerial guidance

SAP Worksheet #9-4—Project Scoping Session (continued)

Comments:

The Partnering Team attended a third scoping session for the UFP SAP October 27, 2009. The goal of this discussion was to obtain concurrence on whether or not to proceed with an RI using the existing data and collect additional data during the remedial design/alternative phase.

The scoping session is documented in the Partnering meeting minutes. These minutes include the concerns and issues discussed.

Action Items:

CH2M HILL to provide a memo documenting nature and extent of contamination at Site 13 prior to December 2009 partnering meeting.

Consensus Decisions:

In order to determine if this is still an acceptable approach to the agencies, the existing data (nature and extent of contamination) will be provided to the agencies prior to the December meeting. Upon review of these data, a meeting will be held to determine if they meet the needs of an RI.

SAP Worksheet #9-5—Project Scoping Session

Project Name: Site 13 Remedial Investigation **Projected Date(s) of Sampling:** Spring 2010 **Project Manager:** Jennifer Myers	**Site Name:** Site 13 **Site Location:** Allegany Ballistics Laboratory, WV

Date of Session: December 8, 2009

Scoping Session Purpose: Obtain concurrence on the sampling approach.

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
William Fraser	Navy Technical Representative (NTR)	NAVFAC Atlantic	(757) 445-6637	william.g.fraser@navy.mil	Manages all ABL Installation Restoration Program (IR Program) activities
John Aubert	NTR	NAVSEA	951.970.7511	RWAJOHN81@aol.com	Reviews SAP
Ji-Sun Yi	Remedial Project Manager (RPM)	EPA Region III	215.814.3377	Yi.ji-sun@epa.gov	Reviews and provides input for EPA on development and modification of the Range Road LTM program
Tom Bass	RPM	WVDEP	304.926.0449	Thomas.l.bass@wv.gov	Reviews and provides input for WVDEP on development and modification of the Range Road LTM program
Steven Glennie	Activity Manager	CH2M HILL/WDC	703.376.5122	Steven.Glennie@ch2m.com	Provide final review of SAP prior to publication
Sankalpa Bajpai	Associate Scientist	CH2M HILL/WDC	703.376.5094	Sankalpa.Bajpai@ch2m.com	Meeting minute taker
Tim Reisch	Tier II Representative	NAVFAC Mid-Atlantic	757.445.6682	timothy.reisch@navy.mil	Provide managerial guidance

SAP Worksheet #9-5—Project Scoping Session (continued)

Comments:

The Partnering Team attended a fourth scoping session for the UFP SAP December 8, 2009. The goal of this discussion was to obtain concurrence on whether or not to proceed with an RI using the existing data and collect additional data during the remedial design/alternative phase.

The scoping session is documented in the Partnering meeting minutes. These minutes include the concerns and issues discussed.

Action Items:

CH2M HILL will prepare a draft UFP SAP for the RI activities at Site 13.

Consensus Decisions:

The team agreed to move forward with the traditional RI route, collecting the additional data required to eliminate data gaps prior to writing an RI. No interim ROD will be produced.

SAP Worksheet #9-6—Project Scoping Session Participants Sheet

Project Name: Site 13 Remedial Investigation **Projected Date(s) of Sampling:** Spring 2011 **Project Manager:** Jennifer Myers	**Site Name:** Site 13 **Site Location:** Allegany Ballistics Laboratory, WV
Date of Session: January 12, 2010 **Scoping Session Purpose:** Internal scoping session	

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Brett Doerr	Senior Consultant	CH2M HILL/VBO	757.671.6219	Brett.Doerr@ch2m.com	Provide input on CSM, DQOs, and SAP worksheets; senior review of SAP
Steven Glennie	Activity Manager	CH2M HILL/WDC	703.376.5122	Steven.Glennie@ch2m.com	Provide final review of SAP prior to publication
William Kappleman	Sr. Ecological Risk Assessor	CH2M HILL/WDC	703.376.5152	William.Kappleman@ch2m.com	Provide guidance on ecological risk screening
Jennifer Myers	Interim Project Manager	CH2M HILL/WDC	703.376.5203	Jennifer.Myers@ch2m.com	Prepare project instructions; manage project goals, budget, and schedule. Review SAP prior to Sr. review and provide final review prior to publication
Roni Warren	Sr. Human Health Risk Assessor	CH2M HILL/WDC	814.364.2454	Roni.Warren@ch2m.com	Provide guidance on human health risk screening

Comments:

The purpose of the meeting was to hold an internal scoping session to discuss revisions to the UFP-SAP draft Worksheets 10, 11, and 17 to reflect a remedial investigation.

Action Items:

UFP-SAP will be prepared as discussed.

Consensus Decisions:

Draft versions of Worksheets 9, 10, 11, and 17 were created based on the meeting discussion.

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SAP Worksheet #10—Problem Definition

This worksheet provides the problem definition for Site 13, including facility and site location descriptions; a brief history of the site; previous investigations conducted; and information to support the conceptual site model (CSM).

Facility Location and Description

The Allegany Ballistics Laboratory (ABL) facility encompasses approximately 1,634 acres of land and is located in Mineral County, in the northeastern part of West Virginia, approximately 10 miles southwest of Cumberland, Maryland, along the West Virginia–Maryland border. The North Branch Potomac River lies to the north and west of the facility and Knobly Mountain lies to the south and east. Several small towns are located near the facility, including Short Gap, West Virginia to the southeast and Pinto, Maryland to the north. The land surrounding the ABL facility is primarily rural, agricultural, and forested.

ABL is a research, development, testing, and production facility for solid propellants and motors used for ammunition, rockets, and armaments. The facility includes approximately 350 buildings and is divided into two distinct operating plants, Plant 1 and Plant 2. Plant 1 is owned by the Navy and is currently leased to ATK Tactical Systems Company, LLC (ATK), by the Naval Sea Systems Command (NAVSEA) through a Facilities Use Contract. It occupies about 1,577 acres and is divided into developed and undeveloped areas. Plant 2, owned and operated by ATK, occupies the remaining 57 acres.

Site Location and Description

Site 13 is located in the southeastern portion of the developed section of Plant 1(**Figure 1**). The site topography is relatively flat and consists of grassed areas and asphalt roadways. Site 13 is currently an unused grassed area and future land use is expected to remain the same. Groundwater at Site 13 is not used as a potable drinking water source, nor is it expected to be used as a potable drinking water source in the future. Groundwater flow direction in the underlying shallow alluvial aquifer is east-northeast as indicated by measured groundwater levels and the direction of horizontal migration of a groundwater plume of trichloroethene (TCE) identified in 2005. TCE was initially discovered when TCE at concentrations less that < 1,500 µg/L were detected in surface water at an outfall to the Plant 1 drainage ditch system (SWMU 27A), which traverses Site 13, during sampling required by the facility's National Pollutant Discharge Elimination System (NPDES) permit. Additional surface water sampling conducted during the Phase III Investigation traced the probable source of TCE in the drainage ditch system to the area near the intersection of H Street and Range Road (CH2M HILL, March 2005).

A full-scale pilot study is currently ongoing at Site 13 to evaluate degradation of the TCE contamination in the alluvial aquifer groundwater. The pilot study consists of enhanced bioremediation with the subsurface injection of an emulsified oil substrate to biostimulate existing bacteria in an effort to reduce TCE concentrations to less than its maximum contaminant level (MCL). Postinjection sampling, performed in August 2009, indicates TCE concentrations have declined.

SAP Worksheet #10—Problem Definition (continued)

Geology

Site 13 is underlain by two distinct geologic units: unconsolidated alluvial deposits of fine sands and silts with clay, gravel, and a basal cobble layer over bedrock. The unconsolidated alluvial unit is consistent with floodplain deposits from the nearby North Branch Potomac River. Immediately overlying the bedrock is a zone of cobbles; this zone is of variable thickness, between 5 and 15 feet.

Hydrology and Hydrogeology

Alluvial groundwater flow is toward the northeast in the direction of the North Branch Potomac River. The contact with bedrock is encountered at various depths within Site 13, and the thickness of the saturated portion of the alluvium at ABL ranges from approximately 10 feet to 25 feet. Groundwater levels are expected to fluctuate with the seasons and at times of heavy precipitation or snow melt; it is therefore likely that the alluvial groundwater periodically discharges to the drainage ditch.

Groundwater flow in the bedrock aquifer is likely confined to fractures and limestone solution cavities, but flow pattern and direction are generally similar to the alluvial aquifer (CH2M HILL, 1996b). Hydrogeologic data suggest an interconnection between the alluvial and bedrock aquifers. The local flow and vertical hydraulic gradient will be confirmed during the RI.

The conceptual site model (CSM) shown in **Figure 3** illustrates the understanding of the site geology and contamination.

Habitats and Biota

As part of the evaluation of SWMU 27A, the habitats and biota within the drainage ditch system on Plant 1 were characterized in June 2004. Two of the reaches of the drainage ditch system evaluated are relevant to Site 13. Reach SSL-1D was in the area of surface water approximately 100 feet both east and west of sample location SSL-1D (**Figure 4**). The second was where the drainage ditch enters the North Branch Potomac River. The results of the survey for these two reaches are provided below.

Reach SSL-1D

There was little water in this reach except for a small pool area at the downstream end of the reach. No measurable flow was noted. The wetted channel was approximately 3 feet in width. Pool depth was approximately 0.12 feet. There was not enough water present to measure water quality parameters. Much of the reach channel was covered with emergent vegetation (cattail and rush), and some floating vegetation (duckweed). Bottom substrate was cobble in the upper portion of the reach and mostly silt in the pool. Habitat quality for aquatic life use was restricted by the limited amount of water and usable substrate. Biologically, the most dominant macroinvertebrates were gastropods (physid snails). Chironomids were abundant; anisopterans and hemipterans were common. Four adult frogs were observed. No fish were noted. Surrounding land use consisted of buildings, roads, and mowed grass.

SAP Worksheet #10—Problem Definition (continued)

Reach 27A-22 (From Culvert to River)

This reach consisted of a small shallow pool. There was no flow at the time of observation. The wetted channel was approximately 3 feet in width. Channel depth was approximately 0.3 feet. General water quality parameters (temperature, dissolved oxygen, and pH) were within State water quality standards. No aquatic vegetation was present in the wetted channel. Bottom substrate material was largely silt with a few boulders. Bank stability was poor with the area very susceptible to high erosion. Habitat quality for aquatic life use was restricted by the limited amount of water and usable substrate. Biologically, the most abundant macroinvertebrates were chironomids. Oligochaetes were common. No amphibians or fish were observed.

Previous Investigations

The following paragraphs summarize the previous investigations conducted at the Site 13.

Phase III Investigation

The Phase III Investigation for SWMU 27A in part sought to identify the source of TCE which had been sporadically detected in various outfalls during the NPDES monitoring program. The results of this investigation are documented in the *Final Phase III/IV Investigation of Solid Waste Management Units 2, 27A, 37E, and 37V Report* (CH2M HILL, 2005). In the sediment sampling conducted during the Phase III Investigation, TCE was detected in one of the samples collected from the drainage ditch downstream of Site 13, monitored as part of the facility's NPDES program, resulting in the collection and analysis for VOCs of additional surface water samples from the main drainage channel and its tributaries upstream of the sampling location. TCE was consistently detected (at concentrations between 11 µg/L and 140 µg/L) in surface water samples. These were collected in the main drainage channel downstream of where the drainage ditch crosses Range Road, the highest being immediately downstream of this intersection. TCE was not detected in samples collected upstream from the Range Road crossing along either branch of the drainage ditch.

Because TCE is no longer used at the facility, contaminated groundwater near the Range Road intersection was believed to be the source of TCE in the drainage ditch. In 2002 and 2003, eight direct-push technology (DPT) groundwater grab samples were collected in an attempt to identify the TCE source and better define the extent of VOCs in alluvial groundwater near SWMU 27A. These grab samples identified an elongated area of dissolved TCE in groundwater, trending to the east-northeast and roughly parallel to the Plant 1 drainage system near the Range Road–H Street intersection. TCE was detected at four groundwater sample locations, three of which exceeded the MCL of 5 µg/L; concentrations ranged from approximately 100 to 4,900 µg/L. No VOCs were detected in one sample collected upgradient from the area where the stream crosses Range Road (CH2M HILL, 2005). Though there are no known potential sources of TCE at SWMU 27A, a search of historical information conducted during the Phase III Investigation revealed that there was a boiler (Building 106A) northeast of the Range Road and H Street intersection where degreasing

SAP Worksheet #10—Problem Definition (continued)

operations dating to 1952 were conducted. No potential source of TCE southwest of the intersection was identified. TCE migration along the facility sewer lines from other IRP sites was ruled out because there are no sewer lines located in the immediate vicinity of the intersection.

Phase IV Investigation

The results of the Phase III direct push investigation were used to guide the Phase IV Investigation in 2004, during which DPT subsurface soil samples were collected and monitoring wells GGW21 through GGW25 were installed and sampled (CH2M HILL, 2004b). Ten borings were advanced in order to collect samples in suspected source areas, including the former boiler area mentioned above, and where TCE concentrations had been observed in the underlying alluvial groundwater. The parameters analyzed were intended to identify constituents that may have been released during boiler operations: Target Compound List (TCL) VOCs and SVOCs and Target Analyte List (TAL) metals. Seven VOCs, including TCE in five samples; six SVOCs; 19 metals; and total petroleum hydrocarbons-diesel range organics (TPH-DRO), which was sampled for at one location, were detected in soil samples collected during the Phase IV investigation.

Additionally, during DPT activities conducted during Phase IV investigations, a petroleum odor and a visible sheen were observed in subsurface soil sample SWMU 27A-29, which was located approximately 15 feet east of monitoring well GGW23 (**Figure 2**). In addition, light non–aqueous phase liquid (LNAPL) was found to be present in GGW23, and the highest concentrations of TCE detected at Site 13 were in this well. Therefore, these results and observations were evaluated to select the area surrounding GGW23 as the location for the design and implementation of a pilot study for TCE degradation.

Initial Pilot Study: In Situ Aerobic Degradation

An initial pilot study was conducted to evaluate the effectiveness of an in situ injection in alluvial groundwater to enhance aerobic degradation of VOCs, and is documented in the 2008 report *Range Road Area Pilot Study Report In Situ Aerobic Degradation of TCE in Groundwater* (CH2M HILL, 2008b). The pilot study consisted of the injection of SoyGold 5000™ (SG5000), a potential cometabolite material that when degraded by microbial organisms could result in the production of enzymes that, in turn, degrade a target constituent. Tasks conducted during the study included the following:

- Installation of two alluvial monitoring wells, GGW26 and GGW27 (**Figure 2**), downgradient of the pilot study area
- Installation of two injection/air sparging points into the alluvial aquifer
- Preinjection groundwater and surface water sample collection to obtain baseline analytical results
- Injection of the SG5000 solution into the injection/sparging points
- Pulsed and continuous air sparging to disperse the SG5000 into the aquifer

SAP Worksheet #10—Problem Definition (continued)

- Post-injection groundwater and surface water sampling to monitor changes in VOC concentrations over time and evaluate the efficacy of the remediation; four post injection sampling events were conducted in 2005 and during a follow-up sampling event in December 2006 following the pilot study conclusion

Groundwater analytical results of the pilot study and follow-up sampling events showed that TCE concentrations were significantly reduced, and TCE anaerobic breakdown products increased in the pilot study area (CH2M HILL, 2008b). The results suggested degradation of TCE through reductive dechlorination rather than aerobic processes, as shown by an increase in anaerobic breakdown products, suggesting that the SG5000 solution injection provided a substrate for dechlorination. Overall, the results of the pilot study indicated that the SG5000 injection was effective in reducing the concentration of TCE in the alluvial aquifer. A similar pattern of reduction in TCE concentrations was observed in SWMU 27A surface water downgradient of the pilot study area.

In addition, subsequent to identifying the area for pilot study, higher TCE concentrations were discovered in the area around well GGW22 (**Figure 2**), upgradient of the initial pilot study area.

Additional Characterization Activities

Additional characterization activities were conducted in 2006 following the initial pilot study to delineate the higher concentrations of VOCs in the alluvial aquifer hydraulically upgradient and cross-gradient of the initial pilot study area (CH2M HILL, 2006). In 2006, six groundwater-monitoring wells (designated GGW30 through GGW35) were installed in the alluvial aquifer during the execution of the additional characterization activities (**Figure 2**).

Following well development, all Site 13 monitoring wells were sampled in December 2006 and analyzed for TCL VOCs. Results from this sampling event identified the highest groundwater concentrations of VOCs in wells GGW34 and GGW22 in the area between G Street, Range Road, H Street, and the Plant 1 drainage ditch as suggested by previous investigations. It was concluded that additional data would be needed to confirm that TCE in groundwater was adequately characterized.

Additional data were collected from the alluvial aquifer in February 2008 using multiple passive diffusion bag (PDB) samplers within select individual monitoring wells (CH2M HILL, 2008c). These samples were collected to examine the vertical stratification of VOCs within the alluvial aquifer. The results of the PDB sampling did not identify significant vertical stratification of VOC concentrations (i.e., average percent difference of values within each well sampled was less than 15 percent).

SAP Worksheet #10—Problem Definition (continued)

During the execution of the initial pilot study and the additional characterization, LNAPL was observed in the general vicinity of GGW23. In order to determine if the LNAPL was related to a release of petroleum hydrocarbons, groundwater samples, also collected in December 2006, were analyzed for total petroleum hydrocarbon (TPH)–gasoline range organics (GRO) and TPH–diesel range organics (DRO) from select wells near GGW23 (GGW23, GGW24, GGW26, and GGW27). Results of these analyses indicated that low concentrations (below 210 µg/L) of TPH-GRO were present in all wells sampled. Results also indicated concentrations of TPH-DRO below 700 µg/L in these wells, which is less than WVDEP guidelines.

Membrane Interface Probe Investigation

Because no specific historical source or release event has been identified for VOCs at Site 13, a membrane interface probe (MIP) survey was performed to determine if there was a yet-undefined VOC source related to LNAPL or TPHs in the vadose zone near the highest concentrations of TCE in groundwater.

A total of 17 MIP borings were advanced at Site 13 in October 2007 (**Figure 5**). The survey began in a location hydraulically downgradient of the monitoring well with the highest concentration of TCE in groundwater (GGW34), in order to observe the MIP response to anticipated high concentrations of VOCs; the investigation then proceeded iteratively in the area of interest based on initial results. Borings were advanced either until refusal or until the CH2M HILL scientist onsite determined that the MIP had been advanced into groundwater and that the MIP instrument response was sufficiently characterized.

After the MIP survey was complete, confirmatory soil samples were collected from the four borings where instrument response consistent with VOCs in the vadose zone was highest (MIP-04, -05, -08, -17). Samples were collected at the depth interval with the highest instrument response from each boring. Field inspection of two of the soil borings encountered a fuel odor and visible staining; two additional samples were collected from these intervals for suspected contamination. The samples, submitted for laboratory analysis for VOCs, TPH-GRO and TPH-DRO, confirmed the results of the MIP survey.

The soil results of this investigation, which were presented in the technical memorandum *Additional Source Characterization Results, Range Road Area, Allegany Ballistics Laboratory, Rocket Center, West Virginia* (CH2M HILL, 2008d), suggest that the vadose zone source of TCE in groundwater at Site 13 has either degraded or been leached from the soil.

Enhanced Bioremediation Pilot Study

A second pilot study at Site 13 was conducted in 2008 to evaluate the effectiveness of an in situ injection in alluvial groundwater to enhance reductive dechlorination of VOCs, including TCE, to concentrations approaching their respective MCLs. The bioremediation enhancement focuses on biostimulation, the modification of the environment to stimulate existing bacteria, using a carbon source amendment. It was implemented using a phased approach: Phase I consisted of data collection to refine the assumptions and design parameters of the study, and Phase II consisted of implementation of the subsurface

SAP Worksheet #10—Problem Definition (continued)

delivery of the carbon source amendment (Regenesis 3-D Microemulsion, or 3DMe™) and groundwater-monitoring events to assess the performance of the technology through reduction in TCE and its degradation products concentrations, namely cis-DCE and vinyl chloride.

To assess groundwater conditions at the Site 13, a baseline sampling event was conducted using existing monitoring wells prior to the installation of injection wells. Samples were collected from nine existing alluvial monitoring wells (GGW22, GGW23, GGW26, GGW27, GGW30, GGW31, GGW32, GGW34, and GGW35, as shown in **Figure 2**) for VOCs, total organic carbon (TOC), chloride, sulfide, sulfate, nitrite, nitrate, alkalinity and methane, ethane, ethane (MEE)] analysis.

The maximum TCE and cis-DCE concentrations were 1,200 µg/L in well GGW34 and 35 µg/L in well GGW27, respectively.

Following installation and development of the 28 injection wells, a total of 58,048 gallons of 3DMe™ dilution were injected into the subsurface at the Site 13 (CH2M HILL, 2009a).

The first round postinjection performance monitoring samples were collected in summer 2009 to evaluate the effectiveness of the pilot study. Samples were collected for VOCs, volatile fatty acids, TOC, chloride, sulfide, sulfate, nitrite, nitrate, alkalinity, and MEE.

TCE was detected at concentrations ranging from 0.28 µg/L in GGW34 to 193 µg/L in GGW22. When compared to the results of the baseline sampling event conducted in August 2008, the reduction in TCE ranged between 80 and 99.9 percent (CH2M HILL 2009b).

Human Health Risk Assessment

No human health risk assessment or risk-based screening has been conducted for groundwater, surface water, and sediment. A screening level HHRA was performed for soil, and presented in the July 3, 2008, technical memorandum *Soil Screening Assessment and Evaluation of Bedrock Aquifer Conditions at the Range Road Area, Allegany Ballistics Laboratory, Rocket Center, West Virginia*. The technical memorandum concluded that there is not an unacceptable level of risk associated with soil at Site 13.

Ecological Risk Assessment

No ecological risk assessment or risk-based screening has been conducted at Site 13. As noted previously, the habitats and biota within the drainage ditch system at and near Site 13 were characterized in June 2004. This evaluation is discussed below.

Conceptual Site Model

A CSM was developed for the Site 13 to illustrate a three-dimensional representation of the site conditions, including the known area of contamination, currently present (and undergoing remediation). Because there is no confining unit between the alluvium and bedrock aquifers, a contamination migration route downward into the underlying bedrock aquifer is possible. As more detailed information is obtained about the site during the RI, the CSM will be revised or updated, as appropriate.

SAP Worksheet #10—Problem Definition (continued)

In general, the CSM relates potentially exposed receptor populations with potential source areas based upon physical site characteristics and complete exposure pathways. Important components of the CSM are the identification of potential source areas, transport pathways, exposure media, exposure pathways and routes, and receptor groups. Actual or potential exposures of human and ecological receptors associated with a site are determined by identifying the most likely, and most important, pathways of contaminant release and transport. A complete exposure pathway has three components:

- A source of chemicals that results in a release to the environment
- A pathway of chemical transport through an environmental medium
- An exposure or contact point for a human and/or ecological receptor

Potential Source Areas

As noted above, previous investigations have concluded that an ongoing source of groundwater contamination is no longer present and has either degraded or already been leached from the soil. The RI data will be evaluated to determine if this conclusion is supported.

Transport Pathways

A transport pathway describes the mechanisms whereby site-related constituents, once released, may be transported to an environmental media (such as surface soil) where receptor exposures may occur. These transport pathways are identified on the CSM (**Figure 4**).

The primary mechanisms for contaminant transport at this site include:

- Downward vertical migration of contaminated groundwater from the alluvial aquifer to the bedrock aquifer (this transport pathway has not been verified, but will be assessed during the RI)
- Migration of contaminated groundwater in the aquifer(s) and periodic discharge from the alluvial aquifer to the surface water and sediment of the drainage ditch, which can, in turn, be transported along the ditch

Exposures and Receptors

Ecological Exposures and Receptors

In aquatic habitats, exposures for ecological receptors are typically limited to surface water and surface sediment. Groundwater is generally considered only as a transport medium since there are no ecological exposures to groundwater until it discharges to a water body or surfaces as a seep, at which time it transitions to pore water and/or surface water.

Habitat quality in the drainage ditch in the vicinity of Site 13 is poor. However, a variety of aquatic invertebrates, and frogs, are known to be present in this reach (although fish appear to be absent) and may be exposed to contaminants discharged from the alluvial groundwater to the pore water and/or surface water of the ditch. The surrounding

SAP Worksheet #10—Problem Definition (continued)

terrestrial habitats consist of buildings, roads, and areas of mowed grass and provide little habitat for most ecological receptors.

Human Health Exposures and Receptors

Access to ABL is restricted; the facility is fenced and must be legally accessed through a guarded gate. However, once on facility, access to the Site 13 is not physically restricted. The site is covered by grass and roads and includes no occupied buildings. Potential current receptors, comprising industrial workers and adult site visitors or adult/youth trespassers, although very unlikely, could be exposed to surface water or sediment in the drainage ditch system. These receptors could be exposed to the surface water and sediment through incidental ingestion and dermal contact. The absence of soil contamination representing a source area or potentially unacceptable exposure risks has been verified during previous investigations. Additionally, groundwater from beneath the site is not used as an industrial or potable water supply; therefore, there is no current exposure to groundwater.

Potential future human health receptors include the current receptors, and if the site is developed for future use, future residents, construction workers, or site workers. The construction workers may also be exposed to shallow groundwater exposed during excavation activities, through dermal contact and inhalation of volatile emissions from the water. Additionally, in the unlikely event that alluvial and/or bedrock groundwater from beneath the site is used as a potable water supply, future residents may be exposed through ingestion and dermal contact and inhalation while showering.

As there are currently no buildings on the site, vapor intrusion is not a current exposure pathway. However, if future buildings are constructed on the site, future building occupants could be exposed to VOCs from the groundwater through vapor intrusion into indoor air and inhalation of the building air.

Project Objectives

The objectives of this RI are to (1) evaluate the nature and extent of VOC contamination associated with Site 13 in the bedrock aquifer and drainage ditch; (2) determine whether the contaminant levels (if present) pose a potentially unacceptable risk (by comparing them to residential adjusted RSLs for groundwater, surface water, and sediment and to ecological screening levels for surface water, pore water, and sediment); and (3) determine whether the contaminant levels (if present) will be sufficiently addressed by the pilot study.

The environmental questions/problems to be addressed by the RI are:

1. **Did historical releases at Site 13 contaminate the bedrock aquifer with VOCs above acceptable levels (i.e., RSLs)?**

Bedrock wells will be installed and groundwater samples will be collected and analyzed as detailed in **Worksheet #11** to determine whether VOC concentrations are present and, if so, are greater than RSLs.

SAP Worksheet #10—Problem Definition (continued)

2. Is the pilot study effective at reducing bedrock groundwater contamination (if present)?

Bedrock groundwater samples will be collected and analyzed for VOCs and wet chemistry on a quarterly basis for 1 year as detailed in **Worksheet #11** to determine whether the pilot study is effective at reducing contaminant concentration levels (if present) within the bedrock aquifer. The decision points and actions in **Figure 6** will be used to determine if site related contaminants are present in the bedrock aquifer and whether the pilot study is effective at reducing contaminant concentration levels (if present).

3. Do water levels and distribution of VOC contamination in the drainage ditch (if present) confirm that the alluvial aquifer contamination attributable to Site 13 is discharging to the drainage ditch?

Monthly water level measurements will be conducted to determine when conditions exist where the groundwater is high enough to intersect the ditch. When these conditions exist, surface water and pore water samples will be collected at nine temporary locations spaced at approximately 20-foot intervals adjacent to where the Site 13 alluvial groundwater is anticipated to intersect the ditch, as shown in **Figure 2**and detailed in **Worksheet #18**. The samples will be collected and analyzed as detailed in **Worksheet #11** to determine whether groundwater contamination attributable to Site 13 is discharging to the ditch.

4. Is the pilot study effective at reducing drainage ditch contamination?

Based upon the sample results (i.e., the detected concentrations) from the nine ditch sampling locations, up to five permanent sample locations (two locations where the contaminated groundwater likely discharges and three predetermined downgradient locations shown in **Figure 2**) will be chosen for collection of surface water, pore water, and bulk sediment samples on a quarterly basis for a period of 1 year. The samples will be collected and analyzed as detailed in **Worksheet #11**. The decision points and actions in **Figure 6-7** will be used to determine whether the pilot study is effective at reducing contaminant concentration levels (if present).

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

Who will use the data?

The data will be used by the ABL Partnering Team (Navy, EPA Region III, and WVDEP) to determine if the VOC plume in the alluvial aquifer underlying Site 13 has adversely impacted the deeper bedrock aquifer and/or drainage ditch and, if so, whether the contamination is at potentially unacceptable levels. The data will also be used to determine if there is a decreasing trend in contaminant concentrations (if present) within the bedrock aquifer, and/or in drainage ditch surface water, pore water, and/or sediment (i.e., whether the pilot study is sufficient to address contamination in the bedrock and drainage ditch).

Within each organization, the data may be used by human health risk assessors, ecological risk assessors, and/or project managers. Other technical disciplines within each organization may use the data as well, such as hydrogeologists and engineers evaluating the data with respect to plume configuration. Chemists will use the data to evaluate overall data quality with respect to data usability.

What are the Project Action Limits (PALs)?

The PALs for the groundwater are the EPA tap water RSLs, adjusted for noncarcinogenic chemicals by dividing by 10 to address exposure to more than one noncarcinogenic chemical that may affect the same target organ (i.e., liver)s or MCLs, whichever is lower. The PALs are provided in **Worksheet #15**. Wet chemistry and VOC data will be compared to previous sampling rounds based on the information in **Worksheet #15-3** to determine the effectiveness of the pilot study on the bedrock groundwater.

The PALs for surface water will be adjusted (as discussed for groundwater) EPA RSL tap water RSLs multiplied by 10 to account for the difference in exposure to groundwater versus surface water and ecological screening values as described in **Worksheet #15**. The PALs for sediment will be adjusted (as discussed for groundwater) EPA residential soil RSLs multiplied by 10 to account for the difference in exposure to sediment versus soil and ecological screening criteria discussed in **Worksheet #15**. The PALs for pore water will be ecological screening values only. Because the alluvial aquifer is the likely source of contamination to other site media, reducing the concentration of VOCs in the alluvial aquifer is expected to reduce concentrations in bedrock groundwater, and ditch surface water, pore water, and sediment, to acceptable levels over time. Therefore, PALs were established for these media with the expectation that they will be used to quantify risk once the ongoing source of contamination has been removed, (i.e., groundwater concentrations reach MCLs). Analytical results from samples collected in the ditch will also be compared to previous rounds of data to determine if VOC concentrations are decreasing. In addition, detected compounds will be compared to those detected in alluvial groundwater to support the determination that the alluvial aquifer is the source of contamination in the ditch.

What will the data be used for?

The data will be used to answer the Environmental Questions defined in **Worksheet #10**.

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

What types of data are needed (matrix, target analytes, analytical groups, field screening, on-site analytical or off-site laboratory techniques, sampling techniques)?

Bedrock groundwater, surface water, sediment and pore water samples will be collected during the field investigation. **Worksheet # 17** contains detailed information on the types of data needed for this project, including proposed sample locations and depth intervals.

The planned analyses for each sample type are presented below. **Worksheet #15** details the laboratory analytical protocol.

Sample Type	Analytical Parameters
Bedrock groundwater	VOCs and wet chemistry parameters (chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, TOC, methane, ethane, ethene, VFAs)
Surface water	VOCs
Pore water	VOCs
Sediment	TOC and VOCs

Sampling techniques are described in **Worksheet #14**.

How "good" do the data need to be in order to support the environmental decision?

The laboratory data need to be of the quality and quantity necessary to answer the environmental questions with sufficient confidence that risk management and remedial decisions can be made for the site. Full quality control and third-party data validation will be performed on the analytical data collected. Detailed quality control data requirements are found in **Worksheet # 20**. Data validation procedures requirements are detailed in **Worksheet #36**.

The laboratory will follow the Measurement Performance Criteria (MPC) in **Worksheet #12** for field QC samples and **Worksheet #28** for laboratory QC samples**.** These MPC are consistent with the DoD Quality Systems Manual (QSM) as applicable and laboratory in-house limits where the QSM does not apply.

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

Detailed information on how much data will be collected is provided on **Worksheet #18**. Numbers of quality assurance/quality control (QA/QC) samples for each chemical analysis are discussed in **Worksheet #20**.

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

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

Water levels will be collected monthly for up to 1 year to determine when the conditions exist where the groundwater is high enough to intersect the ditch. If this is determined prior to completing the first year, the monthly water level gauging will be stopped. When these conditions exist, an initial round of nine surface water and pore water samples will be collected from temporary locations. Based upon the results of these initial samples, up to five permanent sample locations will be identified in the drainage ditch and surface water, pore water, and sediment will be sampled quarterly for 1 year.

Should the groundwater levels not rise to the level of the ditch within 1 year of water level monitoring, sampling of the nine temporary locations will not occur and only the three permanent sample points identified **Figure 2** will be sampled quarterly for 1 year.

The first round of bedrock quarterly sampling will begin a minimum of 2 weeks after bedrock well installation. If feasible, the bedrock sampling will be conducted concurrently with the surface water, sediment and pore water sampling.

- 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 on **Worksheet #14** and **#17**.
- The sample locations associated with Site 13 are shown on **Figure 2**.
- The data will be collected following the SOPs presented in **Worksheet #21**.

Who will collect and generate the data?

The CH2M HILL field team will collect the samples, field measurement results (i.e., photoionization detector [PID] readings, water levels, etc.) and field observations during the events.

The samples will be shipped by overnight courier to Microbac Laboratories under subcontract to CH2M HILL for analysis.

Analytical data generated will be submitted to CH2M HILL. Once received and reviewed by CH2M HILL, analytical data will be submitted to Ward Dickens and his team of internal data validators.

The CH2M HILL data management team will receive the validated data and upload it into an internal database and the Naval Installation Restoration Information Solution(NIRIS), a centralized electronic database used for Navy projects.

How will the data be reported?

Data collected as part of the RI (including the quantitative human health and ecological risk assessments) will be documented in a RI report.

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

The report will be prepared by CH2M HILL and submitted to the Navy as a draft, prior to distribution to the partnering team (Navy, EPA, and WVDEP) for review and approval as a draft final version. 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 according to procedures dictated by the Navy CLEAN program/contract. All analytical data will be uploaded into a centralized database developed and maintained for Navy projects by CH2M HILL and provided for upload to NIRIS. At the end of the project, paper copies of archived laboratory data and validation reports will be provided to the Navy.

PQOs listed in the form of if/then qualitative and quantitative statements.

The PQOs are shown in the decision trees in **Figures 6-7.**

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

Matrix: Groundwater, Pore Water, Surface Water

Analytical Group: TCL VOCs

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	VOCs	One per 10 field samples	Precision	Relative Percent Difference (RPD) < 25%	S&A
Equipment Rinsate Blank		One per week of sampling	Contamination/bias	All target compounds < ½ QL except common lab/field contaminants (acetone, 2-butanone, methylene chloride) < QL	S&A
Trip Blank		One per cooler to the laboratory containing VOCs	Contamination/bias		S&A
Ambient Field Blank		One per week of sampling	Contamination/bias		S&A
Cooler Temperature Blank		One per cooler to the laboratory	Accuracy/Representativeness	Less than or equal to 6°C (without freezing sample)	S

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

Matrix: Sediment

Analytical Group: TCL VOCs

Concentration Level: Low

QC Sample	Analytical Group	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	VOCs	One per 10 field samples	Precision	RPD < 35%	S & A
Ambient Field Blank		One per week of sampling	Contamination/bias	All target compounds < ½ QL except common lab/field contaminants (acetone, 2-butanone, methylene chloride) < QL	S&A
Equipment Rinsate Blank		One per week of sampling	Contamination/bias		S&A
Trip Blank		One per cooler to the laboratory containing VOCs	Contamination/bias		S&A
Cooler Temperature Indicator		One per cooler	Accuracy/Representativeness	Less than or equal to 6°C (without freezing sample)	S

SAP Worksheet #12-3—Measurement Performance Criteria Table—Field QC Samples

Matrix: Groundwater

Analytical Group: Chloride, Nitrate, Nitrite, Sulfate

Concentration Level: Medium

QC Sample	Analytical Group	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	Chloride, Nitrate, Nitrite, Sulfate	One per 10 field samples	Precision	RPD < 25%	S & A
Ambient Field Blank		One per week of sampling	Contamination/bias	All target compounds < ½ QL	S&A
Equipment blank		One per week of sampling	Contamination/bias		S & A
Cooler Temperature Indicator		One per cooler	Accuracy/Representativeness	Less than or equal to 6°C (without freezing sample)	S

SAP Worksheet #12-4—Measurement Performance Criteria Table—Field QC Samples

Matrix: Groundwater

Analytical Group: Sulfide

Concentration Level: Medium

QC Sample	Analytical Group	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	Sulfide	One per 10 field samples	Precision	RPD < 25%	S&A
Ambient Field Blank		One per week of sampling	Contamination/bias	Target compound < ½ QL	S&A
Equipment blank		One per week of sampling	Contamination/bias		S&A
Cooler Temperature Indicator		One per cooler	Accuracy/Representativeness	Less than or equal to 6°C (without freezing sample)	S

SAP Worksheet #12-5—Measurement Performance Criteria Table—Field QC Samples

Matrix: Groundwater

Analytical Group: Alkalinity

Concentration Level: Medium

QC Sample	Analytical Group	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	Alkalinity	One per 10 field samples	Precision	RPD < 25%	S&A
Ambient Field Blank		One per week of sampling	Contamination/bias	Target compound < ½ QL	S&A
Equipment blank		One per week of sampling	Contamination/bias		S&A
Cooler Temperature Indicator		One per cooler	Accuracy/Representativeness	Less than or equal to 6°C (without freezing sample)	S

SAP Worksheet #12-6—Measurement Performance Criteria Table—Field QC Samples

Matrix: Groundwater

Analytical Group: TOC

Concentration Level: Medium

QC Sample	Analytical Group	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	TOC	One per 10 field samples	Precision	RPD < 25%	S&A
Ambient Field Blank		One per week of sampling	Contamination/bias	Target compound < ½ QL	S&A
Equipment blank		One per week of sampling	Contamination/bias		S&A
Cooler Temperature Indicator		One per cooler	Accuracy/Representativeness	Less than or equal to 6°C (without freezing sample)	S

SAP Worksheet #12-7—Measurement Performance Criteria Table—Field QC Samples

Matrix: Groundwater

Analytical Group: Methane, Ethane, Ethene

Concentration Level: Medium

QC Sample	Analytical Group	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	Methane, Ethane, Ethene	One per 10 field samples	Precision	RPD < 25%	S&A
Ambient Field Blank		One per week of sampling	Contamination/bias	All target compounds < ½ QL	S&A
Equipment blank		One per week of sampling	Contamination/bias		S&A
Cooler Temperature Indicator		One per cooler	Accuracy/Representativeness	Less than or equal to 6°C (without freezing sample)	S

SAP Worksheet #12-8—Measurement Performance Criteria Table—Field QC Samples

Matrix: Groundwater

Analytical Group: Volatile Fatty Acids (VFA's)

Concentration Level: Medium

QC Sample	Analytical Group	Frequency	DQIs	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	VFA's	One per 10 field samples	Precision	RPD < 25%	S&A
Ambient Field Blank		One per week of sampling	Contamination/bias	All target compounds < ½ QL	S&A
Equipment blank		One per week of sampling	Contamination/bias		S&A
Cooler Temperature Indicator		One per cooler	Accuracy/Representativeness	Less than or equal to 6°C (without freezing sample)	S

SAP Worksheet #12-9—Measurement Performance Criteria Table— Field QC Samples

Matrix: Sediment

Analytical Group: TOC

Concentration Level: Medium

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	TOC	One per 10 field samples	Precision	RPD < 35%	S&A
Ambient Field Blank		One per week of sampling	Contamination/bias	All target compounds < ½ QL	S&A
Equipment blank		One per week of sampling	Contamination/bias		S&A
Cooler Temperature Indicator		One per cooler	Accuracy/Representativeness	Less than or equal to 6°C (without freezing sample)	S

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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
August 2009 Pilot Study Study Results	CH2M HILL. 2008. Work Plan Addendum for a Pilot Study at the Range Road Area.	CH2M HILL. Groundwater. Range Road Area. August 2009.	Data associated with post injection performance sampling will be reported in the RI report as current conditions.	None

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SAP Worksheet #14—Summary of Project Tasks

Project Logistics

Work will be performed in Level D personal protective equipment (PPE), which includes safety glasses and safety toed boots. Optional PPE includes the use of Tyvek® coveralls. Upgrades to higher levels of PPE are discussed in the HSP, provided as **Appendix B**.

Sampling activities are expected to be performed during normal working hours, except under specific arrangement with ABL for after-hours or weekend activities. All efforts will be taken to minimize impacts to nearby buildings, site activities, and traffic patterns on ABL.

Project Tasks

Tasks involved in meeting the objective of this SAP will be comprised of stream and well gauging, surface water, pore water and sediment sampling and bedrock well installation and groundwater sampling, as described below. Applicable SOPs for project tasks outlined in this section are listed on **Worksheet #21** and provided in **Appendix A**.

Field Investigation

Stream and Well Gauging

Monthly stream and well gauging will be performed to evaluate the stream elevation relative to the groundwater. Synoptic water level measurements will be collected from the Site 13 alluvial and bedrock wells during every monitoring/sampling event. Additionally, surface water levels will be measured at three staff gauges located in the drainage ditch, both upgradient and downgradient of Site 13. Water-level measurements will be made to the nearest 0.01-foot.

Surface Water, Pore Water and Sediment Sampling

Initial Event

When the alluvial groundwater is high enough to intersect the nearby drainage ditch (as evidenced by monthly water level measurements), pore water and surface water samples will be collected using PDB and grab sampling techniques, respectively. Nine sample locations will be spaced at approximately 20-foot intervals along the drainage ditch surrounding the previously identified alluvial TCE plume, as shown in **Figure 2**. The surface water and pore water samples will be analyzed for VOCs. Additionally, field parameters (pH, DO, temperature, specific conductivity, turbidity, and ORP) will be collected at each surface water sampling location. Water depth and flow rate will also be measured.

Quarterly Events

Following the initial round of pore and surface water sampling, quarterly monitoring of surface water, pore water and sediment will continue for a period of 1 year. Sample locations will be determined based on pore water concentration to coincide with the intersection of the plume and ditch as well as the three predetermined locations down gradient of the plume, as shown in **Figure 2**. Aqueous samples will be analyzed for VOCs, sediment samples will be analyzed for VOCs and TOC. Additionally, field parameters (pH,

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

DO, temperature, specific conductivity, turbidity, and ORP) will be collected at each surface water sampling location. Water depth and flow rate will also be measured. Sampling protocols will follow the SOPs found in **Appendix A**. Appropriate QA/QC samples will be collected as specified on **Worksheet #20**.

Bedrock Monitoring Well Installation and Groundwater Sampling

Three bedrock monitoring wells will be installed immediately outside of the previously identified alluvial TCE plume boundary to a depth of 90 below ground surface (bgs). The bedrock monitoring wells are listed in **Worksheet #18** and shown on **Figure 2**. One well will be installed up gradient and the other two wells will be installed down gradient of the plume. A drill rig capable of both air hammer and casing advancement drilling techniques will be used to install bedrock monitoring wells. Air-hammer drilling techniques will be the preferred method however; in the event of borehole collapse casing advancement techniques will be used. A surface casing will be installed to protect the bedrock aquifer from the known contamination in the alluvium. The boreholes will be left open to facilitate sample collection at various depths within the bedrock.

Following a 2-week equilibration period, PDB samples will be installed within the open borehole at approximately 35, 60, and 85 ft bgs (assuming depth to bedrock is 30 ft bgs). PDB will be allowed to equilibrate in each well for a minimum of 2 weeks. Following the PDB equilibration period, the wells will be sampled for TCL VOCs as described in **Appendix A.12**. Additional sample volume from monitoring wells will be collected for MNA parameters as practical after the PDBs are removed from their respective wells, using the procedure described in **Appendix A.6**. Field measurements of groundwater parameters will be collected immediately after all samples have been collected from an individual well. In addition to the standard parameters identified in **Appendix A.5**, values for pH, DO, temperature, specific conductivity, ORP, and ferrous iron (II) will be recorded. Sampling protocols will follow the SOPs referenced in **Worksheet #21** and found in **Appendix A**. Appropriate QA/QC samples will be collected as specified on **Worksheet #20**.

General Sampling Tasks

Document detailed field observations in a field notebook in accordance with applicable SOPs referenced on **Worksheet #21**.

Decontaminate nondisposable sampling equipment before sampling activities at each location in accordance with applicable SOPs referenced on **Worksheet #21**.

Store IDW decontamination rinsate and groundwater in accordance with applicable SOPs referenced on **Worksheet #21**.

Sample location coordinates, northing and easting, will be collected using a Global Positioning System (GPS). New bedrock monitoring wells will be surveyed for northing, easting, and elevation, as described in **Appendix A.18**.

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

Quality Control

Field and laboratory activities will be implemented following SOPs, which are provided in **Appendices A** and **B**, respectively.

QC samples will be collected as outlined on **Worksheet #20**.

Analytical Tasks

The laboratory will calibrate, maintain, test, and inspect analytical instruments (**Worksheets #24** and **#25**).

The laboratory will process and prepare samples for analysis.

The analytical laboratory will process and prepare samples for analyses and analyze all samples for specified analytes as per **Worksheet #18**.

The laboratory will report all sample results on a dry weight basis.

Secondary Data

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

Data Validation, Review, and Management Tasks:

- **Appendix D** provides guidance and checklists on data management steps such as data recording, data transformation, data reduction, data transfer and transmittal, data analysis, and data review. Procedures for data tracking, storage, archiving, retrieval and security for both electronic and hardcopy data are also provided in **Appendix D**. The Project EIS is responsible for data tracking and storage.
- Perform data validation through a third-party subcontractor as per **Worksheets #35 and #36**.
- Perform a data usability assessment as per **Worksheet #37**.

Documentation and Reporting

- Prepare Remedial Investigation Report, discussing the field activities and evaluation of the data and presenting the conclusions and recommendations.

Data Tracking, Storage, Archiving, Retrieval and Security

- Maintain and archive records as discussed in **Worksheet #29**
  Track, Store, and Archive records (performed by the EIS; see Org Chart on **Worksheet #5**).

Assessment/Audit Tasks

- Project assessment and audits will be completed as detailed on **Worksheets #31** and **#32**.

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

The following applies to all of Worksheet #15:

In cases where the PAL is less than the laboratory's corresponding QL and MDL, if that specific constituent is nondetect, the analyte will be considered not present. However, if it is detected, it will be considered to be an exceedance of the PAL.

Matrix: Groundwater

Analytical Group: VOCs

Analyte	CAS Number	Adjusted Tap Water RSLs[1] (µg/L)	Project Quantitation Limit Goal[2] (µg/L)	Laboratory-specific		MS/MSD and LCS Control Limits		
				QLs (µg/L)	MDLs (µg/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
1,1,1-Trichloroethane	71-55-6	910	1	1	0.25	65	130	30
1,1,2,2-Tetrachloroethane	79-34-5	0.067	0.022	1	0.2	65	130	30
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	76-13-1	5900	5	5	0.25	40	160	30
1,1,2-Trichloroethane	79-00-5	0.24	0.08	1	0.25	75	125	30
1,1-Dichloroethane	75-34-3	2.4	0.8	1	0.125	70	135	30
1,1-Dichloroethene	75-35-4	34	1.5	1.5	0.5	70	130	30
1,2,4-Trichlorobenzene	120-82-1	0.41	0.137	1	0.2	65	135	30
1,2-Dibromo-3-chloropropane	96-12-8	0.00032	0.0001	3	1	50	130	30
1,2-Dibromoethane	106-93-4	0.0065	0.002	1	0.25	80	120	30
1,2-Dichlorobenzene	95-50-1	37	1	1	0.125	70	120	30
1,2-Dichloroethane	107-06-2	0.15	0.05	1	0.25	70	130	30
1,2-Dichloropropane	78-87-5	0.39	0.13	1	0.2	75	125	30
1,3-Dichlorobenzene	541-73-1	NC	1	1	0.25	75	125	30
1,4-Dichlorobenzene	106-46-7	0.43	0.143	1	0.125	75	125	30
2-Butanone	78-93-3	710	10	10	2.5	30	150	30
2-Hexanone	591-78-6	4.7	1.567	10	2.5	55	130	30
4-Methyl-2-pentanone	108-10-1	200	10	10	2.5	60	135	30

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

Matrix: Groundwater

Analytical Group: VOCs

Analyte	CAS Number	Adjusted Tap Water RSLs[1] (µg/L)	Project Quantitation Limit Goal[2] (µg/L)	Laboratory-specific		MS/MSD and LCS Control Limits		
				QLs (µg/L)	MDLs (µg/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
Acetone	67-64-1	2200	10	10	2.5	40	140	30
Benzene	71-43-2	0.41	0.137	1	0.125	80	120	30
Bromochloromethane	74-97-5	NC	1	1	0.2	65	130	30
Bromodichloromethane	75-27-4	0.12	0.04	1	0.25	75	120	30
Bromoform	75-25-2	8.5	1.5	1.5	0.5	70	130	30
Bromomethane	74-83-9	0.87	0.29	3	0.5	30	145	30
Carbon disulfide	75-15-0	100	1.5	1.5	0.5	35	160	30
Carbon tetrachloride	56-23-5	0.2	0.067	1	0.25	65	140	30
Chlorobenzene	108-90-7	9.1	1	1	0.125	80	120	30
Chloroethane	75-00-3	2100	1.5	1.5	0.5	60	135	30
Chloroform	67-66-3	0.19	0.063	1	0.125	65	135	30
Chloromethane	74-87-3	19	1	1	0.5	40	125	30
cis-1,2-Dichloroethene	156-59-2	37	1	1	0.25	70	125	30
cis-1,3-Dichloropropene	10061-01-5	0.43	0.143	1	0.25	70	130	30
Cyclohexane	110-82-7	1300	5	5	1	70	130	30
Dibromochloromethane	124-48-1	0.15	0.05	1	0.25	60	135	30
Dichlorodifluoromethane (Freon-12)	75-71-8	40	1	1	0.25	30	155	30
Ethylbenzene	100-41-4	1.5	0.5	1	0.25	75	125	30
Isopropylbenzene	98-82-8	68	1	1	0.25	75	125	30
m- and p-Xylene	m&pXylene	NC	2	2	0.5	75	130	30
Methyl acetate	79-20-9	3700	5	5	1	50	190	30

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

Matrix: Groundwater

Analytical Group: VOCs

Analyte	CAS Number	Adjusted Tap Water RSLs[1] (µg/L)	Project Quantitation Limit Goal[2] (µg/L)	Laboratory-specific		MS/MSD and LCS Control Limits		
				QLs (µg/L)	MDLs (µg/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
Methylcyclohexane	108-87-2	NC	5	5	1	80	130	30
Methylene chloride	75-09-2	4.8	1	1	0.25	55	140	30
Methyl-tert-butyl ether (MTBE)	1634-04-4	13	4.333	5	0.5	65	125	30
o-Xylene	95-47-6	120	1	1	0.25	80	120	30
Styrene	100-42-5	160	1	1	0.125	65	135	30
Tetrachloroethene	127-18-4	0.11	0.037	1	0.25	45	150	30
Toluene	108-88-3	230	1	1	0.25	75	120	30
trans-1,2-Dichloroethene	156-60-5	11	1	1	0.25	60	140	30
trans-1,3-Dichloropropene	10061-02-6	0.43	0.143	1.5	0.5	55	140	30
Trichloroethene	79-01-6	2	0.667	1	0.25	70	125	30
Trichlorofluoromethane (Freon-11)	75-69-4	130	1	1	0.25	60	145	30
Vinyl chloride	75-01-4	0.016	0.005	1	0.25	50	145	30

[1] PALs were developed to be protective of human health and the environment. Refer to Worksheets #10 and #11 for a detailed discussion on development of PALs.

[2] Project QL Goals were determined on a case by case basis and in most cases are at least 3 times less than the PAL. The laboratory will J-qualify results between the QL and MDL. J-qualified results are considered usable for project decisions.

NC = No Criteria

Adjusted Tap Water RSLs are the USEPA Regional Screening Levels for Tap Water adjusted for noncarcinogenic chemicals by dividing by ten to address exposure to more than one noncarcinogenic chemical that my effect the same target organ (i.e., liver).

Shading represents cases where the PAL or Project QL goal is lower than the laboratory QL.

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

Matrix: Surface Water

Analytical Group: VOCs

Analyte	CAS Number	Adjusted Tap Water RSLs × 10 for SW[1] (µg/L)	Eco PALs[1] (µg/L)	Project Quantitation Limit Goal[2] (µg/L)	Laboratory-specific		MS/MSD and LCS Control Limits		
					QLs (µg/L)	MDLs (µg/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
1,1,1-Trichloroethane	71-55-6	9100	11.0	1	1	0.25	65	130	30
1,1,2,2-Tetrachloroethane	79-34-5	0.67	610	0.22	1	0.2	65	130	30
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	76-13-1	59000	NC	5	5	0.25	40	160	30
1,1,2-Trichloroethane	79-00-5	2.4	1,200	0.8	1	0.25	75	125	30
1,1-Dichloroethane	75-34-3	24	47.0	1	1	0.125	70	135	30
1,1-Dichloroethene	75-35-4	340	25.0	1.5	1.5	0.5	70	130	30
1,2,4-Trichlorobenzene	120-82-1	4.1	110	1	1	0.2	65	135	30
1,2-Dibromo-3-chloropropane	96-12-8	0.0032	NC	0.0011	3	1	50	130	30
1,2-Dibromoethane	106-93-4	0.065	NC	0.022	1	0.25	80	120	30
1,2-Dichlorobenzene	95-50-1	370	14.0	1	1	0.125	70	120	30
1,2-Dichloroethane	107-06-2	1.5	910	0.5	1	0.25	70	130	30
1,2-Dichloropropane	78-87-5	3.9	525	1	1	0.2	75	125	30
1,3-Dichlorobenzene	541-73-1	NC	71.0	1	1	0.25	75	125	30
1,4-Dichlorobenzene	106-46-7	4.3	15.0	1	1	0.125	75	125	30
2-Butanone	78-93-3	7100	14,000	10	10	2.5	30	150	30
2-Hexanone	591-78-6	47	99.0	10	10	2.5	55	130	30
4-Methyl-2-pentanone	108-10-1	2000	170	10	10	2.5	60	135	30
Acetone	67-64-1	22000	1,500	10	10	2.5	40	140	30
Benzene	71-43-2	4.1	130	1	1	0.125	80	120	30

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

Matrix: Surface Water

Analytical Group: VOCs

Analyte	CAS Number	Adjusted Tap Water RSLs × 10 for SW[1] (µg/L)	Eco PALs[1] (µg/L)	Project Quantitation Limit Goal[2] (µg/L)	Laboratory-specific		MS/MSD and LCS Control Limits		
					QLs (µg/L)	MDLs (µg/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
Bromochloromethane	74-97-5	NC	NC	1	1	0.2	65	130	30
Bromodichloromethane	75-27-4	1.2	NC	0.4	1	0.25	75	120	30
Bromoform	75-25-2	85	320	1.5	1.5	0.5	70	130	30
Bromomethane	74-83-9	8.7	16.0	2.9	3	0.5	30	145	30
Carbon disulfide	75-15-0	1000	0.92	0.31	1.5	0.5	35	160	30
Carbon tetrachloride	56-23-5	2	240	0.67	1	0.25	65	140	30
Chlorobenzene	108-90-7	91	64.0	1	1	0.125	80	120	30
Chloroethane	75-00-3	21000	NC	1.5	1.5	0.5	60	135	30
Chloroform	67-66-3	1.9	28.0	0.63	1	0.125	65	135	30
Chloromethane	74-87-3	190	5,500	1	1	0.5	40	125	30
cis-1,2-Dichloroethene	156-59-2	370	590	1	1	0.25	70	125	30
cis-1,3-Dichloropropene	10061-01-5	4.3	0.055	0.02	1	0.25	70	130	30
Cyclohexane	110-82-7	13000	NC	5	5	1	70	130	30
Dibromochloromethane	124-48-1	1.5	NC	0.5	1	0.25	60	135	30
Dichlorodifluoromethane (Freon-12)	75-71-8	400	NC	1	1	0.25	30	155	30
Ethylbenzene	100-41-4	15	90.0	1	1	0.25	75	125	30
Isopropylbenzene	98-82-8	680	2.60	0.87	1	0.25	75	125	30
m- and p-Xylene	m- & p-Xylene	NC	67.0	2	2	0.5	75	130	30
Methyl acetate	79-20-9	37000	NC	5	5	1	50	190	30

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

Matrix: Surface Water

Analytical Group: VOCs

Analyte	CAS Number	Adjusted Tap Water RSLs × 10 for SW[1] (µg/L)	Eco PALs[1] (µg/L)	Project Quantitation Limit Goal[2] (µg/L)	Laboratory-specific		MS/MSD and LCS Control Limits		
					QLs (µg/L)	MDLs (µg/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
Methylcyclohexane	108-87-2	NC	NC	5	5	1	80	130	30
Methylene chloride	75-09-2	48	2,200	1	1	0.25	55	140	30
Methyl-tert-butyl ether (MTBE)	1634-04-4	130	10,000	5	5	0.5	65	125	30
o-Xylene	95-47-6	1200	13.0	1	1	0.25	80	120	30
Styrene	100-42-5	1600	72.0	1	1	0.125	65	135	30
Tetrachloroethene	127-18-4	1.1	98.0	0.37	1	0.25	45	150	30
Toluene	108-88-3	2300	9.80	1	1	0.25	75	120	30
trans-1,2-Dichloroethene	156-60-5	110	590	1	1	0.25	60	140	30
trans-1,3-Dichloropropene	10061-02-6	4.3	0.055	0.02	1.5	0.5	55	140	30
Trichloroethene	79-01-6	20	47.0	1	1	0.25	70	125	30
Trichlorofluoromethane(Freon-11)	75-69-4	1300	NC	1	1	0.25	60	145	30
Vinyl chloride	75-01-4	0.16	930	0.05	1	0.25	50	145	30

[1] PALs were developed to be protective of human health and the environment. Refer to Worksheets #10 and #11 for a detailed discussion on development of PALs.

[2] Project QL Goals were determined on a case by case basis and in most cases are at least 3 times less than the PAL. The laboratory will J-qualify results between the QL and MDL. J-qualified results are considered usable for project decisions.

NC = No Criteria

Adjusted Tap Water RSLs are the USEPA Regional Screening Levels for Tap Water adjusted for noncarcinogenic chemicals by dividing by ten to address exposure to more than one noncarcinogenic chemical that my effect the same target organ (i.e., liver).. Values were multiplied by 10 to account for the surface water exposure scenario.

Eco PALs are derived from literature-based screening values.

Shading represents cases where the PAL or Project QL goal is lower than the laboratory QL.

SAP Worksheet #15-3—Reference Limits and Evaluation Table

Matrix: Pore Water

Analytical Group: VOCs

Analyte	CAS Number	Eco PALs[1] (µg/L)	Project Quantitation Limit Goal[2] (µg/L)	Laboratory-specific		MS/MSD and LCS Control Limits		
				QLs (µg/L)	MDLs (µg/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
1,1,1-Trichloroethane	71-55-6	11.0	1	1	0.25	65	130	30
1,1,2,2-Tetrachloroethane	79-34-5	610	1	1	0.2	65	130	30
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	76-13-1	NC	5	5	0.25	40	160	30
1,1,2-Trichloroethane	79-00-5	1,200	1	1	0.25	75	125	30
1,1-Dichloroethane	75-34-3	47.0	1	1	0.125	70	135	30
1,1-Dichloroethene	75-35-4	25.0	1.5	1.5	0.5	70	130	30
1,2,4-Trichlorobenzene	120-82-1	110	1	1	0.2	65	135	30
1,2-Dibromo-3-chloropropane	96-12-8	NC	3	3	1	50	130	30
1,2-Dibromoethane	106-93-4	NC	1	1	0.25	80	120	30
1,2-Dichlorobenzene	95-50-1	14.0	1	1	0.125	70	120	30
1,2-Dichloroethane	107-06-2	910	1	1	0.25	70	130	30
1,2-Dichloropropane	78-87-5	525	1	1	0.2	75	125	30
1,3-Dichlorobenzene	541-73-1	71.0	1	1	0.25	75	125	30
1,4-Dichlorobenzene	106-46-7	15.0	1	1	0.125	75	125	30
2-Butanone	78-93-3	14,000	10	10	2.5	30	150	30
2-Hexanone	591-78-6	99.0	10	10	2.5	55	130	30
4-Methyl-2-pentanone	108-10-1	170	10	10	2.5	60	135	30
Acetone	67-64-1	1,500	10	10	2.5	40	140	30
Benzene	71-43-2	130	1	1	0.125	80	120	30

SAP Worksheet #15-3—Reference Limits and Evaluation Table (continued)

Matrix: Pore Water

Analytical Group: VOCs

Analyte	CAS Number	Eco PALs[1] (µg/L)	Project Quantitation Limit Goal[2] (µg/L)	Laboratory-specific		MS/MSD and LCS Control Limits		
				QLs (µg/L)	MDLs (µg/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
Bromochloromethane	74-97-5	NC	1	1	0.2	65	130	30
Bromodichloromethane	75-27-4	NC	1	1	0.25	75	120	30
Bromoform	75-25-2	320	1.5	1.5	0.5	70	130	30
Bromomethane	74-83-9	16.0	3	3	0.5	30	145	30
Carbon disulfide	75-15-0	0.92	0.31	1.5	0.5	35	160	30
Carbon tetrachloride	56-23-5	240	1	1	0.25	65	140	30
Chlorobenzene	108-90-7	64.0	1	1	0.125	80	120	30
Chloroethane	75-00-3	NC	1.5	1.5	0.5	60	135	30
Chloroform	67-66-3	28.0	1	1	0.125	65	135	30
Chloromethane	74-87-3	5,500	1	1	0.5	40	125	30
cis-1,2-Dichloroethene	156-59-2	590	1	1	0.25	70	125	30
cis-1,3-Dichloropropene	10061-01-5	0.055	0.02	1	0.25	70	130	30
Cyclohexane	110-82-7	NC	5	5	1	70	130	30
Dibromochloromethane	124-48-1	NC	1	1	0.25	60	135	30
Dichlorodifluoromethane (Freon-12)	75-71-8	NC	1	1	0.25	30	155	30
Ethylbenzene	100-41-4	90.0	1	1	0.25	75	125	30
Isopropylbenzene	98-82-8	2.60	0.87	1	0.25	75	125	30
m- and p-Xylene	m- & p-Xylene	67.0	2	2	0.5	75	130	30
Methyl acetate	79-20-9	NC	5	5	1	50	190	30
Methylcyclohexane	108-87-2	NC	5	5	1	80	130	30

SAP Worksheet #15-3—Reference Limits and Evaluation Table (continued)

Matrix: Pore Water

Analytical Group: VOCs

Analyte	CAS Number	Eco PALs[1] (µg/L)	Project Quantitation Limit Goal[2] (µg/L)	Laboratory-specific		MS/MSD and LCS Control Limits		
				QLs (µg/L)	MDLs (µg/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
Methylene chloride	75-09-2	2,200	1	1	0.25	55	140	30
Methyl-tert-butyl ether (MTBE)	1634-04-4	10,000	5	5	0.5	65	125	30
o-Xylene	95-47-6	13.0	1	1	0.25	80	120	30
Styrene	100-42-5	72.0	1	1	0.125	65	135	30
Tetrachloroethene	127-18-4	98.0	1	1	0.25	45	150	30
Toluene	108-88-3	9.80	1	1	0.25	75	120	30
trans-1,2-Dichloroethene	156-60-5	590	1	1	0.25	60	140	30
trans-1,3-Dichloropropene	10061-02-6	0.055	0.02	1.5	0.5	55	140	30
Trichloroethene	79-01-6	47.0	1	1	0.25	70	125	30
Trichlorofluoromethane(Freon-11)	75-69-4	NC	1	1	0.25	60	145	30
Vinyl chloride	75-01-4	930	1	1	0.25	50	145	30

[1] PALs were developed to be protective of the environment. Refer to Worksheets #10 and #11 for a detailed discussion on development of PALs.

[2] Project QL Goals were determined on a case by case basis and in most cases are at least 3 times less than the PAL. The laboratory will J-qualify results between the QL and MDL. J-qualified results are considered usable for project decisions.

NC = No Criteria

Eco PALs are derived from literature-based screening values.

Shading represents cases where the PAL or Project QL goal is lower than the laboratory QL.

SAP Worksheet #15-4—Reference Limits and Evaluation Table

Matrix: Sediment

Analytical Group: VOCs

Analyte	CAS Number	Adjusted Residential Soil RSLs × 10 for SD[1] (µg/kg)	Eco PALs[1] (µg/kg)	Project Quantitation Limit Goal[2] (µg/kg)	Laboratory-specific		MS/MSD and LCS Control Limits		
					QLs (µg/kg)	MDLs (µg/kg)	LCL (%)	UCL (%)	RPD (%)
Dichlorodifluoromethane (Freon-12)	75-71-8	180	NC	10	10	1	35	135	30
Chloromethane	74-87-3	120	NC	10	10	2	50	130	30
Vinyl chloride	75-01-4	0.6	NC	0.20	5	1	60	125	30
Bromomethane	74-83-9	7.3	NC	2.43	10	1	30	160	30
Chloroethane	75-00-3	2100	NC	10	10	1	40	155	30
Trichlorofluoromethane(Freon-11)	75-69-4	790	NC	5	5	1	25	185	30
1,1-Dichloroethene	75-35-4	240	31	5	5	0.5	65	135	30
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	76-13-1	910	NC	10	10	0.5	70	130	30
Acetone	67-64-1	61000	NC	20	20	5	20	160	30
Carbon disulfide	75-15-0	740	0.85	0.28	5	0.5	45	160	30
Methyl acetate	79-20-9	29000	NC	10	10	1	70	130	30
Methylene chloride	75-09-2	110	370	5	5	1	55	140	30
trans-1,2-Dichloroethene	156-60-5	150	400	5	5	0.5	65	135	30
Methyl-tert-butyl ether (MTBE)	1634-04-4	430	NC	5	5	1	54	151	30
1,1-Dichloroethane	75-34-3	33	27	5	5	1	75	125	30
cis-1,2-Dichloroethene	156-59-2	780	400	5	5	0.5	65	125	30
2-Butanone	78-93-3	28000	NC	10	10	2.5	30	160	30
Bromochloromethane	74-97-5	NC	NC	5	5	0.5	70	125	30
Chloroform	67-66-3	3	22	1	5	0.5	70	125	30
1,1,1-Trichloroethane	71-55-6	640	170	5	5	0.5	70	135	30

SAP Worksheet #15-4—Reference Limits and Evaluation Table (continued)

Matrix: Sediment

Analytical Group: VOCs

Analyte	CAS Number	Adjusted Residential Soil RSLs × 10 for SD[1] (µg/kg)	Eco PALs[1] (µg/kg)	Project Quantitation Limit Goal[2] (µg/kg)	Laboratory-specific		MS/MSD and LCS Control Limits		
					QLs (µg/kg)	MDLs (µg/kg)	LCL (%)	UCL (%)	RPD (%)
Cyclohexane	110-82-7	120	NC	10	10	0.5	70	130	30
Carbon tetrachloride	56-23-5	2.5	1200	0.83	5	0.5	65	135	30
Benzene	71-43-2	11	57	3.67	5	0.5	75	125	30
1,2-Dichloroethane	107-06-2	4.3	250	1.43	5	0.5	70	135	30
Trichloroethene	79-01-6	28	1600	5	5	0.5	75	125	30
Methylcyclohexane	108-87-2	NC	NC	10	10	1	70	130	30
1,2-Dichloropropane	78-87-5	9	NC	3.00	5	0.5	70	120	30
Bromodichloromethane	75-27-4	2.7	NC	0.90	5	0.5	70	130	30
cis-1,3-Dichloropropene	10061-01-5	17	0.051	0.02	5	0.5	70	125	30
4-Methyl-2-pentanone	108-10-1	3400	NC	10	10	2.5	45	145	30
Toluene	108-88-3	820	670	5	5	0.5	70	125	30
trans-1,3-Dichloropropene	10061-02-6	17	0.051	0.02	5	0.5	65	125	30
1,1,2-Trichloroethane	79-00-5	11	1200	3.67	5	0.5	60	125	30
Tetrachloroethene	127-18-4	5.5	530	1.83	5	0.5	65	140	30
2-Hexanone	591-78-6	210	NC	10	10	2.5	45	145	30
Dibromochloromethane	124-48-1	6.8	NC	2.27	5	0.5	65	130	30
1,2-Dibromoethane	106-93-4	0.34	NC	0.11	5	0.5	70	125	30
Chlorobenzene	108-90-7	290	820	5	5	0.5	75	125	30
Ethylbenzene	100-41-4	54	3600	5	5	0.5	75	125	30
o-Xylene	95-47-6	430	160	5	5	0.5	75	125	30

SAP Worksheet #15-4—Reference Limits and Evaluation Table (continued)

Matrix: Sediment

Analytical Group: VOCs

Analyte	CAS Number	Adjusted Residential Soil RSLs × 10 for SD[1] (µg/kg)	Eco PALs[1] (µg/kg)	Project Quantitation Limit Goal[2] (µg/kg)	Laboratory-specific		MS/MSD and LCS Control Limits		
					QLs (µg/kg)	MDLs (µg/kg)	LCL (%)	UCL (%)	RPD (%)
m- and p-Xylene	m- &p-xylene	NC	940	5	5	0.5	80	125	30
Styrene	100-42-5	870	559	5	5	0.5	75	125	30
Bromoform	75-25-2	620	650	5	5	0.5	55	135	30
Isopropylbenzene	98-82-8	270	86	5	5	0.5	75	130	30
1,1,2,2-Tetrachloroethane	79-34-5	5.6	940	1.87	5	0.5	55	130	30
1,3-Dichlorobenzene	541-73-1	NC	1700	5	5	0.5	70	125	30
1,4-Dichlorobenzene	106-46-7	24	350	5	5	0.5	70	125	30
1,2-Dichlorobenzene	95-50-1	380	340	5	5	0.5	75	120	30
1,2-Dibromo-3-chloropropane	96-12-8	0.054	NC	0.02	10	2	40	135	30
1,2,4-Trichlorobenzene	120-82-1	62	9200	5	5	0.5	65	130	30

[1] PALs were developed to be protective of the environment. Refer to Worksheets #10 and #11 for a detailed discussion on development of PALs.

[2] Project QL Goals were determined on a case by case basis and in most cases are at least 3 times less than the PAL. The laboratory will J-qualify results between the QL and MDL. J-qualified results are considered usable for project decisions.

NC = No Criteria

Adjusted Tap Water RSLs are the USEPA Regional Screening Levels for Residential Soil, adjusted for cancerous/noncancerous effects by dividing RSLs for noncancerous constituents by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver). All values were values were multiplied by 10 to account for the sediment exposure scenario.

Eco PALs are derived from literature-based screening values.

Shading represents cases where the PAL or Project QL goal is lower than the laboratory QL.

SAP Worksheet #15-5—Reference Limits and Evaluation Table

Matrix: Groundwater

Analytical Group: Wet Chemistry, various

Analyte	CAS Number	Performance Indication Level (µg/L)	Effect	Laboratory-specific		MS/MSD and LCS Control Limits		
				QLs (µg/L)	MDLs (µg/L)	LCL (%)	UCL (%)	RPD (%)
Chloride	16887-00-6	> Background Levels	General water quality parameter. Chloride is produced by anaerobic dechlorination. Elevated levels of chloride may indicate that dechlorination is occurring if observed concentrations are greater than three times background and consistent with chlorinated aliphatic hydrocarbon molar concentrations.	300	100	90	110	20
Nitrate	14797-55-8	< 1000	Nitrate is an alternate electron acceptor for microbial respiration in the absence of oxygen. Depleted levels of nitrate (relative to background) indicate that the groundwater environment is sufficiently reducing to sustain nitrate reduction. Nitrate levels less than 1000 µg/L are desirable for anaerobic dechlorination of chlorinated aliphatic hydrocarbons. In most aquifer systems, concentrations of nitrate are naturally much higher than nitrite.	600	100	90	110	20
Nitrite	14797-65-0			400	100	90	110	20
Sulfate	14808-79-8	< 20,000	Sulfate is an alternate electron acceptor for microbial respiration in the absence of oxygen, nitrate, and ferric iron. Depleted concentrations of sulfate relative to background indicate that the groundwater environment is sufficiently reducing to sustain sulfate reduction and for anaerobic dechlorination to occur. Sulfate levels less than 20,000 µg/L are desirable, but not required, for anaerobic dechlorination to occur. High levels of sulfate in conjunction with the absence of TOC indicate additional substrate may be required to promote anaerobic dechlorination.	2000	500	90	110	20

SAP Worksheet #15-5—Reference Limits and Evaluation Table (continued)

Matrix: Groundwater

Analytical Group: Wet Chemistry, various

Analyte	CAS Number	Performance Indication Level (µg/L)	Effect	Laboratory-specific		MS/MSD and LCS Control Limits		
				QLs (µg/L)	MDLs (µg/L)	LCL (%)	UCL (%)	RPD (%)
Sulfide	18496-25-8	< 20,000	Byproduct of sulfate reduction. Sulfide typically precipitates with iron minerals, but elevated levels of sulfide may be toxic to dechlorinating microorganisms. Elevated levels of sulfide in conjunction with elevated levels of chlorinated aliphatic hydrocarbons may indicate that iron compounds should be added to precipitate sulfides and reduce toxicity effects.	1500	500	85	115	10
Alkalinity	471-34-1	> Background levels	Indicator of biodegradation and the buffering capacity of the aquifer (neutralization of weak acids). Used in conjunction with pH, an increase in alkalinity and stable pH indicates the buffering capacity of the aquifer is sufficient to neutralize metabolic acids produced by degradation of substrates. Concentrations of alkalinity that remain at or below background in conjunction with pH less than 5 indicates that a buffering agent may be required to sustain high rates of anaerobic dechlorination.	15000	5000	85	115	25
TOC	TOC[1]	> 20,000	Indicator of natural organic carbon present at site during baseline characterization and as an indicator of substrate distribution during performance monitoring. TOC concentrations greater than 20,000 to 50,000 µg/L are desired in the anaerobic treatment zone.	2000	500	90	110	15

SAP Worksheet #15-5—Reference Limits and Evaluation Table (continued)

Matrix: Groundwater

Analytical Group: Wet Chemistry, various

Analyte	CAS Number	Performance Indication Level (µg/L)	Effect	Laboratory-specific		MS/MSD and LCS Control Limits		
				QLs (µg/L)	MDLs (µg/L)	LCL (%)	UCL (%)	RPD (%)
Methane	74-82-8	> 1000	Methane levels greater than 1000 µg/L are desirable, but not required, for dechlorination to occur. Methane levels less than 1000 µg/L and the accumulation of cis-1,2-DCE, VC, or other less chlorinated aliphatic hydrocarbons may indicate that additional substrate is required to drive reducing conditions into an environment suitable for reduction of these compounds.	5	1	56	140	40
Ethane	74-84-0	> Background levels	If elevated levels of ethene or ethane are not observed, potential accumulation of cis-1,2-DCE or vinyl chloride should be monitored.	5	1	56	140	40
Ethene	74-85-1			5	1	56	137	40

SAP Worksheet #15-5—Reference Limits and Evaluation Table (continued)

Matrix: Groundwater

Analytical Group: Wet Chemistry, various

Analyte	CAS Number	Performance Indication Level (µg/L)	Effect	Laboratory-specific		MS/MSD and LCS Control Limits		
				QLs (µg/L)	MDLs (µg/L)	LCL (%)	UCL (%)	RPD (%)
Acetic Acid	64-19-7	> 10,000-20,000	VFAs are an indicator of substrate distribution and are also degradation products of more complex substrates (e.g., carbohydrates or vegetable oils). Fermentation of VFAs produces molecular hydrogen for anaerobic dechlorination. Measurable concentrations of VFAs (greater than 10,000 to 20,000 µg/L) are desirable in the treatment zone. The presence of mg/L concentrations of propionate or butyrate is considered favorable. A lack of measurable VFAs in conjunction with elevated levels of VOCs and alternate electron acceptors indicates additional substrate may be required to sustain an anaerobic treatment zone.	1500	500	70	130	30
Butyric Acid	107-92-6			1500	500	70	130	30
Lactic Acid	79-33-4			1500	500	70	130	30
Propionic Acid	79-09-04			15000	5000	70	130	30
Pyruvic Acid	127-17-3			150	50	70	130	30

[1]Contractor-generated CAS number

Compounds in Worksheet #15-5 will not be compared to risk-based criteria. Instead, they will be compared to the above Performance Indication Levels. These compounds will be analyzed for in order to provide more information about the state of the aquifer and ERD performance. See Worksheet #11 for more information.

Any detections of VFAs (lactic, propionic, butyric, pyruvic, and acetic) are indicative of hydrogen availability for reductive dechlorination by indigenous microorganisms. VFA data are used in conjunction with TOC data to evaluate the proliferation of carbon and fatty acid sources (i.e., hydrogen sources for bacteria [e.g., for halorespiration]). It is not necessary to meet the performance indicator level for VFAs, which is ultimately arbitrary.

SAP Worksheet #15-6—Reference Limits and Evaluation Table

Matrix: Sediment

Analytical Group: Wet Chemistry

Analyte	CAS Number	PQLGoal[2] (mg/kg)	Laboratory-specific		MS/MSD and LCS Control Limits		
			QLs (mg/kg)	MDLs (mg/kg)	LCL (%)	UCL (%)	RPD (%)
TOC	TOC	1000	1000	500	70	140	50

NC = No Criteria

Data will be used to assess potential bioavailability of VOCs in sediment

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SAP Worksheet #16—Project Schedule/Timeline Table

Task	Start	Finish
UFP-SAP		
Draft	10/26/2009	3/12/2010
Draft Final	4/05/2010	4/19/2010
Final	6/21/2010	4/22/2011
Fieldwork		
Water Level Monitoring	Spring 2011	Summer 2011
Drainage Ditch Sampling (SW and PW)	Spring 2011	Spring 2011
Bedrock Well Sampling	Summer 2011	Spring 2012
Drainage Ditch Sampling (SW, PW, and SD)	Summer 2011	Spring 2012
RI Report		
Draft	Summer 2012	Summer 2012
Draft Final	Fall 2012	Fall 2012
Final	Winter 2012	Winter 2012

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SAP Worksheet #17—Sampling Design and Rationale

This worksheet presents the sampling design and rationale for Site 13. **Worksheet #14** presents the detailed field tasks at each site, **Worksheet #18** presents the sampling locations, and **Worksheet #19** presents the analytical methods.

Matrix	Depth of Samples	Analysis	Frequency	Number of Samples	Rationale	Sampling Strategy
SW and PW Sampling						
Surface water	Mid water column	VOCs	1 event	9	Samples will be collected and analyzed from locations at 20-foot intervals adjacent to the plume where it likely discharges to the drainage ditch. These data, together with surface and groundwater-level data, will be used to determine if and where the alluvial aquifer is contaminating the drainage ditch.	Samples will be collected using grab and PDB sampling techniques.
Pore water	0-6 inches	VOCs		9		
Bedrock Wells						
Groundwater	Mid Screen	VOCs, Chloride, Nitrate, Nitrite, Sulfate, Sulfide, Alkalinity, TOC, Methane, Ethane, Ethene, VFAs	4 quarterly events	3	Samples will be collected from each of three bedrock monitoring wells to determine if the groundwater within the bedrock aquifer is contaminated with VOCs, attributable to the Site 13 alluvial aquifer contamination, at concentrations that exceed MCLs and to determine bedrock groundwater flow direction. Samples will be collected quarterly for 1 year to account for temporal variability and to evaluate the effectiveness of the pilot study at reducing the VOC concentrations.	The monitoring wells will be purged prior to sampling. Groundwater samples will be collected using low-flow and PDB (for VOC analysis) sampling techniques
Surface water, Pore water and Sediment Sampling						
Surface water	Mid water column	VOCs	4 quarterly events	5	Surface water, pore water, and sediment samples will be collected quarterly to account for temporal variability and to evaluate the effectiveness of the pilot study at reducing the VOC concentrations.	Samples will be collected using a PDB and grab sampling techniques
Pore water	0-6 inches	VOCs		5		
Sediment	0-6 inches	VOCs, TOC		5		

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SAP Worksheet #18—Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number	Matrix	Depth Units	Analytical Group (See Worksheet #19)	Number of Samples	Proposed Sampling Dates	Sampling SOP Reference
AS13-TSW04-MMYY	Surface water	Mid-depth of water column	VOCs	1	Spring 2011	See Appendix A
AS13-TSW05-MMYY				1		
AS13-TSW06-MMYY				1		
AS13-TSW07-MMYY				1		
AS13-TSW08-MMYY				1		
AS13-TSW09-MMYY				1		
AS13-TSW10-MMYY				1		
AS13-TSW11-MMYY				1		
AS13-TSW12-MMYY				1		
AS13-WN01-MMYY	Pore water	0-6 inches	VOCs	1	Spring 2011	
AS13-WN02-MMYY				1		
AS13-WN03-MMYY				1		
AS13-WN04-MMYY				1		
AS13-WN05-MMYY				1		
AS13-WN06-MMYY				1		
AS13-WN07-MMYY				1		
AS13-WN08-MMYY				1		
AS13-WN09-MMYY				1		
AS13-SD52-MMYY	Sediment	0-6 inches	VOCs, TOC	4	Summer 2011 Fall 2011 Winter 2011 Spring 2012	
AS13-SD53-MMYY				4		
AS13-SD54-MMYY				4		
AS13-SD55-MMYY				4		
AS13-SD56-MMYY				4		

SAP Worksheet #18—Sampling Locations and Methods/SOP Requirements Table (continued)

Sampling Location/ID Number	Matrix	Depth Units	Analytical Group (See Worksheet #19)	Number of Samples	Proposed Sampling Dates	Sampling SOP Reference
AS13-TSW13-MMYY	Surface water	Mid-depth of water column	VOCs	4	Summer 2011 Fall 2011 Winter 2011 Spring 2012	See Appendix A
AS13-TSW14-MMYY				4		
AS13-TSW15-MMYY				4		
AS13-TSW16-MMYY				4		
AS13-TSW17-MMYY				4		
AS13-WN010-MMYY	Pore water	0-6 inches	VOCs	4	Summer 2011 Fall 2011 Winter 2011 Spring 2012	
AS13-WN011-MMYY				4		
AS13-WN012-MMYY				4		
AS13-WN013-MMYY				4		
AS13-WN014-MMYY				4		
AS13-GGW36-MMYY	Bedrock groundwater	NA	VOCs(PDBs), Chloride, Nitrate, Nitrite, Sulfate, Sulfide, Alkalinity, TOC, Methane, Ethane, Ethene, VFAs	4	Summer 2011 Fall 2011 Winter 2011 Spring 2012	
AS13-GGW37-MMYY			VOCs(PDBs), Chloride, Nitrate, Nitrite, Sulfate, Sulfide, Alkalinity, TOC, Methane, Ethane, Ethene, VFAs	4		
AS13-GGW38-MMYY			VOCs(PDBs), Chloride, Nitrate, Nitrite, Sulfate, Sulfide, Alkalinity, TOC, Methane, Ethane, Ethene, VFAs	4		
AS13-GGW23-MMYY			VOCs (PDB's), Chloride, Nitrate, Nitrite, Sulfate, Sulfide, Alkalinity, TOC, Methane, Ethane, Ethene, VFAs	4		
AS13-GGW26-MMYY			VOCs (PDB's), Chloride, Nitrate, Nitrite, Sulfate, Sulfide, Alkalinity, TOC, Methane, Ethane, Ethene, VFAs	4		
AS13-GGW27-MMYY			VOCs (PDB's), Chloride, Nitrate, Nitrite, Sulfate, Sulfide, Alkalinity, TOC, Methane, Ethane, Ethene, VFAs	4		

Sampling Location/ID Number	Matrix	Depth Units	Analytical Group (See Worksheet #19)	Number of Samples	Proposed Sampling Dates	Sampling SOP Reference
AS13-GGW30-MMYY			VOCs (PDB's), Chloride, Nitrate, Nitrite, Sulfate, Sulfide, Alkalinity, TOC, Methane, Ethane, Ethene, VFAs	4	April 2010 Dec 2010 Sept 2011	See Appendix A
AS13-GGW31-MMYY			VOCs (PDB's), Chloride, Nitrate, Nitrite, Sulfate, Sulfide, Alkalinity, TOC, Methane, Ethane, Ethene, VFAs	4		
AS13-GGW32-MMYY			VOCs (PDB's), Chloride, Nitrate, Nitrite, Sulfate, Sulfide, Alkalinity, TOC, Methane, Ethane, Ethene, VFAs	4		
AS13-GGW33-MMYY			VOCs (PDB's), Chloride, Nitrate, Nitrite, Sulfate, Sulfide, Alkalinity, TOC, Methane, Ethane, Ethene, VFAs	4		
AS13-GGW34-MMYY			VOCs (PDB's), Chloride, Nitrate, Nitrite, Sulfate, Sulfide, Alkalinity, TOC, Methane, Ethane, Ethene, VFAs	4		
AS13-GGW35-MMYY			VOCs (PDB's), Chloride, Nitrate, Nitrite, Sulfate, Sulfide, Alkalinity, TOC, Methane, Ethane, Ethene, VFAs	4		

MMYY: Month, Year to be determined by sampling date

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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	Preservation Requirements (Chemical, Temperature, Light Protected)	Maximum Holding Time (Preparation/Analysis)[2]
Groundwater, Surface Water, Pore Water	TCL VOCs	SW-846 8260B/ PAT01, MSV01	3 × 40-mL VOC vial	40 mL	pH <2, HCl, Less than or equal to 6°C (without freezing sample)	14 days
Groundwater	Chloride, Nitrate, Nitrite, Sulfate	EPA 300.0/IC01	1 × 250-mL poly bottle	50 mL	l Less than or equal to 6°C (without freezing sample)	48 hrs nitrate & nitrite 28 days sulfate & chloride
	Sulfide	EPA 376.1/K3761	1 × 500-mL poly bottle	500 mL	Zn Acetate NaOH, Less than or equal to 6°C (without freezing sample)	7 days
	Alkalinity	EPA 310.2/K3102	1 × 250-mL poly bottle	10 mL	Less than or equal to 6°C (without freezing sample)	14 days
	Methane, Ethane, Ethene	RSK-175/RSK01	3 × 40-mL VOC vial	40 mL	Less than or equal to 6°C (without freezing sample)	14 days
	VFA's	SW-830MBA/ HPLC03	1 × 250-mL amber bottle	250 mL	pH <2, H_3PO_4, Less than or equal to 6°C (without freezing sample)	28 days
Groundwater	TOC	SW-846 9060/ K4151	1 × 250-mL poly bottle	10 mL	pH <2, H_2SO_4, Less than or equal to 6°C (without freezing sample)	28 days
Sediment	TCL VOCs	SW-846 8260B/ PAT01, MSV01	1-2 ounce glass jar	5 g	Less than or equal to 6°C (without freezing sample)	14 days
	TOC	Lloyd Kahn/K5310	1-2 ounce glass jar	10 g	Less than or equal to 6°C (without freezing sample)	28 days

[1] See **Worksheet #23**.

[2] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted. (Not VTSR)

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SAP Worksheet #20—Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Dups	No. of MS/ MSDs	No. of Field Blanks	No. of Equip. Blanks	No. of VOA Trip Blanks	Total No. of Samples to Lab Per Event
PW and SW Sampling (1 event)								
Pore Water	TCL VOCs	9	1	1/1	1	1	1	15
Surface Water	TCL VOCs	9	1	1/1	1	1	1	15
Bedrock Wells, (4 quarterly events)								
Groundwater	TCL VOCs	3	1	1/1	1	1	1	9
	Chloride, Nitrate, Nitrite, Sulfate	3	1	1/1	1	1	0	8
	Sulfide	3	1	1/1	1	1	0	8
	Alkalinity	3	1	1/1	1	1	0	8
	TOC	3	1	1/1	1	1	0	8
	Methane, Ethane, Ethene	3	1	1/1	1	1	0	8
	VFA's	3	1	1/1	1	1	0	8
SW, PW and SD Sampling, (4 quarterly events)								
Surface Water	TCL VOCs	5	1	1/1	1	1	1	11
Pore Water	TCL VOCs	5	1	1/1	1	1	1	11
Sediment	TCL VOCs	5	1	1/1	1	1	1	11
	TOC	5	1	1/1	1	1	0	10

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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	Chain-of-Custody; February 2009.	CH2M HILL	None	No	
Appendix A.2	Decontamination of Personnel and Equipment; January 2008.	CH2M HILL	For cleansing reusable samplers	No	
Appendix A.3	Decontamination of Drilling Rigs and Equipment; January 2008.	CH2M HILL	Water Level Meter	No	
Appendix A.4	Disposal of Waste Fluids and Solids; January 2008.	CH2M HILL	55-gallon steel drums, labeling equipment	No	
Appendix A.5	Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, Oxidation Reduction Potential, and Temperature Using the Horiba® U-22 with Flow-through Cell; January 2008	CH2M HILL	Horiba U-22	No	
Appendix A.6	Low-Flow Groundwater Sampling from Monitoring Wells; January 2008.	CH2M HILL	Groundwater sampling pumps and tubing, Horiba U-22	No	
Appendix A.7	Sediment Sampling; March 2008.	CH2M HILL	Hand tools, sample containers	No	
Appendix A.8	Packing and Shipping Procedures; October 1996.	CH2M HILL	Lab-Supplied Coolers	No	
Appendix A.9	Surface Water Sampling; March 2008.	CH2M HILL	Hand tools, sample containers	No	
Appendix A.10	VOC Sampling – Water; January 2008.	CH2M HILL	Sample containers	No	
Appendix A.11	Water Level Measurements; January 2008.	CH2M HILL	Water Level meter	No	
Appendix A.12	Passive Diffusion Bag Sampling for VOCs from Monitoring Wells; January 2008.	CH2M HILL	PDB sampling apparatus	No	

SAP Worksheet # 21—Project Sampling SOP References Table (continued)

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work?	Comments
Appendix A.13	Preparing Field Log Books; January 2008.	CH2M HILL	None	No	
Appendix A.14	Multi RAE PID	CH2M HILL	PID	No	
Appendix A.15	Volatiles Monitoring with an OVA	CH2M HILL	OVA	No	
Appendix A.16	Bedrock MW Installation	CH2M HILL	Drill Rig, Well Casing, Well Caps	No	
Appendix A.17	Downhole Geophysical Logging	CH2M HILL	Fluid resistivity and conductivity measuring tool	No	
Appendix A.18	Civil Surveying	CH2M HILL	Subcontractor supplied, GPS	No	

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

Field Equipment	Calibration Activity	Maintenance Activity	Testing/ Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Resp. Person	SOP Reference	Comments
Water quality meter	Calibration of pH, DO and conductivity probes	N/A	Visual Inspection	Daily	Parameter specific per model/instruction manual	Manufacturer technical support for calibration errors	Field Team Leader	A.11	
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% 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.	Field Team Leader	A.5	
Organic Vapor Analyzer (OVA)	Calibrate to fresh air and 100 ppm methane	Check mechanical and electronic parts, verify system continuity, check battery, and clean probes. Calibration check.	Visual Inspection	Beginning of each sampling activity	Ambient air reads 0.0	Follow instructions in manual to clean sensor. Do not use this instrument if unable to calibrate properly.	Field Team Leader	A.15	
Landtec GA-90	Calibrate to 25% LEL methane	Check mechanical and electronic parts, verify system continuity, check battery, and clean probes. Calibration check	Visual Inspection	Beginning of each sampling activity	Ambient air reads 0.0	Follow instructions in manual to clean sensor. Do not use this instrument if unable to calibrate properly.	Field Team Leader	See Instrument Manual	

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

Field Equipment	Calibration Activity	Maintenance Activity	Testing/ Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Resp. Person	SOP Reference	Comments
Multi RAE PID	Calibrate using ambient air and isobutylene 100ppm calibration gas	Recharge daily	Visual Inspection	Daily, before use	Ambient air reads 0.0 ppm +/- 3% Isobutylene gas reads 100 ppm +/- 3%	Follow instructions in manual to clean sensor. Do not use this instrument if unable to calibrate properly.	Field Team Leader	A.14	
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	Field Team Leader	A.6	

SAP Worksheet #23—Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work (Y/N)
MSV01	Volatile Organic Compounds by GC/MS - SW8260A/8260B, Revision 13, 9/15/09	Definitive	GW, SW, PW, SD/ VOCs	Gas Chromatograph/ Mass Spectrometer (GC/MS)	Microbac	N
PAT01	Purge and Trap for Volatile Organics, Revision 12, 5/15/09		GW, SW, PW, SD/ VOCs	GC/MS		
RSK01	Dissolved Methane, Ethane and Ethylene - RSK175, Revision 11, 9/15/09	Screening	GW/MEE	GC		
IC01	Anions Method - SW9056/EPA 300.0, Revision 10, 1/15/10	Screening	GW/Wet Chemistry	Ion Chromatograph (IC)		
K3761	Sulfide (Titrimetric, Iodine) - SM 4500-S/EPA 376.1, Revision 12, 9/15/09	Screening		N/A		
K3102	Alkalinity - Automated Methyl Orange - EPA310.2, Revision 12, 6/15/09	Screening		Automated Analyzer		
K4151	Total Organic Carbon Method (TOC)- 9060A/SM5310C/EPA 415.1, Revision 12, 8/15/09	Screening		TOC analyzer		
K5310	TOC in soil - Lloyd Khan Method, Revision 8, 10/15/09	Screening	Soil/Wet Chemistry	TOC analyzer		
HPLC03	Metabolic Acids - SW830MBA, Revision 4, 8/15/09	Screening	GW/VFA's	High Performance Liquid Chromatograph (HPLC)		
LOGIN01	Sample Receiving and Login - Revision 13, 4/15/09	N/A	N/A	N/A		

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SAP Worksheet #24—Analytical Instrument Calibration Table

Acceptance criteria are compliant with the Department of Defense (DoD) Quality Systems Manual (QSM) version 4.1. For analyses that are not included in the QSM, the laboratory's in-house criteria were applied.

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS (TCL VOCs)	Retention time window position establishment for each analyte and surrogate	Once per Initial 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	N/a	Analyst/Supervisor	MSV01
	Evaluation of relative retention time (RRT)	With each sample.	RRT of each target analyte within ± 0.06 RRT units	Correct problem then rerun Initial Calibration		
	Initial Calibration (ICAL)	Prior to sample analysis; when CCV out of criteria	1. Average response factor (RF) for System Performance Check Compounds (SPCCs): VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-Tetrachloroethane, ≥ 0.1 for chloromethane, bromoform, and 1,1-dichlororethane. 2. Relative Standard Deviation (RSD) for RFs for Calibration Check Compounds (CCCs): VOCs ≤ 30% and one option below; *Option 1*: RSD for each analyte ≤ 15% *Option 2*: linear least squares regression r ≥ 0.995 *Option 3*: nonlinear regression - coefficient of determination r^2 ≥ 0.99	Correct problem; Repeat calibration		
	Initial Calibration Verification (ICV)	After each ICAL	Value of all analytes within ± 20% of expected value	Reanalyze ICV; upon 2nd failure, repeat calibration		
	Continuing Calibration Verification (CCV)	Daily; every 12 hours	1. Average response factor (RF) for SPCCs: VOCs > 0.30 for chlorobenzene and 1,1,2,2-Tetrachloroethane, > 0.1 for chloromethane, bromoform, and 1,1-dichlororethane. 2. % Difference/Drift for CCCs: All analytes ≤ 20% Difference	Reanalyze CCV; if failure, repeat ICAL and reanalyze affected samples		
	BFB Tune	Every 12 hours, prior to ICAL	Mass Criteria Mass 50 15.0-40.0 percent of mass 95 Mass 75 30.0-60 percent of mass 95 Mass 95 Base peak, 100 percent relative abundance Mass 96 5.0 to 9.0 percent of mass 95 Mass 173 Less than 2.0 percent of mass 174 Mass 174 Greater than 50.0 percent of mass 95 Mass 175 5.0 to 9.0 percent of mass 174 Mass 176 95.0 to 101 percent of mass 174 Mass 177 - 5.0 to 9.0 percent of mass 176	Retune and/or clean source; reanalyze affected samples		
GC (Methane, Ethane, Ethene)	ICAL	Initially and upon failure of two consecutive CCVs	RSD< 20% or r^2> 0.99	Correct problem -Repeat calibration	Analyst/supervisor	RSK01
	ICV	After each initial calibration	% Drift ± 30% carbon dioxide ± 60%	Reanalyze ICV; if failure, repeat ICAL		
	CCV	Prior to sequence, every 10 samples and end of sequence	% Drift ±25% carbon dioxide + 60%	Reanalyze CCV; if failure, repeat ICAL		

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

Acceptance criteria are compliant with the Department of Defense (DoD) Quality Systems Manual (QSM) version 4.1. For analyses that are not included in the QSM, the laboratory's in-house criteria were applied.

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
IC (Anions)	ICAL	Daily before sample analysis	R ≥ 0.995	Correct problem - Repeat calibration	Analyst/supervisor	IC01
	ICV	After each initial calibration	All analytes within ±10% of expected value	Reanalyze ICV; if failure, repeat ICAL		
	CCV	Prior to sequence, every 10 samples and end of sequence	±10%	Reanalyze CCV; if failure, repeat ICAL, reanalyze affected samples		
HPLC (VFAs)	ICAL	Initially and upon failure of two consecutive CCVs	R ≥ 0.995	Correct problem -Repeat calibration	Analyst/Supervisor	HPLC03
	ICV	After each initial calibration	< 20 % drift for each analyte	Reanalyze ICV; if failure, repeat calibration		
	CCV	Daily, before sample analysis, every ten samples and end of sequence	< 20 % drift for each analyte	Reanalyze CCV; if failure, repeat calibration		
Smartchem Analyzer (Alkalinity)	ICAL	Daily - each analytical run	R ≥ 0.995	Correct problem -Repeat calibration	Analyst/Supervisor	K3102
	ICV	After each initial calibration	Analyte within ±10% of expected value	Reanalyze ICV; if failure, repeat calibration		
	CCV	Every ten samples and end of sequence	±15%	Reanalyze CCV; if failure, repeat calibration		
TOC Analyzer (Waters)	ICAL	As needed and upon failure of two consecutive CCVs	R ≥ 0.995	Correct problem -Repeat calibration	Analyst/Supervisor	K4151
	ICV	After each initial calibration	Analyte within ±10% of expected value	Reanalyze ICV; if failure, repeat calibration		
	CCV	Every ten samples and end of sequence	±15%	Reanalyze CCV; if failure, repeat calibration		
TOC Analyzer (Soil)	ICAL	As needed and upon failure of two consecutive CCVs	R ≥ 0.995	Correct problem -Repeat calibration	Analyst/Supervisor	K5310
	ICV	After each initial calibration	Analyte within ±15% of expected value	Reanalyze ICV; if failure, repeat calibration		
	CCV	Every ten samples and end of sequence	±15%	Reanalyze CCV; if failure, repeat calibration		
Sulfide	Standardization	Daily before sample analysis	Stock duplicate should not differ by more than 0.2 mL titrant	repeat standardization	Analyst/Supervisor	K3761

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	SOP Reference
GC/MS (VOCs)	Clean mass spectrometer source, change/check helium, change trap, clip column, change purge and trap ferrules, bake out column	See **Worksheet #24** for QC samples	Purge lines, purge flow, trap, ion source, column	Prior to calibration check and/or as necessary	Acceptable ICAL or CCV, see **Worksheet #24**	Correct problem and repeat ICAL or CCV	Analyst/Supervisor	MSV01
GC (Methane, Ethane, Ethene)	Change/check helium, clip column, bake column		Check gases	Prior to calibration check and/or as necessary	Acceptable ICAL or CCV, see **Worksheet #24**	Correct problem and repeat ICAL or CCV	Analyst/Supervisor	RSK01
HPLC (VFAs)	Monitor system pressure, change guard cartridges, reverse column, filter samples @ 0.45 microns		Monitor system pressure, check for leaks, check guard cartridges	Prior to calibration check and/or as necessary	Acceptable ICAL or CCV, see **Worksheet #24**	Correct problem and repeat ICAL or CCV	Analyst/Supervisor	HPLC03
IC (Anions)	Monitor system pressure, monitor baseline detector output, change guard cartridges, degas eluent, filter samples @ 0.45 microns		Monitor system pressure, check for leaks, check guard cartridges	Prior to calibration check and/or as necessary	Acceptable ICAL, see **Worksheet #24**	Correct problem and repeat ICAL or CCV	Analyst/Supervisor	IC01
Smartchem Analyzer (Alkalinity)	Replace drying pad, replace pump tubing, replace lamp	See **Worksheet #24** for QC samples	Check tubing and drying pad	Prior to calibration check and/or as necessary	Acceptable ICAL, see **Worksheet #24**	Correct problem and repeat ICAL or CCV	Analyst/Supervisor	K3102
TOC Analyzer (Water)	Check gas supply, check for leaks, replace CO_2 absorber, replace halogen scrubber, wash TC and IC reactors		check gas, scrubbers, reactors,	Prior to calibration check and/or as necessary	Acceptable ICAL, see **Worksheet #24**	Correct problem and repeat ICAL or CCV	Analyst/Supervisor	K4151
TOC Analyzer (Soil)	Check gas supply, check for leaks, replace CO_2 absorber, replace halogen scrubber, replace combustion tube, replace TC catalyst		check gas, scrubbers, reactors,	Prior to calibration check and/or as necessary	Acceptable ICAL, see **Worksheet #24**	Correct problem and repeat ICAL or CCV	Analyst/Supervisor	K5310

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SAP Worksheet #26-1—Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Project Field Team. Field SOPs are in Appendix A of this SAP.
Sample Packaging (Personnel/Organization): Project Field Team. Field SOPs are in Appendix A of this SAP.
Coordination of Shipment (Personnel/Organization): FTL/CH2M HILL
Type of Shipment/Carrier: FedEx Priority Overnight
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Jane Thompson/Microbac
Sample Custody and Storage (Personnel/Organization): Jane Thompson/Microbac
Sample Preparation (Personnel/Organization): Deanna Hesson (wet chemistry), Mike Albertson (VOCs and Methane, Ethane, Ethene), Mike Cochran (VFA's and anions)
Sample Determinative Analysis (Personnel/Organization): Deanna Hesson (wet chemistry), Mike Albertson (VOCs and Methane, Ethane, Ethene), Mike Cochran (VFA's and anions)
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): 90 days from receipt
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 1 year
Biological Sample Storage (No. of days from sample collection): n/a
SAMPLE DISPOSAL
Personnel/Organization: Jane Thompson/Microbac
Number of Days from Analysis: After submission, the laboratory will keep samples 90 days and the sample extracts for a minimum of 60 days.

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SAP Worksheet #27—Sample Custody Requirements Table

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 places into containers and labeled. Labels will be taped to the jar to ensure they do not separate. Samples will be cushioned with packaging material and placed into coolers containing enough ice to keep the samples less than or equal to 6°C (without freezing sample)degrees Celsius until they are received by the laboratory. The chain of custody will be placed into the cooler in a Ziploc bag. Coolers will be taped up and shipped overnight to the laboratories by FedEx, with the air bill number indicated on the CoC (to relinquish custody). Upon delivery, the laboratory will log in each cooler and report the status of the samples to AGVIQ-CH2M HILL. See Worksheet #21 for SOPs containing sample custody guidance. The CH2M HILL field team will ship all environmental samples to Microbac.
Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal): Laboratory custody procedures can be found in the following SOP, which is referenced in Worksheet #23 and can be found in Appendix E of this SAP: LOGIN01
Sample Identification Procedures: Sample labels will include, at a minimum, client name, site, sample ID, date/time collected, analysis group or method, preservation, and sampler's initials. The field logbook will identify the sample ID with the location and time collected and the parameters requested. The laboratory will assign each field sample a laboratory sample ID based on information in the chain of custody. The laboratory will send sample log-in forms to the EIS to check that sample IDs and parameters are correct.
Chain-of-custody Procedures: Chain of custodies will include, at 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 chain of custody 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 Systems (LIMS) database for each sample.

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SAP Worksheet #28-1—Laboratory QC Samples Table

Acceptance criteria are compliant with the Department of Defense (DoD) Quality Systems Manual (QSM) version 4.1. For analyses that are not included in the QSM, the laboratory's in-house criteria were applied. This applies to all of **Worksheet #28**.

Matrix: Groundwater, Surface Water, Pore Water
Analytical Group: TCL VOCs
Analytical Method/SOP Reference: SW-846 8260B/ MSV01

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch of 20 samples	All target compounds < ½ QL except common lab/field contaminants (acetone, 2-butanone, methylene chloride) < QL	Investigate source of contamination. Reanalyze sample. If required, reprepare all samples processed with contaminated blank.	Analyst/ Supervisor	Bias/Contamination	All target compounds < ½ QL except common lab/field contaminants (acetone, 2-butanone, methylene chloride) < QL
Matrix Spike/ Matrix Spike Duplicate (MS/MSD)		See limits on **Worksheets #15-1, 2, and 3**	Investigate source of problem. Narrate.		Accuracy/Bias/Precision	See limits on **Worksheets #15-1, 2, and 3**
Laboratory Control Sample (LCS)		See limits on **Worksheets #15-1, 2, and 3**	Correct problem. Reanalyze sample. If failures exceed marginal exceedance guidelines, re-prepare all samples in batch.		Accuracy/bias	See limits on **Worksheets #15-1, 2, and 3**
Internal Standards (IS)	every sample	Retention times ±30 seconds and Extracted Ion Current Profile (EICP) area within -50 to +100% of ICAL midpoint standard	Inspect GC/MS for malfunctions or interferences. Reanalyze sample		Accuracy/bias	Retention times ±30 seconds and Extracted Ion Current Profile (EICP) area within -50 to +100% of ICAL midpoint standard
Surrogates	every sample	See limits on **Worksheet #28-1a**	Correct problem reanalyze all failed samples in the associated prep batch.		Accuracy/bias	See limits on **Worksheet #28-1a**

SAP Worksheet #28-1a—Surrogate Recoveries

Analytical Group: VOCs		
	Aqueous Control Limits	
Analyte	Lower	Upper
4-Bromofluorobenzene	75	120
Toluene-d8	85	120
1,2-Dichloroethane-d4	70	120
Dibromofluoromethane	85	115

SAP Worksheet #28-2—Laboratory QC Samples Table

Matrix: Sediment

Analytical Group: TCL VOCs

Analytical Method/SOP Reference: SW-846 8260B/ MSV01

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Method Blank	1 per batch of 20 samples or less	All target compounds < ½ QL except common lab/field contaminants (acetone, 2-butanone, methylene chloride) < QL	Investigate source of contamination. Reanalyze sample. If required, re-prepare all samples processed with contaminated blank.	Analyst/ Supervisor	Bias/Contamination	All target compounds < ½ QL except common lab/field contaminants (acetone, 2-butanone, methylene chloride) < QL
MS/MSD		See limits on **W4**	Investigate source of problem. Narrate.		Accuracy/Bias/Precision	See limits on **Worksheet #15-4**
LCS	every sample	See limits on **Worksheet #15-4**	Correct Problem. Reanalyze sample. If failures exceed marginal exceedance guidelines, re-prepare all samples in batch.		Accuracy/bias	See limits on **Worksheet #15-4**
IS	every sample	Retention times ±30 seconds and Extracted Ion Current Profile (EICP) area within -50 to +100% of ICAL midpoint standard	Inspect GC/MS for malfunctions or interferences. Reanalyze sample		Accuracy/bias	Retention times ±30 seconds and Extracted Ion Current Profile (EICP) area within -50 to +100% of ICAL midpoint standard
Surrogates	every sample	See limits on **Worksheet #28-2a**	Correct problem and reanalyze all samples in the associated prep batch		Accuracy/bias	See limits on **Worksheet #28-2a**

SAP Worksheet #28-2a—Surrogate Recoveries

Analytical Group: VOCs

Analyte	Solid Control Limits	
	Lower	Upper
4-Bromofluorobenzene	85	120
Toluene-d8	85	115

SAP Worksheet #28-3—Laboratory QC Samples Table

Matrix: Groundwater

Analytical Group: Chloride, Nitrate, Nitrite, Sulfate

Analytical Method/SOP Reference	EPA 300.0/ IC01					
QC Sample:	**Frequency/ Number**	**Method/SOP QC Acceptance Limits**	**Corrective Action**	**Person(s) Responsible for Corrective Action**	**DQI**	**Measurement Performance Criteria**
Method Blank	1 per batch of 20 samples	All target compounds < ½ QL	Investigate source of contamination. Reanalyze sample. If required, re-prepare all samples processed with contaminated blank.	Analyst/ Supervisor	Bias/Contamination	All target compounds < ½ QL
MS/MSD		See limits on **Worksheet #15-5**	Investigate source of problem. Narrate.		Accuracy/Bias/Precision	See **Worksheet #15-5**
LCS	1 per batch of 20 samples	See limits on **Worksheet #15-5**	Reanalyze sample. If failures exceed marginal exceedance guidelines, re-prepare all samples in batch.		Accuracy/bias	See **Worksheet #15-5**

SAP Worksheet #28-4—Laboratory QC Samples Table

Matrix	Groundwater
Analytical Group	Sulfide
Analytical Method/ SOP Reference	EPA 376.1/K3761

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Method Blank	1 per batch of 20 samples	Target compound < ½ QL	Investigate source of contamination. Reanalyze sample. If required, re-prepare all samples processed with contaminated blank.	Analyst/ Supervisor	Bias/Contamination	Target compound < ½ QL
MS/MSD	1 per batch of 20 samples	See limits on **Worksheet #15-5**	Investigate source of problem. Narrate.		Accuracy/Bias/Precision	See **Worksheet #15-5**
LCS		See limits on **Worksheet #15-5**	Reanalyze sample. If failures exceed marginal exceedance guidelines, re-prepare all samples in batch.		Accuracy/bias	See limits on **Worksheet #15-5**

SAP Worksheet #28-5—Laboratory QC Samples Table

Matrix: Groundwater

Analytical Group: Alkalinity

Analytical Method/ SOP Reference: EPA 310.2/K3102

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Method Blank	1 per batch of 20 samples	Target compound < ½ QL	Investigate source of contamination. Reanalyze sample. If required, re-prep all samples processed with contaminated blank.	Analyst/ Supervisor	Bias/Contamination	Target compound < ½ QL
MS/MSD		See limits on **Worksheet #155**	Investigate source of problem. Narrate.		Accuracy/Bias/Precision	See **Worksheet #15-5**
LCS		See limits on **Worksheet #15-5**	Reanalyze sample. If failure, re-rep all samples in batch.		Accuracy/bias	See limits on **Worksheet #15-5**

SAP Worksheet #28-6—Laboratory QC Samples Table

Matrix: Groundwater

Analytical Group: TOC

Analytical Method/ SOP Reference: SW-846 9060/ K4151

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch of 20 samples	Target compound < ½ QL	Investigate source of contamination. Reanalyze sample.	Analyst/ Supervisor	Contamination/ Bias	Target compound < ½ QL
MS/MSD		See limits on **Worksheet #15-5**	Investigate source of problem. Narrate.		Accuracy/Bias/ Precision	See **Worksheet #15-5**
LCS		See limits on **Worksheet #15-5**	Reanalyze sample. If failure, reanalyze all samples in batch.		Accuracy/Bias	

SAP Worksheet #28-7—Laboratory QC Samples Table

Matrix: Groundwater

Analytical Group: Methane, Ethane, Ethene

Analytical Method/SOP Reference: RSK-175/ RSK01

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch of 20 samples	All target compounds < ½ QL	Investigate source of contamination. Reanalyze sample.	Analyst/ Supervisor	Contamination/Bias	All target compounds < ½ QL
MS/MSD		See limits on **Worksheet #15-5**	Investigate source of problem. Narrate.		Accuracy/Bias/Precision	See **Worksheet #15-5**
LCS		See limits on **Worksheet #15-5**	Reanalyze sample. If failure, reanalyze all samples in batch.		Accuracy/Bias	See limits on **Worksheet #15-5**

SAP Worksheet #28-8—Laboratory QC Samples Table

Matrix: Groundwater

Analytical Group: VFA's

Analytical Method/SOP Reference: SW 830-MBA/ HPLC03

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQI	Measurement Performance Criteria
Method Blank	1 per batch of 20 samples	All target compounds < ½ QL	Investigate source of contamination. Reanalyze sample.	Analyst/ Supervisor	Contamination/Bias	All target compounds < ½ QL
MS/MSD		See limits on **Worksheet #15-5**	Investigate source of problem. Narrate.		Accuracy/Bias/Precision	See **Worksheet #15-5**
LCS		See **Worksheet #15-5**	Reanalyze sample. If failure, reanalyze all samples in batch.		Accuracy/Bias	See **Worksheet #15-5**

SAP Worksheet #28-9—Laboratory QC Samples Table

Matrix: Sediment

Analytical Group: TOC

Analytical Method/SOP Reference: Lloyd Khan/ K5310

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	1 per batch of 20 samples	All target compounds < ½ QL	Investigate source of contamination. Reanalyze sample.	Analyst/ Supervisor	Contamination	All target compounds < ½ QL
MS/MSD		See limits on **Worksheet #15-6**	Investigate source of problem. Narrate.		Accuracy/Bias/Precision	See **Worksheet #15-6**
LCS		See **Worksheet #15-6**	Reanalyze sample. If failure, reanalyze all samples in batch.		Accuracy	See **Worksheet #15-6**

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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.
Corrective Action Forms	Electronic .pdf copies in the project file. Hardcopy in the project file. Archived at project closeout.
Dust monitor readings	Recorded in Field Notebook. Stored in database.
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 FTL. 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	Hardcopy in the full data package. Archived at project closeout.
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.
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.

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SAP Worksheet #30—Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID Numbers	Analytical Method	Data Package Turnaround Time	Laboratory/Organization	Backup Laboratory/ Organization
Sediment	VOCs	See **Worksheet #18**	SW-846 8260B	28 calendar days	Microbac Kathy Albertson 156 Starlite Drive Marietta, OH 45750 800-373-4071	TBD[1]
	TOC		Lloyd Kahn			
SW	VOCs		SW-846 8260B			
PW	VOCs		SW-846 8260B			
Groundwater	VOCs		SW-846 8260B			
	Chloride, nitrate, nitrite, sulfate		EPA 300.0			
	Sulfide		EPA 376.1			
	Alkalinity		EPA 310.2			
	TOC		SW-846 9060			
	Methane, ethane, ethene		RSK-175			
	VFA's		SW 830-MBA			

[1] A backup laboratory has not been determined. If circumstances render the subcontracted laboratory unable to perform analytical services, another laboratory will be determined at that time

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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	Person(s) Responsible for Responding to sessment Findings	Person(s) Responsible for Identifying and Implementing CA	Person(s) Responsible for Monitoring Effectiveness of CA
Field Performance Audit	1 during sampling activities	Internal	CH2M HILL	Field Auditor (TBD) CH2M HILL	FTL (TBD) CH2M HILL	FTL (TBD) or CH2M HILL	Project QA Officer—Dave Collins/ CH2M HILL
Third-Party Laboratory Technical Systems Audit	Laboratory must have current DoD Environmental Laboratories Accreditation Program (ELAP) evaluation letter which will identify the period of performance. The laboratory must be re-evaluated prior to expiration of period of performance.	External	Third-party accrediting bodies on behalf of DoD ELAP	TBD, third-party accrediting bodies on behalf of DoD ELAP	Dave Bumgarner/ Microbac	Dave Bumgarner/ Microbac	Program Chemist—Anita Dodson/ CH2M HILL

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SAP Worksheet #32—Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (Name, Title, Organization)	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response (Name, Title, Org.)	Timeframe for Response
Field Performance Audit	Checklist and Written Audit Report	Jennifer Myers/ CH2M HILL, Project Manager	Within one week of audit	Memorandum	TBD Field Team Leader CH2M HILL Brett Doerr Activity Quality Manager CH2M HILL	Within one week of receipt of Corrective Action Form
Third-Party Laboratory Technical Systems Audit	Written audit report from third party accrediting body	Dave Bumgarner/ Microbac	Within 2 months of audit	Memorandum	Third Party Auditor, TBD	Within 2 months of receipt of initial notification

Worksheet #32-1—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: **(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:

Anita Dodson/CH2M HILL Navy CLEAN Program Chemist

_____

_____

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 _____

_____

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

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

_____

Yes __ No __ 6) Are quality assurance 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 _____

_____

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

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 _____

_____

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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)
Field Audit Report	One during sampling activities	Submitted with Final Reports	Lisa Carter, Program Field Auditor/ CH2M HILL	Included in next LTM and Postinjection Sampling Reports. See **Worksheet #3** for distribution list.
Data Usability Assessment Report	One after all data are generated and validated	Submitted with Final Reports	Megan Morrison, Project Chemist/ CH2M HILL	Included in RI Report. See **Worksheet #3** for distribution list.

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SAP Worksheet #34—Verification (Step I) Process Table

Verification Input	Description	Internal/External	Responsible for Verification
Planning Documents	Evidence of approval and completeness of UFP-SAP.	Internal	Project Manager: Jennifer Myers
Chain of Custody 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. See CoC SOP (on CD) for further details.	Internal	FTL: TBD Project EIS: Hillary Ott
Field Log Notebooks	Field notes will be reviewed to ensure completeness of field data parameters, shipping information, sample numbers, and sample collection times, etc. The logbook will also be used to document, explain, and justify all deviations from the approved work plan and UFP-SAP.	Internal	Project Manager: Jennifer Myers
Sample Login/Receipt	Upon their arrival at the laboratory, the samples will be cross-referenced against the CoC records. All sample labels will be checked against the CoC, and any mislabeling will be identified, investigated, and corrected. The samples will be logged in at every storage area and work station required by the designated analyses. Individual analysts will verify the completeness and accuracy of the data recorded on the forms.	Internal	Sample Receipt Personnel/ Microbac
Data Package	The laboratory's data package will be reviewed for completeness once received from the laboratory and prior to data validation. A 10% comparison between the hardcopy and electronic deliverables will be performed. The analyte lists, QLs, and MPCs will be reviewed for compliance with the UFP-SAP.	External	Project EIS: Hillary Ott Project Chemist: Megan Morrison
QC Summary Report	A summary of all QC sample results will be verified for completeness once the data is received from the laboratory.	External	Project EIS: Hillary Ott

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SAP Worksheet #35—Validation (Steps IIa and IIb) Process Table

Step IIa/IIb[1]	Validation Input	Description	Responsible for Validation
IIa	SOPs	Review field logbooks, laboratory case narratives, data deliverables for compliance to methods and signatures.	FTL: TBD Project Manager: Jennifer Myers/ CH2M HILL
IIb	QC Results	Verify that QC samples were run and compliant with limits established in the UFP-SAP.	Project Chemist: Megan Morrison/ CH2M HILL
IIb	Project QLs	Ensure all sample results met the project quantification and action limits specified in **Worksheet #15**.	Project Chemist: Megan Morrison/ CH2M HILL
IIb	Raw data	10% review of raw data to confirm laboratory calculations.	Ward Dickens, CH2M HILL

[1]IIa= Compliance with methods, procedures, and contracts.
IIb= Comparison with measurement performance criteria in the SAP.

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SAP Worksheet #36—Analytical Data Validation (Steps IIa and IIb) Summary Table

Step IIa/IIb	Matrix	Analytical Group	Validation Criteria	Data Validator
IIa	GW, SW, PW, SD	VOCs	Analytical methods and laboratory SOPs as presented in this SAP will be used to evaluate compliance against QA/QC criteria. Should adherence to QA/QC criteria yield deficiencies, data may be qualified. The data qualifiers used are those presented in *Region III Modifications to the National Functional Guidelines for Organic Data Review, Multi-Media, Multi-Concentration (September 1994).* The specific qualifiers listed therein may be applied to data should non-conformances against the QA/QC method performance criteria, as presented in this SAP, be identified.	Ward Dickens, CH2M HILL
	GW, SD	TOC		
	GW	Chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, methane, ethane, ethene, VFAs		
IIb	All matrices	All analytical groups	See PALs in **Worksheet #15,** Measurement Performance Criteria in **Worksheets #24** and **#28**, sampling locations in **Worksheet #18**, and schedule in **Worksheet #16.**	Project Manager: Jennifer Myers/CH2M HILL Project Chemist: Megan Morrison/CH2M HILL

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SAP Worksheet #37—Usability Assessment

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:

- Nondetected site contaminants will be evaluated to ensure that project required quantitation limits in **Worksheet #15** were achieved. If project quantitation limits were achieved and the verification and validation steps yielded acceptable data, then the data is considered usable. If project quantitation limits were not achieved, then the reason will be investigated and documented, and the impact on data usability will be discussed.

- During verification and validation steps, data may be qualified as estimated with the following qualifiers: J, UJ, K, L, or UL. These qualifiers represent minor QC deficiencies which will not affect the usability of the data. When major QC deficiencies are encountered, data will be qualified with an R and in most cases are not considered usable for project decisions.

  - J—Analyte present. Reported value is estimated and may or may not be accurate or precise
  - UJ—Analyte not detected. Quantitation limit may be inaccurate or imprecise
  - K—Analyte present. Reported value is estimated and may be biased high. Actual value is expected to be lower
  - L—Analyte present. Reported value is estimated and may be biased low. Actual value is expected to be higher
  - UL—Analyte not detected. Quantitation limit is probably higher.
  - R—Rejected result. Result is not usable.

- Additional qualifiers that may be given by the validator include B, N, NJ, and U:

  - B— Not detected significantly greater than that in an associated blank
  - I—Interferences present which may cause the result to be biased high
  - N—Tentative Identification. Consider Present. Special methods may be needed to confirm its presence or absence in future sampling efforts
  - NJ—Qualitative identification questionable due to poor resolution. Presumptively present at approximate quantity
  - U—Not detected

- For statistical comparison, nondetect values will be represented by a concentration equal to one-half the sample reporting limit. For duplicate sample results, the greater of values will be used for project decisions.

- Analytical data will be checked to ensure the values and any qualifiers are appropriately transferred to the electronic database. These checks include comparison of hardcopy data and qualifiers to the electronic data deliverable. Once the data have been uploaded into the electronic database, another check will be performed to ensure all results were loaded accurately.

SAP Worksheet #37—Usability Assessment (continued)

- Field and laboratory precision will be assessed as RPD between the two results.
- Deviations from the SAP will be reviewed to assess whether corrective action is warranted and to assess impacts to achievement of project objectives.

Describe the documentation that will be generated during the usability assessment and how usability assessment results will be presented so that they identify trends, relationships (correlations), and anomalies:

The following will be prepared by CH2M HILL and presented to and submitted to the Tier I Partnering Team (WVDEP, USEPA, Navy) for review and decisions on the path forward for the site.

- Data tables will be produced to reflect detected and nondetected site COCs and geochemical parameters. Data qualifiers will be reflected in the tables and discussed in the data quality evaluation.
- Graphical representations will be produced to reflect increasing and/or decreasing concentrations of COCs and geochemical parameters.
- Plume maps will be produced to reflect increasing and/or decreasing areas of groundwater contamination.
- A data quality evaluation considering all of the above will be provided as part of presentations to the Partnering Team, followed by the technical memorandum prepared to assess remedy effectiveness. The technical memorandum will identify any data usability limitations and make recommendations for corrective action if necessary.

Identify the personnel responsible for performing the usability assessment.

- The CH2M HILL Team, including the Project Manger and Project Chemist, will compile project data and make recommendations pertaining to the usability of the data. The data will be provided to the Partnering Team for discussion and review, and the Team as a whole will weigh in on the usability of the data.

References

CH2M HILL. 1996a. Remedial Investigation of the Allegany Ballistics Laboratory, Vol. I and II. January.

CH2M HILL. 1996b. Phase II Remedial Investigation of the Allegany Ballistics Laboratory Superfund Site, Vols. I and II. August.

CH2M HILL. 2005. Final Phase III/IV Investigation of Solid Waste Management Units 2, 27A, 37E, and 37V Report. March.

CH2M HILL. 2008a. Work Plan Addendum for Pilot Study at the Range Road Area, Allegany Ballistics Laboratory, Rocket Center, West Virginia. July.

CH2M HILL. 2008b. Range Road Area Pilot Study Report in Situ Aerobic Degradation of TCE in Groundwater, Allegany Ballistics Laboratory, Rocket Center, West Virginia. April.

CH2M HILL. 2008c. Final 2008 Site Management Plan, Allegany Ballistics Laboratory, Rocket Center, West Virginia. September.

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CH2M HILL. 2009a. Final Range Road Area Pilot Study Report, In Situ Aerobic Degradation of TCE in Groundwater. Ballistics Laboratory, Rocket Center, West Virginia. June.

CH2M HILL. 2009b. Summary of Post injection Performance Monitoring and Interim ERD Performance Assessment at Site 13 Range Road. Ballistics Laboratory, Rocket Center, West Virginia. November.

EPA. 1993. EPA Region III Modifications to the Laboratory Data Validation Functional Guidelines for Evaluating Inorganics Analysis.

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EPA. 1999. EPA Contract Laboratory Program National Functional Guidelines for Organic Data Review.

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

EPA. 2004a. EPA Region III Biological Technical Assistance Group (BTAG) Freshwater Screening Benchmarks.

EPA. 2004b. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review.

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

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Figures

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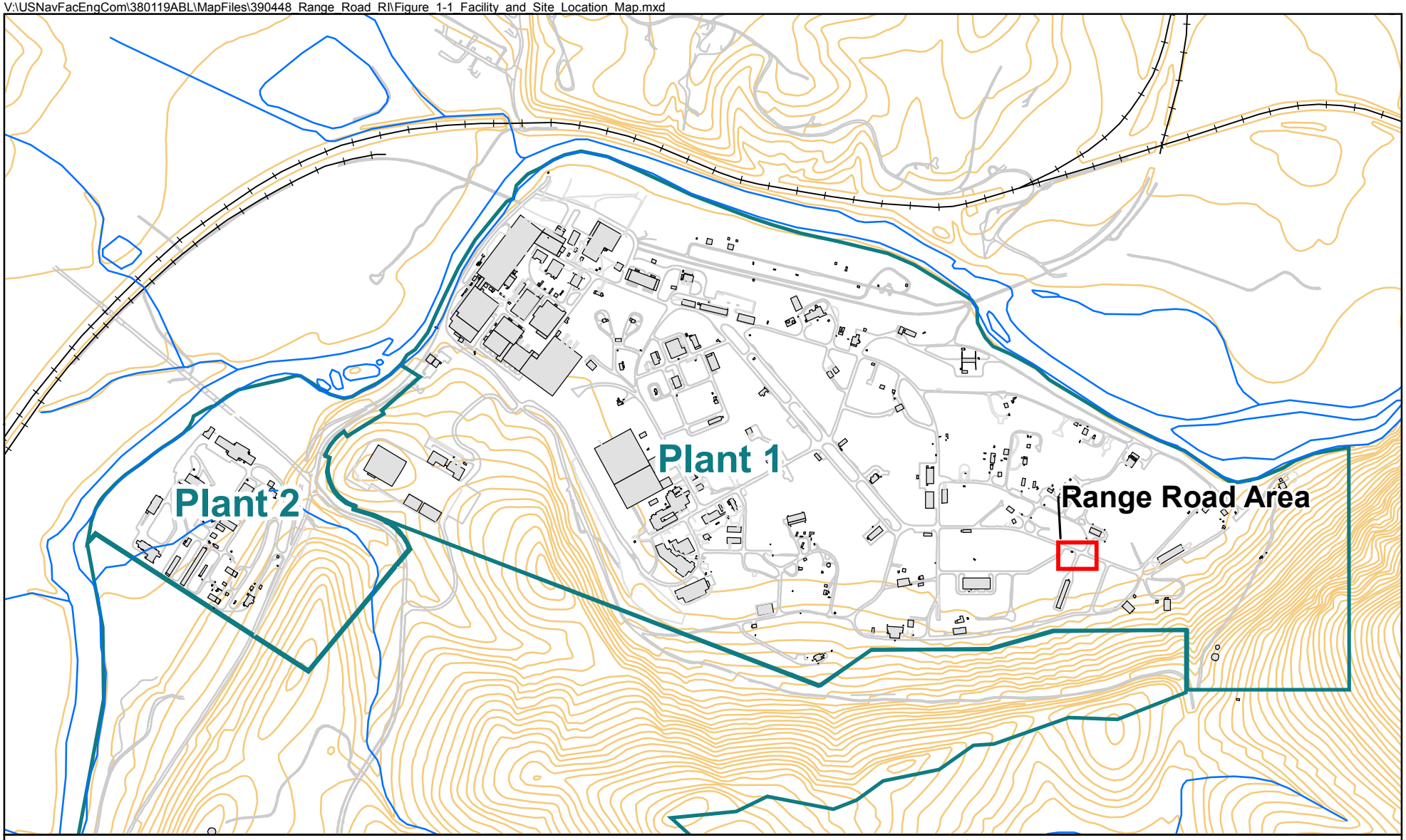

Legend

- Road
- Railroad
- River Bank/Stream
- Topographic Contour
- Building
- Activity Boundary

N

0 500 1,000 2,000 Feet

Figure 1
Facility and Site Location Map
Site 13 Remedial Investigation
Uniform Federal Policy Sampling and Analysis Plan
Allegany Ballistics Laboratory
Rocket Center, West Virginia

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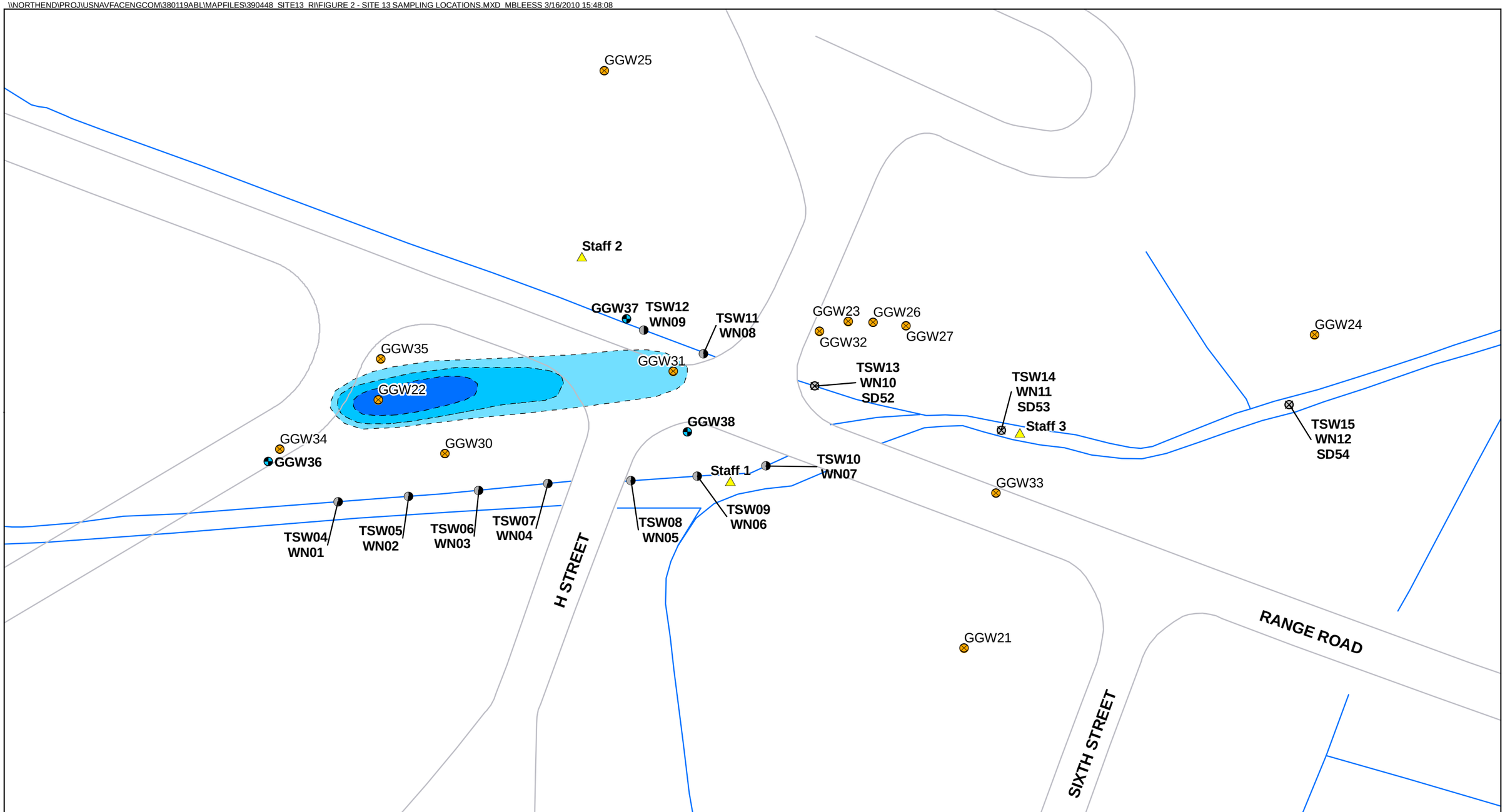

Legend

- Proposed Bedrock Monitoring Well
- Proposed Temporary Surface Water and Pore Water Locations
- Proposed Permanent Surface Water, Pore Water, and Sediment Locations
- Alluvial Monitoring Wells
- Stream Gages
- Paved Roads
- Water Bodies

Inferred TCE Concentrations

- >100 µg/L
- 100-50 µg/L
- 49-5 µg/L

Note:
Two additional permanent surface water, pore water and sediment sampling locations may be chosen based on initial sampling results.

Isoconcentration contour projections based on interpretation of most recent alluvial groundwater monitoring well and PDB data collected during post injection sampling August 2009.

N

0 20 40 80 Feet

1 inch = 40 feet

Figure 2
Sampling Locations
Site 13 Remedial Investigation
Uniform Federal Policy Sampling and Analysis Plan
Allegany Ballistics Laboratory
Rocket Center, West Virginia

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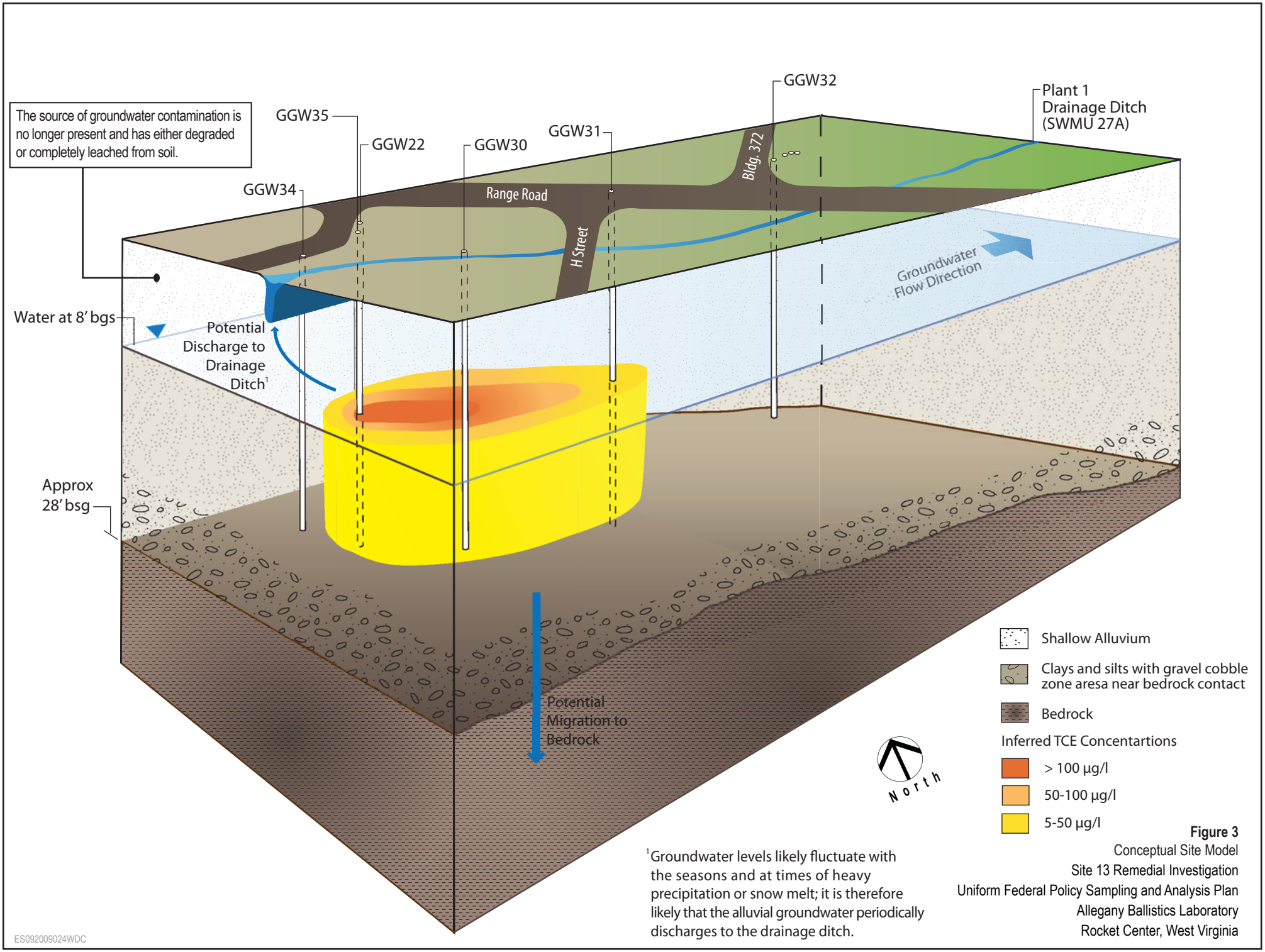

[1]Groundwater levels likely fluctuate with the seasons and at times of heavy precipitation or snow melt; it is therefore likely that the alluvial groundwater periodically discharges to the drainage ditch.

Figure 3
Conceptual Site Model
Site 13 Remedial Investigation
Uniform Federal Policy Sampling and Analysis Plan
Allegany Ballistics Laboratory
Rocket Center, West Virginia

ES092009024WDC

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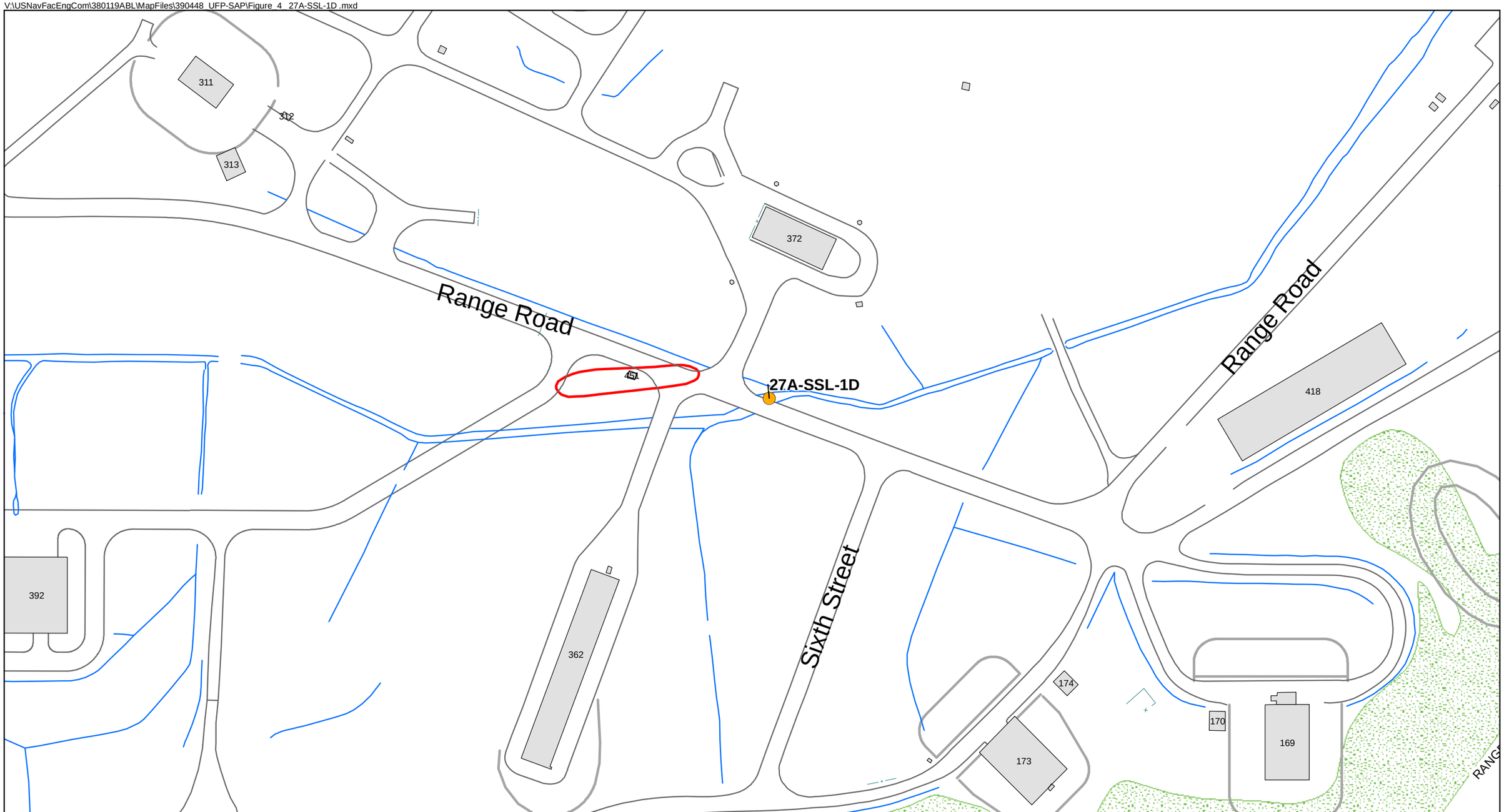

Legend

- Surface Water Sample
- Water Body
- Structures
- Roads
- Vegetation
- Approximate Site Boundary as Defined by Alluvial Groundwater Plume Exceeding 5 ug/L TCE

N

0 50 100 200 Feet

1 inch = 100 feet

Figure 4
Reach SSL-1D
Range Road Remedial Investigation
Uniform Federal Policy Sampling and Analysis Plan
Allegany Ballistics Laboratory
Rocket Center, West Virginia

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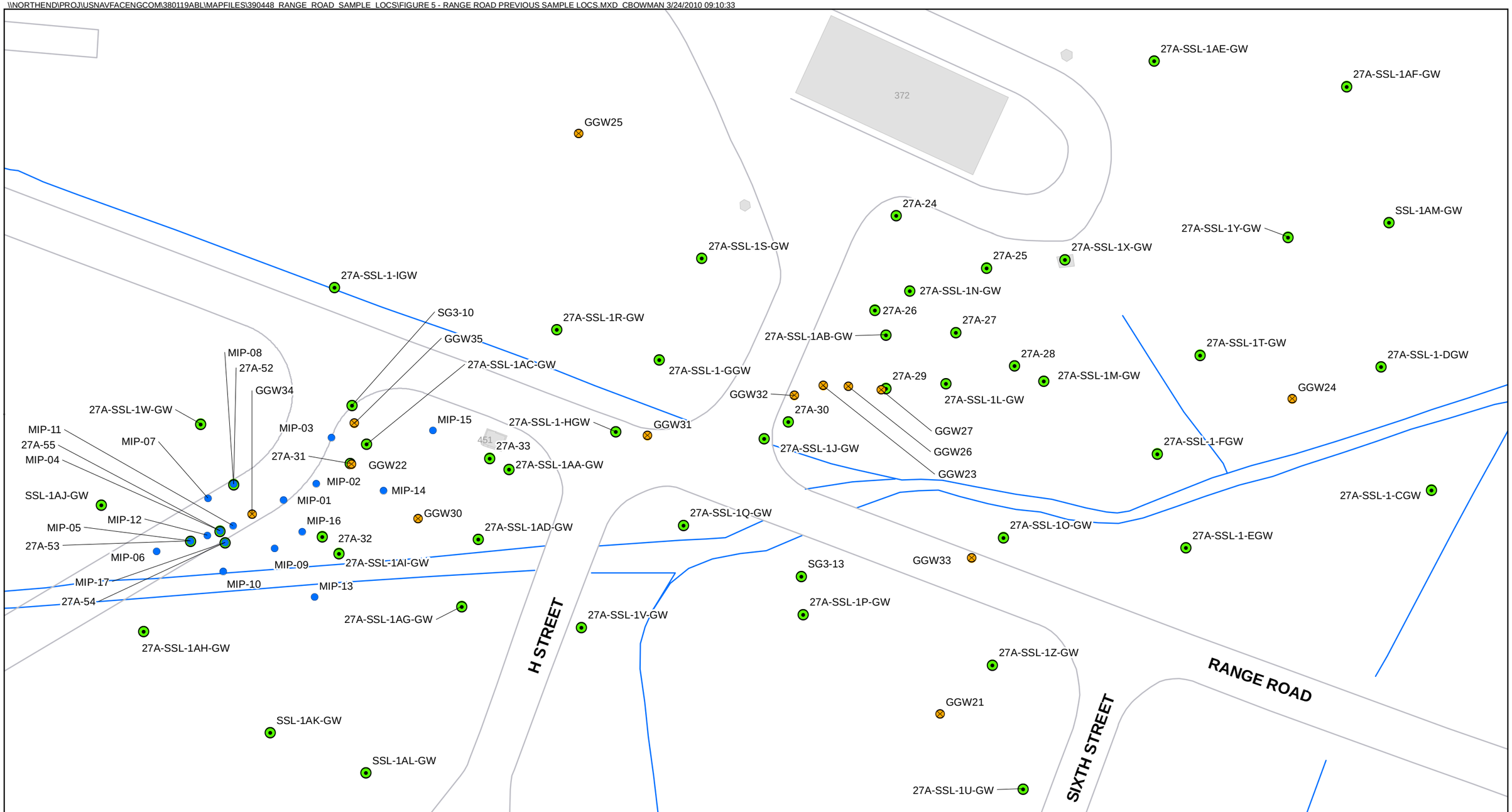
\\NORTHEND\PROJ\USNAVFACENGCOM\380119ABL\MAPFILES\390448_RANGE_ROAD_SAMPLE_LOCS\FIGURE 5 - RANGE ROAD PREVIOUS SAMPLE LOCS.MXD CBOWMAN 3/24/2010 09:10:33



Legend

- Alluvial Monitoring Wells
- MIP Boring Location
- DPT Sample Location
- Paved Roads
- Water Bodies
- Buildings

N

0 20 40 80 Feet

1 inch = 40 feet

Figure 5
Previous Sample Locations
Site 13 Remedial Investigation
Uniform Federal Policy Sampling and Analysis Plan
Allegany Ballistics Laboratory
Rocket Center, West Virginia

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Figure 6. Range Road Bedrock Aquifer Decision Tree

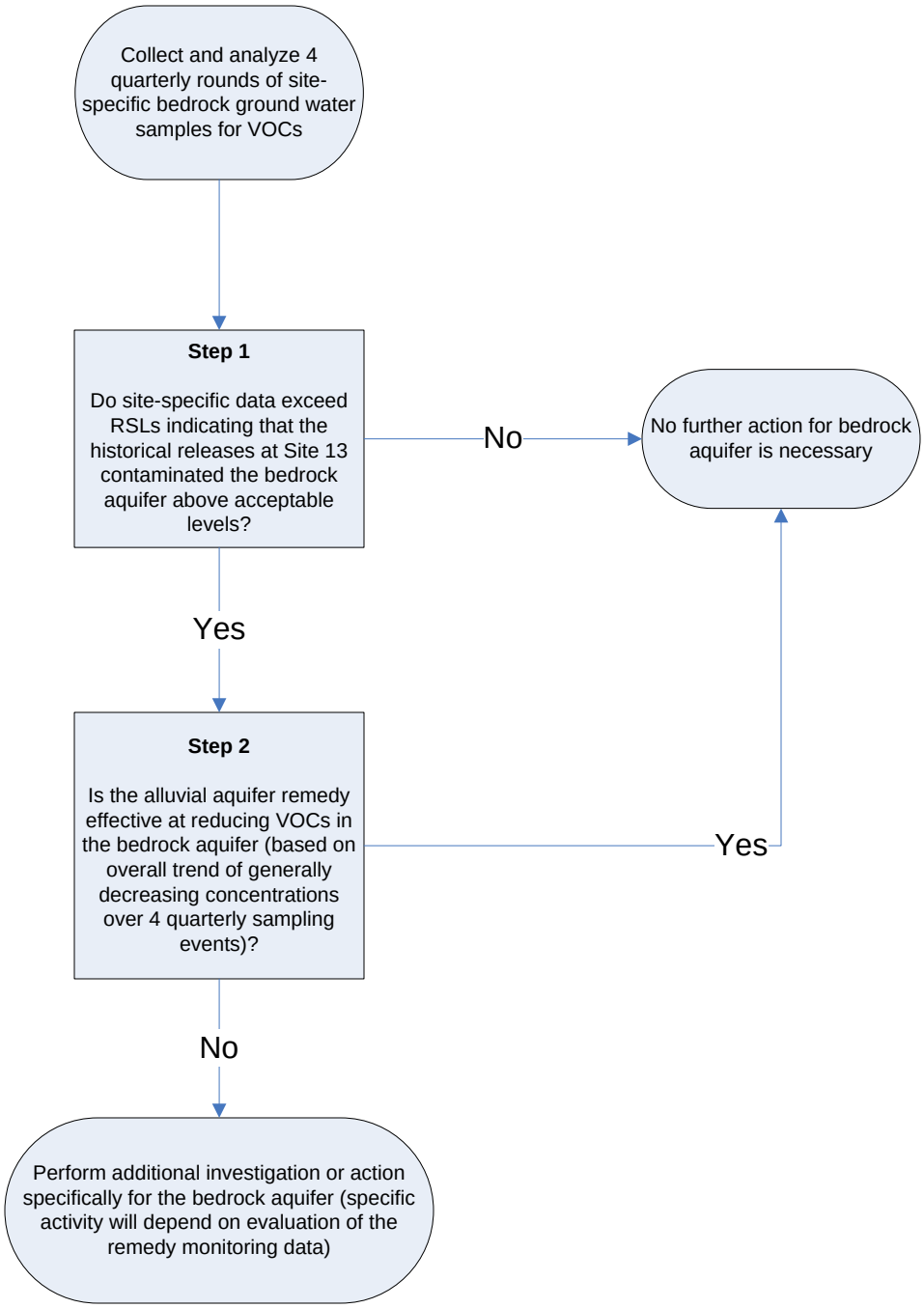
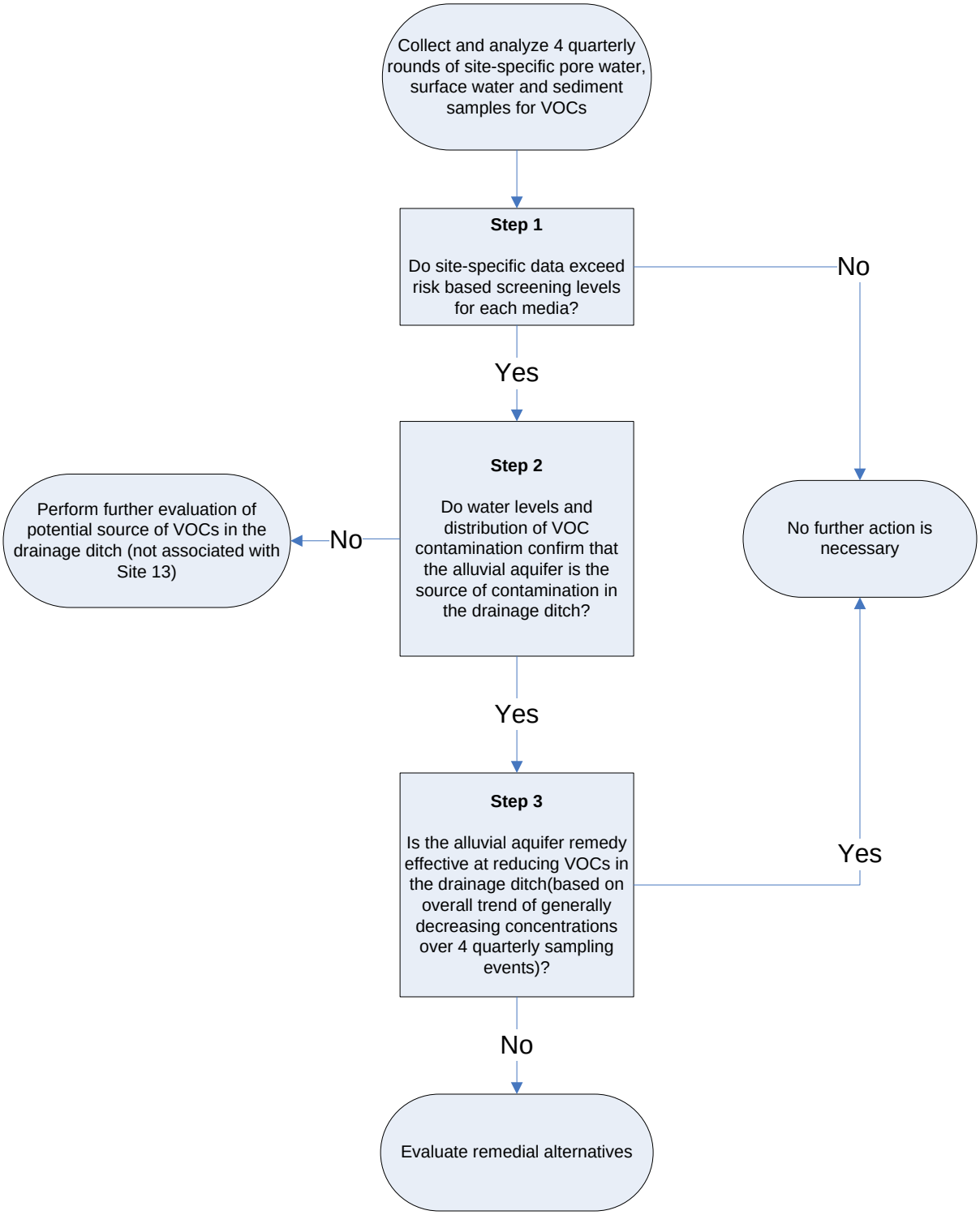


Figure 7. Range Road Drainage Ditch Decision Tree



Appendix A
Field Standard Operating Procedures

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 Responsibilities

Project Manager - The Project Manager is responsible for ensuring that project-specific plans are in accordance with these procedures, where applicable, or that other, approved procedures are developed. The Project Manager is responsible for development of documentation of procedures which deviate from those presented herein. The Project Manager is responsible for ensuring that chain-of-custody procedures are implemented. The Project Manager also is responsible for determining that custody procedures have been met by the analytical laboratory.

Field Team Leader - The Field Team Leader is responsible for determining that chain-of-custody procedures are implemented up to and including release to the shipper or laboratory. It is the responsibility of the Field Team Leader to ensure that these procedures are implemented in the field and to ensure that personnel performing sampling activities have been briefed and trained to execute these procedures.

Sample Personnel - It is the responsibility of the field sampling personnel to initiate chain-of-custody procedures, and maintain custody of samples until they are relinquished to another custodian, the sample shipper, or to a common carrier.

V 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.

V.1 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.

V.1.1 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., 01/21/08).
- 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.

V.2 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 of.

V.2.1 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.)

V.2.2 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.

VI 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.

VII Attachments

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

VIII 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.

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)
- Distilled 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® (or Alconox®)and water solution
- Concentrated (V/V) pesticide grade methanol (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
- Phthalate-free gloves such as Nitrile
- 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% methanol solution pumped through the pump. (DO NOT USE ACETONE).

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 DOT-approved 55-gallon drums.

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 methanol solution (DO NOT USE ACETONE).
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.

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.

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.

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®, methanol, 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

Decontamination of Drilling Rigs and Equipment

I. Purpose and Scope

The purpose of this guideline is to provide methods for the decontamination of drilling rigs, downhole drilling tools, and water-level measurement equipment. Personnel decontamination procedures are not addressed in this SOP; refer to the site safety plan and SOP *Decontamination of Personnel and Equipment*. Sample bottles will not be field decontaminated; instead they will be purchased with certification of laboratory sterilization.

II. Equipment and Materials

- Portable steam cleaner and related equipment
- Potable water
- Phosphate-free detergent such as Liquinox®
- Buckets
- Brushes
- Distilled organic-free water
- Methanol, pesticide grade
- ASTM–Type II grade water or Lab Grade DI Water
- Aluminum foil

III. Procedures and Guidelines

A. Drilling Rigs and Monitoring Well Materials

Before the onset of drilling, after each borehole, before drilling through permanent isolation casing, and before leaving the site, heavy equipment and machinery will be decontaminated by steam cleaning at a designated area. The steam-cleaning area will be designed to contain decontamination wastes and waste waters and can be an HDPE-lined, bermed pad. A pumping system will be used to convey decontaminated water from the pad to drums.

Surface casings may be steam cleaned in the field if they are exposed to contamination at the site prior to use.

B. Downhole Drilling Tools

Downhole tools will be steam cleaned before the onset of drilling, prior to drilling through permanent isolation casing, and between boreholes, and prior to leaving the site. This will include, but is not limited to, rods, split spoons or similar samplers, coring equipment, augers, and casing.

Before the use of a sampling device such as a split-spoon sampler for the collection of a soil sample for physical characterization, the sampler shall be cleaned by scrubbing with a detergent solution followed by a potable water rinse.

Before the use of a sampling device such as a split-spoon sampler for the collection of a soil sample for chemical analysis, the sampler shall be decontaminated following the procedures outlined in the following subsection.

C. Field Analytical Equipment

1. Water Level Indicators

   Water level indicators that consist of a probe that comes into contact with the groundwater must be decontaminated using the following steps:

   a. Rinse with tap water
   b. Rinse with de-ionized water
   c. Solvent rinse with methanol
   d. Rinse with de-ionized water

2. Probes

   Probes, for example, pH or specific ion electrodes, geophysical probes, or thermometers that would come in direct contact with the sample, will be decontaminated using the procedures specified above unless manufacturer's instructions indicate otherwise. For probes that make no direct contact, for example, OVM equipment, the probe will be wiped with clean paper-towels or cloth wetted with methanol.

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

- The effectiveness of field cleaning procedures will be monitored by rinsing decontaminated equipment with organic-free water and submitting the rinse water in standard sample containers for analysis. Anytime a sampling event occurs, at least one such quality control sample shall be collected.

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 potentially hazardous 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 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.

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 fenced drum storage area by the drilling services subcontractor. Drums should be stored on pallets on plastic sheeting 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. Prior to disposal to the sanitary sewer system, 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.

STANDARD OPERATING PROCEDURE

Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, ORP, and Temperature Using the Horiba® U-22 with Flow-through Cell

I. Purpose and Scope

The purpose of this procedure is to provide a general guideline for using the Horiba® U-22 for field measurements of pH, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (ORP), and temperature of groundwater samples. The operator's manual should be consulted for detailed operating procedures.

II. Equipment and Materials

- Horiba® U-22 Water Quality Checker with flow-though cell
- Distilled water in squirt bottle
- Horiba® U-22 Auto-Calibration Standard Solution

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 ^{o}C	+/- 1.0 ^{o}C
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 Horiba® Standard Solution. Calibration procedure:

1. Fill the calibration beaker to about 2/3 with the pH 4 standard solution.

2. Fit 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.

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, pH will read 4.0 +/- 3%, conductivity will read 4.49 +/- 3%, and turbidity will read 0 +/- 3%

C. Sample Measurement:

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

IV. Key Checks and Preventive Maintenance

- Calibrate meter
- Clean probe with deionized water when done
- Refer to operations manual for recommended maintenance
- 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.

STANDARD OPERATING PROCEDURE

Low-Flow Groundwater Sampling from Monitoring Wells

I. Purpose and Scope

This procedure 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

- Flow-through cell with inlet/outlet ports for purged groundwater and watertight ports for each probe
- Meters to monitor pH, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (ORP), and temperature (e.g., Horiba® U-22 or similar)
- Water-level indicator
- In-line disposable 0.45µm filters (QED® FF8100 or equivalent)
- Adjustable-rate positive-displacement pump, submersible pump, or peristaltic pump
- Generator
- Disposable polyethylene tubing
- Plastic sheeting
- Well-construction information
- Calibrated bucket or other container and watch with second indicator to determine flow rate
- Sample containers
- Shipping supplies (labels, coolers, and ice)
- Field book

III. Procedures and Guidelines

A. Setup and Purging

1. For the well to be sampled, information is obtained on well location, diameter(s), depth, and screened interval(s), and the method for disposal of purged water.

2. Instruments are calibrated 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 SOP *Water Level Measurements*. **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 installation log.

7. Attach and secure the polyethylene 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 at least 2 feet above the bottom of the well to avoid mobilization of any sediment present in the bottom. Preferably, the pump should be in the middle of the screen.

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. 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.

10. 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 0.5-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.

11. During purging, the field parameters are measured frequently (every 3 to 5 minutes) until the parameters have stabilized. Field parameters are considered stabilized 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 or as low as practicable given sampling conditions
- ORP: within 10 mV

B. Sample Collection

Once purging has been completed, the well is ready to be sampled. The elapsed time between completion of purging and collection of the groundwater sample from the well 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 bottles that are appropriate to the respective analysis and that have been cleaned to laboratory standards. Each bottle typically will have been previously prepared with the appropriate preservative, if any.

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

1. Sample identification (site name, location, and project number; sample name/number and location; sample type and matrix; whether the sample is filtered or not; 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 (preservatives added; laboratory sent to, date and time sent; laboratory sample number, chain-of-custody number, sample bottle lot number)

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 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. Samples may be field filtered before transfer to the sample bottle. Filtration must occur in the field immediately upon collection. Inorganics, including metals, are to be collected and preserved in the filtered form as well as the unfiltered form. The recommended method is through the use of a disposable in-line filtration module (0.45-micron

filter) using the pressure provided by the pumping device for its operation.

4. Samples for analysis for volatile organic compounds should be collected first, if such samples are required.

5. Adequate space is left in the bottle to allow for expansion, except for VOC vials, which are filled to overflowing and capped.

6. The bottle is capped, then labeled clearly and carefully following the procedures in SOP *Packaging and Shipping Procedures*.

7. Samples are placed in appropriate containers and, if necessary, packed with ice in coolers as soon as practical.

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. It may not be possible to prevent drawdown in the well if the water-bearing unit has sufficiently low permeability. If the water level was in the screen to start with, do not worry about it because there is no stagnant water in the riser above the screen to begin with.

   If the water level in the well is in the riser above the screen at the beginning of purging, then be sure you pump out sufficient volume from the well to remove the volume of water in the riser above the screen. For a 2-inch diameter well, each foot of riser contains 0.163 gallons; for a 4-inch riser, each foot of riser contains 0.653 gallons; for a 6-inch riser, each foot of riser contains 1.47 gallons.

   Alternatively, the water in the riser above the screen can be removed by lowering the pump into the well until the pump intake is just below the water level, starting the pump, running it at a low rate, and slowly lowering the pump as the water level in the riser declines. This approach can be terminated when the water level reaches the top of the screen, at which time the stagnant water in the riser has been removed. This may not be a practical approach for dedicated sampling equipment. As with typical low-flow sampling, the flow rate should be kept as low as practicable.

3. There may be circumstances where a positive-displacement or submersible pump cannot be used. An example is at isolated, hard-to-reach locations where the required power supply cannot be brought. In this case, a peristaltic pump may be used. Samples can be collected by the procedures described above for all but those for VOC analysis. The water to be placed in the vials for VOC analysis should not be run

through the peristaltic pump but instead should be collected by the following:

- Stop the pump when it is time to collect the VOC sample.
- Disconnect the tubing upstream from the pump (a connector must be installed in the line to do this).
- Pinching the tubing to keep the water in the tubing, remove the tubing from the well. Be sure that the tubing does not contact other than clean surfaces.
- Place the end of the tubing that was in the well into each VOC vial and fill the vial by removing the finger from the other end of the tube.
- Once the vials are filled, return the tubing to the well and collect any other samples required.

4. Nondedicated sampling equipment is removed from the well, cleaned, and decontaminated in accordance with SOP *Decontamination of Personnel and Equipment*. Disposable polyethylene 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

Sediment Sampling

I. Purpose

These general outlines describe the collection and handling of sediment samples during field operations.

II. Scope

The sediment sampling procedures generally describe the equipment and techniques needed to collect representative sediment samples. Operators manual , if available, should be consulted for specific details

III. Equipment and Materials

- Sample collection device (hand corer, scoop, dredge, grab sampler, or other suitable device)
- Stainless steel spoon or spatula for media transfer
- Measuring tape
- Log book
- Personal protection equipment (rubber or latex gloves, boots, hip waders, etc.)
- Materials for classifying soils, particularly the percentage of fines
- Sample jars, including jars for Total Organic Carbon and pH, as appropriate

IV. Procedures and Guidelines

1. Field personnel will start downstream and work upstream to prevent contamination of unsampled areas. In surface water bodies that are tidally influenced, sampling will be performed at low tide and under low flow conditions to minimize the dilution of possible contaminants. Sediment sampling activities will not occur immediately after periods of heavy rainfall.

2. Make a sketch of the sample area that shows important nearby river features and permanent structures that can be used to locate the sample points on a map. Whenever possible, include measured distances from such identifying features. Also include depth and width of waterway, rate of flow, type and consistency of sediment, and point and depth of sample removal (along shore, mid-channel, etc).

3. Note in the field book any possible outside sources of contamination. For example, the outlet to a drainage culvert in the water body near your sampling location.

4. Transfer sample into appropriate sample jars with a stainless steel utensil. Be especially careful to avoid the loss of the very fine clay/silt particles when collecting the sample. The fine particles have a higher adsorption capacity than larger particles. Minimize the amount of water that is collected within the sample matrix. Decant the water off of the sample slowly and carefully to maximize retention of the very fine particles. The sampler's fingers should never touch the sediment since gloves may introduce organic interference into the sample. Classify the soil type of the sample using the Unified Soil Classification System, noting particularly the percentage of silt and clay.

5. Samples for volatile organics should immediately be placed in jars. Rocks and other debris should be removed before placement in jars.

6. For channel sampling, be on the alert for submerged hazards (rocks, tree roots, drop-offs, loss silt and muck) which can make wading difficult.

7. Sample sediment for TOC and pH also, to give context to organic and inorganic data during the risk assessment.

8. Follow the site safety plan designed for the specific nature of the site's sampling activities and locations.

9. Decontaminate all sampling implements and protective clothing according to prescribed procedures.

V. Attachments

None.

VI. Key Checks and Items

- Start downstream, work upstream.
- Log exact locations using permanent features.
- Beware of hidden hazards.

STANDARD OPERATING PROCEDURE

Packaging and Shipping Procedures

I. 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.

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.

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.

I. Separate copies of forms. Seal proper copies (traffic reports, packing lists) along with a return address label within a large zip-lock bag and tape to inside lid of cooler.

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. **Do not** cover custody seals.

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.

II. Medium- and High-Concentration Samples:

Medium- and high-concentration samples are packaged using the same techniques used to package low-concentration samples, with several additional restrictions. First, a special airbill including a Shipper's Certification for Restricted Articles is required. Second, "Flammable Liquid N.O.S." or "Flammable Solid N.O.S." (as appropriate) labels must be placed on at least two sides of the cooler. Third, sample containers are packaged in metal cans with lids before being placed in the cooler, as indicated below:

- Place approximately ½ inch of vermiculite in the bottom of the can.
- Position the sample jar in the zip-loc bag so that the sample tags can be read through the plastic bag.
- Place the jar in the can and fill the remaining volume with vermiculite.
- Close the can and secure the lid with metal clips.
- Write the traffic report number on the lid.
- Place "This Side Up" and "Flammable Liquid N.O.S." or "Flammable Solid N.O.S." (as appropriate) labels on the can.
- Place the cans in the cooler.
- For medium concentration samples, ship samples with ice or "blue ice" inside the coolers. (Double bag ice in zip-lock plastic bags.)

III. Special Instructions for Shipping Medium and High Concentration Samples by Federal Express

A. Label cooler as hazardous shipment:

- Write shipper's address on outside of cooler. If address is stenciled on, just write "shipper" above it.
- Write or affix sticker saying "This Side Up" on two adjacent sides.
- Write or affix sticker saying "ORM-E" with box around it on two adjacent sides. Below ORM-E, write NA#9188.
- Label cooler with "Hazardous Substance, N.O.S." and "liquid" or "solid," as applicable.

B. Complete the special shipping bill for restricted articles.

- Under <u>Proper Shipping Name</u>, write "Hazardous Substance, N.O.S." and "liquid" or "solid," as applicable.

- Under Class, write "ORM-E.
- "Under Identification No., write NA No. 9188.

C. For high concentration samples, ship samples with "blue ice" only inside coolers.

STANDARD OPERATING PROCEDURE

Surface Water Sampling

I. Purpose and Scope

This procedure presents the techniques used in collecting surface water samples. Materials, equipment, and procedures may vary; refer to the Field Sampling Plan and operators manuals for specific details.

II. Materials and Equipment

Materials and equipment vary depending on type of sampling; the Field Sampling Plan should be consulted for project-specific details. Typical equipment required includes:

- Open tube sampler
- Dip sampler
- Weighted bottle sampler
- Hand pump
- Kemmerer or Van Dorn sampler
- Depth-integrating sampler
- Peristaltic pump
- Sample containers
- Meters for specific conductance, temperature, pH, and dissolved oxygen

III. Procedures and Guidelines

Before surface water samples are taken, all sampler assemblies and sample containers are cleaned and decontaminated as described in SOP *Decontamination of Personnel and Equipment*. Surface water samples collected from water bodies tidally influenced should be collected at low tide and under low flow conditions to minimize the dilution of potential contaminants. Methods for surface water sample collection are described below.

A. Manual Sampling

Surface water samples are collected manually by submerging a clean glass, stainless steel, or Teflon container into the water body. Samples may be collected at depth with a covered bottle that can be removed with a tripline. The most common sampler types are beakers, sealable bottles and jars, pond samplers, and weighted bottle samplers. Pond samplers have a fixed or telescoping pole attached to the sample container. Weighted bottle samplers are lowered below water surface, where the attached bottle is opened, allowed to fill, and pulled out of the water. When retrieved, the bottle is tightly capped and removed from the sampler

assembly. Specific types of weighted bottle samplers include dissolved oxygen, Kemmerer, or Van Dorn, and are acceptable in most instances.

A sample is taken with the following specific steps:

1. The location and desired depth for water sampling are selected.
2. The sample site is approached from downstream in a manner that avoids disturbance of bottom sediments as much as possible. The sample bottle is gently submerged with the mouth pointed upstream and the bottle tilted slightly downstream. Bubbles and floating materials should be prevented from entering the bottle. If using a Peristaltic pump, lower the tubing into the water to the desired depth.
3. For weighted bottle samplers, the assembly is slowly lowered to the desired depth. The bottle stopper is unseated with a sharp tug and the bottle is allowed to fill until bubbles stop rising to the surface.
4. When the bottle is full, it is gently removed from the water. If sample transfer is required, it should be performed at this time.
5. Measure dissolved oxygen, specific conductance, temperature, and pH at the sampling location.

IV. Attachments

None.

V. Key Checks and Items

- Start downstream, work upstream
- Log exact locations using permanent features
- Beware of hidden hazards

STANDARD OPERATING PROCEDURE

VOC Sampling--Water

I. Purpose

To provide general guidelines for sampling aqueous volatile organic compounds.

II. Scope

Standard techniques for collecting representative samples are summarized. Site-specific details are discussed in the Field Sampling Plan.

III. Equipment and Materials

- Sample vials pre-preserved at laboratory with Hydrochloric acid (HCl)
- Surgical or latex gloves

IV. Procedures and Guidelines

1. Sample VOCs before sampling other analyte groups.

2. When sampling for VOCs, especially residential wells, evaluate the area around the sampling point for possible sources of air contamination by VOCs. Products that may give off VOCs and possibly contaminate a sample include perfumes and cosmetics, skin applied pharmaceuticals, automotive products (gasoline, starting fluid, windshield deicers, carburetor cleaners, etc.) and household paint products (paint strippers, thinners, turpentine, etc.).

3. Keep the caps off the sample vials for as short a time as possible.

4. Wear clean latex or surgical gloves.

5. Fill the sample vial immediately, allowing the water stream to strike the inner wall of the vial to minimize formation of air bubbles. DO NOT RINSE THE SAMPLE VIALS BEFORE FILLING.

6. Fill the sample vial with a minimum of turbulence, until the water forms a positive meniscus at the brim.

7. Replace the cap by gently setting it on the water meniscus. Tighten firmly, but DO NOT OVERTIGHTEN.

8. Invert the vial and tap it lightly. If you see air bubbles in the sample, do not add more sample. Use another vial to collect another sample. Repeat if necessary until you obtain a proper sample.

V. Attachments

None.

VI. Key Checks and Items

- Check for possible sources of contamination.
- Fill slowly, with as little turbulence as possible.
- Check for air bubbles.

STANDARD OPERATING PROCEDURE

Water-Level Measurements

I. Purpose and Scope

The purpose of this procedure is to provide a guideline for the measurement of the depth to groundwater in piezometers and monitoring wells, even where a second phase of floating liquid (e.g., gasoline) is encountered, and on staff gages in surface-water bodies. This SOP includes guidelines for discrete measurements of static water levels and does not cover the use of continuously recording loggers (see SOP *Use of Data Loggers and Pressure Transducers)*.

II. Equipment and Materials

- Electronic water-level meter (Solinst® or equivalent) with a minimum 100-foot tape; the tape should have graduations in increments of 0.01 feet or less
- Interface probe (Solinst® Model 122 Interface Meter or equivalent)

III. Procedures and Guidelines

Verify that the unit is turned on and functioning properly. Slowly lower the probe on its cable into the piezometer or well until the probe just contacts the water surface; the unit will respond with a tone or light signal. Note the depth from a reference point indicated on the piezometer or well riser. Typically this is the top of the protective casing. If no reference is clearly visible, measure the depth to water from the northern edge of the riser. If access to the top of the riser is difficult, sight across the top of the locking casing adjacent to the measuring point, recording the position of the cable when the probe is at the water surface.

Measure the distance from this point to the closest interval marker on the tape, and record the water level reading in the logbook. Water levels will be measured to the nearest 0.01-foot. Also measure and record the three following readings: (1) the depth of the piezometer or well; (2) the distance from the reference point to the top of the protective casing; and (3) the distance to the surface of the concrete pad or to ground. The depth of the piezometer or well may be measured using the water-level probe with the instrument turned off.

Free product light or dense nonaqueous phase liquid may be present in the piezometer or well. If the presence of free product is suspected, the thickness of the product should be determined using appropriate equipment (e.g., Solinst® Model 122 Interface Meter). The depth to water also is determined with this equipment and the water-level meter should not be used in the piezometer or well as long as product is present. Typically, a constant sound is emitted from the device when free product is

encountered and an alternating on/off beep sound is emitted when water is encountered.

The apparent elevation of the water level in the well or piezometer is determined by measuring both the apparent depth to water and the thickness of free product. The corrected water-level elevation is calculated by the following equation:

$$WL_c = Wl_a + (\text{Free-product thickness} \times 0.80)$$

Where WL_c = Corrected water-level elevation

Wl_a = Apparent water-level elevation

0.80 = Typical value for the density of petroleum hydrocarbon products.

If free product is detected on the surface of the water in the piezometer or well, the value of sampling should be reconsidered because of the potential for contaminating the sampling equipment.

Staff gages may be installed in some surface-water bodies. These facilities typically are constructed by attaching a calibrated, marked staff gage to a wood or metal post, driving the post into the bottom of the surface-water body, and surveying the elevation of the top of the post to a resolution or 0.01-foot. The elevation of the water in the surface-water body then can be determined by reading off the distance the water level is from the top of the post. A shield or other protection may be needed to calm the fluctuations in water level if the gage is installed at a location exposed to wind or wave.

IV. Attachments

None.

V. Key Checks

- Before each use, verify that the battery is charged by pressing the test button on the water-level meter.
- Verify that the unit is operating correctly by testing the probe in distilled or de-ionized water. Leave the unit turned off when not in use.

STANDARD OPERATING PROCEDURE

Passive Diffusion Bag Sampling for VOCs from Monitoring Wells

I. Purpose and Scope

This procedure presents general guidelines for the collection of groundwater samples from monitoring wells using passive diffusion bag (PDB) sampling procedures. The supplier of the PDB samplers and PDB sampler hardware should be consulted for procedures specific to the type of sampler and hardware assembly being used.

II. Equipment and Materials

- Water-level indicator
- Two-foot long plastic PDB sampler diffusive membranes (may be pre-filled with certified, laboratory-grade, analyte-free, deionized water)
- Certified, laboratory-grade, analyte-free, deionized water (for filling PDB samplers if they are not pre-filled by the PDB supplier)
- Two-foot long protective mesh sleeves
- Pre-measured harnesses, hanger assembly, and/or polyethylene rope for PDB samplers
- Stainless steel weight material
- 2-gallon resealable plastic bags for storing dedicated PDB hardware
- Well-construction information
- Sample containers
- Shipping supplies (labels, coolers, and ice)
- Field book

III. Procedures and Guidelines

A. Setup and Deployment of the PDB Samplers

This section will discuss the setup and deployment of the PDB samplers in a typical monitoring well. It is preferred that the PDB samplers be filled in the laboratory or other supplier. However, PDB samplers may be filled in the field. The following discussion assumes that the PDB samplers will be filled with certified, laboratory-grade deionized water in the field. Disregard Step 3 below if PDB samplers are filled by the supplier.

Field personnel shall wear latex or nitrile gloves while setting up and handling the PDB sampler. Do not expose PDB samplers to areas where there are exhaust fumes or other fumes.

1. Prior to field mobilization, use well construction information to determine the depth(s) for installing the two-foot long PDB sampler. Initial PDB sampling events may require that PDB samplers be installed at multiple depths to determine the vertical variability of concentrations characteristic for each well.

   The sampler should be positioned in the well riser in accordance with the Work Plan.

2. Measure the depth to groundwater in each monitoring well following the SOP for Water-Level Measurements to make sure the PDB sampler will be entirely submerged during the sampling event.

3. Fill the PDB sampler in the field by removing the plug from the sampler bottom, inserting the provided funnel into the sampler, and pouring certified, laboratory-grade deionized water into the sampler. The sampler should be filled until water rises and stands at least half way into the funnel. Remove excess bubbles from the sampler, and then remove the funnel and securely replace the plug.

4. Slide the filled PDB sampler into a clean mesh sleeve to protect the sampler from abrasions in the monitoring well.

5. Attach the pre-measured harness or polyethylene rope to the well head to secure the PDB sampler during deployment. Next, attach the pre-measured harness and a stainless-steel weight to the PDB sampler. If a pre-measured harness is not used, attach a hangar assembly and/or a measured length of polyethylene rope and a stainless-steel weight to the PDB sampler. To keep the PDB sampler submerged a stainless-steel weight should be attached to the bottom of the PDB sampler.

6. Slowly lower the stainless-steel weight, PDB sampler, and line into the well riser until the line holding the PDB sampler is taut.

7. Close and lock the well casing to prevent precipitation from entering the well and to prevent handling of the PDB sampler during the equilibration period.

B. PDB Sampler Equilibration and Sample Recovery

For VOC sampling, the PDB sampler should be left in the well riser for a period of at least two weeks (14 days) prior to collection of the groundwater sample.

Field personnel shall wear latex or nitrile gloves when collecting water samples. Gloves shall be replaced after the sampler has been pulled out of the well but prior to sample collection. PDB sample recovery should be conducted as follows:

1. Slowly remove the PDB sampler from the well by pulling up the weighted line. Avoid exposing the sampler to heat or agitation.

2. Examine the exterior of the sampler for tears in the membrane material. Make a detailed observation in the field notes of any residues or discoloration on the exterior of the sampler. Water from samplers in which the membrane has been damaged cannot be submitted for analysis.

3. Remove the sampler from the weighted line. Discard the rope and decontaminate the weight, harness, and/or hangar assembly for future use. If pre-measured and dedicated harnesses, weights, and/or hangar assemblies are used, these can be placed in plastic bags labeled with the monitoring well station ID. Decontamination shall consist of a liquinox/deionized water wash and deionized water rinse.

4. To minimize cross contamination, remove any excess liquid from the exterior of the sampler by wiping off the PDB sampler with a paper towel.

5. To transfer the water from the sampler to sample containers, cut open the sampler at the pouring spout (located at one end of the sampler) and slowly tilt the sampler over the sample containers, trying to avoid spilling any of the water.

6. Any unused water in the PDB sampler should be transferred to a 55-gallon drum and managed per the Investigation Derived Waste Management Plan.

7. Dispose the PDB sampler membrane, rope, and gloves in accordance with the Investigation Derived Waste Management Plan.

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

- Carefully handle the PDB samplers during setup and retrieval as to avoid damage to the sampler membranes or cross contamination.
- Do not expose PDB samplers to areas where there are exhaust fumes or other fumes.
- Determine depths for PDB sampler installation prior to field mobilization. PDB samplers may require installation at multiple depths during initial deployment.
- When possible, use pre-filled PDB samplers filled by the laboratory and pre-measured harnesses for PDB samplers.
- Do not use water from PDB samplers for laboratory analysis if the PDB sampler membrane is damaged.

- For VOC analysis, PDB samplers will require at least two weeks between deployment and sample recovery.

STANDARD OPERATING PROCEDURE

Preparing Field Log Books

I. Purpose

To provide general guidelines for entering field data into log books during site investigation and remediation field 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 of 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, orange-covered 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.

STANDARD OPERATING PROCEDURE

Multi RAE Photoionization Detector (PID)

I. Purpose

The purpose of this SOP is to provide general reference information for using the Multi RAE PID in the field. Calibration and operation, along with field maintenance, will be included in this SOP.

II. Scope

This procedure provides information into the field operation and general maintenance of the Multi RAE PID. Review of the information contained herein will ensure that this type of field monitoring equipment will be properly utilized. Review of the owner's instruction manuals is a necessity for more detailed descriptions.

III. Definitions

Carbon Monoxide Sensor (CO) - Expresses the Carbon Monoxide concentration in parts per million (ppm).

Volatile Organic Compound (VOC) – Expresses the VOC concentration in parts per million (ppm)

Lower Explosive Limit (LEL) - Combustible gas is expressed as a percent of the lower explosive limit.

Hydrogen Sulfide Sensor (H_2S) - Expresses the Hydrogen Sulfide concentration in parts per million (ppm).

Oxygen Sensor (OXY) - Expresses the Oxygen concentration as a percentage.

ppm - parts per million: parts of vapor or gas per million parts of air by volume.

IV. Responsibilities

Project Manager - The Project Manager is responsible for ensuring that project-specific plans are in accordance with these procedures, where applicable, or that other approved procedures are developed. The Project Manager is responsible for selecting qualified individuals for the monitoring activities.

Health and Safety Coordinator - The Health and Safety Coordinator is responsible for developing a site-specific Health and Safety Plan (HASP) which specifies air monitoring requirements.

Field Team Leader - It is the responsibility of the Field Team Leader to implement these procedures in the field, and to ensure that the field team performing air monitoring activities have been briefed and trained to execute these procedures before the start of site operations.

Safety Coordinator-Hazard Worker (SC-HW)- The SC-HW is responsible for ensuring that the specified air monitoring equipment is on site, calibrated, and used correctly by the field personnel. The SC-HW will coordinate these activities with the Field Team Leader if the SC-HW is not the Field Team Leader as well.

Field team - It is the responsibility of the field team to follow these procedures or to follow documented project-specific procedures as directed by the Field Team Leader/ Safety Coordinator-Hazard Worker. The field personnel are responsible for documenting all air monitoring results in the field logbook during each field investigation.

V. Procedures

The Multi RAE utilizes the principle of detecting sensors. The PID operates on the principle that most organic compounds and some inorganic compounds are be ionized when they are bombarded by high-energy ultraviolet light. These compounds absorb the energy of the light, which excites the molecule and results in a loss of electron and the formation of a positively charged ion. The number of ions formed and the ion current produced is directly proportional to mass and concentration. The amount of energy required to displace an electron is called ionization potential (IP). The air sample is drawn into a UV lamp using a pump or a fan. The energy of the lamp determines whether a particular chemical will be ionized. Each chemical compound has a unique ionizing potential. When the UV light energy is greater than the ionization potential of the chemical, ionization will occur. When the sample is ionized, the electrical signal is displayed on an analog or digital output. Although the output does not distinguish between chemicals, it does detect an increase in the ion current. If only one chemical is present in the air, it is possible to use PIDs quantitatively. Chemical structure and lamp intensity affects the sensitivity of the instrument to a given contaminant. All PID readings are relative to the calibration gas, usually isobutylene. It is important to calibrate the PID in the same temperature and elevation that the equipment will be used, and to determine the background concentrations in the field before taking measurements. For environments where background readings are high, factory zero calibration gas should be used.

The following subsections will discuss Multi RAE calibration, operation, and maintenance. These sections, however, do not take the place of the instruction manual.

A. Calibration

For Multi RAE configured with O_2, LEL, H_2S, CO, sensors and a 10.6eV PID Lamp.

Start up Instrument

- Press **Mode** button
- Observe displays:

On!……..

Multi RAE Version X.XX

Model Number SN XXXX

Date Time Temp

Checking Sensor Ids….

VOC Installed

CO Installed

H_2S Installed

OXY Installed

LEL Installed

H_2S VOC CO LEL OXY

Alarm Limits=

XX XX.X XX XX High XX.X

XX XX.X XX XX Low XX.X

XX XX.X XX STEL

XX XX.X XX TWA

```
Battery = X.XV
Shut off at 4.2V
```

```
User Mode=
```

```
Alarm Mode=
```

```
Datalog Time Left
```

```
Datalog Mode
```

```
Datalog Period
```

```
Unit ready in…..
10 Seconds
```

- The pump will start, the seconds will count down to zero, and the instrument will be ready for use

Calibration Check and Adjustment

Allow instrument to warm up for 15 minutes.

- Depress the **[N/-]** key first, then while depressing the **[N/-]**, depress the **[Mode]** key also and depress both keys for 5 seconds.
- Display will read:

```
Calibrate
Monitor?
```

- Press the **[Y/+]** key
- Display will read:

```
Fresh Air
Calibration?
```

- If "Zero Air" is necessary, attach the calibration adapter over the inlet port of the Multi RAE Monitor and connect the other end of the tube to the gas regulator (HAZCO loaner regulator LREG.5, RAE Systems P/N 008-3011 or suitable .5 LPM regulator) on the Zero Air bottle (HAZCO P/N SGZA, RAE P/N 600-0024). If no Zero Air is available, perform the Fresh Air Calibration in an area free of any detectable vapor.
- Press the **[Y/+]** key
- Display will read:

```
Zero….
In progress…
```

```
CO Zeroed!
Reading = X
```

VOC Zeroed! Reading = X

LEL Zeroed! Reading = X

OXY Zeroed! Reading = X

Zero Cal done!
H_2S Zeroed! Reading = X

In each of the above screens, "X" is equal to the reading of the sensor before it was zeroed.

- Display will then read:

Multiple Sensor Calibration?

- Press the **[Y/+]** key
- The display shows all of the pre-selected sensors and the "OK?" question:

CO H_2S LEL OK? OXY

- Apply calibration gas – use either HAZCO Services Part Number R-SGRAE4 or Rae Systems Part Number 008-3002 – using a .5 LPM regulator and direct tubing.
- Press the **[Y/+]** key. Display will read:

Apply Mixed gas

Calibration In progress …

- The display will count down showing the number of remaining seconds:

CO cal'ed Reading=50

H_2S cal'ed Reading=25

LEL cal'ed Reading=50

OXY cal'ed Reading=20.9

```
Calibration done
Turn off gas!
```

- Display will read:

```
Single Sensor
Calibration?
```

- Press the **[Y/+]**.
- Display will read:

```
CO VOC H2S
LEL pick? OXY
```

- Attach 100 ppm Isobutylene (HAZCO P/N r-SGISO or Rae P/N 600-0002) using a 1.0 LPM regulator (HAZCO P/N LR10HS or Rae P/N 008-3021). Open regulator.
- Press the **[Mode]** key once, the V of VOC will be highlighted.
- Press the **[Y/+]**. The display will read:

```
Apply VOC Gas
```

```
Calibration
In progress…
```

- The display will count down showing the number of remaining seconds:, then display:

```
VOC cal'd
Reading=100
```

```
Calibration done
Turn off gas!
```

```
Single Sensor
Calibration?
```

- Press **[Mode]** key twice to return to main screen.
- **CALIBRATION IS COMPLETE!**

B. Operation

Due to the Multi RAE having many functions in terms of operation, it is recommended that you follow the operational procedures as outlined in the instruction manual from pages 9 to 14.

C. Site Maintenance

After each use, the meter should be recharged and the outside of the instruments should be wiped clean with a soft cloth.

D. Scheduled Maintenance

Function	Frequency
Check alarm and settings	Monthly/before each use
Clean screens and gaskets around sensors	Monthly
Replace sensors	Biannually or when calibration is unsuccessful

VI. Quality Assurance Records

Quality assurance records will be maintained for each air monitoring event. The following information shall be recorded in the field logbook.

- Identification - Site name, date, location, CTO number, activity monitored, (surface water sampling, soil sampling, etc), serial number, time, resulting concentration, comments and identity of air monitoring personnel.
- Field observations - Appearance of sampled media (if definable).
- Additional remarks (e.g, Multi RAE had wide range fluctuations during air monitoring activities.)

VII. References

Multi RAE Plus Multiple Gas Monitor User Manual, RAE Systems, Revision B1, November 2003.

STANDARD OPERATING PROCEDURE

Volatiles Monitoring with an OVA

I. Purpose and Scope

The purpose of this procedure is to provide guidelines for the calibration and use of an OVA Organic Vapor Analyzer.

II. Equipment and Materials

- Operations manual
- An OVA hand readout unit and side pack assembly
- 100 ppm methane as calibration gas
- T-type feeder tube with 1.5 liter/min. regulator

III. Procedures and Guidelines

ONLY PROPERLY TRAINED PERSONNEL SHOULD USE THIS INSTRUMENT. FOR SPECIFIC INSTRUCTIONS, SEE OPERATIONS MANUAL.

OVA, Organic Vapor Analyzer

1. Introduction

   The OVA Organic Vapor Analyzer is designed to detect organic materials in air. It uses a flame-ionization detector (FID) as its detection principle. This detector allows the monitor to respond to a wide variety of organic compounds.

2. Operational Checks

   - See OVA Operators Manual included with instrument.

3. Calibration

   - See OVA Operators Manual included with instrument.

IV. Key Checks and Preventative Maintenance

- Check battery.
- Zero and calibrate.
- Verify sensor probe is working.
- Recharge unit after use.

A complete preventative maintenance program is beyond the scope of this document. For specific instructions, refer to the operations manual.

- A complete spare instrument should be available whenever field operations require volatiles monitoring.
- Spare parts should be on hand so minor repairs may be made in the field.
- Batteries should be charged daily.
- Occasionally allow the batteries to totally discharge before recharging to prevent battery memory from occurring.

STANDARD OPERATING PROCEDURE

Installation of Bedrock Monitoring Wells

I. Purpose and Scope

The purpose of this procedure is to outline equipment and methods that will be used for bedrock well installation and development. Installing monitoring wells in unconsolidated materials using sonic drilling is discussed in SOP *Installation of Monitoring Wells Using Sonic Drilling*. Methods for drilling and installing shallow and deep, surface-cased wells in unconsolidated materials are presented in SOPs *Installation of Shallow Monitoring Wells* and *Installation of Surface-Cased Monitoring Wells,* respectively.

II. Equipment and Materials

Drilling

- Drilling Rig (hollow-stem auger and air-rotary or air-hammer)

Surface casing

- 8-inch to 12-inch ID steel or Schedule 80 PVC, depending upon conditions
- Temporary bottom plug
- Bentonite for grout: pure, additive-free powdered bentonite
- Cement-Bentonite Grout. Proportion 6 to 8 gallons of water per 94-pound bag of Portland cement; 3 to 10 pounds of bentonite added per bag of cement to reduce shrinkage.

Well Installation

- Polyvinyl chloride (PVC), Schedule 40, minimum 2-inch ID, flush-threaded well riser: alternatively, stainless-steel riser
- PVC, Schedule 40, minimum 2-inch ID, flush-threaded, factory slotted well screen: alternatively, stainless-steel screen
- PVC or stainless steel bottom cap, threaded to match the well screen.
- Centering guides (if used). Same material as the casing, except stainless steel may be used in lieu of PVC.
- Clean silica sand, provided in factory-sealed bags, well-rounded, containing no organic material, anhydrite, gypsum, mica, or calcareous material; primary (coarse

– e.g., Morie #2) filter pack, and secondary (fine – e.g., Morie #00) filter pack. Grain size determined based on sediments observed during drilling.

- Bentonite seal: Pure, additive-free bentonite pellets or chips.
- Bentonite for grout: Pure, additive-free powdered bentonite.
- Cement-Bentonite Grout: Proportion 6 to 8 gallons of water per 94-pound bag of Portland cement; 3 to 10 pounds of bentonite added per bag of cement to reduce shrinkage.
- Above-grade protective casing: Permanent isolation casing with heavy duty locking cover, painted with epoxy paint for rust protection, industrial lock.
- Flush-mount protective casing: Morrison 9-inch or 12-inch 519 manhole cover; rubber seal for cover; heavy duty locking cap on permanent isolation casing.

Development

- Surge block
- Pump and associated development equipment
- Calibrated meters to ensure pH, temperature, specific conductance, Eh, and dissolved oxygen of development water
- Containerization for water produced from well

III. Procedures and Guidelines

A. Drilling Methods

Boreholes for the bedrock monitoring wells will be drilled in several stages. Hollow-stem auger drilling and air-rotary or air-hammer drilling procedures are detailed below.

1. Hollow Stem Auger Drilling

Hollow stem auger drilling techniques may be used to drill boreholes for installation of surface isolation casing. Alternatively, mud-rotary drilling also may be used. 10-1/4-inch minimum ID HSA will be used to drill the borehole into competent bedrock.

The use of water or other fluid to assist in hollow stem drilling is to be avoided.

The bit of the auger is placed at the ground surface and then turned with the drilling rig. To collect split spoon samples, the auger is advanced to the top of the sampling depth, and the split-spoon sample is collected from below the auger head. The split spoon is advanced through repeated blows from a 140- or 300-pound hammer dropped from a height of 30 inches. Thin-walled tube samplers are advanced by

pressing down on the rods with the weight of the drilling rig. Split-spoon samples will be collected at selected intervals for chemical analysis and/or lithologic classification. Soil sampling procedures are detailed in SOPs *Soil Boring Sampling – Split Spoons* and *Soil Sampling*.

The borehole will be advanced as deep as possible until auger refusal is met. Ultimately it will be necessary to extend the borehole a minimum of 5 feet into competent bedrock for seating of the surface casing. This will be addressed in the next section.

Soil brought to the surface on the outside of the augers should be containerized at a convenient space away from the working area. Soil may be stored on plastic sheeting and containerized at the completion of activities at the well cluster.

Drilling equipment will be decontaminated before drilling in accordance with the procedures detailed in SOP *Decontamination of Drilling Rigs and Equipment*.

2. Bedrock Drilling

The borehole will be advanced into the bedrock for a minimum of 5 feet using air rotary or air hammer. The borehole will be of sufficient diameter (at least 8 inches) so that an 6-inch surface casing can be installed into the borehole. Once the borehole is drilled to at least 5 feet into the bedrock, the surface casing is installed per the procedure described in the Section B below.

Air-rotary or air-hammer drilling techniques will be used to install wells in each of the bedrock monitoring boreholes. When the borehole is advanced beyond the 6-inch surface casing, the borehole will have a diameter of 5-7/8 inches.

The bit, drill rods, and other borehole rotary drilling equipment will be decontaminated prior to the initiation of drilling and between each borehole location, in accordance with the decontamination procedures detailed in SOP *Decontamination of Drilling Rigs and Equipment*.

Prior to the continuing air-rotary or air-hammer drilling in boreholes where a surface casing has been installed, the bit, drill rods, and other downhole rotary drilling equipment will be thoroughly decontaminated before being inserted into the borehole.

Drill cuttings and decontamination fluids generated during rotary drilling activities will be contained according to the procedures detailed in SOP *Disposal of Waste Fluids and Solids* and the Investigation Derived Waste Management Plan (IDWMP).

B. Surface Casing Installation

Surface casing will be constructed of 6-inch ID steel or PVC with a minimum wall thickness of 0.20 inches. Casing lengths will be welded or connected by threaded connections sealed with Teflon tape. The steel casing and threaded couplings must be free of paint, varnish, or coatings of any kind, both inside and outside. Threaded connections must be free of oils or grease. Welding of the casing is permissible provided that the welds meet the Standards of the American Welding Society.

Surface casing will be decontaminated prior to installation in accordance with the procedures detailed in SOP *Decontamination of Drilling Rigs and Equipment*.

Permanent surface casing will be placed in the bottom of the borehole. The surface casing will be grouted in place by installing the grout through a tremie pipe from the bottom of the annulus to the ground surface.

Alternatively, the surface casing will be installed and grouted in place by a grout displacement method. The bottom of the surface casing is fitted with a tight, drillable plug. The borehole is then filled with the estimated volume of cement-bentonite grout to fill the annular space, and the casing is lowered to the bottom of the borehole (displacement method). If the weight of the casing is not sufficient to displace the grout and allow the casing to sink to the bottom of the borehole, the casing may be filled with clean water.

After the surface casing installation, the grout will be allowed to set up for at least 16-24 hours before drilling proceeds. Once the surface casing is installed, all water in the casing will be removed and disposed of according to SOP *Disposal of Waste Fluids and Solids* and the IDWMP before drilling is resumed. All water in the surface casing will be removed before drilling resumes in order to prevent carrying contamination downward into deeper intervals of the water-bearing unit.

C. Monitoring Well Installation

The borehole will be completed with either air-rotary or air-hammer methods to the proper depth. If the borehole has been drilled to a depth greater than that at which the well is to be set, the borehole will be backfilled with bentonite pellets or chips or a bentonite-cement slurry to a depth approximately 1 foot below the intended well depth. Approximately 1 foot of clean sand will be placed on top of the bentonite to return the borehole to the proper depth for well installation.

The appropriate lengths of well screen, nominally 10 feet (with bottom cap), and casing will be joined watertight, and lowered to the bottom of the borehole. Centering guides, if used, will be placed at intervals around the well casing, at the base of the screen, and 5 feet above the top of the well screen.

Selection of final filter pack and well screen depths for the wells shall be made in the field.

A primary sand pack consisting of clean nominally Morie No. 2 silica sand will be placed around the well screen. The sand will be placed into the borehole at a uniform rate, in a manner that will allow even placement of the sand pack. During placement of the sand, the position of the top of the sand will be continuously sounded using a stainless steel weight attached to a fiberglass tape measure. The primary sand pack will be extended from the bottom of the borehole to a minimum height of 2 feet above the top of the well screen. A secondary (fine – e.g., Morie #00) sand pack will then be installed to a minimum of 1 foot above the primary sand pack.

A non-additive bentonite seal at least 2 feet thick will be placed above the sand pack. The seal will be placed into the borehole in a manner that will prevent bridging. The position of the top of the bentonite seal will be verified using a weighted tape measure. A hydration period of at least 30 minutes will be allowed following installation of the bentonite seal.

Above the bentonite seal, an annular seal of cement-bentonite grout will be placed. The cement-bentonite grout will be installed continuously in one operation from the top of the bentonite seal to the ground surface. The cement-bentonite grout will be installed through a tremie pipe. The tremie pipe must be plugged at the bottom. Small openings along the bottom 1-foot length of pipe will allow the grout to diffuse laterally into the borehole and to avoid disturbance the bentonite seal.

D. Monitoring-Well Completion

For monitoring wells that will be completed above-grade, the surface casing itself will serve as the protective casing. The surface casing will be finished 2 to 3 feet above grade and fitted with a locking steel cap. A concrete pad with four guard posts will be installed.

The concrete pad will be square, approximately 3 feet per side, and poured into wooden forms. The concrete will be sloped away from the protective casing. The concrete pad will extend at least 6 inches below and 6 inches above the ground surface.

Four steel guard posts will be installed around the locking casing. Guard posts would be concrete-filled, at least 2 inches in diameter, and would extend at least 2 feet into the ground and 3 feet above the ground. The protective casing and guard posts will be painted with an epoxy paint to prevent rust.

For monitoring wells with flush-mount completions, a Morrison 519 manhole cover with a rubber-sealed cover and drain will be installed. The top of the manhole will be positioned approximately 1 inch above grade. A square concrete pad, approximately 3 feet per side, will be installed as a concrete collar surrounding the road box cover, and will slope uniformly downward to the adjacent grade. The road box and installation thereof will be of sufficient strength to withstand normal vehicular traffic. The concrete pad will extend at least 12 inches below the ground surface.

Inside the manhole, a locking cap will be placed over the permanent casing.

Each well will be labeled on the exterior of the locking cap with a metal stamp indicating the permanent well number.

E. Well Development

Well development will be accomplished using a combination of surging throughout the well screen and pumping, until the physical and chemical parameters of the discharge water that are measured in the field have stabilized and the turbidity of the discharge water is substantially reduced. Fine-grained materials in the surficial aquifer at the site may not allow low turbidity results to be achieved.

Well development will begin by surging the well screen, starting at the bottom of the screen and proceeding upwards, throughout the screened zone. Following surging, the well will be pumped to remove the fine materials that have been drawn into the well. During pumping, measurements of pH, temperature, and specific conductance will be recorded.

Development will continue by alternately surging and pumping until the discharge water is free from sand and silt, the turbidity is substantially reduced, and the pH, temperature, and specific conductance have stabilized at regional background levels, based on historical data. Development will continue for a minimum of 30 minutes and until the water removed from the well is as clear of turbidity as practicable.

Well development equipment will be decontaminated prior to initial use and after the development of each well. Decontamination procedures are detailed in SOP *Decontamination of Personnel and Equipment*. Water generated during well development will be contained and managed as detailed in the SOP *Disposal of Waste Fluids and Solids* and the IDWMP.

IV. Attachments

Schematic diagram of bedrock monitoring-well construction

STANDARD OPERATING PROCEDURE

Downhole Geophysical Logging

I. Purpose and Scope

The purpose of this procedure is to provide a general guideline for methods of downhole geophysical logging that are commonly used in investigations. The methods covered in this procedure are: fluid resistivity, temperature, caliper, brine tracing, and video. Such methods as natural gamma, spontaneous potential, electric resistivity of geologic materials, and flow logging are not covered.

Downhole geophysical logging normally is subcontracted to professionals who are experienced and their expertise should be relied upon. The procedure focuses on key aspects of the work that should be observed and documented.

II. Equipment and Materials

- Caliper logging tool
- Temperature logging tool
- Fluid resistivity logging tool
- Brine injection apparatus
- Fluid conductivity logging tool
- Video-camera logging tool
- Decontamination materials

III. Procedures and Guidelines

A. Fluid-Resistivity Logging

Fluid-resistivity logging provides a measurement of the resistivity of the borehole fluid between closely spaced electrodes in the probe. Abrupt and significant changes in fluid resistivity in the borehole may indicate the entry of groundwater of differing resistivity into the borehole via fractures and other openings in the geologic materials surrounding the borehole. The logging record is taken continuously in units of ohm-meters.

Fluid-resistivity logging should be run at slow speeds to assure the proper flow of water through the tool. As long a time as possible should be allowed between drilling and logging the borehole so that the fluid resistivity can equilibrate between borehole and surrounding geologic materials. The fluid-resistivity log should be one of the first logs run because other logging methods will disturb the water in the borehole.

The logging equipment should be adequately decontaminated before the first use on the

site and between boreholes.

B. Temperature Logging

Temperature logs are the continuous records of the temperature of the water in a borehole. They can provide information on the source and movement of groundwater into and out of the borehole. Generally the temperature of the groundwater in the borehole will increase with depth with the geothermal gradient. Deviations from this general trend may indicate where groundwater is flowing up, down, into, or out of the borehole.

All temperature sensors have an inherent response lag, or time constant, so that the logging speed must be constant and slow enough that the temperatures are accurately reflected at the true depths on the log. The temperature log may be made using the same tool as the fluid-resistivity log. As long a time as possible should be allowed between drilling and logging the borehole so that the temperature can equilibrate between borehole and surrounding geologic materials. The temperature log should be one of the first logs run because other logging methods will disturb the water in the borehole.

The logging equipment should be adequately decontaminated before the first use on the site and between boreholes.

C. Caliper Logging

The caliper log is a record of the average diameter of the borehole. Caliper logs primarily are run to determine where fractures or other openings might intersect the borehole and whether or not squeezing or other effects may have reduced the diameter of the borehole. This method is usually the final run of the borehole log.

A caliper log featuring arm-type devices is preferable to one featuring bow springs because of greater sensitivity of the arms. Logs should have at least 1 inch of chart width per inch of hole diameter to provide adequate sensitivity of recording. Several feet of casing should be logged so that the accuracy of the tool can be checked.

The logging equipment should be adequately decontaminated before the first use on the site and between boreholes.

D. Brine Tracing

Brine tracing is used to measure natural or artificially induced flow within a borehole. Data on borehole flow is related to well construction, vertical differences in hydraulic head within the open or screened interval in the well, and the relative magnitude or permeability of the water-bearing units open to the well. A slug of high-conductivity tracer such as a high concentration of sodium chloride is injected into the water column in the well and the movement of the slug is measured with a fluid-conductivity detector and timed. The depth at which any significant changes in brine concentration is noted that might indicate that the tracer is moving out of the borehole, or is suddenly diluted

by groundwater moving into the borehole.

The assumption is that the tracer is in a solution that has a greater density than the water in the borehole. Therefore, the tracer typically is injected at the top of the water column. The tracer is sinking on its own due to the difference in density between the tracer and the groundwater in the borehole; therefore, the rate of movement of the traces should not necessarily be considered the rate of vertical flow in the borehole. The dilution and movement are monitored by moving the detector slowly up and down through the tracer. Care is required so that the movement of the detector does not cause excessive spreading of the tracer; this effect can be minimized by using the smallest-diameter probe available.

The logging equipment should be adequately decontaminated before the first use on the site and between boreholes.

E. Video Logging

Video logging provides a real-time and recorded image of the actual conditions in the borehole. The video log typically is used to identify the depths of fractures and other openings in the borehole. The video log should be the first log run because other logging methods will disturb the water in the borehole and possible obscure the video image.

The log should be run at a sufficiently slow speed that features can be accurately recorded. The field geologist, if possible, should observe the logging image so that the operator can be directed to stop or reduce logging speed at any critical locations, such as intervals where flow may be occurring as indicated by the movement of particles in the borehole. If a non-aqueous phase liquid (NAPL), particularly one that floats on the surface, is present in the borehole, the image may be so deleteriously affected that the NAPL may have to be removed from the borehole before logging can be completed. The field geologist should obtain a copy of the video in DVD format while the operator is still in the field.

The logging equipment should be adequately decontaminated before the first use on the site and between boreholes.

IV. Attachments

- None

V. Key Checks and Preventive Maintenance

- Ensure that subcontractor follows their procedures, particularly those for calibration of the instruments and the rate of logging.
- Obtain copies of logs at the site.
- Video, temperature and fluid-resistivity logs should be run first so that the

disturbance caused by the other logging methods does not disrupt the results of these three methods.

- Adequate development of the well is important so that fluids such as drilling mud that may have been used in the borehole do not provide false readings of changes in fluid resistivity.
- Decontaminate as necessary.

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 ± 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

Appendix B
Health and Safety Plan

Project-Specific
Health and Safety Plan

Site 13 - Range Road Area, Long-Term Monitoring Plan

Allegany Ballistic Laboratory
Rocket Center, West Virginia

September 2009

Prepared for

Department of the Navy
Atlantic Division
Naval Facilities Engineering Command

Prepared by

CH2MHILL

CHANTILLY, VIRGINIA

Project-Specific Health and Safety Plan

Introduction

This Project-Specific Health and Safety Plan (HASP) presents the hazards known or anticipated to be present at the Allegany Ballistic Laboratory (ABL) during the pilot study at the Range Road Area scheduled to take place in April 2010 through November 2011. This Project-Specific HASP 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 not otherwise covered in the Master HASP for ABL (CH2M HILL, 2009).

The ABL Master HASP has been previously developed and must accompany/supplement this Project-Specific HASP. The Master HASP contains information pertinent to the general conditions at ABL, such as general site information, hazard evaluation and control, personnel responsibilities and requirements, a general description of personal protective equipment, customary decontamination procedures, and emergency response procedures. On-site personnel must review both the Master-HASP and the project-specific HASP and sign an agreement to comply with its provisions prior to commencing on-site work. The Master-HASP and project-specific HASP are considered operational documents that are subject to revisions in response to various project-specific conditions that may be encountered. However, these documents may be modified or updated only with the approval of the site Health and Safety Officer (SHSO) and Project Manager in consultation with the HSM.

Policy

CH2M HILL's policy is that on-site hazardous waste management activities be performed in conformance with both the Master HASP and a Project-Specific HASPs. The documents are written based on the anticipated hazards and expected work conditions, and apply to field activities to be performed under the Work Plan. Applicability of this Master-HASP and the Project-Specific HASPs extends to all CH2M HILL employees, CH2M HILL's subcontractors, and visitors entering the site. CH2M HILL subcontractors must follow an established health and safety plan; in most cases, either adopting this master plan with appropriate project-specific HASP (e.g., surveyor), or adopting same and amending both with safety and/or health requirements specific to their work (e.g., driller). HASPs authored by a subcontractor must be reviewed by CH2M HILL's SHSO before commencing on-site work. After being reviewed, this information will become part of the appropriate project-specific HASP.

This Project-Specific HASP in combination with the Master HASP will, at a minimum, meet the requirements under Occupational Safety and Health Administration (OSHA) Standard *29 Code of Federal Regulations* (CFR) 1910.120 (Hazardous Waste Operations and Emergency Response).

PRE-ENTRY REQUIREMENTS

During site mobilization, the Site Health and Safety Officer (SHSO) will perform a reconnaissance of each site as identified in the project-specific Work Plan (WP) to evaluate and determine the chemical, physical, and environmental hazards; establish or confirm emergency points of contact and procedures; and review any other issues deemed necessary to address site safety and health. The SHSO will then conduct a health and safety briefing with the site personnel to discuss data obtained from the previous site reconnaissance, provisions outlined in this Master HASP and project-specific HASP, and appropriate safety and health procedures and protocols.

CH2M HILL HEALTH AND SAFETY PLAN

This HASP will be kept on the site during field activities and will be reviewed as necessary. The plan will be amended or revised as project activities or conditions change or when supplemental information becomes available. The plan adopts, by reference, the Standards of Practice (SOPs) in the CH2M HILL *Corporate Health and Safety Program, Program and Training Manual*, as appropriate. In addition, this plan adopts procedures in the project Work Plan. The Site Safety Coordinator (SSC) is to be familiar with these SOPs and the contents of this plan. CH2M HILL's personnel and subcontractors must read both the Master HASP and this Project-Specific HASP, and sign **Attachment 1** of both documents.

Project Information and Description

PROJECT NO:	**390448**
CLIENT:	**Department of the Navy, Atlantic Division, Naval Facilities Engineering Command**
PROJECT/SITE NAME:	Allegany Ballistic Laboratory Range Road Area
SITE ADDRESS:	Rocket Center, West Virginia
CH2M HILL PROJECT MANAGER:	Mark Callaghan/WDC
CH2M HILL OFFICE:	15010 Conference Center Drive Suite 200 Chantilly, VA 20151
DATE PROJECT SPECIFIC HASP PREPARED:	25 September, 2009
DATE(S) OF SITE WORK:	April 2010 through November 2011 (Tentative)

SITE DESCRIPTIONS AND HISTORY: The Range Road Area is located in the southeast corner of Plant 1 at the intersection of Range Road and H Street (See Figure 1-1). The site is located approximately 900 feet from North Branch Potomac River. The site is relatively flat, with land elevations between about 660 feet above mean sea level (amsl) and 670 feet amsl. Land use immediately around the Range Road Area is industrial. The majority of the site is grass-covered, but a significant portion is covered by facility buildings and roads.

The objective of this work is to determine if volatile organic compounds (VOCs) in the alluvium, specifically, trichloroethene (TCE), have infiltrated the bedrock aquifer, surface water, or and sediment at the site at concentrations greater than the Maximum Contaminant Levels (MCLs).

The Range Road Area is adjacent to and within safety exclusion zones for explosive mixing and transport activities and remedial activities will be likely be impacted by plant activities that require personnel to depart.

1 Tasks to be Performed Under this Plan

1.1 Description of Tasks

(Reference *Work Plan Addendum for Pilot Study Activities at the Range Road Area*, CH2MHILL, May 2008)

Refer to project documents (i.e., Project Instructions) for detailed task information. A health and safety task hazard analysis (Section 1.2) has been performed for each task and is incorporated in this plan through task-specific hazard controls and requirements for monitoring and protection.

1.1.1 Hazwoper-Regulated Tasks for Range Road Area

- Bedrock well installation
- Groundwater Sampling
- Pore water/surface water/sediment sampling
- IDW generation/sampling/disposal

POTENTIALHAZARDS	Bedrock well installation	Groundwater Sampling	Pore water/Surface water /Sediment Sampling	IDW generation/sampling/ disposal
Abrasive Blasting				
Aerial Lifts				
Arsenic				
Asbestos Hazard				
Benzene	X	X	X	X
Biological Hazards	X	X	X	X
Cadmium				
Chainsaws				
Chemical Hazard-Dermal/Inhalation	X	X	X	X
Compressed Gas Cylinders		X	X	
Concrete & Masonry Work				
Confined Space Entry				
Crane-Suspended Personnel Platforms				
Cranes				
Demolition				
Diving				
Drilling	X			
Electrical Safety		X		
Energized Electrical Work				
Excavations	X			
Fall Protection				
Field Vehicles	X	X	X	X
Fire Prevention	X	X	X	X
Flight Line Hazards				
Forklifts				X
Formaldehyde				
Hand & Power Tools	X	X	X	X
Haul Truck Operations				
Heavy Equipment				
Hexavalent Chromium				
Highly Hazardous Chemicals, Toxics, Reactives (as defined by 29 CFR 1910.119)				
Hoists	X			X
Lead				
Lockout /Tagout				
Manual Lifting	X	X	X	X
Methylene Chloride				
Noise	X	X	X	X
PCBs				
Powder-Actuated Tools				

Pressure Washing/Equip Decon	X			
Pressurized Lines/Equipment	X			
Rigging	X			X
Scaffolding				
Stairways and Ladders	X	X	X	X
Steel erection				
Utilities (underground/overhead)	X			X
Vacuum Truck/Pumping Operations				
Vehicle Traffic	X	X	X	X
Vinyl Chloride	X	X		X
Visible Lighting	X	X	X	X
Welding and Cutting				
Wild/Domestic Animals	X	X	X	X
Work Alone				
Work Over Water				

1.3 Project HS&E Change Management Form

*This evaluation form should be reviewed on a **continual basis** to determine if the current project-specific HASP adequately addresses ongoing project work, and it should be modified whenever new tasks are contemplated or changed conditions are encountered.*

Project Task: Project Manager: Mark Callaghan

Project Number: Project Name:

Evaluation Checklist	Yes	No
1. Has CH2M HILL staff changed?		
2. Has a new subcontractor been added to the project?		
3. Is any chemical or product to be used that is not listed in **Attachment 7** of the plan?		
4. Are all tasks addressed in Section 1.1 of the project-specific HASP?		
5. Have new contaminants or higher than anticipated levels of original contaminants been encountered?		
6. Have other safety, equipment, activity, or environmental hazards been encountered that are not addressed in Section 2.1 of the plan?		

If the answer is "YES" to Questions 1-3, a HASP revision is NOT needed. Please take the following actions:

- Confirm that the staff's medical and training status is current—check training records at: http://www.int.ch2m.com/hands (or contact your regional SPA) and confirm subcontractor qualifications.
- Confirm with the project KA that subcontractor safety performance has been reviewed and is acceptable.
- Confirm with H&S that subcontractor safety procedures have been reviewed and are acceptable.

If the answer is "YES" to Questions 4-6, a HASP revision MAY BE NEEDED. To determine if a revision is needed, please contact HS&E directly or complete the field project start-up form at: http://www.int.ch2m.com/hsdocgen/fppricing.asp**.**

2 Hazard Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the site or the particular hazard. 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 Site Safety Coordinator (SSC) for clarification.

In addition to the controls specified in this section, "Project-Activity Self-Assessment Checklists" are contained in **Attachment 8**. These checklists are to be used to assess the adequacy of CH2M HILL and subcontractor project-specific safety requirements. The objective of the self-assessment process is to identify gaps in project safety performance, and prompt for corrective actions in addressing these gaps. Self-assessment checklists should be completed early in the project, when tasks or conditions change, or when otherwise specified by the HSM. The self-assessment checklists, including documented corrective actions, should be made part of the permanent project records, and be promptly submitted to the HSM.

Project-specific frequency for completing self-assessments: **Initially and if conditions change (as determined by the SSC).**

2.1 Project-Specific Hazards

2.1.1 Inclement Weather

- Work may proceed in light rain- wear rain gear.
- Exposure to slips, trips and falls is increased during rainy and snowing conditions.
- Take cover in field vehicle during adverse weather conditions (High winds, heavy rain).
    - Work shall cease and cover sought in the event of lightning or tornado warnings.
    - Identify "Take Shelter" areas before starting project.
    - Work may proceed in light rain- wear rain gear.
- Notify the Project Manager and Client Representative after shelter has been sought.
- Adverse weather conditions requiring immediate suspension of field work 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 electric activity. Outdoor activities will cease upon observing lightning, 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 time frame is extended until electrical activity ceases.
- Sustained wind speeds of 20 miles per hour (mph) or wind gusts of 25 mph for boating activities.
- Sustained wind speeds of 25 mph or wind gusts of 35 mph for high profile work where wind chill is not a factor, i.e., greater than 60°F.
- Sustained wind speeds of 40 mph or wind gusts of 45 mph 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 suspension of hoist use.
- An equivalent wind chill factor of -24°F on the wind chill factor chart (below) will trigger systematic shut down of all non-emergency work activities.
- A tornado/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, take the following precautions: Seek shelter among densely wooded areas.
    - Avoid lone trees as shelter.
    - Avoid open, bare areas.
    - Do not cross water bodies.

2.1.2 Field Vehicle (Driving)

- Familiarize yourself with vehicle features.
  - Mirror adjustments, seat adjustments, cruise control features, etc.
  - Pre-program radio stations.
- Ensure snow, ice and fog are completely removed from windows prior to driving.
- Review driving directions prior to departing
- Inspect vehicle prior to departure (tire pressure, tread, signals, horn, and lights).
- Adjust headrest to proper position.
- Always wear seatbelt while operating vehicle.
- Inquire; and obtain, a vehicle pass from the client if required.
- Observe warning signs, yield to traffic, and observe all posted traffic signs.
- Pull off the road, put the car in park and turn on flashers before talking on a mobile phone.
- Maintain a First Aid kit, Bloodborne Pathogens kit and Fire Extinguisher in the field vehicle at all times.
- Close car doors slowly and carefully. Fingers can get pinched in doors or in the trunk.
- Use a spotter when backing up near monitoring wells.
- Turn off vehicle when leaving it. Leave keys in vehicle.
- Maintain valuables in the trunk.

2.1.3 Wireless Phone Restrictions

- Wireless phones are only to be used in areas where work is not in progress (only in office buildings or parked cars).
- The use of pagers in the work area is allowed (Treat wireless phone like a pager i.e. check caller ID and call back in proper location).

2.1.4 Bedrock Well Installation

(Reference CH2M HILL SOP HSE-204, *Drilling* (See **Attachment 8**))

- Only authorized personnel are permitted to operate drill rigs.
- Stay clear of areas surrounding drill rigs during every startup.
- Stay clear of the rotating augers and other rotating components of drill rigs.
- Stay as clear as possible of all hoisting operations. Loads shall not be hoisted overhead of personnel.
- Do not wear loose-fitting clothing or other items such as rings or watches that could get caught in moving parts. Long hair should have it restrained.
- If equipment becomes electrically energized, personnel shall be instructed not to touch any part of the equipment or attempt to touch any person who may be in contact with the electrical current. The utility company or appropriate party shall be contacted to have line de-energized prior to approaching the equipment.
- Smoking around drilling operations is prohibited.
- Wear hearing protection as specified in Section 4.0

The SSC shall complete the H&S Self-Assessment Checklist – Drilling included in Attachment 8 of this amendment to verify compliance with CH2M HILL's drilling program.

2.1.5 Procedures for Locating Buried Utilities

- Refer to the Master HASP for ABL specific utility locating procedures.

2.1.6 Groundwater Sampling

- Wear the appropriate PPE when sampling, including safety glasses, nitrile gloves, and steel toe boots (refer to Section 4).
- Monitor headspace of wells prior to sampling to minimize any vapor inhalation (refer to Section 5 on air monitoring).
- Use caution when opening well lids. Wells may contain poisonous spiders and hornet or wasp nests.
- Use the appropriate lifting procedures (see Master HASP) when unloading equipment and sampling at each well.
- Avoid sharp edges on well casings.
- If dermal contact with the groundwater and acid used in sample preservation, wash exposed skin thoroughly with soap and water.
- Avoid eating and drinking on site and during sampling.
- Use ear plugs during sampling if sampling involves a generator.
- Containerize all purge water and transport to the appropriate storage area.

2.17 Respiratory Protection

(Reference CH2M HILL SOP HSE-121, *Respiratory Protection*)

- Respirator users must have completed appropriate respirator training within the past 12 months. Level B training is required for supplied-air respirators (SAR) and self-contained breathing apparatus (SCBA) use.
- 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 that alter the effectiveness of the specified respiratory protection, the HSM 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.
- 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 SSC shall verify the air meets Grade D air specifications.

The SSC shall complete the H&S Self-Assessment Checklist – Respiratory Protection included in Attachment 8 of this amendment to verify compliance with CH2M HILL's respiratory protection program.

2.1.8 Slips, Trips, and Falls

- Institute and maintain good housekeeping practices.
- Pick up tools and debris in the work area.
- Walk or climb only on equipment and/or surfaces designed for personnel access.
- Be aware of poor footing and potential slipping and tripping hazards in the work area.

2.1.9 IDW Drum Sampling

Personnel are permitted to handle and/or sample drums containing investigation-derived waste (IDW) only; handling or sampling other drums requires a plan revision or amendment approved by the CH2M HILL HSM. The following control measures will be taken when sampling drums containing IDW:

- Minimize transportation of drums.
- Sample only labeled drums or drums known to contain IDW.
- Use caution when sampling bulging or swollen drums. Relieve pressure slowly.
- If drums contain, or potentially contain, flammable materials, use non-sparking tools to open.
- Picks, chisels, and firearms may not be used to open drums.
- Reseal bung holes or plugs whenever possible.
- Avoid mixing incompatible drum contents.
- Sample drums without leaning over the drum opening.
- Transfer the content of drums using a method that minimizes contact with material.

The SSC shall complete the H&S Self-Assessment Checklist –Waste Characterization, Sampling and Analysis included in Attachment 8 of this amendment to verify compliance with CH2M HILL's policies.

2.1.10 Trichloroethene (TCE)

- Do not enter regulated work areas unless training, medical monitoring, and PPE requirements established by the competent person have been met.
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas.
- Skin absorption and inhalation are potential routes of TCE exposure.
- TCE is considered a "Confirmed Human Carcinogen."
- A Short Term Exposure Limit (STEL: 200 ppm over 15 minutes) exists for this material.
- TCE has a sweet odor, like chloroform.
- Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained from the competent person.

2.2.1 Exclusion Zones

- Buildings (2000, 2003, and 2008) have a quantity distance arc around them when people are working in them. Personnel shall not be within these QD arcs when plant operations are being conducted within these buildings.
- Consult with SSC prior to performing work within/adjacent to the defined Buildings arcs.

2.2 General Hazards

Refer to the Master HASP for the following practices and hazards:

- **General Practices and House Keeping**
- **Hazard Communication** (CH2M HILL SOP HSE-107)
- **Shipping and Transportation of Chemical Products** (CH2M HILL's Procedures for Shipping and Transporting Dangerous Goods)
- **Lifting** (CH2M HILL SOP HSE-112)
- **Fire Prevention and Control**
- **Electrical** (CH2M HILL SOP HSE-206)
- **Stairways and Ladders** (CH2M HILL SOP HSE-214)

- **Heat and Cold Stress** (CH2M HILL SOP HSE-117)
- **Handling of Compressed Gas Cylinders**
- **Procedures for Locating Buried Utilities**

2.3 Biological Hazards and Controls

- Refer to the Master HASP for detailed information pertaining to biological hazards and controls.

2.4 Radiological Hazards and Controls

Refer to CH2M HILL's *Corporate Health and Safety Program, Program and Training Manual,* and *Corporate Health and Safety Program, Radiation Protection Program Manual*, for standards of practice in contaminated areas.

Hazards	Controls
• None.	• None.

Contaminants of Concern

(Refer to Project Files for more detailed contaminant information)

Contaminant	Location and Maximum[a] Concentration	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Trichloroethylene (TCE)	GW - 4900µg/L	10 ppm	1,000 Ca	Headache, vertigo, visual disturbance, eye and skin irritation, fatigue, giddiness, tremors, sleepiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury	9.45

3 Project Organization and Personnel

3.1 CH2M HILL Employee Medical Surveillance and Training

(Reference CH2M HILL SOPs HSE-113, *Medical Surveillance,* and HSE-110, *Training)*

The employees listed below are enrolled in the CH2M HILL Comprehensive Health and Safety Program and meet state and federal hazardous waste operations requirements for 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training. Employees designated "SSC" have completed a 12-hour site safety coordinator course, and have documented requisite field experience. An SSC with a level designation (D, C, B) equal to or greater than the level of protection being used must be present during all tasks performed in exclusion or decontamination zones. Employees designated "FA-CPR" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones. The employees listed below are currently active in a medical surveillance program that meets state and federal regulatory requirements for hazardous waste operations. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

Pregnant employees are to be informed of and are to follow the procedures in CH2M HILL's SOP, *Reproduction Protection*, including obtaining a physician's statement of the employee's ability to perform hazardous activities before being assigned fieldwork.

Employee Name	Office	Responsibility	SSC/FA-CPR
Vicki Waranoski	WDC	Field Team Leader	NA
Christopher Reed	WDC	Field Team Leader/SSC	SSC-HW/FA-CPR

3.2 Field Team Chain of Command and Communication Procedures

- Refer to the Master HASP for detailed information pertaining to Field Team Chain of Command and Communication Procedures.

3.2.1 Client

- Refer to the Master HASP for detailed client contact information.

3.2.2 CH2M HILL

- Refer to the Master HASP for detailed CH2M HILL contact information.

3.2.3 CH2M HILL Subcontractors

(Reference CH2M HILL SOP HSE-215, *Contracts, Subcontracts and HSE&Q Practices*)

TBD

The subcontractors listed above are covered by this HSP and must be provided a copy of this plan. However, this plan does not address hazards associated with the tasks and equipment that the subcontractor has expertise in (e.g., drilling, excavation work, electrical). Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit these procedures to CH2M HILL for review before the start of field work. Subcontractors must comply with the established health and safety plan(s). The CH2M HILL SSC should verify that subcontractor employee training, medical clearance, and fit test records are current and must monitor and enforce compliance with the established plan(s). CH2M HILL's oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

CH2M HILL should continuously endeavor to observe subcontractors' safety performance. 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. In addition to this level of observation, the SSC is responsible for confirming CH2M HILL subcontractor performance against both the subcontractor's safety plan and applicable self-assessment checklists. Self-assessment checklists contained in **Attachment 8** are to be used by the SSC to review subcontractor performance.

Health and safety related communications with CH2M HILL subcontractors should be conducted as follows:

- Brief subcontractors on the provisions of this plan, and require them to sign the Employee Signoff Form included in **Attachment 1**.
- Request subcontractor(s) to brief the project team on the hazards and precautions related to their work.
- When apparent non-compliance/unsafe conditions or practices are observed, notify the subcontractor safety representative and require corrective action – the subcontractor is responsible for determining and implementing necessary controls and corrective actions.
- When repeat non-compliance/unsafe conditions are observed, notify the subcontractor safety representative and stop affected work until adequate corrective measures are implemented.
- When an apparent imminent danger exists, immediately remove all affected CH2M HILL employees and subcontractors, notify subcontractor safety representative, and stop affected work until adequate corrective measures are implemented. Notify the Project Manager and HSM as appropriate.
- Document all oral health and safety related communications in project field logbook, daily reports, or other records.

4 Personal Protective Equipment (PPE)

(Reference CH2M HILL SOP HSE-117, *Personal Protective Equipment*, HSE-121, *Respiratory Protection*)

PPE Specifications [a]

Task	Level	Body	Head	Respirator [b]
• General site entry. No chemical exposure anticipated • Geophysical Surveys	D	**Coveralls:** Work clothes **Boots:** Steel-toe, leather work boots **Gloves:** Work gloves.	Hardhat [c] Safety glasses Ear protection [d]	None required
• Bedrock well installation • IDW management * Groundwater sampling does not require tyvek	Modified D	**Coveralls:** Uncoated Tyvek® **Boots:** Safety -toe, chemical-resistant boots OR Safety -toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Safety glasses Ear protection [d]	None required
• Tasks requiring upgrade	C	**Coveralls:** Polylaminated Tyvek® **Boots:** Steel-toe, chemical-resistant boots OR steel-toe, leather work boots with outer rubber boot covers **Gloves:** Inner & outer surgical-style nitrile gloves.	Hardhat [c] Splash shield [c] Ear protection [d] Spectacle inserts	APR, full face, MSA Ultratwin or equivalent; with GME-H cartridges or equivalent[e].

Reasons for Upgrading or Downgrading Level of Protection

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 (Section 5) exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decreases 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] No facial hair that would interfere with respirator fit is permitted.

[c] Hardhat and splash-shield areas are to be determined by the SSC.

[d] Ear protection should be worn when conversations cannot be held at distances of 3 feet or less without shouting.

[e] Cartridge change-out schedule is at least every 8 hours (or one work day), except if relative humidity is > 85%, or if organic vapor measurements are > midpoint of Level C range (refer to Section 5)--then at least every 4 hours. If encountered conditions are different than those anticipated in this HSP, contact the HSM.

[f] Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the HSM, and an SSC qualified at that level is present.

5 Air Monitoring/Sampling

(Reference CH2M HILL SOP HSE-207, *Exposure Monitoring)*

5.1 Air Monitoring Specifications

Instrument	Tasks	Action Levels[a]	PPE	Frequency[b]	Calibration
PID: MultRae with 10.6 eV lamp or equivalent	• All intrusive activites • IDW Mgmt. • GW sampling	0-1 ppm → 1-5 ppm → > 100 ppm →	Level D Level C Level B. Not authorized. Notify HSM	Initially and periodically during task	Daily
Dust Monitor: Visual	• All intrusive activites • IDW Mgmt	No Dust → Visible Dust→	Level D Level D. Practice dust suppression techniques/engineering controls	Continuous during task	NA
Nose-Level Monitor [e]: Voice	• All activities	Must shout to be heard at 3 feet →	Hearing protection required Stop; re-evaluate	Continuous during task	NA

[a] Action levels apply to sustained breathing-zone measurements above background for more than 5 minutes.
[b] The exact frequency of monitoring depends on field conditions and is to be determined by the SC-HW; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3", "at surface/SB-2", etc.).

5.2 Calibration Specifications

(Refer to the respective manufacturer's instructions for proper instrument-maintenance procedures)

Instrument	Gas	Span	Reading	Method
PID: OVM, 10.6 or 11.8 eV bulb	100 ppm isobutylene	RF = 1.0	100 ppm	1.5 lpm reg T-tubing
PID: MiniRAE, 10.6 eV bulb	100 ppm isobutylene	CF = 100	100 ppm	1.5 lpm reg T-tubing
PID: TVA 1000	100 ppm isobutylene	CF = 1.0	100 ppm	1.5 lpm reg T-tubing

5.3 Air Sampling

Sampling, in addition to real-time monitoring, may be required by other OSHA regulations where there may be exposure to certain contaminants. Air sampling typically is required when site contaminants include lead, cadmium, arsenic, asbestos, and certain volatile organic compounds. Contact the HSM immediately if these contaminants are encountered.

Method Description
Not required

Personnel and Areas

Results must be sent immediately to the HSM. Regulations may require reporting to monitored personnel. Results reported to:

HSM: Steve Beck/MKE

6.0 Decontamination

(Reference CH2M HILL SOP HS-218, *Hazardous Waste Operations*

- **Refer to Section 6.0 of Master HASP**

6.1 Decontamination Specifications

Personnel	Sample Equipment
• Hand wash/rinse • Dispose of PPE in municipal trash, or contain for disposal	• Wash/rinse equipment • Solvent-rinse equipment • Contain solvent waste for offsite disposal

6.2 Diagram of Personnel-Decontamination Line

- **Refer to Figure 6-1 of Master HASP**

7.0 Spill-Containment Procedures

- **Refer to Master HASP**

8.0 Site-Control Plan

- **Refer to Master HASP**

8.1 Site-Control Procedures

(Reference CH2M HILL SOP HS-218, Hazardous Waste Operations)

- **Refer to Master HASP**

8.2 Hazwoper Compliance Plan

(Reference CH2M HILL *Enterprise wide core standard Written Plans)*

- **Refer to Master HASP**

9.0 Emergency Response Plan

(Reference CH2M HILL, SOP HS-106, *Emergency Planning*)

9.1 Pre-Emergency Planning

- **Refer to Master HASP**

9.2 Emergency Contacts

- **Refer to Master HASP and Attachment 2**

9.3 Emergency Equipment and Supplies

The SSC should mark the locations of emergency equipment on the site map and post the map.

Emergency Equipment and Supplies	Location
20 LB (or two 10-lb) fire extinguisher (A, B, and C classes)	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	On the SSC

9.3 Incident Response

- **Refer to Master HASP**

9.4 Emergency Medical Treatment

- **Refer to Master HASP**

9.5 Evacuation

- **Refer to Master HASP**

9.6 Evacuation Signals

- **Refer to Master HASP**

9.7 Incident Notification and Reporting

- **Refer to Master HASP**

10.0 Behavioral Based Loss Prevention

10.1 Job Hazard Analysis (JHA)

- **Refer to Attachment 3**

10.2 Pre-Task Safety Plans (PTSP)

- **Refer to Attachment 4**
- **Complete a PTSP from for each day or the project, completion of a STAC daily is recommended**

10.3 Safe Behavior Observations

- **Complete one per week**
- **Refer to Attachment 5**

10.4 Loss/Near-Loss Investigations

- **Refer to Master HASP**

11.0 Approval

This project-specific Health and Safety Plan 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, purposes, dates, and personnel specified and must be amended if those conditions change.

11.1 Original Plan

Written/Approved By: Mark Orman/MKE **Date: 5/14/2008**

11.2 Revisions

Revisions Made By: **Date:**

Revisions Approved By: **Date:**

12.0 Attachments

Attachment 1: Employee Signoff Sheet
Attachment 2: Emergency Contacts
Attachment 3: Job Hazard Analysis – Direct Push/ MIP (Drilling)
Attachment 4: Pre-Task Safety Plan
Attachment 5: Safe Work Observation Form
Attachment 6: Project-Specific Chemical Product Hazard Communication Form
Attachment 7: Chemical-Specific Training Form
Attachment 8: Self-Assessment Checklist (Respiratory Protection, Drilling, and Waste Characterization, Sampling and Analysis)
Attachment 9: Material Safety Data Sheets
Attachment 10: Tick-Borne Pathogen Fact Sheet

EMPLOYEE SIGN-OFF SHEET

CH2MHILL

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**

Emergency Contact Sheet

Emergency Contacts

24-hour CH2M HILL Health Resources 1-800-756-1130

Medical Emergency – 911

CH2M HILL Medical Consultant
Dr. Jerry Burke, Health Resources
600 West Cummings Park, Suite 3400
Woburn, MA, 01801-4511
781-938-4653 (after hours calls will be returned within 20 min)

Fire/Spill Emergency -- 911
Facility Fire Response #:(304)-726-5310
Cresaptown Fire Dept #: (301)-729-1111

Local Occupational Physician
Dr. Laura Staton
46440 Benedict Drive, Suite 108
Sterling, VA 22170
703-444-5656

Security & Police – 911
Facility Security #: (304)-726-5310
WV State Police #: (304)-746-2100

Utilities Emergency
Water: (304)-726-5310
Potomac Edison Electric: (304)-263-3700

Health and Safety Manager (HSM)
Name: Steve Beck/MKE
Phone: 414-272-2426 ext. 277
Cell Phone: 414-526-4517

Designated Safety Coordinator (DSC)
Name: Michael Zamboni/WDC
Phone: 703-376-5301

Regional Human Resources Department
Name: Cindy Bauder/WDC
Phone: 703-376-5027

Project Manager
Name: Mark Callaghan/WDC
Phone: 703/376-5056

Corporate Human Resources Department
Name: Pete Hannon/DEN
Phone: 303-771-0900

Federal Express Dangerous Goods Shipping
Phone: 800/238-5355

CH2M HILL Emergency Number for Shipping Dangerous Goods
Phone: 800/255-3924

Worker's Compensation
Complete IRF to initiate process. For immediate assistance contact Regional HR Dept. or for an after hours emergency contact Jennifer Rindahl: 303/918/8130

Automobile Accidents:
Rental: Linda Anderson/COR 720/286-2401
CH2M HILL owned or fleet vehicle: Linda George/DEN 720-286-2057

Contact the Project Manager. Generally, the Project Manager will contact relevant government agencies.

Facility Alarms: There are four different alarms signals. See Attachment 9 - ABL Safety, Security, and Environmental Rules in the Master HASP.

Evacuation Assembly Area(s): If the emergency affects the immediate work area, exit to building 415 until the all clear alarm sounds.

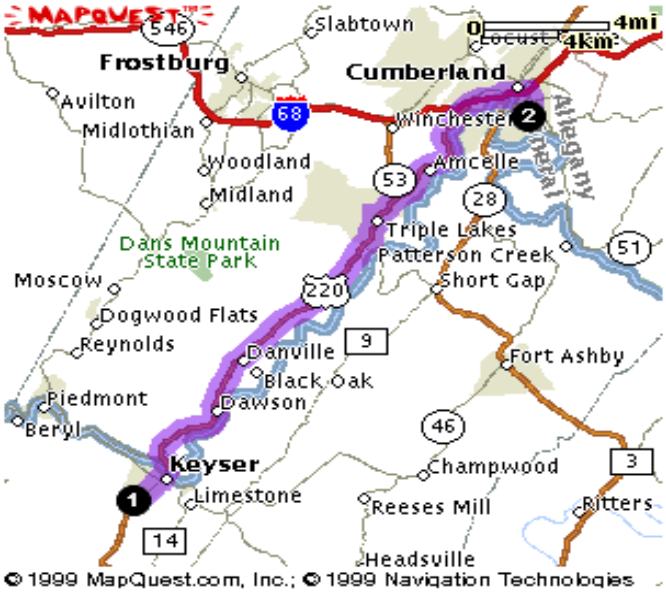
Facility/Site Evacuation Route(s):

Hospital Name/Address:	Memorial Hospital 600 Memorial Ave Cumberland, MD 21502	**Hospital Phone #:** 301-777-4000

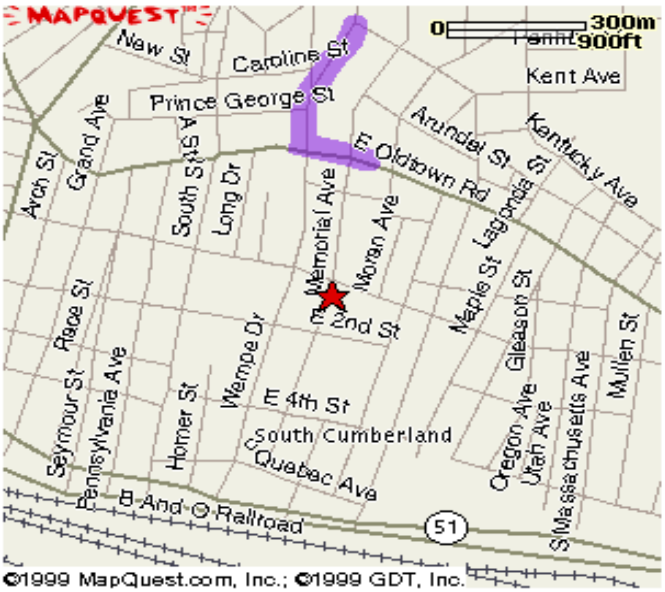
Directions to Hospital

Figure A2-1 includes driving directions and a highlighted map to the hospital.

FIGURE A2-1
HOSPITAL ROUTE MAP
ALLEGANY BALLISTICS LABORATORY, ROCKET CENTER, WEST VIRGINIA



Full Route



Destination

Directions to Hospital

- WV State Route 956 can no longer be accessed from Site 5. You must first go through the tunnel under State Route 956 back to Site 1.
- From Site 1, turn right (west) on WV State Route 956 - cross river
- Turn right on US Route 220 and head northeast for approximately 10 miles
- Bear right onto the on-ramp to W. Industrial Blvd (Hwy 51) and head south for 0.5 miles
- Turn left onto Lamont St and follow for approximately 0.3 miles
- Bear right onto W. Oldtown Rd for 0.7 miles.
- Turn left on Memorial Ave., heading north to 600 Memorial Ave.

CH2MHILL

HEALTH AND SAFETY PLAN
ATTACHMENT 3

JOB HAZARD ANALYSIS (JHA)

PRE-TASK SAFETY PLAN (PTSP)
OR
STAC CARD

CH2MHILL

Pre-Task Safety Plan (PTSP)

Project: _____ Location: _____Date:_____

Supervisor: _____ Job Activity:_____

_____

Task Personnel:

_____
_____
_____
_____

List Tasks:

_____
_____
_____
_____

Tools/Equipment Required for Tasks (ladders, scaffolds, fall protection, cranes/rigging, heavy equipment, power tools):

_____
_____
_____

Potential H&S 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

Other Potential Hazards (Describe):

_____
_____
_____
_____
_____

CH2MHILL

Hazard Control Measures (Check All That Apply):			
PPE __ Thermal/lined __ Eye __ Dermal/hand earing __ Respiratory __ Reflective vests __ Flotation device	Protective Systems __ Sloping __ Shoring __ Trench box __ Barricades __ Competent person __ Locate buried utilities __ Daily inspections	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
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 __ 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 CSE __ Flame retardant clothing __ Appropriate goggles
Confined Space Entry __ Isolation __ Air monitoring __ Trained personnel __ Permit completed __ Rescue	Medical/ER __ First-aid kit __ Eye wash __ FA-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 __ Cranes and rigging	Training: __ Hazwaste __ Construction __ Competent person __ Task-specific (THA) __ Hazcom
Field Notes:_____ _____ _____			

Name (Print): _____

Signature:_____ Date:_____

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SAFETY HAZARD ANALYSIS CARD

Name/Company: _____

Date/Time: _____

Job Description: _____

Daily Safety Goal: _____

PRE-TASK CHECKLIST

SAFETY EQUIPMENT (Check all that apply)

- ❑ PPE
- ❑ Equipment in HSP/FSI available

List: _____

_____

_____

- ❑ Inspected/in good condition
- ❑ Trained in use
- ❑ Fall protection
- ❑ Inspect before use
- ❑ Trained in use
- ❑ Monitoring Equipment
- ❑ Equipment in HSP/FSI available
- ❑ Inspected/maintained
- ❑ Within calibration range

PERMITS

- ❑ Confined space
- ❑ Lock-out/Tagout
- ❑ Hot work/welding
- ❑ Electrical
- ❑ Excavation/Drilling

EXAMPLE HAZARD AND CONTROL MEASURES

(Use to help you complete the reverse side)

OVERHEAD WORK (People/equipment above workers)

- ❑ Barricades
- ❑ Signage
- ❑ Flaggers

WORKING FROM HEIGHTS

- ❑ Personnel trained
- ❑ Fall protection equipment available
- ❑ Guardrails and/or railings
- ❑ Safety net
- ❑ Ladder
- ❑ Inspect before use
- ❑ Proper placement

SPILLS

- ❑ Spill Prevention Plan
- ❑ Secondary containment available
- ❑ Spill kit available

HEAVY EQUIPMENT (Drill rigs, backhoes, excavators, etc)

- ❑ Personnel trained
- ❑ Site-specific plan in place
- ❑ Maintenance/inspection checklist available
- ❑ Equipment on firm, level surface
- ❑ Competent person onsite (excavation)
- ❑ Dig permit obtained
- ❑ Underground utilities identified
- ❑ Overhead utilities identified
- ❑ Safety equipment identified in HSP/FSI available
- ❑ Able to work outside of operating radius (People/equipment above workers)

TOOLS

- ❑ Correct tool for job
- ❑ Inspected and maintained
- ❑ Proper explosion rating
- ❑ Guards in place

ELECTRICAL

- ❑ Power tools & extension cord inspection
- ❑ Qualified personnel work on/near energized equipment
- ❑ Lockout/tagout equipment available
- ❑ Equipment grounded
- ❑ GCIFs in use
- ❑ Safe clearances maintained

LIFTING

- ❑ Assistance required
- ❑ Mechanical lift (dolley, crane, chain fall, etc)**CHEMICAL**
- ❑ Trained
- ❑ MSDS available and reviewed
- ❑ Medically monitored
- ❑ PPE available per the HSP/FSI
- ❑ Air sampling/equipment available per the HSP/FSI

GENERAL

- ❑ Heat stress management planned (rest-work schedules, liquid available, work hours shifted to cooler hours, etc)
- ❑ Aisle-ways clear
- ❑ Fire extinguishers available
- ❑ Good housekeeping maintained
- ❑ Trash containers used and emptied
- ❑ Containers labeled
- ❑ Safety glasses/goggles used when flying objects/particulars present

OFFICE/ERGONOMICS

- ❑ Neutral position when working on a computer
- ❑ Slip, trip, and fall hazards removed
- ❑ Drawers closed when not in use
- ❑ Top drawers closed before bottom drawers opened

DRIVING

- ❑ Seat belt fastened
- ❑ Mirrors and headsets adjusted
- ❑ Valid drivers license for vehicle type

OTHER

- ❑ _____
- ❑ _____
- ❑ _____

WHAT AM I DOING? (List Tasks)	WHAT ARE THE POSSIBLE HAZARDS OF THE TASK I'M DOING? (List Potential Hazards)	WHAT WILL I DO TO REDUCE THE LIKELIHOOD OR SEVERITY OF THE HAZARD? (List Control Measures)

HS&E
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SAFE BEHAVIOR OBSERVATION FORM

CH2MHILL

Safe Behavior Observation Form		
Project:	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…			

PROJECT-SPECIFIC CHEMICAL PRODUCT HAZARD COMMUNICATION FORM

CH2MHILL

Project-Specific Chemical Product Hazard Communication Form

This form must be completed prior to performing activities that expose personnel to hazardous chemicals products. Upon completion of this form, the SSC shall verify that training is provided on the hazards associated with these chemicals and the control measures to be used to prevent exposure to CH2M HILL and subcontractor personnel. Labeling and MSDS systems will also be explained.

Project Name: **Project Number:**

MSDSs will be maintained at the following location(s):

Hazardous Chemical Products Inventory

Chemical	Quantity	Location	MSDS Available	Container labels	
				Identity	Hazard
Methane	1 liter, compressed	Support Zone			
Isobutylene	1 liter, compressed	Support Zone			
Pentane	1 liter, compressed	Support Zone			
Hydrochloric acid	< 500 ml	Support Zone / sample bottles			
Nitric acid	< 500 ml	Support Zone / sample bottles			
Sulfuric Acid	< 500 ml	Support Zone / sample bottles			
Sodium hydroxide	< 500 ml	Support Zone / sample bottles			
Methanol	< 1 Gallon	Support/Decon Zones			
Hexane	< 1 Gallon	Support/Decon Zones			
pH buffers	< 500 ml	Support Zone			
MSA Sanitizer	< 1 liter	Support/Decon Zones			
Alconox/Liquinox	< 1liter	Support/Decon Zones			

Refer to SOP HSE-107 *Hazard Communication* for more detailed information.

CHEMICAL-SPECIFIC TRAINING FORM

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CHEMICAL-SPECIFIC TRAINING 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.

HS&E SELF ASSESSMENT CHECKLISTS

- *Drilling*
- *Respiratory Protection*

CH2MHILL

HS&E Self-Assessment Checklist – DRILLING

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's written safety plan.

This checklist is to be used at locations where: 1) CH2M HILL employees are potentially exposed to drilling hazards, 2) CH2M HILL staff are providing support function related to drilling activities, and/or 3) CH2M HILL oversight of a drilling subcontractor is required.

Safety Coordinator may consult with drilling subcontractors when completing this checklist, but shall not direct the means and methods of drilling operations nor direct the details of corrective actions. Drilling subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered being imminently dangerous (possibility of serious injury or death) shall be corrected immediately, or all exposed personnel shall be removed from the hazard until corrected.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to drilling hazards (complete Section 1).
☐ Evaluate CH2M HILL support functions related to drilling activities (complete Section 2)
☐ Evaluate a CH2M HILL subcontractor's compliance with drilling safety requirements (complete entire checklist).
Subcontractors Name: _____

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the drilling subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in SOP HSE-35.

SECTION 1 - SAFE WORK PRACTICES (4.1)

	Yes	No	N/A	N/O
1. Personnel cleared during rig startup	☐	☐	☐	☐
2. Personnel clear of rotating parts	☐	☐	☐	☐
3. Personnel not positioned under hoisted loads	☐	☐	☐	☐
4. Loose clothing and jewelry removed	☐	☐	☐	☐
5. Smoking is prohibited around drilling operation	☐	☐	☐	☐
6. Personnel wearing appropriate personal protective equipment (PPE), per written plan	☐	☐	☐	☐
7. Personnel instructed not to approach equipment that has become electrically energized	☐	☐	☐	☐

SECTION 2 - SUPPORT FUNCTIONS (4.2)

FORMS/PERMITS (4.2.1)

8. Driller license/certification obtained	☐	☐	☐	☐
9. Well development/abandonment notifications and logs submitted and in project files	☐	☐	☐	☐
10. Water withdrawal permit obtained, where required	☐	☐	☐	☐

	Yes	No	N/A	N/O
11. Dig permit obtained, where required	☐	☐	☐	☐
UTILITY LOCATING (4.2.2)				
12. Location of underground utilities and structures identified	☐	☐	☐	☐
WASTE MANAGEMENT (4.2.3)				
13. Drill cuttings and purge water managed and disposed properly	☐	☐	☐	☐
DRILLING AT HAZARDOUS WASTE SITES (4.2.4)				
14. Waste disposed of according to project's written safety plan	☐	☐	☐	☐
15. Appropriate decontamination procedures being followed, per project's written safety plan	☐	☐	☐	☐
DRILLING AT ORDNANCE EXPLOSIVES (OE)/UNEXPLODED ORDNANCE (UXO) SITES (4.2.5)				
16. OE plan prepared and approved	☐	☐	☐	☐
17. OE/UXO avoidance provided, routes and boundaries cleared and marked	☐	☐	☐	☐
18. Initial pilot hole established by UXO technician with hand auger	☐	☐	☐	☐
19. Personnel remain inside cleared areas	☐	☐	☐	☐

SECTION 3 - DRILLING SAFETY REQUIREMENTS (4.3)

GENERAL (4.3.1)				
20. Only authorized personnel operating drill rigs	☐	☐	☐	☐
21. Daily safety briefing/meeting conducted with crew	☐	☐	☐	☐
22. Daily inspection of drill rig and equipment conducted before use	☐	☐	☐	☐
DRILL RIG PLACEMENT (4.3.2)				
23. Location of underground utilities and structures identified	☐	☐	☐	☐
24. Safe clearance distance maintained from overhead power lines	☐	☐	☐	☐
25. Drilling pad established, when necessary	☐	☐	☐	☐
26. Drill rig leveled and stabilized	☐	☐	☐	☐
27. Additional precautions taken when drilling in confined areas	☐	☐	☐	☐
DRILL RIG TRAVEL (4.3.3)				
28. Rig shut down and mast lowered and secured prior to rig movement	☐	☐	☐	☐
29. Tools and equipment secured prior to rig movement	☐	☐	☐	☐
30. Only personnel seated in cab are riding on rig during movement	☐	☐	☐	☐
31. Safe clearance distance maintained while traveling under overhead power lines	☐	☐	☐	☐
32. Backup alarm or spotter used when backing rig	☐	☐	☐	☐
DRILL RIG OPERATION (4.3.4)				
33. Kill switch clearly identified and operational	☐	☐	☐	☐
34. All machine guards are in place	☐	☐	☐	☐
35. Rig ropes not wrapped around body parts	☐	☐	☐	☐
36. Pressurized lines and hoses secured from whipping hazards	☐	☐	☐	☐
37. Drill operation stopped during inclement weather	☐	☐	☐	☐
38. Air monitoring conducted per written safety plan for hazardous atmospheres	☐	☐	☐	☐
39. Rig placed in neutral when operator not at controls	☐	☐	☐	☐
DRILL RIG SITE CLOSURE (4.3.5)				
40. Ground openings/holes filled or barricaded	☐	☐	☐	☐
41. Equipment and tools properly stored	☐	☐	☐	☐
42. All vehicles locked and keys removed	☐	☐	☐	☐
DRILL RIG MAINTENANCE (4.3.6)				
28. Defective components repaired immediately	☐	☐	☐	☐
29. Lockout/tagout procedures used prior to maintenance	☐	☐	☐	☐
30. Cathead in clean, sound condition	☐	☐	☐	☐

31. Drill rig ropes in clean, sound condition ☐ ☐ ☐ ☐
32. Fall protection used for fall exposures of 6 feet (U.S.) 1.5 meters (Australia) or greater ☐ ☐ ☐ ☐
33. Rig in neutral and augers stopped rotating before cleaning ☐ ☐ ☐ ☐
34. Good housekeeping maintained on and around rig ☐ ☐ ☐ ☐

SECTION 4

Complete this section for all items checked “No” in previous sections. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: ________________________________ Project Manager: __________________________________

CH2MHILL

H&S Self-Assessment Checklist: RESPIRATORY PROTECTION

This checklist is provided as a method of verifying compliance with the OSHA respiratory protection standard. It shall be used at locations where CH2M HILL personnel are using respiratory protection, or are required to perform oversight of a subcontractor using respiratory protection, or both.

CH2M HILL staff shall not direct the means and methods of subcontractor use of respiratory protection nor direct the details of corrective actions. The subcontractor must determine how to correct deficiencies and CH2M HILL staff must carefully rely on their expertise. Items considered being imminently dangerous (possibility of serious injury or death) must be corrected immediately or all exposed personnel must be removed from the hazard until corrected.

Completed checklists must be sent to the appropriate regional health and safety program manager for review.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to (check only one of the boxes below):

☐ Evaluate CH2M HILL compliance with its respiratory protection program (SOP HS-08)
☐ Evaluate a CH2M HILL subcontractor's compliance with its respiratory protection program
Subcontractor's Name: _____

- Check "Yes" if an assessment item is complete or correct.
- Check "No" if an item is incomplete or deficient. Section 2 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HS-08.

SECTION 1	Yes	No	N/A	N/O
TRAINING (6.1)				
1. Respirator users have completed appropriate training on the respirator to be used	☐	☐	☐	☐
2. Training is current within the past 12 months	☐	☐	☐	☐
3. Attachment 1 of SOP HS-08 distributed to employees using respirators voluntarily	☐	☐	☐	☐
MEDICAL EVALUATION (6.2)				
4. Respirator users completed medical evaluation protocol	☐	☐	☐	☐
5. Respirator use does not exceed any physician's written recommendation limitations	☐	☐	☐	☐
6. Respirator users know to report any medical signs or symptoms related to respirator use	☐	☐	☐	☐

FIT TESTING (6.3)

7. Respirator users of tight-fitting facepieces have passed a fit test ☐☐☐☐
8. Fit test is current within the past 12 months ☐☐☐☐
9. Respirator users know to have new fit test performed if any change affects respirator fit ☐☐☐☐

RESPIRATOR SELECTION (6.4)

10. All feasible engineering controls have been considered in reducing exposure levels ☐☐☐☐
11. Appropriate respiratory protection and limitations are specified in HSP/FSI ☐☐☐☐
12. Cartridge or canister change-out schedule is specified in HSP/FSI ☐☐☐☐

RESPIRATOR USE (6.5)

13. Respirator use is limited to those specified in HSP/FSI ☐☐☐☐
14. HSM notified of changes in site conditions that may alter effectiveness of specified respirators ☐☐☐☐
15. Respirator users of tight-fitting facepieces are cleanly shaven ☐☐☐☐
16. Respirator users of tight-fitting facepieces perform user seal check before each use ☐☐☐☐
17. Cartridges or canisters replaced according to change-out schedule in HSP/FSI ☐☐☐☐
18. Respirator users informed to report any gas or vapor breakthrough to SSC/DSC ☐☐☐☐
19. SSC/DSC knows to report any gas or vapor breakthrough to HSM ☐☐☐☐
20. Personnel not entering IDLH areas until standby-person established with appropriate e equipment ☐☐☐☐

RESPIRATOR INSPECTION (6.6)

21. Respirators in regular use are inspected before each use and during cleaning ☐☐☐☐
21. Emergency response respirators are inspected and documented monthly ☐☐☐☐
22. Defective respirators are taken out of service or repaired ☐☐☐☐

RESPIRATOR CLEANING AND DISINFECTING (6.7)

23. Respirators in regular use are cleaned and disinfected as necessary ☐☐☐☐
24. Emergency and transferred respirators are cleaned and disinfected after use ☐☐☐☐

RESPIRATOR STORAGE (6.8)

25. Respirators are properly stored to prevent contamination and deformation ☐☐☐☐
26. Emergency respirators are accessible and clearly marked as emergency respirators ☐☐☐☐

RESPIRATOR REPAIRS (6.9)

27. Respirator repair is limited to routine maintenance ☐☐☐☐
28. Respirators beyond routine repair are removed from service ☐☐☐☐

BREATHING AIR SUPPLIED BY CYLINDER (6.10.1)

29. Cylinders are marked with NIOSH approval label ☐☐☐☐
30. Certificate of analysis meets Grade D specifications ☐☐☐☐
31. Certificate of analysis is kept onsite ☐☐☐☐

BREATHING AIR SUPPLIED BY COMPRESSOR (6.10.2)

32. Breathing air meets Grade D specifications ☐☐☐☐

33. Compressor intake is located away from exhaust gases ☐☐☐☐
34. Compressor is provided with sorbent filters ☐☐☐☐
35. Sorbent filter change-out documentation is kept on the compressor ☐☐☐☐
36. High temperature or carbon monoxide alarm provided on oil-lubricated compressors ☐☐☐☐
37. If high temperature alarm is used alone, carbon monoxide levels are monitored ☐☐☐☐
38. Practical measures taken to control carbon monoxide levels on non oil-lubricated compressors ☐☐☐☐

SECTION 2

Complete this section for all items checked "No" in Section 1. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned or Taken	Date Corrected

Auditor: ________________________ Project Manager: _____________________________________

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CH2MHILL

MATERIALS SAFETY DATA SHEETS

Tick-Borne Pathogen Fact Sheet

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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 notifiable 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

There are five varieties of hard-bodied ticks that have been associated with tick-borne pathogens. These include:

- Deer (Black Legged) Tick (eastern and pacific varieties)
- Lone Star Tick
- Dog Tick
- Rocky Mountain Wood Tick

These 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. For 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 & Symptoms

There are six notifiable tick-borne pathogens that cause human illness in the United States. These pathogens may be transmitted during a tick bite—normally hours after attachment. The illnesses, presented in approximate order of most common to least, include:

- 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.

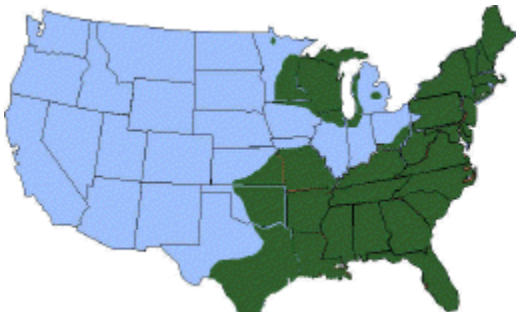
Deer Tick

From Left: adult female, adult male, nymph, and larvae Deer Tick (cm scale)

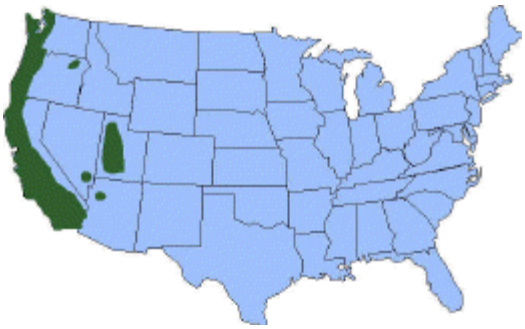
Lone Star Tick

Dog Tick

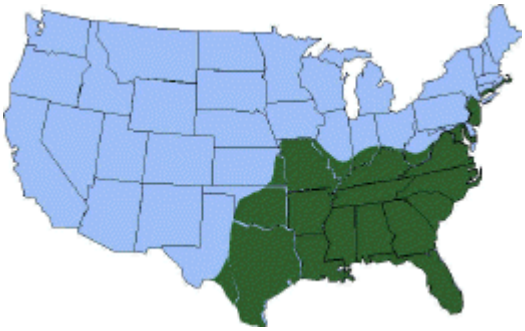
Rocky Mountain Wood Tick



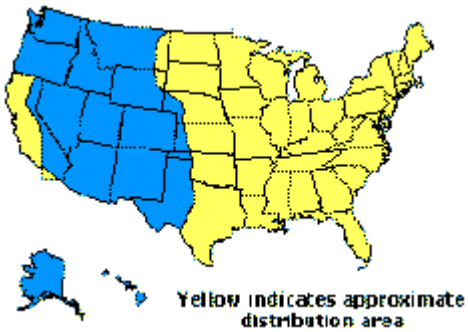
Distribution of Deer Tick (dark green)

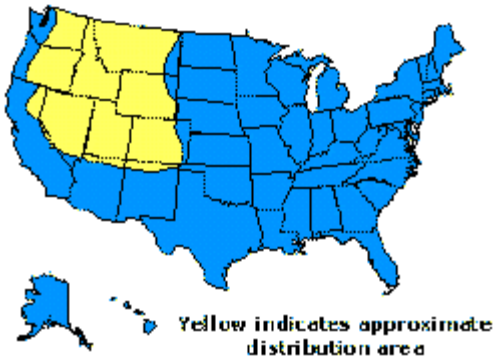


Distribution of Pacific Deer Tick (dark green)



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

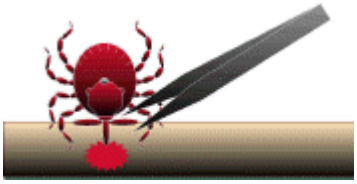
A tick check should be performed after field survey before entering the field vehicle (you do not want to infest your field vehicle with ticks). Have your field partner check your back; the backs of your legs, arms, and neck; and your hairline. Shake off clothing as thorough as possible before entering the vehicle. Once the field day is complete, repeat this procedure and perform a thorough self check.

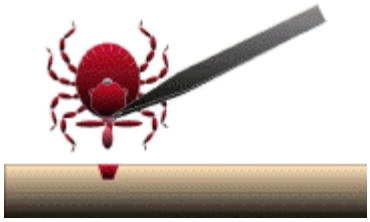
If a tick has embedded itself into the skin, remove the tick as described below. After removal, preserve the specimen in a small air tight bag and send it to Clongen Laboratories, LLC located in Germantown, Maryland for analysis. The laboratory will have results within 1-3 days. A tick testing submission form (attached) should be properly completed and submitted with the tick.

Tick Removal

1. Use 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. Do not squeeze, crush, or puncture 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. You may wish to save the tick for identification in case you become ill. Your doctor can use the information to assist in making an accurate diagnosis. Place the tick in a plastic bag and put it in your freezer. Write the date of the bite on a piece of paper with a pencil and place it in the bag.

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. Consult a healthcare professional if infection or symptoms and effects of tick-borne illnesses develop.

Medical treatment for tick-borne infections includes antibiotics and other medical interventions. Diagnosis of specific illness involves both clinical and laboratory confirmations. Preventative antibiotic treatment in non-ill individuals who have had a recent tick bite is recommended in specific cases only.

Previously infected individuals are not conferred immunity—re-infection from future tick bites can occur even after a person has contracted a tick-borne disease.

CH2M HILL employees shall attempt to complete the following to obtain Tick Analysis:

1. For tick removal, follow the instructions in your tick removal kit using a fine pointed pair of tweezers. If the tick is alive, place it in two layered zip-lock bags. It is highly recommended that you wear gloves when removing the tick from the skin to avoid infection.
2. It is important to remove the entire tick and place it in a zip lock bag.
3. Place the zip-lock bag in an envelope and fill out the sample submission form from the Clongen website. Please identify yourself as a CH2M HILL employee by completing all the contact information in the form. The cost of the analysis will be paid for; you do not have to use a credit card or check. The account will be assigned a blanket PO and billed directly to Health Resources for payment.
4. In 1 – 3 days, you will be contacted to discuss the results of your tick testing and any necessary treatment. In the mean time, should your current condition change in any way, please contact the Health Resources Nurse Case Manager who assisted you.

Appendix C
Laboratory Standard Operating Procedures

Appendix D
Data Management Plan

Version 3

Navy CLEAN
Data Management Plan

Prepared for

Navy CLEAN & Joint Venture Programs

June 2010

CH2MHILL

Preface

This document presents the standardized six-step workflow process for environmental data management being performed for the Navy Comprehensive Long-Term Environmental Action - Navy (CLEAN) and Joint Venture Programs. Included in Appendix A is the responsible, approve, support, consult, and inform (RASCI) diagram along with the associated roles and responsibilities, which is the basis for the Navy CLEAN and Joint Venture Programs Data Management Plan (DMP). Following are the six steps in the workflow process:

1. Project planning and database setup
2. Sample collection and management
3. Laboratory analysis
4. Data validation and loading
5. Data management
6. Data evaluation and reporting

Figure P-1 presents a simplified presentation of the workflow process specific to the Navy CLEAN and Joint Venture Programs.

Figure P-2 presents, in more detail, the tools used in each step of the process. CH2M HILL uses the Sample Tracking Sheet (STS) to initiate the sample collection, documentation, and tracking processes. All field-related data is captured in the Field Data Entry Tool (FDETool). During the laboratory analysis and data validation phase, the SNEDD-QC-Tool software will be used to help evaluate the quality of the data. At the data management step, the SVMTool will be used to format the data and the CH-IMPTool will be used to transfer the data into the Navy CLEAN data warehouse. At the data evaluation stage, the XTabReports Tool will be used to query data from the data warehouse, and the Crosstab Cleanup Tool (CCTool) and the Raw, Detects, and Exceedance (RDE) Formatting Tool will produce and format data tables and comparisons to project action levels. Appropriate section(s) of the DMP include additional details on each of the tools used.

Change Management

This DMP is a "living" document and content may be revised or amended to accommodate changes in the scope of environmental investigations or data management requirements that affect the entire Navy CLEAN and Joint Venture Programs. In addition, the DMP appendices will be subject to modification as new or improved methods of data management are developed and implemented.

Any modifications made to the tools will be communicated to the project team via e-mail. As revisions are finalized, they will be distributed electronically to all users. After revision, it is the user's responsibility to conform to revised portions of the DMP.

Amendments will be versioned and released according to the following naming scheme: [Document Name_v#.#_yymmdd]. If a significant change is made to any of these files, the version number will increase by one integer. The revision history is shown in the following table.

REVISION HISTORY

Navy CLEAN and Joint Venture Programs Data Management Plan

Revision Date	Initiator	Purpose

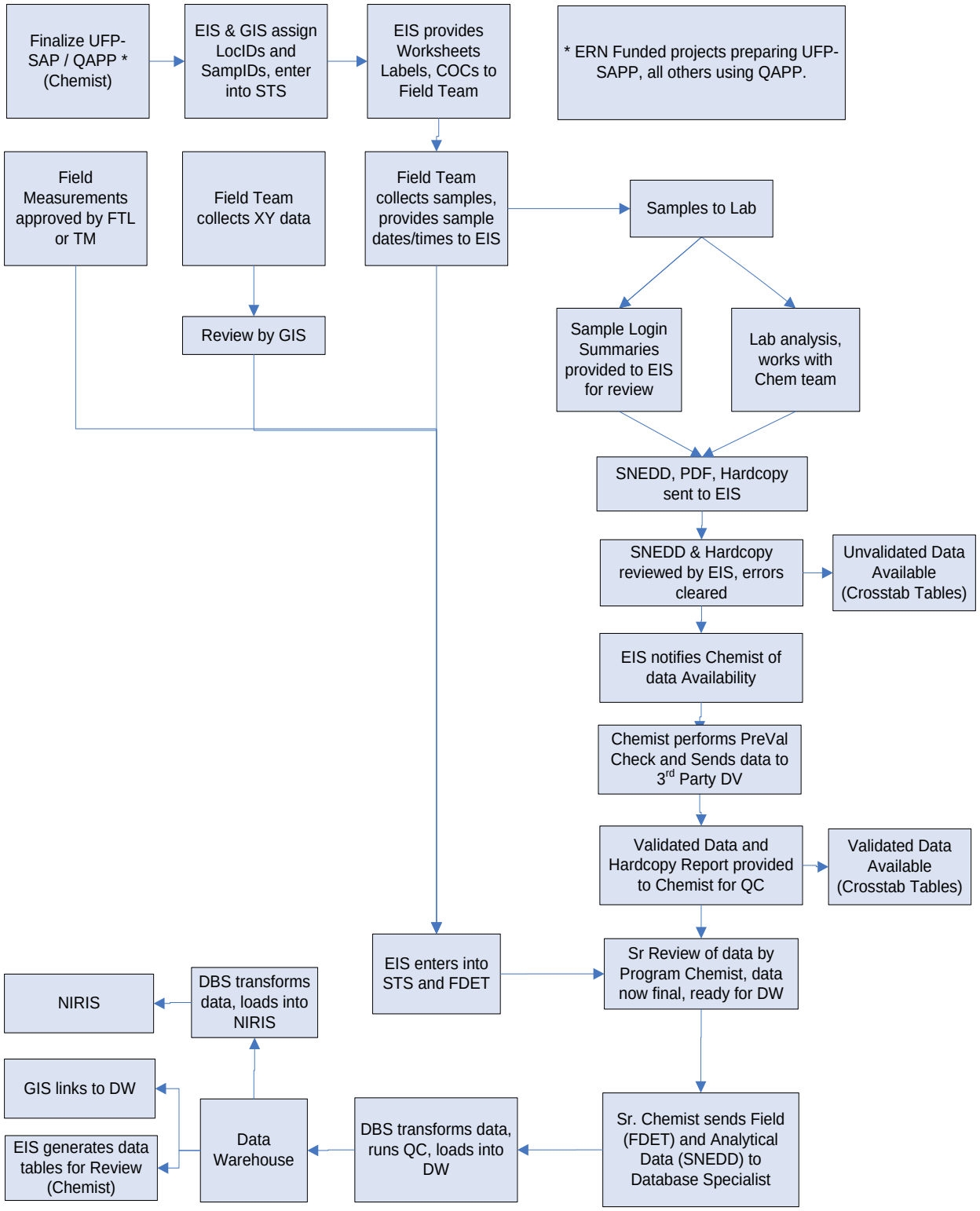


FIGURE P-1
ENVIRONMENTAL DATA MANAGEMENT WORKFLOW PROCESS

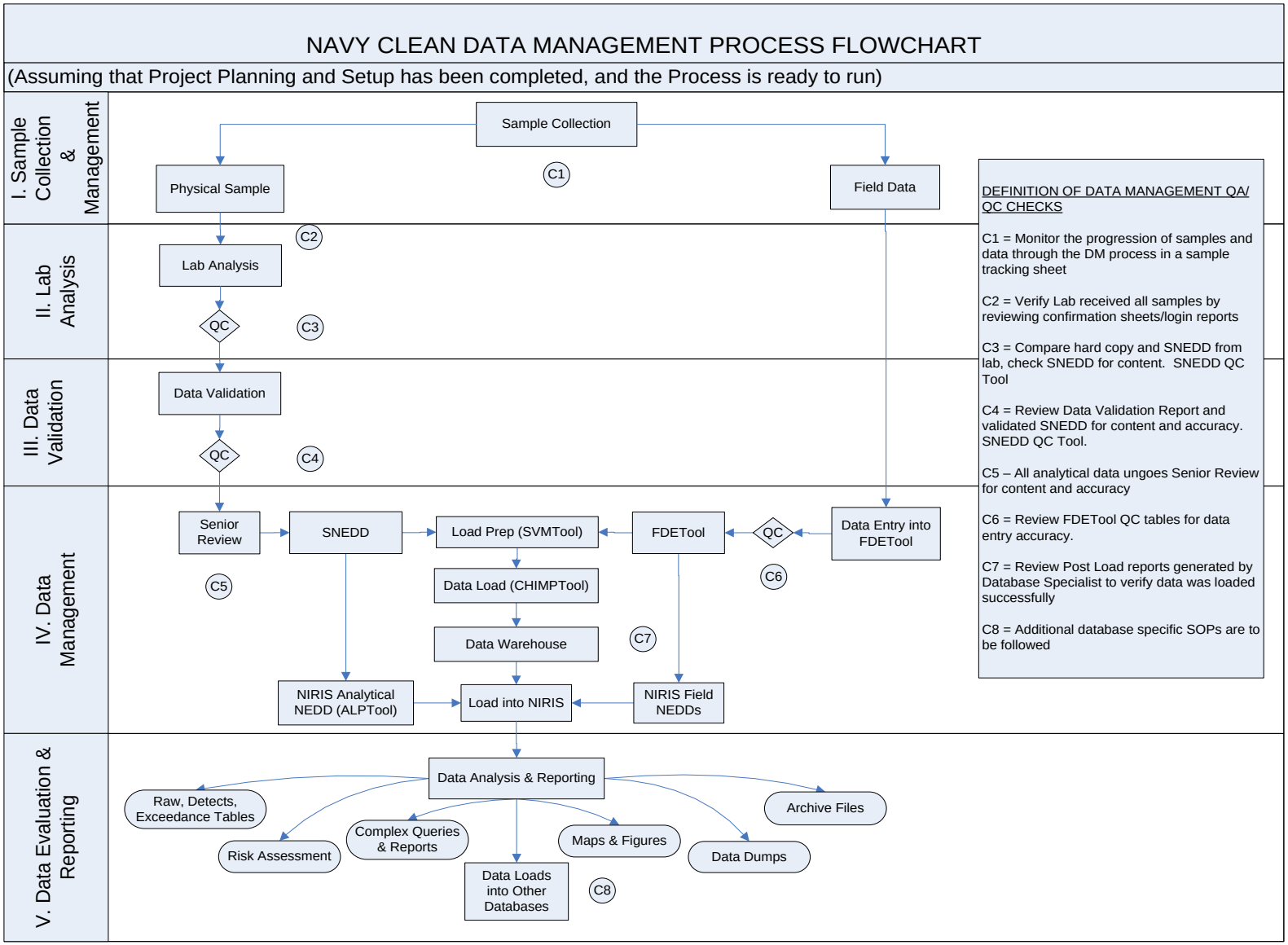


FIGURE P-2
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Acronyms and Abbreviations

ALPTool	Archive Load and Prep Tool
AM	Activity Manager
CAD	computer-aided design
COC	chain-of-custody
DBMS	Database Management System
DBS	Database Specialist
EIS	Environmental Information Specialist
DMP	Data Management Plan
EDD	electronic data deliverable
EDM	Environmental Data Management
EMS	Enterprise Management Solutions
ERP	Environmental Restoration Program
ERPIMS	Environmental Restoration Program Information Management System
EVS	Environmental Visualization System
FD	Field Duplicate
FDETool	Field Data Entry Tool
FTL	Field Team Leader
GA	GIS Analyst
GIS	geographic information system
ID	identification
IDW	investigation-derived waste
IRP	Installation Restoration Program
MS	matrix spike
MSD	matrix spike duplicate
N/FD	normal/field duplicate
NAVFAC	Naval Facilities Engineering Command
NEDD	NIRIS Electronic Data Deliverable

NIRIS	Naval Installation Restoration Information Solution
ODBC	open database connectivity
PC	Project Chemist
PCL	Program Chemistry Lead
PDL	Program Data Management Lead
PGL	Program GIS Lead
PM	Project Manager
QA	quality assurance
QC	quality control
RASCI	responsible, approve, support, consult, and inform
RDM	Regional Database Manager
SDG	Sample Delivery Group
SIMS	Site Information Management System
SNEDD	Supplemental NIRIS Electronic Data Deliverable
SOP	standard operating procedure
STS	Sample Tracking Sheet
SVMTool	SNEDD to VDMS Mapping Tool
VDMS	Validated Data Management System

SECTION 1

Introduction

This Data Management Plan (DMP) describes the methods CH2M HILL will use to manage and present environmental data to support work it is conducting for the Navy CLEAN and Joint Venture Programs. These processes and procedures are part of an overall environmental data management system called the SNEDD Approach to the Validation Data Management System (VDMS), hosted by CH2M HILL.

Project members and any subcontractors supporting program data needs for site characterization and remediation activities can use this DMP. It is a living document that is flexible enough to meet the dynamic needs of the teams and stakeholders. Data management program details and procedures are included in the appendices.

1.1 Purpose

This document outlines how environmental data for the Navy CLEAN and Joint Venture Programs will be obtained and managed using an Enterprise Management Solutions (EMS) approach. The systematic approach will facilitate the retrieval of data from project files and the data warehouse when they are needed, help ensure that the required data are collected and are of the appropriate quality, and help ensure that data records are not lost during transfer to the central program database repository.

1.2 Scope of the Data Management Plan

The scope of the data management activities addressed by this plan includes the following:

- **Roles.** Definition of staff roles and responsibilities.
- **Project Planning and Setup.** Use standard templates and database applications; provide guidance and standard operating procedures (SOPs) for formatting, reviewing, and transferring data collected in the field to the Database Management System (DBMS).
    - **Provide a structured, yet flexible data set.** The DBMS will store all types of environmental data and provides a standard framework for all projects within the Navy CLEAN Program to use. The DBMS is organized and structured, yet flexible enough to allow additional data and data types to be added at any time over the life of the program.
    - **Provide data that are well documented.** The DBMS will retain enough descriptive and source information for technical defensibility and legal admissibility of the data.
- **Sample Collection and Management.** Items that will be captured through standardized forms or applications include chains-of-custody (COCs), field parameter information, groundwater elevation data, and sample tracking records.
- **Laboratory Analysis.** Laboratory data will be reported in the Supplemental Naval Installation Restoration Information Solution (NIRIS) Electronic Data Deliverable (SNEDD)

format specifications that analytical laboratories are required to use to transfer analytical data electronically to CH2M HILL. (Provided to laboratories via a scope of work.) Management and archive procedures will be implemented for hard copy and electronic project documentation.

- **Data Validation.** Internal and external data validation will be conducted in accordance with the appropriate Program and EPA requirements. All deliverables will be subjected to Senior Review quality assurance (QA) and quality control (QC) measures. Management and archive procedures will be implemented for hard copy and electronic project documentation.
- **Data Management.** QA and QC measures will be implemented to provide accurate representation of all data collected and to be stored in the DBMS. QA/QC procedures include restricting data import or entry to specific valid value lists that will not allow incorrect data to be included in the DBMS.
- **Data Evaluation and Reporting.** Reporting and delivery support will be provided from a single DBMS source and allow relatively simple and rapid access to stored data for environmental characterization, report generation, modeling, geographic information system (GIS) mapping, statistical analyses, and risk assessments.
    - **Provide data visualization capabilities.** Data will be accurately represented for use in models, GIS, boring log programs (Environmental Visualization System [EVS), computer-aided design (CAD), graphics, and other software used for mapping, graphing, charting, analyzing, and displaying environmental data.
    - **Provide the ability to compare data electronically.** Tools will allow the electronic comparison of project data to specific reference or screening criteria.
    - **Provide the ability to transfer data to different formats.** The DBMS will provide the ability to reformat, convert, and transfer the data to any format as required by specific end-user applications.

SECTION 2

Roles and Responsibilities

The Navy CLEAN and Joint Venture Programs Environmental Data Management (EDM) team will work together to properly execute the DMP and ensure that the project objectives and scope are realized. The EDM team is composed of data management, chemistry, and GIS resources. The EDM team is responsible for all aspects of planning, execution, management and reporting environmental of data. Data are derived from sampling events related to investigative and remedial activities for Navy CLEAN and Joint Venture projects.

Responsibilities related to data management and information solutions functions are grouped into roles, as listed in Table 1. The SNEDD DM Process Checklist referenced in Appendix C documents the specific responsibilities associated with each of these roles.

TABLE 1
Navy CLEAN and Joint Venture Environmental Data Management Program Team
The Navy CLEAN Program Data Management Plan

Title	Name/Address	Phone	Fax	E-mail
Navy CLEAN Activity Manager (AM)	Various	Various	Various	Various
Navy CLEAN Project Manager (PM)	Various	Various	Various	Various
Field Team Leader (FTL)	Various	Various	Various	Various
Program Critigen Team Lead	Mike Dierstein 5700 Cleveland Street Suite 101 Virginia Beach, VA 23462	757-671-6216	757-497-6885	mdierste@critigen.com
Program Data Management Lead (PDL)	Chelsea Leigh 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6208	773-695-1378	cleigh@critigen.com
Database Specialist (DBS)	Bhavana Reddy 15010 Conference Center Dr. Suite 200 Chantilly, VA 20151	703- 462-3784	703- 376-5010	breddy@critigen.com
Program Chemistry Lead (PCL)	Anita Dodson 5700 Cleveland Street Suite 101 Virginia Beach, VA 23462	757-671-6218	757-497-6885	adodson@ch2m.com
Project Chemist (PC)	Mike Zamboni 15010 Conference Center Dr. Suite 200 Chantilly, VA 20151	703-376-5111	703-376-5801	mzamboni@ch2m.com
Project Chemist (PC)	Megan Morrison 15010 Conference Center Dr. Suite 200 Chantilly, VA 20151	703-376-5053	703-376-5801	megan.morrison@ch2m.com

TABLE 1
Navy CLEAN and Joint Venture Environmental Data Management Program Team
The Navy CLEAN Program Data Management Plan

Title	Name/Address	Phone	Fax	E-mail
Project Chemist (PC)	Bianca Kleist 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6281	757-497-6885	bkleist@ch2m.com
Project Chemist (PC)	Juan Acaron 3011 S.W. Williston Road. Gainesville, FL 32608	352-384-7002-		juan.acaron@ch2m.com
Project Chemist (PC)	Kristina Lambert 3011 S.W. Williston Road. Gainesville, FL 32608	352-335-5877		kristina.lambert@ch2m.com
Project Chemist (PC)	Clairette Campbell 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6335	757-497-6885	clairette.campbell@ch2m.com
Environmental Information Specialist (EIS)	Rebekha Shaw 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6279	757-497-6885	rshaw22@ch2m.com
Environmental Information Specialist (EIS)	Gwendolyn Buckley 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-8311	757-497-6885	Gbuckle1@ch2m.com
Environmental Information Specialist (EIS)	Victoria Brynildsen 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6252	757-497-6885	vbrynildsen@ch2m.com
Environmental Information Specialist (EIS)	Troy Horn 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-8311	757-497-6885	troy.horn@ch2m.com

TABLE 1
Navy CLEAN and Joint Venture Environmental Data Management Program Team
The Navy CLEAN Program Data Management Plan

Title	Name/Address	Phone	Fax	E-mail
Environmental Information Specialist (EIS)	Hillary Ott 15010 Conference Center Dr. Suite 200 Chantilly, VA 20151	703-376-5165	703-376-5801	hillary.ott@ch2m.com
Environmental Information Specialist (EIS)	Andrew Louder 15010 Conference Center Dr. Suite 200 Chantilly, VA 20151	703-376-5111	703-376-5801	andrew.louder@ch2m.com
Environmental Information Specialist (EIS)	Angela Krause 1000 Abernathy Road Suite 1600 Atlanta, GA 30328	678-530-4073	703-376-5801	angela.krause@ch2m.com
Program GIS Lead (PGL)	Mike Dierstein 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6216	757-497-6885	mdierstein@critigen.com
GIS Analyst (GA)	Blake Hathaway 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6230	757-497-6885	bhathawa@critigen.com
GIS Analyst (GA)	Mary Beth Artese 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6228	757-497-6885	martese@critigen.com
GIS Analyst (GA)	Mark Unwin 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6261	757-497-6885	munwin@critigen.com
GIS Analyst (GA)	Chris Bowman 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6276	757-497-6885	cbowman@critigen.com

TABLE 1
Navy CLEAN and Joint Venture Environmental Data Management Program Team
The Navy CLEAN Program Data Management Plan

Title	Name/Address	Phone	Fax	E-mail
GIS Analyst (GA)	Matt Rissing 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6243	757-497-6885	mrissing@critigen.com
GIS Analyst (GA)	Forrest Cain 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6271	757-497-6885	fcain@critigen.com

SECTION 3

Data Management System Description

During field investigation, monitoring, and remedial activities, CH2M HILL will collect a variety of environmental information to support data analysis, reporting, and decision-making activities. To meet current regulatory QA requirements, a complete audit trail of the information flow must be implemented. The six steps in the workflow process are (Appendix B):

1. Project planning and database setup
2. Sample collection and management
3. Laboratory analysis
4. Data validation
5. Data management and loading
6. Data evaluation and reporting

Each step in the data management process must be adequately planned, executed, and documented. Figure 1 presents a simplified presentation of the workflow process specific to the Navy CLEAN and Joint Venture Programs. Figure 2 presents, in more detail, the tools used in each step of the process.

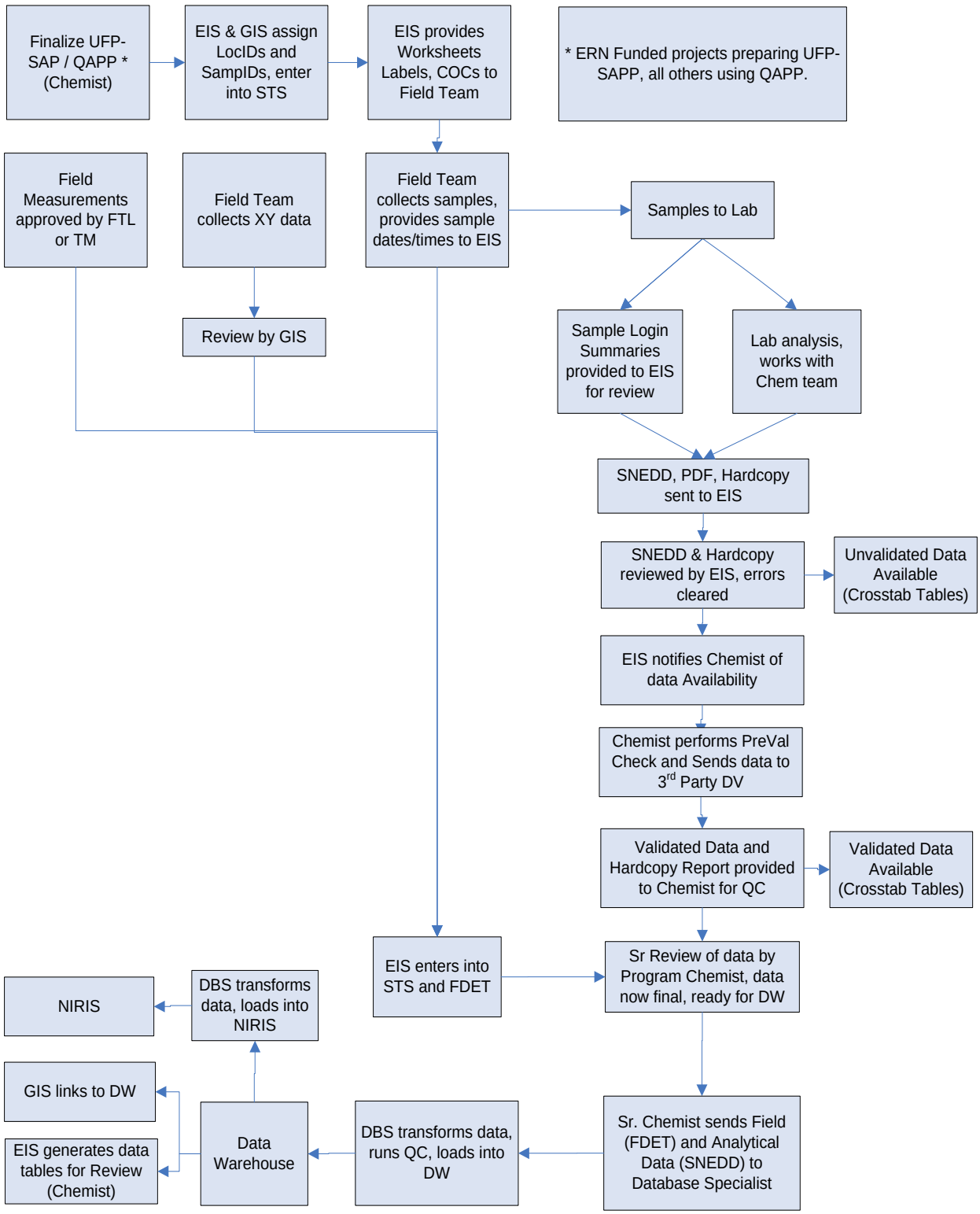


FIGURE 1
ENVIRONMENTAL DATA MANAGEMENT WORKFLOW PROCESS

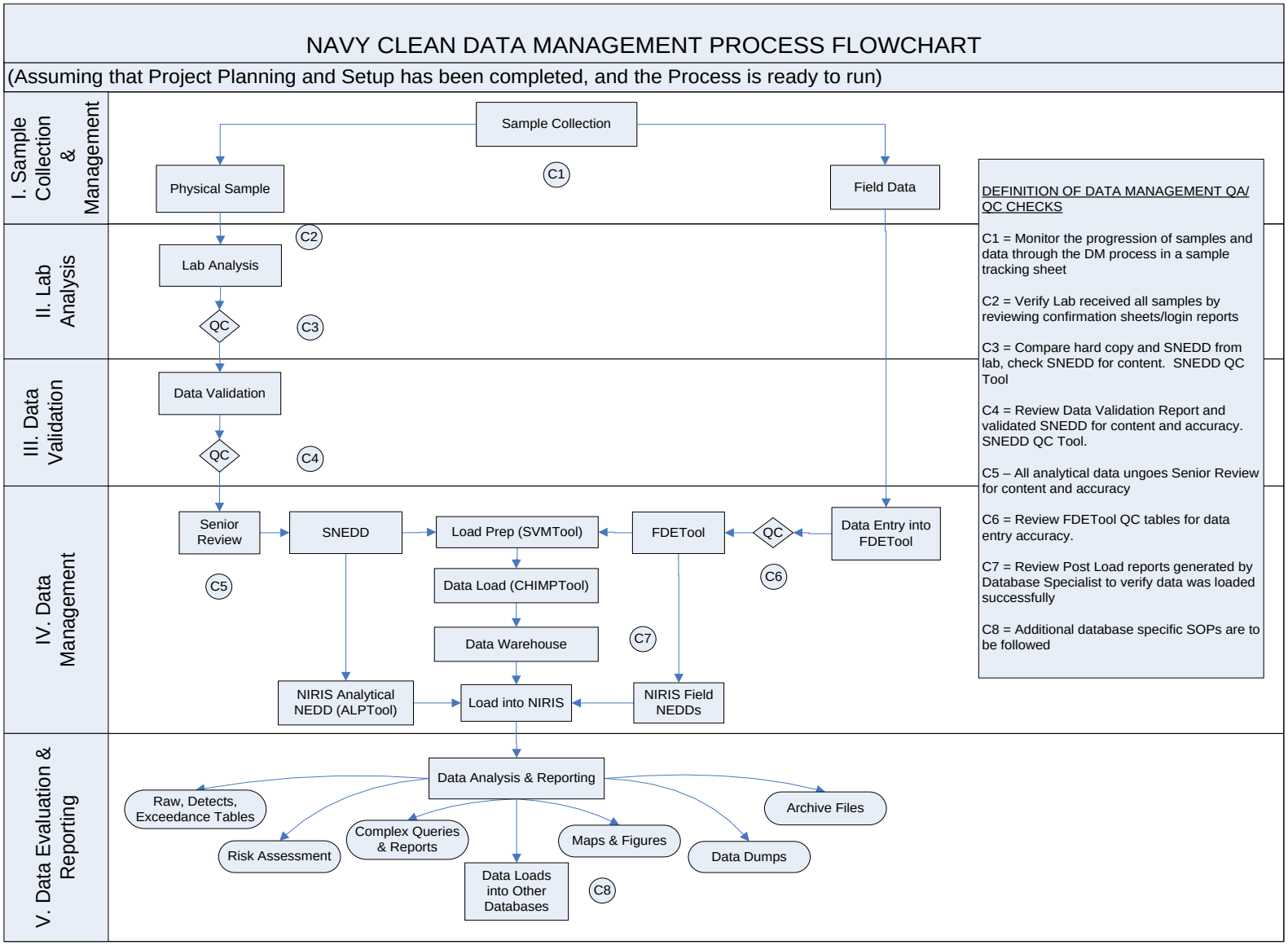


FIGURE 2
DBMS PROCESS

SECTION 4

Phases of Data Management

4.1 Project Planning and Setup

Project planning starts when a new project or task is identified in the program. Evaluation of what is required from data management and visualization occurs to determine the data needs. The Program Critigen Team Lead (Critigen Lead) works with the Program Data Management Lead (PDL) and the project and/or activity manager to determine what is expected and required from the data management and visualization team. Specific items that should be considered are as follows:

- Inputs – Determine what data will be collected and stored in the database. Determine frequency and quantity. Determine what tools will be used to handle data input.
- Historical Data – This is a unique data input and requires special consideration. The PDL ***must*** work with the other technical leads to assess what effort will be required. This step is often missed, and the resulting data quality issues created from inadequate planning in this area can plague the project for its entire duration.
- Outputs – Determine what data will need to be presented in reports, figures, and electronic deliverables. Determine frequency and quality requirements. Determine preliminary data, validated data, and what tools will most effectively handle the output requirements. Discuss how the outputs needed by the team will be requested and documented.
- Visualization – Determine necessity for GIS and CAD.

After the information above is determined, the data management scope, schedule, and budget are developed and endorsed by the Project Manager (PM), PDL, Program GIS Lead (PGL) and Program Chemistry Lead (PCL). The team can then proceed upon client authorization of the overall project budget. Figure 3 shows the process for project planning.

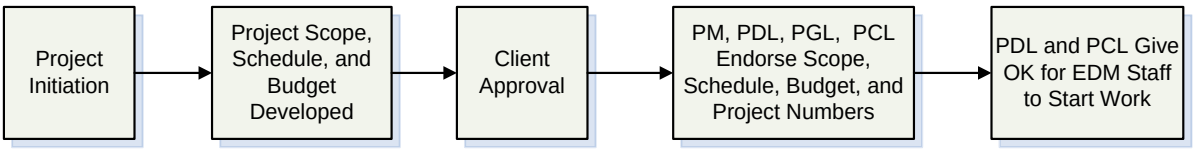


FIGURE 3
PROJECT PLANNING

4.1.1 Database Setup and Administration

CH2M HILL Database

The PDL will oversee the administration of the DBMS, including the design, development, and maintenance of the program database, tools and data management processes. Database and data management process design and development will focus on providing rapid data entry

and data retrieval while promoting data integrity through various automated procedures. The PDL will perform the database maintenance, which consists of the following:

- Assisting with the allocation of sufficient system storage for the program database
- Adding, altering, and deleting users, roles, and privileges
- Periodically defragmenting and compacting the database for more efficient operation
- Upgrading database software and associated applications as necessary
- Maintaining an approved list of valid values for data consistency
- Maintaining redundancy control to ensure that each data record is unique and consistent with conventions
- Performing routine virus checks on incoming and outgoing data

The DBMS is comprised of the Data Warehouse and associated SNEDD-Approach tools, and will support the storage, analysis, display, and reporting of the Navy's environmental, analytical, and geotechnical data. The DBMS will consist of primary data tables that store the environmental data, dependent tables that store more details related to the data in the primary tables, and look-up tables that store valid values to provide input to the primary tables. The EIS will maintain the table content and the PDL will manage it. All SNEDD-Approach tools will adhere to version control procedures to ensure that the most current versions and look-up tables are used at all times.

Valid values are critical to any large relational database. Tables 2 and 3 provide examples of valid values for the Navy CLEAN and Joint Venture Programs' sites, stations, and samples. Inconsistencies in naming conventions, subtle analyte or method spelling differences, and the use of non-standard abbreviations can result in lost data and incorrect conclusions. Most tables and forms in the program database will use look-up tables for acceptable valid values and will not allow the entry of data that do not conform.

The primary purpose of managing data in a relational database environment is to ensure that each data record is unique and that the information contained within each field is consistent with conventions defined in other areas of the database. To ensure that each record is unique, a key field or fields will be identified within each data table. The VDMS Data Warehouse architecture supports this approach and eliminates the possibility of data redundancy.

NIRIS Database

All Navy CLEAN and Joint Venture data must be loaded into the Navy's own internal database system, the Naval Installation Restoration Information Solution (NIRIS). NIRIS is a web-based centralized database that has been implemented across all Naval Facilities Engineering Command (NAVFAC) offices and will be used by the Navy and contractors to manage, evaluate, and visualize data, documents and records for Navy and the Marine Corps sites. NIRIS manages all Environmental Restoration Program (ERP) analytical and spatial data, which includes the Munitions Response and Installation Restoration Program (IRP) data, ensuring institutional memory is preserved, land use controls are maintained, and remedial actions are effective.

CH2M HILL will use the SNEDD Approach to VDMS system to track, collect, review, and prepare Navy-related sample and project data for loading into NIRIS. Project data stored in the VDMS Data Warehouse must be consistent and comparable with data that is loaded and stored within NIRIS. As such, all associations between VDMS and NIRIS valid values, output reports, and data tables will be tracked and maintained.

4.1.2 Data Security Procedures

Some SNEDD Approach to VDMS applications and data are stored in a secure location with login and password protection. Authorized users will have logins and passwords in advance. The PDL will provide security access to these tools. Access2003 must be installed on the computer that the user will be using to run these applications, and proper licenses distributed. Files received from any subcontractors will be scanned for common viruses using industry standard, current virus protection programs. The file servers storing the data must be running current virus software, with automatic virus signature updates.

NIRIS data are stored in a secure location with login and password protection. Users who require access to NIRIS and the data contained therein will need to follow procedures outlined in the SOP Access to NIRIS to procure security certificates, training, and access rights to installation-specific data. Authorized users of NIRIS will be assigned logins and passwords maintained by the Navy. For further information on NIRIS or obtaining NIRIS access, consult with the Critigen Lead or PDL.

4.1.3 Data Backup and Recovery

All project data management files will reside on CH2M HILL's terminal server, "Gaia," and will have a tape backup or equivalent created in accordance with CH2M HILL's network server management policy.

4.2 Sample Collection and Management

Sample control during the sampling phase is required to ensure the integrity of the associated data. Sample control must be maintained and documented from the point of collection through the point of disposal. Sample control will be managed both in the field and in the laboratory, and will be documented using field logbooks and a Chain of Custody (COC). When custody of a sample is transferred from one party to another, the recipient of the sample assumes responsibility for maintaining control of the sample and documenting that control on the COC. Figure 4 shows the process for planning and executing field sampling events.

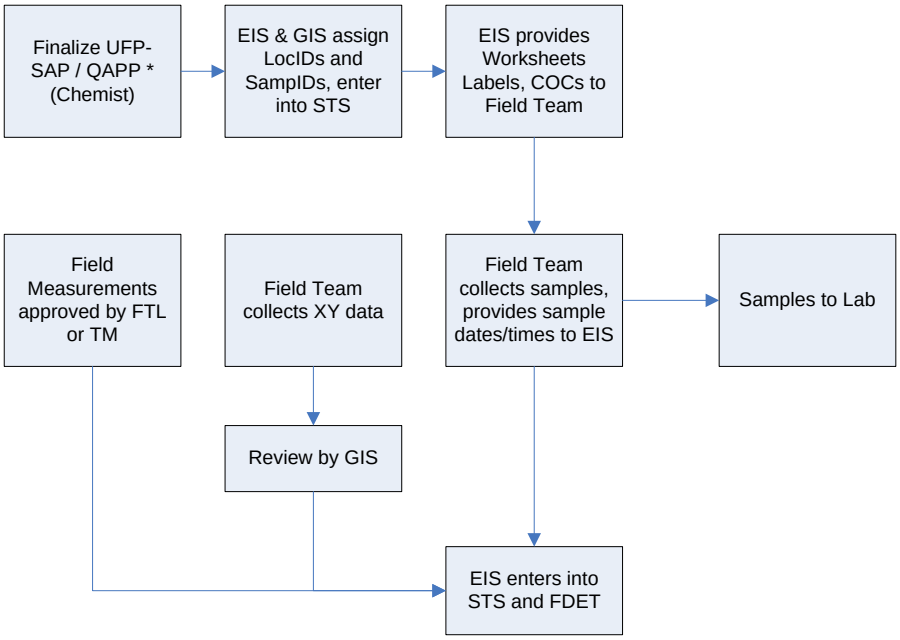


FIGURE 4
FIELD SAMPLING

4.2.1 Sample Tracking Sheet

During the planning stage, the PM specifies the data requirements for the sampling event. The work plan or similar document will provide project-specific data requirements for a given sampling event. The Project Chemist (PC) is responsible for reviewing the Sampling and Analysis Plan and ensuring that the FTL is aware of the number of field and laboratory QC samples required for the sampling event (trip blanks, equipment blanks, field blanks, field duplicates, matrix spikes, and matrix spike duplicates). All of this information is to be entered into the STS.

The STS will be used in advance to identify sampling container and preservation requirements, identify analytical laboratories for samples, aid in the generation of labels for sample bottles before the sampling event, and prepare COC forms after sampling is complete.

4.2.2 Sample Nomenclature Guidelines

The following guidelines are provided for sample nomenclature, COC clarification, and eData expectations.

Station ID (Location)

Field station data are information assigned to a physical location in the field at which some sort of sample is collected. For example, a monitoring well that has been installed will require a name that will uniquely identify it with respect to other monitoring wells or other types of sample locations. The station name provides a key in a database to which any samples collected from that location can be linked to form a relational database structure.

Before beginning fieldwork, the FTL will review the proposed level of effort and coordinate a list of unique station identification names, or station IDs, with the PDL or EIS. The FTL will be

responsible for enforcing the use of the standardized ID system and agreed upon station IDs during all field activities.

Each station will be uniquely identified by an alphanumeric code that will describe the station's attributes. These attributes are facility, Area of Concern (AOC)/Site/Operable Unit (OU) number, station type, sequential station number, and possibly an additional qualifier as needed. The naming scheme to be used for the identification of a sampling station is documented in Table 2.

For example, if the first sample location at next month's event within Yorktown Site 30 is at a soil location, then the location ID could possibly be YS30-SO391 because that was the next available sequence number for soil locations. This should also be reflected in the Sample ID. QC and IDW station IDs must be established for each site that they are associated with.

Please consult with the PDL or EIS should any questions arise. This will avoid complications that could occur if a station is mislabelled and ensure there are unique identifiers for every sampling location. Required deviations to this format in response to field conditions will be documented in the field logbook.

Sample ID

Field sample data are information assigned to a physical piece of material collected in the field for which some sort of analysis will be run. Before collecting samples, the FTL will review the proposed level of effort and coordinate a list of unique sample identification names, or sample IDs, with the PDL or EIS. The FTL will be responsible for enforcing the use of the standardized ID system and agreed upon sample IDs during all field activities.

Each sample will be uniquely identified by an alphanumeric code that will describe the sample's attributes. These attributes are facility, Area of Concern (AOC)/Site/Operable Unit (OU) number, sample/station type, sequential station number, modifier (as needed), depth (as needed), date, and date modifier (as needed). The naming scheme to be used for the identification of samples is documented in Table 3.

The standardized ID system will identify all samples collected during sampling activities. The system will provide a tracking procedure to ensure accurate data retrieval of all samples taken. For example, a surface soil sample collected from station YS30-SO391 reference above in June of 2009 will result in a sample ID of YS30-SS391-0609.

Please consult with the PDL or EIS should any questions arise. This will avoid complications that could occur if a sample is mislabelled and ensure there are unique identifiers for every sample. Required deviations to this format in response to field conditions will be documented in the field logbook.

Navy Clean		
First Segment	**Second Segment**	
Facility, Site Number	Station Type	Station Number, Modifier
AA,ANN	AA	NNN_A
Notes: "A"= alphabetic "N"= numeric		

Facility:

A = ABL
AN = Anacostia
BA = Bainbridge
BW = Bloodsworth Island
BR = Bremerton
CA = Cheatham Annex
CH = Cherry Point
CI = Craney Island
CL = Camp Lejeune
CP = Camp Peary
CR = Carderock
DA = Dahlgren
DN = Dam Neck
DR = Driver
IH = Indian Head
LS = Little Creek
NA = Naval Academy
NB = Naval Station Norfolk
NM = NNMC (Bethesda Naval Hospital)
NN = Norfolk Naval Shipyard
NR = Naval Research Laboratory
NWA = Northwest Annex
OC = Oceana
PA = Pax River
PI = Pineros Islands
QU = Quantico
RO = Rota
RR = Roosevelt Roads
SI = Sigonella
SJ = St. Juliens
SS = Sabana Seca
VE = Vieques East
VW = Vieques West
WN = Washington Navy Yard
WO = White Oak
Y = Yorktown

Site/AOC/SWMU Number – Sequential Number:

Site = S01, S02, S03…
Site Screening Area = SA01, SA02, SA03…
AOC = A01, A02, A03…
AOI = AI01, AI02, AI03…
SWMU = W01, W02…
Building = B01, B02, B03…
Range = R01, R02…
LIA – LI Area, East Vieques

BSxx = Background locations outside of site (BS25 = Background Site 25)
BKL = Background locations outside of the facility
BKG = Background locations (inside base)

QC and IDW Stations
Site ID (First Segment) followed by –QC or -IDW

Station Type:

AGT = Above Ground Tank
AS = Ash
BH = Borehole
CO = Concrete
DP = Direct Push
DR = Drill Rig
EW = Extraction Well
FG = Frog
FS = Fish
GB = Geotechnical Boring
GP = Geoprobe
GV = Gas Vent
HP = Holding Pond/Lagoon
IDW = Investigative Derived Waste
IW = Injection Well
LW = Leach Well
MA = Alluvial Monitoring Well
MB = Bedrock Monitoring Well
MU = UST Monitoring Well
MW = Monitoring Well (GW for Y)
PC = Paint Chip
PW = Production Well
QC = Quality Control
RK = Rock
RC = Recovery Well
RM = Remediation Well
RW = Residential Well
SD = Sediment Location
SG = Soil Gas
SL = Storm Sewer Line Sediment
SO = Soil Location
SP = Seep
ST = Storm Water
SU = Sump
SV = Soil Vapor
SW = Surface Water
SWS = Surface Water Body (for SW and SD)
UST = Underground Storage Tank
TA = Tap Water
TD = Tidal Station
TI = Tissue Sample (general)
TO = Tadpole
TP = Test Pit
TR = Trench Sediment
TS = Treatment System
TW = Temporary Well
WA = Alluvial Extraction Well
WB = Bedrock Extraction Well
WL = Water Supply Well
WN = Pore Water
WP = Wipe Sample
WT = Water Table Piezometer

Station Number:
Sequential Station Number (i.e., 01, 02, 03…)

Modifier (used selectively):
D = Deep monitoring well
S = Shallow monitoring well

Example Station IDs:

YS01-DP02 = Direct push soil location #2 at Yorktown Naval Weapons Station Site 1
CHR05-MW02S = Shallow monitoring well location 2, at the Cheatham Annex facility, Range 5.
NMBKL-SD02 = Background sediment location #2 located outside of NNMC
CHBS03-SO05 = Soil location #5, located in reference area outside of Site 3 in Cherry Point
VEW04-QC = QC Station at East Vieques SWMU-4
CAA08-IDW = IDW Station at Cheatham Annex AOC-8

TABLE 2

STATION ID SCHEME

Navy Clean			
First Segment	**Second Segment**	**3rd Segment**	**Fourth Segment**
Site ID Facility, AOC Number	Station/Sample Type, Station Number, Modifier	Depth (As Needed)	Date (MMYY) $_A$
AA,ANN	AANNN$_A$	A	NNNN$_A$
Notes: "A"= alphabetic "N"= numeric			

A = ABL
AN = Anacostia
BA = Bainbridge
BW = Bloodsworth Island
BR = Bremerton
CA = Cheatham Annex
CH = Cherry Point
CI = Craney Island
CL = Camp Lejeune
CP = Camp Peary
CR = Carderock
DA = Dahlgren
DN = Dam Neck
DR = Driver
IH = Indian Head
LS = Little Creek
NA = Naval Academy
NB = Naval Station Norfolk
NM = NNMC (Bethesda Naval Hospital)
NN = Norfolk Naval Shipyard
NR = Naval Research Laboratory
NWA = Northwest Annex
OC = Oceana
PA = Pax River
PI = Pineros Islands
QU = Quantico
RO = Rota
RR = Roosevelt Roads
SI = Sigonella
SJ = St. Juliens
SS = Sabana Seca
VE = Vieques East
VW = Vieques West
WN = Washington Navy Yard
WO = White Oak
Y = Yorktown

Site/AOC/SWMU – Sequential Number:

Site = S01, S02, S03…
Site Screening Area = SA01, SA02, SA03…
AOC = A01, A02, A03…
AOI = AI01, AI02, AI03…
SWMU = W01, W02…
Building = B01, B02, B03…
Range = R01, R02…
LIA – LI Area, East Vieques

BSxx = Background locations outside of site (BS25 = Background Site 25)
BKL = Background locations outside of the facility
BKG Background locations (inside base)

Sample Type:
AGT = Above Ground Tank
AH = Air - Headspace
AS = Ash
BH = Borehole
CO = Concrete
DR = Drill Rig
DS = Direct Push—Soil
DW = Direct Push—Groundwater
EW = Extraction Well
FG = Frog
FS = Fish
GB = Geotechnical Boring
GP = Geoprobe
GV = Gas Vent
HP = Holding Pond/Lagoon
IW = Injection Well
LF = Free Product
LW = Leach Well
MA = Alluvial Monitoring Well
MB = Bedrock Monitoring Well
MU = UST Monitoring Well
MW = Monitoring Well (GW for Y)
PC = Paint Chip
PW = Production Well
RK = Rock
SW = Surface Water
RC = Recovery Well
RM = Remediation Well
RW = Residential Well
SB = Subsurface Soil
SD = Sediment Location
SG = Soil Gas
SL = Storm Sewer Line Sediment
SO = Soil Location (Composite)
SP = Seep
SS = Surface Soil
SSD = Subsurface Sediment
ST = Storm Water
SU = Sump
SV = Soil Vapor
SW = Surface Water
UST = Underground Storage Tank
TA = Tap Water
TD = Tidal Station
TI = Tissue Sample (general)
TO = Tadpole
TP = Test Pit
TR = Trench Sediment
TS = Treatment System
TW = Temporary Well
WA = Alluvial Extraction Well
WB = Bedrock Extraction Well
WL = Water Supply Well
WN = Pore Water
WP = Wipe Sample
WT = Water Table Piezometer

Station Number:
Sequential Number (e.g., 001, 002, 003)

Modifier (used selectively):
D = Deep monitoring well
S = Shallow monitoring well
P = Duplicate

Depth:

Use only if applicable. A sequential letter is used to reflect varying depths, as actual depths can change in the field after sample planning has occurred. E.g. A, B, C…

Sample Number:

1. Duplicate Samples - Use a 'P' modifier in the second segment of the sample ID, directly after the location number to indicate a duplicate sample. E.g. AB01-MW11P-0506

2. MS/MSD Samples – Append a modifier of '-MS' for matrix spike or '-SD' for matrix spike duplicate to the end of the sample ID.

3. QC & IDW Samples (Blank Samples & Waste Char.) - Format consists of Facility, AOC Number, Qualifier Code, Sequential Qualifier Number-Date (AAANN-AANN-MMDDYY). E.g. LSA05-TB02-061106

Qualifier Codes:
TB = Trip Blank
FB = Field Blank
EB = Equipment Blank
WQ = Source Blank
WS = Waste Char. Soil
WW = Waste Char. Water

4. Drill Rig Samples – Format consists of Facility, AOC Number, Station Type, Station Number, Date. E.g. YS12-DR02-020507

5. Multiple samples - Should multiple samples be collected from the same location in a given day/month (affects only samples not differentiated by depth), a sequential letter will be added to the end of the fourth segment (date). E.g. A, B, C…

Example Sample IDs:

WNA01-MW102S-0105A = The first shallow groundwater sample collected at monitoring well location 102 in January 2005 in AOC01 at the Washington Navy Yard facility.
PIW01-SW023P-0306 = Pineros Island duplicate surface water sample collected at location 23, at SMWU-1 in March 2006.
SSW06-FB01-061106 = The first field blank collected on June 11, 2006 at SMWU-6 in Sabana Seca.

TABLE 3

STATION ID SCHEME

4.2.3 Sample Collection

A photocopy of each field logbook page completed during sampling and of each COC will be made by the FTL and forwarded to the EIS at predefined intervals during sampling events. This information will serve as notification to the EIS of samples being shipped to an offsite lab and of the field crew's sampling progress.

Communication with field and laboratory staff will occur daily during the field event. The EIS will resolve issues that arise in the field (i.e. bottle ware shortage, equipment failure, etc). The lab will be informed of the shipment dates and the number of coolers or samples being sent. Laboratory login reports will be reviewed to ensure samples were received in good condition (i.e. no breakage, within holding time, within designated temperature). The field crew and PM will be notified if there were problems with shipment.

4.2.4 Chain-of-Custody

A single COC number per laboratory / cooler should be generated each day (there can be multiple pages to one COC number). MSs and MSDs will be requested at a set frequency for each project (usually one per 20 samples collected). MS and MSD samples should not be taken from field duplicates (FDs) or field blanks. FDs will be requested at a set frequency for each project (usually one per 10 samples). FDs should not be taken from MSs, MSDs, or field blanks. The MS and MSD samples listed on the COC should be spiked and analyzed by the laboratory.

A 100% QC will be performed on COCs received from the field crew. The field crew and/or lab will be notified if corrections need to be made to the COCs or lab login reports. Any corrections or modifications made will be noted in a Corrections-To-File Letter.

4.2.5 Sample and Document Tracking

The STS will be updated with sample collection and tracking information, and kept current throughout the data management process. All samples collected, resulting deliverables, and deliverable dates will be tracked throughout the data management process to ensure that the project schedule is met and subcontractor invoices are evaluated correctly.

All documentation acquired during the data management process, including Statements of Work (SOWs), Bids, COCs, Field Notes, Sample Tracking Sheets, Login Reports, Corrections-to-File Letters, FDETool QC tables, Post Load Reports, Invoices, and Communication Logs shall be compiled throughout the process to be stored in the appropriate Activity's Project Notebook.

4.2.6 Field Data

Once the field data and samples are collected, necessary field measurements, such as water levels and other data collected in the field should be entered into the FDETool. Any data entered into the FDETool must be exported into an excel file to facilitate a manual QC review of the data. The correction of any anomalies should be verified with the PM and PC. The information entered into the FDETool will be linked with related analytical data reported in the SNEDD within the SVMTool. Field data and laboratory analytical data are linked by sample ID and date/time. This allows verification analytical results for all samples have been received and reported by the laboratory.

4.3 Laboratory Analysis

Figure 5 shows the laboratory analysis process. Upon receipt of samples from the field, the laboratory will verify that the COC forms correctly identify and detail all samples submitted. Each COC form must be signed with the date and time of receipt by the laboratory. Samples will be logged in by the laboratory using information from the COC forms and the project instructions.

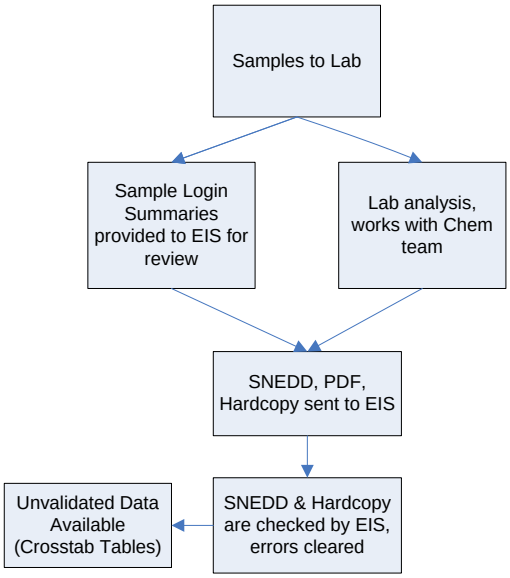


FIGURE 5
LABORATORY ANALYSIS

Samples will be analyzed as specified on the accompanying COC forms and in the Laboratory SOW. Generally, questions or noted inconsistencies identified by the laboratory should be addressed directly to the EIS. Login summaries detailing all samples and analyses received by the lab should be provided daily to the EIS for review. All discrepancies should be corrected to ensure that all samples are analyzed as per project instructions.

The SNEDD-QC-Tool is used to QC the laboratory's SNEDD. Before the laboratory analytical data is formatted into data tables or sent for validation, the laboratory SNEDD must be processed through CH2M Hill's SNEDD-QC-Tool Microsoft Access database application. The SNEDD-QC-Tool includes several automated diagnostic checks to verify format and content compliance with SNEDD specifications. Upon SNEDD receipt at CH2M Hill, the EIS will check the SNEDD using the SNEDD-QC-Tool to verify correct format and content. If errors are found, the laboratory will be notified of the errors, and the SNEDD corrected.

The laboratory will attach the signed COCs to their hard copy data deliverables to officially relinquish control of the data back to the Environmental Contractor within the specified turnaround time. Data archiving forms will be generated and affixed to each laboratory report received per Sample Delivery Group (SDG) for cataloguing, tracking, and archiving purposes.

Hard copy data and SNEDDs will be reviewed to ensure that they are complete and acceptable as outlined in the Data QC Checklist. A 10% comparison between the hard copy and SNEDD content will be conducted to ensure consistency, resolve discrepancies, and document data error issues (for example, EDD re-submissions, turnaround time problems, hard copy incompleteness). All detected errors should be resolved with the laboratory.

These checks ensure the consistency and the validity of the SNEDD and hardcopy content before the data are reported in preliminary tables or sent for validation. The objective of using the SNEDD-QC-Tool is to ensure that the validation process is performed on consistently high-quality data and minimize the chance of finding data errors later in the validation process, which would require the laboratory to resend corrected data and start the validation process over again.

Preliminary raw and detects tables will be generated from data reported in the SNEDD with the SNEDD Crosstab Tool. A separate table must be created for each matrix, and provided to the PM for review.

4.4 Data Validation

Once the preliminary data verification is complete, the PC is notified by the EIS that the data is available for validation. The PC will perform a Prevalidation QC of the data for completeness, and notify the data validator in advance of when to expect data and of any samples or analyses that should not be validated (i.e. grain size should not be validated). For internal data validation, the EIS will notify the PC of data availability, and provide the hardcopy data and a QC Association Table.

Upon receipt of data from CH2M HILL, data validation will be performed in accordance with the Data Validation SOW, UFP SAP, and any other documents required. Generally, questions or noted inconsistencies identified by the validator should be addressed directly to laboratory, with the PC notified of issues and resolutions identified.

4.4.1 External Data Validation

For external data validation, a copy of the SNEDD, hard copy data, and a QC Association Table will be provided to the data validator. The PC will coordinate the return of the data package to CH2M HILL for archiving with the data validator.

Data Validators will provide the following materials to the PC within the required turn around time:

- Hardcopy Data Validation Report
- Validated Version of the SNEDD (external validation)

Once returned to CH2M HILL, the SNEDD will be run through the SNEDD-QC-Tool, which includes automated diagnostic checks for validated data to verify format and content compliance with SNEDD validation specifications. The PC will review the validated data to ensure that they are complete and acceptable as outlined in the Data QC Checklist. A 100% QC check will be performed on the validated results to ensure that the hard copy data matches the SNEDD. All detected errors should be resolved with the data validator.

Data archiving forms will be generated and affixed to each Data Validation Report per SDG received for cataloguing, tracking, and archiving purposes.

Validated raw and detects tables will be generated from data reported in the validated SNEDD by with the SNEDD Crosstab Tool. A separate table must be created for each matrix, and provided to the PM for review.

4.4.2 Internal Data Validation

For internal data validation, a copy of the SNEDD, hard copy data, and a QC Association Table will be provided to the PC.

The PC will evaluate QC information, associated validation logic, and apply qualifiers to data in the SNEDD and on the laboratory Form Is when QC criteria are not achieved. Qualifier criteria will be based on the Quality Assurance Project Plan. A hardcopy data validation report will be generated. Data archiving forms will be generated and affixed to each Data Validation Report per SDG validated for cataloguing, tracking, and archiving purposes

Validated raw and detects tables will be generated from data reported in the validated SNEDD by the Navy RD Formatting Tool – Unval/Val SNEDD. A separate table must be created for each matrix, and provided to the PM for review.

4.4.3 Unvalidated Data Preload Check

Occasionally, unvalidated data will need to be loaded into the database. Although the data will not be validated, it will undergo a basic Preload Check by the PC to ensure laboratory compliance with project guidelines and determine results to be reported as the best result where multiple runs were conducted for a given sample/analysis. The PCL will provide input and oversight to ensure that data flags are applied correctly by the PC.

4.4.4 Senior Review

The PCL will verify that the final SNEDD and hardcopy data are complete and acceptable. Any identified discrepancies will be resolved with the assistance of the PC, EIS, laboratory, or validator as needed.

4.5 Data Preparation and Loading

Once the data are considered final and approved by the PCL, they are exported from the SNEDD to the project Data Warehouse. Field and laboratory data are merged into a format that is amenable to the warehouse. The backbone is a SQL-server-based data warehouse.

4.5.1 Data Preparation

As part of the normal process of loading data into the warehouse, data standardization tasks must be completed. A Database Specialist (DBS) will load data into the warehouse using the following three programs: SNEDD-QC-Tool, SVMTool and Navy CH-IMPTool.

A final QC of the data reported in the SNEDD is conducted with the SNEDD-QC-Tool. Any identified discrepancies will be resolved with the assistance of the PCL, PC, or EIS as needed. SNEDDs that pass all of the QA/QC checks in the SNEDD-QC-Tool are then processed with the SVMTool.

The SVMTool links the field data contained in the FDETool to the analytical data contained in the SNEDD. A series of logical QC checks are run to ensure that all data links correctly minimum data requirements are met. The tool then merges the data into a format compatible with the data warehouse structure.

4.5.2 Data Loading

CH2M HILL Loading

The Navy CH-IMPTool runs an additional series of QC checks and adds project-specific formatting, and loads the data into the warehouse. The following tasks need to be completed to load the data for project use:

- **Unit Standardization:** Analytical units and the associated results, reporting limits, and method detection limits will need to be converted to a consistent set of units as required by the project.
- **Resolve Reanalysis and Dilutions:** All samples that had an associated reanalysis or dilution run by the laboratory must have all of the excluded or rejected results marked as not the best result for reporting.
- **Resolve Analytical Overlap and Split Samples:** Analytical overlap occurs when a sample is analyzed by two or more methods that report the same analyte. To resolve any issues not previously resolved, the following logic is used to select the usable result:
  - If the overlapping results are all non-detections, the lowest non-detection result is selected.
  - If the overlapping results are all detected, the highest detected result is selected.
  - If the overlapping results consist of a mixture of detections and non-detections, the highest detected result is selected.

When data are loaded into the warehouse, an automated script will run to identify the “best” result when more than one analytical result exists.

NIRIS Loading

All Navy CLEAN and Joint Venture data must be loaded into NIRIS. Following the successful loading of data into the data warehouse, the DBS will use the FDETool and ALPTool to generate project NIRIS Electronic Data Deliverables (NEDD) files. Field-related NEDDs will be generated from the final version of the FDETool. The final version of the project SNEDD will be processed through the ALPTool to generate the analytical NEDD.

The DBS will use NIRIS’s Data Checker Loader Tool to QC and submit the project NEDD files into NIRIS. The NIRIS Regional Database Manager (RDM) will load the data into NIRIS, and will work with the DBS to resolve any potential issue that may arise during loading. Following

notification of successful data loading from the RDM, the DBS will query the data from NIRIS for review to ensure data integrity and accuracy.

4.5.3 Data Warehouse

The data warehouse is a Microsoft SQL Server 2005 relational database. This database, and all other SNEDD-Approach tools used, has a data structure designed to achieve compliance with NIRIS and Navy data reporting standards specified for Navy CLEAN and the Joint Venture Program.

The warehouse will use valid value tables when applying reference attributes to project data. Such reference data include the names of site objects and sampling locations, sampling matrix and method categories, analyte names, units. These reference tables are critical for maintaining the completeness and accuracy of data sets and are essential for accurate querying of the data.

Data are loaded and stored so that relationships among categories of data are enforced. For instance, all sampling records must be associated with a valid site object such as a planned sediment sampling location. The project repository database and collection, analysis, and reporting tools used in the DBMS are designed to enforce, for any project data record, entries in fields that refer to other types of data as required by the overall data model.

4.6 Data Reporting

Data reporting includes the following tasks:

- Retrieving data from the data warehouse for project deliverables, data visualization, or consumption by third parties
- Reviewing initial data and producing data queries and draft reports to dissect and disassemble the data
- Producing any requested client and regulatory agency data deliverables

Data for project deliverables, data visualization, or consumption by third parties will be retrieved from the warehouse, and will be equivalent to the real-time state of the project repository database. PMs and GIS Analysts (GAs) will work with the EIS and PCL for quality queries and data for reports.

4.6.1 Tables, Figures, and Diagrams

Once the data have been sufficiently analyzed, the list of requested data reports (tables, figures, diagrams) can be developed and finalized by the project team and submitted to the PCL and PM for review.

All requests for figures or graphics are to be directed to the GA assigned as the Point of Contact (POC) for that particular Navy installation. All requests for analytical data (crosstab tables, data dumps, third party deliverables etc) should be directed to the EIS assigned as the POC for that particular Navy installation. The EIS will generate a data deliverable from the data warehouse or NIRIS (as needed) suitable for end use and will provide data support to the end user. All requests for data statistics and calculations should be directed to the Risk Assessor assigned to the project.

4.6.2 GIS

The Navy CLEAN program will utilize ESRI's suite of GIS software for the majority of GIS-related tasks. The GIS data model will consist of one or more geodatabases (GDBs) per installation. Each installation will maintain one common installation GDB, which will store the common infrastructure data such as buildings, roads, topography, hyrdography, utilities, etc. The common installation GDB should adhere, as much as possible, to the Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE) data model. All project specific GDBs shall be developed and named for ease of interpretation by the GA.

All station location information for each installation will be pulled directly from the data warehouse and stored in the common installation GDB as a data table. The data warehouse must contain valid coordinate information for the locations to be displayed correctly. Valid coordinate information will be maintained in the data warehouse by the EIS, and updated as necessary by the DBS.

ESRI's ArcMap 9.3 (or the latest version available) will be utilized for spatially displaying the environmental data within maps and figures, as well as for spatial analysis. The GA will need to coordinate efforts with the EIS on all requests that require the display of environmental sample data on a map to ensure that the appropriate data is queried from the data warehouse and linked to the appropriate station location table within the GIS.

4.6.3 Site Information Management System

This is currently not being used on the Navy CLEAN and Joint Venture Programs.

SIMS is a tool for publishing data of sufficient quality from the project. However, the project data warehouse will remain the database of record for the project.

SIMS provides many standard report formats, all of which are used in conjunction with the Query Tool feature, to isolate and retrieve information. Users can generate and save their queries using a graphical point-and-click tool. Reports in a wide variety of formats also can be requested and produced.

4.6.4 Legacy Data

Legacy data are those collected from any contractor other than CH2M HILL and data collected by CH2M HILL that have not been managed in accordance with Navy CLEAN and Joint Venture Program requirements. Legacy data are commonly compiled from various electronic and hard copy sources including spreadsheets, databases, technical reports, and laboratory hard copy data reports. When working with legacy data, usability assessment must be completed for the project team to be able to use the data with confidence. In order to assess the data properly, the legacy data needs to be evaluated by skilled professionals that are familiar with the type of data being evaluated so that any errors identified in the data can be corrected when possible or qualified in a manner to reflect the limitations of the data's use.

The PM has overall responsibility for the selection for inclusion of legacy data into the data management process. The PDL and PCL will work with the PM to establish the data review and import process, compile a comprehensive data inventory, and identify staff to facilitate data review.

The PDL and PCL will work with the EIS to determine the appropriate intermediary files and tools used to collect the data. The PDL and PCL will oversee the data review and flagging process and approve the data for upload into the Data Warehouse. The EIS is responsible for assembling the field and laboratory data in formats that facilitate data review, aid the PDL and PCL in overseeing the data review and flagging process, schedule, conversion of the data to the proper data warehouse format, and then loading the data into the Data Warehouse after approval by the PDL and PCL.

The GA, PDL, PCL, and PM have the primary responsibility for reviewing the data in their area of expertise and providing the PCL with data usability flags to be associated with each record.

SECTION 5

Project Closeout

The project completion/closeout phase includes the following:

- Archive hard copy and electronic documents
- Conduct project closeout meeting

5.1 Archive Procedures

A large variety of technical data will be generated during the field investigations. The EIS and PC will collect all hard copy and electronic data they are responsible for and verify that the incoming records are legible and in suitable condition for storage. Record storage will be performed in two stages:

- Storage during the project
- Permanent storage following project completion

During the project, CH2M HILL will store data hardcopy reports in CH2M HILL offices. Physical records will be secured in steel file cabinets or shelves, and labelled with the appropriate project identification. Electronic data will be maintained on CH2M HILL's corporate local area network servers.

Information generated from field activities will be documented on appropriate forms and will be maintained in the project file. These include COC records, field logbooks, well construction forms, boring logs, location sketches, and site photographs. In addition, notes from project meetings and telephone conversations will be filed.

Following project completion, both hard copy and electronic data deliverables will be archived. Team staff will provide all hard copies of laboratory and validation reports to the Data Closeout Coordinator to be prepped and shipped to Stone Mountain for archiving. Final laboratory SNEDDs and loading files will be provided to the PDL, to be archived on CH2M HILL's corporate local area network servers.

Any modifications made to the SNEDD-Approach tools, criteria data sets, lookup tables, etc will be communicated to the project team via e-mail. As revisions are finalized, they will be distributed electronically to all users, and old versions will be archived on Gaia. After revision, it is the user's responsibility to conform to revised portions of the DMP.

5.2 Invoice Review and Approval

The EIS is responsible for tracking all data deliverables throughout the data management process to ensure that the project schedule is maintained, subcontractors comply with all required turn around times, and data provided are complete and acceptable. Following project completion, EISs are to review and provide comments on all laboratory and data validator invoices regarding data quality and schedule compliance prior to approval by the PM.

5.3 Project Closeout

At the end of each project, the PM will notify team staff of project closeout. The PM will coordinate and verify that all pertinent data has been archived. The PM may also review lessons learned, suggest process improvements, or revisions to the DMP and other project documentation as deemed necessary.

Appendix A
Environmental Data Management Work Process

Environmental Data Management Work Process

1.0 Project Planning & Setup	2.0 Sample Collection & Management	3.0 Lab Analysis	4.0 Data Validation	5.0 Data Management	6.0 Data Evaluation & Reporting
1.1 Project Setup	2.1 Sample Management	3.1 Sample Analysis	4.1 Internal Chemical Data Validation	5.1 CH2M HILL Data	6.1 Data Prep & Processing for Reporting
1.2 QAPP, SAP, DMP, DQOs Integration	2.2 Sample Collection	3.2 EDD Management	4.2 External Chemical Data Validation	5.2 Other Contractor & Legacy Data	6.2 Tabular Data Queries & Reports
1.3 Laboratory Setup	2.3 Sample Data Management	3.3 Hard Copy Management	4.3 Senior Review of Validated Data	5.3 Database Maintenance & Administration	6.3 Field Logs and Graphs
1.4 Database Setup					6.4 GIS Queries and Maps

Appendix B
Life of a Sample

A Sample's Life

Step-by-Step Outline of Navy CLEAN and JV Data Management Process, and Roles & Responsibilities

Step 1

Planning Phase

- Staffing Schedules
- Kickoff Meeting – Include the EIS & PC
- Project Instructions (PIs)
  - Sample Nomenclature provided in table
  - Reviewed by DMC (Chelsea Bennet) or Database Specialist

Step 2A

Sample Collection

- Daily collection and shipments of samples
- One COC/cooler; One FedEx slip/cooler
- Coordinate w/ EIS for tracking & Lab notification
- GPS conducted (if applicable)

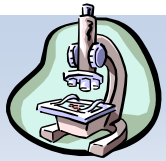
Step 2B

Sample Tracking

- EIS cross checks COC against PIs
- Also reviews lab confirmation sheets to verify all samples were received and in appropriate condition

Step 3

Lab Analysis



- Standard 28-day unless otherwise arranged
- EIS reviews data for accuracy and works with lab to resolve discrepancies
- EIS tracks schedule and keeps PM informed
- EIS inputs STSP information from Log Books
- EIS can generate Unvalidated Raw and Detects Data Tables

Step 4

Data Validation

- PC reviews all data for accuracy against the PIs
- PC sends data from lab to Data Validator
- Delays may occur if there is missing data or data is late from the lab\
- EIS can generate Validated Raw and Detects Data Tables

Step 5

Data Load

- PCL sends data to Database Specialist to be loaded into the Data Warehouse (DW)
- (Sometimes this involves assistance from PM, FTL, PC, and/or EIS)

Step 6

Quality Assurance/ Quality Control

- EIS & PC are notified that data is loaded
- EIS verifies info loaded is correct (Sample, Station, Analyses, Result)
- EIS then helps decide whether info needs to be updated or not
- File and archive all Lab and DV deliverables

Step 7

Report Generation

- Raw, Detects, Exceedance Reports
- Data Requests
- Exceedance Reports (criteria needed prior to this step and selected by PM)
- Human Health Risk Assessment
- Eco Risk Assessment

End of our Sample's Life?

- Data may be used in reports, posted on web, put into GIS, etc
- In that regard, a sample's life doesn't really ever end!
- Hopefully our sample had no exceedances and everyone is happy.

Appendix C
Standard Operating Procedures

The following SOPs can be located on the Ariadne server at the following link:
\\ariadne\Proj\CLEANII\DataMgmt\EIS\Reference Manual\2010

Checklist – Archive and NIRIS Load Prep

Checklist – Data QC

Checklist - EIS Project Start-up Questions

Checklist - Generating RDE Tables

Checklist - Historic Data Cleanup

Checklist - SNEDD DM Process

Roles – Data Management Coordinator

Roles – EIS

Roles – Project Manager

Template – STS & QC Association Table

SOP-114 - CHIMPTool

SOP-126 - XTab Reports Tool

SOP - Access to NIRIS

SOP - Cherry Point Exceedance Formatting Wizard

SOP – CLEAN SNEDD Loading with CHIMPTool

SOP - Corrections to File

SOP - Data Archiving Procedures

SOP - Data Shipping

SOP – FDET

SOP – FDET Setup

SOP – NIRIS Importer Validator Tool

SOP – SVMTool

SOP – Valid Value Setup

Appendix D
Electronic Data Deliverable Specifications

CH2M HILL SNEDD Format			
Field Name	**Field Format**	**REQ**	**Field Description**
Contract_ID	A13	R	Contract ID assigned by Division Contracting Office, not including dashes. Found on Statement of Work. (e.g. D459559365800)
DO_CTO_Number	A4	R	CTO or TO # assigned by Navy. (e.g. CTO-12 = 0012, TO-54 = TO54)
Phase	A8	NR	Task Phase, Annual Quarter, etc (e.g. QTR1)
Installation_ID	A20*	R	Unique identifier for installation. (e.g. WHIDBEY)
Sample_Name	A50	R	CH2M HILL Sample ID (from Chain Of Custody).
CH2M_Code	A4*	R	CH2M HILL Preparation Method Code (e.g. NONS)
Analysis_Group	A9*	R	The CH2M HILL code for the analysis performed on the sample.
Analytical_Method	A20*	R	Analytical Method used to analyze sample fraction. (e.g. 6010)
PRC_Code	A15*	R	NIRIS code for the analytical method category (e.g. PCHAR)
Lab_Code	A10*	R	CH2M HILL Code assigned to laboratory (e.g. COMP)
Lab_Name	A50*	R	The name of the laboratory that conducted the analysis, in all CAPS.
Leachate_Method	A16*	RA	Code for the leachate method used on sample. (e.g. SW1310)
Sample_Basis	A16*	R	Sample basis of analysis; wet weight, dry weight etc. (e.g. DRY)
Extraction_Method	A16*	RA	Code for the extraction method used on sample. (e.g. FLTRES)
Result_Type	A16*	R	Type of results; dilution, reanalysis etc. (e.g. 000)
Lab_QC_Type	A15*	R	Code for Laboratory Sample (MS, MSD, LBLK, LCS)
Sample_Medium	A16*	R	Sample medium reported by the laboratory. (e.g. L)
QC_Level	A16*	R	QC Level of data package : EPA levels I to IV. (e.g. 3)
DateTime_Collected	MM/DD/YYYY 00:00	R	Date and time sample was collected. Use 24 hour clock. (e.g. 02/13/2007 15:34)
Date_Received	MM/DD/YYYY	R	The date the sample was received in the lab (in 10 characters). (e.g. 03/24/2007)
Leachate_Date	YYYYMMDD	RA	Date the sample was leached. Req'd if sample was leached and/or Leachate Method provided. (e.g. March 12, 2007 = 20070312)
Leachate_Time	HH:MM:SS	RA	Time the sample was leached. Use 24 hour clock, with 8 characters. (e.g. 14:30:05). Req'd if sample was leached and/or Leachate Method provided.
Extraction_Date	YYYYMMDD	RA	Date that the lab extracted the sample. Req'd if Extraction Method provided.
Extraction_Time	HH:MM:SS	RA	Time of day lab extracted the sample. Use 24 hour clock, with 8 characters. Req'd if Extraction Method provided. (e.g. 02:15:00)
Analysis_Date	YYYYMMDD	R	Date that the lab performed the analysis.
Analysis_Time	HH:MM:SS	R	Time of day that the lab extracted the sample. Use 24 hour clock, with 8 characters.
Lab_Sample_ID	A20	R	Unique ID assigned to the sample by the laboratory.
Dilution	N10,2	R	Dilution factor used. Default value is 1 (e.g. 10)
Run_Number	N4	R	Number distinguishing multiple or repeat analyses by the same method (incl. RA, RE, DL, etc). Must

CH2M HILL SNEDD Format			
Field Name	**Field Format**	**REQ**	**Field Description**
			be equal to or greater than 1.
Percent_Moisture	N6,3	RA	Percent moisture of the sample. (e.g. 20)
Percent_Lipid	N6,3	RA	Percent lipid of the sample.
Chem_Name	A55*	R	The name of the compound being analyzed.
Analyte_ID	A20*	R	Analyte ID (CAS Number) assigned to the analyte. (e.g. 7440-47-3)
Analyte_Value	N18,7	R	Leave Blank for Validator to enter the final analyte concentration.
Original_Analyte_Value	N18,7	R	Analyte concentration value originally generated by the Laboratory.
Result_Units	A16*	R	Unit of measure for the analyte value. (e.g. UG_L)
Lab_Qualifier	A16*	RA	Lab data qualifier. Values will not be rejected if not in domain table.
Validator_Qualifier	A16*	RA	Leave blank for Validator. Values will not be rejected if not in domain table.
GC_Column_Type	A16*	RA	Data code for the type of GC column used in an analysis.
Analysis_Result_Type	A4*	R	Type of analysis performed (allowed: SURR or TRG).
Result_Narrative	A120	RA	Additional information or comments associated with the result.
QC_Control_Limit_Code	A16*	RA	Type of quality control limit. Req'd if QC criteria and upper/lower accuracy included. (e.g. CLPA)
QC_Accuracy_Upper	N6,3	RA	Upper QC limit of % recovery as measured for a known target analyte spiked into a QC sample. (e.g. 25.45)
QC_Accuracy_Lower	N6,3	RA	Lower QC limit of % recovery as measured for a known target analyte spiked into a QC sample. (e.g. 10.15)
Control_Limit_Date	YYYYMMDD	RA	Date a control limit is established.
QC_Narrative	A120	RA	Leave blank for Validator. Enter DV_Qual_Code.
MDL	N18,7	RA	Method Detection Limit. Required for QSM Version 3.X
Detection_Limit	N18,7	RA	Reported Detection Limit. Required for QSM Version 3.X
QSM_Version	N18,7*	RA	QSM Version of data reported
DL	N18,7	RA	QSM4.1 defined Detection Limit. Required if QSM Version is 4.1 or greater.
LOD	N18,7	RA	QSM4.1 defined Limit of Detection. Required if QSM Version is 4.1 or greater. Non-Detects shall be reported to this value.
LOQ	N18,7	RA	QSM4.1 defined Limit of Quantitation. Required if QSM Version is 4.1 or greater.
SDG	A50	R	Lab code for a group of samples in a data deliverable package.
Analysis_Batch	A20	R	Lab code for a batch of analyses analyzed together.
Validator_Name	A50*	R	Leave Blank. Name of Validator in all CAPS. (e.g. CONTRACTOR INC.)
Val_Date	YYYYMMDD	RA	Populated by Validator/Reviewer. Validation/Review QC date.