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FINAL UNIFORM FEDERAL POLICY SAMPLING AND ANALYSIS PLAN ADDENDUM FOR SITE 13 REMEDIAL INVESTIGATION NIROP ROCKET CENTER WV

12/1/2013

CH2M HILL

SAP Worksheet #1a—Title and Approval Page

Final

Uniform Federal Policy Sampling and Analysis Plan Addendum Site 13 Remedial Investigation

Allegany Ballistics Laboratory Rocket Center, West Virginia

Contract Task Order WE08

December 2013

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

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

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Executive Summary

Introduction

This document presents the Sampling and Analysis Plan (SAP) Addendum, which was developed using the framework of the Navy's Uniform Federal Policy (UFP) for a Remedial Investigation (RI) at Site 13 of the Allegany Ballistics Laboratory (ABL), located in Rocket Center, West Virginia. This UFP-SAP Addendum was prepared to modify the original UFP-SAP for the Site 13 RI, prepared November 2011 (Appendix A). CH2M HILL prepared this document under the Department of the Navy (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 (CTO) WE08, for submittal to NAVFAC Mid-Atlantic, the U.S. Environmental Protection Agency (USEPA) Region III, and the West Virginia Department of Environmental Protection (WVDEP). In March 2012, the Navy, USEPA, and WVDEP concluded that additional groundwater sampling is required to support the Site 13 RI based on the following rationale:

1. There is only comprehensive alluvial groundwater data set is limited to a few wells in the VOC plume and was collected prior to the pilot studies.
2. Changes in the geochemistry of the alluvial groundwater as a result of 2 substrate injection pilot studies may have impacted metals constituents; therefore, concentrations representing current aquifer conditions should be used to quantify risk.
3. In soil, some metals concentrations exceeded soil to groundwater SSLs (MCL based).
4. EPA requested metals data from the bedrock to account for vertical migration potential metals contaminants.

These additional data will be used to further evaluate potentially unacceptable risk remaining onsite in the alluvial aquifer following the pilot study and to further evaluate the presence or absence of contamination (and potential risks, if present) in the bedrock aquifer. This SAP Addendum includes additional alluvial and bedrock groundwater sampling in support of the RI and information pertinent to the additional sampling. Additional information including site background, history, investigations, and information to support the conceptual site model can be found in the November 2011 UFP-SAP (**Appendix A**).

Site 13 Background

Site 13, formerly known at the Range Road Area, is located in the southeastern portion of the developed section of Plant 1. 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. Trichloroethene (TCE) was initially discovered when concentrations of TCE of less than 1,500 micrograms per liter were found in surface water at an outfall to the Plant 1 drainage ditch system (Solid Waste Management Unit 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 (CH2MHILL, 2005).

Pilot Study

The second of two pilot studies was completed in November 2008 at Site 13 to evaluate the enhancement of the degradation of the TCE contamination in the alluvial aquifer groundwater through bioremediation. The pilot study consisted of subsurface injection of an emulsified oil substrate to biostimulate existing bacteria to reduce site-wide TCE concentrations.

Three rounds of post-injection sampling have been performed to evaluate the performance and effectiveness of the pilot study. The first 9-month post-injection groundwater sampling occurred in August 2009, followed by the 18-month sampling in May 2010, and 27-month sampling in February 2011. The results of the post-injection sampling events verify that the substrate injections were effective at enhancing the reductive dechlorination process at Site 13 (CH2MHILL, 2011).

Remedial Investigation

An RI was initiated in November 2011 at Site 13. The objectives of the RI are to (1) evaluate the nature and extent of site-related contamination in the soil, groundwater (alluvial and bedrock), surface water, and sediment, and (2) determine whether contaminant levels pose a potentially unacceptable risk to human health or the environment. In order to delineate and evaluate contamination at Site 13, initial sampling and analysis was performed in accordance to the UFP-SAP from November 2011 (Appendix A). The initial SAP proposed stream and well gauging, groundwater sampling from the bedrock aquifer, and surface water, pore water, and sediment sampling. A summary of results from the samples collected during the RI is presented below.

Stream and Well Gauging

Monthly stream and well gauging was performed to evaluate the stream elevation relative to the shallow groundwater and determine if the alluvial aquifer groundwater is discharging to the ditch. Surface water elevations recorded between 2005 and 2011 have been consistently higher than groundwater elevations, suggesting that the drainage ditch is losing water to the alluvial aquifer, and therefore that the alluvial aquifer is not discharging to surface water onsite.

Surface Water, Pore Water, and Sediment Sampling

Surface water, pore water, and sediment sampling were initially proposed in the UFP-SAP (November 2011); however, the Navy, USEPA, and WVDEP subsequently concluded this sampling was not necessary based on the following:

- TCE has not been detected in NPDES permit sampling in the drainage ditch since late 2007.
- Water level data collected in accordance with the November 2011 SAP suggest that the alluvial groundwater is not discharging to the drainage ditch.
- Available data indicate that if a transport pathway from groundwater to surface water and sediment exists, it is intermittent and infrequent and does not present a risk to human health or the environment.
- The decrease in groundwater concentrations following the pilot study decreases the potential for significant transport should discharge occur.

Bedrock Groundwater Sampling

Groundwater samples from the bedrock aquifer were proposed to determine if volatile organic compound (VOC) contamination in the alluvium migrated to the bedrock aquifer. Three bedrock boreholes were drilled to 100 to 112 feet below ground surface immediately outside of the alluvial TCE plume boundary, as shown on **Figure 1**, and sampled for VOCs using passive diffusion bag samplers in July 2011. VOCs were not detected in the bedrock groundwater samples.

A second bedrock groundwater sampling event was conducted in January 2012. Samples were analyzed for target compound list VOCs and natural attenuation parameters. VOCs were not detected in the bedrock groundwater samples.

Groundwater Sampling Addendum

This UFP-SAP Addendum presents additional groundwater sampling and analysis, agreed upon by the Navy, USEPA, and WVDEP in May 2012, to capture the current conditions in the alluvial and bedrock aquifers at Site 13.

Groundwater samples will be collected from 13 site alluvial monitoring wells, 5 background monitoring wells, and 3 bedrock monitoring wells, as shown on **Figure 1**. The Site alluvial groundwater samples will be analyzed for target compound list VOCs and all the alluvial and bedrock groundwater samples will be analyzed for target analyte list total and dissolved metals. In addition, the site alluvial groundwater samples will be sampled for total organic carbon, chloride, sulfide, sulfate, nitrite, nitrate, alkalinity, volatile fatty acids, ferrous iron, dissolved oxygen, and methane, ethane, and ethane.

Report Presentation

This SAP Addendum details the procedures necessary to complete the previously described sampling in support of the RI and has been completed under contract number N62470-08-D-1000, CTO WE08, in accordance with the Navy's UFP-SAP policy guidance to ensure that environmental data collected are scientifically sound, of known and documented quality, and suitable for intended uses. The laboratory information cited in this SAP Addendum is specific to ENCO Laboratories. If additional laboratory services are requested that require modification to the existing SAP or this SAP addendum, revised SAP worksheets will be submitted to the Navy and regulatory agencies for approval.

This SAP Addendum consists of the worksheets amended for the changes to the original 37 worksheets specific to the UFP-SAP to incorporate the modifications to the original SAP and the addition of groundwater samples. The following SAP worksheets were revised to incorporate the changes to the initial SAP, the addition of groundwater samples, and project staff changes (if not listed below, the original worksheet in the November 2011 SAP still applies):

- SAP Worksheet # 1a – Title and Approval Page
- SAP Worksheet #2a – SAP Identifying Information
- SAP Worksheet #3a – Distribution List
- SAP Worksheet #4a – Project Personnel Sign-Off Sheet
- SAP Worksheet #5a – Project Organizational Chart
- SAP Worksheet #6a – Communication Pathways
- SAP Worksheet #7a – Personnel Responsibilities Table
- SAP Worksheet #9-7 – Project Scoping Session Participants Sheet
- SAP Worksheet #9-8 – Project Scoping Session Participants Sheet
- SAP Worksheet #10a – Problem Definition
- SAP Worksheet #11a – Project Quality Objectives/Systematic Planning Process Statements
- SAP Worksheet # 12-1a – Measurement Performance Criteria Table – Field QC Samples
- SAP Worksheet # 12-3a – Measurement Performance Criteria Table – Field QC Samples
- SAP Worksheet # 12-4a – Measurement Performance Criteria Table – Field QC Samples
- SAP Worksheet # 12-5a – Measurement Performance Criteria Table – Field QC Samples
- SAP Worksheet # 12-6a – Measurement Performance Criteria Table – Field QC Samples
- SAP Worksheet # 12-7a – Measurement Performance Criteria Table – Field QC Samples
- SAP Worksheet # 12-8a – Measurement Performance Criteria Table – Field QC Samples
- SAP Worksheet # 12-10 – Measurement Performance Criteria Table – Field QC Samples
- SAP Worksheet # 12-11 – Measurement Performance Criteria Table – Field QC Samples
- SAP Worksheet # 12-12 – Measurement Performance Criteria Table – Field QC Samples
- SAP Worksheet #14a – Summary of Project Tasks
- SAP Worksheet # 15-1a – Measurement Performance Criteria Table – Field QC Samples
- SAP Worksheet # 15-5a – Measurement Performance Criteria Table – Field QC Samples
- SAP Worksheet # 15-7 – Measurement Performance Criteria Table – Field QC Samples
- SAP Worksheet # 15-8 – Measurement Performance Criteria Table – Field QC Samples
- SAP Worksheet # 15-9 – Measurement Performance Criteria Table – Field QC Samples

- SAP Worksheet #16a – Project Schedule/Timeline Table
- SAP Worksheet #17a – Sampling Design and Rationale
- SAP Worksheet #18a – Sampling Locations and Methods/SOP Requirements Table
- Worksheet #19a – Analytical SOP Requirements Table
- SAP Worksheet #20a – Field Quality Control Sample Summary Table
- SAP Worksheet #23a – Analytical SOP References Table
- SAP Worksheet #24a – Analytical Instrument Calibration Table
- SAP Worksheet #25a – Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table
- SAP Worksheet #26a – Sample Handling System
- SAP Worksheet #28-1a - Laboratory QC Samples Table
- SAP Worksheet #28-3a - Laboratory QC Samples Table
- SAP Worksheet #28-4a - Laboratory QC Samples Table
- SAP Worksheet #28-5a - Laboratory QC Samples Table
- SAP Worksheet #28-6a - Laboratory QC Samples Table
- SAP Worksheet #28-7a - Laboratory QC Samples Table
- SAP Worksheet #28-8a - Laboratory QC Samples Table
- SAP Worksheet #28-10 - Laboratory QC Samples Table
- SAP Worksheet #28-11 - Laboratory QC Samples Table
- SAP Worksheet #28-12 - Laboratory QC Samples Table
- SAP Worksheet #28-13 - Laboratory QC Samples Table
- SAP Worksheet #28-14 - Laboratory QC Samples Table
- SAP Worksheet #30a – Analytical Services Table

All tables are embedded within the worksheets. All figures are presented at the end of the document. The initial UFP-SAP from November 2011 is provided in **Appendix A**. The field standard operating procedures are provided, and data management documentation is included in the November 2011 UFP-SAP in **Appendix A**. The Department of Defense Environmental Laboratory Accreditation Program certification letter for ENCO is provided in **Appendix B**.

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Appendixes

A Uniform Federal Policy Sampling and Analysis Plan Site 13 Remedial Investigation – November 2011
B DOD ELAP Certification Letter

Attachments

1 Site 13 Background Data Set

Figures

1 Sampling Locations

Acronyms and Abbreviations

°C	degree Celsius
µg/L	microgram per liter
%D	percent difference; percent drift
ABL	Allegany Ballistics Laboratory
AM	Activity Manager
amu	atomic mass units
AQM	Activity Quality Manager
bgs	below ground surface
BTAG	Biological Technical Assistance Group
CA	Corrective Action
CAS	Chemical Abstract Service
CCB	continuing calibration blank
CCC	calibration check compound
CCV	continuing calibration verification
CLEAN	Comprehensive Long-term Environmental Action–Navy
COC	contaminant of concern
COD	coefficient of determination
CTO	Contract Task Order
CVAA	cold vapor atomic absorption
DDT	dichlorodiphenyltrichloroethane
DEN	Denver
DL	Detection Limit
DO	dissolved oxygen
DoD	Department of Defense
DQI	data quality indicator
DQO	data quality objective
DV	Data Validator
EIS	Environmental Information Specialist
ERA	Ecological Risk Assessment
Fe^{2+}	ferrous iron
FTL	Field Team Leader
GC/MS	gas chromatograph/mass spectrometer
H&S	health and safety
HCl	hydrochloric acid
HHRA	human health risk assessment
HNO3	nitric acid
HPLC	high-performance liquid chromatography
HSO	Health and Safety Officer
HSP	Health and Safety Plan
ICAL	initial calibration
ICB	initial calibration blank
ICP	inductively coupled plasma
ICP-MS	inductively coupled plasma-mass spectrometer

ICS	interference check solution
ICV	initial calibration verification
ID	Identification
IRP	Installation Restoration Program
IS	Internal Standard
LC/MS/MS	liquid chromatography/mass spectrometry/mass spectrometry
LCS	laboratory control sample
LOD	limit of detection
LOQ	Limit of Quantitation
LTM	long-term monitoring
MCL	maximum contaminant level
MDL	Method Detection Limit
ml	milliliter
MPC	Measurement Performance Criteria
MS	matrix spike
MSA	method of standard additions
MSD	matrix spike duplicate
NA	not applicable
NAVFAC	Naval Facilities Engineering Command
NAVSEA	Naval Sea Systems Command
Navy	Department of the Navy
NC	no criterion
NPDES	National Pollutant Discharge Elimination System
NTR	Navy Technical Representative
PAH	polycyclic aromatic hydrocarbon
PAL	Project Action Limit
PDB	passive diffusion bag
PETN	pentaerythritol tetranitrate
PM	Project Manager
PQL	Project Quantitation Limit
PQO	project quality objective
PS	post-spike
PT	proficiency testing
QA	quality assurance
QAO	Quality Assurance Officer
QC	quality control
QSM	Quality Systems Manual
RDX	cyclotrimethylenetrinitramine
RF	response factor
RI	Remedial Investigation
RL	reporting limit
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RRT	relative retention time
RSD	Relative Standard Deviation
RSL	regional screening level
S/N	signal-to-noise
SAP	Sampling and Analysis Plan

SOP	standard operating procedure
SPCC	Spill Prevention, Control, and Countermeasure
SVOC	semivolatile organic compound
TAL	target analyte list
TBD	to be determined
TCE	trichloroethene
TCL	Target Compound List
TOC	total organic carbon
UFP	Uniform Federal Policy
USEPA	U.S. Environmental Protection Agency
VBO	Virginia Beach Office
VFA	volatile fatty acid
VOA	volatile organic analyte
VOC	volatile organic compound
WVDEP	West Virginia Department of Environmental Protection

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SAP Worksheet #2a—SAP Identifying Information

Dates of scoping sessions pertinent to this SAP Addendum:

Scoping Session	Date
Navy, USEPA, and WVDEP Meetings	May 16, 2012
Navy, USEPA, and WVDEP Meetings	May 31, 2012

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SAP Worksheet #3a—Distribution List

Refer to Worksheet #3 of the Final UFP-SAP, Site 13 Remedial Investigation, Allegany Ballistics Laboratory, dated November 2011 (Final RI UFP-SAP) (Appendix A). **Worksheet #3a** below provides a summary of the changes to the referenced worksheet. Individuals no longer on the distribution list are identified with "(Deleted)" next to their name and added individuals are identified with"(Added)" next to their names.

Name of Sampling and Analysis Plan (SAP) Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
Walter Bell	NTR	NAVFAC Atlantic	(757) 341-0484	Walt.J.Bell@navy.mil
Catherine Guynn	WVDEP RPM	WVDEP	304-926-0499 ext 1288	Catherine.N.Guynn@wv.gov
Sarah Kloss	Remedial Project Manager (RPM)	United States Environmental Protection Agency (USEPA) Region III	(215) 814-3379	Kloss.Sarah@epamail.epa.gov
Jamie Butler	Activity Manager (AM)	CH2M HILL	(757) 671-6212	jamie.butler@ch2m.com
Ronnie Wambles	Laboratory Project Manager	ENCO Laboratories	(407) 826-5314	rwambles@encolabs.com
Herb Kelly	Senior Chemist/ Data Validator (DV)	CH2M HILL	(352) 384-7100	herb.kelly@ch2m.com

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SAP Worksheet #4a—Project Personnel Sign-Off Sheet

Refer to Worksheet #4 of the Final RI UFP-SAP (Appendix A). **Worksheet #4a** below provides a summary of the changes to the referenced worksheet. Individuals no longer on the sign-off list are identified with "(Deleted)" next to their name and added individuals are identified with"(Added)" next to their names.

Name	Organization/Title/Role	Telephone Number	Signature/ E-mail Receipt	SAP Section Reviewed	Date SAP Read
Ronnie Wambles	ENCO Laboratories	(407) 826-5314			
Herb Kelly	CH2M HILL/ Senior Chemist and DV	(352) 384-7100			

Notes:

Sign off sheets will be maintained with the project files.

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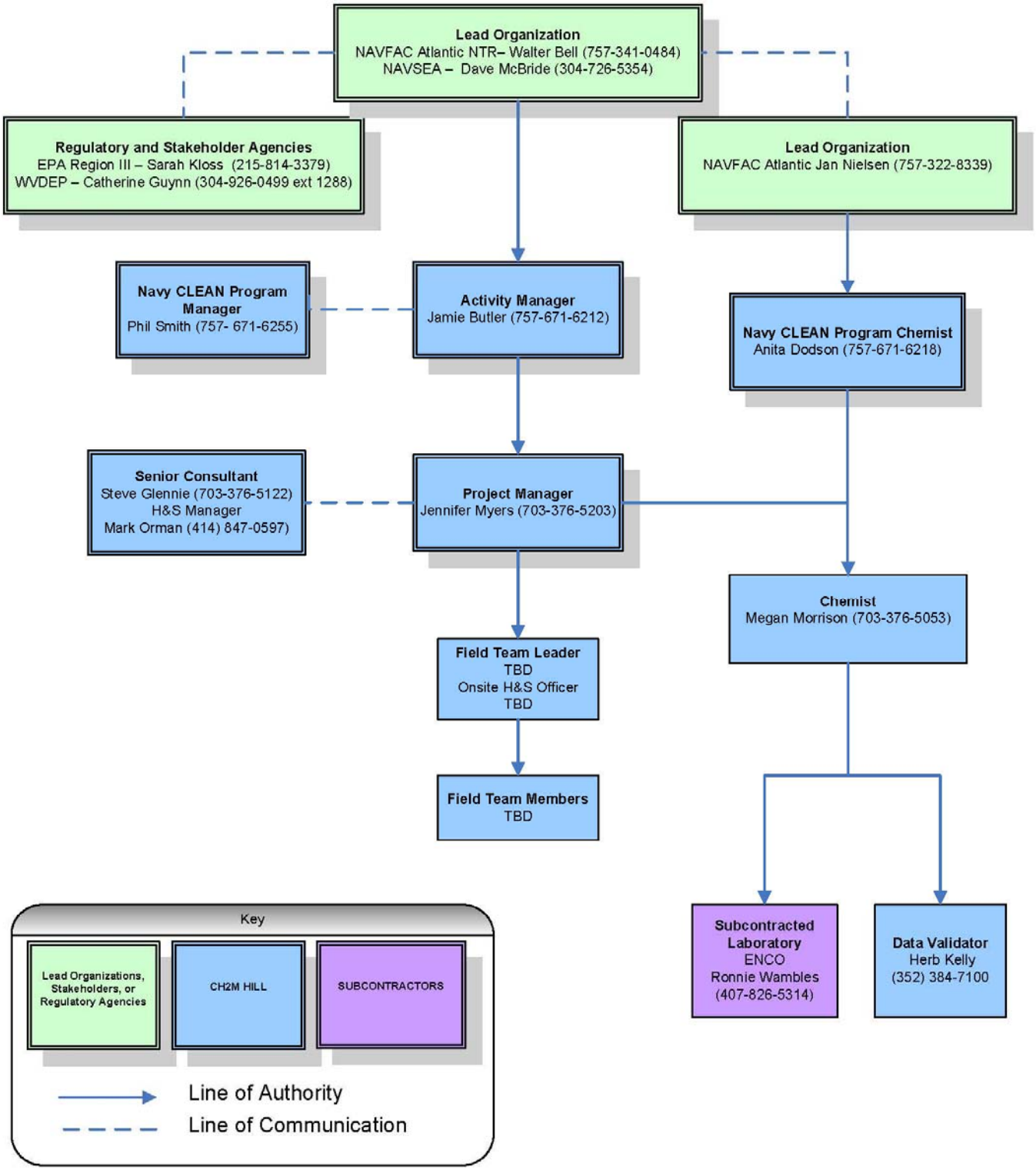
SAP Worksheet #5a—Project Organizational Chart



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SAP Worksheet #6a—Communication Pathways

Refer to Worksheet #6 of the Final RI UFP-SAP (Appendix A). **Worksheet #6a** below provides a summary of the changes to the referenced worksheet. New members of the team are shown as having replaced individuals that are no longer part of the team or whose roll on the team has changed.

Communication Drivers	Responsible Affiliation	Name	Phone Number/E-mail	Procedure
Communication with the Department of the Navy (Navy) (lead agency)	Navy NTR	Walter Bell replaced William Fraser	Walter. J. Bell@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 USEPA	USEPA RPM	Sarah Kloss replaced Ji-Sun Yi	Kloss.Sarah@epamail.epa.gov	• Primary contact for USEPA; can delegate communication to other internal or external points of contact • Has 60 days for SAP review • Navy RPM will notify USEPA via e-mail within 24 hours for field changes affecting the scope or implementation of the SAP
Communication with WVDEP	WVDEP RPM	Catherine Guynn replaced Tom Bass	Catherine.N.Guynn@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 Uniform Federal Policy (UFP)-SAP	Navy Chemist	Ken Bowers replaced Janice Nielsen	Ken.Bowers @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, USEPA, and WVDEP	CH2M HILL AM	Jamie Butler replaced Steve Glennie	Jamie.Butler@ch2m.com	• Primary contacts for CH2M HILL to Navy, USEPA, and WVDEP; can delegate communication to other points of contact within CH2M HILL • Forwards information and materials about the project to Navy RPM, USEPA, and WVDEP as needed

SAP Worksheet #6a—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number/E-mail	Procedure
Data tracking from collection through upload to database and management of analytical lab and data validation sub contractors. Analytical CAs and release of analytical data	CH2M HILL Project Chemist	Megan Morrison assumed procedures for Hillary Ott as well as original procedures	Megan.Morrison@ch2m.com	• Tracks data from sample collection through database upload • Primary contact for laboratories' PMs • Communicates with subs by phone, following up with e-mail to document decisions and actions • Reports lab issues to PM • 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 • Analytical laboratory CAs will be identified by, or brought to the attention of, the Project Chemist on a daily basis.
Reporting lab data quality issues	ENCO PM and CH2M HILL DV	Ronnie Wambles and Herb Kelly replaced Ryan Hall and Ward Dickens	rwambles@encolabs.com herb.kelly@ch2m.com	• Report analytical laboratory CAs 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 will be by phone, followed up with e-mail to document decisions and actions

SAP Worksheet #7a—Personnel Responsibilities Table

Refer to Worksheet #7 of the Final RI UFP-SAP (Appendix A). **Worksheet #7a** below provides a summary of the changes to the referenced worksheet. Individuals no longer on the team are identified with "(Deleted)" next to their name and added individuals are identified with"(Added)" next to their names. Individuals whose responsibilities to the team are indicated as such

Name	Title/Role	Organizational Affiliation	Responsibilities
Walter Bell	RPM	NAVFAC Atlantic	Manages all ABL Installation Restoration Program (IRP) activities
Sarah Kloss	RPM	USEPA Region III	Reviews SAP and provides input for the USEPA
Catherine Guynn	WVDEP RPM	WVDEP	Reviews SAP and provides input for the WVDEP
Jamie Butler	AM	CH2M HILL	Oversees overall project status for all projects implemented at ABL
Steve Glennie	Senior Consultant-AQM	CH2M HILL	Provides overall technical quality control (QC) of the field investigation design and implementation; responsible for audits, CA, checks of quality assurance (QA) performance. Provides SAP delivery support and QA oversight
Megan Morrison	Project Chemist	CH2M HILL	Coordinates laboratory and data validation subcontracts and oversees performance of laboratory and data validation. Writes and coordinates chemistry-specific UFP-SAP worksheets. Provides sample tracking, data management, and communication with laboratory
Ronnie Wambles	Laboratory PM	ENCO	Manages sample tracking and maintains good communication with Project Chemist
Herb Kelly	DV	CH2M HILL	Responsible for validation of environmental data

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SAP Worksheet #9-7—Project Scoping Session

Project Name: Site 13 Remedial Investigation (RI) **Projected Date(s) of Sampling:** Fall 2012 **PM:** Jennifer Myers	**Site Name:** Site 13 **Site Location:** ABL, West Virginia

Date of Session: May 16, 2012

Scoping Session Purpose: Obtain concurrence on the sampling approach.

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
William Fraser	NTR	NAVFAC Atlantic	(757) 445-6637	mailto:William.G.Fraser@navy.mil	Manages all ABL IRP activities
John Aubert	NTR	NAVSEA	(951) 970-7511	RWAJOHN81@aol.com	Reviews SAP
Joe Foran	Facilitator	The Management Edge			Meeting Moderator
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 long-term monitoring (LTM) program
Jamie Butler	AM	CH2M HILL/Virginia Beach Office (VBO)	(757) 671-6212	Jamie.Butler@ch2m.com	Provides final review of SAP prior to publication
Sandy Brown	Minute Taker	CH2M HILL/Denver (DEN)	(720) 286-2619	Sandra.Brown@ch2m.com	Meeting minute taker
Bruce Beach	Tier II Representative	USEPA Region III	(215) 814-3364	Beach.Bruce@epa.gov	Provides managerial guidance
Steve Hirsh	Tier II Representative	USEPA Region III	(215) 814-3352	Hirsh.Steven@epa.gov	Provides managerial guidance
Mark Leipert	USEPA Hydrogeologist	USEPA Region III	(215) 814-3341	Leipert.Mark@epa.gov	Provides technical guidance
Walt Bell	NTR	NAVFAC	(757) 341-0484	Walt.J.Bell@navy.mil	Reviews SAP
Sarah Kloss	USEPA RPM/ Timekeeper	USEPA Region III	(215) 814-3379	Kloss.Sarah@epamail.epa.gov	Reviews and provides input for USEPA on development and modifications Site 13 LTM program
Jennifer Myers	PM	CH2M HILL/VBO	(757) 671-6215	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	Toxicologist	CH2M HILL/WDC	(814) 364-2454	Roni.Warren@ch2m.com	Provides guidance on risk screening
Nancy Rios	Toxicologist	USEPA	(215) 814-3324	rios-jafolla.nancy@epa.gov	Provides technical guidance

SAP Worksheet #9-7—Project Scoping Session (continued)

Overview:

The Navy, USEPA, and WVDEP participated in a scoping session for the UFP-SAP on May 16, 2012. The goal of this discussion was to obtain consensus on the approach for collection of additional groundwater to characterize current conditions at the site in support of the Site 13 RI. The scoping session is documented in the May 2012 Partnering meeting minutes and summarized below.

In October 2011, prior to this scoping session, the Team was presented with the bedrock groundwater sampling results from the July 2011 sampling event. The groundwater results from the 3 bedrock borings did not indicate the presence of VOCs in the bedrock. In addition, water level measurements collected since 2005 indicated that the alluvial aquifer was not discharging to the drainage ditch. Based on this information, the Team revisited the need for sediment/surface water data collection or additional bedrock sampling.

During the November 2011 Partnering meeting the Team was presented with a summary of all analytical data collected to date and assumptions for assessment of risk to complete the RI. Based on the presented information, the Team tentatively agreed that soil has been adequately characterized and the memo summarizing the risk screening completed for soil in 2008 would be included as an attachment to the RI. It was further agreed that no additional data was necessary to evaluate ecological risk associated with sediment and surface water. In addition, because groundwater elevation data did not indicate discharge of groundwater to surface water in the vicinity of Site 13, pore water sample collection was not warranted to complete the RI. However, the following data gaps were identified:

1) There is no facility wide background groundwater data set;
2) EPA is concerned that the bedrock groundwater may not be fully characterized since samples were only analyzed for VOCs;
3) Contaminants other than VOCs in the alluvial groundwater were last analyzed in 2004 (pre-EIB injection). EPA and WVDEP inquired whether more data for non-VOC constituents should be collected in order to understand current conditions because surfactant injections could have mobilized metals in groundwater.

The following action items were created for the May 2012 scoping session:

1) EPA and WVDEP to talk with their agency technical support to verify whether additional alluvial groundwater data is needed to complete the RI;
2) EPA to confirm with agency technical support whether additional analytes are warranted in the bedrock borings;
3) CH2MHILL to evaluate data for an appropriate background data set to be used in RI.

To address the action item from the November 2011 Partnering meeting, CH2M HILL reviewed the historical data and sent an email to the Team on December 23, 2011, proposing five existing monitoring wells for use as background alluvial wells (4GW01, 3GW03, GGW05, GW07, and GW25). In samples collected from these 5 wells, no VOCs had been detected and the detected metal constituent concentrations had been within a sufficiently narrow range as to suggest that they were representative of background conditions. The 5 wells were therefore recommended for use as background comparison at Range Road based on their proximity to the site and constituent concentrations. GGW10 is another alluvial well proximal to the site; however, due to the presence of constituents dissimilar to those found at other wells, and also due to higher total metal concentrations, it was considered an outlier and eliminated from consideration. A figure showing the well locations and the raw analytical data from these wells are included as **Attachment 1**.

SAP Worksheet #9-7—Project Scoping Session (continued)

Based on the outcome of the November 2011 action items, EPA, WVDEP and the Navy agreed additional alluvial and bedrock groundwater samples are warranted to characterize the nature and extent of contamination and quantify human health risk associated with Site 13 releases. The proposed path forward presented during the scoping session was to amend the Site 13 UFP-SAP with additional bedrock and alluvial groundwater sampling parameters and rationale, update the 2008 soil risk screening using current toxicity criteria, and evaluate the soil-to-groundwater pathway. The EPA further suggested adding perchlorate to the groundwater analytical parameters. It was also noted by the EPA that metals exceed the soil to groundwater screening levels and suggested that additional soil data should be collected and that metals be evaluated further to determine if there is a site release of metals.

Action Items:

The USEPA and Navy will further evaluate available soil and groundwater data and the Team will discuss the issue further via a future conference call.

Path Forward:

The team agreed that one round of additional alluvial and bedrock groundwater sampling will take place and that the samples will be analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), metals (total and dissolved), and explosives including perchlorate to address the perceived data gaps. In addition, alluvial groundwater samples will be sampled for total organic carbon (TOC), chloride, sulfide, sulfate, nitrite, nitrate, alkalinity, volatile fatty acids (VFAs), ferrous iron (Fe^{2+}), dissolved oxygen (DO), and methane, ethane, and ethane, to support future remediation design, if necessary. This approach was modified during a subsequent scoping session.

SAP Worksheet #9-8—Project Scoping Session

Project Name: Site 13 RI **Projected Date(s) of Sampling:** Fall 2012 **PM:** Jennifer Myers	**Site Name:** Site 13 **Site Location:** ABL, West Virginia
Date of Session: May 31, 2012 **Scoping Session Purpose:** Obtain concurrence on the sampling approach.	

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
William Fraser	NTR	NAVFAC Atlantic	(757) 445-6637	william.g.fraser@navy.mil	Manages all ABL IRP activities
Sandy Brown	Minute Taker	CH2M HILL/DEN	(720) 286-2619	Sandra.Brown@ch2m.com	Meeting minute taker
Mark Leipert	USEPA Hydrogeologist	USEPA Region III	(215) 814-3341	Leipert.Mark@epa.gov	Provides technical guidance
Walt Bell	NTR	NAVFAC	(757) 341-0484	Walt.J.Bell@navy.mil	Will replace William Fraser as site NTR
Jamie Butler	AM	CH2M HILL/VBO	(757) 671-6212	Jamie.Butler@ch2m.com	Provides final review of SAP prior to publication
Jennifer Myers	PM	CH2M HILL/VBO	(757) 671-6215	Jennifer.Myers@ch2m.com	Prepare project instructions; manage project goals, budget, and schedule. Review SAP prior to senior review and provide final review prior to publication
Sarah Kloss	USEPA RPM/ Timekeeper	USEPA Region III	(215) 814-3379	Kloss.Sarah@epamail.epa.gov	Reviews and provides input for USEPA on development and modifications Site 13 LTM program

Overview:

The Navy, USEPA, and WVDEP had a scoping session via conference call for the Site 13 UFP-SAP Addendum on May 31, 2012. The goal of this discussion was to obtain Team concurrence on whether the collection of additional soil samples would be required for the Site 13 risk evaluation.

Action Items:

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

Path Forward:

The Team agreed to move forward with submission of the revised UFP-SAP leaving analysis list as previously discussed, putting the issue of taking additional soil samples on hold pending the results of the groundwater samples.

SAP Worksheet #9-9—Project Scoping Session

Project Name: Site 13 RI **Projected Date(s) of Sampling:** Fall 2013 **PM:** Jennifer Myers	**Site Name:** Site 13 **Site Location:** ABL, West Virginia
Date of Session: May 16, 2013 **Scoping Session Purpose:** Obtain concurrence on the sampling approach.	

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Sandy Brown	Minute Taker	CH2M HILL/DEN	(720) 286-2619	Sandra.Brown@ch2m.com	Meeting minute taker
Cathy Guynn	WVDEP RPM	WVDEP	304-926-0499 ext 1288	Catherine.N.Guynn@wv.gov	Reviews and provides input for WVDEP on development and modifications Site 13 IRP activities
Walt Bell	NTR	NAVFAC	(757) 341-0484	Walt.J.Bell@navy.mil	Manages all ABL IRP activities
Jamie Butler	AM	CH2M HILL/VBO	(757) 671-6212	Jamie.Butler@ch2m.com	Provides final review of SAP prior to publication
Jennifer Myers	PM	CH2M HILL/VBO	(757) 671-6215	Jennifer.Myers@ch2m.com	Prepare project instructions; manage project goals, budget, and schedule. Review SAP prior to senior review and provide final review prior to publication
Sarah Kloss	USEPA RPM	USEPA Region III	(215) 814-3379	Kloss.Sarah@epamail.epa.gov	Reviews and provides input for USEPA on development and modifications Site 13 IRP activities

Overview:

Following Navy chemistry review and comments on the basis for the analyte list proposed in the SAP, the Navy, USEPA, and WVDEP agreed to revisit the analyte list. A scoping session was held via conference call May 16, 2013 to obtain Team concurrence on the analytical groups to be included in the SAP Addendum. The team discussed rationale to support the initial proposed analysis of SVOCs, perchlorate, or explosives in the alluvial and bedrock and the additional VOC sampling in the bedrock. Historical perchlorate data presented to the team supported the decision that groundwater sample analysis for perchlorate is unnecessary. The EPA and WVDEP agreed that analysis of explosives, perchlorate, and SVOCs in either the bedrock or alluvial was unnecessary as these constituents are not site contaminants. They further agreed that additional VOC data is not warranted for the bedrock groundwater. The team agreed however, that metals data are necessary because elevated metals are present in other facility-wide bedrock wells and in the Site 13 alluvial aquifer.

Action Items:

CH2M HILL will prepare a revised UFP-SAP Addendum for the RI activities at Site 13.

Path Forward:

The team agreed to collect alluvial and bedrock groundwater samples as part of the additional RI efforts. The alluvial aquifer groundwater samples will be analyzed for VOCs and metals (total and dissolved) and the bedrock aquifer groundwater samples will be analyzed for metals (total and dissolved). In addition, alluvial groundwater samples will be sampled for total organic carbon (TOC), chloride, sulfide, sulfate, nitrite, nitrate, alkalinity, volatile fatty acids (VFAs), ferrous iron (Fe^{2+}), dissolved oxygen (DO), and methane, ethane, and ethane, to support future remediation design, if necessary.

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SAP Worksheet #10a—Conceptual Site Model

This worksheet provides the conceptual site model (CSM) for Site 13 as it pertains to this addendum. Background information pertinent to the additional RI activities provided in this SAP addendum is detailed in this worksheet. Additional background information including facility and site location descriptions; history of the site; previous investigations conducted; and information to support the CSM can be found **Worksheet #10** in the November 2011 UFP-SAP (**Appendix A**).

Site 13 Background

Site 13, formerly known at the Range Road Area, is located in the southeastern portion of the developed section of Plant 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. TCE was initially discovered when concentrations of TCE less than 1,500 micrograms per liter (µg/L) were found in surface water at an outfall to the Plant 1 drainage ditch system (Solid Waste Management Unit 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 (CH2MHILL 2005).

Post Injection Alluvial Groundwater Performance Monitoring

Three rounds of post-injection sampling were conducted to evaluate the performance and effectiveness of the pilot study. The first 9-month post-injection groundwater sampling occurred in August 2009, followed by the 18-month sampling in May 2010, and 27-month sampling in February 2011. Due to an anomalous sample result for TCE during the February 2011 sampling event, VOCs were resampled on June 22, 2011, from well GGW-22 (**Figure 1**). The results of the post-injection sampling events verify that the substrate injection was effective at enhancing the reductive dechlorination process at Site 13 (CH2MHILL 2011). However, VOC concentrations remain above the MCL in alluvial aquifer groundwater.

Remedial Investigation

In order to evaluate contamination in the bedrock aquifer at Site 13, bedrock groundwater sampling and analysis was performed in July 2011 in accordance with the UFP-SAP from November 2011. Subsequent discussions (WS 9-7 and WS 9-8) concluded that there was no need to collect surface water/pore water/sediment samples as previously planned; however, based on the data gaps associated with metals data for alluvial and bedrock wells, and because elevated metals are present in other facility-wide bedrock wells and in the Site 13 alluvial aquifer, additional groundwater sampling is warranted as discussed in WS 9-9. Additional sampling is discussed in WS 11.

Stream and Well Gauging

Monthly stream and well gauging was performed to evaluate the stream elevation relative to the groundwater and determine if the alluvial aquifer is discharging to the ditch. Synoptic water level measurements were collected from the Site 13 alluvial and bedrock wells and staff gauges monthly and during groundwater sampling events. Stream gauging was not always conducted due to the drainage ditch being dry during the monitoring period.

Results indicate that surface water elevations in the ditch recorded between 2005 and 2011 as well as the elevation of the bottom of the ditch have been consistently higher than groundwater elevations, suggesting that the drainage ditch is losing water to the alluvial aquifer, and thus the alluvial aquifer is not discharging to surface water onsite, at least not continuously.

SAP Worksheet #10a—Conceptual Site Model (continued)

Surface Water, Pore Water, and Sediment Sampling

Surface water, pore water, and sediment sampling were initially proposed in the UFP-SAP (November 2011) and would have been conducted within the drainage ditch; however, the Navy, USEPA, and WVDEP subsequently agreed this sampling was not necessary based on the following:

- TCE has not been detected in NPDES permit sampling conducted in the drainage ditch since late 2007
- Water level data collected in accordance with the November 2011 SAP suggest that the alluvial groundwater is not discharging to the drainage ditch
- Available data indicate that if a transport pathway from groundwater to surface water and sediment exists, it is intermittent and infrequent and does not present a risk to human health or the environment
- The decrease in groundwater concentrations following the injections of biostimulating substrate during the pilot study decreases the potential for significant transport should discharge occur

Bedrock Groundwater Sampling

Three bedrock boreholes (GGW36, GGW37, GGW38) were drilled to depths of 100 to 112 feet below ground surface (bgs) immediately outside of the alluvial TCE plume boundary using air rotary drilling techniques, as shown on **Figure 1**, to evaluate whether contamination exists in the bedrock aquifer. Groundwater was encountered at 13 feet bgs at each borehole. The boreholes were not completed as monitoring wells, but left open to facilitate multi-depth incremental sampling. Groundwater samples were collected in July 2011 using four passive diffusion bag (PDB) samplers spaced roughly equal distance apart from just below the surface casing to the total depth of each borehole for a total of 12 PDB samples. Groundwater samples were collected after a 3-week equilibration period and analyzed for target compound list (TCL) VOCs and natural attenuation parameters. No VOCs were detected in the bedrock groundwater samples.

A second bedrock groundwater sampling event was conducted in January 2012. One PDB sampler was placed in each borehole at the midpoint of the water column (approximately 60-70 feet bgs). The samplers were allowed to equilibrate for approximately 6 weeks prior to sample collection. Samples were analyzed for TCL VOCs and natural attenuation parameters. VOCs were not detected in the bedrock groundwater samples.

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

This section presents the project quality objectives (PQOs) for the upcoming field investigation at Site 13; the overall project objectives are can be found **Worksheet #10** in the November 2011 UFP-SAP (**Appendix A**).

Problem Statement and Objectives

The extent of the VOC plume was delineated through DPT in 2002 and 2003. In 2004, monitoring well samples primarily from the upgradient (western) portion of the plume were analyzed for a comprehensive suite of analytes. Subsequent investigations focused on the COCs, TCE and its degradation products; however, two pilot studies have been conducted at the site determine the ability of injected solutions into the groundwater to enhance the reductive dechlorination process. These injections have changed the geochemistry of the alluvial groundwater and potentially impacted concentrations of metals constituents in groundwater. Therefore, the data from 2004 may not be representative of current alluvial aquifer conditions. VOC and metals groundwater data is needed to quantify potential risk currently posed by the alluvial groundwater at the site.

In addition, EPA requested that metals data be collected from the bedrock aquifer account for migration of potential contaminants between the alluvial and bedrock aquifers.

Based on the above information, the Navy, USEPA, and WVDEP agreed to collect additional groundwater samples to address data gaps associated with the alluvial and bedrock groundwater data. This information will be used to evaluate potential risks posed by any contamination identified and, if unacceptable risk attributable to the site is deemed to be present, to determine whether remedial/removal action, or control mechanisms are warranted.

The environmental questions and problems to be addressed by this Addendum are:

1. **What are the current concentrations of VOCs, and metals, in the alluvial and metals in the bedrock groundwater at Site 13, and do they sufficiently characterize nature and extent?**

Alluvial and bedrock groundwater samples will be collected using the low flow/zero drawdown sampling protocols; and analyzed as detailed below to sufficiently characterize the nature and extent of contamination.

2. **Do the concentrations of constituents detected in the groundwater present potentially unacceptable human health risk relative to background?**

Analytical results from the alluvial and bedrock groundwater samples will be used to conduct a human health risk assessment (HHRA) to assess whether the constituent concentrations detected in alluvial and/or bedrock groundwater present potentially unacceptable human health risk. Those constituents identified as posing potentially unacceptable risk will be evaluated relative to the background to help determine whether unacceptable risks are site-related. The proposed background wells (**Attachment 1**) will be sampled for total and dissolved metals during the investigation.

3. **If unacceptable risks attributable to the site are identified, what remedial/removal actions and/or control mechanisms are warranted?**

If unacceptable risks are identified, a Feasibility Study will be completed to address COCs attributable to a site release.

What are the Project Action Limits (PALs)?

The PALs for the groundwater are the USEPA tap water regional screening levels (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 (such as the liver) or maximum contaminant levels (MCLs), whichever is lower. The PALs are provided in **Worksheet #15a**.

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

In cases where the PAL is less than the laboratory's corresponding limit of detection (LOD), if the specific constituent is not detected, the analyte will be considered not present. However, if the constituted is detected, it will be documented as an exceedance of the PAL.

What will the data be used for?

The data will be used to answer the Environmental Questions and will support the Navy, VDEQ, and EPA with decision-making necessary to identify a suitable path forward to achieve site closure.

What types of data are needed (matrix, target analytes, analytical groups, field screening, onsite analytical or offsite laboratory techniques, or sampling techniques)?

Alluvial groundwater and bedrock groundwater samples will be collected during the field investigation. The planned analyses for each sample type are presented below:

Sample Type	Analytical Parameters
Alluvial groundwater	VOCs, target analyte list (TAL) total and dissolved metals, Fe2+, DO, and wet chemistry parameters (chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, total organic carbon, methane, ethane, ethane, and VFAs)
Bedrock groundwater	TAL total and dissolved metals,
Background groundwater	TAL total and dissolved metals

Sampling techniques are described in **Worksheet #14a**. **Worksheet #15** in the November 2011 UFP-SAP (**Appendix A**) details the laboratory analytical protocol. **Worksheet # 17a** contains detailed information on the types of data needed for this project, including proposed sample locations and depth intervals. Regarding the total and dissolved metals analyses of groundwater data in an HHRA, if dissolved and total metals concentrations are similar (meaning if dissolved and total metals concentrations for samples collected from the same monitoring well are within one order of magnitude of each other) total metal results will be used for that monitoring well in the HHRA. Total metals data will be used for a construction worker exposure scenario because the construction worker would be directly exposed to groundwater via a subsurface activity, such as excavation. If a notable disparity exists between dissolved and total metals concentrations collected from a monitoring well, as demonstrated by total metals concentrations that are over one order of magnitude greater (that is, 10 times greater) than dissolved metals concentrations of aluminum, iron, and manganese in mutual samples, dissolved metals data would be used for that well in the HHRA.

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 QC and data validation will be completed for all analytical data except the wet chemistry parameters. Detailed QC data requirements are found in **Worksheet # 20a**. Data validation procedures requirements are detailed in **Worksheet #36** of the November 2011 UFP-SAP and provided in **Appendix A**.

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

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

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

Groundwater samples will be collected from both the alluvial and bedrock groundwater monitoring wells during one sampling event during fall 2013. Additionally, 5 alluvial wells adjacent to the site will be sampled and analyzed for metals to establish background values**.**

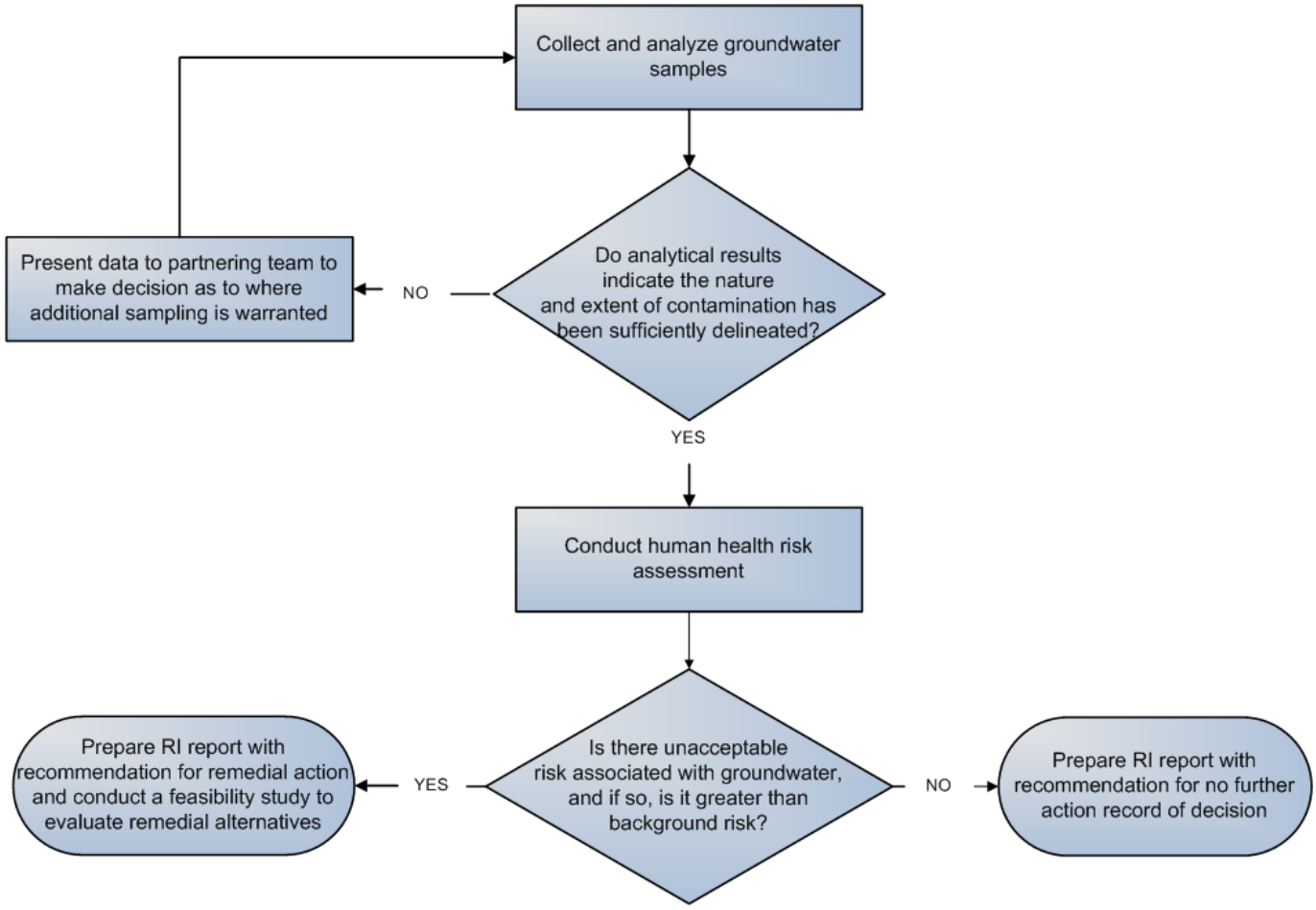
- Detailed information on when the data will be collected is provided in **Worksheet #16a**.
- Detailed information on where and how the data will be collected is provided on **Worksheets #14a** and **#17a**.
- The sample locations associated with Site 13 are shown on **Figure 1**.

What are the Project Quality Objectives (PQOs) in the form of if/then statements?

The PQOs are listed as follows and are shown below in the form of a decision tree:

If the detected constituent concentrations in groundwater pose potentially unacceptable risk to human health and are above proposed background data set concentrations, then the RI will be prepared with a recommendation for remedial action, and a Feasibility Study will be conducted to evaluate remedial alternatives for groundwater.

If the detected constituent concentrations in groundwater do not pose unacceptable potentially unacceptable risk above site-specific background concentrations, then further investigation and/or remediation of groundwater is not warranted, and the RI will be prepared with a recommendation for no further action for groundwater at the site.



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

Matrix: Groundwater (Alluvial)
Analytical Group: VOC
Concentration Level: Low (SW-846 8260B)

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 Duplicate	VOC	One per 10 field samples	Precision	%Relative Percent Difference (RPD) ≤30%	S & A
Equipment Rinseate Blank		One per day	Bias/Contamination	No target analytes > ½ limit of quantitation (LOQ); no common laboratory contaminants > LOQ.	S
Trip Blank		One per cooler containing samples for VOC samples	Bias/Contamination	No target analytes > ½ LOQ; no common laboratory contaminants > LOQ.	S & A
Temperature Blank		One per cooler	Accuracy/Representativeness	2 to 6 degrees Celsius (°C)	S

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

Matrix: Groundwater (Alluvial)
Analytical Group: Chloride, Nitrate, Nitrite, Sulfate
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)
Cooler Temperature Indicator	Chloride, Nitrate, Nitrite, Sulfate	One per cooler	Accuracy/Representativeness	2 to 6 degrees Celsius (°C)	S

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

Matrix: Groundwater (Alluvial)
Analytical Group: Sulfide
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)
Cooler Temperature Indicator	Sulfide	One per cooler	Accuracy/Representativeness	2 to 6 degrees Celsius (°C)	S

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

Matrix: Groundwater (Alluvial)
Analytical Group: Alkalinity
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)
Cooler Temperature Indicator	Alkalinity	One per cooler	Accuracy/Representativeness	2 to 6 degrees Celsius (°C)	S

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

Matrix: Groundwater (Alluvial)
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)
Cooler Temperature Indicator	TOC	One per cooler	Accuracy/Representativeness	2 to 6 degrees Celsius (°C)	S

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

Matrix: Groundwater (Alluvial)

Analytical Group: Methane, Ethane, Ethene

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)
Cooler Temperature Indicator	Methane, Ethane, Ethene	One per cooler	Accuracy/Representativeness	2 to 6 degrees Celsius (°C)	S

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

Matrix: Groundwater (Alluvial)
Analytical Group: Volatile Fatty Acids (VFAs)
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)
Cooler Temperature Indicator	Volatile Fatty Acids (VFAs)	One per cooler	Accuracy/Representativeness	2 to 6 degrees Celsius (°C)	S

SAP Worksheet #12-10—Measurement Performance Criteria Table—Field QC Samples

Matrix: Groundwater (Bedrock, Alluvial, Background)
Analytical Group: TAL Metals (Total and Dissolved)
Concentration Level: Low (SW-846 6020A, SW-846 7470A)

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 Duplicate	TAL Metals (Total and Dissolved)	One per 10 field samples	Precision	%RPD ≤20%	S & A
Equipment Rinseate Blank		One per day	Bias/Contamination	No target analytes > ½ LOQ.	S
Temperature Blank		One per cooler	Accuracy/Representativeness	2 to 6°C	S

SAP Worksheet #13a—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
Initial comprehensive data set 2004	CH2M HILL, 2005.Final Phase III/IV Investigation of Solid Waste Management Units 2, 27A, 37E, and 37V Report	CH2M HILL. Alluvial Groundwater, soil, surface water, and sediment. 2004	Data was used to assist the placement of RI sample locations. Soil, surface water, and sediment data generated was used to conduct human health screening	Data was collected prior to remedial injections and not representative of current conditions.
2005, Initial Pilot Study Results	CH2M HILL 2008, Range Road Area Pilot Study Report In Situ Aerobic Degradation of TCE in Groundwater	CH2M HILL. Alluvial groundwater. Range Road Area. 2005	Data used to characterized alluvial groundwater flow.	None
2006, Additional Characterization Activities	CH2M HILL 2008, Additional Source Characterization Results, Range Road Area, Allegany Ballistics Laboratory, Rocket Center, West Virginia	CH2M HILL, Alluvial groundwater and Soil, Range Road Area, December 2006, October 2007 and February 2008	Data was used to assist the placement of RI sample locations.	None
2007, Membrane Interface Probe Investigation	CH2M HILL 2008, Additional Source Characterization Results, Range Road Area	CH2M HILL, Alluvial groundwater Range Road Area, December 2006 and February 2008	Data was used to assist the placement of RI sample locations.	None
2008, Pilot Study Baseline groundwater results	CH2M HILL, 2009, Final Range Road Area Pilot Study Report, In Situ Aerobic Degradation of TCE in Groundwater	CH2M HILL, Alluvial groundwater, Range Road Area, October 2008	Data was used to assist the placement of RI sample locations and will be used to assist the evaluation of the effectiveness of the pilot study.	None
February 2011 27-month post-injection sample Results	CH2M HILL. 2011. Summary of 27-Month Post-Injection Monitoring and ERD Performance Assessment at Site 13, Range Road	CH2M HILL. Groundwater. Range Road Area. August 2009, February 2011, May 2010	Data associated with post injection performance sampling will be used to evaluate the effectiveness of the pilot study.	None

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SAP Worksheet #14a—Summary of Project Tasks

Project Tasks

Tasks involved in meeting the objective of this SAP Addendum will be composed of groundwater sampling, described as follows. Applicable standard operating procedures (SOPs) for project tasks outlined in this worksheet are listed on **Worksheet #21** of the November 2011 UFP-SAP provided in **Appendix A**.

Field Investigation

Groundwater Sampling

The three monitoring wells in the bedrock aquifer; and 13 site monitoring wells and 5 background monitoring wells in the alluvial aquifer will be sampled for TAL total and dissolved metals. In addition, the 13 site alluvial groundwater samples will be analyzed for VOCs, Fe^{2+}, DO, chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, TOC, VFAs, and methane, ethane, and ethane. The monitoring wells are listed in **Worksheet #18a** and shown on **Figure 1**. Sampling protocols will follow the SOPs referenced in **Worksheet #21** of **Appendix A**.

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

Matrix: Groundwater (Alluvial)
Analytical Group: VOC

ANALYTE	Chemical Abstract Service (CAS) #	RSLs Tap Water Adjusted, November 2012 (µg/L)	MCL (µg/L)	Project Quantitation Limit (PQL) Goal[2] (µg/L)	PAL[1] Reference	LOQ (µg/L)	Limit of Detection (LOD) (µg/L)	Detection Limit (DL) (µg/L)	Lower Control Limit (%)	Upper Control Limit (%)	% RPD
1,1,1-Trichloroethane	71-55-6	750	200	100.00	MCL	2.0	1.0	0.80	65	130	30
1,1,2,2-Tetrachloroethane	79-34-5	0.066	NC	0.03	RSL	2.0	1.0	0.54	65	130	30
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	76-13-1	5300	NC	2650.00	RSL	2.0	1.0	0.73	47	173	30
1,1,2-Trichloroethane	79-00-5	0.041	5	0.02	RSL	2.0	1.0	0.76	75	125	30
1,1-Dichloroethane	75-34-3	2.4	NC	1.20	RSL	2.0	1.0	0.62	70	135	30
1,1-Dichloroethene	75-35-4	26	7	3.50	MCL	2.0	1.0	0.94	70	130	30
1,2,4-Trichlorobenzene	120-82-1	0.39	70	0.20	RSL	2.0	1.0	0.70	65	135	30
1,2-Dibromo-3-chloropropane	96-12-8	0.00032	0.2	0.00	RSL	10	5.0	0.96	50	130	30
1,2-Dibromoethane	106-93-4	0.0065	0.05	0.00	RSL	2.0	1.0	0.78	80	120	30
1,2-Dichlorobenzene	95-50-1	28	600	14.00	RSL	2.0	1.0	0.73	70	120	30
1,2-Dichloroethane	107-06-2	0.15	5	0.08	RSL	2.0	1.0	0.63	70	130	30
1,2-Dichloropropane	78-87-5	0.38	5	0.19	RSL	2.0	1.0	0.80	75	125	30
1,3-Dichlorobenzene	541-73-1	NC	1.0	0.00	Not applicable (NA)	2.0	1.0	0.77	75	125	30
1,4-Dichlorobenzene	106-46-7	0.42	75	0.21	RSL	2.0	1.0	0.76	75	125	30
2-Butanone	78-93-3	490	NC	245.00	RSL	25	12	4.5	30	150	30
2-Hexanone	591-78-6	3.4	NC	1.70	RSL	5.0	2.5	1.4	55	130	30
4-Methyl-2-pentanone	108-10-1	100	NC	50.00	RSL	5.0	2.5	0.79	60	135	30
Acetone	67-64-1	1200	NC	600.00	RSL	25	12	1.8	40	140	30
Benzene	71-43-2	0.39	5	0.20	RSL	2.0	1.0	0.71	80	120	30
Bromodichloromethane	75-27-4	0.12	80	0.06	RSL	2.0	1.0	0.52	75	120	30
Bromoform	75-25-2	7.9	80	3.95	RSL	2.0	1.0	0.75	70	130	30
Bromomethane	74-83-9	0.7	NC	0.35	RSL	2.0	1.0	0.95	30	145	30
Carbon disulfide	75-15-0	72	NC	36.00	RSL	10	5.0	2.6	35	160	30
Carbon tetrachloride	56-23-5	0.39	5	0.20	RSL	2.0	1.0	0.94	65	140	30
Chlorobenzene	108-90-7	7.2	100	3.60	RSL	2.0	1.0	0.72	80	120	30
Chloroethane	75-00-3	2100	NC	1050.00	RSL	2.0	1.0	0.98	60	135	30
Chloroform	67-66-3	0.19	80	0.10	RSL	2.0	1.0	0.80	65	135	30

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

Matrix: Groundwater (Alluvial)
Analytical Group: VOC

ANALYTE	CAS #	RSLs Tap Water Adjusted, November 2012 (µg/L)	MCL (µg/L)	PQL Goal[2] (µg/L)	PAL[1] Reference	LOQ (µg/L)	LOD (µg/L)	DL (µg/L)	Lower Control Limit (%)	Upper Control Limit (%)	% RPD
Chloromethane	74-87-3	19	NC	9.50	RSL	2.0	1.0	0.82	40	125	30
cis-1,2-Dichloroethene	156-59-2	2.8	70	1.40	RSL	2.0	1.0	0.53	70	125	30
cis-1,3-Dichloropropene	10061-01-5	0.41	NC	0.21	RSL	2.0	1.0	0.59	70	130	30
Cyclohexane	110-82-7	1300	NC	650.00	RSL	2.0	1.0	0.93	45	147	30
Dibromochloromethane	124-48-1	0.15	80	0.08	RSL	2.0	1.0	0.44	60	135	30
Dichlorodifluoromethane (Freon-12)	75-71-8	19	NC	9.50	RSL	2.0	1.0	0.74	30	155	30
Ethylbenzene	100-41-4	1.3	700	0.65	RSL	2.0	1.0	0.69	75	125	30
Isopropylbenzene	98-82-8	39	NC	19.50	RSL	2.0	1.0	0.67	75	125	30
m- and p-Xylene	m&pXYLENE	19	NC	9.50	RSL	4.0	2.0	1.3	75	130	30
Methyl acetate	79-20-9	1600	NC	800.00	RSL	2.0	1.0	0.95	24	129	30
Methylcyclohexane	108-87-2	NC	NC	0.00	RSL	2.0	1.0	0.64	55	121	30
Methylene chloride	75-09-2	8.4	5	2.50	MCL	10	5.0	0.71	55	140	30
Methyl-tert-butyl ether	1634-04-4	12	NC	6.00	RSL	2.0	1.0	0.60	65	125	30
o-Xylene	95-47-6	19	NC	9.50	RSL	2.0	1.0	0.53	80	120	30
Styrene	100-42-5	110	100	50.00	MCL	2.0	1.0	0.61	65	135	30
Tetrachloroethene	127-18-4	3.5	5	1.75	RSL	2.0	1.0	0.76	45	150	30
Toluene	108-88-3	86	1000	43.00	RSL	2.0	1.0	0.72	75	120	30
trans-1,2-Dichloroethene	156-60-5	8.6	100	4.30	RSL	2.0	1.0	0.73	60	140	30
trans-1,3-Dichloropropene	10061-02-6	0.41	NC	0.21	RSL	2.0	1.0	0.73	55	140	30
TCE	79-01-6	0.26	5	0.13	RSL	2.0	1.0	0.89	70	125	30
Trichlorofluoromethane (Freon-11)	75-69-4	110	NC	55.00	RSL	2.0	1.0	0.94	60	145	30
Vinyl chloride	75-01-4	0.015	2	0.01	RSL	2.0	1.0	0.71	50	145	30
Xylene, total	1330-20-7	19	NC	9.50	RSL	4.0	3.0	1.3	75	130	30

Notes:
[1] PALs were developed to be protective of human health and the environment. See **Worksheet #11** for a discussion of the PALs**.**
[2] PQL Goals were determined on a case-by-case basis and in most cases are at least 2 times less than the PAL.
The RSL Tap Water for Groundwater values were adjusted from the USEPA RSLs Table (November2012).
MCL values are from the USEPA federal MCLs.
NC – No Criteria
Shading represents instances where the PAL is lower than the LOD. Non-detects will not be treated as exceedances, though they will be reported at a value greater than the PQL Goal.

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

Matrix: Groundwater (Alluvial)

Analytical Group: Wet Chemistry, various

Analyte	CAS Number	Performance Indication Level (µg/L)	Effect	Laboratory-specific			MS/MSD and LCS Control Limits		
				LOQ (µg/L)	LOD (µg/L)	DL (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.	5000	1200	290	90	110	10
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.	1000	210	52	90	110	10
Nitrite	14797-65-0			100	44	35	90	110	10
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.	5000	260	70	90	110	10

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

Matrix: Groundwater (Alluvial)
Analytical Group: Wet Chemistry, various

Analyte	CAS Number	Performance Indication Level (µg/L)	Effect	Laboratory-specific			MS/MSD and LCS Control Limits		
				LOQ (µg/L)	LOD (µg/L)	DL (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.	1000	1000	450	86	105	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.	2000	2000	2000	90	110	10
TOC	TOC1	> 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.	10000	660	220	85	115	21
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.	1	0.964	0.43	74	120	18

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

Matrix: Groundwater (Alluvial)
Analytical Group: Wet Chemistry, various

Analyte	CAS Number	Performance Indication Level (µg/L)	Effect	Laboratory-specific			MS/MSD and LCS Control Limits		
				LOQ (µg/L)	LOD (µg/L)	DL (µg/L)	LCL (%)	UCL (%)	RPD (%)
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.	2	1.96	0.2	75	123	14
Ethene	74-85-1			3	2.71	0.54	72	131	12
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.	100	100	31	73	125	10
Butyric Acid	107-92-6			100	100	31	80	120	10
Lactic Acid	79-33-4			200	200	95	70	130	30
Propionic Acid	79-09-04			100	100	63	80	120	10
Pyruvic Acid	127-17-3			100	100	10	37	142	10

[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.

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SAP Worksheet #15-7—Reference Limits and Evaluation Table

Matrix: Groundwater (Alluvial, Bedrock, and background)

Analytical Group: TAL Metals (Total and Dissolved)

ANALYTE	CAS #	RSLs Tap Water Adjusted, November 2012 (µg/L)	MCL (µg/L)	PQL Goal[2] (µg/L)	PAL[1] Reference	LOQ (µg/L)	LOD (µg/L)	DL (µg/L)	Lower Control Limit (%)	Upper Control Limit (%)	% RPD
Aluminum	7429-90-5	1600	NC	800.00	RSL	50.0	25.0	6.80	80	120	20
Antimony	7440-36-0	0.6	6	0.30	RSL	2.00	0.440	0.110	80	120	20
Arsenic	7440-38-2	0.045	10	0.02	RSL	20.0	10.0	0.610	80	120	20
Barium	7440-39-3	290	2000	145.00	RSL	10.0	8.00	2.00	80	120	20
Beryllium	7440-41-7	1.6	4	0.80	RSL	0.740	0.370	0.0940	80	120	20
Cadmium	7440-43-9	0.69	5	0.35	RSL	8.00	4.00	0.110	80	120	20
Calcium	7440-70-2	NC	NC	1200	NA	2400	1200	36.0	80	120	20
Chromium	7440-47-3	0.031	100	0.02	RSL	6.00	3.00	0.450	80	120	20
Cobalt	7440-48-4	0.47	NC	0.24	RSL	1.00	0.840	0.210	80	120	20
Copper	7440-50-8	62	1300	31.00	RSL	1.00	0.880	0.220	80	120	20
Iron	7439-89-6	1100	NC	550.00	RSL	30.0	15.0	3.80	80	120	20
Lead	7439-92-1	15	15	7.50	RSL, MCL	1.20	0.600	0.160	80	120	20
Magnesium	7439-95-4	NC	NC	120	NA	240	120	30.0	80	120	20
Manganese	7439-96-5	32	NC	16.00	RSL	2.56	1.28	0.320	80	120	20
Mercury	7439-97-6	0.43	2	0.22	RSL	0.200	0.0690	0.0230	80	120	20
Nickel	7440-02-0	30	NC	15.00	RSL	2.40	1.20	0.320	80	120	20
Potassium	7440-09-7	NC	NC	1750	NA	3500	1750	48.0	80	120	20
Selenium	7782-49-2	7.8	50	3.90	RSL	5.20	2.60	0.650	80	120	20
Silver	7440-22-4	7.1	NC	3.55	RSL	0.240	0.120	0.0290	80	120	20
Sodium	7440-23-5	NC	NC	120	NA	240	120	32.0	80	120	20
Thallium	7440-28-0	0.016	2	0.01	RSL	0.460	0.230	0.0580	80	120	20
Vanadium	7440-62-2	7.8	NC	3.90	RSL	1.00	0.800	0.200	80	120	20
Zinc	7440-66-6	470	NC	235.00	RSL	12.0	6.00	1.60	80	120	20

Notes:

[1] PALs were developed to be protective of human health and the environment. See **Worksheet #11** for a discussion of the PALs**.**

[2] PQL Goals were determined on a case-by-case basis and in most cases are at least 2 times less than the PAL.

The Tap Water RSL for Groundwater values were adjusted from the USEPA RSLs Table (November 2012).

MCL values are from the USEPA federal MCLs.

NC – No Criteria

Shading represents instances where the PAL is lower than the LOD. Non-detects will not be treated as exceedances, though they will be reported at a value greater than the PQL Goal.

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SAP Worksheet #16a—Project Schedule/Timeline Table

Task	Start	Finish
UFP-SAP Addendum		
Draft	June 2012	June 2013
Draft Final	June 2013	August 2013
Final	October 2013	December 2013
Fieldwork		
Water Level Monitoring	Fall 2013	Fall 2013
Alluvial Well Sampling	Fall 2013	Fall 2013
Bedrock Well Sampling	Fall 2013	Fall 2013
RI Report		
Draft	Spring 2014	Spring 2014
Draft Final	Summer 2014	Summer 2014
Final	Fall 2014	Fall 2014

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SAP Worksheet #17a—Sampling Design and Rationale

This worksheet presents the sampling design and rationale for this addendum. **Worksheet #14a** presents the detailed field tasks at each site; **Worksheet #18a** presents the sampling locations; and **Worksheet #19a** presents the analytical methods to be used.

Matrix	Depth of Samples	Analysis	Frequency	Number of Samples	Rationale	Sampling Strategy
Alluvial Wells						
Groundwater	Mid screen	VOCs, total and dissolved metals, chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, TOC, methane, ethane, ethene, VFAs, Fe2+, and DO	1 event	13	Recent sampling at the site has focused on VOCs; metals data are old and do not reflect current aquifer conditions because the two pilot studies could have changed the groundwater chemistry, thereby possibly mobilizing metals constituents. Groundwater samples will be collected from the existing 13 alluvial monitoring wells to evaluate current site-wide VOCs and metals concentrations.	The monitoring wells will be purged before sampling. Groundwater samples will be collected using low-flow sampling techniques.
Bedrock Wells						
Groundwater	Mid depth of open borehole	Total and dissolved metals	1 event	3	Historically, metals have been detected in the alluvial groundwater; however, only VOCs have been sampled for in the bedrock. In order to determine if the groundwater within the bedrock aquifer is contaminated with constituents attributable to the Site 13 alluvial aquifer contamination, samples will be collected from the three existing bedrock monitoring wells for metals.	The monitoring wells will be purged before sampling. Groundwater samples will be collected using low-flow sampling techniques
Background Wells						
Groundwater	Mid Screen	Total and dissolved metals	1 event	3	There are no established background values for metals in groundwater at ABL. In order to evaluate potential site related releases to groundwater associated with metals, groundwater samples will be collected from five monitoring wells adjacent to the site. (Attachment 1).	The monitoring wells will be purged before sampling. Groundwater samples will be collected using low-flow sampling techniques

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

Sampling Location/ Identification (ID) Number	Matrix	Depth Below Top of Casing (BTOC)	Analytical Group (See Worksheet #19)	Number of Samples	Proposed Sampling Dates	Sampling SOP Reference
AS13-GGW21-MMYY	Alluvial groundwater	23.5 ft BTOC	VOCs, total and dissolved metals, chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, TOC, methane, ethane, ethene, and VFAs	1	Fall 2013	**Appendix A**
AS13-GGW22-MMYY		24 ft BTOC	VOCs, total and dissolved metals, chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, TOC, methane, ethane, ethene, and VFAs	1		
AS13-GGW23-MMYY		16 ft BTOC	VOCs, total and dissolved metals, chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, TOC, methane, ethane, ethene, and VFAs	1		
AS13-GGW24-MMYY		22 ft BTOC	VOCs, total and dissolved metals, chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, TOC, methane, ethane, ethene, and VFAs	1		
AS13-GGW25-MMYY		21 ft BTOC	VOCs, total and dissolved metals, chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, TOC, methane, ethane, ethene, and VFAs	1		
AS13-GGW26-MMYY	Alluvial Groundwater	19.5 ft BTOC	VOCs, total and dissolved metals, chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, TOC, methane, ethane, ethene, and VFAs	1	Fall 2013	**Appendix A**
AS13-GGW27-MMYY		23.5’ BTOC	VOCs, total and dissolved metals, chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, TOC, methane, ethane, ethene, and VFAs	1		

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

Sampling Location/ Identification (ID) Number	Matrix	Depth Below Top of Casing (BTOC)	Analytical Group (See Worksheet #19)	Number of Samples	Proposed Sampling Dates	Sampling SOP Reference
AS13-GGW30-MMYY	Alluvial Groundwater	12.5 ft BTOC	VOCs, total and dissolved metals, chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, TOC, methane, ethane, ethene, and VFAs	1	Fall 2013	**Appendix A**
AS13-GGW31-MMYY		17.5 ft BTOC	VOCs, total and dissolved metals, chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, TOC, methane, ethane, ethene, and VFAs	1		

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

Sampling Location/ ID Number	Matrix	Depth Below Top of Casing (BTOC)	Analytical Group (See Worksheet #19)	Number of Samples	Proposed Sampling Dates	Sampling SOP Reference
AS13-GGW32-MMYY	Alluvial Groundwater	20 ft BTOC	VOCs, total and dissolved metals, chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, TOC, methane, ethane, ethene, and VFAs	1	Fall 2013	**Appendix A**
AS13-GGW33-MMYY		20 ft BTOC	VOCs, total and dissolved metals, chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, TOC, methane, ethane, ethene, and VFAs	1		
AS13-GGW34-MMYY		12.5 ft BTOC	VOCs, total and dissolved metals, chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, TOC, methane, ethane, ethene, and VFAs	1		
AS13-GGW35-MMYY		12.5 ft BTOC	VOCs, total and dissolved metals, chloride, nitrate, nitrite, sulfate, sulfide, alkalinity, TOC, methane, ethane, ethene, and VFAs	1		
AS13-GGW36-MMYY	Bedrock Groundwater	60-70 feet bgs	total and dissolved metals	1		
AS13-GGW37-MMYY			total and dissolved metals	1		
AS13-GGW38-MMYY			total and dissolved metals	1		
AS13-GGW25-MMYY	Background Groundwater	21 ft BTOC	total and dissolved metals	1		
4GW1-MMYY		15-20 feet BTOC	total and dissolved metals	1		
AS13-GGW05-MMY		15-20 feet BTOC	total and dissolved metals	1		
AS13-GGW07-MMY		15-20 feet BTOC	total and dissolved metals	1		
3GW3-MMYY		15-20 feet BTOC	total and dissolved metals	1		

Notes:
1 The field team may choose field duplicate locations in the field.
2 Appendix that contains the SOP to be used for the sample collection procedures. **Worksheet #21** also lists the SOPs and describes them in more detail.
MMYY: month and year TBD by sampling date

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SAP Worksheet #19a—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	VOC	SW-846 8260B / VGCMS-05	3X 40-milliliter (ml) volatile organic analyte (VOA) vials	40 ml	Hydrochloric acid (HCl) to pH<2, Cool to <6°C	14 days
	TAL Metals (Total and Dissolved)	SW-846 6020A, SW0846 7470A/MET-03 & MET-15	500-ml plastic	40 ml	Nitric acid (HNO3) to pH <2	180 days
	Alkalinity	310.1 / WETS-61	1 of 250 ml HDPE	20mL	Cool to <6°C	14 days
	Chloride, Nitrate, Nitrite, Sulfate	EPA 300.0 / WETS-57		50mL	Cool to <6°C	28 days
	Sulfide	EPA 376.1/WETS-061	250mL Plastic	250	ZnAc+NaOH to pH >12, Cool to 6° C	7 days
	TOC	SW-846 9060A / WETS-66	2X40mL VOA Vials	40mL	Cool to <6°C	28 days
	Methane, Ethane, and Ethene	RSK-175 / VGC-11	2X40mL VOA Vials	40ml	Cool to <6°C	7 days
	Volatile Fatty Acids	VGC-13 / VGC-13	2X40mL VOA Vials	40ml	Cool to <6°C	14 days

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

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SAP Worksheet #20a—Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Dups	No. of Matrix Spike (MS)/ Matrix Spike Duplicates (MSDs) [1]	No. of Field Blanks[2]	No. of Equip. Blanks[2]	No. of VOA Trip Blanks[2]	Total No. of Samples to Lab per Event
Alluvial Wells								
Groundwater	VOC	13	2	1/1	-	3	3	23
	TAL Metals (Total)	13	2	1/1	-	3	-	20
	TAL Metals (Dissolved)	13	2	1/1	-	3	-	20
	Alkalinity	13	2	1/1	-	-	-	17
	Chloride, Nitrate, Nitrite, and Sulfate	13	2	1/1	-	-	-	17
	Methane, Ethane, and Ethene	13	2	1/1	-	-	-	17
	Sulfide	13	2	1/1	-	-	-	17
	TOC	13	2	1/1	-	-	-	17
	Volatile Fatty Acids by AM23G	13	2	1/1	-	-	-	17
Bedrock Wells								
Groundwater	TAL Metals (Total)	3	1	1/1	-	1	-	7
	TAL Metals (Dissolved)	3	1	1/1	-	1	-	7
Background Wells								
Groundwater	TAL Metals (Total)	3	1	1/1	-	1	-	7
	TAL Metals (Dissolved)	3	1	1/1	-	1	-	7

Notes:
[1] Although the MS/MSD is not typically considered a field QC, it is included here because location determination is often established in the field.
[2] The number of equipment blanks, field blanks, and trip blanks is based on a fundamental assumption of the number of sampling days each site will require. It was assumed that the groundwater sampling will occupy two days and will occur simultaneously with the soil sampling. It was assumed that the soil sampling will occupy one day.

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SAP Worksheet #23a—Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and Number	Date reviewed if not revised	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM	Modified for Project Work? (Y/N)
LOGINS-03	Receiving Samples (Rev. 11, Effective 07/31/2012)	NA	NA	NA	NA	No	No
ADMIN-14	Waste Disposal and Characterization (Rev. 6, 09/16/2011)	NA	NA	NA	NA	No	No
VGCMS-05	Analysis of VOCs by Gas Chromatograph/Mass Spectrometer (GC/MS) (Rev. 18, 07/25/2012)	NA	Definitive	Aqueous/ Solids, Volatile Organics	GC/MS	No	No
EXMT-07	Acid Digestion of Aqueous Samples & Extracts for Analysis by Inductively Coupled Plasma (ICP) or Inductively Coupled Plasma-Mass Spectrometer (ICP-MS) (Rev.7, 08/23/2011)	NA	NA	Aqueous Extraction, Metals	NA	No	No
MET-15	Metals Analysis by ICP-MS (Rev. 5, 2/14/2011)	2/1/2012	Definitive	Aqueous, Metals	ICP-MS	Y - Do not Perform Method of Standard Additions (MSA)	No
MET-03	Mercury in Waters (Rev. 5, 02/20/2012)	NA	Definitive	Aqueous, Metals	Cold Vapor Atomic Absorption (CVAA)	Y - Do not Perform MSA	No

SAP Worksheet #23a—Analytical SOP References Table (continued)

Lab SOP Number	Title, Revision Date, and Number	Date reviewed if not revised	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM	Modified for Project Work? (Y/N)
VGC-11	Analysis of Dissolved Gases by Headspace GC/TCD/FID (Rev. 5, 06/24/2011)	08/14/2012	Definitive	Aqueous Dissolved Gases	GC	none	No
VGC-13	Volatile Fatty Acids in Aqueous Samples By HPLC/UV (Rev. 4, 11/02/2011)	9/28/2012	Definitive	Aqueous, Wet Chemistry	GC	none	No
WETS-004	Alkalinity (Titrametric, pH 4.5); EPA Method 310.1 (Rev. 9, 07/30/2012)	NA	Definitive	Aqueous/Solids, Alkalinity	Buret	none	No

SAP Worksheet #24a—Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference1
GC/MS (VOC)	Tuning	Prior to initial calibration (ICAL) and at the beginning of each 12-hour period.	Refer to method for specific ion criteria.	Retune instrument and verify. Rerun affected samples.	Analyst	VGCMS-05
	Minimum five-point ICAL for all analytes	ICAL prior to sample analysis.	1. Average response factor (RF) for Spill Prevention, Control, and Countermeasures (SPCCs): VOCs ≥0.30 for chlorobenzene and 1,1,2,2-tetrachlorolethane; VOCs ≥0.1 for chloromethane, bromoform, and 1,1-dichloroethane. 2. Relative Standard Deviation (RSD) for RFs for calibration check compounds (CCCs): VOCs ≤ 30% and one of the following options: Option 1: RSD for each analyte ≤ 15% Option 2: linear least squares regression r ≥ 0.995 Option 3: non-linear regression. Coefficient of determination (COD) r2 ≥ 0.990 (six points will be used for second order; seven points will be used for third order)	Correct problem then repeat ICAL.		
	Second-source initial calibration verification (ICV)	Once after each ICAL.	All project analytes within ± 20% of true value.	Correct problem and verify second-source standard. Rerun second-source ICV. If that fails, correct problem and repeat ICAL.		
	Retention time window position establishment for each analyte and surrogate.	Once per ICAL.	Position will be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial continuing calibration verification (CCV) is used.	NA		
	Evaluation of relative retention times (RRTs)	With each sample.	RRT of each target analyte within ± 0.06 RRT units.	Correct problem, then rerun ICAL.		
	CCV	Daily before sample analysis and every 12 hours of analysis time.	1. Average RF for SPCCs: VOCs≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachlorolethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-dichloroethane. 2. Percent Difference or Drift (%D) for all target compounds and surrogates: VOCs ≤ 20%D (Note: D = difference when using RFs or drift when using least squares regression or non-linear calibration).	DoD project-level approval must be obtained for each of the failed analytes or CA must be taken. Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.		

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

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference[1]
ICP-MS (Metals)	Tuning	Prior to ICAL.	Mass calibration≤ 0.1 atomic mass units (amu) from the true value; resolution < 0.9 amu full width at 10% peak height; for stability, RSD≤ 5% for at least four replicate analyses.	Retune instrument then reanalyze tuning solutions.	Analyst	MET-15
	ICAL for all analytes (minimum two-point calibration)	Daily ICAL prior to sample analysis.	More than one calibration standard is used, r 0.995.	Correct problem, then repeat ICAL.		
	Second-source ICV	Once after each ICAL, prior to beginning a sample run.	Value of second source for all analytes within ± 10% of true value.	Verify second-source standard. Rerun second-source ICV. If that fails, correct problem and repeat ICAL.		
	CCV	After every 10 field samples and at the end of the analysis sequence.	All analytes within ± 10% of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.		
	Calibration blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence.	No analytes detected > LOD.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.		
	Interference check solutions (ICS-A and ICS-AB)	At the beginning of an analytical run and every 12 hours.	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes) ICS-AB: Within ± 20% of true value.	Terminate analysis, locate and correct problem, reanalyze ICS, reanalyze all samples.		
CVAA (Mercury)	ICAL minimum five standards and a calibration blank	ICAL daily prior to sample analysis.	r >0.995; accepted if the ICV passes.	Correct problem, then repeat ICAL.	Analyst	MET-03
	Second-source Calibration Verification (SCV)	Once per ICAL, prior to beginning a sample run.	Less than 10% difference from ICV for all target analytes.	Correct problem, then repeat. If still fails, repeat ICAL.		
	CCV	Following SCV, after every 10 samples and the end of the sequence.	Within +/- 20% of true value.	Correct problem, then repeat. If still fails, repeat ICAL. Reanalyze all samples since the last successful calibration verification.		
	Calibration blank	Daily after ICAL and every 10 samples.	No analytes detected > LOD.	Correct problem, re-prep and reanalyze calibration blank. Reanalyze all samples following the last acceptable calibration blank.		

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

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference[1]
GC (Methane, Ethane, and Ethene)	Initial calibration (ICAL) for all analytes	Daily ICAL prior to sample analysis.	Calculate response factor (RF) for each standard, compute average response factor and percent RSD. RSD <20%. Optionally, a linear regression curve may be fit if the correlation coefficient > 0.990.	Correct problem then repeat ICAL.	Analyst	VGC-11
	Second source calibration verification	Once after each ICAL.	All project analytes within ± 25% of true value.	Verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.		
	Continuing calibration verification (CCV)	Before any samples in sequences that don't include initial calibrations, after every 24 hours, and at the end of the sequence.	All project analytes within ± 20% of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.		
IC (Chloride, Nitrate, Nitrite, Sulfate)	Initial calibration (ICAL), minimum of three standards and a calibration blank	Every 6 months, ICAL prior to sample analysis.	Coefficient of determination at least 0.995	Correct problem then repeat ICAL.	Analyst	WETS-57
	Second source calibration verification	Once after each ICAL.	All analytes within ± 10% of true value and retention times within appropriate windows	Verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.		
IC (Chloride, Nitrate, Nitrite, Sulfate)	Continuing calibration verification (CCV)	After every 10 field samples and at the end of the analysis sequence.	All project analytes within established retention time windows. Within ± 10% of true value.	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Analyst	WETS-57
	Retention Time Windows	One per multipoint calibration	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA		
TOC Analyzer (TOC)	Initial calibration (ICAL), minimum of five standards and a calibration blank	Annually, ICAL prior to sample analysis.	Coefficient of determination at least 0.995	Correct problem then repeat ICAL.	Analyst	WETS-66

Note:
DoD QSM v. 4.2 is the basis for specifications on this table. Specifications are based on the SW-846 method that will be performed. Laboratory SOPs and analytical methods are the basis for WCHEM analysis.

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SAP Worksheet #25a—Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference
GC/MS (VOC)	Clean sources, maintain vacuum pumps.	Tuning	Instrument performance and sensitivity.	Service vacuum pumps twice per year, other maintenance as needed.	Tune and CCV pass criteria.	Recalibrate instrument.	Analyst	VGCMS-05
	Change septum, clean injection port, change or clip column, install new liner, change trap.	Sensitivity check	Instrument performance and sensitivity.	Daily or as needed.	Tune and CCV pass criteria.	Re-inspect injector port, cut additional column, reanalyze CCV, and recalibrate instrument.		
ICP-MS (Metals)	Clean, inspect, change cones.	Monitor Internal Standard (IS) counts for variation	Instrument performance and sensitivity.	As needed.	Monitor IS counts for variation.	Recalibrate.	Analyst	MET-15
	Clean, inspect, change spray chamber, injector, torch.	Monitor IS counts for variation	Instrument performance and sensitivity.	As needed.	Monitor IS counts for variation.	Recalibrate.		
	Replace pump windings.	Monitor IS counts for variation	Instrument performance and sensitivity.	As needed.	Monitor IS counts for variation.	Replace windings, recalibrate and reanalyze.		
CVAA (Mercury)	Replace disposables, flush lines.	Sensitivity check	Instrument performance and sensitivity.	Daily or as needed.	CCV pass criteria.	Recalibrate.	Analyst	MET-03
	Clean lens.	Sensitivity check	Instrument performance and sensitivity.	Daily or as needed.	Method Blank pass criteria.	Recalibrate.		
	Replace pump tubing.	Flow Rate Check	Instrument performance and sensitivity.	As needed.	Monitor flow rate for variation.	Replace windings, recalibrate and reanalyze.		
GC (Methane, Ethane, and Ethene)	Injection port maintenance	MEE and VFAs	Evaluate baseline and peak shapes	As needed	Analyst judgment of excessive tailing or baseline fluctuation	Clip the guard column, replace the injection port liner, replace the gold seal, clean the injection port, replace the injection port septum.	Analyst	VGC-11; VGC-13
IC Chloride, Nitrate, Nitrite, Sulfate)	Fill eluent bottles and Fill reservoir water bottle.	Chloride, Nitrate, Nitrite, Sulfate	Visual	Weekly or as needed	NA	Fill bottle as needed	Analyst	WETS-57
	Check back pressure is below 2300 PSI.		Visual	Weekly or as needed	NA	clean or replace guard column and frit		
	Check IC for leaks.		visual check for liquid or pressure fluctuation	Weekly or as needed	NA	fix leak		

SAP Worksheet #25a—Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table (continued)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference
TOC Analyzer (TOC)	Inspect/Clean TOC syringe.	TOC	Visual	Monthly	NA	Clean as needed	Analyst	WETS-66
	Inspect Permeation Dryer.	NA	Visual	Monthly	NA	Replace if humidity observed		
	Test fittings on 8 port valve	NA	Visual check for leaks	Monthly	NA	Replace or tight fittings as needed		
	Replace Injection Line.	NA	Peak shape and uniformity between injection replicas	As needed	CCV pass criteria	Replace line		
	Replace Corrosive Scrubber(Tin and Copper).	NA	Color discoloration	As needed	CCV pass criteria	Replace Tin and Copper		
	Replace/wash and condition Catalys and Combustion Tube	NA	CCV passing	As needed	CCV pass criteria	Replace and condition.		

SAP Worksheet #26-1a—Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Project Field Team.
Sample Packaging (Personnel/Organization): Project Field Team.
Coordination of Shipment (Personnel/Organization): FTL/CH2M HILL
Type of Shipment/Carrier: FedEx Priority Overnight
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): ENCO employees
Sample Custody and Storage (Personnel/Organization): ENCO employees
Sample Preparation (Personnel/Organization): ENCO employees
Sample Determinative Analysis (Personnel/Organization): ENCO employees
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: ENCO employees
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 #28-1a—Laboratory QC Samples Table

Matrix: Groundwater (Alluvial)
Analytical Group: VOC
Analytical Method/SOP Reference: SW-846 8260B / VGCMS-05

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method blank	One per preparatory batch	No analytes detected > ½ reporting limit (RL) and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > RL (see Box D-1 of DoD QSM).	Correct problem, then see criteria in Box D-1of the DoD QSM. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/Contamination	No analytes detected > ½ reporting limit (RL) and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > RL (see Box D-1 of DoD QSM).
LCS		See **Worksheet #15-1a**	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.		Precision and Accuracy/Bias	See **Worksheet #15-1**
MS		Same as LCS.	In the absence of client-specific requirements, flag the data.		Precision and Accuracy/Bias	Same as LCS.
MSD		Same as LCS and RPD ≤30%.	In the absence of client-specific requirements, flag the data.		Precision and Accuracy/Bias	Same as LCS and RPD ≤30%.
IS	Spiked in every sample	Retention time within 30 seconds from retention time of the midpoint standard in the ICAL; areas within -50% to +100% of ICAL midpoint standard.	Inspect GC/MS for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.		Precision and Accuracy	Retention time within 30 seconds from retention time of the midpoint standard in the ICAL; areas within -50% to +100% of ICAL midpoint standard.
Surrogates		Dibromofluoromethane 85-115%, Toluene-d8 85-120%, 1,2-Dichloroethane-d4 70-120%, 4-Bromofluorobenzene 75-120%	Re-prep and reanalyze sample unless objective evidence of suspected or confirmed sample matrix effects are available. If insufficient sample exists for reanalysis, client will be contacted for instructions. In the absence of client instruction, data will be qualified.		Precision and Accuracy/Bias	Dibromofluoromethane 85-115%, Toluene-d8 85-120%, 1,2-Dichloroethane-d4 70-120%, 4-Bromofluorobenzene 75-120%

Notes:
DoD-QSM v 4.2 is the basis for this table.

SAP Worksheet #28-3a—Laboratory QC Samples Table

Matrix: Groundwater (Alluvial)
Analytical Group: Chloride, Nitrate, Nitrite, Sulfate
Analytical Method/SOP Reference: EPA 300/WETS-57

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	One per preparatory blank	No target analytes > 1/2 LOQ	Correct problem; then repeat. If the method blank still fails; repeat initial calibration.	Analyst	Bias/ contamination	No target analytes > 1/2 LOQ
LCS		90-110%	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. Client will be contact for guidance about whether to re-prep samples. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	90-110%
MS/MSD		90-110%, RPD 10%	In the absence of client specific requirements, flag the data		Precision and Accuracy/Bias	90-110%, RPD 10%

Notes:

DoD-QSM v 4.2 is the basis for this table.

SAP Worksheet #28-4a—Laboratory QC Samples Table

Matrix: Groundwater (Alluvial)
Analytical Group: Sulfide
Analytical Method/SOP Reference: EPA 376.1/WETS-61

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	One per preparatory blank	No target analytes > 1/2 LOQ	Correct problem; then repeat. If the method blank still fails; repeat initial calibration.	Analyst	Bias/ contamination	No target analytes > 1/2 LOQ
LCS		86-105%	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. Client will be contact for guidance about whether to re-prep samples. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	86-105%
MS/MSD		86-105%, RPD 10%	In the absence of client specific requirements, flag the data		Precision and Accuracy/Bias	86-105%, RPD 10%

Notes:

DoD-QSM v 4.2 is the basis for this table.

SAP Worksheet #28-5a—Laboratory QC Samples Table

Matrix: Groundwater (Alluvial)
Analytical Group: Alkalinity
Analytical Method/SOP Reference: EPA 310.1 / WETS-004

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	One per preparatory blank	No target analytes > 1/2 LOQ	Correct problem; then repeat. If the method blank still fails; repeat initial calibration.	Analyst	Bias/ contamination	No target analytes > 1/2 LOQ
LCS		90-110%	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. Client will be contact for guidance about whether to re-prep samples. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	90-110%
MS/MSD		90-110%, RPD 10%	In the absence of client specific requirements, flag the data		Precision and Accuracy/Bias	90-110%, RPD 10%

Notes:

DoD-QSM v 4.2 is the basis for this table.

SAP Worksheet #28-6a—Laboratory QC Samples Table

Matrix: Groundwater (Alluvial)

Analytical Group: TOC

Analytical Method/SOP Reference: SW-846 9060 / WETS-066

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	One per preparatory batch	No target analytes > 1/2 LOQ	Correct problem; then repeat. If the method blank still fails; repeat initial calibration.	Analyst	Bias/ contamination	No target analytes > 1/2 LOQ
LCS		90-110%	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	90-110%
MS/MSD		90-110%, RPD 10%	In the absence of client specific requirements, flag the data		Precision and Accuracy/Bias	90-110%, RPD 10%

Notes:

DoD-QSM v 4.2 is the basis for this table.

SAP Worksheet #28-7a—Laboratory QC Samples Table

Matrix: Groundwater (Alluvial)

Analytical Group: Methane, Ethane, and Ethene

Analytical Method/SOP Reference: RSK-175 / VGC-11

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	One per preparatory batch	No target analytes > 1/2 LOQ; no common laboratory contaminants > LOQ	Correct problem. If required, re-prep and re-analyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/ contamination	No target analytes > 1/2 LOQ
LCS		See **Worksheet #15-5a**	LCS is reanalyzed. If still fails, samples along with QC, are re-prepped and re-analyzed. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	See **Worksheet #15-5a**
MS/MSD		Same as LCS, See **Worksheet #15-5a** for RPD	In the absence of client specific requirements, flag the data		Precision and Accuracy/Bias	Same as LCS, See **Worksheet #15-5a** for RPD

Notes:

DoD-QSM v 4.2 is the basis for this table.

SAP Worksheet #28-8a—Laboratory QC Samples Table

Matrix: Groundwater (Alluvial)
Analytical Group: VFAs
Analytical Method/SOP Reference: VGC-13

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	One per preparatory batch	No target analytes > 1/2 LOQ; no common laboratory contaminants > LOQ	Correct problem. If required, re-prep and re-analyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/ contamination	No target analytes > 1/2 LOQ
LCS		See **Worksheet #15-5a**	LCS is reanalyzed. If still fails, samples along with QC, are re-prepped and re-analyzed. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	See **Worksheet #15-5a**
MS/MSD		Same as LCS, See **Worksheet #15-5a** for RPD	In the absence of client specific requirements, flag the data		Precision and Accuracy/Bias	Same as LCS, See **Worksheet #15-5a** for RPD
Surrogate	One per preparatory batch	Trimethylacetic Acid 80% - 124%	Re-prep and re-analyze sample unless objective evidence of suspected or confirmed sample matrix effects are available. If insufficient sample exists for reanalysis, client will be contacted for instructions. In the absence of client instruction, data will be qualified.		Precision and Accuracy/Bias	Method/SOP

SAP Worksheet #28-10—Laboratory QC Samples Table

Matrix: Groundwater (Alluvial and Bedrock)

Analytical Group: TAL Metals excluding Mercury (Total and Dissolved)

Analytical Method/SOP Reference: SW-846 6020A / MET-15

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch.	No analytes detected > ½ RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > RL (see Box D-1 of DoD QSM).	Correct problem, then see criteria in Box D-1of the DoD QSM. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/Contamination	No analytes detected > ½ RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > RL (see Box D-1 of DoD QSM).
LCS		See **Worksheet #15-3.**	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.		Precision and Accuracy/Bias	See **Worksheet #15-3.**
MS		Same as LCS.	Perform a dilution test and/or post-spike (PS) to evaluate matrix effects.		Precision and Accuracy/Bias	Same as LCS.
MSD		Same as LCS.	Perform a dilution test and/or PS to evaluate matrix effects.		Precision and Accuracy/Bias	Same as LCS.
Dilution Test		Recovery within ±10% of true value.	Perform PS.		Precision and Accuracy/Bias	Recovery within ±10% of true value.
PS	When dilution test fails or analyte concentration for all samples < 50x LOD.	Recovery within ±25% of true value.	If dilution test recovers outside of QC acceptance limits but PS meets QC acceptance criteria, matrix effects are not confirmed, reprep and reanalyze sample.		Precision and Accuracy/Bias	Recovery within ±25% of true value.
IS	Spiked in every sample.	IS intensity within 30-120% of intensity of IS in ICAL.	Reanalyze sample at 5X dilution with the addition of appropriate amounts of IS		Precision and Accuracy	IS intensity within 30-120% of intensity of IS in ICAL.

Notes:

DoD-QSM v 4.2 is the basis for this table.

SAP Worksheet #28-11—Laboratory QC Samples Table

Matrix: Groundwater (Alluvial and Bedrock)

Analytical Group: Total Metals (Mercury)

Analytical Method/SOP Reference: SW-846 7470B/MET-03

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch.	No analytes detected > ½ RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > RL (see Box D-1 of DoD QSM).	Correct problem, then see criteria in Box D-1of the DoD QSM. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/Contamination	No analytes detected > ½ RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > RL (see Box D-1 of DoD QSM).
LCS		See **Worksheet #15-3.**	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available.		Precision and Accuracy/Bias	See **Worksheet #15-3.**
MS		Same as LCS.	In the absence of client-specific requirements, flag the data.		Precision and Accuracy/Bias	Same as LCS.
MSD		Same as LCS and RPD ≤ 20%.	In the absence of client-specific requirements, flag the data.		Precision and Accuracy/Bias	Same as LCS and RPD ≤ 20%.

Notes:
DoD-QSM v 4.2 is the basis for this table.

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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
Groundwater	VOC	See Worksheet #18	SW-846 8260B	28 calendar days	ENCO Ronnie Wambles 10775 Central Port Drive Orlando, FL 32824 (407) 826-5314	TBD[1]
	Alkalinity		EPA 310.1			
	Chloride, Nitrate, Nitrite, Sulfate		EPA 300.0			
	TAL Metals (Total and Dissolved)		SW-846 6020A			
	Total and Dissolved Mercury		SW-846 7470A			
	Sulfide		EPA 376.1			
	TOC		SW-846 9060A			
	Methane, Ethane, Ethene		RSK-175			
	Volatile Fatty Acids		VGC-13			

[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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References

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

CH2M HILL. 2011. *Summary of 27-Month Post-Injection Performance Monitoring and Interim ERD Performance Assessment at Site 13, Range Road, Technical Memorandum Allegany Ballistics Laboratory, Rocket Center, West Virginia*. November

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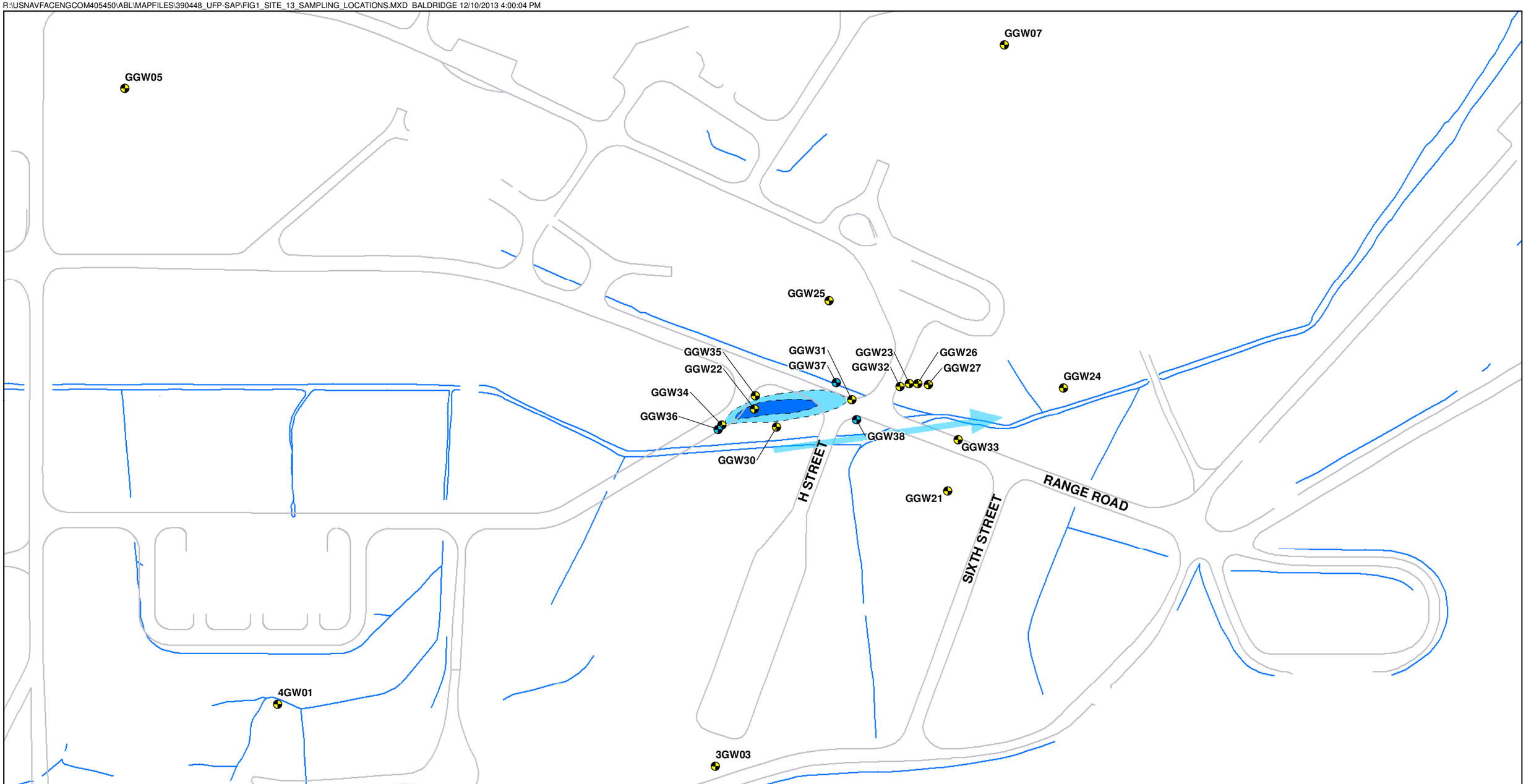
Figures

R:\USNAVFACENGCOM405450\ABL\MAPFILES\390448_UFP-SAP\FIG1_SITE_13_SAMPLING_LOCATIONS.MXD BALDRIDGE 12/10/2013 4:00:04 PM



Legend

- Bedrock Monitoring Well
- Alluvial Monitoring Wells
- Groundwater Flow Direction
- Paved Roads
- Water Bodies

Inferred TCE Concentrations

- 5 - 50 µg/L
- >50 µg/L

Note

Isoconcentration contour projections based on interpretation of most recent alluvial sampling in January of 2012.

N

0 60 120 Feet

1 inch = 120 feet

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

CH2MHILL

Appendix A
Uniform Federal Policy Sampling and Analysis Plan
Site 13 Remedial Investigation
November 2011

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

November 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)

Review Signatures:

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Brett Doerr/CH2M HILL Activity Quality Manager/Date

5/5/11
Steven Glennie/CH2M HILL Activity Manager/Date

5/5/11
Jennifer Myers/CH2M HILL Project Manager/Date

Approval Signatures:

Draft UFP-SAP signed 6/18/10 by Jonathan Tucker

Janice Nielsen/Navy Chemist/NAVFAC Atlantic/Date

Other Approval Signatures:

5/9/11
William Fraser/Navy Technical Representative /NAVFAC Mid-Atlantic/Date

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

Thomas Bass/WVDEP Remedial Project Manager/Date

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

Review Signatures:

5/6/11

Brett Doerr/CH2M HILL Activity Quality Manager/Date

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Draft UFP-SAP signed 10/15/10 by Janice Nielsen

Janice Nielsen/Navy Chemist/NAVFAC Atlantic/Date

Other Approval Signatures:

5/9/11

William Fraser/Navy Technical Representative /NAVFAC Mid-Atlantic/Date

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 at 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 Test America 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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Appendices

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
Sarah Kloss	Remedial Project Manager (RPM)	EPA Region III	(215) 814-3379	Kloss.Sarah@epamail.epa.gov
Tom Bass	RPM	WVDEP	(304) 926-0449	Thomas.I.Bass@wv.gov
Jamie Butler	Activity Manager (AM)	CH2M HILL	(757) 671-6212	Jamie.Butler @ch2m.com
Jennifer Myers	Project Manager (PM)	CH2M HILL	(703) 376-5203	Jennifer.Myers@ch2m.com
Steve Glennie	Senior Consultant/Activity Quality Manager (AQM)	CH2M HILL	(703) 376-5122	Steven.Glennie@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		
Ryan Hall	Project Manager	Test America Laboratories- Pittsburgh (TAL-Pittsburgh)	(412) 963-2430	ryan.hall@testamericainc.com
Ward Dickens or his designee	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			
Ryan Hall	TAL-Pittsburgh	(412) 963-2430			
Ward Dickens or his designee	CH2M HILL/ Senior Chemist and Data Validator	(352) 384-7049			

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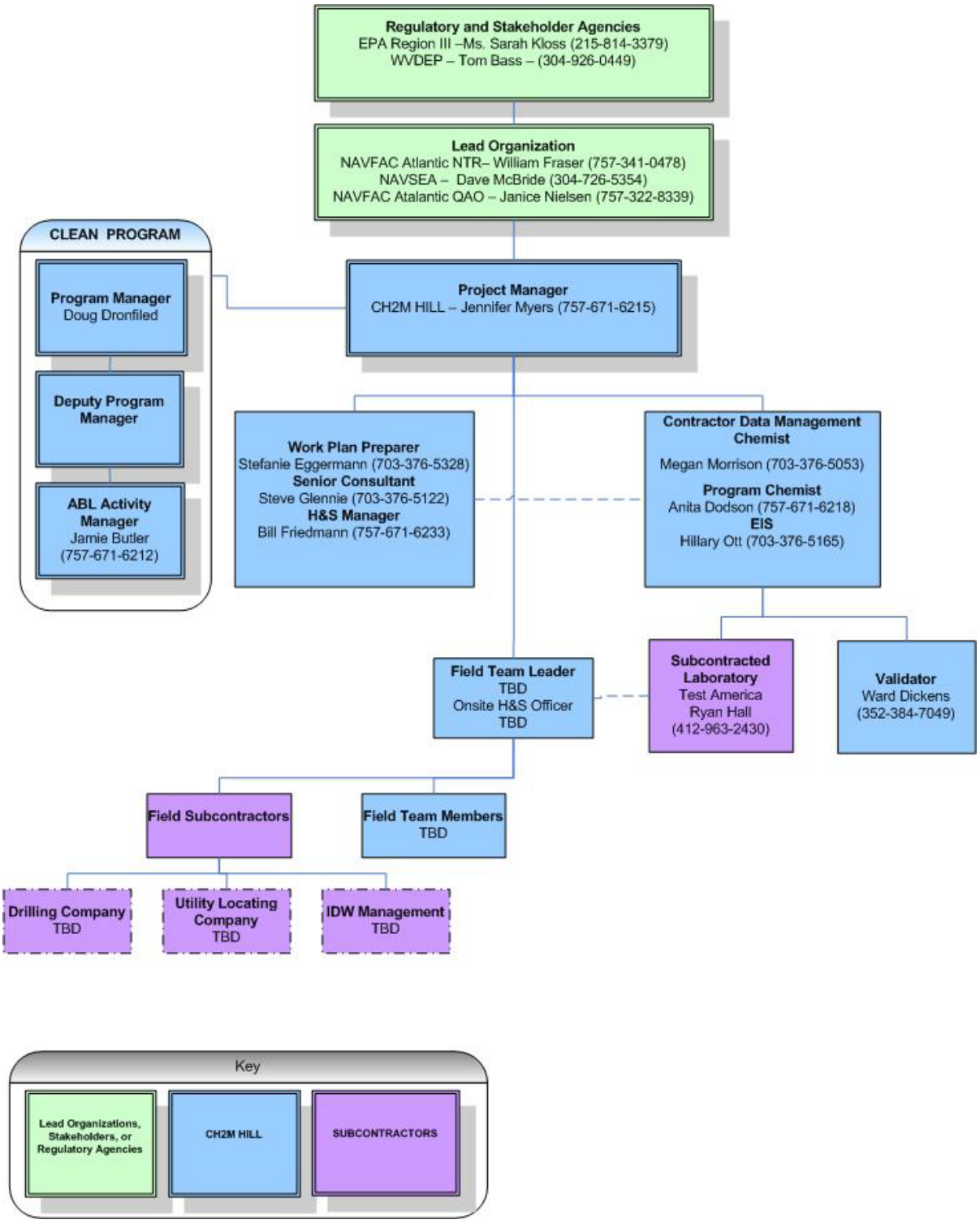
SAP Worksheet #5—Project Organizational Chart



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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	Sarah Kloss	Kloss.Sarah@epamail.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	Jamie Butler	Jamie.Butler@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	TAL-Pittsburgh Project Manager and CH2M HILL Data Validator	Ryan Hall Ward Dickens	ryan.hall@testamericainc.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
Sarah Kloss	RPM	EPA Region III	Reviews SAP and provides input for the EPA
Tom Bass	RPM	WVDEP	Reviews SAP and provides input for the WVDEP
Jamie Butler	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
Steve Glennie	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
Ryan Hall	Laboratory PM	TAL-Pittsburgh	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 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 TAL-Pittsburgh under subcontract to CH2M HILL for analysis. TAL-Pittsburgh will send VFA and Methane, Ethane, Ethene samples to TAL-Buffalo. All laboratory project management will be conducted through the Pittsburgh laboratory.

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.

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

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.

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 LOQ except common lab/field contaminants (acetone, 2-butanone, methylene chloride) < LOQ	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 LOQ except common lab/field contaminants (acetone, 2-butanone, methylene chloride) < LOQ	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 LOQ	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 LOQ	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 LOQ	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 LOQ	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 LOQ	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 LOQ	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 LOQ	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 sediment 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 internally 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 LOD and DL, 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] (ug/L)	Project Quantitation Limit Goal[2] (ug/L)	Laboratory-specific			MS/MSD and LCS Control Limits		
				LOQ (ug/L)	LOD (ug/L)	DL (ug/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
1,1,1-Trichloroethane	71-55-6	910	303.33	5	1.0297	1.0297	65	130	30
1,1,2,2-Tetrachloroethane	79-34-5	0.067	0.02	5	0.9323	0.9323	65	130	30
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	76-13-1	5900	1966.67	5	0.3304	0.3304	62	122	30
1,1,2-Trichloroethane	79-00-5	0.24	0.08	5	1.1613	1.1613	75	125	30
1,1-Dichloroethane	75-34-3	2.4	0.8	5	1.0131	1.0131	70	135	30
1,1-Dichloroethene	75-35-4	34	11.33	5	1.0662	1.0662	70	130	30
1,2,4-Trichlorobenzene	120-82-1	0.41	0.14	5	0.3767	0.3767	65	135	30
1,2-Dibromo-3-chloropropane	96-12-8	0.00032	0.0001	5	0.3521	0.3521	50	130	30
1,2-Dibromoethane	106-93-4	0.0065	0.002	5	0.6118	0.6118	80	120	30
1,2-Dichlorobenzene	95-50-1	37	12.33	5	0.6815	0.6815	70	120	30
1,2-Dichloroethane	107-06-2	0.15	0.05	5	0.959	0.959	70	130	30

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

Analyte	CAS Number	Adjusted Tap Water RSLs[1] (ug/L)	Project Quantitation Limit Goal[2] (ug/L)	Laboratory-specific			MS/MSD and LCS Control Limits		
				LOQ (ug/L)	LOD (ug/L)	DL (ug/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
1,2-Dichloropropane	78-87-5	0.39	0.13	5	1.2753	1.2753	75	125	30
1,3-Dichlorobenzene	541-73-1	NC	0.5058	5	0.5058	0.5058	75	125	30
1,4-Dichlorobenzene	106-46-7	0.43	0.14	5	0.5262	0.5262	75	125	30
2-Butanone	78-93-3	710	236.67	5	1.0841	1.0841	30	150	30
2-Hexanone	591-78-6	4.7	1.57	5	0.5695	0.5695	55	130	30
4-Methyl-2-pentanone	108-10-1	200	66.67	5	0.591	0.591	60	135	30
Acetone	67-64-1	2200	733.33	20	1.6505	1.6505	40	140	30
Benzene	71-43-2	0.41	0.14	5	0.9894	0.9894	80	120	30
Bromochloromethane	74-97-5	NC	1.0066	5	1.0066	1.0066	65	130	30
Bromodichloromethane	75-27-4	0.12	0.04	5	0.9311	0.9311	75	120	30
Bromoform	75-25-2	8.5	2.83	5	1.0686	1.0686	70	130	30
Bromomethane	74-83-9	0.87	0.29	5	1.5756	1.5756	30	145	30
Carbon disulfide	75-15-0	100	33.33	5	1.0741	1.0741	35	160	30
Carbon tetrachloride	56-23-5	0.2	0.07	5	1.0832	1.0832	65	140	30
Chlorobenzene	108-90-7	9.1	3.03	5	0.5261	0.5261	80	120	30
Chloroethane	75-00-3	2100	700.00	5	0.7471	0.7471	60	135	30

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

Analyte	CAS Number	Adjusted Tap Water RSLs[1] (ug/L)	Project Quantitation Limit Goal[2] (ug/L)	Laboratory-specific			MS/MSD and LCS Control Limits		
				LOQ (ug/L)	LOD (ug/L)	DL (ug/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
Chloroform	67-66-3	0.19	0.06	5	1.0077	1.0077	65	135	30
Chloromethane	74-87-3	19	6.33	5	1.3907	1.3907	40	125	30
cis-1,2-Dichloroethene	156-59-2	37	12.33	5	0.6651	0.6651	70	125	30
cis-1,3-Dichloropropene	10061-01-5	0.43	0.14	5	0.7261	0.7261	70	130	30
Cyclohexane	110-82-7	1300	433.33	5	0.5967	0.5967	63	131	30
Dibromochloromethane	124-48-1	0.15	0.05	5	0.6482	0.6482	60	135	30
Dichlorodifluoromethane (Freon-12)	75-71-8	40	13.33	5	0.635	0.635	30	155	30
Ethylbenzene	100-41-4	1.5	0.5	5	0.6202	0.6202	75	125	30
Isopropylbenzene	98-82-8	68	22.67	5	0.5308	0.5308	75	125	30
m- and p-Xylene	m&pXYLENE	NC	1.2808	10	1.2808	1.2808	75	130	30
Methyl acetate	79-20-9	3700	1233.33	5	1.2276	1.2276	50	150	30
Methylcyclohexane	108-87-2	NC	0.5568	5	0.5568	0.5568	50	150	30
Methylene chloride	75-09-2	4.8	1.60	5	1.0892	1.0892	55	140	30
Methyl-tert-butyl ether (MTBE)	1634-04-4	13	4.33	5	1.0259	1.0259	65	125	30
o-Xylene	95-47-6	120	40.00	5	0.7335	0.7335	80	120	30
Styrene	100-42-5	160	53.33	5	0.6394	0.6394	65	135	30

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

Analyte	CAS Number	Adjusted Tap Water RSLs[1] (ug/L)	Project Quantitation Limit Goal[2] (ug/L)	Laboratory-specific			MS/MSD and LCS Control Limits		
				LOQ (ug/L)	LOD (ug/L)	DL (ug/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
Tetrachloroethene	127-18-4	0.11	0.04	5	0.8249	0.8249	45	150	30
Toluene	108-88-3	230	76.67	5	0.8451	0.8451	75	120	30
trans-1,2-Dichloroethene	156-60-5	11	3.67	5	0.7517	0.7517	60	140	30
trans-1,3-Dichloropropene	10061-02-6	0.43	0.14	5	0.5823	0.5823	55	140	30
Trichloroethene	79-01-6	0.23	0.08	5	0.8011	0.8011	70	125	30
Trichlorofluoromethane(Freon-11)	75-69-4	130	43.33	5	1.1192	1.1192	60	145	30
Vinyl chloride	75-01-4	0.016	0.005	5	1.2902	1.2902	50	145	30

[1] PALs were developed to be protective of human health. 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 minimum PAL. The laboratory will J-qualify results between the LOQ and DL. J-qualified results are considered usable for project decisions. If no PALs are available, the PQL Goal is equal to the Laboratory LOD.

NC = No Criteria

Adjusted Tap Water RSLs are the USEPA Regional Screening Levels for Tap Water, adjusted for noncancerous effects. by dividing RSLs based on noncancer by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver).

Shading represents cases where the PAL is lower than the laboratory LOD.

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

Matrix: Surface Water

Analytical Group: VOCs

Analyte	CAS Number	Adjusted Tap Water RSLs x 10 for SW[1] (ug/L)	Eco PALs[1] (ug/L)	Project Quantitation Limit Goal[2] (ug/L)	Laboratory-specific			MS/MSD and LCS Control Limits		
					LOQ (ug/L)	LOD (ug/L)	DL (ug/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
1,1,1-Trichloroethane	71-55-6	9100	11	3.67	5	1.0297	1.0297	65	130	30
1,1,2,2-Tetrachloroethane	79-34-5	0.67	610	0.22	5	0.9323	0.9323	65	130	30
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	76-13-1	59000	NC	19666.67	5	0.3304	0.3304	62	122	30
1,1,2-Trichloroethane	79-00-5	2.4	1200	0.8	5	1.1613	1.1613	75	125	30
1,1-Dichloroethane	75-34-3	24	47	8	5	1.0131	1.0131	70	135	30
1,1-Dichloroethene	75-35-4	340	25	8.33	5	1.0662	1.0662	70	130	30
1,2,4-Trichlorobenzene	120-82-1	4.1	110	1.37	5	0.3767	0.3767	65	135	30
1,2-Dibromo-3-chloropropane	96-12-8	0.0032	NC	0.001	5	0.3521	0.3521	50	130	30
1,2-Dibromoethane	106-93-4	0.065	NC	0.02	5	0.6118	0.6118	80	120	30
1,2-Dichlorobenzene	95-50-1	370	14	4.67	5	0.6815	0.6815	70	120	30
1,2-Dichloroethane	107-06-2	1.5	910	0.5	5	0.959	0.959	70	130	30
1,2-Dichloropropane	78-87-5	3.9	525	1.3	5	1.2753	1.2753	75	125	30
1,3-Dichlorobenzene	541-73-1	NC	71	23.67	5	0.5058	0.5058	75	125	30
1,4-Dichlorobenzene	106-46-7	4.3	15	1.43	5	0.5262	0.5262	75	125	30
2-Butanone	78-93-3	7100	14000	2366.67	5	1.0841	1.0841	30	150	30

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

Analyte	CAS Number	Adjusted Tap Water RSLs x 10 for SW[1] (ug/L)	Eco PALs[1] (ug/L)	Project Quantitation Limit Goal[2] (ug/L)	Laboratory-specific			MS/MSD and LCS Control Limits		
					LOQ (ug/L)	LOD (ug/L)	DL (ug/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
2-Hexanone	591-78-6	47	99	15.67	5	0.5695	0.5695	55	130	30
4-Methyl-2-pentanone	108-10-1	2000	170	56.67	5	0.591	0.591	60	135	30
Acetone	67-64-1	22000	1500	500	20	1.6505	1.6505	40	140	30
Benzene	71-43-2	4.1	130	1.37	5	0.9894	0.9894	80	120	30
Bromochloromethane	74-97-5	NC	NC	1.0066	5	1.0066	1.0066	65	130	30
Bromodichloromethane	75-27-4	1.2	NC	0.4	5	0.9311	0.9311	75	120	30
Bromoform	75-25-2	85	320	28.33	5	1.0686	1.0686	70	130	30
Bromomethane	74-83-9	8.7	16	2.9	5	1.5756	1.5756	30	145	30
Carbon disulfide	75-15-0	1000	0.92	0.31	5	1.0741	1.0741	35	160	30
Carbon tetrachloride	56-23-5	2	240	0.67	5	1.0832	1.0832	65	140	30
Chlorobenzene	108-90-7	91	64	21.33	5	0.5261	0.5261	80	120	30
Chloroethane	75-00-3	21000	NC	7000	5	0.7471	0.7471	60	135	30
Chloroform	67-66-3	1.9	28	0.63	5	1.0077	1.0077	65	135	30
Chloromethane	74-87-3	190	5500	63.33	5	1.3907	1.3907	40	125	30
cis-1,2-Dichloroethene	156-59-2	370	590	123.33	5	0.6651	0.6651	70	125	30
cis-1,3-Dichloropropene	10061-01-5	4.3	0.055	0.02	5	0.7261	0.7261	70	130	30
Cyclohexane	110-82-7	13000	NC	4333.33	5	0.5967	0.5967	63	131	30

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

Analyte	CAS Number	Adjusted Tap Water RSLs x 10 for SW[1] (ug/L)	Eco PALs[1] (ug/L)	Project Quantitation Limit Goal[2] (ug/L)	Laboratory-specific			MS/MSD and LCS Control Limits		
					LOQ (ug/L)	LOD (ug/L)	DL (ug/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
Dibromochloromethane	124-48-1	1.5	NC	0.5	5	0.6482	0.6482	60	135	30
Dichlorodifluoromethane (Freon-12)	75-71-8	400	NC	133.33	5	0.635	0.635	30	155	30
Ethylbenzene	100-41-4	15	90	5	5	0.6202	0.6202	75	125	30
Isopropylbenzene	98-82-8	680	2.6	0.87	5	0.5308	0.5308	75	125	30
m- and p-Xylene	m&pXYLENE	NC	67	22.33	10	1.2808	1.2808	75	130	30
Methyl acetate	79-20-9	37000	NC	12333.33	5	1.2276	1.2276	50	150	30
Methylcyclohexane	108-87-2	NC	NC	0.5568	5	0.5568	0.5568	50	150	30
Methylene chloride	75-09-2	48	2200	16	5	1.0892	1.0892	55	140	30
Methyl-tert-butyl ether (MTBE)	1634-04-4	130	10000	43.33	5	1.0259	1.0259	65	125	30
o-Xylene	95-47-6	1200	13	4.33	5	0.7335	0.7335	80	120	30
Styrene	100-42-5	1600	72	24	5	0.6394	0.6394	65	135	30
Tetrachloroethene	127-18-4	1.1	98	0.37	5	0.8249	0.8249	45	150	30
Toluene	108-88-3	2300	9.8	3.27	5	0.8451	0.8451	75	120	30
trans-1,2-Dichloroethene	156-60-5	110	590	36.67	5	0.7517	0.7517	60	140	30
trans-1,3-Dichloropropene	10061-02-6	4.3	0.055	0.02	5	0.5823	0.5823	55	140	30
Trichloroethene	79-01-6	2.3	47	0.77	5	0.8011	0.8011	70	125	30

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

Analyte	CAS Number	Adjusted Tap Water RSLs x 10 for SW[1] (ug/L)	Eco PALs[1] (ug/L)	Project Quantitation Limit Goal[2] (ug/L)	Laboratory-specific			MS/MSD and LCS Control Limits		
					LOQ (ug/L)	LOD (ug/L)	DL (ug/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
Trichlorofluoromethane(Freon -11)	75-69-4	1300	NC	433.33	5	1.1192	1.1192	60	145	30
Vinyl chloride	75-01-4	0.16	930	0.05	5	1.2902	1.2902	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 minimum PAL. The laboratory will J-qualify results between the LOQ and DL. J-qualified results are considered usable for project decisions. If no PALs are available, the PQL Goal is equal to the Laboratory LOD.

NC = No Criteria

Adjusted Tap Water RSLs are the USEPA Regional Screening Levels for Tap Water, adjusted for cancerous/ noncancerous effects. by dividing RSLs based on noncancer by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver). Values were multiplied by 10 to account for surface water.

Eco PALs are derived from literature-based screening values.

Shading represents cases where the PAL is lower than the laboratory LOD.

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

Matrix: Pore Water

Analytical Group: VOCs

Analyte	CAS Number	Eco PALs[1] (ug/L)	Project Quantitation Limit Goal[2] (ug/L)	Laboratory-specific			MS/MSD and LCS Control Limits		
				LOQ (ug/L)	LOD (ug/L)	DL (ug/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
1,1,1-Trichloroethane	71-55-6	11	3.67	5	1.0297	1.0297	65	130	30
1,1,2,2-Tetrachloroethane	79-34-5	610	203.33	5	0.9323	0.9323	65	130	30
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	76-13-1	NC	0.3304	5	0.3304	0.3304	62	122	30
1,1,2-Trichloroethane	79-00-5	1200	400	5	1.1613	1.1613	75	125	30
1,1-Dichloroethane	75-34-3	47	15.67	5	1.0131	1.0131	70	135	30
1,1-Dichloroethene	75-35-4	25	8.33	5	1.0662	1.0662	70	130	30
1,2,4-Trichlorobenzene	120-82-1	110	36.67	5	0.3767	0.3767	65	135	30
1,2-Dibromo-3-chloropropane	96-12-8	NC	0.3521	5	0.3521	0.3521	50	130	30
1,2-Dibromoethane	106-93-4	NC	0.6118	5	0.6118	0.6118	80	120	30
1,2-Dichlorobenzene	95-50-1	14	4.67	5	0.6815	0.6815	70	120	30
1,2-Dichloroethane	107-06-2	910	303.33	5	0.959	0.959	70	130	30
1,2-Dichloropropane	78-87-5	525	175	5	1.2753	1.2753	75	125	30
1,3-Dichlorobenzene	541-73-1	71	23.67	5	0.5058	0.5058	75	125	30
1,4-Dichlorobenzene	106-46-7	15	5	5	0.5262	0.5262	75	125	30

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

Matrix: Pore Water

Analytical Group: VOCs

Analyte	CAS Number	Eco PALs[1] (ug/L)	Project Quantitation Limit Goal[2] (ug/L)	Laboratory-specific			MS/MSD and LCS Control Limits		
				LOQ (ug/L)	LOD (ug/L)	DL (ug/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
2-Butanone	78-93-3	14000	4666.67	5	1.0841	1.0841	30	150	30
2-Hexanone	591-78-6	99	33	5	0.5695	0.5695	55	130	30
4-Methyl-2-pentanone	108-10-1	170	56.67	5	0.591	0.591	60	135	30
Acetone	67-64-1	1500	500	20	1.6505	1.6505	40	140	30
Benzene	71-43-2	130	43.33	5	0.9894	0.9894	80	120	30
Bromochloromethane	74-97-5	NC	1.0066	5	1.0066	1.0066	65	130	30
Bromodichloromethane	75-27-4	NC	0.9311	5	0.9311	0.9311	75	120	30
Bromoform	75-25-2	320	106.67	5	1.0686	1.0686	70	130	30
Bromomethane	74-83-9	16	5.33	5	1.5756	1.5756	30	145	30
Carbon disulfide	75-15-0	0.92	0.31	5	1.0741	1.0741	35	160	30
Carbon tetrachloride	56-23-5	240	80	5	1.0832	1.0832	65	140	30
Chlorobenzene	108-90-7	64	21.33	5	0.5261	0.5261	80	120	30
Chloroethane	75-00-3	NC	0.7471	5	0.7471	0.7471	60	135	30
Chloroform	67-66-3	28	9.33	5	1.0077	1.0077	65	135	30

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

Matrix: Pore Water

Analytical Group: VOCs

Analyte	CAS Number	Eco PALs[1] (ug/L)	Project Quantitation Limit Goal[2] (ug/L)	Laboratory-specific			MS/MSD and LCS Control Limits		
				LOQ (ug/L)	LOD (ug/L)	DL (ug/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
Chloromethane	74-87-3	5500	1833.33	5	1.3907	1.3907	40	125	30
cis-1,2-Dichloroethene	156-59-2	590	196.67	5	0.6651	0.6651	70	125	30
cis-1,3-Dichloropropene	10061-01-5	0.055	0.02	5	0.7261	0.7261	70	130	30
Cyclohexane	110-82-7	NC	0.5967	5	0.5967	0.5967	63	131	30
Dibromochloromethane	124-48-1	NC	0.6482	5	0.6482	0.6482	60	135	30
Dichlorodifluoromethane (Freon-12)	75-71-8	NC	0.635	5	0.635	0.635	30	155	30
Ethylbenzene	100-41-4	90	30	5	0.6202	0.6202	75	125	30
Isopropylbenzene	98-82-8	2.6	0.87	5	0.5308	0.5308	75	125	30
m- and p-Xylene	m&pXYLENE	67	22.33	10	1.2808	1.2808	75	130	30
Methyl acetate	79-20-9	NC	1.2276	5	1.2276	1.2276	50	150	30
Methylcyclohexane	108-87-2	NC	0.5568	5	0.5568	0.5568	50	150	30
Methylene chloride	75-09-2	2200	733.33	5	1.0892	1.0892	55	140	30
Methyl-tert-butyl ether (MTBE)	1634-04-4	10000	3333.33	5	1.0259	1.0259	65	125	30
o-Xylene	95-47-6	13	4.33	5	0.7335	0.7335	80	120	30
Styrene	100-42-5	72	24	5	0.6394	0.6394	65	135	30

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

Matrix: Pore Water

Analytical Group: VOCs

Analyte	CAS Number	Eco PALs[1] (ug/L)	Project Quantitation Limit Goal[2] (ug/L)	Laboratory-specific			MS/MSD and LCS Control Limits		
				LOQ (ug/L)	LOD (ug/L)	DL (ug/L)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
Tetrachloroethene	127-18-4	98	32.67	5	0.8249	0.8249	45	150	30
Toluene	108-88-3	9.8	3.27	5	0.8451	0.8451	75	120	30
trans-1,2-Dichloroethene	156-60-5	590	196.67	5	0.7517	0.7517	60	140	30
trans-1,3-Dichloropropene	10061-02-6	0.055	0.02	5	0.5823	0.5823	55	140	30
Trichloroethene	79-01-6	47	15.67	5	0.8011	0.8011	70	125	30
Trichlorofluoromethane(Freon-11)	75-69-4	NC	1.1192	5	1.1192	1.1192	60	145	30
Vinyl chloride	75-01-4	930	310	5	1.2902	1.2902	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 minimum PAL. The laboratory will J-qualify results between the LOQ and DL. J-qualified results are considered usable for project decisions. If no PALs are available, the PQL Goal is equal to the Laboratory LOD.

NC = No Criteria

Eco PALs are derived from literature-based screening values.

Shading represents cases where the PAL is lower than the laboratory LOD.

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

Matrix: Sediment

Analytical Group: VOCs

Analyte	CAS Number	Adjusted Residential Soil RSLs x 10 for SD[1] (ug/kg)	Eco PALs[1] (ug/kg)	Project Quantitation Limit Goal[2] (ug/kg)	Laboratory-specific			MS/MSD and LCS Control Limits		
					LOQ (ug/kg)	LOD (ug/kg)	DL (ug/kg)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
1,1,1-Trichloroethane	71-55-6	640	170	56.67	250	51.49	51.49	70	135	30
1,1,2,2-Tetrachloroethane	79-34-5	5.6	940	1.87	250	46.62	46.62	55	130	30
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	76-13-1	910	NC	303.33	250	16.52	16.52	55	130	30
1,1,2-Trichloroethane	79-00-5	11	1200	3.67	250	58.07	58.07	60	125	30
1,1-Dichloroethane	75-34-3	33	27	9	250	50.66	50.66	75	125	30
1,1-Dichloroethene	75-35-4	240	31	10.33	250	53.31	53.31	65	135	30
1,2,4-Trichlorobenzene	120-82-1	62	9200	20.67	250	18.84	18.84	65	130	30
1,2-Dibromo-3-chloropropane	96-12-8	0.054	NC	0.018	250	17.61	17.61	40	135	30
1,2-Dibromoethane	106-93-4	0.34	NC	0.11	250	30.59	30.59	70	125	30
1,2-Dichlorobenzene	95-50-1	380	340	113.33	250	34.08	34.08	75	120	30
1,2-Dichloroethane	107-06-2	4.3	250	1.43	250	47.95	47.95	70	135	30
1,2-Dichloropropane	78-87-5	9	NC	3	250	63.77	63.77	70	120	30
1,3-Dichlorobenzene	541-73-1	NC	1700	566.67	250	25.29	25.29	70	125	30
1,4-Dichlorobenzene	106-46-7	24	350	8	250	26.31	26.31	70	125	30

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

Matrix: Sediment

Analytical Group: VOCs

Analyte	CAS Number	Adjusted Residential Soil RSLs x 10 for SD[1] (ug/kg)	Eco PALs[1] (ug/kg)	Project Quantitation Limit Goal[2] (ug/kg)	Laboratory-specific			MS/MSD and LCS Control Limits		
					LOQ (ug/kg)	LOD (ug/kg)	DL (ug/kg)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
2-Butanone	78-93-3	28000	NC	9333.33	250	54.21	54.21	30	160	30
2-Hexanone	591-78-6	210	NC	70	250	28.48	28.48	45	145	30
4-Methyl-2-pentanone	108-10-1	3400	NC	1133.33	250	29.55	29.55	45	145	30
Acetone	67-64-1	61000	NC	20333.33	1000	250	250	20	160	30
Benzene	71-43-2	11	57	3.67	250	49.47	49.47	75	125	30
Bromochloromethane	74-97-5	NC	NC	46.56	250	46.56	46.56	70	125	30
Bromodichloromethane	75-27-4	2.7	NC	0.9	250	53.43	53.43	70	130	30
Bromoform	75-25-2	620	650	206.67	250	78.78	78.78	55	135	30
Bromomethane	74-83-9	7.3	NC	2.43	250	53.71	53.71	30	160	30
Carbon disulfide	75-15-0	740	0.85	0.28	250	54.16	54.16	45	160	30
Carbon tetrachloride	56-23-5	2.5	1200	0.83	250	26.31	26.31	65	135	30
Chlorobenzene	108-90-7	290	820	96.67	250	50.33	50.33	75	125	30
Chloroethane	75-00-3	2100	NC	700	250	37.36	37.36	40	155	30
Chloroform	67-66-3	3	22	1	250	50.39	50.39	70	125	30

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

Matrix: Sediment

Analytical Group: VOCs

Analyte	CAS Number	Adjusted Residential Soil RSLs x 10 for SD[1] (ug/kg)	Eco PALs[1] (ug/kg)	Project Quantitation Limit Goal[2] (ug/kg)	Laboratory-specific			MS/MSD and LCS Control Limits		
					LOQ (ug/kg)	LOD (ug/kg)	DL (ug/kg)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
Chloromethane	74-87-3	120	NC	40	250	69.54	69.54	50	130	30
cis-1,2-Dichloroethene	156-59-2	780	400	133.33	250	33.26	33.26	65	125	30
cis-1,3-Dichloropropene	10061-01-5	17	0.051	0.017	250	36.31	36.31	70	125	30
Cyclohexane	110-82-7	120	NC	40	250	29.84	29.84	64	130	30
Dibromochloromethane	124-48-1	6.8	NC	2.27	250	32.41	32.41	65	130	30
Dichlorodifluoromethane (Freon-12)	75-71-8	180	NC	60	250	31.75	31.75	35	135	30
Ethylbenzene	100-41-4	54	3600	18	250	31.01	31.01	75	125	30
Isopropylbenzene	98-82-8	270	86	28.67	250	26.54	26.54	75	130	30
m- and p-Xylene	m&pXYLENE	NC	940	313.33	250	61.38	61.38	80	125	30
Methyl acetate	79-20-9	29000	NC	9666.67	250	51.3	51.3	48	132	30
Methylcyclohexane	108-87-2	NC	NC	27.84	250	27.84	27.84	66	135	30
Methylene chloride	75-09-2	110	370	36.67	250	54.46	54.46	55	140	30
Methyl-tert-butyl ether (MTBE)	1634-04-4	430	NC	143.33	500	64.04	64.04	75	126	30
o-Xylene	95-47-6	430	160	53.33	250	36.68	36.68	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 x 10 for SD[1] (ug/kg)	Eco PALs[1] (ug/kg)	Project Quantitation Limit Goal[2] (ug/kg)	Laboratory-specific			MS/MSD and LCS Control Limits		
					LOQ (ug/kg)	LOD (ug/kg)	DL (ug/kg)	Lower Control Limit (LCL) (%)	Upper Control Limit (UCL) (%)	RPD (%)
Styrene	100-42-5	870	559	186.33	250	31.97	31.97	75	125	30
Tetrachloroethene	127-18-4	5.5	530	1.83	250	41.25	41.25	65	140	30
Toluene	108-88-3	820	670	223.33	250	42.26	42.26	70	125	30
trans-1,2-Dichloroethene	156-60-5	150	400	50	250	37.59	37.59	65	135	30
trans-1,3-Dichloropropene	10061-02-6	17	0.051	0.017	250	29.12	29.12	65	125	30
Trichloroethene	79-01-6	4.4	1600	1.47	250	40.06	40.06	75	125	30
Trichlorofluoromethane(Freon-11)	75-69-4	790	NC	263.33	250	55.96	55.96	25	185	30
Vinyl chloride	75-01-4	0.6	NC	0.2	250	64.51	64.51	60	125	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 minimum PAL. The laboratory will J-qualify results between the LOQ and DL. J-qualified results are considered usable for project decisions. If no PALs are available, the PQL Goal is equal to the Laboratory LOD.

NC = No Criteria
Adjusted Tap Water RSLs are the USEPA Regional Screening Levels for Residential Soil, adjusted for cancerous/ noncancerous effects. by dividing RSLs based on noncancer by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver). Values were multiplied by 10 to account for sediment.

Eco PALs are derived from literature-based screening values.

Shading represents cases where the PAL is lower than the laboratory LOD.

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

Matrix: Groundwater

Analytical Group: Wet Chemistry, various

Analyte	CAS Number	Performance Indication Level (ug/L)	Effect	Laboratory-specific			MS/MSD and LCS Control Limits		
				LOQ (ug/L)	LOD (ug/L)	DL (ug/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.	1000	195.2	195.2	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.	50	42.5	42.5	90	110	20
Nitrite	14797-65-0			50	24	24	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.	1000	214.1	214.1	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 (ug/L)	Effect	Laboratory-specific			MS/MSD and LCS Control Limits		
				LOQ (ug/L)	LOD (ug/L)	DL (ug/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.	3000	1227	1227	85	115	20
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.	5000	411.1	411.1	80	120	20
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.	1000	188.5	188.5	80	120	20

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

Matrix: Groundwater

Analytical Group: Wet Chemistry, various

Analyte	CAS Number	Performance Indication Level (ug/L)	Effect	Laboratory-specific			MS/MSD and LCS Control Limits		
				LOQ (ug/L)	LOD (ug/L)	DL (ug/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.	1	0.222	0.222	67	140	50
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.	1.5	0.492	0.492	41	176	50
Ethene	74-85-1			1.5	0.523	0.523	62	143	50
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.	1000	150	150	80	120	20
Butyric Acid	107-92-6			1000	160	160	80	120	20
Lactic Acid	79-33-4			1000	140	140	80	120	20
Propionic Acid	79-09-04			1000	170	170	80	120	20
Pyruvic Acid	127-17-3			1000	80	80	80	120	20

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

Matrix: Groundwater

Analytical Group: Wet Chemistry, various

Analyte	CAS Number	Performance Indication Level (ug/L)	Effect	Laboratory-specific			MS/MSD and LCS Control Limits		
				LOQ (ug/L)	LOD (ug/L)	DL (ug/L)	LCL (%)	UCL (%)	RPD (%)

[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	Project Quantitation Limit Goal[2] (mg/kg)	Laboratory-specific			MS/MSD and LCS Control Limits		
			LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)	LCL (%)	UCL (%)	RPD (%)
TOC	TOC	1000	1000	250.95	250.95	75	125	20

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 2012	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 2012	
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 2012 Fall 2012 Winter 2012 Spring 2013	
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 2012 Fall 2012 Winter 2012 Spring 2013	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 2012 Fall 2012 Winter 2012 Spring 2013	
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 2012 Fall 2012 Winter 2012 Spring 2013	
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		

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-GGW30-MMYY			VOCs (PDB's), Chloride, Nitrate, Nitrite, Sulfate, Sulfide, Alkalinity, TOC, Methane, Ethane, Ethene, VFAs	4	June 2011 November 2011 February 2012 May 2012	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/ PT-MS-002	3 x 40 mL VOC vial	40 mL	pH <2, HCl	14 days
Groundwater	Chloride, Nitrate, Nitrite, Sulfate	EPA 300.0/ PT-GC-009	1 x 250 mL poly bottle	50 mL	cool, 4°C	48 hrs nitrate & nitrite 28 days sulfate & chloride
	Sulfide	EPA 376.1/ PT-WC-010	1 x 500 mL poly bottle	500 mL	Zn Acetate NaOH	7 days
	Alkalinity	EPA 310.1/ PT-WC-003	1 x 250 mL poly bottle	10 mL	cool, 4°C	14 days
	Methane, Ethane, Ethene	RSK-175/ BF-GV-001	3 x 40 mL VOC vial	40 mL	cool, 4°C	14 days
	VFA's	SM5560 Modified/ BF-MB-009	1 x 250 mL amber bottle	250 mL	pH <2, H_3PO_4	28 days
Groundwater, Surface Water	TOC	SW-846 9060/ PT-WC-017	1 x 250 mL poly bottle	10 mL	pH <2, H_2SO_4	28 days
Sediment	TCL VOCs	SW-846 8260B/ PT-MS-002	1-2 ounce glass jar	5 g	cool, 4°C	14 days
	TOC	Lloyd Kahn/ PT-GC-010	1-2 ounce glass jar	10 g	cool, 4°C	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)
PT-GC-009	Determination of Inorganic Ions by Ion Chromatography (IC), Revision 11, 7/28/2010	Screening	Aqueous/ Chloride, Nitrate, Nitrite, Sulfate	IC	TA Pittsburgh	N
PT-GC-010	Total Organic Carbon Analysis for Solid and Sediment Matrices, Revision 4, 6/23/2010	Screening	Sediment/ TOC	Thermo Flash EA 1112 Series	TA Pittsburgh	N
PT-MS-002	Determination of Volatile Organics by GC/MS, Revision 17, 8/16/2011	Definitive	Aqueous, Sediment/ VOCs	GCMS	TA Pittsburgh	Y
PT-QA-027	Sample Receipt and Chain of Custody, Revision 15, 6/13/2011	NA	All	NA	TA Pittsburgh	N
PT-WC-003	Alkalinity, EPA Method 510.1 & SM2320B, Revision 5, 9/23/2010	Screening	Aqueous/ Alkalinity	Titration	TA Pittsburgh	N
PT-WC-010	Total Sulfide as Acid Soluble Sulfide, Revision 11, 10/3/2010	Screening	Aqueous/ Sulfide	Titration	TA Pittsburgh	N
PT-WC-017	Total Organic Carbon (TOC) and Total Inorganic Carbon (TIC), Revision 9, 9/9/2010	Screening	Aqueous/ TOC	TOC Analyzer	TA Pittsburgh	N
BF-GV-001	Dissolved Gasses-Modified RSK-175, Revision 4, 4/12/2011	Screening	Aqueous/ Methane, Ethane, Ethene	GC	TA Buffalo	N
BF-MB-009	Volatile Fatty Acids, Revision 1, 8/16/11	Screening	Aqueous/ Volatile Fatty Acids	IC	TA Buffalo	N

Laboratory SOP PT-MS-002 was modified in order to use DoD QSM limits for LCS and MS/MSD Recoveries, Surrogate Recoveries, and Calibration criteria. Test America Pittsburgh's policy in their SOP was to use internal laboratory criteria (statistically based) for these QC samples. However, in some cases these limits were broader than those in the DoD QSM. Test America has agreed to apply DoD QSM limits and criteria where applicable. Their LIMS system is not set up not compare to QSM limits for sediment; therefore, the analyst and/or their supervisor will perform a manual comparison to criteria after analysis is complete. If there are any exceedances, they will consult with the CH2M HILL project chemist.

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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 (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	PT-MS-002
	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*: non-linear regression - coefficient of determination r^2 ≥ 0.99	Correct problem; Repeat calibration		
	Initial Calibration Verification (ICV)	After each initial calibration	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%D	Reanalyze CCV; if failure, repeat ICAL. Reanalyze all samples since last acceptable CCV.		
	BFB Tune	Every 12 hours	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; rerun 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	BF-GV-001
	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 (Chloride, Nitrate, Nitrite, Sulfate)	ICAL	Daily before sample analysis	R $\geq$ 0.995	Correct problem - Repeat calibration	Analyst/supervisor	PT-GC-009
	ICV	After each initial calibration	All analytes within $\pm$10% of expected value	Reanalyze ICV; if failure, repeat ICAL		
	CCV	Prior to sequence, every 10 samples and end of sequence	$\pm$10%	Reanalyze CCV; if failure, repeat ICAL		
IC (VFAs)	ICAL	Initially and upon failure of two consecutive CCVs	R $\geq$ 0.995	Correct problem -Repeat calibration	Analyst/Supervisor	BF-MB-009
	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		
TOC Analyzer (Waters)	ICAL	As needed and upon failure of two consecutive CCVs	R $\geq$ 0.995	Correct problem -Repeat calibration	Analyst/Supervisor	PT-WC-017
	ICV	After each initial calibration	Analyte within $\pm$10% of expected value	Reanalyze ICV; if failure, repeat calibration		
	CCV	Every ten samples and end of sequence	$\pm$15%	Reanalyze CCV; if failure, repeat calibration		
TOC Analyzer (Sediment)	ICAL	As needed and upon failure of two consecutive CCVs	R $\geq$ 0.995	Correct problem -Repeat calibration	Analyst/Supervisor	PT-GC-010
	ICV	After each initial calibration	Analyte within $\pm$15% of expected value	Reanalyze ICV; if failure, repeat calibration		
	CCV	Every ten samples and end of sequence	$\pm$15%	Reanalyze CCV; if failure, repeat calibration		

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	Clean mass spectrometer source, change/check helium, change trap, clip column, change purge and trap ferrules, bake out column	VOCs	Purge lines, purge flow, trap, ion source, column	Prior to calibration check and/or as necessary	Acceptable ICAL or CCV	Correct problem and repeat ICAL or CCV	Analyst / Supervisor	PT-MS-002
GC	Change/check helium, clip column, bake column	Methane, Ethane, Ethene	Check gases					BF-GV-001
IC	Monitor system pressure, change guard catridges, reverse column, filter samples @ 0.45 microns	VFAs	Monitor system pressure, check for leaks, check guard catridges					BF-MB-009
IC	Monitor system pressure, monitor baseline detecter output, change guard catridges, degas eluent, filter samples @ 0.45 microns	Chloride, Nitrate, Nitrite, Sulfate	Monitor system pressure, check for leaks, check guard catridges		Acceptable ICAL			PT-GC-009
TOC Analyzer (Water)	Check gas supply, check for leaks, replace CO_2 absorber, replace halogen scrubber, wash TC and IC reactors	TOC	check gas, scrubbers, reactors,					PT-WC-017
TOC Analyzer (Soil)	Check gas supply, check for leaks, replace CO_2 absorber, replace halogen scrubber, replace combustion tube, replace TC catalyst	TOC	check gas, scrubbers, reactors,					PT-GC-010

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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): TAL-Pittsburgh and Buffalo employees
Sample Custody and Storage (Personnel/Organization): TAL-Pittsburgh and Buffalo employees
Sample Preparation (Personnel/Organization): TAL-Pittsburgh and Buffalo employees
Sample Determinative Analysis (Personnel/Organization): TAL-Pittsburgh and Buffalo employees
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: TAL-Pittsburgh and Buffalo employees
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 TAL-Pittsburgh. TAL-Pittsburgh will send VFA and MEE samples to TAL-Buffalo.
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: PT-QA-027
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: SW846-8260B/ PT-MS-002

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 <1/2 LOQ except common lab/field contaminants (acetone, 2-butanone, methylene chloride) < LOQ	Investigate source of contamination. Reanalyze sample. If required, reprep all samples processed with contaminated blank.	Analyst/ Supervisor	Bias/ Contamination	All target compounds <1/2 LOQ except common lab/field contaminants (acetone, 2-butanone, methylene chloride) < LOQ
Laboratory Control Sample (LCS)		See limits on Worksheet #15-1	Correct problem, then reprep and reanalyze LCS and all associated samples.		Accuracy/bias	See limits on Worksheet #15-1
Matrix Spike (MS)			Contact client for additional measures to be taken.		Accuracy/bias	
Matrix Spike Duplicate (MSD)					Accuracy/bias, precision	
Internal Standards (IS)	every sample	Retention times ±30 seconds and EICP area within -50 to +100% of ICAL midpoint std	Inspect GC/MS for malfunctions or interferences. Reanalyze sample		Accuracy/bias	Retention times ±30 seconds and EICP area within -50 to +100% of ICAL midpoint std
Surrogates	every sample	See limits on Worksheet #28-1a	Reanalyze sample		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: SW846-8260B/ PT-MS-002

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 or less	All target compounds <1/2 LOQ except common lab/field contaminants (acetone, 2-butanone, methylene chloride) < LOQ	Investigate source of contamination. Reanalyze sample. If required, reprep all samples processed with contaminated blank.	Analyst/ Supervisor	Bias/ Contamination	All target compounds <1/2 LOQ except common lab/field contaminants (acetone, 2-butanone, methylene chloride) < LOQ
LCS	1 per batch of 20 samples or less	See limits on Worksheet #15-4	Contact project chemist. Correct problem, then reprep and reanalyze LCS and all associated samples.		Accuracy/bias	See limits on Worksheet #15-4
MS			Contact client for additional measures to be taken.		Accuracy/bias	
MSD					Accuracy/bias, precision	
IS	every sample	Retention times ±30 seconds and EICP area within -50 to +100% of ICAL midpoint std	Inspect GC/MS for malfunctions or interferences. Reanalyze sample		Accuracy/bias	Retention times ±30 seconds and EICP area within -50 to +100% of ICAL midpoint std
Surrogates	every sample	See limits on Worksheet #28-2a	Reanalyze sample		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/ PT-GC-009

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 < 1/2 LOQ	Investigate source of contamination. Reanalyze sample. If required, reprep all samples processed with contaminated blank.	Analyst/ Supervisor	Bias/ Contamination	All target compounds < 1/2 LOQ
MS/MSD		See limits on Worksheet #15-5	Examine recovery of LCS; if LCS is not acceptable, re-prepare and reanalyze batch		Accuracy/ bias, precision	See Worksheet #15-5
LCS		See limits on Worksheet #15-5	Reanalyze sample. If failures exceed marginal exceedance guidelines, reprep 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/ PT-WC-010

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 < 1/2 LOQ	Case narrative anomaly - initiate CAR.	Analyst/ Supervisor	Bias/ Contamination	Target compound < 1/2 LOQ
MS/MSD		See limits on Worksheet #15-5	If criteria is not met, repeat the analysis once. Results with the better RPD will be reported.		Accuracy/bias, precision	See Worksheet #15-5
LCS		See limits on Worksheet #15-5	Case narrative anomaly - initiate CAR.		Accuracy/bias	See Worksheet #15-5

SAP Worksheet #28-5—Laboratory QC Samples Table

Matrix: Groundwater

Analytical Group: Alkalinity

Analytical Method/ SOP Reference: EPA 310.2/ PT-WC-003

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 < 1/2 LOQ	Investigate source of contamination. Reanalyze sample. If required, reprep all samples processed with contaminated blank.	Analyst/ Supervisor	Bias/ Contamination	Target compound < 1/2 LOQ
MS/MSD		See limits on Worksheet #15-5	Reanalyze sample. If failure, reprep all samples in batch.		Accuracy/bias, precision	See limits on Worksheet #15-5
LCS		See limits on Worksheet #15-5	Reanalyze sample. If failure, reprep 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/ PT-WC-017

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 < 1/2 LOQ	Investigate source of contamination. Reanalyze sample.	Analyst/ Supervisor	Contamination	Target compound < 1/2 LOQ
MS/MSD		See limits on Worksheet #15-5	Reanalyze sample. If failure, reanalyze all samples in batch.		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 Worksheet #15-5

SAP Worksheet #28-7—Laboratory QC Samples Table

Matrix: Groundwater

Analytical Group: Methane, Ethane, Ethene

Analytical Method/ SOP Reference: RSK-175/ BF-GV-001

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 < 1/2 LOQ	Investigate source of contamination. Reanalyze sample.	Analyst/ Supervisor	Contamination	Target compound < 1/2 LOQ
MS/MSD		See limits on Worksheet #15-5	Reanalyze sample. If failure, reanalyze all samples in batch.		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 Worksheet #15-5

SAP Worksheet #28-8—Laboratory QC Samples Table

Matrix: Groundwater

Analytical Group: VFA's

Analytical Method/ SOP Reference: SM 5560 M/ BF-MB-009

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 < 1/2 LOQ	Investigate source of contamination. Reanalyze sample.	Analyst/ Supervisor	Contamination	Target compound < 1/2 LOQ
MS/MSD		See limits on Worksheet #15-5	Reanalyze sample. If failure, reanalyze all samples in batch.		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 Worksheet #15-5

SAP Worksheet #28-9—Laboratory QC Samples Table

Matrix: Sediment

Analytical Group: TOC

Analytical Method/ SOP Reference: Lloyd Kahn/ PT-GC-010

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 < 1/2 LOQ	Investigate source of contamination. Reanalyze sample.	Analyst/ Supervisor	Contamination	Target compound < 1/2 LOQ
MS/MSD		See limits on Worksheet #15-6	Reanalyze sample. If failure, reanalyze all samples in batch.		Accuracy/bias, precision	See Worksheet #15-6
LCS		See limits on Worksheet #15-6	Reanalyze sample. If failure, reanalyze all samples in batch.		Accuracy/bias	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	TAL-Pittsburgh Ryan Hall 301 Alpha Drive Pittsburgh PA 15238 (412) 963-2430	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		TAL-Buffalo TBD 10 Hazelwood Drive Amherst, NY 14228 716-691-2600	
	VFA's		SM 5560 Modified			

[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	QA Officer, TAL-Pittsburgh	QA Officer, TAL-Pittsburgh	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	QA Officer, TAL-Pittsburgh	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/ TAL-Pittsburgh and Buffalo
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

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Appendix B
DOD ELAP Certification Letter

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

ENVIRONMENTAL CONSERVATION LABORATORIES – ORLANDO
10775 Central Port Drive
Orlando, FL 32824
Russell Macomber Phone: 407 826 5314
rmacomber@encolabs.com

ENVIRONMENTAL

Valid To: March 31, 2014 Certificate Number: 3000.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 4.2 of the DoD Quality Systems Manual for Environmental Laboratories) accreditation is granted to this laboratory to perform recognized EPA methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

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

5301 Buckeystown Pike, Suite 350 | Frederick, Maryland 21704-8373 | Phone: 301 644 3248 | Fax: 301 662 2974 | www.A2LA.org

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Metals	EPA 6020A/200.8	EPA 6020A
Zinc	EPA 6020A/200.8	EPA 6020A
Microbiology		
Total Coliforms	SM 9222B	----------
Fecal Coliforms	SM 9222D	----------
General Chemistry		
Acidity, as $CaC0_3$	EPA 305.1/SM 2310 B (4A)	----------
Alkalinity as $CaC0_3$	EPA 310.1/SM 2320 B	EPA 310.1/SM 2320 B
Alkalinity as $CaC0_3$	EPA 310.2	EPA 310.2
Biochemical oxygen demand	EPA 405.1/SM 5210 B	----------
Bromide	EPA 300.0/9056A	EPA 9056A
Carbonaceous BOD (CBOD)	SM 5210 B	----------
Chemical oxygen demand	EPA 410.4	----------
Chloride	EPA 300.0/9056A	EPA 9056A
Chromium VI	EPA 7196/ SM 3500-Cr D	EPA 7196
Conductivity	EPA 120.1	----------
Cyanide	EPA 335.2/SM 4500-CN E	EPA 9014
Cyanide, Reactive	----------	SW-846 7.3.3
Ferric iron (calculated)	SM 3500-Fe D	----------
Ferrous iron	SM 3500-Fe D	----------
Fluoride	EPA 300.0/9056A	EPA 9056A
Hardness	EPA 130.2/SM 2340 C	----------
Kjeldahl nitrogen -total	EPA 351.2	EPA351.2
Nitrate as N	EPA 300.0/353.1/9056A	EPA 353.1/9056A
Nitrate-nitrite	EPA 300.0/353.1/9056A	EPA 353.1/9056A
Nitrite as N	EPA 300.0/354.1/9056A/SM 4500-NO_2 B	EPA 9056A/ SM 4500-NO_2 B
Organic nitrogen	EPA 351.2/350.1	EPA 351.2/350.1
Orthophosphate as P	EPA 365.1	----------
Orthophosphate as P	EPA 365.3	----------
pH	EPA 150.1/9040C/SM 4500-H^+-B	EPA 9045D
Phosphorus, total	EPA 365.4	EPA 365.4
Residue-filterable (TDS)	SM 2540 C	----------
Residue-nonfilterable (TSS)	SM 2540 D	----------
Residue-total	SM 2540 B/SM 2540 G/EPA 160.3	SM 2540G/EPA 160.3
Residue-volatile	EPA 160.4	EPA 160.4
Sulfate	EPA 300.0/9056A	EPA 9056A
Sulfide	EPA 376.1/SM 4500-S E	EPA 9030B/9034
Sulfide, Reactive	----------	SW-846 7.3.4
Surfactants -MBAS	SM 5540 C	----------
Total nitrate-nitrite	EPA 9056 A/SM 4500-$N0_3$ H	EPA 9056 A/SM 4500-$N0_3$ H
Total cyanide	EPA 9014	EPA 9014
Total nitrogen	TKN + Total nitrate-nitrite	TKN + Total nitrate-nitrite
Total Organic Carbon	EPA 9060A/SM 5310B	TOC Walkley Black
Total phenolics	EPA 420.1	EPA 420.1
Total, fixed, and volatile residue	SM 2540 G	SM 2540 G
Turbidity	EPA 180.1	----------
Un-ionized ammonia	DEP SOP 10/03/83	DEP SOP 10/03/83
Extractable Organics		
1,2,4-Trichlorobenzene	EPA 8270D/625	EPA 8270D

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Extractable Organics		
1,2,4,5-Tetrachlorobenzene	EPA 8270D/625	EPA 8270D
1,2-Dichlorobenzene	EPA 8270D/625	EPA 8270D
1,2-Diphenylhydrazine	EPA 8270D/625	EPA 8270D
1,3-Dichlorobenzene	EPA 8270D/625	EPA 8270D
1,4-Dichlorobenzene	EPA 8270D/625	EPA 8270D
1- Methylnaphthalene	EPA 8270D/625/ Scan-Sim	EPA 8270D/ Scan-Sim
2,3,4,6-Tetrachlorophenol	EPA 8270D/625	EPA 8270D
2,4,5-Trichlorophenol	EPA 8270D/625	EPA 8270D
2,4,6-Trichlorophenol	EPA 8270D/625	EPA 8270D
2,4-Dichlorophenol	EPA 8270D/625	EPA 8270D
2,4-Dimethylphenol	EPA 8270D/625	EPA 8270D
2,4-Dinitrophenol	EPA 8270D/625	EPA 8270D
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270D/625/ Scan-Sim	EPA 8270D
2,6-Dichlorophenon	EPA 8270D/625	EPA 8270D
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270D/625	EPA 8270D
2-Chloronaphthalene	EPA 8270D/625	EPA 8270D
2-Chlorophenol	EPA 8270D/625	EPA 8270D
2·Methyl-4,6-dinitrophenol	EPA 8270D/625	EPA 8270D
2-Methylnaphthalene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
2-Methylphenol (o-Cresol)	EPA 8270D/625	EPA 8270D
2-Nitroaniline	EPA 8270D/625	EPA 8270D
2-Nitrophenol	EPA 8270D/625	EPA 8270D
3,3'-Dichlorobenzidine	EPA 8270D/625	EPA 8270D
3/4-Methylphenols (m/p-Cresols)	EPA 8270D/625	EPA 8270D
3-Nitroaniline	EPA 8270D/625	EPA 8270D
4-Bromophenyl phenyl ether	EPA 8270D/625	EPA 8270D
4-Chloro-3-methylphenol	EPA 8270D/625	EPA 8270D
4-Chloroaniline	EPA 8270D/625	EPA 8270D
4-Chlorophenyl phenyl ether	EPA 8270D/625	EPA 8270D
4-Nitrophenol	EPA 8270D/625	EPA 8270D
Acenaphthene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Acenaphthylene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
4-Melhylphenol (p-Cresol)	EPA 8270D/625	EPA 8270D
4-Nitroaniline	EPA 8270D/625	EPA 8270D
Acetophenone	EPA 8270D/625	EPA 8270D
Anthracene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Atrazine	EPA 8270D/625	EPA 8270D
Benzaldehyde	EPA 8270D/625	EPA 8270D
Benzidine	EPA 8270D/625/ Scan-Sim	EPA 8270D
Benzo(a)anthracene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Benzo(a)pyrene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Benzo(b)fluoranthene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Benzo(g,h,i)perylene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Benzo(k)fluoranthene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Benzyl alcohol	EPA 8270D/625	EPA 8270D
1,1-Biphenyl	EPA 8270D/625	EPA 8270D
bis(2-Chloroethoxy) methane	EPA 8270D/625	EPA 8270D
bis(2-Chloroethyl) ether	EPA 8270D/625	EPA 8270D
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 8270D/625	EPA 8270D
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270D/625	EPA 8270D

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Extractable Organics		
Butyl benzyl phthalate	EPA 8270D/625	EPA 8270D
Caprolactam	EPA 8270D/625	EPA 8270D
Carbazole	EPA 8270D/625	EPA 8270D
Chrysene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Dibenz(a,h)anthracene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Dibenzofuran	EPA 8270D/625	EPA 8270D
Diethyl phthalate	EPA 8270D/625	EPA 8270D
Dimethyl phthalate	EPA 8270D/625/ Scan-Sim	EPA 8270D
Di-n-butyl phthalate	EPA 8270D/625	EPA 8270D
Di-n-octyl phthalate	EPA 8270D/625	EPA 8270D
Fluoranthene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Fluorene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Hexachlorobenzene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Hexachlorobutadiene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Hexachlorocyclopentadiene	EPA 8270D/625	EPA 8270D
Hexachloroethane	EPA 8270D/625	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Isodrin	EPA 8270D/625	EPA 8270D
Isophorone	EPA 8270D/625	EPA 8270D
Naphthalene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Nitrobenzene	EPA 8270D/625	EPA 8270D
n-Nitrosodimethylamine	EPA 8270D/625	EPA 8270D
n-Nitrosodi-n-propylamine	EPA 8270D/625	EPA 8270D
n-Nitrosodiphenylamine	EPA 8270D/625	EPA 8270D
n-Nitrosopyrrolidine	EPA 8270D/625	EPA 8270D
Pentachlorophenol	EPA 8270D/625/ Scan-Sim	EPA 8270D
Phenanthrene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Phenol	EPA 8270D/625	EPA 8270D
Pyrene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Pyridine	EPA 8270D/625	EPA 8270D
Total Petroleum Hydrocarbons (TPH)	FL·PRO	FL·PRO
Volatile Organics		
1,1,1,2-Tetrachloroethane	EPA 8260B/624	EPA 8260B
1,1,1-Trichloroethane	EPA 8260B/624	EPA 8260B
1,1,2,2-Tetrachloroethane	EPA 8260B/624	EPA 8260B
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 8260B/624	EPA 8260B
1,1,2-Trichloroethane	EPA 8260B/624	EPA 8260B
1,1-Dichloroethane	EPA 8260B/624	EPA 8260B
1,1-Dichloroethene	EPA 8260B/624	EPA 8260B
1,1-Dichloropropene	EPA 8260B/624	EPA 8260B
1,2,3-Trichlorobenzene	8260B/624	EPA 8260B
1,2,3-Trichloropropane	EPA 8260B/624	EPA 8260B
1,2,4-Trichlorobenzene	EPA 8260B/624	EPA 8260B
1,2,4-Trimethylbenzene	EPA 8260B/624	EPA 8260B
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504/8011/8260B	EPA 8260B
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 504/8011/8260B	EPA 8260B
1,2-Dichlorobenzene	EPA 8260B/624	EPA 8260B
1,2-Dichloroethane	EPA 8260B/624	EPA 8260B

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Volatile Organics		
1,2-Dichloropropane	EPA 8260B/624	EPA 8260B
1,3,5-Trimethylbenzene	EPA 8260B/624	EPA 8260B
1,3-Dichlorobenzene	EPA 8260B/624	EPA 8260B
1,3-Dichloropropane	EPA 8260B/624	EPA 8260B
1,4-Dichlorobenzene	EPA 8260B/624	EPA 8260B
1,4-Dioxane (1,4-Diethylencoxide)	EPA 8260B/8260C SIM/624	EPA 8260B/8260C SIM
2,2-Dichloropropane	EPA 8260B/624	EPA 8260B
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260B/624	EPA 8260B
2-Chloroethyl vinyl ether	EPA 8260B/624	EPA 8260B
2-Chlorotoluene	EPA 8260B/624	EPA 8260B
2-Hexanone	EPA 8260B/624	EPA 8260B
4-Chlorotoluene	EPA 8260B/624	EPA 8260B
4-Methyl-2-pentanone (MIBK)	EPA 8260B/624	EPA 8260B
Acetone	EPA 8260B/624	EPA 8260B
Acetonitrile	EPA 8260B/624	EPA 8260B
Acrolein (Propenal)	EPA 8260B/624	EPA 8260B
Acrylonitrile	EPA 8260B/624	EPA 8260B
Allyl chloride (3-Chloropropene)	EPA 8260B/624	EPA 8260B
Benzene	EPA 8260B/624	EPA 8260B
Bromobenzene	EPA 8260B/624	EPA 8260B
Bromochloromethane	EPA 8260B/624	EPA 8260B
Bromodichloromethane	EPA 8260B/624	EPA 8260B
Bromoform	EPA 8260B/624	EPA 8260B
Carbon tetrachloride	EPA 8260B/624	EPA 8260B
Carbon disulfide	EPA 8260B/624	EPA 8260B
Chlorobenzene	EPA 8260B/624	EPA 8260B
Chloroethane	EPA 8260B/624	EPA 8260B
Chloroform	EPA 8260B/624	EPA 8260B
Chloroprene	EPA 8260B/624	EPA 8260B
cis-1,2-Dichloroethene	EPA 8260B/624	EPA 8260B
cis-1,3-Dichloropropene	EPA 8260B/624	EPA 8260B
Cyclohexane	EPA 8260B/624	EPA 8260B
Dibromochloromethane	EPA 8260B/624	EPA 8260B
Dibromomethane	EPA 8260B/624	EPA 8260B
Dichlorodifluoromethane	EPA 8260B/624	EPA 8260B
Ethyl methacrylate	EPA 8260B/624	EPA 8260B
Hexachlorobutadiene	EPA 8260B/624	EPA 8260B
Ethylbenzene	EPA 8260B/624	EPA 8260B
Iodomethane (Methyl iodide)	EPA 8260B/624	EPA 8260B
Isobutyl alcohol (2-Methyl-l-propanol)	EPA 8260B/624	EPA 8260B
Isopropylbenzene	EPA 8260B/624	EPA 8260B
m+p-Xylenes	EPA 8260B/624	EPA 8260B
Methacrylonitrile	EPA 8260B/624	EPA 8260B
Methyl acetate	EPA 8260B/624	EPA 8260B
Methyl bromide (Bromomethane)	EPA 8260B/624	EPA 8260B
Methyl chloride (Chloromethane)	EPA 8260B/624	EPA 8260B
Methyl methacrylate	EPA 8260B/624	EPA 8260B
Methyl tert-butyl ether (MTBE)	EPA 8260B/624	EPA 8260B
Methylcyclohexane	EPA 8260B/624	EPA 8260B

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Volatile Organics		
Methylene chloride	EPA 8260B/624	EPA 8260B
Naphthalene	EPA 8260B/624	EPA 8260B
n-Butylbenzene	EPA 8260B/624	EPA 8260B
n-Propylbenzene	EPA 8260B/624	EPA 8260B
o-Xylene	EPA 8260B/624	EPA 8260B
Pentachloroethane	EPA 8260B/624	EPA 8260B
p-Isopropyltoluene	EPA 8260B/624	EPA 8260B
Propionitrile (Ethyl cyanide)	EPA 8260B/624	EPA 8260B
sec-Butylbenzene	EPA 8260B/624	EPA 8260B
Styrene	EPA 8260B/624	EPA 8260B
tert-Butylbenzene	EPA 8260B/624	EPA 8260B
Tetrachloroethene (Perchloroethylene)	EPA 8260B/624	EPA 8260B
Toluene	EPA 8260B/624	EPA 8260B
trans-1,2-Dichloroethene	EPA 8260B/624	EPA 8260B
trans-1,3-Dichloropropene	EPA 8260B/624	EPA 8260B
trans-1,4-Dichloro-2-butene	EPA 8260B/624	EPA 8260B
Trichloroethene (Trichloroethylene)	EPA 8260B/624	EPA 8260B
Trichlorofluoromethane	EPA 8260B/624	EPA 8260B
Vinyl acetate	EPA 8260B/624	EPA 8260B
Vinyl chloride	EPA 8260B/624	EPA 8260B
Xylene (total)	EPA 8260B/624	EPA 8260B
Pesticides-Herbicides-PCBs		
2,4,5-T	EPA 8151A /615	EPA 8151A
2,4-D	EPA 8151A /615	EPA 8151A
2,4-DB	EPA 8151A /615	EPA 8151A
3,5-Dichlorobenzoic acid	EPA 8151A /615	EPA 8151A
4.4'-DDD	EPA 8081B/608	EPA 8081B
4.4'-DDE	EPA 8081B/608	EPA 8081B
4,4'·DDT	EPA 8081B/608	EPA 8081B
4-Nitrophenol	EPA 8151A/615	EPA 8151A
Acifluorfen	EPA 8151A/615	EPA 8151A
Aldrin	EPA 8081B/608	EPA 8081B
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
alpha-Chlordane	EPA 8081B/608	EPA 8081B
Aroclor-1016(PCB-1016)	EPA 8082A/608	EPA 8082A
Aroclor-1221 (PCB-1221)	EPA 8082A/608	EPA 8082A
Aroclor-1232 (PCB-1232)	EPA 8082A/608	EPA 8082A
Aroclor-1242 (PCB-1242)	EPA 8082A/608	EPA 8082A
Aroclor-1248 (PCB-1248)	EPA 8082A/608	EPA 8082A
Aroclor-1254 (PCB-1254)	EPA 8082A/608	EPA 8082A
Aroclor-1260 (PCB-1260)	EPA 8082A/608	EPA 8082A
Aroclor-1262 (PCB-1262)	EPA 8082A/608	EPA 8082A
Aroclor-1268 (PCB-1268)	EPA 8082A/608	EPA 8082A
Azinphos-methyl (Guthion)	EPA 8141B	EPA 8141B
Bentazon	EPA 8151A/615	EPA 8151A
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
Bolstar (Sulprofos)	EPA 8141B	EPA 8141B
Chloramben	EPA 8151A/615	EPA 8151A

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Pesticides-Herbicides-PCBs		
Chlordane (tech.)	EPA 8081B/608	EPA 8081B
Chlorpynfos	EPA 8141B	EPA 8141B
Coumaphos	EPA 8141B	EPA 8141B
Dacthal (DCPA)	EPA 8151A/615	EPA 8151A
Dalapon	EPA 8151A/615	EPA 8151A
delta-BHC	EPA 8081B/608	EPA 8081B
Demeton, Total	EPA 8141B	EPA 8141B
Diazinon	EPA 8141B	EPA 8141B
Dicamba	EPA 8151A/615	EPA 8151A
Dichlorofenthion	EPA 8141B	EPA 8141B
Dichloroprop (Dichlorprop)	EPA 8151A/615	EPA 8151A
Dlchlorovos (DDVP, Dichtorvos)	EPA 8141B	EPA 8141B
Dieldrin	EPA 8081B/608	EPA 8081B
Dimethoate	EPA 8141B	EPA 8141B
Dinoseb (2-sec-buty1-4 ,6-dinilrophenol, DNB P)	EPA 8151A/615	EPA 8151A
Disulfoton	EPA 8141B	EPA 8141B
Endosulfan I	EPA 8081B/608	EPA 8081B
Endosulfan II	EPA 8081B/608	EPA 8081B
Endosulfan sulfate	EPA 8081B/608	EPA 8081B
Endrin	EPA 8081B/608	EPA 8081B
Endrin aldehyde	EPA 8081B/608	EPA 8081B
Endrin ketone	EPA 8081B/608	EPA 8081B
EPN	EPA 8141B	EPA 8141B
Ethion	EPA 8141B	EPA 8141B
Ethoprop	EPA 8141B	EPA 8141B
fensulfothion	EPA 8141B	EPA 8141B
fenthion	EPA 8141B	EPA 8141B
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
gamma-Chlordane	EPA 8081B/608	EPA 8081B
Heptachlor	EPA 8081B/608	EPA 8081B
Heptachlor epoxide	EPA 8081B/608	EPA 8081B
Isodrin	EPA 8081B/608	EPA 8081B
Malathion	EPA 8141B	EPA 8141B
MCPA	EPA 8151A/615	EPA 8151A
MCPP	EPA 8151A/615	EPA 8151A
Merphos	EPA 8141B	EPA 8141B
Methoxychlor	EPA 8081B/608	EPA 8081B
Methyl parathion (Parathion. methyl)	EPA 8141B	EPA 8141B
Mevinphos	EPA 8141B	EPA 8141B
Mirex	EPA 8081B/608	EPA 8081B
Monocrotophos	EPA 8141B	EPA 8141B
Naled	EPA 8141B	EPA 8141B
Parathion, ethyl	EPA 8141B	EPA 8141B
Pentachlorophenol	EPA 8151A/615	EPA 8151A
Phorate	EPA 8141B	EPA 8141B
Picloram	EPA 8151A/615	EPA 8151A
Ronnel	EPA 8141B	EPA 8141B
Silvex (2A.5-TP)	EPA 8151B/615	EPA 8151B
Stirofos	EPA 8141B	EPA 8141B

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Pesticides-Herbicides-PCBs		
Sulfotepp	EPA 8141B	EPA 8141B
Tetraethyl pyrophosphate (TEPP)	EPA 8141B	EPA 8141B
Tokuthion (Prothiophos)	EPA 8141B	EPA 8141B
Toxaphene (Chlorinated camphene)	EPA 8081B/608	EPA 8081B
Trichloronate	EPA 8141B	EPA 8141B

Preparation Methods

Fraction	Analytical Method	Preparation Method
Cyanide	EPA 9014 EPA 335.2 /SM 4500-CN E	EPA 9010C
TX	EPA 9056A	EPA 5050
Metal water prep	EPA 6020A/200.8	EPA 3005A
Metals soil prep	EPA 6020A	EPA 3050B
Metals TCLP prep	EPA 6020A/200.8	EPA 3010A
Extractable organics and Pesticides water prep	EPA 8270D/625/8081B/8082A/ 608/ 8141B	EPA 3510C
Extractable organics and Pesticides waste prep	EPA 8270D/625/8081B/8082A/ 608/ 8141B	EPA 3580A
Extractable organics and Pesticides soil prep	EPA 8270D/625/8081B/8082A/ 608/ 8141B	EPA 3550C
Organics water and mid-level soil prep	EPA 8260B/624	EPA 5030B
Organics low-level soil prep	EPA 8260B/624	EPA 5035
Soil/water leachate	Wets	ENCO WETS-88
SPLP	Wets, Organics, and Metals	EPA 1312
TCLP	Wets, Organics, and Metals	EPA 1311

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

ENVIRONMENTAL CONSERVATION LABORATORIES - ORLANDO

Orlando, FL

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in version 4.2 of the DoD Quality System Manual for Environmental Laboratories (QSM); accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009*).

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION
CORPORATE SEAL 1978
DISTRICT OF COLUMBIA
A2LA

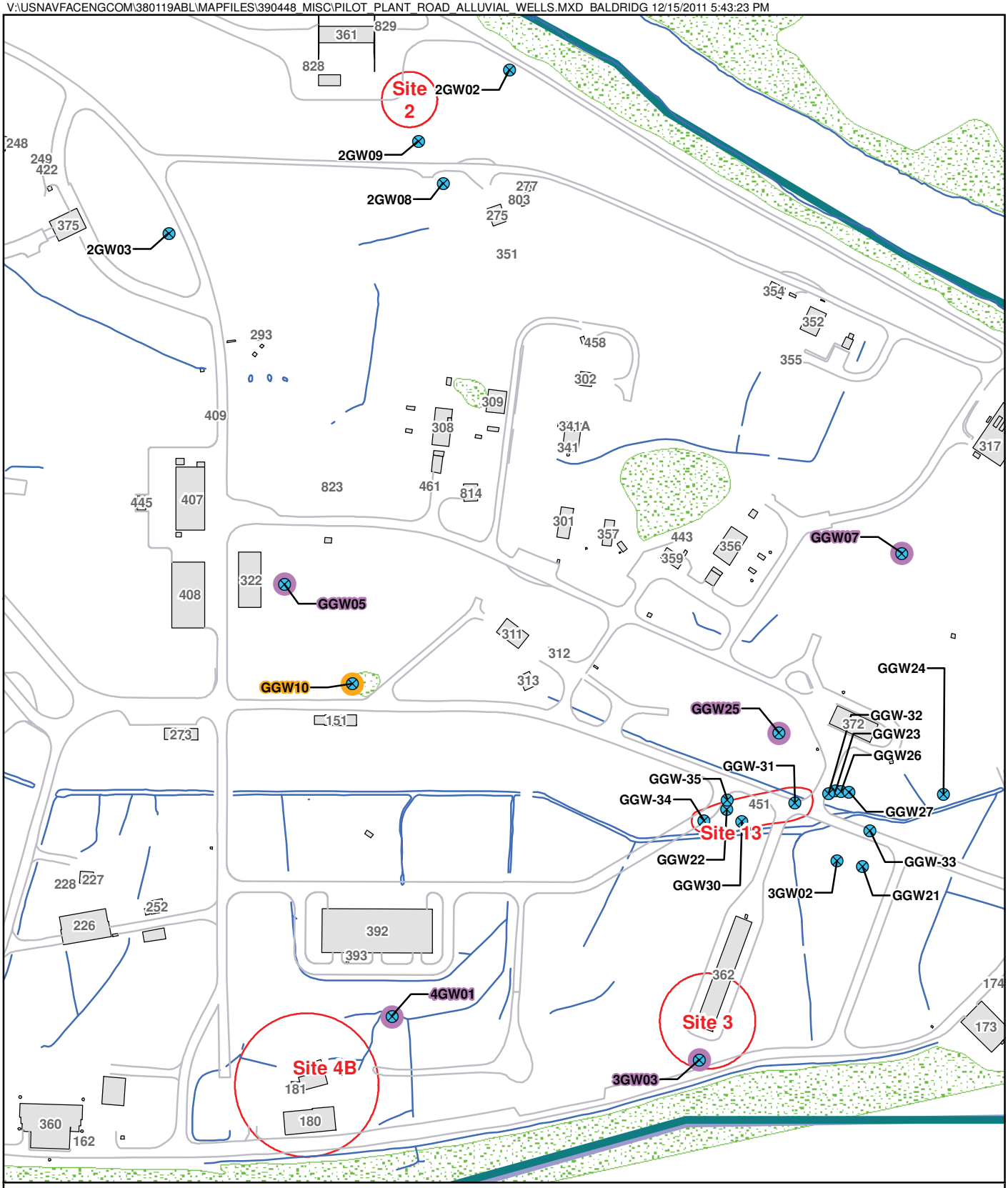
Presented this 29th day of May 2012.

President & CEO
For the Accreditation Council
Certificate Number 3000.01
Valid to March 31, 2014

For the tests or types of tests to which this accreditation applies, please refer to the laboratory's Environmental Scope of Accreditation.

Attachment 1
Background Data Set

V:\USNAVFACENGCOM\380119ABL\MAPFILES\390448_MISC\PILOT_PLANT_ROAD_ALLUVIAL_WELLS.MXD BALDRIDG 12/15/2011 5:43:23 PM



Legend

- Monitroing Well - Alluvial
- IR Sites
- Structures

N

0 125 250 Feet

Alluvial Well Locations
Allegany Ballistics Laboratory
Rocket Center, West Virginia

Note: Wells highlighted in purple are proposed for background comparision

CH2MHILL

ABL
Historical Data
Raw Analytical Results
Attachement 1

Station ID	3GW03						GGW05			GGW07		GGW10	
Sample ID	3GW3(85)	3GW3(86)	3GW3(87)	3GW3(92)	3GW3(94)	AS03-3GW03-AP	GGW5(92)	GGW5(94)	GGW5(03)	GGW7(92)	GGW7(94)	GGW10(94)	GGW10(03)
Sample Date	12/05/85	03/06/86	07/22/87	01/01/92	12/02/94	06/09/00	01/01/92	12/05/94	01/09/03	01/01/92	12/02/94	12/05/94	01/09/03
Chemical Name													
Volatile Organic Compounds (UG/L)													
1,1,1-Trichloroethane	NA	2 J	5 U	5 U	NA	NA	5 UJ	10 U	0.5 U	5 U	NA	10 U	2.4
1,1,2,2-Tetrachloroethane	10 U	10 U	5 U	5 UJ	NA	NA	5 UJ	10 U	0.5 U	5 UJ	NA	10 U	0.5 U
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	NA	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	NA	0.5 U
1,1,2-Trichloroethane	10 U	10 U	5 U	5 U	NA	NA	5 U	10 U	0.5 U	5 U	NA	10 U	0.5 U
1,1-Dichloroethane	10 U	10 U	5 U	5 U	NA	NA	5 U	10 U	0.5 U	5 U	NA	10 U	0.5 U
1,1-Dichloroethene	10 U	10 U	5 U	5 U	NA	NA	5 U	10 U	0.5 U	5 U	NA	10 U	0.5 U
1,2,3-Trichlorobenzene	NA	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	NA	0.5 U
1,2,4-Trichlorobenzene	10 U	10 U	10 U	NA	NA	NA	NA	NA	0.5 U	NA	NA	10 U	0.5 U
1,2-Dibromo-3-chloropropane	NA	NA	NA	NA	NA	NA	NA	NA	1 R	NA	NA	NA	1 R
1,2-Dibromoethane	NA	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	NA	0.5 U
1,2-Dichlorobenzene	10 U	10 U	10 U	NA	NA	NA	NA	NA	0.5 U	NA	NA	NA	0.5 U
1,2-Dichloroethane	10 U	10 U	5 U	5 U	NA	NA	5 UJ	10 U	0.5 U	5 U	NA	10 U	0.5 U
1,2-Dichloroethene (total)	NA	NA	NA	5 U	NA	NA	5 U	10 U	NA	5 U	NA	10 U	NA
1,2-Dichloropropane	NA	10 U	5 U	5 U	NA	NA	5 U	10 U	0.5 U	5 U	NA	10 U	0.5 U
1,3-Dichlorobenzene	10 U	10 U	10 U	NA	NA	NA	NA	NA	0.5 U	NA	NA	10 U	0.5 U
1,4-Dichlorobenzene	10 U	10 U	10 U	NA	NA	NA	NA	NA	0.5 U	NA	NA	10 U	0.5 U
2-Butanone	10 U	10 U	10 U	10 UJ	NA	NA	10 U	10 U	5 UJ	10 UJ	NA	10 U	5 UJ
2-Chloroethyl vinyl ether	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	NA	NA	10 U	10 U	NA	NA	10 U	10 U	5 U	10 U	NA	10 U	5 U
4-Methyl-2-pentanone	10 U	10 U	10 U	10 U	NA	NA	10 U	10 U	5 U	10 U	NA	10 U	5 U
Acetone	NA	NA	29 B	10 J	NA	NA	10 U	14 J	2.6 B	10 UJ	NA	10 U	5 U
Benzene	10 U	2 J	5 U	5 U	NA	NA	5 U	10 U	0.5 U	5 U	NA	10 U	0.5 U
Bromochloromethane	NA	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	NA	0.5 U
Bromodichloromethane	NA	10 U	5 U	5 U	NA	NA	5 UJ	10 U	0.5 U	5 U	NA	10 U	0.5 U
Bromoform	10 U	10 U	5 U	5 UJ	NA	NA	5 UJ	10 U	0.5 U	5 UJ	NA	10 U	0.5 U
Bromomethane	10 U	10 U	10 U	10 U	NA	NA	10 U	10 U	0.5 U	10 U	NA	10 U	0.5 U
Carbon disulfide	NA	NA	5 U	5 U	NA	NA	5 U	10 U	0.5 U	5 U	NA	10 U	0.33 B
Carbon tetrachloride	NA	10 U	5 U	5 U	NA	NA	5 UJ	10 U	0.5 U	5 U	NA	10 U	0.5 U
Chlorobenzene	10 U	10 U	5 U	5 U	NA	NA	5 U	10 U	0.5 U	5 U	NA	10 U	0.5 U
Chloroethane	10 U	10 U	10 U	10 U	NA	NA	10 U	10 U	0.5 U	10 U	NA	10 U	0.5 U
Chloroform	10 U	10 U	5 U	5 U	NA	NA	5 U	10 U	0.5 U	5 U	NA	10 U	0.5 U
Chloromethane	10 U	10 U	10 U	10 UJ	NA	NA	10 UJ	10 U	0.5 U	10 UJ	NA	10 U	0.5 U
cis-1,2-Dichloroethene	NA	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	NA	0.5 U
cis-1,3-Dichloropropene	10 U	10 U	5 U	5 U	NA	NA	5 U	10 U	0.5 U	5 U	NA	10 U	0.5 U
Cyclohexane	NA	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	NA	0.5 U
Dibromochloromethane	10 U	10 U	5 U	5 U	NA	NA	5 U	10 U	0.5 U	5 U	NA	10 U	0.5 U
Dichlorobenzenes, total	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Dichlorodifluoromethane (Freon-12)	NA	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	NA	0.5 U
Ethylbenzene	10 U	10 U	5 U	5 U	NA	NA	5 U	10 U	0.5 U	5 U	NA	10 U	0.5 U
Isopropylbenzene	NA	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	NA	0.5 U
Methyl acetate	NA	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	NA	0.5 U
Methylcyclohexane	NA	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	NA	0.5 U
Methylene chloride	6 J	8 J	3 B	5 UJ	NA	NA	1 J	10 U	1.3 B	1 UJ	NA	10 U	1.5 B
Methyl-tert-butyl ether (MTBE)	NA	NA	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	NA	0.5 U
Styrene	NA	NA	5 U	5 U	NA	NA	5 U	10 U	0.5 U	5 U	NA	10 U	0.5 U
Tetrachloroethene	10 U	10 U	5 U	5 U	NA	NA	5 U	10 U	0.5 U	5 U	NA	10 U	0.5 U
Toluene	10 U	10 U	5 U	5 U	NA	NA	5 U	10 U	0.5 U	5 U	NA	10 U	0.5 U
trans-1,2-Dichloroethene	10 U	1 J	5 U	NA	NA	NA	NA	NA	0.5 U	NA	NA	NA	0.5 U
trans-1,3-Dichloropropene	10 U	10 U	5 U	5 U	NA	NA	5 U	10 U	0.5 U	5 U	NA	10 U	0.5 U
Trichloroethene	10 U	47	3 J	5 U	NA	NA	13	10 U	0.5 U	1 J	NA	10 U	0.5 U
Trichlorofluoromethane (Freon-11)	10 U	10 U	NA	NA	NA	NA	NA	NA	0.5 U	NA	NA	NA	0.5 U
Vinyl acetate	NA	NA	10 U	10 UJ	NA	NA	10 U	NA	NA	10 UJ	NA	NA	NA
Vinyl chloride	10 U	10 U	10 U	10 U	NA	NA	10 U	10 U	0.5 U	10 U	NA	10 U	0.5 U
Xylene, total	10 U	10 U	5 U	5 U	NA	NA	5 U	10 U	0.5 U	5 U	NA	10 U	0.5 U
Semivolatile Organic Compounds (UG/L)													
2,2'-Oxybis(1-chloropropane)	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
2,4,5-Trichlorophenol	NA	50 U	50 U	NA	NA	NA	NA	NA	NA	NA	NA	25 U	NA

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Station ID	3GW03						GGW05			GGW07		GGW10	
Sample ID	3GW3(85)	3GW3(86)	3GW3(87)	3GW3(92)	3GW3(94)	AS03-3GW03-AP	GGW5(92)	GGW5(94)	GGW5(03)	GGW7(92)	GGW7(94)	GGW10(94)	GGW10(03)
Sample Date	12/05/85	03/06/86	07/22/87	01/01/92	12/02/94	06/09/00	01/01/92	12/05/94	01/09/03	01/01/92	12/02/94	12/05/94	01/09/03
Chemical Name													
2,4,6-Trichlorophenol	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
2,4-Dichlorophenol	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
2,4-Dimethylphenol	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
2,4-Dinitrophenol	50 U	50 U	50 U	NA	NA	NA	NA	NA	NA	NA	NA	25 U	NA
2,4-Dinitrotoluene	3 U	1.5 U	0.6 U	50 UJ	NA	NA	50 UJ	NA	NA	50 UJ	NA	10 U	NA
2,6-Dinitrotoluene	3 U	3.6	0.55 U	50 UJ	NA	NA	50 UJ	NA	NA	50 UJ	NA	10 U	NA
2-Chloronaphthalene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
2-Chlorophenol	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
2-Methylnaphthalene	NA	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
2-Methylphenol	NA	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
2-Nitroaniline	NA	50 U	50 U	NA	NA	NA	NA	NA	NA	NA	NA	25 U	NA
2-Nitrophenol	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
3,3'-Dichlorobenzidine	20 U	20 U	20 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
3-Nitroaniline	NA	50 U	50 U	NA	NA	NA	NA	NA	NA	NA	NA	25 U	NA
4,6-Dinitro-2-methylphenol	50 U	50 U	50 U	NA	NA	NA	NA	NA	NA	NA	NA	25 U	NA
4-Bromophenyl-phenylether	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
4-Chloro-3-methylphenol	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
4-Chloroaniline	NA	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
4-Chlorophenyl-phenylether	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
4-Methylphenol	NA	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
4-Nitroaniline	NA	50 U	50 U	NA	NA	NA	NA	NA	NA	NA	NA	25 U	NA
4-Nitrophenol	50 U	50 U	50 U	NA	NA	NA	NA	NA	NA	NA	NA	25 U	NA
Acenaphthene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Acenaphthylene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Anthracene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Benzidine	50 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzo(a)anthracene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Benzo(a)pyrene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Benzo(b)fluoranthene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Benzo(g,h,i)perylene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Benzo(k)fluoranthene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Benzoic acid	NA	50 U	50 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Benzyl alcohol	NA	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
bis(2-Chloroethoxy)methane	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
bis(2-Chloroethyl)ether	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
bis(2-Ethylhexyl)phthalate	15	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Butylbenzylphthalate	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	2 J	NA
Carbazole	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Chrysene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Dibenz(a,h)anthracene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
SVOA (NG/L)													
Dibenzofuran	NA	10,000 U	10,000 U	NA	NA	NA	NA	NA	NA	NA	NA	10,000 U	NA
SVOA (UG/L)													
Diethylphthalate	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Dimethyl phthalate	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Di-n-butylphthalate	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Di-n-octylphthalate	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Fluoranthene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Fluorene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Hexachlorobenzene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Hexachlorobutadiene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Hexachlorocyclopentadiene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Hexachloroethane	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Indeno(1,2,3-cd)pyrene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Isophorone	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Naphthalene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
n-Nitrosodimethylamine	10 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
n-Nitroso-di-n-propylamine	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
n-Nitrosodiphenylamine	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Nitrobenzene	3 U	0.9 U	10 U	28 UJ	NA	NA	28 UJ	NA	NA	28 UJ	NA	10 U	NA

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Station ID	3GW03						GGW05			GGW07		GGW10	
Sample ID	3GW3(85)	3GW3(86)	3GW3(87)	3GW3(92)	3GW3(94)	AS03-3GW03-AP	GGW5(92)	GGW5(94)	GGW5(03)	GGW7(92)	GGW7(94)	GGW10(94)	GGW10(03)
Sample Date	12/05/85	03/06/86	07/22/87	01/01/92	12/02/94	06/09/00	01/01/92	12/05/94	01/09/03	01/01/92	12/02/94	12/05/94	01/09/03
Chemical Name													
Pentachlorophenol	50 U	50 U	50 U	NA	NA	NA	NA	NA	NA	NA	NA	25 U	NA
Phenanthrene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Phenol	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10	NA
Pyrene	10 U	10 U	10 U	NA	NA	NA	NA	NA	NA	NA	NA	10 U	NA
Explosives (UG/L)													
1,3,5-Trinitrobenzene	3 U	0.8 U	0.56 U	24 U	NA	NA	24 UJ	NA	NA	24 U	NA	NA	NA
1,3-Dinitrobenzene	3 U	0.8 U	0.61 U	24 UJ	NA	NA	24 UJ	NA	NA	24 UJ	NA	NA	NA
2,4,6-Trinitrotoluene	5 U	1.3 U	8.93	24 UJ	NA	NA	24 UJ	NA	NA	24 UJ	NA	NA	NA
2,4-Diamino-6-nitrotoluene	28 U	8 U	7.2 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2,6-Diamino-4-nitrotoluene	28 U	8 U	9.24 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Amino-4,6-dinitrotoluene	NA	NA	3.24 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Nitrotoluene	NA	NA	NA	26 UJ	NA	NA	26 U	NA	NA	26 UJ	NA	NA	NA
3-Nitrotoluene	NA	NA	NA	28 UJ	NA	NA	28 U	NA	NA	28 UJ	NA	NA	NA
4-Amino-2,6-dinitrotoluene	NA	NA	2.48 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
HMX	7 U	1.8 U	1.3 U	26 U	NA	NA	26 U	NA	NA	26 U	NA	NA	NA
Nitroglycerin	200 U	0.2 U	5,200	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Perchlorate	NA	NA	NA	NA	NA	5 U	NA	NA	NA	NA	NA	NA	NA
RDX	4 U	1 U	1.61	24 U	NA	NA	24 U	NA	NA	24 U	NA	NA	NA
Tetryl	4 U	1 U	NA	26 UJ	NA	NA	26 UJ	NA	NA	26 UJ	NA	NA	NA
Total Metals (UG/L)													
Aluminum	NA	NA	NA	NA	29,000	NA	22,800	NA	1,580	46,800	NA	######	242
Antimony	NA	NA	NA	NA	32 U	NA	12.4 U	NA	5 U	12.4 U	NA	32 U	5 U
Arsenic	NA	NA	NA	NA	45.2	NA	3.5 B	NA	2.6 U	4.1 B	NA	398	15.1
Barium	200 U	500 U	200 U	NA	295	NA	263	NA	57.6 J	453	NA	3,010	409
Beryllium	NA	NA	NA	NA	2.4 B	NA	1.6	NA	0.1 U	2.9	NA	15.1	0.1 U
Cadmium	2 U	10 U	5 U	NA	9.8	NA	2.7 U	NA	0.3 U	2.7 U	NA	52.9	0.3 U
Calcium	NA	NA	NA	NA	66,400	NA	26,200	NA	17,400	21,000	NA	######	######
Chromium	10 U	25 U	10 U	NA	71.1	NA	32.1	NA	2.7 J	57.1	NA	227	1.4 J
Cobalt	NA	NA	NA	NA	35.5 B	NA	26.7	NA	1.8 J	94	NA	217	1.2 J
Copper	NA	NA	NA	NA	69	NA	58.5	NA	3.9 J	61	NA	963	1.2 J
Cyanide	NA	NA	NA	NA	10 U	NA	NA	10 U	10 U	NA	10 U	10 U	10 U
Iron	NA	NA	NA	NA	74,000	NA	47,600	NA	2,370	70,400	NA	######	3,360
Lead	5 U	5 U	5 U	NA	45.3	NA	15.2	NA	5.9	44.6	NA	281	1.8 U
Magnesium	NA	NA	NA	NA	15,200	NA	8,660	NA	6,420	9,980	NA	44,000	11,800
Manganese	NA	NA	NA	NA	800	NA	1,090	NA	42.8	3,530	NA	3,500	710
Mercury	500 U	0.5 U	0.2 U	NA	0.2 B	NA	0.16 U	NA	0.1 U	0.16 U	NA	0.83	0.1 U
Nickel	40 U	10 U	40 U	NA	76.9	NA	45.9	NA	6.9 J	73	NA	413	1.8 J
Potassium	NA	NA	NA	NA	4,710 B	NA	5,190	NA	765 J	8,000	NA	16,200	949 J
Selenium	NA	NA	NA	NA	2.7 B	NA	1.9 U	NA	1.8 U	18.6 U	NA	6.6 U	1.8 U
Silver	2 U	10 U	10 U	NA	4 U	NA	1.5 U	NA	0.6 U	1.5 U	NA	32.1	0.6 U
Sodium	NA	NA	NA	NA	10,500	NA	14,300	NA	7,790	5,660	NA	21,600	24,500
Thallium	NA	NA	NA	NA	3 U	NA	2.1 UJ	NA	2 U	20.6 UJ	NA	3 U	2 U
Vanadium	NA	NA	NA	NA	59.4	NA	39.9	NA	2.5 J	79.4	NA	382	0.6 U
Zinc	50 U	500 U	31.5	NA	186	NA	119 B	NA	17.4 J	214 J	NA	1,170	5.5 B
Dissolved Metals (UG/L)													
Aluminum, Dissolved	NA	NA	NA	NA	36.8 U	NA	NA	21.2 U	41.8 J	NA	14.9 U	14 U	19.3 U
Antimony, Dissolved	NA	NA	NA	NA	32 U	NA	NA	32 U	5 U	NA	32 U	32 U	5 U
Arsenic, Dissolved	NA	NA	NA	NA	4.8 B	NA	NA	2 U	2.6 U	NA	2 U	2.8 B	7.7 J
Barium, Dissolved	NA	NA	NA	NA	90.8 B	NA	NA	31.4 B	46.5 J	NA	72.9 B	283	417
Beryllium, Dissolved	NA	NA	NA	NA	1 U	NA	NA	1 U	0.1 U	NA	1 U	1 U	0.1 U
Cadmium, Dissolved	NA	NA	NA	NA	3 U	NA	NA	3 U	0.3 U	NA	3 U	3 U	0.3 U
Calcium, Dissolved	NA	NA	NA	NA	59,400	NA	NA	14,100	17,600	NA	21,100	93,700	######
Chromium, Dissolved	NA	NA	NA	NA	5 U	NA	NA	5 UJ	0.67 J	NA	5 U	5 UJ	0.62 J
Cobalt, Dissolved	NA	NA	NA	NA	3 U	NA	NA	3 U	1 J	NA	3 U	3 U	0.6 U
Copper, Dissolved	NA	NA	NA	NA	4.9 U	NA	NA	4.4 B	1.5 J	NA	4.9 U	3.8 B	1 U
Iron, Dissolved	NA	NA	NA	NA	2,970	NA	NA	68 U	259	NA	22.9 U	51.5 U	2,300
Lead, Dissolved	NA	NA	NA	NA	1 U	NA	NA	1 U	2.1 J	NA	1 U	1 U	1.8 U

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Station ID	3GW03						GGW05			GGW07		GGW10	
Sample ID	3GW3(85)	3GW3(86)	3GW3(87)	3GW3(92)	3GW3(94)	AS03-3GW03-AP	GGW5(92)	GGW5(94)	GGW5(03)	GGW7(92)	GGW7(94)	GGW10(94)	GGW10(03)
Sample Date	12/05/85	03/06/86	07/22/87	01/01/92	12/02/94	06/09/00	01/01/92	12/05/94	01/09/03	01/01/92	12/02/94	12/05/94	01/09/03
Chemical Name													
Magnesium, Dissolved	NA	NA	NA	NA	9,200	NA	NA	4,640 B	6,370	NA	5,850	8,400	12,000
Manganese, Dissolved	NA	NA	NA	NA	461	NA	NA	45.8	33.2	NA	135	174	140
Mercury, Dissolved	NA	NA	NA	NA	0.14 U	NA	NA	0.13 U	0.1 U	NA	0.35	0.13 U	0.1 U
Nickel, Dissolved	NA	NA	NA	NA	7.2 B	NA	NA	7 U	5.3 J	NA	9.9 B	7 U	1.3 U
Potassium, Dissolved	NA	NA	NA	NA	1,840 B	NA	NA	328 B	252 J	NA	356 B	1,010 B	927 J
Selenium, Dissolved	NA	NA	NA	NA	2 U	NA	NA	2 U	1.8 U	NA	2 U	2 U	1.8 U
Silver, Dissolved	NA	NA	NA	NA	4 U	NA	NA	4 R	0.6 U	NA	4 U	4 R	0.6 U
Sodium, Dissolved	NA	NA	NA	NA	9,880	NA	NA	7,870	7,910	NA	4,390 B	18,400	24,800
Thallium, Dissolved	NA	NA	NA	NA	3 U	NA	NA	4.2 B	2 U	NA	3.1 B	3 U	2 U
Vanadium, Dissolved	NA	NA	NA	NA	1 U	NA	NA	1 U	0.6 U	NA	1 U	1 U	0.6 U
Zinc, Dissolved	NA	NA	NA	NA	4.3 B	NA	NA	12.5 B	11.9 J	NA	8.3 B	3.3 B	4.5 B
Wet Chemistry													
Chromium (hexavalent) (mg/l)	0.1 U	0.01 U	0.02 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate (mg/l)	5 U	2.5 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrate/Nitrite (mg/l)	NA	NA	2.9	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrocellulose (mg/l)	NA	NA	25 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nitrocellulose (ug/l)	200 U	0.2 U	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
pH (ph)	7.5	7	7.4	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

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Notes:

Shading indicates detections

NA - Not analyzed

B - Analyte not detected above the level reported in blanks

J - Analyte present, value may or may not be accurate or precise

R - Unreliable Result

U - The material was analyzed for, but not detected

UJ - Analyte not detected, quantitation limit may be inaccurate

MG/L - Milligrams per liter

PH - pH units

UG/L - Micrograms per liter

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StationID	4GW01					GGW25		
SampleID	4GW1(85)	4GW1(86)	4GW1(87)	4GW1(92)	4GW1(94)	27A-GGW25-1	27A-GGW25-0305	27A-GGW25-1206
SampleDate	12/5/1985	3/7/1986	7/22/1987	1/1/1992	12/5/1994	4/6/2004	3/2/2005	12/5/2006
Chemical Name								
Volatile Organic Compounds (UG/L)								
1,1,1-Trichloroethane	NS	**1 J**	5 U	5 U	NS	0.5 U	10 U	10 UJ
1,1,2,2-Tetrachloroethane	10 U	10 U	5 U	5 UJ	NS	0.5 U	10 U	10 UJ
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	NS	NS	NS	NS	NS	0.5 U	10 U	10 UJ
1,1,2-Trichloroethane	10 U	10 U	5 U	5 U	NS	0.5 U	10 U	10 UJ
1,1-Dichloroethane	10 U	10 U	5 U	5 U	NS	0.5 U	10 U	10 UJ
1,1-Dichloroethene	10 U	10 U	5 U	5 U	NS	0.5 U	10 U	10 UJ
1,2,3-Trichlorobenzene	NS	NS	NS	NS	NS	0.5 U	NS	NS
1,2,4-Trichlorobenzene	10 U	10 U	10 U	NS	NS	0.5 U	10 U	10 UJ
1,2-Dibromo-3-chloropropane	NS	NS	NS	NS	NS	0.5 U	10 U	10 UJ
1,2-Dibromoethane	NS	NS	NS	NS	NS	0.5 U	10 U	10 UJ
1,2-Dichlorobenzene	10 U	10 U	10 U	NS	NS	0.5 U	10 U	10 UJ
1,2-Dichloroethane	10 U	10 U	5 U	5 U	NS	0.5 U	10 U	10 UJ
1,2-Dichloroethene (total)	NS	NS	NS	5 U	NS	NS	NS	NS
1,2-Dichloropropane	NS	10 U	5 U	5 U	NS	0.5 U	10 U	10 UJ
1,3-Dichlorobenzene	10 U	10 U	10 U	NS	NS	0.5 U	10 U	10 UJ
1,4-Dichlorobenzene	10 U	10 U	10 U	NS	NS	0.5 U	10 U	10 UJ
2-Butanone	10 U	10 U	10 U	10 U	NS	5 R	10 U	10 UJ
2-Chloroethyl vinyl ether	10 U	10 U	10 U	NS	NS	NS	NS	NS
2-Hexanone	NS	NS	10 U	10 U	NS	5 U	10 U	10 UJ
4-Methyl-2-pentanone	10 U	10 U	10 U	10 U	NS	5 U	10 U	10 UJ
Acetone	NS	NS	18 B	10 UJ	NS	5 R	10 U	10 UJ
Benzene	10 U	10 U	5 U	5 U	NS	0.5 U	10 U	10 UJ
Bromochloromethane	NS	NS	NS	NS	NS	0.5 U	NS	NS
Bromodichloromethane	NS	10 U	5 U	5 U	NS	0.5 U	10 U	10 UJ
Bromoform	10 U	10 U	5 U	5 UJ	NS	0.5 U	10 U	10 UJ
Bromomethane	10 U	10 U	10 U	10 U	NS	0.5 U	10 U	10 UJ
Carbon disulfide	**23**	NS	5 U	5 U	NS	0.5 U	10 U	10 UJ
Carbon tetrachloride	NS	10 U	5 U	5 U	NS	0.5 U	10 U	10 UJ
Chlorobenzene	10 U	10 U	5 U	5 U	NS	0.5 U	10 U	10 UJ
Chloroethane	10 U	10 U	10 U	10 U	NS	0.5 U	10 U	10 UJ
Chloroform	10 U	10 U	5 U	5 U	NS	0.5 U	10 U	10 UJ
Chloromethane	10 U	10 U	10 U	10 UJ	NS	0.46 B	10 U	10 UJ
cis-1,2-Dichloroethene	NS	NS	NS	NS	NS	0.5 U	10 U	10 UJ
cis-1,3-Dichloropropene	10 U	10 U	5 U	5 U	NS	0.5 U	10 U	10 UJ
Cyclohexane	NS	NS	NS	NS	NS	0.5 U	10 U	10 UJ
Dibromochloromethane	10 U	10 U	5 U	5 UJ	NS	0.5 U	10 U	10 UJ
Dichlorobenzenes, total	10 U	10 U	NS	NS	NS	NS	NS	NS
Dichlorodifluoromethane (Freon-12)	NS	NS	NS	NS	NS	0.5 U	10 U	10 UJ
Ethylbenzene	10 U	10 U	5 U	5 U	NS	0.5 U	10 U	10 UJ
Isopropylbenzene	NS	NS	NS	NS	NS	0.5 U	10 U	10 UJ
Methyl acetate	NS	NS	NS	NS	NS	0.5 R	10 U	10 UJ
Methylcyclohexane	NS	NS	NS	NS	NS	0.5 U	10 U	10 UJ
Methylene chloride	**6 J**	**4 J**	4 B	**1 J**	NS	0.5 U	1.5 B	10 UJ
Methyl-tert-butyl ether (MTBE)	NS	NS	NS	NS	NS	0.5 U	10 U	10 UJ
Styrene	NS	NS	5 U	5 U	NS	0.5 U	10 U	10 UJ
Tetrachloroethene	10 U	10 U	5 U	5 UJ	NS	0.5 U	10 U	10 UJ
Toluene	10 U	**1 J**	**2 J**	5 U	NS	0.5 U	10 U	10 UJ
trans-1,2-Dichloroethene	10 U	10 U	5 U	NS	NS	0.5 U	10 U	10 UJ
trans-1,3-Dichloropropene	10 U	10 U	5 U	5 U	NS	0.5 U	10 U	10 UJ
Trichloroethene	10 U	**37**	**1 J**	5 UJ	NS	0.5 U	10 U	10 B
Trichlorofluoromethane (Freon-11)	10 U	10 U	NS	NS	NS	0.5 U	10 U	10 UJ
Vinyl acetate	NS	NS	10 U	10 U	NS	NS	NS	NS
Vinyl chloride	10 U	10 U	10 U	10 U	NS	0.5 U	10 U	10 UJ
Xylene, total	10 U	10 U	5 U	5 U	NS	0.5 U	10 U	10 UJ

ABL
Historical Data
Raw Analytical Results
Attachement 1

Semivolatile Organic Compounds (UG/L)								
1,1-Biphenyl	NS	NS	NS	NS	NS	5.3 U	NS	NS
1,2,4,5-Tetrachlorobenzene	NS	NS	NS	NS	NS	5.3 U	NS	NS
2,2'-Oxybis(1-chloropropane)	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
2,4,5-Trichlorophenol	NS	50 U	50 U	NS	NS	21 U	NS	NS
2,4,6-Trichlorophenol	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
2,4-Dichlorophenol	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
2,4-Dimethylphenol	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
2,4-Dinitrophenol	50 U	50 U	50 U	NS	NS	21 U	NS	NS
2,4-Dinitrotoluene	3 U	10 U	0.6 U	NS	NS	5.3 U	NS	NS
2,6-Dinitrotoluene	3 U	10 U	0.55 U	NS	NS	5.3 U	NS	NS
2-Chloronaphthalene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
2-Chlorophenol	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
2-Methylnaphthalene	NS	10 U	10 U	NS	NS	5.3 U	NS	NS
2-Methylphenol	NS	10 U	10 U	NS	NS	5.3 U	NS	NS
2-Nitroaniline	NS	50 U	50 U	NS	NS	21 U	NS	NS
2-Nitrophenol	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
3,3'-Dichlorobenzidine	20 U	20 U	20 U	NS	NS	5.3 U	NS	NS
3-Nitroaniline	NS	50 U	50 U	NS	NS	21 U	NS	NS
4,6-Dinitro-2-methylphenol	50 U	50 U	50 U	NS	NS	21 U	NS	NS
4-Bromophenyl-phenylether	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
4-Chloro-3-methylphenol	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
4-Chloroaniline	NS	10 U	10 U	NS	NS	5.3 U	NS	NS
4-Chlorophenyl-phenylether	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
4-Methylphenol	NS	10 U	10 U	NS	NS	5.3 U	NS	NS
4-Nitroaniline	NS	50 U	50 U	NS	NS	21 U	NS	NS
4-Nitrophenol	50 U	50 U	50 U	NS	NS	21 U	NS	NS
Acenaphthene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Acenaphthylene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Acetophenone	NS	NS	NS	NS	NS	5.3 U	NS	NS
Anthracene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Atrazine	NS	NS	NS	NS	NS	5.3 U	NS	NS
Benzaldehyde	NS	NS	NS	NS	NS	5.3 U	NS	NS
Benzidine	50 U	NS	NS	NS	NS	NS	NS	NS
Benzo(a)anthracene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Benzo(a)pyrene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Benzo(b)fluoranthene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Benzo(g,h,i)perylene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Benzo(k)fluoranthene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Benzoic acid	NS	50 U	50 U	NS	NS	NS	NS	NS
Benzyl alcohol	NS	10 U	10 U	NS	NS	NS	NS	NS
bis(2-Chloroethoxy)methane	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
bis(2-Chloroethyl)ether	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
bis(2-Ethylhexyl)phthalate	10 U	10 U	10 U	NS	NS	**2.5 K**	NS	NS
Butylbenzylphthalate	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Caprolactam	NS	NS	NS	NS	NS	5.3 U	NS	NS
Chrysene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Dibenz(a,h)anthracene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Semivolatile Organic Compounds(NG/L)								
Dibenzofuran	NS	10000 U	10000 U	NS	NS	5300 U	NS	NS
Semivolatile Organic Compounds(UG/L)								
Diethylphthalate	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Dimethyl phthalate	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Di-n-butylphthalate	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Di-n-octylphthalate	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Fluoranthene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Fluorene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Hexachlorobenzene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Hexachlorobutadiene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS

Hexachlorocyclopentadiene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Hexachloroethane	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Indeno(1,2,3-cd)pyrene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Isophorone	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Naphthalene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
n-Nitrosodimethylamine	10 U	NS	NS	NS	NS	NS	NS	NS
n-Nitroso-di-n-propylamine	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
n-Nitrosodiphenylamine	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Nitrobenzene	3 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Pentachlorophenol	50 U	50 U	50 U	NS	NS	5.3 U	NS	NS
Phenanthrene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Phenol	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Pyrene	10 U	10 U	10 U	NS	NS	5.3 U	NS	NS
Explosives (UG/L)								
1,3,5-Trinitrobenzene	3 U	NS	0.56 U	NS	NS	NS	NS	NS
1,3-Dinitrobenzene	3 U	NS	0.61 U	NS	NS	NS	NS	NS
2,4,6-Trinitrotoluene	5 U	NS	0.78 U	NS	NS	NS	NS	NS
2,4-Diamino-6-nitrotoluene	NS	NS	7.2 U	NS	NS	NS	NS	NS
2,6-Diamino-4-nitrotoluene	NS	NS	9.24 U	NS	NS	NS	NS	NS
2-Amino-4,6-dinitrotoluene	NS	NS	3.24 U	NS	NS	NS	NS	NS
4-Amino-2,6-dinitrotoluene	NS	NS	2.48 U	NS	NS	NS	NS	NS
HMX	7 U	NS	1.3 U	NS	NS	NS	NS	NS
Nitroglycerin	200 U	NS	5000 U	NS	NS	NS	NS	NS
Perchlorate	NS	NS	NS	NS	NS	1 U	NS	NS
RDX	4 U	NS	0.63 U	NS	NS	NS	NS	NS
Tetryl	4 U	NS	NS	NS	NS	NS	NS	NS
Total Metals (UG/L)								
Aluminum	NS	NS	NS	**7290**	NS	**7150**	NS	NS
Antimony	NS	NS	NS	12.4 U	NS	4.1 U	NS	NS
Arsenic	NS	NS	NS	2.4 B	NS	**4.1 J**	NS	NS
Barium	200 U	500 U	200 U	**87.4**	NS	**159 J**	NS	NS
Beryllium	NS	NS	NS	0.24 U	NS	0.4 B	NS	NS
Cadmium	2 U	10 U	5 U	2.7 U	NS	0.3 U	NS	NS
Calcium	NS	NS	NS	**135000**	NS	**23700**	NS	NS
Chromium	10 U	25 U	10 U	**18**	NS	**8.5 J**	NS	NS
Cobalt	NS	NS	NS	**10**	NS	**4.3 J**	NS	NS
Copper	NS	NS	NS	40.6 B	NS	8.6 B	NS	NS
Cyanide	NS	NS	NS	NS	10 U	10 U	NS	NS
Iron	NS	NS	NS	**22700**	NS	**10100**	NS	NS
Lead	5 U	**7**	5 U	**27.6**	NS	**5.3 K**	NS	NS
Magnesium	NS	NS	NS	**10000**	NS	**8330 K**	NS	NS
Manganese	NS	NS	NS	**1230**	NS	**240**	NS	NS
Mercury	500 U	0.5 U	0.2 U	0.16 U	NS	0.1 U	NS	NS
Nickel	40 U	10 U	40 U	**41.4**	NS	**17.7 J**	NS	NS
Potassium	NS	NS	NS	**3280**	NS	**1970 J**	NS	NS
Selenium	NS	NS	NS	1.9 U	NS	2.3 U	NS	NS
Silver	2 U	10 U	10 U	1.5 U	NS	0.9 U	NS	NS
Sodium	NS	NS	NS	**12300**	NS	**9970 L**	NS	NS
Thallium	NS	NS	NS	2.1 UJ	NS	4.1 UL	NS	NS
Vanadium	NS	NS	NS	**15.7**	NS	**10.8 J**	NS	NS
Zinc	50 U	500 U	20 U	153 B	NS	**32.3**	NS	NS
Dissolved Metals (UG/L)								
Aluminum, Dissolved	NS	NS	NS	NS	NS	36.2 B	NS	NS
Antimony, Dissolved	NS	NS	NS	NS	NS	4.1 U	NS	NS
Arsenic, Dissolved	NS	NS	NS	NS	NS	3.4 U	NS	NS
Barium, Dissolved	NS	NS	NS	NS	NS	**95.6 J**	NS	NS
Beryllium, Dissolved	NS	NS	NS	NS	NS	0.05 U	NS	NS
Cadmium, Dissolved	NS	NS	NS	NS	NS	0.3 U	NS	NS

Calcium, Dissolved	NS	NS	NS	NS	NS	**22600**	NS	NS
Chromium, Dissolved	NS	NS	NS	NS	NS	0.7 U	NS	NS
Cobalt, Dissolved	NS	NS	NS	NS	NS	**1 J**	NS	NS
Copper, Dissolved	NS	NS	NS	NS	NS	2.7 B	NS	NS
Iron, Dissolved	NS	NS	NS	NS	NS	27.9 B	NS	NS
Lead, Dissolved	NS	NS	NS	NS	NS	1.7 U	NS	NS
Magnesium, Dissolved	NS	NS	NS	NS	NS	**7160 K**	NS	NS
Manganese, Dissolved	NS	NS	NS	NS	NS	**118**	NS	NS
Mercury, Dissolved	NS	NS	NS	NS	NS	0.1 U	NS	NS
Nickel, Dissolved	NS	NS	NS	NS	NS	10.5 B	NS	NS
Potassium, Dissolved	NS	NS	NS	NS	NS	**434 J**	NS	NS
Selenium, Dissolved	NS	NS	NS	NS	NS	2.3 U	NS	NS
Silver, Dissolved	NS	NS	NS	NS	NS	0.9 U	NS	NS
Sodium, Dissolved	NS	NS	NS	NS	NS	**9510 L**	NS	NS
Thallium, Dissolved	NS	NS	NS	NS	NS	4.1 U	NS	NS
Vanadium, Dissolved	NS	NS	NS	NS	NS	1.2 U	NS	NS
Zinc, Dissolved	NS	NS	NS	NS	NS	**14.7 J**	NS	NS
Wet Chemistry								
Chloride (MG/L)	NS	NS	NS	NS	NS	NS	**28**	NS
Chromium (hexavalent) (MG/L)	0.1 U	0.01 U	0.02 U	NS	NS	NS	NS	NS
Nitrate/Nitrite (MG/L)	NS	NS	0.1 U	NS	NS	NS	NS	NS
Nitrocellulose (MG/L)	NS	NS	25 U	NS	NS	NS	NS	NS
Nitrocellulose (UG/L)	200 U	NS	NS	NS	NS	NS	NS	NS
pH (PH)	**7.2**	**7.2**	**7.2**	NS	NS	NS	NS	NS
Total organic carbon (TOC) (MG/L)	NS	NS	NS	NS	NS	NS	2.4 B	NS
Total Petroleum Hydrocarbons ()								
TPH-diesel range (UG/L)	NS	NS	NS	NS	NS	70 B	NS	NS
TPH-gas range (UG/L)	NS	NS	NS	NS	NS	100 U	NS	NS

Notes

Bold indicates the analyte was detected

NA = Not analyzed

B = The analyte was detected in the associated method and/or calibration blank.

J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.

K = The analyte was positively identified, but the associated numerical value may be biased high.

L = The analyte was positively identified, but the associated numerical value may be biased low.

R = The sample results are rejected due to serious deficiencies in the ability to analyze the sample and to meet the quality control criteria. The presence or absence of the analyte cannot be verified.

U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.

UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.

MG_L = milligram per liter

NG_L = nanogram per liter

UG_L = microgram per liter