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JEB LITTLE CREEK
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FINAL SAMPLING AND ANALYSIS PLAN FOR 1, 4 DIOXANE GROUNDWATER SAMPLING
IN SUPPORT OF FIVE YEAR REVIEW REMEDY PROTECTIVNESS DETERMINATION AT
SITE 11 JEB LITTLE CREEK VIRGINIA BEACH VA (PUBLIC DOCUMENT)

04/01/2015
CH2M HILL

SAP Worksheet #1—Title Page

Final

**Sampling and Analysis Plan for
1,4-Dioxane Groundwater Sampling
in Support of Five-Year Review Remedy
Protectiveness Determination at Site 11**

**Joint Expeditionary Base Little Creek
Virginia Beach, Virginia**

Contract Task Order WE61

April 2015

Prepared for

**Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic**

Under the

**NAVFAC CLEAN 8012 Program
Contract N62470-11-D-8012**

Prepared by



CH2MHILL

Virginia Beach, Virginia

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

Approval Signatures:

NAVFAC Atlantic – Chemist

Other Approval Signatures:

Matthew Stepien
NAVFAC Mid-Atlantic – Remedial Project Manager

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USEPA Region 3 – Remedial Project Manager

Paul Herman, P.E.
VDEQ – Remedial Project Manager

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Executive Summary

On October 1, 2009, Hampton Roads' first Joint Base was established. This new installation comprises the former Naval Amphibious Base (NAB) Little Creek and the Army Post Fort Story; the new name is Joint Expeditionary Base (JEB) Little Creek-Fort Story. With the forming of this new command, the Department of the Navy (Navy) assumed responsibility for managing both properties and has merged public meetings regarding the ongoing environmental restoration. However, separate records are maintained to ensure the integrity of ongoing efforts at both properties. When required for public notices and distributions, the former bases are identified jointly as JEB Little Creek-Fort Story. For Environmental Restoration Program documents, the bases are referred to separately as JEB Little Creek or JEB Fort Story.

This Sampling and Analysis Plan (SAP) was prepared under the Navy Comprehensive Long-Term Environmental Action (CLEAN) Contract N62470-11-D-8012, Contract Task Order (CTO) WE61, for submittal to the Navy, specifically Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic, the United States Environmental Protection Agency (USEPA) Region 3, and the Virginia Department of Environmental Quality (VDEQ). Representatives of the Navy, USEPA, and VDEQ work jointly as the JEB Little Creek Tier I Partnering Team.

This Navy-specific SAP includes 37 worksheets that detail various aspects of the environmental investigation process and provide guidelines for the field activities and data quality assessment. The intent of the SAP is to ensure that environmental data collected or compiled are scientifically sound, of known and documented quality, and are suitable for the intended uses. This SAP was developed in accordance with the following three guidance documents:

- Guidance for Quality Assurance Project Plans, USEPA QA/G-5, QAMS (USEPA, 2002)
- Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) (USEPA, 2005)
- Guidance on Systematic Planning Using the Data Quality Objectives Process (USEPA, 2006)

The second comprehensive Five-Year Review for JEB Little Creek, finalized in 2014, concluded the remedy for Site 11 is in place, functioning as designed, and currently protective of human health and the environment. However, the contaminants identified at this site are associated with 1,4-dioxane, which was not included in prior groundwater sample analysis. Because risk-based screening levels are now available for this compound, an evaluation to determine the presence or absence of 1,4-dioxane in site groundwater is warranted. The objective of this investigation is to evaluate long-term remedy protectiveness at Site 11, specifically by determining the presence or absence of 1,4-dioxane in site groundwater. The SAP objectives will be met through the collection of one round of groundwater samples for analysis of 1,4-dioxane. If 1,4-dioxane is detected and data are not adequate to define the nature and extent of 1,4-dioxane contamination in groundwater or support development and evaluation of remedial action alternatives, then a contingency sampling event will be conducted. The contingency sampling event will include groundwater sampling for 1,4-dioxane from existing Site 11 monitoring wells and may include direct push technology (DPT) groundwater sampling or the installation of additional monitoring wells (either permanent or temporary wells) to delineate the horizontal extent of 1,4-dioxane in the shallow aquifer groundwater. The sample locations will be determined based on the results of the primary event. The contingency event will be conducted under an addendum to this Uniform Federal Policy (UFP)-SAP. This SAP provides the criteria to be used to evaluate the groundwater data, and provides the decision tree agreed upon by the Partnering Team for the path forward to evaluate remedy protectiveness at Site 11.

The laboratory information in this Work Plan is specific to Empirical Laboratories, LLC (Empirical) of Nashville, Tennessee. The laboratory was selected based on a competitive selection process. If additional laboratory services are requested requiring 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 Navy's UFP-SAP guidance. All tables and figures are included following the worksheets. Field standard operating procedures (SOPs) are included as **Appendix A** and Empirical's Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) accreditation is provided in **Appendix B**.

SAP Worksheets

SAP Worksheet #1—Title Page	1
Executive Summary	5
Acronyms and Abbreviations	9
SAP Worksheet #2—SAP Identifying Information	13
SAP Worksheet #4—Project Personnel Sign-Off Sheet	17
SAP Worksheet #5—Project Organizational Chart	19
SAP Worksheet #6—Communication Pathways.....	21
SAP Worksheet #7—Personnel Responsibilities Table	25
SAP Worksheet #8—Special Personnel Training Requirements Table	27
SAP Worksheet #9-1—Project Scoping Session Participants Sheet	29
SAP Worksheet #10—Conceptual Site Model	31
SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements	35
SAP Worksheet #12—Measurement Performance Criteria Table	39
SAP Worksheet #13—Secondary Data Criteria and Limitations Table	41
SAP Worksheet #14—Summary of Project Tasks	43
SAP Worksheet #15—Reference Limits and Evaluation Table	45
SAP Worksheet #16—Project Schedule/Timeline Table (optional format).....	47
SAP Worksheet #17—Sampling Design and Rationale	49
SAP Worksheet #18—Sampling Locations and Methods/SOP Requirements Table.....	51
SAP Worksheet #19—Analytical SOP Requirements Table	53
SAP Worksheet #20—Field Quality Control Sample Summary Table.....	55
SAP Worksheet #21—Project Sampling SOP References Table	57
SAP Worksheet #22—Field Equipment Calibration, Maintenance, Testing, and Inspection Table	59
SAP Worksheet #23—Analytical SOP References Table	61
SAP Worksheet #24—Analytical Instrument Calibration Table.....	63
SAP Worksheet #25—Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table	65
SAP Worksheet #26—Sample Handling System	67
SAP Worksheet #27—Sample Custody Requirements Table	69
SAP Worksheet #28—Laboratory QC Samples Table	71
SAP Worksheet #29—Project Documents and Records Table	73
SAP Worksheet #30—Analytical Services Table	75
SAP Worksheet #31—Planned Project Assessments Table	77
SAP Worksheet #32—Assessment Findings and Corrective Action Responses	79
SAP Worksheet #32-1—Corrective Action Form	81
SAP Worksheet #32-2—Field Performance Audit Checklist	83
SAP Worksheet #33—QA Management Reports Table	85
SAP Worksheets #34 through #36—Data Verification and Validation (Steps I and IIa/IIb) Process Table	87
SAP Worksheet #37—Usability Assessment.....	91

Appendixes

- A Field Standard Operating Procedures
- B Laboratory DoD ELAP Accreditation

Figures

- 1 Base and Site 11 Location Map
- 2 Site 11 Boundary and Immediate Vicinity
- 3 Site 11 Conceptual Site Model
- 4 Site 11 Potentiometric Surface Contour Map
- 5 Site 11 Total COC Isoconcentration Contours (Remedial Action Baseline)
- 6 Site 11 Groundwater Sampling Locations
- 7 Site 11 Decision Tree
- 8 Project Schedule

Acronyms and Abbreviations

AM	Activity Manager
amsl	above mean sea level
AQM	Activity Quality Manager
bgs	below ground surface
CA	corrective action
CAS	Chemical Abstracts Service (registry number)
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLEAN	Comprehensive Long-term Environmental Action—Navy
COC	contaminant of concern
CTO	Contract Task Order
°C	degree(s) Celsius
DL	detection limit
DO	dissolved oxygen
DoD	Department of Defense
DPT	direct push technology
EDD	electronic data deliverable
ELAP	Environmental Laboratory Accreditation Program
ERD	enhanced reductive dechlorination
FQM	Field Quality Manager
FS	Feasibility Study
ft	feet/foot
ft/day	feet per day
ft/ft	feet per foot
ft/yr	feet per year
FTL	Field Team Leader
GC	gas chromatograph
H&S	health and safety
HHRA	human health risk assessment
HSM	Health and Safety Manager
HASP	Health and Safety Plan
ICAL	initial calibration
ICV	initial calibration verification
ID	identification
IDW	investigation-derived waste
IRI	Interim Remedial Investigation
IS	internal standards
JEB	Joint Expeditionary Base
L	liter
LCL	lower confidence limit

LCS	laboratory control sample
LCSD	laboratory control sample duplicate
LOD	limit of detection
LOQ	limit of quantitation
LTM	long-term monitoring
LUC	land use controls
MIP	membrane interface probe
MPC	measurement performance criteria
MS	mass spectrometer
MS	matrix spike
MSD	matrix spike duplicate
N/A	not applicable
NAB	Naval Amphibious Base
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NIRIS	Navy Installation Restoration Information System
NTU	nephelometric turbidity unit
ORP	oxidation-reduction potential
PAL	project action limit
PC	Project Chemist
PCE	tetrachloroethene
PID	photoionization detector
PM	Project Manager
POC	point of contact
PQL	project quantitation limit
QA	quality assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	quality control
QL	quantitation limit
QSM	Quality Systems Manual
RF	response factor
RI	Remedial Investigation
ROD	Record of Decision
RPD	relative percent difference
RSD	relative standard deviation
RPD	relative percent difference
RSL	regional screening level
RPM	Remedial Project Manager
S&A	sampling and analytical
SAP	Sampling and Analysis Plan
SME	Subject Matter Expert
SOP	Standard Operating Procedure
SRI	Supplemental Remedial Investigation
SSC	Site Safety Coordinator

STC	Senior Technical Consultant
SVOC	semivolatile organic compound
TBD	to be determined
TCA	trichloroethane
TCE	trichloroethene
UCL	upper confidence limit
UFP	Uniform Federal Policy
µg/L	microgram(s) per liter
USEPA	United States Environmental Protection Agency
VDEQ	Virginia Department of Environmental Quality
VOC	volatile organic compound
yr	year

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SAP Worksheet #2—SAP Identifying Information

Site Name/Number: Site 11 – Former School of Music Plating Shop

Operable Unit: Not applicable (N/A)

Contractor Name: CH2M HILL

Contract Number: N62470-11-D-8012, Contract Task Order (CTO) WE61

Contract Title: Comprehensive Long-term Environmental Action—Navy (CLEAN) 8012

1. This Sampling and Analysis Plan (SAP) was prepared in accordance with the requirements of:
 - Guidance for Quality Assurance Project Plans, QA/G-5, QAMS (USEPA, 2002)
 - Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP) (USEPA, 2005)
 - Guidance on Systematic Planning Using the Data Quality Objectives Process (USEPA, 2006)
2. Identify regulatory program:

Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)

3. This SAP is specific to:

Site 11

4. List dates of scoping sessions that were held:

Scoping Session	Date
Groundwater Sampling Approach for 1,4-dioxane	November 4, 2014

5. List dates and titles of any SAP documents written for previous site work that are relevant to the current investigation.

Title	Date
Master Project Plans for Naval Amphibious Base Little Creek	April 2007
Long-term Monitoring Sampling and Analysis Plan for Sites with Groundwater Impacted by Chlorinated organic Compounds Post-ROD Groundwater Monitoring Sampling	March 2012

6. List organizational partners (stakeholders) and connection with lead organization:
 - **Lead Organization**—Naval Facilities Engineering Command (NAVFAC), Mid-Atlantic
 - **Lead Regulatory Agency**—USEPA Region 3
 - **State Regulatory Agency**—Virginia Department of Environmental Quality (VDEQ)
7. If any required SAP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below:

All SAP elements required for this project are described on the 37 Uniform Federal Policy (UFP)-SAP Worksheets.

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SAP Worksheet #3—Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number (Optional)	E-mail Address or Mailing Address
Matthew Stepien	Remedial Project Manager (RPM)	NAVFAC Mid-Atlantic	757-341-0380	matthew.stepien@navy.mil
Jeff Boylan	RPM	USEPA Region 3	215-814-2094	boylan.jeffrey@epa.gov
Paul Herman, P.E.	RPM	VDEQ	804-698-4464	peherman@deq.virginia.gov
Cecilia Landin	Activity Manager (AM)	CH2M HILL	757-671-6266	cecilia.landin@ch2m.com
Nathaniel Price	Project Manager (PM)	CH2M HILL	757-671-6280	nathaniel.Price@CH2M.com
Megan Morrison	Project Chemist (PC)	CH2M HILL	210-310-3744	megan.morrison@ch2m.com
To be determined (TBD)	Field Team Leader (FTL)/Field Quality Manager (FQM)	CH2M HILL	TBD	TBD
TBD	Field Team Member/ Site Safety Coordinator	CH2M HILL	TBD	TBD
Sonya Gordon	Laboratory PM	Empirical	615-345-1115	sgordon@empirlabs.com
Herb Kelly	Senior Chemist, Data Validator	CH2M HILL	352-384-7100	herb.kelly@ch2m.com

Note: Hardcopy and electronic versions will be made available to additional staff as requested.

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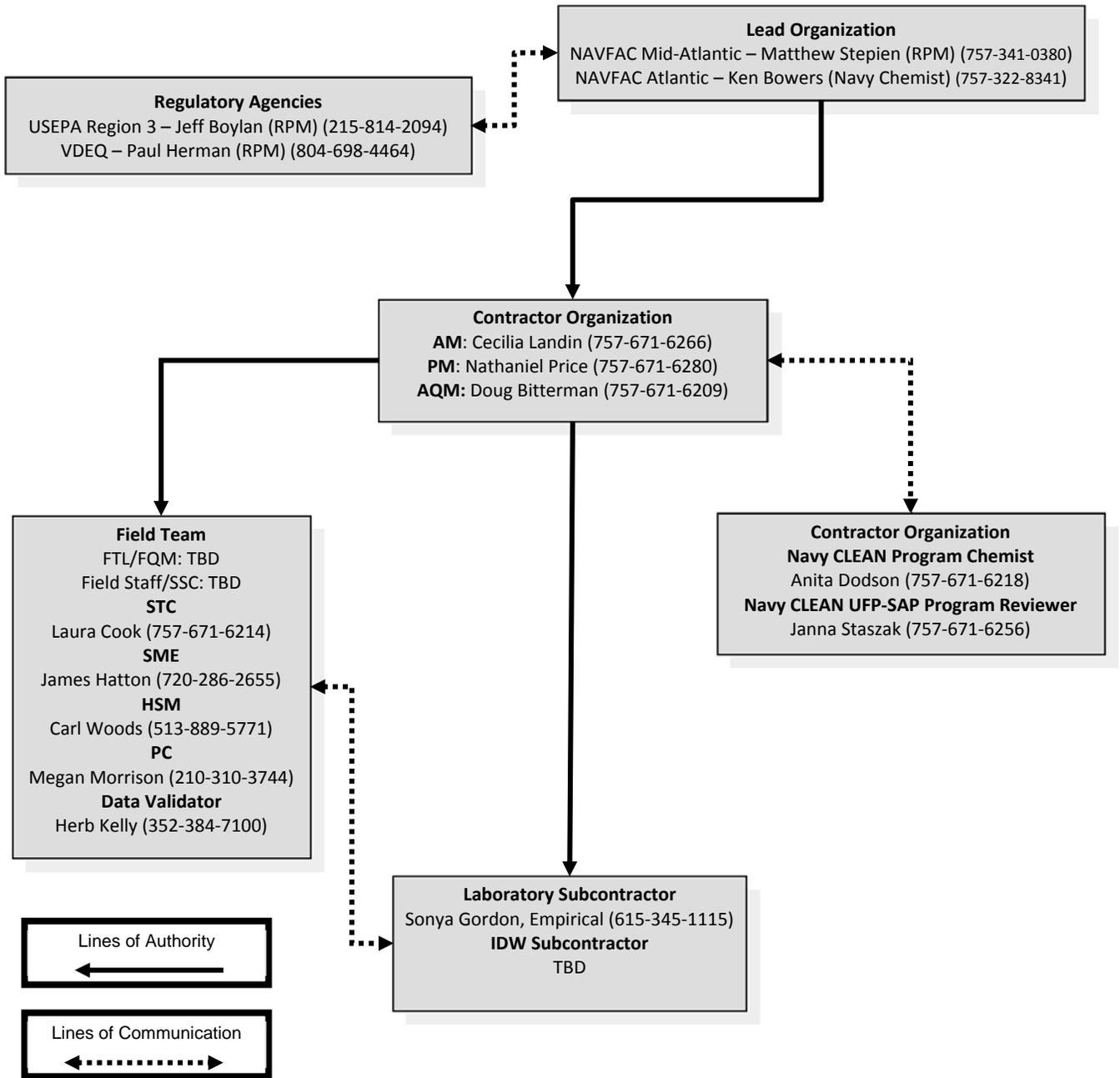
SAP Worksheet #4—Project Personnel Sign-Off Sheet

Name	Title/Role	Telephone Number	Signature/E-mail Receipt	Date SAP Read
Subcontractors				
Sonya Gordon	Laboratory PM/ Empirical	615-345-1115		
TBD	Investigation-derived Waste (IDW) PM	TBD		
CH2M HILL				
Cecilia Landin	AM	757-671-6266		
Nathaniel Price	PM	757-671-6280		
Carl Woods	Program Health and Safety Manager (HSM)	513-889-5771		
Anita Dodson	Navy CLEAN Program Chemist	757-671-6218		
Janna Staszak	Navy CLEAN Program UFP-SAP reviewer	757-671-6256		
Doug Bitterman	Activity Quality Manager (AQM)	757-671-6209		
Laura Cook	Senior Technical Consultant (STC)	757-671-6214		
James Hatton	Subject Matter Expert (SME)	720-286-2655		
Megan Morrison	PC	210-310-3744		
Herb Kelly	Data Validator	352-384-7100		
TBD	FTL/FQM	TBD		
TBD	Field Team Member/ Site Safety Coordinator (SSC)	TBD		

Note: Signed versions of **Worksheet #4** will be kept on file at CH2M HILL along with other project documents.

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SAP Worksheet #5—Project Organizational Chart



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SAP Worksheet #6—Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure
Communication with the Department of the Navy (Navy) (i.e., NAVFAC Mid-Atlantic, lead agency).	Navy RPM	Matthew Stepien	757-341-0380	Primary point of contact (POC) for Navy related to technical issues associated with sampling. RPM can delegate communication to other internal or external POCs. RPM will notify United States Environmental Protection Agency (USEPA) and VDEQ via email within 24 hours for field changes affecting the project scope or implementation. Navy will have 30 days for work plan review prior to regulatory (USEPA and VDEQ) review. All sampling data will be presented and discussed during Partnering Team meetings.
Communication with USEPA Region 3 (regulatory agency).	USEPA RPM	Jeff Boylan	215-814-2094	Primary POC for USEPA. USEPA RPM may delegate communication to other internal or external POCs. Upon notification of field changes, USEPA will have 24 hours to approve or comment on the field changes. All data will be presented and discussed during Partnering Team meetings.
Communication with VDEQ (regulatory agency).	VDEQ RPM	Paul Herman	804-698-4464	Primary POC for VDEQ. VDEQ RPM may delegate communication to other internal or external POCs. Upon notification of field changes, VDEQ will have 24 hours to approve or comment on the field changes. All data will be presented and discussed during Partnering Team meetings.
Communication regarding overall project status and implementation and primary POC with Navy RPM, USEPA, and VDEQ.	CH2M HILL AM	Cecilia Landin	757-671-6266	All information and materials about the project will be forwarded to the Partnering Team by the AM. The AM oversees all site projects and will receive project status reports from the PM. If field changes occur during sampling activities, the AM will work with the Navy RPM to communicate the field changes to the Partnering Team via email and/or phone within 24 hours. All data will be communicated to the Partnering Team via email and meetings.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure
Overall quality and technical communications for project implementation and data interpretation.	CH2M HILL AQM	Doug Bitterman	757-671-6209	CH2M HILL internal team will contact the site AQM regarding questions/issues during work planning and field implementation—as appropriate—for questions, general or specific issues, and quality control (QC). The AQM may present or discuss project issues/data with the Partnering Team during meetings at the AM's (or Team's) request, and will have 24 hours to respond to questions as necessary. In addition, the AQM will review deliverables as necessary prior to Partnering Team discussion or distribution.
Overall technical guidance for project implementation and data interpretation.	CH2M HILL STC	Laura Cook	757-671-6214	CH2M HILL internal team will contact the site STC regarding questions/issues during work planning, field implementation, and data interpretation—as appropriate—for questions, general or specific issues, and QC. The STC may present or discuss project issues/data with the Partnering Team during meetings at the AM's (or Team's) request, and will have 24 hours to respond to questions as necessary. In addition, the STC will review data and deliverables, as necessary, prior to Partnering Team discussion or distribution.
Technical guidance for project implementation and data interpretation.	CH2M HILL SME	James Hatton	720-286-2655	The SME may present or discuss project issues/data with the Partnering Team during meetings at the AM's (or Team's) request, and will have 24 hours to respond to questions as necessary. In addition, the SME will review data and deliverables, as necessary, prior to Partnering Team discussion or distribution.
Communications regarding project management and implementation of all project phases. Primary POC with AM.	CH2M HILL PM	Nathaniel Price	757-671-6280	CH2M HILL PMs communicate project-related information consistently. Standard monthly progress reports and invoices will be prepared and submitted by the PM to the Navy. The PM also reports project information and status directly to the AM.
Reporting laboratory data quality issues.	Laboratory PM	Sonya Gordon, Empirical	615-345-1115	All quality assurance (QA)/QC issues with project field samples will be reported as soon as possible to the PC by the laboratory.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure
Reporting data quality issues.	Data Validator	Herb Kelly	352-384-7100	The data validator reviews and qualifies analytical data as necessary. The data, along with a validation narrative, are returned to the PC within 14 calendar days.
Data Tracking from collection through upload to database.	CH2M HILL PC	Megan Morrison	210-310-3744	PC will track data from sample collection through upload to the database ensuring Work Plan requirements are met by laboratory and field staff.
Field corrective actions (CAs).	CH2M HILL FTL/FQM	TBD	TBD	Any CAs for field issues will be determined by the FTL and reported to the PM within 4 hours.
Health and safety (H&S).	CH2M HILL SSC	TBD	TBD	Responsible for the adherence to the site safety requirements described in the Health and Safety Plan (HASP). Will report H&S incidents and near misses to PM. Responsible for onsite H&S reports and training records.
Work Plan changes in field.	CH2M HILL FTL/FQM	TBD	TBD	Documentation of deviations from the Work Plan will be made in the field logbook and the PM will be notified immediately. Deviations can be made only with PM approval.
Analytical CAs.	CH2M HILL PC	Megan Morrison	210-310-3744	PC will be the main POC for the laboratory. Any CAs for analytical issues will be determined by the PC and reported to the PM as soon as possible. Informs PM, RPM, and Quality Assurance Officer (QAO) of any laboratory issues that would cause negative impacts to project delivery or would cause the project Data Quality Objectives to not be met.

Note: Stop Work Order: Any field member may immediately stop work if an unsafe condition, which is immediately threatening to human health, is observed. Ultimately, the FTL, PM, and AM may stop work for a period of time. NAVFAC Mid-Atlantic may stop work at any time.

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SAP Worksheet #7—Personnel Responsibilities Table

Name	Title/Role	Organizational Affiliation	Responsibilities
Matthew Stepien	RPM	NAVFAC Mid-Atlantic	Coordinates the work of Navy resources to accomplish Environmental Restoration Program goals and policies at JEB Little Creek.
Cecilia Landin	AM	CH2M HILL	Oversees Environmental Restoration Program activities at Joint Expeditionary Base (JEB) Little Creek.
Nathaniel Price	PM	CH2M HILL	Manages project and directs and oversees project staff. PM is responsible for implementation of the Program Quality Management Plan.
Laura Cook	STC	CH2M HILL	Provides senior technical support for investigative sampling and data assessments.
James Hatton	SME	CH2M HILL	Provides senior technical support for investigative sampling and data assessments.
Doug Bitterman	AQM	CH2M HILL	Provides senior technical support for investigative sampling and data assessments.
Janna Staszak	Navy CLEAN Program UFP-SAP reviewer	CH2M HILL	Provides UFP-SAP project delivery support and program-level review of UFP-SAP; responsible for reviewing audit results and CAs.
Anita Dodson	Navy CLEAN Program Chemist	CH2M HILL	Provides UFP-SAP project delivery support and program-level review of UFP-SAP; performs data evaluation and QA oversight.
Megan Morrison	PC	CH2M HILL	Assists in UFP-SAP preparation, interaction with the laboratory and data validator, and QA oversight. Assists with data management, manages sample tracking, and communicates with laboratory and data validator.
TBD	FTL/FQM	CH2M HILL	Coordinates all field activities and sampling. Tracks, stores, and retrieves laboratory and field supplies.
Carl Woods	CH2M HILL HSM	CH2M HILL	Prepares HASP; manages H&S for all field activities.
Sonya Gordon	Laboratory Subcontractor PM	Empirical	Manages samples tracking and maintains good communication with PC.
Herb Kelly	Data Validator	CH2M HILL	Validates data received from laboratory prior to data use.
TBD	IDW Disposal Subcontractor	TBD	Responsible for manifest, transportation, and disposal of IDW.

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SAP Worksheet #8—Special Personnel Training Requirements Table

No specialized training is required for this project implementation.

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

Project Name: Site 11 1,4-dioxane Groundwater Sampling Projected Date(s) of Sampling: May 2015 Current AM: Cecilia Landin		Site Name: Site 11, Former School of Music Plating Shop Site Location: JEB Little Creek, Virginia Beach, VA			
Date of Session: November 4, 2014 Scoping Session Purpose: Scope 1,4-dioxane groundwater sampling approach in response to five-year review issue/recommendation.					
Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Matthew Stepien	RPM	NAVFAC Mid-Atlantic	757- 341-0380	matthew.stepien@navy.mil	RPM
Jeff Boylan	RPM	USEPA Region 3	215-814-2094	boylan.jeffrey@epa.gov	Regulator
Paul Herman	RPM	VDEQ	804-698-4464	peherman@deg.virginia.gov	Regulator
Cecilia Landin	AM	CH2M HILL	757-671-6266	cecilia.landin@ch2m.com	AM
Nathaniel Price	Deputy AM/PM	CH2M HILL	757-671-6280	nathaniel.price@ch2m.com	Deputy AM/PM

Objective:

Conduct scoping for 1,4-dioxane groundwater sampling at Site 11 in response to five-year review issue/recommendation.

Overview:

The Tier I Partnering Team reviewed the project objective, environmental questions to be answered, proposed monitoring well network, project action levels, decision matrix, and risk assessment protocol. To determine long-term remedy protectiveness at Site 11, the team decided that groundwater sampling be conducted to determine the presence or absence of 1,4-dioxane in groundwater and, if present, assess potential human health risks. One round of sampling was proposed by the Navy to be conducted from 2 source and 10 sidegradient/downgradient monitoring wells to provide adequate site coverage for detection (2 source area wells) and delineation (5 perimeter wells, 3 wells south of the previously repaired leaking sanitary sewer line, and 2 downgradient wells) sampling of 1,4-dioxane in groundwater. Although groundwater currently flows in a more westerly direction, monitoring wells south of the source area have been included in the proposed network to account for historic groundwater flow in this direction resulting from a previously repaired leaking sanitary sewer line. All samples will be analyzed for 1,4-dioxane and data will be compared against the most current USEPA tap-water regional screening level (RSL). If 1,4-dioxane is present in groundwater at concentrations above the RSL, associated potential unacceptable risks will be calculated using the 95-percent upper confidence limit (UCL) of the mean concentration and will include all of the previously identified contaminants of concern (COCs) to evaluate the potential for their contributions to cumulative risk. The Team agreed with the proposed approach.

The Team reviewed the decision matrix proposed by the Navy. USEPA suggested the presence/absence of 1,4-dioxane could be determined through the screening of the data against the tap-water RSL. If 1,4-dioxane is not detected or detected only at levels below the tap-water RSL, then USEPA would consider 1,4-dioxane to be not present in site groundwater. VDEQ questioned whether a detected concentration of 1,4-dioxane below the RSL may be indicative of this constituent having migrated from the source area and questioned whether a detection of this kind should warrant further investigation. The Team agreed to update the decision matrix to not include a statement determining presence/absence of 1,4-dioxane in groundwater based on exceedances of the tap-water RSL, but rather base presence/absence on detections of 1,4-dioxane in groundwater and assess whether data are indicative of a “source area” of 1,4-dioxane at locations not sampled.

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

USEPA asked if the Team had sufficiently reviewed other sites to determine if 1,4-dioxane sampling needed to be completed. CH2M HILL noted this was addressed in the 2014 Five-year Review for all sites with volatile organic compound (VOC) groundwater plumes. All other sites at Little Creek have tetrachloroethene (PCE) as the parent product, and therefore, do not warrant sampling for 1,4-dioxane.

VDEQ asked the Team if 1,4-dioxane is a floater or a sinker in groundwater. USEPA responded that 1,4-dioxane has a specific gravity of 1.04 and is soluble in water, so it would be present throughout the water column; therefore, sampling existing site monitoring wells screened at the base of the aquifer is sufficient for determining the presence/absence of 1,4-dioxane. VDEQ asked if 1,4-dioxane poses any vapor intrusion risks. CH2M HILL indicated 1,4-dioxane is a semivolatile organic compound (SVOC) and the current regulatory position is 1,4-dioxane is not sufficiently volatile to pose potential vapor intrusion risks. CH2M HILL noted the current remedy is not effective in treating 1,4-dioxane; therefore, if it is identified as a site COC, additional remedial alternatives may need to be evaluated to address 1,4-dioxane.

SAP Worksheet #10—Conceptual Site Model

JEB Little Creek encompasses 2,215 acres in the northwest corner of Virginia Beach, Virginia, adjacent to the Chesapeake Bay (**Figure 1**). JEB Little Creek is primarily an industrial facility that provides logistic and support services for local commands, organizations, home-ported ships, and other United States and allied units to meet amphibious warfare-training requirements of the United States Armed Forces. The area surrounding the facility is low lying and relatively flat. Land development surrounding the Base is residential, commercial, and industrial.

Site 11, the Former School of Music Plating Shop, is located in the eastern portion of the base, near the intersection of Seventh and E Streets (**Figure 2**). The former plating shop operated between 1964 and 1974, after which plating operations were transferred to a separate facility. During operation, small quantities of plating baths, acids, and lacquer strippers were disposed of in the plating shop sink, which drained into an in-ground, concrete neutralization tank and its associated piping, and eventually into the storm sewer system. It was reported that approximately 10 gallons of plating baths, acids, and lacquer stripper were discharged into the neutralization tank through the shop sinks each year of its operation. During its period of operation, the plating shop reportedly used silver cyanide, copper cyanide, chromic acid, nickel plating baths, and various acids. In addition, lacquer strippers and lacquer were also used. There are no records of chlorinated solvents being used at this site; however, degreasing solvents such as trichloroethene (TCE) and 1,1,1-trichloroethane (TCA) historically have been associated with similar operations at other facilities. 1,4-Dioxane was used as a stabilizer in degreasing operations, therefore commonly associated with TCA (Mohr et al., 2010); and is also associated with lacquer and lacquer strippers (USEPA, 1995). The neutralization tank, piping, and surrounding soil were excavated and removed in 1996. The conceptual site model for Site 11 is shown in **Figure 3**.

The Second Comprehensive Five-Year Review for JEB Little Creek, which was finalized in March 2014, determined that the contaminants identified in the groundwater of the site indicated a potential for the presence of 1,4-dioxane. Specifically, 1,4-dioxane is associated with TCA use. However, 1,4-dioxane was not included in the analytical suite used to investigate the site and it is not known if this contaminant is present on the site. Previous investigation and remediation work completed at this site do not address 1,4-dioxane. The lack of 1,4-dioxane groundwater data constitutes a data gap for this site.

The ground surface in the vicinity of Site 11 is generally level and approximately 10 feet above mean sea level (amsl). The site includes the School of Music (Building 3602) and storage buildings (Building 3650 and Building 3651, formerly the plating shop), a landscaped lawn, an asphalt parking lot, and a concrete drive behind Building 3602. The majority of precipitation is lost through stormwater runoff, which is collected by man-made stormwater drainage ditches and discharged to the stormwater sewer system, evaporation, and infiltration. There are no surface water bodies within the boundary of Site 11. Site 11 is located approximately 1,500 feet south of the golf course ponds and approximately 3,750 feet south of the Chesapeake Bay. Access to the site is unrestricted to those with access to JEB Little Creek.

Shallow Columbia aquifer groundwater at Site 11 is encountered at depths from approximately 5 to 7 feet below the ground surface (bgs). The Columbia aquifer, representative of Holocene and Pleistocene age deposits (Tabb Shirley, Chuckatuck, Charles City and upper Windsor Formations), extends to a depth of approximately 24 feet bgs. At the base of the Columbia aquifer lies Yorktown confining unit, representative of the lower Windsor and Bacon Castle Formation. The Yorktown confining unit separates the Columbia aquifer from the underlying Yorktown aquifer, representative of the Yorktown Formation. Prior to implementation of the 2009 remedial action, which included the repair of a leaking sanitary sewer line behind Building 3602, groundwater flow was generally directed to the south/southwest. Following repair of the sanitary sewer line, groundwater flow is now directed predominantly to the west (**Figure 4**). The groundwater gradient underlying Site 11 is relatively flat and the water table elevation varies by less than 1 foot across the site. Based on a hydraulic conductivity of 3.15 feet per day (ft/day), an estimated effective porosity of 0.35, and a hydraulic gradient of 0.0011 feet per foot (ft/ft),

the average lateral shallow groundwater flow velocity at the site is estimated to be approximately 0.010 ft/day (3.6 feet per year [ft/yr]).

1,4-Dioxane is thought to be associated with chlorinated VOCs that were historically released to groundwater from the former plating shop neutralization tank. Groundwater contamination includes elevated concentrations near a former source area (the former neutralization tank excavated in 1996) and a downgradient plume (**Figure 5**). The groundwater plume depicted on **Figure 5** shows the 2009 pre-injection baseline COC concentrations in order to depict the entirety of the groundwater plume prior to injections and illustrate the areas of elevated 1,1,1-TCA concentrations which provide the rationale for the sampling locations where elevated concentrations of 1,4-dioxane would be expected. Chlorinated VOCs detected in groundwater include “parent” products TCE and 1,1,1-TCA as well as their respective series of breakdown products produced by natural biodegradation processes. While it is thought that 1,4-dioxane is more mobile than most chlorinated VOCs, initially sampling the known locations of chlorinated VOCs in groundwater will provide a reasonable indication of the potential for 1,4-dioxane to be present in groundwater and the potential extent, should it be detected at this site.

No potentially unacceptable human health risks or hazards associated with exposure to site soil were identified based on known chlorinated VOC contamination. It was concluded that exposure to shallow groundwater may pose potentially unacceptable hazards and risks for future construction workers, industrial workers, and adult/child residents. Risks and hazards were primarily associated with exposure to VOCs in groundwater. No potentially unacceptable risks were identified from exposure to indoor air under existing site conditions. No potentially unacceptable ecological risks were identified.

A Record of Decision (ROD) for Site 11 was signed in July 2007 outlining the selected remedy of groundwater treatment through enhanced reductive dechlorination (ERD) and land use controls (LUCs) to meet the following remedial action objectives:

- Prevent exposure to Site 11 groundwater until concentrations of VOCs have been reduced to levels that allow for unlimited use and unrestricted exposure.
- Reduce concentrations of VOCs in Site 11 groundwater to cleanup levels to the maximum extent practicable within a reasonable amount of time.
- Remedial action construction was initiated in June 2007 and completed in May 2010 and consisted of sanitary sewer repairs, pre-construction/baseline groundwater monitoring, installation of injection and monitoring wells, injection of substrate, and post-injection groundwater sampling. A survey plat outlining land use restrictions was filed with the City of Virginia Beach in June 2011. Groundwater and vapor intrusion long-term monitoring (LTM) was initiated in March 2012 and is currently ongoing.
- The Second Comprehensive Five-Year Review for JEB Little Creek was finalized in March 2014. Based on the review, issues and recommendations were identified for Site 11 as presented on **Table 1**. During the Five-Year Review period, risk-based screening levels for evaluating human health risks associated with exposure to 1,4-dioxane were established. 1,4-Dioxane is a stabilizer that was commonly used in chlorinated solvents, including 1,1,1-TCA, which has been detected at elevated levels (maximum concentration of 62,000 micrograms per liter [$\mu\text{g/L}$] during pre-injection baseline sampling in February 2009) at Site 11. Groundwater samples have not been analyzed for 1,4-dioxane at Site 11; therefore, its presence or absence in site groundwater is unknown at this time. The Five-Year Review concluded that the remedy at Site 11 is in place, functioning as designed, and is currently protective of human health and the environment. Exposure pathways that could result in unacceptable risk are being controlled through LUCs. There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy. However, it was concluded that in order to evaluate the long-term protectiveness of the remedy, a groundwater evaluation to determine the presence or absence of 1,4-dioxane is warranted.

SAP Worksheet #10—Conceptual Site Model (continued)

TABLE 1
Issues, Recommendations, and Follow-up Actions for Site 11

Issue	Recommendations and Follow-up Actions	Party Responsible	Milestone Date*	Affects Protectiveness	
				Current	Future
Issues Identified for Follow-Up Action During Current Five-Year Review					
RSL established for 1,4-dioxane. Previous sampling did not include analysis of this constituent; therefore, the presence or absence of 1,4-dioxane in Site 11 groundwater is unknown.	Sampling for 1,4-dioxane to confirm its presence or absence in groundwater.	Navy	September 2015	N	TBD

*Achievement of milestone dates are dependent on Navy funding.

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

Environmental Questions Answered by this Project

Is 1,4-dioxane present in Site 11 groundwater?

One round of groundwater samples will be collected from 12 existing monitoring wells (2 source and 10 down/side gradient; see **Worksheet #17** for rationale) and analyzed for 1,4-dioxane. While it is thought that 1,4-dioxane is more mobile than most chlorinated VOCs, initially sampling the known locations of chlorinated VOCs in groundwater will provide a reasonable indication of the potential for 1,4-dioxane to be present in groundwater and the potential extent, should it be detected at this site. If 1,4-dioxane is detected and data are not adequate to define the nature and extent of 1,4-dioxane contamination in groundwater or support development and evaluation of remedial action alternatives, then a contingency sampling event will be conducted under an addendum to this UFP-SAP. Data will be compared to the most recent tap-water RSL.

If present, do concentrations of 1,4-dioxane pose potentially unacceptable risks to human health or the environment?

If any 1,4-dioxane data exceed the tap-water RSL, an updated baseline human health risk assessment will be conducted to determine whether human exposure to 1,4-dioxane in Site 11 groundwater poses potentially unacceptable risks. There is no potential exposure pathway for ecological receptor exposure to groundwater; therefore, evaluation of ecological risks associated with 1,4-dioxane in groundwater are not warranted.

If concentrations of 1,4-dioxane pose potentially unacceptable risks to human health or the environment, are concentrations outside of the LUC boundary above the cleanup level?

If 1,4-dioxane contributes to potential unacceptable risks, an interim risk-based cleanup level will be calculated. In order to determine if the remedy is currently protective of the human health (i.e. contamination is within the existing LUC boundary), data collected from side/downgradient monitoring wells will be compared to the interim cleanup level to determine whether concentrations posing potentially unacceptable risks are present outside of the LUC boundary or may be approaching the LUC boundary.

Who will use the data?

Participants from the Tier I Partnering Team (VDEQ, USEPA, Navy, and CH2M HILL) will use the data to evaluate long-term remedy protectiveness through determining if 1,4-dioxane is present, and if present, assessing if concentrations of 1,4-dioxane pose potentially unacceptable risks to human health. Other technically focused disciplines within each organization may use the data as well. Chemists will use the data to evaluate overall data quality with respect to subcontracted laboratories. If 1,4-dioxane is present in Site 11 groundwater, human health risk assessors will use the data to determine if potentially unacceptable risks are present in Site 11 groundwater. Engineers may use the data in designing remedial or mitigation systems in the future.

What are the Project Action Limits (PALs)?

The PAL for 1,4-dioxane is the USEPA tap-water RSL and is provided in **Worksheet #15**.

For what will the data be used?

Groundwater data will be used to evaluate long-term remedy protectiveness by determining if 1,4-dioxane is present, and if present, whether concentrations of 1,4-dioxane pose potentially unacceptable risks to human health. Data will be used to determine whether further investigation and/or remedial action for 1,4-dioxane are warranted. Should observations be made such that the data are unable to answer these questions, the Partnering Team will reconvene to discuss the path forward.

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

The 1,4-dioxane groundwater data will be compared to the current tap-water RSL. Human health risks will be calculated for future residents and industrial workers who may use groundwater as a potable water supply and future construction workers who could be exposed to groundwater during excavation activities. In addition to 1,4-dioxane, previously identified COCs from the two most recent rounds of Site 11 groundwater LTM sampling will be included in the risk calculations to evaluate the cumulative risk to receptors. Potentially unacceptable risk will be determined if 1,4-dioxane contributes a non-carcinogenic hazard above 0.1 to a cumulative target organ hazard above 1 or a carcinogenic risk above 1×10^{-6} to a cumulative carcinogenic risk above 1×10^{-4} .

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

Worksheet #17 contains detailed information on the types of data needed for this project, except for groundwater quality stabilization parameters, which are discussed in the paragraph below. Groundwater samples will be collected from monitoring wells using a peristaltic pump and low-flow sampling protocol (Standard Operating Procedure [SOP]-004) and analyzed at an offsite laboratory for 1,4-dioxane. Samples will be collected from the approximate midpoint of the screen interval of each monitoring well.

Water quality parameters (pH, dissolved oxygen [DO], oxidation reduction potential [ORP], turbidity, specific conductivity, salinity, and temperature) will be recorded in the field during well purging prior to sampling using a water quality meter (for example, Horiba or YSI with flow-through cell) in accordance with SOP-003. DO will be field measured using CHEMets field test kits.

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

Quantifiable analytical results will be the primary basis for project decisions. The limit of quantitation (LOQ), which is defined as the lowest calibrated concentration for a target analyte, will be the metric to define whether an analytical result is quantifiable. The laboratory will report all non-detected analytes at the limit of detection (LOD), which is the minimum concentration of a substance reliably detected by the given analytical method. The laboratory detection limit (DL) is the statistical lowest concentration at which the laboratory will report results. Laboratory data specified for validation on **Worksheet #36** will be forwarded to a data validator for analytical method validation against measurement performance criteria (MPC) contained in this SAP. A Level IV package (includes raw data) is required for all validated data. QC data requirements are detailed in **Worksheets #12, #20, #24, and Worksheet #28**.

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 in **Worksheet #17**. One round of groundwater samples will be collected from 12 existing monitoring wells at Site 11 and analyzed for 1,4-dioxane.

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

Worksheets #14 and #17 describe which groundwater monitoring wells will be sampled and for what parameters. Detailed information on how data will be collected is provided on **Worksheet #14**. The proposed monitoring well network at Site 11 for this investigation is illustrated on **Figure 6**. Groundwater sampling is scheduled to be completed in May 2015 as detailed in **Worksheet #16**.

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

CH2M HILL field personnel will collect the groundwater samples. All laboratory analytical data will be generated by Empirical. Data will be validated by CH2M HILL.

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

Data will be summarized and reported in either a technical memorandum or UFP-SAP addendum, as appropriate. In addition to the technical memorandum or UFP-SAP addendum, a Five-Year Review addendum will be completed to document the updated remedy protectiveness determination.

How will the data be archived?

The data will be loaded to the Navy Installation Restoration Information System (NIRIS) database. Hardcopy data will be released to the Navy following completion of the project.

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

The Partnering Team agreed on key decision conditions that will help answer the environmental questions being asked.

The monitoring network is illustrated on **Figure 6**. The if/then statements are detailed in the form of a decision diagram presented in **Figure 7**. If the maximum detected concentration exceeds the tap-water RSL, potential human health risks will be calculated following USEPA risk assessment methodology and using the analytical data from the samples collected from monitoring wells within the source area of the contaminant plume.

If 1,4-dioxane is detected and data are not adequate to define the nature and extent of 1,4-dioxane contamination in groundwater or support development and evaluation of remedial action alternatives, then a contingency sampling event will be conducted. The contingency sampling event will include groundwater sampling for 1,4-dioxane from existing Site 11 monitoring wells and may include DPT groundwater sampling or the installation of additional monitoring wells (either permanent or temporary wells) to delineate the horizontal extent of 1,4-dioxane in the shallow aquifer groundwater. The sample locations will be determined based on the results of the primary event. The contingency event will be conducted under an addendum to this UFP-SAP, which will include updates to **Worksheets #9, #14, #16, #17, and #18**.

SAP Worksheet #12—Measurement Performance Criteria Table

Matrix: Groundwater

Analytical Group: Select SVOCs (1,4-dioxane)

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	SVOCs	One per 10 field samples	Precision	Aqueous: relative percent difference (RPD) < 25%	S&A
Equipment Rinsate Blank		One per week of sampling	Contamination/Bias	All target compounds <1/2 LOQ	S&A
Cooler Temperature Blank		One per cooler to the laboratory	Accuracy/Representativeness	≤6 degrees Celsius (°C)	S

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SAP Worksheet #13—Secondary Data Criteria and Limitations Table

The intent of this worksheet is to identify all secondary data and information that will be used for the project, including the originating source of the data. This worksheet documents how the existing data will be used and the limitations to the use of the existing data.

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
Historical groundwater data from Interim RI (IRI), RI/Feasibility Study (FS), Supplemental RI, Membrane Interface Probe (MIP) Investigation, and Supplemental Remedial Investigation (SRI) Addendum	IRI (Ebasco, 1991) RI/FS (FWES, 1994) SRI (CH2M HILL, 2004) MIP Investigation (CH2M HILL, 2003) Revised Human Health Risk Assessment (HHRA)/SRI Addendum (CH2M HILL, 2006)	Ebasco Environmental, in agreement with the Navy, USEPA, and VDEQ, collected groundwater samples during the IRI in 1991. FWES, in agreement with the Navy, USEPA, and VDEQ collected groundwater samples during the RI/FS in 1993. CH2M HILL, in agreement with the Navy, USEPA, and VDEQ, collected groundwater samples during the SRI, MIP Investigation, and SRI Addendum in 1998, 1999, 2001, 2003, and 2005.	The detections of 1,1,1-TCA in the groundwater analytical data from these investigations were used during the 2014 Five-Year Review as an indicator of potential 1,4-dioxane in the groundwater.	None.
Groundwater data from the last two rounds of long-term monitory (LTM) sampling (sampling conducted semiannually in March and September)	Remedy Performance Management and Monitoring Report (Osage) ¹	CH2M HILL, in agreement with the Navy, USEPA, and VDEQ, initiated LTM groundwater sampling at Site 11 in March 2012. Osage, in agreement with the Navy, USEPA, and VDEQ, took over LTM groundwater sampling in March 2014.	If an HHRA is required, groundwater analytical data for all COCs will be included in the risk calculations to evaluate the cumulative risk to receptors.	None.

¹ The Remedy Performance Management and Monitoring Report has not been completed. However, the data that will be used in the report is currently available and will be used for the project.

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SAP Worksheet #14—Summary of Project Tasks

Field Tasks

SOPs for all field tasks expected to be completed are included in **Appendix A** and tabulated on **Worksheet #21**. These field tasks include the following.

Mobilization

Mobilization for the field effort includes procurement of necessary field equipment and initial transport to the site. Equipment and supplies will be brought to the site when the CH2M HILL field team mobilizes for field activities. Prior to beginning any phase of work, all onsite workers will review this SAP and the project-specific HASP. A field team kickoff meeting will be held to discuss the scope of field activities, discuss any safety issues, and ensure that personnel are familiar with work items and worker responsibilities.

Groundwater Sampling

Groundwater samples will be collected from 12 existing monitoring wells at Site 11 (**Figure 6**). Groundwater samples will be analyzed for 1,4-dioxane as identified in **Worksheet #15**.

Static water levels and total well depths will be gauged and recorded immediately prior to purging and sampling of a well, and static water levels will be gauged and recorded during purging in accordance with low-flow sampling procedures. Groundwater samples will be collected using a peristaltic pump following low-flow sampling protocol as described in the SOPs. All groundwater samples will be collected by placing the sample tubing intake in the middle of the screen interval. Water quality stabilization parameters (pH, DO, ORP, turbidity, specific conductivity, salinity, and temperature) will be collected using a water quality meter (for example, Horiba or YSI) and recorded during purging in accordance with low-flow sampling procedures, and parameter stabilization requirements will be met before samples are collected. The aquifer is considered stable after at least one well volume has been purged and successive water quality readings collected 3 to 5 minutes apart have stabilized as follows:

- pH within 0.1 pH units
- Conductivity within 3 percent
- DO within 10 percent
- ORP within 10 millivolts
- Turbidity measurement within 10 percent for values greater than 5 nephelometric turbidity unit (NTU); if 3 turbidity values are less than 5 NTU, groundwater will be considered stabilized

Following purging and prior to sample collection, CHEMet test kits will be used to measure DO.

Information will be recorded in the field notebook as described in SOP-006. In addition, the water quality meter will be calibrated daily (at a minimum) and calibration readings recorded in the field notebook.

Equipment Decontamination

With the exception of the water-level indicator, nondisposable sampling equipment is not anticipated to be used. The water level indicator will be rinsed with deionized water between each measurement. All decontamination liquids will be containerized and handled according to the IDW Handling subsection that follows. Disposable equipment (for example, tubing for low-flow sampling, paper towels, disposable personal protective equipment, etc.) will be disposed of as solid waste.

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

Analytical and Validation Tasks

- **Quality Control**
 - SOPs for field (**Appendix A**) and laboratory activities being performed will be implemented.
 - QC samples to be collected are outlined on **Worksheet #20**.
- **Analytical Tasks**
 - The laboratory will maintain, test, inspect, and calibrate analytical instruments (**Worksheets #24 and #25**).
 - The laboratory will process and prepare samples for analysis.
 - The laboratory will analyze groundwater samples for 1,4-dioxane as shown on **Worksheet #18**.
- **Procedures for recording data, including guidelines for recording and correcting data**
 - Project Assessment and Audit (**Worksheets #31 and #32**)
 - Data Review
 - Data Validation (**Worksheets #35 and #36**)
 - Data Usability Assessment (**Worksheet #37**)

SAP Worksheet #15—Reference Limits and Evaluation Table

Matrix: Groundwater

Analytical Group: Select SVOCs

Analyte	CAS Number	PAL: Tap-water RSL (November 2014) ^{1,4} µg/L	Project Quantitation Limit Goal ² (µg/L)	Laboratory-specific (µg/L)			LCS, MS, and MSD %R and RPD Limits ³		
				LOQ	LOD	DL	LCL	UCL	%RPD
1,4-dioxane	123-91-1	0.78	0.26	0.5	0.25	0.125	5	110	30

¹ Refer to **Worksheets #10 and #11** for a detailed discussion on development of PALs.

² Project quantitation limit (PQL) goals are 3 times lower than the PAL.

³ 1,4-Dioxane limits are not provided in the DoD QSM; therefore, limits are consistent with the in-house laboratory control limits.

⁴ Tap-water RSLs, are the USEPA Regional Screening Levels for Tap water, November 2014, which are the lower of the RSL based on a noncarcinogenic hazard quotient of 0.1 or carcinogenic risk of 1×10^{-6} . The most recent RSL available will be used for data screening and evaluation.

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SAP Worksheet #16—Project Schedule/Timeline Table (optional format)

Figure 8 presents the tentative project schedule for implementation of the primary 1,4-dioxane groundwater sampling at Site 11. This schedule may be accelerated or delayed based on document review and subcontracting timetables. Contingency sampling, if warranted, and follow-on reporting of investigation results and the associated schedule will be determined following completion of the primary Site 11 1,4-dioxane groundwater sampling.

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SAP Worksheet #17—Sampling Design and Rationale

Sample Type	Location (See Figure 6)	Matrix	Depth of Samples	Analysis	Method	Primary Number of Samples	Rationale	Sampling Strategy
Site 11 Source Area Wells	LS11-MW38D, LS11-MW39D	Groundwater	Middle of well screen	1,4-dioxane	SW-846 8270D	2	Groundwater samples will be collected from 2 source area monitoring wells to evaluate whether 1,4-dioxane was released to groundwater in the area with the highest concentrations of 1,1,1-TCA.	Groundwater samples will be collected using a peristaltic pump and low-flow sampling protocol. Water quality stabilization parameters (pH, DO, ORP, turbidity, specific conductivity, salinity, and temperature) will be measured and readings recorded and stabilized before samples are collected. During sample collection, CHEMet test kits will be used to measure DO. Samples will be placed in laboratory-prepared sampling containers, packed on ice, and shipped to an offsite laboratory. All samples will be analyzed on a 28-day turnaround time.
Site 11 Perimeter Wells	LS11-MW11D, LS11-MW12D, LS11-MW13D, LS11-MW14D, LS11-MW15D	Groundwater	Middle of well screen	1,4-dioxane	SW-846 8270D	5	Groundwater samples will be collected from 5 perimeter monitoring wells to evaluate potential migration of 1,4-dioxane and whether 1,4-dioxane is present outside of the LUC boundary at concentrations that may pose potentially unacceptable risks to human health.	
Site 11 Sidegradient Wells	LS11-MW40D, LS11-MW41D, LS11-MW42D	Groundwater	Middle of well screen	1,4-dioxane	SW-846 8270D	3	Although groundwater flow is currently to the west/southwest, prior to the repairs of the leaking sanitary sewer line behind Building 3602 in 2009, groundwater flow was directed to the south/southwest. Therefore, groundwater samples will be collected from the 3 sidegradient wells to evaluate if 1,4-dioxane historically migrated in this direction.	
Site 11 Downgradient Wells	LS11-MW43D, LS11-MW44D	Groundwater	Middle of well screen	1,4-dioxane	SW-846 8270D	2	Following completion of the 2009 sanitary sewer line repairs, groundwater flow is predominantly to the west/southwest; therefore, groundwater samples will be collected from the 2 downgradient wells to evaluate if groundwater flow has caused a western migration of 1,4-dioxane.	

Note: Sample locations were jointly selected by the JEB Little Creek Partnering Team (**Worksheet #9**). If sample locations become inaccessible, the Navy will be notified and efforts will be made to temporarily relocate the obstruction if feasible. Deviations from the SAP will be reviewed to assess whether corrective action is warranted and to assess impacts to achievement of project objectives. Sample locations and associated sampling information included in table is for the primary sampling event because the contingency sample locations will be dependent upon the results of the primary sampling event.

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

This worksheet details the matrix, the sample collection depth, the sampling frequency, and the analytical parameters. The worksheet also provides reference to the SOPs.

Station ID	Sampling Location/ ID ¹	Matrix	Depth	Analytical Group	Number of samples	Sampling SOP Reference
Groundwater Samples						
LS11-MW11D	LS11-MW11D-MMY	GW	15 – 20	Select SVOCs (1,4-dioxane)	12 (+2 field duplicates)	See Worksheet #21
LS11-MW12D	LS11-MW12D-MMY		15 – 20			
LS11-MW13D	LS11-MW13D-MMY		15 – 20			
LS11-MW14D	LS11-MW14D-MMY		18 – 23			
LS11-MW15D	LS11-MW15D-MMY		15 – 20			
LS11-MW38D	LS11-MW38D-MMY		19 – 24			
LS11-MW39D	LS11-MW39D-MMY		16 – 21			
LS11-MW40D	LS11-MW40D-MMY		15 – 20			
LS11-MW41D	LS11-MW41D-MMY		15 – 20			
LS11-MW42D	LS11-MW42D-MMY		15 – 20			
LS11-MW43D	LS11-MW43D-MMY		23 – 28			
LS11-MW44D	LS11-MW44D-MMY		20 – 25			
QA/QC Samples^{2,3}						
LS11-QC	LS11-EB-MMDDYY	Equipment Blank	N/A	Select SVOCs (1,4-dioxane)	1 per week	See Worksheet #21
	LS11-MWXXDP-MMY	Field Duplicate	TBD		1 per 10 field samples	
	LS11-MWXXD-MMY-MS	MS	TBD		1 per 20 field samples	
	LS11-MWXXD-MMY-SD	MSD	TBD		1 per 20 field samples	

Note: Sample locations and associated sampling information included in table is for the primary sampling event because the contingency sample locations will be dependent upon the results of the primary sampling event.

QA/QC sample IDs include additional identifiers; P = Duplicate; EB = Equipment Blank.

¹ MMY will be replaced by the 2-digit month and 2-digit year that the sample is collected. MMDDYY will be replaced by the 2-digit month, 2-digit day, and 2-digit year that the sample is collected.

² For EB QA/QC samples, the actual number of equipment blanks to be collected will be based upon the number of days it takes to perform sampling.

³ The actual number and location of field duplicate and MS/MSD samples will be field determined.

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SAP Worksheet #19—Analytical SOP Requirements Table

Matrix	Analysis Group	Analytical and Preparation Method/ SOP Reference¹	Containers (Number, Size, and Type)	Sample Volume	Preservation Requirements (Chemical, Temperature, Light Protected)	Maximum Holding Time (Preparation/ Analysis)²
Groundwater	GC/MS (Select SVOCs, 1,4-Dioxane)	SOP201, 300	Two 1-liter (L) glass amber bottles	1000 mL	Cool to ≤ 6°C	7 days until extraction/ 40 days to analysis

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	Maximum No. of Sampling Locations	No. of Field Duplicates (one per 10 samples)	No. of MS/MSDs ¹ (one per 20 samples)	No. of Trip Blanks (one per cooler that contains VOC samples)	No. of Equip. Blanks (one per week)	Maximum Total No. of Samples to Laboratory ²
Groundwater	Select SVOCs (1,4-Dioxane)	12	2	1/1	0	1	17

¹MS/MSDs are collected as triple volume from sampling locations but are not considered to be separate samples. They are included in the total number of samples in order to count the total amount of sample volume sent to the laboratory.

²Number of samples shown is for the primary event. If the contingency event is conducted, the same measurement performance criteria listed on **Worksheets #12-1** and **#12-2** will apply.

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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? (Y/N)	Comments
SOP-001	<i>Decontamination of Personnel and Equipment, 04/2014</i>	CH2M HILL	Sampling and H&S equipment	N	None
SOP-002	<i>Disposal of Waste Fluids and Solids, 08/2013</i>	CH2M HILL	55-gallon drums	N	None
SOP-003	<i>Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, ORP, and Temperature Using a Horiba U-22 or YSI Water Quality Parameter Meter with Flow-through Cell, 08/2013</i>	CH2M HILL	Horiba U-22 or YSI	N	None
SOP-004	<i>Low-Flow Groundwater Sampling from Monitoring Wells – USEPA Region I and III, 08/2013</i>	CH2M HILL	Peristaltic pump	N	None
SOP-005	<i>Water-Level Measurements, 08/2013</i>	CH2M HILL	Water level meter	N	None
SOP-006	<i>Preparing Field Log Books, 08/2013</i>	CH2M HILL	N/A	N	None
SOP-007	<i>Equipment Blank and Field Blank Preparation, 08/2013</i>	CH2M HILL	Peristaltic pump	N	None
SOP-008	<i>Sampling Contents of Tanks and Drums, 08/2013</i>	CH2M HILL	Bailer	N	None
SOP-009	<i>Chain-of-Custody, 08/2013</i>	CH2M HILL	N/A	N	None
SOP-010	<i>Multi RAE Photoionization Detector (PID), 08/2013</i>	CH2M HILL	Multi-Rae photoionization detector (PID)	N	None
SOP-011	<i>Established Joint Expeditionary Base (JEB) Little Creek-Fort Story Sample Identification Naming Scheme, 08/2013</i>	CH2M HILL	N/A	N	None
N/A	<i>Horiba U-22 or YSI probe</i>	Manufacturer	Horiba U-22 or YSI probe	N	Instructions for use provided within each kit.
N/A	<i>CHEMet® Test Kit</i>	Manufacturer	CHEMet Test Kit	N	Instructions for use provided within each kit.

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

Field Equipment	Activity	Frequency	Acceptance Criteria	CA	Resp. Person	SOP Reference	Comments
Horiba U-22 pH probe	Calibrate probe using Horiba U-22 Auto-Calibration Standard Solution	None; performed by rental company.	pH reads 4.0 ± 3 percent	Contact rental and/or manufacturer support for probe malfunctions	FTL	SOP-003	Worksheet #21 and Appendix A
Horiba U-22 Specific Conductance Probe	Calibrate probe using Horiba U-22 Auto-Calibration Standard Solution	None; performed by rental company.	Conductivity reads 4.49 ± 3 percent	Contact rental and/or manufacturer support for probe malfunctions	FTL	SOP-003	Worksheet #21 and Appendix A
Horiba U-22 Turbidity Probe	Calibrate probe using Horiba U-22 Auto-Calibration Standard Solution	None; performed by rental company.	turbidity reads 0 ± 3 percent	Contact rental and/or manufacturer support for probe malfunctions	FTL	SOP-003	Worksheet #21 and Appendix A
Horiba U-22 DO and Temperature Probes	Calibrate probe using Horiba U-22 Auto-Calibration Standard Solution	None; performed by rental company.	Consistent with the current atmospheric pressure and ambient temperature	Contact rental and/or manufacturer support for probe malfunctions	FTL	SOP-003	Worksheet #21 and Appendix A
Horiba U-22	Calibrate probe using Horiba U-22 Auto-Calibration Standard Solution	Daily, as needed	Stable readings after 3 minutes pH reads 4.0 ± 3 percent conductivity reads 4.49 ± 3 percent turbidity reads 0 ± 3 percent	Contact rental and/or manufacturer support for probe malfunctions	FTL	SOP-003	Worksheet #21 and Appendix A
YSI probe	Calibrate probes	Daily, as needed	Parameter specific per model/instruction manual	Contact rental and/or manufacturer support for PID malfunctions	FTL	SOP-003	Worksheet #21 and Appendix A
Groundwater sampling pumps and tubing	No calibration required	No calibration required	Maintained in good working order per manufacturer's recommendations	Contact rental and/or manufacturer support for pump malfunctions	FTL	SOP-004	Worksheet #21 and Appendix A
MultiRAE	Calibration	Daily before use and when unstable readings occur	Isobutylene reads 100 parts per million; methane reads 50 percent lower explosive level; Oxygen reads 20.9 percent; Hydrogen sulfide reads 25 parts per million; Carbon monoxide reads 50 parts per million	Inspect connections to ensure proper seal; calibrate again Do not use instrument if not able to calibrate properly	FTL	MultiRAE 2000 Manufacturer's Instructions	Worksheet #21
Water Level Meter	No calibration required	No calibration required	Maintained in good working order per manufacturer's recommendations	Contact rental and/or manufacturer support for meter malfunctions	FTL	SOP-005	Worksheet #21 and Appendix A
CHEMet Test Kits	No calibration required	No calibration required	Maintained in good working order per manufacturer's recommendations	Contact rental and/or manufacturer support for equipment malfunctions	FTL	N/A	Operating instructions are provided by the manufacturer within each test kit

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SAP Worksheet #23—Analytical SOP References Table

Lab Address: Empirical Laboratories
 621 Mainstream Drive, Suite 270
 Nashville, TN 37228

Contact: Sonya Gordon

Phone number 615-345-1115

Lab SOP Number	Title, Revision Date, and Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM?	Modified for Project Work?
QS10	Laboratory Sample Receiving, Log In and Storage 07/29/2014 R21	Receiving	N/A	N/A	N	N
QS14	Analytical Laboratory Waste Disposal 07/29/2014 R09	Waste	N/A	N/A	N	N
SOP201	GC/MS SEMIVOLATILES, Regular and Low-Level, BY USEPA METHOD 625 AND SW846 METHOD 8270C/8270D 10/21/2014 R27	Definitive	Aqueous/ SVOCs	GC/MS	N	N
SOP300	GC/MS Semi-Volatile BNA-Aqueous Matrix Extraction Using SW-846 Method 3510C for 8270/625 Analysis 07/31/2014 R21	Definitive	Aqueous/ SVOCs	N/A	N	N

Note: DoD ELAP accreditation expiration date: 11/30/2015.

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SAP Worksheet #24—Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC/MS (Select SVOCs, 1,4-Dioxane)	Tuning	Prior to ICAL and at the beginning of each 12-hour period	Must meet the ion abundance criteria required by the method.	Manual tuning; replacement of the ion source or filament. Rerun affected samples.	Analyst/ Supervisor	Empirical SOP-201
	ICAL	Prior to sample analysis (minimum 5-point)	Average RF for SVOC SPCC ≥ 0.05 ; RSD for CCCs for SVOCs $\leq 30\%$; RSD for each analyte $\leq 15\%$ or linear least squares regression ≥ 0.995 ($r^2 \geq 0.990$) or non-linear regression (minimum 6-point) coefficient of determination ≥ 0.990 .	Correct problem then repeat ICAL		
	ICV	After each ICAL	All analytes within $\pm 20\%$ of the expected value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		
	CCV	Daily prior to sample analysis for 12-hour analysis period	RF for SVOC SPCC ≥ 0.05 ; % difference/drift for target analytes $\leq 20\%$.	If analyte exceeds with a positive bias and is non-detect, no corrective action will be performed. Detected analytes and analytes with negative bias will be requested for qualification/narration with client. If client approval is not received, correct problem, then rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV. If reanalysis cannot be performed, data must be qualified and explained in the case narrative.		
	Retention time window position establishment	Once after each ICAL for each analyte and surrogate.	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		

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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 (Select SVOCs, 1,4-Dioxane)	Replace/clean ion source; clean injector, replace injector liner, replace/clip capillary column, flush/replace tubing on purge and trap; replace trap	SVOCs	Ion source, injector liner, column, column flow, purge lines, purge flow, trap	As needed	See Worksheet #24	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data	Analyst/ Supervisor	Empirical SOP 201

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SAP Worksheet #26—Sample Handling System

The intent of this worksheet is to identify components of the project-specific sample handling system. The worksheet records personnel (and their organizational affiliations) who are primarily responsible for ensuring proper handling, custody, and storage of field samples from the time of collection, to laboratory delivery, to final sample disposal. Additionally, the number of days field samples and their extracts/digestates will be archived prior to disposal are indicated on this worksheet.

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): FTL and Field Team Members/CH2M HILL
Sample Packaging (Personnel/Organization): FTL and Field Team Members/CH2M HILL
Coordination of Shipment (Personnel/Organization): FTL and Field Team Members/CH2M HILL
Type of Shipment/Carrier: Overnight/FedEx
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Empirical employees
Sample Custody and Storage (Personnel/Organization): Empirical employees
Sample Preparation (Personnel/Organization): Empirical employees
Sample Determinative Analysis (Personnel/Organization): Empirical employees
SAMPLE ARCHIVING
Field Sample Storage (Number of days from sample collection): 90 days from receipt
Sample Extract/Digestate Storage (Number of days from extraction/digestion): 1 year
Biological Sample Storage (Number of days from sample collection): N/A
SAMPLE DISPOSAL
Personnel/Organization: Empirical 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

Sample Labeling Procedures

Sample labels will include, at a minimum, client name, site, sample ID, date/time collected, preservative use, analysis group or method, and sampler's initials. A standardized numbering system will be used to identify all samples collected. The numbering system will provide a tracking procedure to ensure accurate data retrieval of all samples collected. Each sample will be designated by an alphanumeric code that will identify the facility, site, station ID, matrix sampled, and/or date and depth sampled. QA/QC samples will have a unique sample designation. The sample ID scheme for all samples collected during the investigation will use the format shown in the SOP-009, *Chain-of-Custody*, and SOP-011, *Little Creek Sample Naming Scheme (Appendix A)*. The field logbook will identify the sample ID with the location, depth, date/time collected, and the parameters requested.

Field Sample Custody Procedures (Sample Collection, Packaging, Shipment, and Delivery to Laboratory)

Field samples will be collected by the field team members under the supervision of the FTL/FQM. As samples are collected, they will immediately be placed in the appropriate containers and labeled, as outlined previously. The labels will be filled out in the field by the field crew at the time of sample collection and QC reviewed before being placed into the shipping container, at which time the sample will be logged in on the chain-of-custody form and field logbook. The integrity of the sample labels affixed to those samples that will be shipped in containers carrying ice will be maintained through the practice of placing sample containers in Ziploc-type bags.

Aqueous samples will be cushioned with packaging material and placed into coolers containing enough ice to keep the samples below 6°C until they are received by the laboratory. The chain-of-custody will also be placed into the cooler inside a Ziploc-type bag and taped to the top of the inside of the shipping container.

Samples will be shipped to the laboratory via FedEx, with the airbill number indicated on the chain-of-custody (to relinquish custody). The FTL is responsible for the care and custody of samples until they are shipped or otherwise delivered to the laboratory custodian. Upon delivery, the laboratory will log in each shipping container and report the status of the samples as discussed as follows.

Chain-of-custody Procedures

Chains-of-custody will include, at a minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information (SOP-009, *Chain of Custody [Appendix A]*). 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 also have the sampler's name and signature. 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 System database for each sample.

Laboratory Sample Custody Procedures (Receipt of Samples, Archiving, and Disposal)

The laboratory receiving samples will comply with all sample custody requirements outlined in the laboratory (see appendix for site-specific information). SOP-009, *Chain-of-Custody*, outlines procedures for documenting sample custody and provides examples of a chain-of-custody form and a custody seal (**Appendix A**).

SAP Worksheet #27—Sample Custody Requirements Table (continued)

Sample Integrity

A sample tracking system will be followed to ensure sample authenticity and data defensibility. A field team member or the PC will notify the laboratory of upcoming field sampling activities and the subsequent transfer of samples to the laboratory. The PC will ensure that samples have arrived to the laboratory in the appropriate timeframe and the condition of samples upon receipt is satisfactory. If samples are not delivered to the laboratory in the acceptable timeframe or condition, the PM or AM will be notified and the decision will be made whether to recollect samples.

The PC is responsible for checking the chain-of-custody forms against the field logbook and field project instructions to verify the sample ID, times, analyses, and methods are correct on the chain-of-custody form. Any discrepancies will be resolved with the field team and relayed to the laboratory. These actions will be documented by both the laboratory and the PC. The laboratory is responsible for providing the PC with sample log-in sheets the day of sample receipt for the PC to verify the laboratory has accounted for all samples shipped and has correctly logged the samples into its software system.

SAP Worksheet #28—Laboratory QC Samples Table

Matrix: Aqueous

Analytical Group: SVOCs

Analytical Method/SOP Reference: SW-846 8270D-low level full scan for 1,4-Dioxane only/ SOP201

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 batch of 20 or less	No analytes detected > ½ LOQ	Investigate source of contamination and correct the problem. Reanalyze the method blank. If acceptance limits are still not met and sample material/holding time available, reprep affected samples.	Analyst, Laboratory Supervisor	Bias / Contamination	Same as Method / SOP QC Acceptance Limits.
LCS		See Worksheet #15	Correct problem, then reanalyze the LCS. If acceptance limits are still not met and sample material/holding time available, reprep affected samples.		Precision / Accuracy / Bias	
MS/MSD	One per SDG or every 20 samples.	See Worksheet #15	CA will not be taken for samples when recoveries are outside limits and surrogate and LCS criteria are met unless RPDs indicate obvious extraction/analysis difficulties, then reprep MS/MSD.		Precision / Accuracy / Bias	
IS	All Samples 1,4-DCB-d4 for 1,4-dioxane DCB = Dichlorobenzene	Retention times for internal standard must be + 30 seconds of the daily CCV and the responses within -50% to +100% of ICAL midpoint for each internal standard.	Inspect GC/MS for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning		Precision / Accuracy / Bias	
Surrogates	All Samples Note: Acid surrogates do not apply to 1,4-dioxane analysis	2-Fluorobiphenyl: 50-110% Terphenyl-d14: 50-135% Nitrobenzene-d5: 40-110%	If surrogates are high and sample is < LOQ, no CA is taken. If surrogates are low and sample volume available, re-extract/ re-analyze affected samples.		Accuracy / Bias	

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SAP Worksheet #29—Project Documents and Records Table

Document	Where Maintained
<ul style="list-style-type: none"> • Field notebooks • Sample receipt, chain-of-custody, and tracking records • Air bills • Custody seals • CA forms • Electronic data deliverables (EDDs) • ID of QC samples • Meteorological data from field • Sampling locations and sampling plan • Sampling notes and drilling logs • Water quality parameters • Standard traceability logs • Equipment calibration logs • Sample preparation logs • Run logs • Equipment maintenance, testing, and inspection logs • Reported field sample results • Reported result for standards, QC checks, and QC samples • Instrument printouts (raw data) for field samples, standards, QC checks, and QC samples • Data package completeness checklists • Sample disposal records • Extraction/clean-up records • Raw data (stored on disk) • Fixed laboratory audit checklists • Data validation reports • Laboratory QA Plan • Method detection limit study information 	<ul style="list-style-type: none"> • Field data deliverables (e.g., logbooks entries, chains-of-custody, air bills, EDDs) will be kept on CH2M HILL's local intranet server. • Field parameter data will be loaded with the analytical data into the Data Warehouse. • Analytical laboratory hardcopy deliverables and data validation reports will be saved on the network server. • Electronic data from the laboratory will be loaded into the Data Warehouse and NIRIS • Following project completion, hardcopy deliverables such as logbooks, chains-of-custody, raw data, data validation reports, etc. will be archived indefinitely.

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SAP Worksheet #30—Analytical Services Table

Matrix	Analytical Group	Sample Locations/ ID Number	Analytical Method	Data Package Turnaround Time	Laboratory / Organization	Backup Laboratory / Organization ¹
Groundwater	Select SVOCs	See Worksheet #18	SW-846 8270D	28 calendar days	Empirical Laboratories Sonya Gordon 621 Mainstream Drive, Suite 270, Nashville, TN 37228 615-345-1115	TBD

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 (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing CAs (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Offsite Laboratory Technical Systems Audit	Laboratory must have current DoD Environmental Laboratory Accreditation Program (ELAP) accreditation 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 body	Third-party accrediting body	Laboratory QAO, Empirical	Laboratory QAO, Empirical	CH2M HILL Chemist

Note: DoD ELAP accreditation is required for definitive data only.

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SAP Worksheet #32—Assessment Findings and Corrective Action Responses

The intent of this worksheet is to describe the activities for identifying and correcting any problems encountered during the project that have the potential to impact data quality (for example, sampling error). The CA form is provided as **Worksheet #32-1**.

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Laboratory Performance and Systems Audits	Written Audit Report from third party accrediting body	Laboratory QAO, Empirical	Within 2 months of audit	Memorandum	Auditor, TBD	Within 2 months of receipt of initial notification
Safe Work Observation	Safe Work Observation Form	Carl Woods HSM CH2M HILL Nathaniel Price PM CH2M HILL	Within 1 week of Safe Work Observation	Memorandum	Field Team Member CH2M HILL	Immediately

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SAP Worksheet #32-1—Corrective Action Form

Person initiating corrective action (CA) _____ Date _____

Description of problem and when identified:

Cause of problem, if known or suspected:

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

CA implemented by: _____ Date: _____

CA initially approved by: _____ Date: _____

Follow-up date: _____

Final CA approved by: _____ Date: _____

Information copies to:

Anita Dodson/ Navy CLEAN Program Chemist

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SAP Worksheet #32-2—Field Performance Audit Checklist

Project Responsibilities

Project No.: _____ Date: _____

Project Location: _____ Signature: _____

Team Members:

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

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

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

Sample Collection

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

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

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

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

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

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

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

Yes No 7) Are photographs taken and documented?
Comments _____

Document Control

Yes No 1) Have any accountable documents been lost?
Comments _____

Yes No 2) Have any accountable documents been voided?
Comments _____

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

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

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

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

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

SAP Worksheet #33—QA Management Reports Table

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
QA Management Report/ Technical Memorandum	Once results are received from data validator	60 days after receipt of data from validator	PM – CH2M HILL	Reports will be maintained in the project files

The following will be addressed in the QA/QC section of QA Management Report/Technical Memorandum:

- Summary of project QA/QC programs and trainings
- Conformance of project activities to SAP requirements and procedures
- Status of project and schedule delays
- Deviations from approved SAP and approved amendments to SAP
- Description and findings of audits
- Results of data review activities in terms of amount of usable data generated (results of the Chemist's QC check on data prior to loading into CH2M HILL's database)
- Required CAs and effectiveness of CA implementation
- Data usability assessments in terms of accuracy, precision, representativeness, completeness, comparability, and sensitivity
- Limitations on use of measurement data generated

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SAP Worksheets #34 through #36—Data Verification and Validation (Steps I and IIa/IIb) Process Table

Data Review Input	Description	Responsible for Verification/Validation	Step I/IIa/IIb ¹	Internal / External ²
Field Notebooks	Field notes will be reviewed to ensure completeness of field data parameters, shipping information, 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.	FQM, PM/CH2M HILL	Step I	Internal
Chain-of-Custody and Shipping Forms	Chain-of-custody 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 chain-of-custody will be initialed by the reviewer, a copy of the chain-of-custody retained in the project file, and the original and remaining copies taped inside the cooler for shipment. See COC SOP (on CD) for further details.	FQM and Project Chemist/CH2M HILL	Step I	Internal / External
Sample Condition upon 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. Any discrepancies or missing or broken containers will be communicated to the chemist in the form of laboratory logins.	Subcontracted laboratory PM, Empirical Project Chemist/CH2M HILL	Step I	External
Documentation of Laboratory Method Deviations	Laboratory method deviations will be discussed and approved. Documentation will be incorporated into the case narrative, which will become part of the final hardcopy data package.	Project Chemist/CH2M HILL	Step I	Internal
EDDs	EDDs will be compared against hardcopy laboratory results (10-percent check).	Project Chemist/CH2M HILL	Step I	External
Case Narrative	Case narratives will be reviewed during the data validation process. This is verification that they were generated and applicable to the data packages.	Data Validator/CH2M HILL	Step I	External
Laboratory Data	All laboratory data packages will be verified for completeness and technical accuracy prior to submittal.	PM/Empirical	Step I	Internal

SAP Worksheets #34 through #36—Data Verification and Validation (Steps I and IIa/IIb) Process Table (continued)

Data Review Input	Description ¹	Responsible for Verification/Validation	Step I/IIa/IIb ¹	Internal / External ²
Laboratory Data	The data will be verified for completeness. In order to ensure completeness, EDDs and PDFs will be compared to the SAP and Sample Details Table. This is verification that all samples were included in the laboratory data and that correct analyte lists were reported.	Project Chemist/ CH2M HILL	Step I	External
Audit and CA Reports	Upon report completion, a copy of all audit reports will be placed in the project file. If CAs are required, a copy of the documented CA taken will be attached to the appropriate audit report in the QA project file. Periodically, and at the completion of site work, site file audit reports and CA forms will be reviewed internally to ensure that all appropriate CAs have been taken and that CA reports are attached. If CAs have not been taken, the PM will be notified to ensure action is taken.	PM and Project Chemist/ CH2M HILL	Step I	Internal / External
Laboratory Methods	The EDDs will be compared to the SAP to ensure that the laboratory analyzed samples using the correct methods.	Project Chemist/ CH2M HILL	Step IIa	External
Analyte lists	The EDDs will be compared to the SAP to ensure that the laboratory reported all analytes in accordance with Worksheet #15 .	Project Chemist/ CH2M HILL	Step IIa	External
Reporting Limits	The reporting limits in the data package will be reviewed to ensure that the laboratory met the project-designated QLs in accordance with Worksheet #15 . If QLs were not met, the reason will be determined and documented.	Project Chemist/CH2M HILL	Step IIb	External
Laboratory SOPs	The data package will be reviewed to ensure that approved analytical laboratory SOPs were followed (Worksheet #23).	Data Validator/CH2M HILL	Step IIa	External
Sample Chronology	Holding times from collection to extraction or analysis and from extraction to analysis will be considered during the data validation process.	Data Validator/CH2M HILL	Step IIa/IIb	External
Raw Data	10 percent of raw data will be reviewed to confirm laboratory calculations. For a recalculated result, attempt to re-create the reported numerical value. Ask the laboratory for clarification if a discrepancy is identified which cannot reasonably be attributed to rounding (in general, this is outside 5 percent difference).	Data Validator/CH2M HILL	Step IIa	External
Onsite Screening	All non-analytical field data will be reviewed against SAP requirements for completeness and accuracy based on the field calibration records.	FQM /CH2M HILL	Step IIb	Internal
Documentation of Method QC Results	The data package will be reviewed to ensure that all required QC samples were run and met limits.	Data Validator/CH2M HILL	Step IIa	External

SAP Worksheets #34 through #36—Data Verification and Validation (Steps I and IIa/IIb) Process Table (continued)

Data Review Input	Description ¹	Responsible for Verification/Validation	Step I/IIa/IIb ¹	Internal / External ²
Documentation of Field QC Sample Results	The data package will be reviewed to ensure that all required QC samples were run and met limits.	Project Chemist/ CH2M HILL and Data Validator/CH2M HILL	Step IIb	External
Analytical Data Verification (1,4-dioxane)	Data will be reviewed against the analytical methods for outstanding QA/QC issues, and anomalies by the laboratory. Issues will be summarized in the case narrative. The CH2M HILL Chemist will review the analytical results and case narrative before the data are loaded to ensure no major problems exist.	PM/Empirical Project Chemist/ CH2M HILL	Step IIa and IIb	External
Analytical Data Validation (1,4-dioxane)	Analytical methods and laboratory SOPs will be evaluated against QA/QC criteria to ensure compliance, as presented in this SAP. QA/QC criteria for field QC samples are presented in Worksheet #12 . LOQs, LODs, and DLs are presented in Worksheet #15 . QA/QC criteria for calibrations are presented in Laboratory SOPs (referenced in Worksheet #23). QA/QC criteria for laboratory QC samples are presented in Worksheet #28 . Data may be qualified if QA/QC exceedances have occurred. Data qualifiers will be those presented in Region 3 Modifications to the National Functional Guidelines for Organic Data Review (USEPA, 1994). 100 percent of the data generated will undergo analytical data validation. Of the 100 percent validated, 10 percent of results will be re-calculated from the raw data to verify calculations.	Data Validator/CH2M HILL	Step IIa and IIb	External

¹ I = verification.

IIa = compliance with methods, procedures, and contracts [see Table 10, page 117, UFP-QAPP manual, V.1, March 2005.].

IIb = compliance with measurement performance criteria [see Table 11, page 118, UFP-QAPP manual, V.1, March 2005.].

Should CH2M HILL find discrepancies during the verification or validation procedures previously detailed, an e-mail documenting the issue will be circulated to the internal project team, and a Correction to File Memorandum will be prepared identifying the issues and the CA needed. This Memorandum will be sent to the laboratory, or applicable party, and maintained in the project file.

² Internal/external are with respect to the data generator.

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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:

- Non-detected site contaminants will be evaluated to ensure that project required project quantitation limits (PQLs) in **Worksheet #15** were achieved. If PQLs were achieved and the verification and validation steps yielded acceptable data, then the data is considered usable.
- 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 that 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, is not considered usable for project decisions.
 - J – Analyte present. Reported value may or may not be accurate or precise.
 - UJ – Analyte not detected. QL may be inaccurate or imprecise.
 - K – Analyte present. Reported value may be biased high. Actual value is expected to be lower.
 - L – Analyte present. Reported value may be biased low. Actual value is expected to be higher.
 - UL – Analyte not detected. QL is probably higher.
 - R – Rejected result. Result not reliable.
- Additional qualifiers that may be given by the validator are as follows:
 - B – Not detected substantially above the level reported in laboratory or field blanks (less than 5 times the concentration in the blanks).
 - I – Interferences present which may cause the results to be biased high.
 - N – Tentative ID. Consider Present. Special methods may be needed to confirm its presence or absence in future sampling efforts.
 - NJ – Qualitative ID questionable due to poor resolution. Presumptively present at approximate quantity.
 - U – Not Detected.
- For statistical comparisons, the data will be reviewed to determine the most appropriate method (that is, one-half the reporting limit) for incorporating nondetect values based upon the type of evaluation being conducted. For duplicate sample results, the most conservative value 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 EDD. Once the data has been uploaded into the electronic database, another check will be performed to ensure that all results were loaded accurately.
- Field and laboratory precision will be compared as RPD between the two results.
- Deviations from the SAP will be reviewed to assess whether CA is warranted and to assess impacts to achievement of project objectives.

Describe the evaluative procedures used to assess overall measurement error associated with the project:

- To assess whether a sufficient quantity of acceptable data are available for decision making, the data will be reconciled with MPC following validation and review of data quality indicators.

SAP Worksheet #37—Usability Assessment (continued)

- If significant biases are detected with laboratory QA/QC samples, it will be evaluated to assess impact on decision making. Low biases will be described in greater detail as they represent a possible inability to detect compounds that may be present at the site.
- If significant deviations are noted between laboratory and field precision, the cause will be further evaluated to assess impact on decision making.

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

- Data tables will be produced to reflect detected and non-detected constituents. Data qualifiers will be reflected in the tables and discussed in the data quality evaluation.
- Plume maps will be produced to reflect areas of groundwater contamination if present.
- A data quality evaluation considering all of the above will be provided as part of presentations to the Tier I Partnering Team (VDEQ, USEPA, Navy, and CH2M HILL), followed by a technical memorandum to make recommendation for no further action or a UFP SAP Addendum if additional investigation is needed to determine the nature and extent of 1,4-dioxane in Site 11 groundwater. The report will identify any data usability limitations and make recommendations for CA if necessary.

Identify the personnel responsible for performing the usability assessment:

- The CH2M HILL Team, including the PM, PC, and STCs, will review the data and compile a presentation for the Tier I Partnering Team. The Tier I Partnering Team (VDEQ, USEPA, Navy, and CH2M HILL) as a whole will assess the usability of the data.

Figures



Legend

-  Installation Boundary
-  LUC Boundary

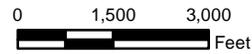


Figure 1
Base and Site 11 Location Map
Site 11 1,4-dioxane Groundwater SAP
JEB Little Creek
Virginia Beach, VA



Legend

- ⊗ Monitoring Well
- Flushmount Access to Existing 45° Directional Monitoring Well
- LUC Boundary
- Water Line
- Sanitary Sewer
- Sanitary Sewer Line Repaired

- Storm Water
- Heat Cool Line
- Electrical Cable Line

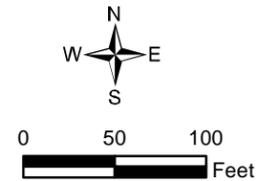


Figure 2
 Site 11 Boundary and Immediate Vicinity
 Site 11 1,4-dioxane Groundwater SAP
 JEB Little Creek
 Virginia Beach, Virginia

LEGEND

- Site 11 LUC Boundary
- ▼ Groundwater Table Elevation
- Groundwater Flow Direction
- Columbia Aquifer (Unsaturated Zone)
- Columbia Aquifer (Saturated Zone)
- Yorktown Confining Unit
- Yorktown Aquifer
- Known COC Plume

Future Industrial Workers:
Ingestion of groundwater

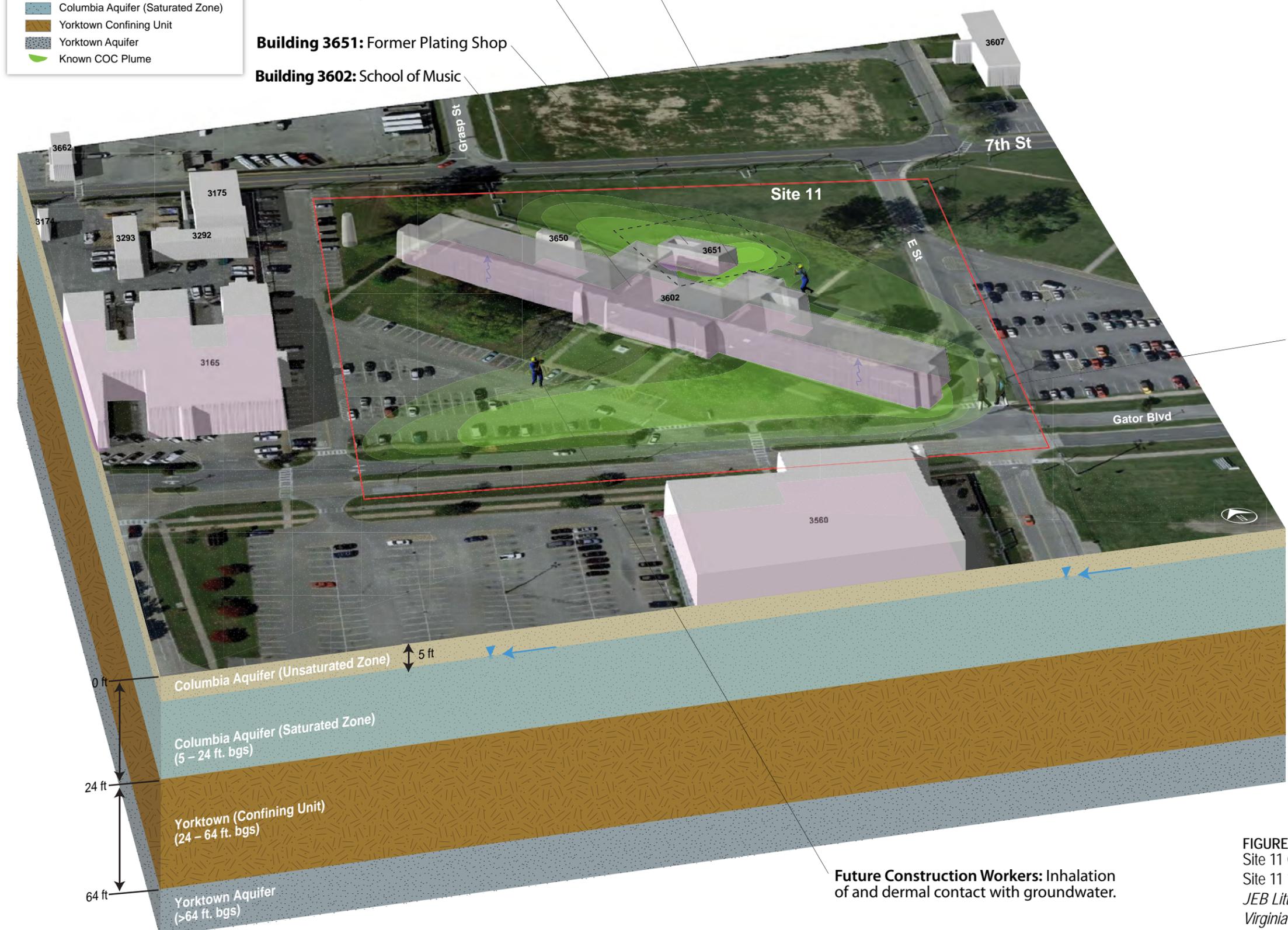
Source Removal: Former Neutralization Tank along with piping and surrounding soil removed by excavation in 1996

Building 3651: Former Plating Shop

Building 3602: School of Music

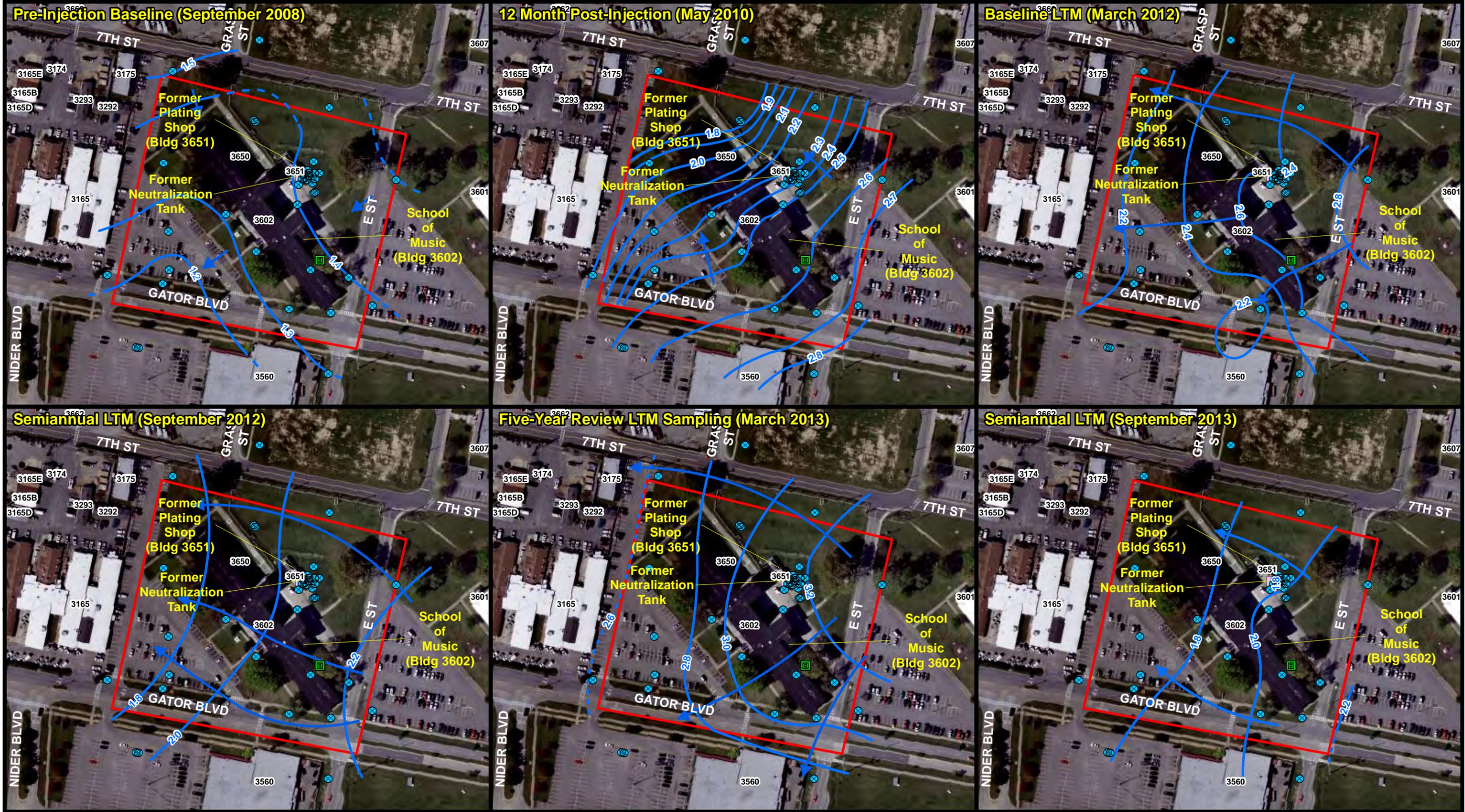
Future Residents: Ingestion of, inhalation (while showering) of, and dermal contact with groundwater.

Future Construction Workers: Inhalation of and dermal contact with groundwater.



Note: Extent of known COC concentrations based on 2005 analytical results (does not include 1,4-dioxane)

FIGURE 3
Site 11 Conceptual Site Model
Site 11 1,4-dioxane Groundwater SAP
JEB Little Creek
Virginia Beach, Virginia



- Legend**
- Monitoring Well
 - Flushmount Access to Existing 45° Directional Monitoring Well
 - LUC Boundary
 - Groundwater Contour (dashed where inferred)
 - Groundwater Flow Direction

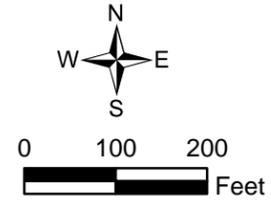


Figure 4
 Site 11 Potentiometric Surface Contour Map
 Site 11 1,4-dioxane Groundwater SAP
 JEB Little Creek
 Virginia Beach, Virginia

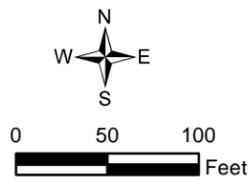


Legend

- ⊕ Monitoring Well
- Isoconcentration Contour (Dashed where inferred)
- Isoconcentrations (September 2008 and February 2009)**
- 1-10
- 10-100
- 100-1,000
- 1,000-10,000
- >10,000

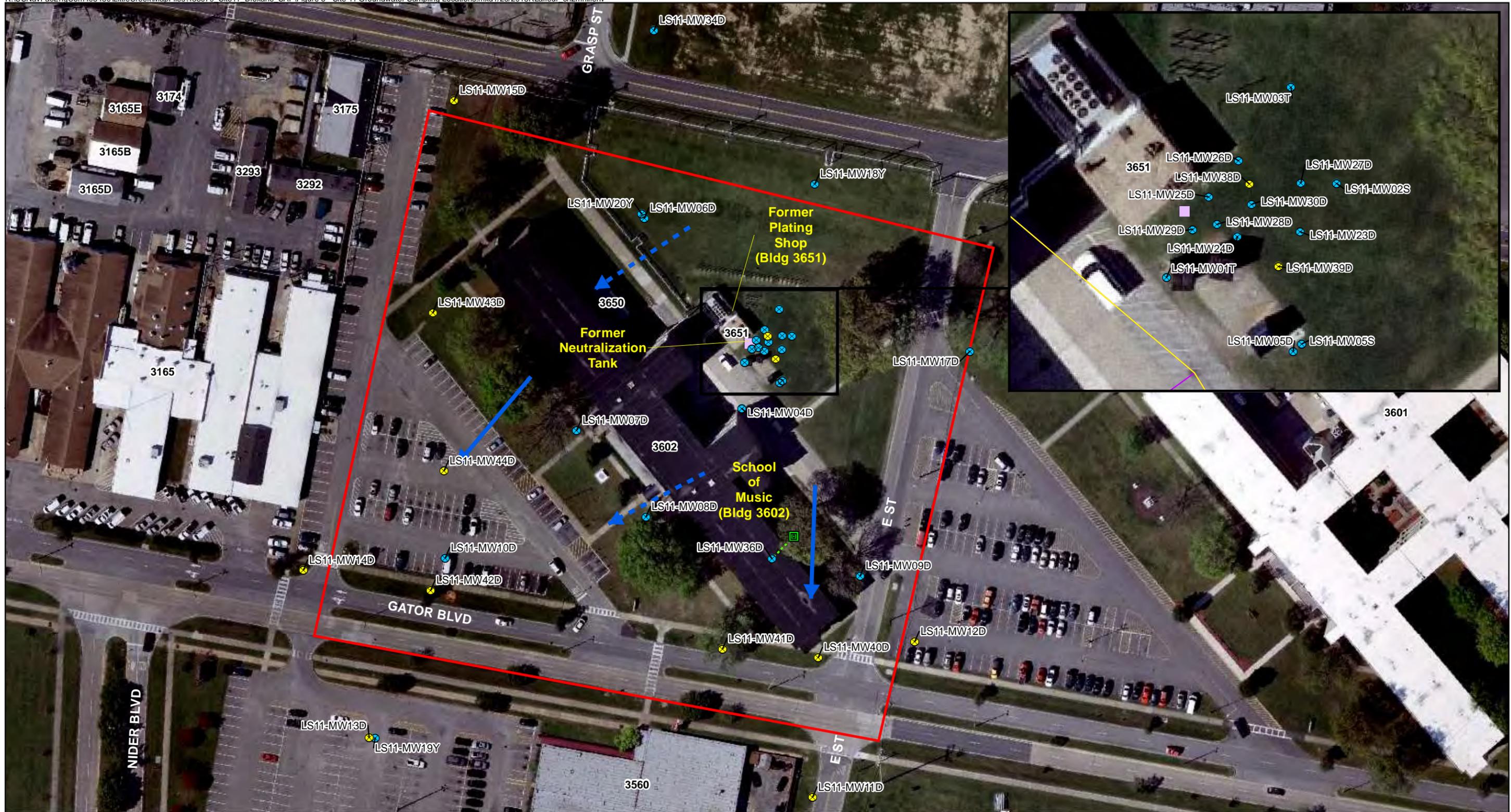
□ LUC Boundary

Note:
 Baseline Sampling took place in Aug/Sep 2008 and Jan/Feb 2009
 ND- Analytes not detected at concentrations greater than the cleanup goal



Concentrations are in µg/L

Figure 5
 Site 11 Total COC Isoconcentration Contours
 Columbia Aquifer (Remedial Action Baseline)
 Site 11 1, 4 - dioxane Groundwater SAP
 JEB Little Creek
 Virginia Beach, Virginia



- Legend**
- Monitoring Well
 - Monitoring Well Proposed for Sampling
 - Flushmount Access to Existing 45° Directional Monitoring Well
 - ▶ Groundwater Flow Direction (September 2014)
 - ▶ Groundwater Flow Direction (April 2005*)
 - LUC Boundary

*From groundwater measurements collected prior to completion of repair of leaking sanitary sewer line during 2009 Remedial Action.

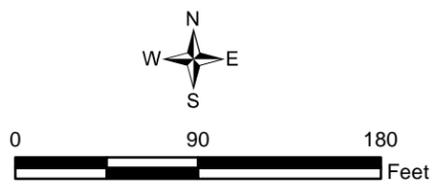


Figure 6
 Site 11 Groundwater Sampling Locations
 Site 11 1,4-dioxane Groundwater SAP
 JEB Little Creek
 Virginia Beach, Virginia

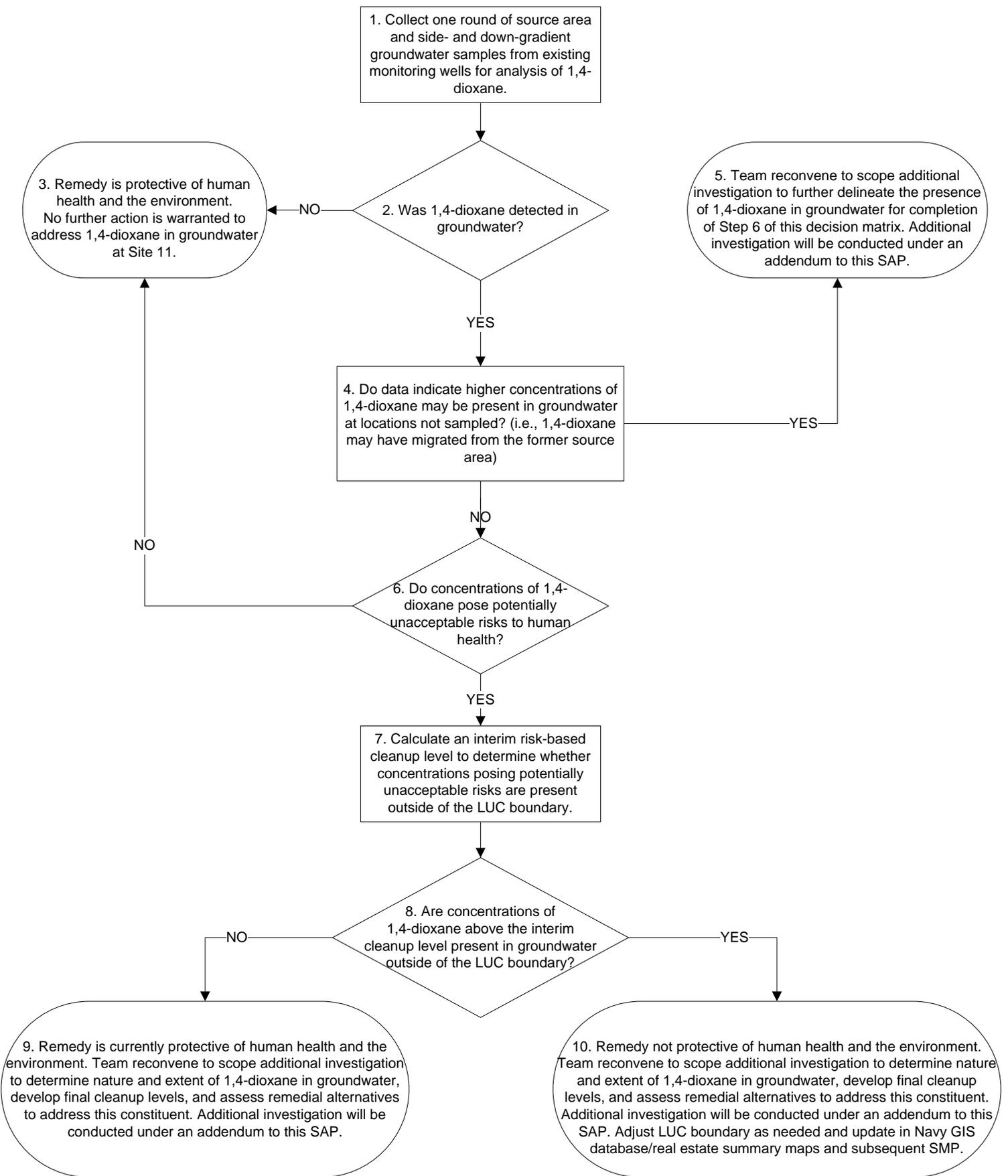
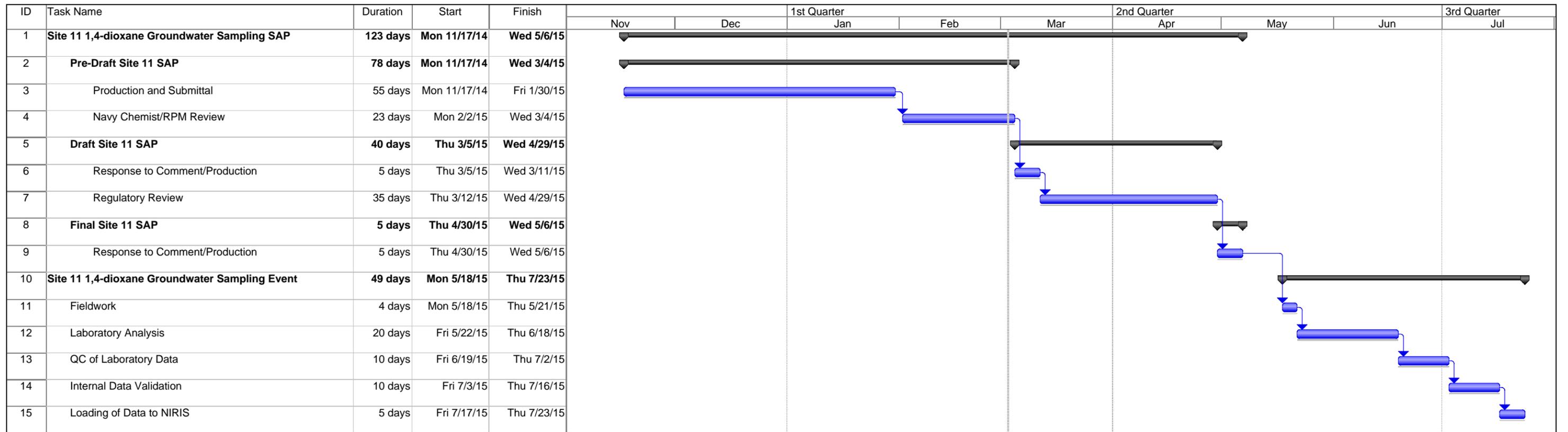


Figure 7
Site 11 Decision Tree
Site 11 1,4-dioxane Groundwater SAP
JEB Little Creek
Virginia Beach, Virginia



Appendix A
Field Standard Operating Procedures

Decontamination of Personnel and Equipment

I. Purpose

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

II. Scope

This is a general description of decontamination procedures.

III. Equipment and Materials

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

IV. Procedures and Guidelines

A. PERSONNEL DECONTAMINATION

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

1. Wash boots in Liquinox[®] solution, then rinse with water. If disposable latex booties are worn over boots in the work area, rinse with Liquinox[®] solution, remove, and discard into DOT-approved 55-gallon drum.
2. Wash outer gloves in Liquinox[®] solution, rinse, remove, and discard into DOT-approved 55-gallon drum.
3. Remove disposable coveralls (“Tyveks”) and discard into DOT-approved 55-gallon drum.
4. Remove respirator (if worn).
5. Remove inner gloves and discard.
6. At the end of the work day, shower entire body, including hair, either at the work site or at home.
7. Sanitize respirator if worn.

B. SAMPLING EQUIPMENT DECONTAMINATION – GROUNDWATER SAMPLING PUMPS

Sampling pumps are decontaminated after each use as follows.

1. Don phthalate-free gloves.
2. Spread plastic on the ground to keep equipment from touching the ground
3. Turn off pump after sampling. Remove pump from well and remove and dispose of tubing. Place pump in decontamination tube.
4. Turn pump back on and pump 1 gallon of Liquinox[®] solution through the sampling pump.
5. Rinse with 1 gallon of 10% isopropanol solution pumped through the pump. (DO NOT USE ACETONE). (Optional)
6. Rinse with 1 gallon of tap water.
7. Rinse with 1 gallon of deionized water.
8. Keep decontaminated pump in decontamination tube or remove and wrap in aluminum foil or clean plastic sheeting.
9. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.
10. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in either DOT-approved 55-gallon drums or with solid waste in garbage bags, dependent on Facility/project requirements.

C. SAMPLING EQUIPMENT DECONTAMINATION – OTHER EQUIPMENT

Reusable sampling equipment is decontaminated after each use as follows.

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

D. HEALTH AND SAFETY MONITORING EQUIPMENT DECONTAMINATION

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

E. SAMPLE CONTAINER DECONTAMINATION

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

1. Wipe container with a paper towel dampened with Liquinox[®] solution or immerse in the solution AFTER THE CONTAINERS HAVE BEEN SEALED. Repeat the above steps using potable water.
2. Dispose of all used paper towels in a DOT-approved 55-gallon drum or with solid waste in garbage bags, dependent on Facility/project requirements.

F. HEAVY EQUIPMENT AND TOOLS

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

1. Set up a decontamination pad in area designated by the Facility
2. Steam clean heavy equipment until no visible signs of dirt are observed. This may require wire or stiff brushes to dislodge dirt from some areas.

V. Attachments

None.

VI. Key Checks and Items

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

Disposal of Waste Fluids and Solids

I. Purpose and Scope

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

II. Equipment and Materials

A. Fluids

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

B. Solids

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

III. Procedures and Guidelines

A. Methodology

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

be labeled as they are filled in the field and labels indicating that the contents are pending analysis affixed.

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

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

B. Labels

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

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

C. Fluids

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

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

D. Solids

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

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

E. Storage and Disposal

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

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

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

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

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

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

I. Purpose and Scope

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

II. Equipment and Materials

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

III. Procedures and Guidelines

A. Parameters and Specifications:

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

B. Calibration:

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

Horiba Calibration procedure:

1. Fill a calibration beaker with standard solution to the recommended fill line.
2. Insert the probe into the beaker. All the parameter sensors will now be immersed in the standard solution except the D.O. sensor; the D.O. calibration is done using atmospheric air.
3. Turn power on and allow some time for the machine to warm-up prior to starting the calibration. When the initial readings appear to stabilize the instrument is ready to calibrate.
4. Press CAL key to put the unit in the calibration mode.
5. Press the ENT key to start automatic calibration. Wait a moment, and the upper cursor will gradually move across the four auto-calibration parameters one by one: pH, COND, TURB, and DO. When the calibration is complete, the readout will briefly show END. The instrument is now calibrated.
6. If the unit is calibrated properly the instrument readings, while immersed in the standard solution, will match the standard solution values provided on the solution container. The typical standard solution values are: pH = 4.0 +/- 3%, conductivity 4.49 mS/cm +/- 3%, and turbidity = 0 NTU +/- 3%.
7. Record the calibration data (e.g. time, instrument ID, solution lot number and expiration date, final calibrated readings, and solution temperature in the field logbook.

YSI Calibration procedure:

1. Press the **On/off** key to display the run screen
2. Press the **Escape** key to display the main menu screen
3. Use the arrow keys to highlight the **Calibrate**
4. Press the **Enter** key. The Calibrate screen is displayed
5. Choose the parameter to calibrate

A. *Conductivity Calibration:*

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

- 1) Use the arrow keys to highlight the **Conductivity** selection
- 2) Press **Enter**. The Conductivity Calibration Selection Screen is displayed.
- 3) Use the arrow keys to highlight the Specific Conductance selection.
- 4) Press **Enter**. The Conductivity Calibration Entry Screen is displayed.
- 5) Place the correct amount of conductivity standard (see Instrument Manual) into a clean, dry or pre-rinsed transport/calibration cup.
- 6) Carefully immerse the sensor end of the probe module into the solution.

- 7) Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.
NOTE: The sensor must be completely immersed past its vent hole. Using the recommended volumes from the Instrument Manual Calibration Volumes should ensure that the vent hole is covered.
- 8) Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.
NOTE: Do not over tighten as this could cause damage to the threaded portions.
- 9) Use the keypad to enter the calibration value of the standard you are using.
NOTE: Be sure to enter the value in **mS/cm at 25°C**.
- 10) Press **Enter**. The Conductivity Calibration Screen is displayed.
- 11) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
- 12) Observe the reading under Specific Conductance. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
- 13) Press **Enter**. This returns you to the Conductivity Calibrate Selection Screen
- 14) Press **Escape** to return to the calibrate menu.
- 15) Rinse the probe module and sensors in tap or purified water and dry.

B. Dissolved Oxygen Calibration:

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

- 1) Go to the calibrate screen as described in Section
NOTE: The instrument must be on for at least 20 minutes to polarize the DO sensor before calibrating.
- 2) Use the arrow keys to highlight the **Dissolved Oxygen** selection.
- 3) Press **Enter**. The dissolved oxygen calibration screen is displayed.
- 4) DO calibration in mg/L is carried out in a water sample which has a known concentration of dissolved oxygen (usually determined by a Winkler titration).
- 5) Use the arrow keys to highlight the **DO mg/L** selection.
- 6) Press **Enter**. The DO mg/L Entry Screen is displayed.
- 7) Place the probe module in water with a known DO concentration.
NOTE: Be sure to completely immerse all the sensors.
- 8) Use the keypad to enter the known DO concentration of the water.
- 9) Press **Enter**. The Dissolved Oxygen mg/L Calibration Screen is displayed.
- 10) Stir the water with a stir bar, or by rapidly moving the probe module, to provide fresh sample to the DO sensor.
- 11) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
- 12) Observe the DO mg/L reading, when the reading is stable (shows no significant change for approximately 30 seconds), press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
- 13) Press **Enter**. This returns you to the DO calibration screen.
- 14) Press **Escape** to return to the calibrate menu.
- 15) Rinse the probe module and sensors in tap or purified water and dry.

C. *pH Calibration:*

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

- 13) Observe the reading under pH, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
- 14) Press **Enter**. This returns you to the Specified pH Calibration Screen.
- 15) Rinse the probe module, transport/calibration cup and sensors in tap or purified water and dry.
- 16) Repeat steps 6 through 13 above using a second pH buffer.
- 17) Press **Enter**. This returns you to the pH Calibration Screen.
- 18) Press **Escape** to return to the calibrate menu.
- 19) Rinse the probe module and sensors in tap or purified water and dry.

D. ORP Calibration:

- 1) Go to the calibrate screen.
- 2) Use the arrow keys to highlight the **ORP** selection.
- 3) Press **Enter**. The ORP calibration screen is displayed.
- 4) Place the correct amount of a known ORP solution into a clean, dry or pre-rinsed transport/calibration cup.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the ORP sensor with a small amount of solution that can be discarded. Be certain that you avoid cross-contamination with other solutions.
- 5) Carefully immerse the sensor end of the probe module into the solution.
- 6) Gently rotate and/or move the probe module up and down to remove any bubbles from the ORP sensor.

NOTE: The sensor must be completely immersed.
- 7) Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.
- 8) Use the keypad to enter the correct value of the calibration solution you are using at the current temperature.
- 9) Press **Enter**. The ORP calibration screen is displayed.
- 10) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
- 11) Observe the reading under ORP, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
- 12) Press **Enter**. This returns you to the Calibrate Screen.
- 13) Rinse the probe module and sensors in tap or purified water and dry. Record the calibration data (e.g. time, instrument ID, solution lot number and expiration date, final calibrated readings, and solution temperature in the field logbook.

C. Sample Measurement:

Horiba measurement procedure:

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

YSI measurement procedure:

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

IV. Key Checks and Preventive Maintenance

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

V. References

YSI 556 Multi Probe System Operator Manual

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

I. Purpose and Scope

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

II. Equipment and Materials

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

III. Procedures and Guidelines

A. Setup and Purging

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

4. Plastic sheeting is placed on the ground, and the well is unlocked and opened. All decontaminated equipment to be used in sampling will be placed only on the plastic sheeting until after the sampling has been completed. To avoid cross-contamination, do not let any downhole equipment touch the ground.
5. All sampling equipment and any other equipment to be placed in the well is cleaned and decontaminated before sampling in accordance with *SOP Decontamination of Personnel and Equipment*.
6. Water level measurements are collected in accordance with the *Water Level Measurements SOP*. **Do not measure the depth to the bottom of the well at this time**; this reduces the possibility that any accumulated sediment in the well will be disturbed. Obtain depth to bottom information from well construction log.
7. Attach and secure the tubing to the low-flow pump. Lower the pump slowly into the well and set it at approximately the middle of the screen. Place the pump intake in the middle of the saturated screen length and should be at least two feet above the bottom of the well to avoid mobilization of any sediment present in the bottom.
8. Insert the measurement probes into the flow-through cell. The purged groundwater is directed through the cell, allowing measurements to be collected before the water contacts the atmosphere.
9. If using a generator, locate it 30 feet downwind from the well to avoid exhaust fumes contaminating the samples.
10. Start purging the well at 0.2 to 0.5 liters per minute. Avoid surging. Purging rates for more transmissive formations could be started at 0.5-liter to 1 liter per minute. The initial field parameters of pH, specific conductance, dissolved oxygen, ORP, turbidity, and temperature of water are measured and recorded in the field logbook.
11. The water level should be monitored during purging, and, ideally, the purge rate should equal the well recharge rate so that there is little or no drawdown in the well (i.e., less than 0.3-foot). The water level should stabilize for the specific purge rate. There should be at least 1 foot of water over the pump intake so there is no risk of the pump suction being broken, or entrainment of air in the sample. Record adjustments in the purge rate and changes in depth to water in the logbook. Purge rates should, if needed, be decreased to the minimum capabilities of the pump (0.1- to 0.2-liter per minute) to avoid affecting well drawdown.
12. During purging, the field parameters are measured frequently (every 5 minutes) until the parameters have stabilized. Field parameters are considered stable when measurements meet the following criteria:
 - pH: within 0.1 pH units
 - Specific conductance: within 3 percent

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

B. Sample Collection

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

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

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

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

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

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

5. The bottle is capped and clearly labeled.
6. Immediately upon collection, all samples for chemical analysis are to be placed in a closed container on ice unless it is not possible to do so. Although unusual and uncommon, there may be instances where it is not possible to have containers with ice at the sample location. In these instances, the samples should be placed on ice as soon as practical and during the time between collection and placing the samples on ice, the samples should be kept as cool as possible.
7. Nondedicated equipment is cleaned and decontaminated in accordance with the *Decontamination of Personnel and Equipment SOP*.

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

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

C. Additional remarks

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

IV. Attachments

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

V. Key Checks and Preventative Maintenance

- The drawdown in the well should be minimized as much as possible (preferably no more than 0.5-foot to 1 foot) so that natural groundwater-flow conditions are maintained as closely as possible.

- The highest purging rate should not exceed 1 liter per minute. This is to keep the drawdown minimized.
- Stirring up of sediment in the well should be avoided so that turbidity containing adsorbed chemicals is not suspended in the well and taken in by the pump.
- Overheating of the pump should be avoided to minimize the potential for losing VOCs through volatilization.
- Keep the working space clean with plastic sheeting and good housekeeping.
- Maintain field equipment in accordance with the manufacturer's recommendations. This will include, but is not limited to:
 - Inspect sampling pump regularly and replace as warranted
 - Inspect quick-connects regularly and replace as warranted
 - Verify battery charge, calibration, and proper working order of field measurement equipment prior to initial mobilization and daily during field efforts

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

White Paper on Low-Flow Sampling

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

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

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

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

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

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

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

Water-Level Measurements

I. Purpose and Scope

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

II. Equipment and Materials

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

III. Procedures and Guidelines

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

Measure the distance from this point to the closest interval marker on the tape, and record the water level reading in the logbook. Water levels will be measured to the nearest 0.01-foot. Also when specified in the project plans, measure and record the depth of the piezometer or well. The depth of the piezometer or well may be measured using the water-level probe with the instrument turned off.

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

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

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

Where WL_c = Corrected water-level elevation

WL_a = Apparent water-level elevation

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

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

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

IV. Attachments

None.

V. Key Checks

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

(47)

MAY 12, 2003

EXAMPLE

0715 ARRIVE ON SITE AT XYZ SITE.
 CH2M HILL STAFF:
 John Smith: FIELD TEAM LEADER
 Bob Builder: SITE SAFETY COORD.
 WEATHER: OVERCAST + COOL, 45°F
 CHANCE OF LATE SHOWERS
 SCOPE: • COLLECT GROUNDWATER
 SAMPLES FOR LTM WORK AT SITE 14
 • SUPERVISE SURVEY CREW
 AT SITE 17

0725 BB ~~STARTS~~ JS CALIBRATES
 PID: 101 ppm / 100 ppm OK
 PID Model #, SERIAL #

0730 BB CALIBRATES HORIBA METER
 Model #, SERIAL #
 → LIST CALIBRATION RESULTS

0738 SURVEY CREW ARRIVES ON SITE
 → LIST NAMES

0745 BB HOLDS H+S TALK ON SLIPS,
 TRIPS, FALLS, TICKS + AIR MONITORING
 JS + SURVEY CREW ATTEND
 NO H+S ISSUES IDENTIFIED AS
 CONCERNS. ALL WORK IS IN "LEVEL D."

0755 JS CONDUCTS SITE-WIDE AIR MONITORING
 All readings = 0.0 ppm IN

JS
5-12-03

MAY 12, 2003

EXAMPLE

(48)

SITE 14 LTM
 BREATHING ZONE (BZ)

0805 Mobilize to well MW-22 to
 SAMPLE, SURVEYORS SETTING UP
 AT SITE 17

0815 PM (PAUL PAPER PUSHER) CALLS AND
 INFORMS JS TO COLLECT GWO SAMPLE
 AT WELL MW-44 TODAY FOR 24 HOUR
 TAT ANALYSIS OF VOCIS

0820 Purging MW-22
 → RECORD WATER QUALITY DATA JS
 5-12-03

0843 Collect SAMPLE AT MW-22 FOR
 TOTAL TAT METALS AND VOCIS; NO
 DISSOLVED METALS NEEDED PER PPL

0905 JS + BB Mobilize to SITE 17 to
 SHOW SURVEYORS WELLS TO SURVEY.

0942 Mobilize to well MW-22 to
 Collect SAMPLE ...

0950 CAN NOT ACCESS WELL MW-22
 DUE TO BASE OPERATIONS; CONTACT
 PAUL PAPER PUSHER AND HE STATED
 HE WILL CHECK ON GAINING ACCESS
 WITH BASE CONTACT.

0955 Mobilize to well MW-19

JS
5-12-03

Equipment Blank and Field Blank Preparation

I. Purpose

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

II. Scope

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

III. Equipment and Materials

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

IV. Procedures and Guidelines

- A. Decontaminate all sampling equipment that has come in contact with sample according to SOP *Decontamination of Personnel and Equipment*.
- B. To collect an equipment blank for volatile analysis from the surfaces of sampling equipment other than pumps, pour blank water over one piece of equipment and into two 40-ml vials until there is a positive meniscus, then seal the vials. Note the sample number and associated piece of equipment in the field notebook as well as the type and lot number of the water used.

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

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

- C. When collecting an equipment blank from a pump, run an extra gallon of deionized water through the pump while collecting the pump outflow into appropriate containers. Make sure the flow rate is low when sampling VOCs. If a Grundfos Redi-Flo2 pump with disposable tubing is used, remove the disposable tubing after sampling but before decon. When decon is complete, put a 3- to 5-foot segment of new tubing onto the pump to collect the equipment blank.
- D. To collect a field blank, slowly pour ASTM Type II or lab grade water directly into sample containers.
- E. Document and ship samples in accordance with the procedures for other samples.
- F. Collect next field sample.

V. Attachments

None.

VI. Key Checks and Items

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

Sampling Contents of Tanks and Drums

I. Scope and Application

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

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

II. Summary of Methods

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

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

III. Comments

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

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

any headspace gases is warranted. As a minimum, a preliminary check with a Multi RAE or equivalent may be of aid in selecting a sampling method.

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

IV. Required Equipment and Apparatus

- A. **Health and safety equipment/materials:** As listed in the site safety plan.
- B. **Sampling equipment:** COLIWASA, glass sample tubes, Kemmerer depth sampler, Bacon Bomb, gravity corer.
- C. **Tools:** Rubber mallet, bung wrench, speed wrench with socket, etc., (all non-sparking), paint marker.
- D. **Heavy equipment:** Backhoe equipped with explosion shield, drum grappler, and 3-foot copper-beryllium (non-sparking) spike with 6-inch collar (to puncture top of drums for sampling, if necessary).
- E. **Sample Containers:** As specified in the field sampling plan.

V. Procedures

A. Drums

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

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

7. When sampling a previously sealed vessel, a check should be made for the presence of bottom sludge. This is accomplished by measuring the depth to apparent bottom, then comparing it to the known interior depth.
8. Agitation to disrupt the layers and rehomogenize the sample is physically difficult and almost always undesirable. If the vessel is greater than 3 feet in depth (say, a 55-gallon drum), the appropriate sampling method is to slowly lower the sampling device (i.e., suction line of peristaltic pump, glass tube) in known increments of length. Discrete samples can be collected from various depths, then combined or analyzed separately. If the depth of the vessel is greater than the lift capacity of the pump, an at-depth water sampler, such as the Kemmerer or Bacon Bomb type, may be required.
9. Extract a representative sample from the drum using a glass rod, COLIWASA, Bacon Bomb, Kemmerer bottle, or gravity corer (See Attachments). Ensure that the entire depth of material is penetrated. Depending on the size of the opening of the drum, three to four takes should be collected from random locations across the drum surface, to ensure a representative sample. Any observed stratification must be recorded in logbook, including number and thickness of the layers and a conceptualized sketch.
10. Record a visual description of the sample (e.g., liquid, solid, color, viscosity, and percent layers).
11. When possible, sampling equipment (like glass tubes) should be expendable and be left inside the drum for disposal with drum contents, once sampling is completed.
12. Place lid, bung, cap, etc., back in place on drum. Tighten hand tight. If necessary, the sampling port can be sealed using a cork.
13. Wipe up spilled material with lab wipes. Wipe off sample containers.
14. Mark the drum with a unique sample identification number and date using a paint marker.
15. Samples will be handled as high hazard samples. Samples will be placed in containers defined according to the analytical needs, wiped clean, and then packed in paint cans for shipping. Packaging, labeling, and preparation for shipment procedures will follow procedures as specified in the field sampling plan.

B. Underground Storage Tanks

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

2. Sampling team will locate a sampling port on the tank. Personnel should be wearing appropriate protective clothing at this time and carrying sampling gear.
3. Do not attempt to climb down into tank. Sampling MUST BE accomplished from the top.
4. Collect a sample from the upper, middle, and lower section of the tank contents with one of the recommended sampling devices.
5. If compositing is necessary, ship samples to laboratory in separate containers for laboratory compositing.
6. Samples will be handled as hazardous. Samples will be placed in appropriate containers and packed with ice in a cooler. Packaging, labeling, and preparation for shipment will follow procedures specified in the field sampling plan.

C. Tank Trailers or Above-Ground Storage Tanks

1. A sampling team of two is required. One will collect samples, the other will relay required equipment and implements.
2. Samples will be collected through the manhole (hatch) on top of the tanker or the fill port. Do not open valves at the bottom. Before opening the hatch, check for a pressure gauge or release valve. Open the release valve slowly to bring the tank to atmospheric pressure.
3. If tank pressure is too great, or venting releases large amounts of toxic gas, discontinue venting and sampling immediately. Measure vented gas with organic vapor analyzer and explosimeter.
4. If no release valve exists, slowly loosen hatch cover bolts to relieve pressure in the tank. (Again, stop if pressure is too great.)
5. Once pressure in tank has been relieved, open the hatch and withdraw sample using one of the recommended sampling devices.
6. Sample each trailer compartment.
7. If compositing is necessary, ship samples to laboratory in separate containers for laboratory compositing.
8. Samples will be handled as hazardous. Samples will be placed in appropriate containers and packed with ice in a cooler. Packaging, labeling, and preparation for shipment will follow procedures specified in the field sampling plan.

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

Drum

Glass tube	—	Procedure 1
COLIWASA	—	Procedure 2

Storage Tank and Tank Trailer

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

VI. Contamination Control

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

VIII. Attachments

- A. Collection of Liquid-Containerized Wastes Using Glass Tubes
- B. Sampling Containerized Wastes Using the Composite Liquid Waste Sample (COLIWASA)
- C. Sampling Containerized Wastes Using the Bacon Bomb Sampler
- D. Gravity Corer for sampling Sludges in Large Containers
- E. Construction of a Typical COLIWASA
- F. Drum Opening Techniques and Equipment

IX. References

A Compendium of Superfund Field Operations Methods, EPA/540/P-87/001, U.S. Environmental Protection Agency, Washington, D.C., 1987.

Data Quality Objectives for Remedial Activities - Development Process, EPA/540/G-87/003, U.S. Environmental Protection Agency, Washington, D.C., 1987.

Annual Book of ASTM Standards, Standard Recommended Practices for Sampling Industrial Chemicals, ASTM-E-300, 1986.

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

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

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

X. Field Checklist

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

Attachment A Collection of Liquid-Containerized Wastes Using Glass Tubes

Discussion

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

Uses

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

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

Procedures for Use

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

Optional Method (if sample of bottom sludge is desired)

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

Note:

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

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

Discussion

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

Uses

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

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

Procedures for Use

1. Check to make sure the sampler is functioning properly. Adjust the locking mechanism, if present, to make sure the neoprene rubber stopper provides a tight closure.
2. Put the sampler in the open position by placing the stopper rod handle in the T-position and pushing the rod down until the handle sits against the sampler's locking block.
3. Slowly lower the sampler into the liquid waste. Lower the sampler at a rate that permits the levels of the liquid inside and outside the sampler tube to be about the same. If the level of the liquid in the sample tube is lower than that outside the sampler, the sampling rate is too fast and will result in a non-representative sample.
4. When the sampler stopper hits the bottom of the waste container, push the sampler tube downward against the stopper to close the sampler. Lock the sampler in the closed position by turning the T-handle until it is upright and one end rests tightly on the locking block.

5. Slowly withdraw the sampler from the waste container with one hand while wiping the sampler tube with a laboratory wipe with the other hand. A phase boundary, if present, can be observed through the tube.
6. Carefully discharge the sample into a suitable sample container by slowly pulling the lower end of the T-handle away from the locking block while the lower end of the sampler is positioned in a sample container.
7. Unscrew the T-handle of the sampler and disengage the locking block.

Attachment C: Sampling Containerized Wastes using the Bacon Bomb Sampler

Discussion

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

Uses

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

Procedures for Use

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

Attachment D: Gravity Corer for Sampling Sludges in Large Containers

Discussion

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

Uses

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

Procedures for Use

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

Attachment E: Construction of a Typical COLIWASA

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

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

The sampler is assembled as follows:

- a. Attach the swivel to the T-handle with the 3.18-cm (1-1/4 in) long bolt and secure with the 0.48-cm (3/16-in) National Coarse (NC) washer and lock nut.
- b. Attach the PTFE stopper to one end of the stopper rod and secure with the 0.95-cm (3/8-in) washer and lock nut.
- c. Install the stopper and stopper rod assembly in the sampling tube.
- d. Secure the locking block sleeve on the block with glue or screw. This block can also be fashioned by shaping a solid plastic rod on a lathe to the required dimension.
- e. Position the locking block on top of the sampling tube such that the sleeveless portion of the block fits inside the tube, the sleeve sits against the top end of the tube, and the upper end of the stopper rod slips through the center hole of the block.
- f. Attach the upper end of the stopper rod to the swivel of the T-handle.
- g. Place the sampler in the close position and adjust the tension on the stopper by screwing the T-handle in or out.

Attachment F: Drum Opening Techniques and Equipment ¹

I. Introduction

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

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

II. Manual Drum Opening

A. Bung Wrench

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

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

B. Drum Deheader

One means by which a drum can be opened manually when a bung is not removable with a bung wrench is by using a drum deheader. This tool is constructed of forged steel with an alloy steel blade and is designed to cut the lid of a drum off or part way

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

off by means of a scissors-like cutting action. A limitation of this device is that it can be attached only to closed head drums (i.e., DOT Specification 17E and 17F drums); drums with removable heads must be opened by other means.

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

C. Hand Pick or Spike

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

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

III. Remote Opening

A. Backhoe Spike

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

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

The spike should be decontaminated after each drum is opened to prevent cross contamination. Even though some splash or spray may occur when this method is

used, the operator of the backhoe can be protected by mounting a large shatter-resistant shield in front of the operator's cage. This, combined with the normal sampling safety gear, should be sufficient to protect the operator. Additional respiratory protection can be afforded by providing the operator with an on-board airline system. The hole in the drum can be sealed with a cork.

B. Hydraulic Devices

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

C. Pneumatic Devices

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

IV. Summary

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

Attachment A
Example Sample Label



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

Client _____
Sample No. _____
Location _____
Analysis _____
Preservative **HCL** _____
Date _____ By _____

CEIMIC CORPORATION

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

SITE NAME	DATE
ANALYSIS	TIME
	PRESERVATIVE

SAMPLE TYPE

Grab Composite Other _____

COLLECTED BY: _____

Attachment B
Example Chain-of-Custody Record

Attachment C
Example Custody Seal



CUSTODY SEAL

Date

Signature

Multi RAE Photoionization Detector (PID)

I. Purpose

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

II. Scope

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

III. Definitions

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

Volatile Organic Compound (VOC) - Expresses the VOC concentration in ppm

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

Hydrogen Sulfide Sensor (H₂S) - Expresses the Hydrogen Sulfide concentration in ppm.

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

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

IV. Procedures

The Multi RAE utilizes the principle of detecting sensors. The PID operates on the principle that most organic compounds and some inorganic compounds are ionized when they are bombarded by high-energy ultraviolet light. These compounds absorb the energy of the light, which excites the molecules and results in a loss of electron and the formation of a positively charged ion. The number of ions formed and the ion current produced is directly proportional to mass and concentration. The amount of energy required to displace an electron is called photo ionization potential (PIP). The air sample is drawn into a UV lamp using a pump or a fan. The energy of the lamp determines whether a particular chemical will be ionized. Each chemical compound has a unique ionizing potential. When the UV light energy is greater than

the ionization potential of the chemical, ionization will occur. When the sample is ionized, the electrical signal is displayed on an analog or digital output. Although the output does not distinguish between chemicals, it does detect an increase in the ion current. If only one chemical is present in the air, it is possible to use PIDs quantitatively. Chemical structure and lamp intensity affects the sensitivity of the instrument to a given contaminant. All PID readings are relative to the calibration gas, usually isobutylene. It is important to calibrate the PID in the same temperature and elevation that the equipment will be used, and to determine the background concentrations in the field before taking measurements. For environments where background readings are high, factory zero calibration gas should be used.

Note: for volatile and semi-volatile compounds, knowing the PIP is critical in determining the appropriate instrument to use when organic vapor screening. Consult the QAPP and manufacturer's manual to determine that the proper instrument has been selected for the contaminate vapors of interest. If an expected compound at a site has a PIP less than 11.7 eV, it is possible to use a PID. If the ionization potential is greater than 11.7eV, an FID is required.

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

A. Calibration

For Multi RAE configured with O₂, LEL, H₂S, CO, sensors and a 10.6eV PID Lamp.

Start up Instrument

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

On!.....

Multi RAE
Version X.XX

Model Number
SN XXXX

Date Time
Temp

Checking Sensor
Ids...

VOC Installed

CO Installed

H₂S Installed

OXY Installed

LEL Installed

H₂S VOC CO
LEL OXY

Alarm Limits=

XX XX.X XX
XX High XX.X

XX XX.X XX
XX Low XX.X

XX XX.X XX
STEL

XX XX.X XX
TWA

Battery = X.XV
Shut off at 4.2V

User Mode=

Alarm Mode=

Datalog Time Left

Datalog Mode

Datalog Period

Unit ready in.....
10 Seconds

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

Calibration Check and Adjustment

Allow instrument to warm up for 15 minutes.

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

- Display will read:

Calibrate Monitor?

- Press the [Y/+] key

- Display will read:

Fresh Air Calibration?

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

- Press the [Y/+] key

- Display will read:

Zero.... In progress...

CO Zeroed! Reading = X

VOC Zeroed! Reading = X

LEL Zeroed! Reading = X

OXY Zeroed! Reading = X

Zero Cal done!
H ₂ S Zeroed! Reading = X

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

- Display will then read:

Multiple Sensor Calibration?

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

CO H ₂ S LEL OK? OXY

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

Apply Mixed gas

Calibration In progress ...

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

CO cal'ed Reading=50

H ₂ S cal'ed Reading=25

LEL cal'ed Reading=50

OXY cal'ed Reading=20.9

Calibration done Turn off gas!

- Display will read:

Single Sensor Calibration?

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

CO VOC H ₂ S LEL pick? OXY
--

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

- Press the [Y/+]. The display will read:

Apply VOC Gas

Calibration
In progress...

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

VOC cal'd
Reading=100

Calibration done
Turn off gas!

Single Sensor
Calibration?

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

B. Operation

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

C. Site Maintenance

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

D. Scheduled Maintenance

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

V. Quality Assurance Records

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

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

VI. References

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

STANDARD OPERATING PROCEDURE

Established Joint Expeditionary Base (JEB) Little Creek-Fort Story Sample Identification Naming Scheme

First Segment			Second Segment		
Facility	Site Type	Site Number	Station Type	Station Number	Qualifier
A	AA	NNN	AA	NNN	AAAA
Note: "N" = numeric, "A" = alphanumeric					
<u>Facility</u> L = Little Creek <u>Location Type</u> S = Installation restoration site W = Solid waste management unit (SWMU) BG = Non-site-specific background samples A = Area of concern (AOC) REF = Reference samples <u>Location Number</u> 003 – Pier 10 Sandblast Yard (SWMU 3) 005 – Port Ops Boat Painting Area (SWMU 5) 006 – Seabee Area-CB124 (SWMU 6) 007 – Small Boats Sandblast Yard (SWMU 7) 008 – West Annex Sandblast Yard (SWMU 8) 013 – Former Pesticide Shop (SWMU 13) 018 – PWC Transportation Garage Spent Battery Shop, Collection Area, Bldg. 3661 (SWMU 118) 07 – Amphibious Base Landfill (Site 7) 08 – Demolition Debris Landfill (Site 8) 09 – Driving Range Landfill (Site 9) 096 – CB301 Seabee Vehicle Maintenance Facility Scrap Storage Area (SWMU 96) 097 – CB301 Seabee Vehicle Maintenance Facility Storm Drain (SWMU 97) 098 – Elevated Causeways Mechanic Shop Material Dispensing Area (SWMU 98) 10 – Sewage Treatment Plant (Site 10) 11 – School of Music Plating Shop (Site 11) 11a – TCE Plume adjacent to Site 11 (Site 11a) 12 – Exchange Laundry Waste Disposal Area (Site 12) 13 – Public Works PCP Dip Tank and Wash Rack (Site 13) 116 – MWR Recreation Boat Maintenance Facility, Bldg. 3021) 119 – Former Special Warfare Group 2 Electronics Shop, Bldg. W112 (SWMU 119) D – PCB Transformer Leak, Bldg. 3530 (AOC D)			<u>Station Type</u> BD = Building BI* = Biota sample stations (i.e., benthic [B], crabs [C], fish [F], mussels [M], etc.) DR = Drum GP = In-situ sample groundwater station (i.e., geoprobe and hydropunch) IS = IDW soil IW = IDW water ML = Multilevel sampler MM = Multimedia station (e.g: surface water and sediment) MW = Monitoring well PW = Potable supply well PZ = Piezometer RW = Groundwater recovery well SA = Sanitary sewer SD = Sediment sample location SEEP = Groundwater Seep Location SG = Soil gas SL = Sewer line (sanitary) SO = Soil sample location ST = Storm sewer SW = Surface water sample location TP = Test pit location TW = Temporary well <u>Number</u> Monitoring Well Number <u>Qualifier</u> S = Shallow Well (<15 ft) D = Deep Well (15-30 ft) P = duplicate sample Y = Yorktown Aquifer Well T = Screened Across Shallow and Deep		

TABLE 4-2

Field Sampling Naming Scheme

Joint Expeditionary Base (JEB) Little Creek-Fort Story Master Project Plans

Virginia Beach, Virginia First Segment			Second Segment			Third Segment
Facility	Site Type	Site Number	Sample Type	Sample Number	Qualifier	Additional Qualifiers (sample depth, sampling round, etc.)
A	AA	NNN	AA	NNN or NNNN	A	As Applicable
Notes: "A" = alphabetic, "N" = numeric						
<p><u>Facility</u> L = Little Creek</p> <p><u>Location Type</u> S = Installation restoration site W = Solid waste management unit (SWMU) BG = Non-site-specific background samples A = Area of concern (AOC) REF = Reference samples</p> <p><u>Location Number</u> 003 – Pier 10 Sandblast Yard (SWMU 3) 005 – Port Ops Boat Painting Area (SWMU 5) 006 – Seabee Area-CB124 (SWMU 6) 007 – Small Boats Sandblast Yard (SWMU 7) 008 – West Annex Sandblast Yard (SWMU 8) 013 – Former Pesticide Shop (SWMU 13) 018 – PWC Transportation Garage Spent Battery Shop, Collection Area, Bldg. 3661 (SWMU 118) 07 – Amphibious Base Landfill (Site 7) 08 – Demolition Debris Landfill (Site 8) 09 – Driving Range Landfill (Site 9) 096 – CB301 Seabee Vehicle Maintenance Facility Scrap Storage Area (SWMU 96) 097 – CB301 Seabee Vehicle Maintenance Facility Storm Drain (SWMU 97) 098 – Elevated Causeways Mechanic Shop Material Dispensing Area (SWMU 98)</p>			<p><u>Sample Type</u> DP = Direct Push Groundwater Sample IA = Indoor Air MW = Monitoring Well OA = Outdoor Air SB = Subsurface Soil SD = Sediment SS = Surface Soil SV = Soil Vapor SW = Surface Water TB = Trip Blank FB = Field Blank EB = Equipment Blank</p> <p><u>Sample Number</u> 1. Station Samples (NN) Well number 2. QC Samples (NNNNNN) MMDDYY : month, day, and year of sampling event</p> <p><u>Qualifier</u> S = Shallow Well (<15 ft) D = Deep Well (15-30 ft) P = Duplicate sample Y = Yorktown Aquifer Well T = Screened Across Shallow and Deep</p>			<p><u>Additional Qualifiers</u> 1. QC Samples (NN) Sequential QC sample number for that day (if needed)</p> <p><u>Example</u> LS07-EB011304 Equipment blank collected on January 13, 2004 during sampling at Site 7.LS07-</p> <p>2. Quarters A = 1st Quarter B = 2nd Quarter C = 3rd Quarter D = 4th Quarter</p> <p><u>Example</u> MW03-04C Groundwater samples collected from monitoring well 3 at Site 7 in the third quarter of 2004..</p>
<p><u>Notes:</u></p> <ul style="list-style-type: none"> • Segments are separated by a dash. • Qualifiers are as applicable only 						

Appendix B
Laboratory DoD ELAP Accreditation



**LABORATORY
ACCREDITATION
BUREAU**



Certificate of Accreditation

ISO/IEC 17025:2005

Certificate Number L2226

Empirical Laboratories, LLC

621 Mainstream Drive, Suite 270
Nashville TN 37228

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation valid through: November 30, 2015



**R. Douglas Leonard, Jr., President, COO
Laboratory Accreditation Bureau
Presented the 30th of January 2013**

*See the laboratory's Scope of Accreditation for details of accredited parameters

**Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

Scope of Accreditation For Empirical Laboratories, LLC

621 Mainstream Drive, Suite 270
Nashville, TN 37228
Marcia K. McGinnity
877-345-1113

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.2) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to Empirical Laboratories, LLC to perform the following tests:

Accreditation granted through: **November 30, 2015**

Testing - Environmental

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8260B/C; EPA 624	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B/C; EPA 624	1,1,1-Trichloroethane (1,1,1-TCA)
GC/MS	EPA 8260B/C; EPA 624	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/C; EPA 624	1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)
GC/MS	EPA 8260B/C; EPA 624	1,1,2-Trichloroethane
GC/MS	EPA 8260B/C; EPA 624	1,1-Dichloroethane (1,1-DCA)
GC/MS	EPA 8260B/C; EPA 624	1,1-Dichloroethene (1,1-DCE)
GC/MS	EPA 8260B/C; EPA 624	1,1-Dichloropropene
GC/MS	EPA 8260B/C; EPA 624	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B/C; EPA 624	1,2,3-Trichloropropane
GC/MS	EPA 8260B/C; EPA 624	1,2,4-Trichlorobenzene
GC/MS	EPA 8260B/C; EPA 624	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/C; EPA 624	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B/C; EPA 624	1,2-Dibromoethane (EDB)
GC/MS	EPA 8260B/C; EPA 624	1,2-Dichlorobenzene

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8260B/C; EPA 624	1,2-Dichloroethane (EDC)
GC/MS	EPA 8260B/C; EPA 624	1,2-Dichloropropane
GC/MS	EPA 8260B/C; EPA 624	1,3,5- Trichlorobenzene
GC/MS	EPA 8260B/C; EPA 624	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B/C; EPA 624	1,3-Dichlorobenzene
GC/MS	EPA 8260B/C; EPA 624	1,3-Dichloropropane
GC/MS	EPA 8260B/C; EPA 624	1,4-Dichlorobenzene
GC/MS	EPA 8260B/C; EPA 624	1,4-Dioxane
GC/MS	EPA 8260B/C; EPA 624	1-Chlorohexane
GC/MS	EPA 8260B/C; EPA 624	2,2-Dichloropropane
GC/MS	EPA 8260B/C; EPA 624	2-Butanone (Methyl ethyl ketone; MEK)
GC/MS	EPA 8260B/C; EPA 624	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B/C; EPA 624	2-Chlorotoluene
GC/MS	EPA 8260B/C; EPA 624	2-Hexanone (Methyl butyl ketone; MBK)
GC/MS	EPA 8260B/C; EPA 624	4-Chlorotoluene
GC/MS	EPA 8260B/C; EPA 624	4-Methyl-2-pentanone (Methyl isobutyl ketone; MBK)
GC/MS	EPA 8260B/C; EPA 624	Acetone
GC/MS	EPA 8260B/C; EPA 624	Acetonitrile
GC/MS	EPA 8260B/C; EPA 624	Acrolein
GC/MS	EPA 8260B/C; EPA 624	Acrylonitrile
GC/MS	EPA 8260B/C; EPA 624	Allyl chloride
GC/MS	EPA 8260B/C; EPA 624	Benzene
GC/MS	EPA 8260B/C; EPA 624	Bromobenzene
GC/MS	EPA 8260B/C; EPA 624	Bromochloromethane
GC/MS	EPA 8260B/C; EPA 624	Bromodichloromethane
GC/MS	EPA 8260B/C; EPA 624	Bromoform
GC/MS	EPA 8260B/C; EPA 624	Bromomethane
GC/MS	EPA 8260B/C; EPA 624	Carbon Disulfide
GC/MS	EPA 8260B/C; EPA 624	Carbon Tetrachloride
GC/MS	EPA 8260B/C; EPA 624	Chlorobenzene

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8260B/C; EPA 624	Chloroethane
GC/MS	EPA 8260B/C; EPA 624	Chloroform
GC/MS	EPA 8260B/C; EPA 624	Chloromethane
GC/MS	EPA 8260B/C; EPA 624	Chloroprene
GC/MS	EPA 8260B/C; EPA 624	cis-1,2-Dichloroethene (cis-1,2-DCE)
GC/MS	EPA 8260B/C; EPA 624	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/C; EPA 624	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C; EPA 624	Cyclohexane
GC/MS	EPA 8260B/C; EPA 624	Dibromochloromethane
GC/MS	EPA 8260B/C; EPA 624	Dibromomethane
GC/MS	EPA 8260B/C; EPA 624	Dichlorodifluoromethane (CFC-12)
GC/MS	EPA 8260B/C; EPA 624	Diethyl ether
GC/MS	EPA 8260B/C; EPA 624	Di-isopropyl ether
GC/MS	EPA 8260B/C; EPA 624	Ethyl tert-butyl ether (ETBE)
GC/MS	EPA 8260B/C; EPA 624	Ethyl methacrylate
GC/MS	EPA 8260B/C; EPA 624	Ethylbenzene
GC/MS	EPA 8260B/C; EPA 624	Hexachlorobutadiene
GC/MS	EPA 8260B/C; EPA 624	Hexane
GC/MS	EPA 8260B/C; EPA 624	Iodomethane
GC/MS	EPA 8260B/C; EPA 624	Isobutyl alcohol
GC/MS	EPA 8260B/C; EPA 624	Isopropylbenzene (Cumene)
GC/MS	EPA 8260B/C; EPA 624	m,p-Xylenes
GC/MS	EPA 8260B/C; EPA 624	Methacrylonitrile
GC/MS	EPA 8260B/C; EPA 624	Methyl Acetate
GC/MS	EPA 8260B/C; EPA 624	Methyl methacrylate
GC/MS	EPA 8260B/C; EPA 624	Methyl tert-Butyl Ether (MTBE)
GC/MS	EPA 8260B/C; EPA 624	Methylcyclohexane
GC/MS	EPA 8260B/C; EPA 624	Methylene Chloride, or Dichloromethane
GC/MS	EPA 8260B/C; EPA 624	Naphthalene
GC/MS	EPA 8260B/C; EPA 624	n-Butylbenzene

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8260B/C; EPA 624	n-Propylbenzene
GC/MS	EPA 8260B/C; EPA 624	o-Xylene
GC/MS	EPA 8260B/C; EPA 624	p-Isopropyltoluene
GC/MS	EPA 8260B/C; EPA 624	Propionitrile
GC/MS	EPA 8260B/C; EPA 624	sec-Butylbenzene
GC/MS	EPA 8260B/C; EPA 624	Styrene
GC/MS	EPA 8260B/C; EPA 624	tert-Amyl alcohol
GC/MS	EPA 8260B/C; EPA 624	tert-Butyl alcohol
GC/MS	EPA 8260B/C; EPA 624	tert-Amyl methyl ether
GC/MS	EPA 8260B/C; EPA 624	tert-Butylbenzene
GC/MS	EPA 8260B/C; EPA 624	Tetrachloroethene (PCE; PERC)
GC/MS	EPA 8260B/C; EPA 624	Tetrahydrofuran
GC/MS	EPA 8260B/C; EPA 624	Toluene
GC/MS	EPA 8260B/C; EPA 624	trans-1,2-Dichloroethene (trans-1,2-DCE)
GC/MS	EPA 8260B/C; EPA 624	trans-1,3-Dichloropropene
GC/MS	EPA 8260B/C; EPA 624	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C; EPA 624	Trichloroethene (TCE)
GC/MS	EPA 8260B/C; EPA 624	Trichlorofluoromethane (CFC-11)
GC/MS	EPA 8260B/C; EPA 624	Vinyl acetate
GC/MS	EPA 8260B/C; EPA 624	Vinyl Chloride (VC)
GC/MS	EPA 8260B/C; EPA 624	Xylenes (Total)
GC/MS	EPA 8270C/D; EPA 625	1,1'-Biphenyl
GC/MS	EPA 8270C/D; EPA 625	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C/D; EPA 625	1,2,4-Trichlorobenzene
GC/MS	EPA 8270C/D; EPA 625	1,2-Dichlorobenzene
GC/MS	EPA 8270C/D; EPA 625	1,2-Diphenylhydrazine
GC/MS	EPA 8270C/D; EPA 625	1,3-Dichlorobenzene
GC/MS	EPA 8270C/D; EPA 625	1,4-Dichlorobenzene
GC/MS	EPA 8270C/D; EPA 625	1,4-Dioxane
GC/MS	EPA 8270C/D; EPA 625	1-Methylnaphthalene

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D; EPA 625	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C/D; EPA 625	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/D; EPA 625	2,4,6-Trichlorophenol (TCP)
GC/MS	EPA 8270C/D; EPA 625	2,4-Dichlorophenol (DCP)
GC/MS	EPA 8270C/D; EPA 625	2,4-Dimethylphenol
GC/MS	EPA 8270C/D; EPA 625	2,4-Dinitrophenol
GC/MS	EPA 8270C/D; EPA 625	2,4-Dinitrotoluene (DNT)
GC/MS	EPA 8270C/D; EPA 625	2,6-Dichlorophenol
GC/MS	EPA 8270C/D; EPA 625	2,6-Dinitrotoluene
GC/MS	EPA 8270C/D; EPA 625	2-Chloronaphthalene
GC/MS	EPA 8270C/D; EPA 625	2-Chlorophenol
GC/MS	EPA 8270C/D; EPA 625	2-Methylnaphthalene
GC/MS	EPA 8270C/D; EPA 625	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270C/D; EPA 625	2-Nitroaniline
GC/MS	EPA 8270C/D; EPA 625	2-Nitrophenol (ONP)
GC/MS	EPA 8270C/D; EPA 625	3,3'-Dichlorobenzidine (DCB)
GC/MS	EPA 8270C/D; EPA 625	3-Methylphenol/4-Methylphenol
GC/MS	EPA 8270C/D; EPA 625	3-Nitroaniline
GC/MS	EPA 8270C/D; EPA 625	4,6-Dinitro-2-methylphenol (DNOC)
GC/MS	EPA 8270C/D; EPA 625	4-Bromophenyl phenyl ether
GC/MS	EPA 8270C/D; EPA 625	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D; EPA 625	4-Chloroaniline
GC/MS	EPA 8270C/D; EPA 625	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270C/D; EPA 625	4-Methylphenol (p-Cresol)
GC/MS	EPA 8270C/D; EPA 625	4-Nitroaniline (PNA)
GC/MS	EPA 8270C/D; EPA 625	4-Nitrophenol (PNP)
GC/MS	EPA 8270C/D; EPA 625	Acenaphthene
GC/MS	EPA 8270C/D; EPA 625	Acenaphthylene
GC/MS	EPA 8270C/D; EPA 625	Acetophenone
GC/MS	EPA 8270C/D; EPA 625	Aniline

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D; EPA 625	Anthracene
GC/MS	EPA 8270C/D; EPA 625	Atrazine
GC/MS	EPA 8270C/D; EPA 625	Benzaldehyde
GC/MS	EPA 8270C/D; EPA 625	Benzidine
GC/MS	EPA 8270C/D; EPA 625	Benzo(a)anthracene
GC/MS	EPA 8270C/D; EPA 625	Benzo(a)pyrene
GC/MS	EPA 8270C/D; EPA 625	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D; EPA 625	Benzo(g,h,i)perylene
GC/MS	EPA 8270C/D; EPA 625	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D; EPA 625	Benzoic Acid
GC/MS	EPA 8270C/D; EPA 625	Benzyl Alcohol
GC/MS	EPA 8270C/D; EPA 625	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270C/D; EPA 625	bis(2-Chloroethyl)ether (BCEE)
GC/MS	EPA 8270C/D; EPA 625	bis(2-chloroisopropyl)ether, or 2,2'-oxybis(1-Chloropropane)
GC/MS	EPA 8270C/D; EPA 625	bis(2-Ethylhexyl)phthalate (BEHP)
GC/MS	EPA 8270C/D; EPA 625	Butyl benzyl phthalate (BBP)
GC/MS	EPA 8270C/D; EPA 625	Caprolactam
GC/MS	EPA 8270C/D; EPA 625	Carbazole
GC/MS	EPA 8270C/D; EPA 625	Chrysene
GC/MS	EPA 8270C/D; EPA 625	Dibenz(a,h)anthracene
GC/MS	EPA 8270C/D; EPA 625	Dibenzofuran (DBF)
GC/MS	EPA 8270C/D; EPA 625	Diethyl phthalate (DEP)
GC/MS	EPA 8270C/D; EPA 625	Dimethyl phthalate (DMP)
GC/MS	EPA 8270C/D; EPA 625	Di-n-butyl phthalate (DBP)
GC/MS	EPA 8270C/D; EPA 625	Di-n-octyl phthalate (DNOP)
GC/MS	EPA 8270C/D; EPA 625	Fluoranthene
GC/MS	EPA 8270C/D; EPA 625	Fluorene
GC/MS	EPA 8270C/D; EPA 625	Hexachlorobenzene (HCB)
GC/MS	EPA 8270C/D; EPA 625	Hexachlorobutadiene (HCBd)
GC/MS	EPA 8270C/D; EPA 625	Hexachlorocyclopentadiene (HCCPD)

Non-Potable Water		
Technology	Method	Analyte
GC/MS	EPA 8270C/D; EPA 625	Hexachloroethane (HCE)
GC/MS	EPA 8270C/D; EPA 625	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C/D; EPA 625	Isophorone
GC/MS	EPA 8270C/D; EPA 625	Naphthalene
GC/MS	EPA 8270C/D; EPA 625	Nitrobenzene
GC/MS	EPA 8270C/D; EPA 625	N-Nitrosodimethylamine
GC/MS	EPA 8270C/D; EPA 625	N-Nitroso-di-n-propylamine (NDPA)
GC/MS	EPA 8270C/D; EPA 625	N-nitrosodiphenylamine (NDPHA)
GC/MS	EPA 8270C/D; EPA 625	Pentachlorophenol
GC/MS	EPA 8270C/D; EPA 625	Phenanthrene
GC/MS	EPA 8270C/D; EPA 625	Phenol
GC/MS	EPA 8270C/D; EPA 625	Pyrene
GC/MS	EPA 8270C/D; EPA 625	Pyridine
GC/ECD	EPA 8081A/B	4,4'-DDD
GC/ECD	EPA 8081A/B	4,4'-DDE
GC/ECD	EPA 8081A/B	4,4'-DDT
GC/ECD	EPA 8081A/B	Aldrin
GC/ECD	EPA 8081A/B	alpha-BHC (alpha-HCH)
GC/ECD	EPA 8081A/B	alpha-Chlordane
GC/ECD	EPA 8081A/B	beta-BHC (beta-HCH)
GC/ECD	EPA 8081A/B	delta-BHC (delta-HCH)
GC/ECD	EPA 8081A/B	Dieldrin
GC/ECD	EPA 8081A/B	Endosulfan I
GC/ECD	EPA 8081A/B	Endosulfan II
GC/ECD	EPA 8081A/B	Endosulfan sulfate
GC/ECD	EPA 8081A/B	Endrin
GC/ECD	EPA 8081A/B	Endrin aldehyde
GC/ECD	EPA 8081A/B	Endrin ketone
GC/ECD	EPA 8081A/B	gamma-BHC (Lindane; gamma-HCH)
GC/ECD	EPA 8081A/B	gamma-Chlordane

Non-Potable Water		
Technology	Method	Analyte
GC/ECD	EPA 8081A/B	Heptachlor
GC/ECD	EPA 8081A/B	Heptachlor epoxide
GC/ECD	EPA 8081A/B	Methoxychlor
GC/ECD	EPA 8081A/B	Chlordane (n.o.s.)
GC/ECD	EPA 8081A/B	Toxaphene
GC/ECD	EPA 8082A	Aroclor-1016
GC/ECD	EPA 8082A	Aroclor-1221
GC/ECD	EPA 8082A	Aroclor-1232
GC/ECD	EPA 8082A	Aroclor-1242
GC/ECD	EPA 8082A	Aroclor-1248
GC/ECD	EPA 8082A	Aroclor-1254
GC/ECD	EPA 8082A	Aroclor-1260
GC/ECD	EPA 8082A	Aroclor-1262
GC/ECD	EPA 8082A	Aroclor-1268
GC/ECD	EPA 8151A	2,4,5-T
GC/ECD	EPA 8151A	2,4,5-TP (Silvex)
GC/ECD	EPA 8151A	2,4-D
GC/ECD	EPA 8151A	2,4-DB
GC/ECD	EPA 8151A	Dalapon
GC/ECD	EPA 8151A	Dicamba
GC/ECD	EPA 8151A	Dichlorprop
GC/ECD	EPA 8151A	Dinoseb
GC/ECD	EPA 8151A	MCPA
GC/ECD	EPA 8151A	MCPP (Mecoprop)
HPLC/UV	EPA 8330A/B	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330A/B	1,3-Dinitrobenzene
HPLC/UV	EPA 8330A/B	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	EPA 8330A/B	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	EPA 8330A/B	2,6-Dinitrotoluene (DNT)
HPLC/UV	EPA 8330A/B	2,6-Dinitrotoluene

Non-Potable Water		
Technology	Method	Analyte
HPLC/UV	EPA 8330A/B	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330A/B	2-Nitrotoluene (ONT)
HPLC/UV	EPA 8330A/B	3,5-Dinitroaniline
HPLC/UV	EPA 8330A/B	3-Nitrotoluene
HPLC/UV	EPA 8330A/B	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330A/B	4-Nitrotoluene (PNT)
HPLC/UV	EPA 8330A/B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	EPA 8330A/B	Nitrobenzene
HPLC/UV	EPA 8330A/B	Nitroglycerin
HPLC/UV	EPA 8330A/B	Nitroguanidine
HPLC/UV	EPA 8330A/B	Octahydro-1,3,5,6-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330A/B	3,5-Dinitroaniline
HPLC/UV	EPA 8330A/B	PETN
GC/FID	FL PRO	Petroleum Range Organics
GC/FID	EPA 8015B/C	TPH DRO
GC/FID	EPA 8015B/C	TPH ORO
GC/FID	EPA 8015B/C	TPH GRO
GC/FID	RSK-175	Methane
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/ECD	EPA 8011	1,2-Dibromoethane (EDB)
GC/ECD	EPA 8011	1,2-Dibromo-3-chloropropane (DBCP)
HPLC/MS	EPA 6850	Perchlorate
ICP	EPA 6010B/C; EPA 200.7	Aluminum
ICP	EPA 6010B/C; EPA 200.7	Antimony
ICP	EPA 6010B/C; EPA 200.7	Arsenic
ICP	EPA 6010B/C; EPA 200.7	Barium
ICP	EPA 6010B/C; EPA 200.7	Beryllium

Non-Potable Water		
Technology	Method	Analyte
ICP	EPA 6010B/C; EPA 200.7	Boron
ICP	EPA 6010B/C; EPA 200.7	Cadmium
ICP	EPA 6010B/C; EPA 200.7	Calcium
ICP	EPA 6010B/C; EPA 200.7	Chromium, total
ICP	EPA 6010B/C; EPA 200.7	Cobalt
ICP	EPA 6010B/C; EPA 200.7	Copper
ICP	EPA 6010B/C; EPA 200.7	Iron
ICP	EPA 6010B/C; EPA 200.7	Lead
ICP	EPA 6010B/C; EPA 200.7	Magnesium
ICP	EPA 6010B/C; EPA 200.7	Manganese
CVAA	EPA 7470A; EPA 245.1	Mercury
ICP	EPA 6010B/C; EPA 200.7	Molybdenum
ICP	EPA 6010B/C; EPA 200.7	Nickel
ICP	EPA 6010B/C; EPA 200.7	Potassium
ICP	EPA 6010B/C; EPA 200.7	Selenium
ICP	EPA 6010B/C; EPA 200.7	Silver
ICP	EPA 6010B/C; EPA 200.7	Sodium
ICP	EPA 6010B/C; EPA 200.7	Strontium
ICP	EPA 6010B/C; EPA 200.7	Thallium
ICP	EPA 6010B/C; EPA 200.7	Tin
ICP	EPA 6010B/C; EPA 200.7	Titanium

Non-Potable Water		
Technology	Method	Analyte
ICP	EPA 6010B/C; EPA 200.7	Vanadium
ICP	EPA 6010B/C; EPA 200.7	Zinc
ICP	SM 2340 B-2011; EPA 200.7; EPA 6010C	Hardness
IC	EPA 300.0	Bromide
IC	EPA 300.0	Chloride
IC	EPA 300.0	Fluoride
IC	EPA 300.0	Nitrate
IC	EPA 300.0	Nitrite
IC	EPA 300.0	Sulfate
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate
Titration	SM 2320 B-2011	Alkalinity
Colorimetric	SM 4500 NH3 G-2011	Ammonia
Probe	SM 5210 B-2011	BOD
Probe	SM 5210 B-2011	CBOD
Colorimetric	EPA 410.4	COD
Colorimetric	EPA 9012A/B SM 4500 CN G-2011	Cyanide
UV/Vis	EPA 7196A SM 3500 Cr B-2011	Hexavalent Chromium
Physical	EPA 1010A	Ignitability / Flashpoint
Colorimetric	EPA 353.2	Nitrate/Nitrite
Colorimetric	EPA 353.2 MOD	Nitrocellulose
Colorimetric	SM 4500 NO2 B-2011	Nitrite as N
Gravimetric	EPA 1664A	Oil and Grease
Physical	EPA 9095B	Paint Filter

Non-Potable Water		
Technology	Method	Analyte
Probe	EPA 9040B/C SM 4500 H+ B-2011	pH(Corrosivity)
Titration	Chap.7, Sect. 7.3.4 Mod.	Reactive Sulfide
Titration	SM 4500 S2 F-2011	Sulfide
UV/Vis	SM 4500 P B5-2011	Total Phosphorus (as P)
UV/Vis	SM 4500 P E-2011	Ortho-Phosphate (as P)
TOC	EPA 9060A; SM 5310 C-2011	Total Organic Carbon
Gravimetric	SM 2540 C-2011	TDS
Gravimetric	SM 2540 D-2011	TSS
Preparation	Method	Type
Preparation	EPA 1311	TCLP
Preparation	EPA 3005A	Metals digestion
Preparation	EPA 3010A	Metals digestion
Preparation	EPA 3510C	Organics Liquid Extraction
Preparation	EPA 5030A/B	Purge and Trap Water

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8260B/C	1,1,1-Trichloroethane (1,1,1-TCA)
GC/MS	EPA 8260B/C	1,1,1,2-Tetrachloroethane
GC/MS	EPA 8260B/C	1,1,2,2-Tetrachloroethane
GC/MS	EPA 8260B/C	1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)
GC/MS	EPA 8260B/C	1,1,2-Trichloroethane
GC/MS	EPA 8260B/C	1,1-Dichloroethane (1,1-DCA)
GC/MS	EPA 8260B/C	1,1-Dichloroethene (1,1-DCE)
GC/MS	EPA 8260B/C	1,1-Dichloropropene
GC/MS	EPA 8260B/C	1,2,3-Trichlorobenzene
GC/MS	EPA 8260B/C	1,2,3-Trichloropropane
GC/MS	EPA 8260B/C	1,2,4-Trichlorobenzene

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8260B/C	1,2,4-Trimethylbenzene
GC/MS	EPA 8260B/C	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	EPA 8260B/C	1,2-Dibromoethane (EDB)
GC/MS	EPA 8260B/C	1,2-Dichlorobenzene
GC/MS	EPA 8260B/C	1,2-Dichloroethane (EDC)
GC/MS	EPA 8260B/C	1,2-Dichloropropane
GC/MS	EPA 8260B/C	1,3,5-Trichlorobenzene
GC/MS	EPA 8260B/C	1,3,5-Trimethylbenzene
GC/MS	EPA 8260B/C	1,3-Dichlorobenzene
GC/MS	EPA 8260B/C	1,3-Dichloropropane
GC/MS	EPA 8260B/C	1,4-Dichlorobenzene
GC/MS	EPA 8260B/C	1,4-Dioxane
GC/MS	EPA 8260B/C	1-Chlorohexane
GC/MS	EPA 8260B/C	2,2-Dichloropropane
GC/MS	EPA 8260B/C	2-Butanone (Methyl ethyl ketone; MEK)
GC/MS	EPA 8260B/C	2-Chloroethyl vinyl ether
GC/MS	EPA 8260B/C	2-Chlorotoluene
GC/MS	EPA 8260B/C	2-Hexanone (Methyl butyl ketone; MBK)
GC/MS	EPA 8260B/C	4-Chlorotoluene
GC/MS	EPA 8260B/C	4-Methyl-2-pentanone (Methyl isobutyl ketone; MIBK)
GC/MS	EPA 8260B/C	Acetone
GC/MS	EPA 8260B/C	Acetonitrile
GC/MS	EPA 8260B/C	Acrolein
GC/MS	EPA 8260B/C	Acrylonitrile
GC/MS	EPA 8260B/C	Allyl chloride
GC/MS	EPA 8260B/C	Benzene
GC/MS	EPA 8260B/C	Bromobenzene
GC/MS	EPA 8260B/C	Bromochloromethane
GC/MS	EPA 8260B/C	Bromodichloromethane
GC/MS	EPA 8260B/C	Bromoform

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8260B/C	Bromomethane
GC/MS	EPA 8260B/C	Carbon Disulfide
GC/MS	EPA 8260B/C	Carbon Tetrachloride
GC/MS	EPA 8260B/C	Chlorobenzene
GC/MS	EPA 8260B/C	Chloroethane
GC/MS	EPA 8260B/C	Chloroform
GC/MS	EPA 8260B/C	Chloromethane
GC/MS	EPA 8260B/C	Chloroprene
GC/MS	EPA 8260B/C	cis-1,2-Dichloroethene (cis-1,2-DCE)
GC/MS	EPA 8260B/C	cis-1,3-Dichloropropene
GC/MS	EPA 8260B/C	cis-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	Cyclohexane
GC/MS	EPA 8260B/C	Dibromochloromethane
GC/MS	EPA 8260B/C	Dibromomethane
GC/MS	EPA 8260B/C	Dichlorodifluoromethane (CFC-12)
GC/MS	EPA 8260B/C	Diethyl ether
GC/MS	EPA 8260B/C	Di-isopropyl ether
GC/MS	EPA 8260B/C	Ethyl methacrylate
GC/MS	EPA 8260B/C	Ethyl tert-butyl ether (ETBE)
GC/MS	EPA 8260B/C	Ethylbenzene
GC/MS	EPA 8260B/C	Hexachlorobutadiene
GC/MS	EPA 8260B/C	Hexane
GC/MS	EPA 8260B/C	Iodomethane
GC/MS	EPA 8260B/C	Isobutyl alcohol
GC/MS	EPA 8260B/C	Isopropylbenzene (Cumene)
GC/MS	EPA 8260B/C	m,p-Xylenes
GC/MS	EPA 8260B/C	Methacrylonitrile
GC/MS	EPA 8260B/C	Methyl Acetate
GC/MS	EPA 8260B/C	Methyl methacrylate
GC/MS	EPA 8260B/C	Methyl Tert-Butyl Ether (MTBE)

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8260B/C	Methylcyclohexane
GC/MS	EPA 8260B/C	Methylene Chloride, or Dichloromethane
GC/MS	EPA 8260B/C	Naphthalene
GC/MS	EPA 8260B/C	n-Butylbenzene
GC/MS	EPA 8260B/C	n-Propylbenzene
GC/MS	EPA 8260B/C	o-Xylene
GC/MS	EPA 8260B/C	p-Isopropyltoluene
GC/MS	EPA 8260B/C	Propionitrile
GC/MS	EPA 8260B/C	sec-Butylbenzene
GC/MS	EPA 8260B/C	Styrene
GC/MS	EPA 8260B/C	tert-Amyl alcohol
GC/MS	EPA 8260B/C	Tert-Amyl ethyl ether
GC/MS	EPA 8260B/C	tert-Amyl methyl ether
GC/MS	EPA 8260B/C	tert-Butyl alcohol
GC/MS	EPA 8260B/C	tert-Butylbenzene
GC/MS	EPA 8260B/C	Tetrachloroethene (PCE; PERC)
GC/MS	EPA 8260B/C	Tetrahydrofuran
GC/MS	EPA 8260B/C	Toluene
GC/MS	EPA 8260B/C	trans-1,2-Dichloroethene (trans-1,2-DCE)
GC/MS	EPA 8260B/C	trans-1,3-Dichloropropene
GC/MS	EPA 8260B/C	trans-1,4-Dichloro-2-butene
GC/MS	EPA 8260B/C	Trichloroethene (TCE)
GC/MS	EPA 8260B/C	Trichlorofluoromethane (CFC-11)
GC/MS	EPA 8260B/C	Vinyl acetate
GC/MS	EPA 8260B/C	Vinyl Chloride (VC)
GC/MS	EPA 8260B/C	Xylenes (Total)
GC/MS	EPA 8270C/D	1,1'-Biphenyl
GC/MS	EPA 8270C/D	1,2,4,5-Tetrachlorobenzene
GC/MS	EPA 8270C/D	1,2,4-Trichlorobenzene
GC/MS	EPA 8270C/D	1,2-Dichlorobenzene

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	1,2-Diphenylhydrazine
GC/MS	EPA 8270C/D	1,3-Dichlorobenzene
GC/MS	EPA 8270C/D	1,4-Dichlorobenzene
GC/MS	EPA 8270C/D	1,4-Dioxane
GC/MS	EPA 8270C/D	1-Methylnaphthalene
GC/MS	EPA 8270C/D	2,3,4,6-Tetrachlorophenol
GC/MS	EPA 8270C/D	2,4,5-Trichlorophenol
GC/MS	EPA 8270C/D	2,4,6-Trichlorophenol (TCP)
GC/MS	EPA 8270C/D	2,4-Dichlorophenol (DCP)
GC/MS	EPA 8270C/D	2,4-Dimethylphenol
GC/MS	EPA 8270C/D	2,4-Dinitrophenol
GC/MS	EPA 8270C/D	2,4-Dinitrotoluene (DNT)
GC/MS	EPA 8270C/D	2,6-Dichlorophenol
GC/MS	EPA 8270C/D	2,6-Dinitrotoluene
GC/MS	EPA 8270C/D	2-Chloronaphthalene
GC/MS	EPA 8270C/D	2-Chlorophenol
GC/MS	EPA 8270C/D	2-Methylnaphthalene
GC/MS	EPA 8270C/D	2-Methylphenol (o-Cresol)
GC/MS	EPA 8270C/D	2-Nitroaniline
GC/MS	EPA 8270C/D	2-Nitrophenol (ONP)
GC/MS	EPA 8270C/D	3,3'-Dichlorobenzidine (DCB)
GC/MS	EPA 8270C/D	3-Methylphenol/4-Methylphenol
GC/MS	EPA 8270C/D	3-Nitroaniline
GC/MS	EPA 8270C/D	4,6-Dinitro-2-methylphenol (DNOC)
GC/MS	EPA 8270C/D	4-Bromophenyl phenyl ether
GC/MS	EPA 8270C/D	4-Chloro-3-methylphenol
GC/MS	EPA 8270C/D	4-Chloroaniline
GC/MS	EPA 8270C/D	4-Chlorophenyl phenyl ether
GC/MS	EPA 8270C/D	4-Methylphenol (p-Cresol)
GC/MS	EPA 8270C/D	4-Nitroaniline (PNA)

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	4-Nitrophenol (PNP)
GC/MS	EPA 8270C/D	Acenaphthene
GC/MS	EPA 8270C/D	Acenaphthylene
GC/MS	EPA 8270C/D	Acetophenone
GC/MS	EPA 8270C/D	Aniline
GC/MS	EPA 8270C/D	Anthracene
GC/MS	EPA 8270C/D	Atrazine
GC/MS	EPA 8270C/D	Benzaldehyde
GC/MS	EPA 8270C/D	Benzidine
GC/MS	EPA 8270C/D	Benzo(a)anthracene
GC/MS	EPA 8270C/D	Benzo(a)pyrene
GC/MS	EPA 8270C/D	Benzo(b)fluoranthene
GC/MS	EPA 8270C/D	Benzo(g,h,i)perylene
GC/MS	EPA 8270C/D	Benzo(k)fluoranthene
GC/MS	EPA 8270C/D	Benzoic Acid
GC/MS	EPA 8270C/D	Benyl alcohol
GC/MS	EPA 8270C/D	bis(2-Chloroethoxy)methane
GC/MS	EPA 8270C/D	bis(2-Chloroethyl)ether (BCEE)
GC/MS	EPA 8270C/D	bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)
GC/MS	EPA 8270C/D	bis(2-Ethylhexyl)phthalate (BEHP)
GC/MS	EPA 8270C/D	Butyl benzyl phthalate (BBP)
GC/MS	EPA 8270C/D	Caprolactam
GC/MS	EPA 8270C/D	Carbazole
GC/MS	EPA 8270C/D	Chrysene
GC/MS	EPA 8270C/D	Dibenz(a,h)anthracene
GC/MS	EPA 8270C/D	Dibenzofuran (DBF)
GC/MS	EPA 8270C/D	Diethyl phthalate (DEP)
GC/MS	EPA 8270C/D	Dimethyl phthalate (DMP)
GC/MS	EPA 8270C/D	Di-n-butyl phthalate (DBP)

Solid and Chemical Materials		
Technology	Method	Analyte
GC/MS	EPA 8270C/D	Di-n-octyl phthalate (DNOP)
GC/MS	EPA 8270C/D	Fluoranthene
GC/MS	EPA 8270C/D	Fluorene
GC/MS	EPA 8270C/D	Hexachlorobenzene (HCB)
GC/MS	EPA 8270C/D	Hexachlorobutadiene (HCBd)
GC/MS	EPA 8270C/D	Hexachlorocyclopentadiene (HCCPD)
GC/MS	EPA 8270C/D	Hexachloroethane (HCE)
GC/MS	EPA 8270C/D	Indeno(1,2,3-cd)pyrene
GC/MS	EPA 8270C/D	Isophorone
GC/MS	EPA 8270C/D	Naphthalene
GC/MS	EPA 8270C/D	Nitrobenzene
GC/MS	EPA 8270C/D	N-Nitrosodimethylamine
GC/MS	EPA 8270C/D	N-Nitroso-di-n-propylamine (NDPA)
GC/MS	EPA 8270C/D	N-nitrosodiphenylamine (NDPHA)
GC/MS	EPA 8270C/D	Pentachlorophenol
GC/MS	EPA 8270C/D	Phenanthrene
GC/MS	EPA 8270C/D	Phenol
GC/MS	EPA 8270C/D	Pyrene
GC/MS	EPA 8270C/D	Pyridine
GC/ECD	EPA 8081A/B	4,4'-DDD
GC/ECD	EPA 8081A/B	4,4'-DDE
GC/ECD	EPA 8081A/B	4,4'-DDT
GC/ECD	EPA 8081A/B	Aldrin
GC/ECD	EPA 8081A/B	alpha-BHC (alpha-HCH)
GC/ECD	EPA 8081A/B	alpha-Chlordane
GC/ECD	EPA 8081A/B	beta-BHC (beta-HCH)
GC/ECD	EPA 8081A/B	delta-BHC (delta-HCH)
GC/ECD	EPA 8081A/B	Chlordane (n.o.s.)
GC/ECD	EPA 8081A/B	Dieldrin
GC/ECD	EPA 8081A/B	Endosulfan I

Solid and Chemical Materials		
Technology	Method	Analyte
GC/ECD	EPA 8081A/B	Endosulfan II
GC/ECD	EPA 8081A/B	Endosulfan sulfate
GC/ECD	EPA 8081A/B	Endrin
GC/ECD	EPA 8081A/B	Endrin aldehyde
GC/ECD	EPA 8081A/B	Endrin ketone
GC/ECD	EPA 8081A/B	gamma-BHC (Lindane; gamma-HCH)
GC/ECD	EPA 8081A/B	gamma-Chlordane
GC/ECD	EPA 8081A/B	Heptachlor
GC/ECD	EPA 8081A/B	Heptachlor epoxide
GC/ECD	EPA 8081A/B	Methoxychlor
GC/ECD	EPA 8081A/B	Toxaphene
GC/ECD	EPA 8082A	Aroclor-1016
GC/ECD	EPA 8082A	Aroclor-1221
GC/ECD	EPA 8082A	Aroclor-1232
GC/ECD	EPA 8082A	Aroclor-1242
GC/ECD	EPA 8082A	Aroclor-1248
GC/ECD	EPA 8082A	Aroclor-1254
GC/ECD	EPA 8082A	Aroclor-1260
GC/ECD	EPA 8082A	Aroclor-1262
GC/ECD	EPA 8082A	Aroclor-1268
HPLC/UV	EPA 8330A	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330A	1,3-Dinitrobenzene
HPLC/UV	EPA 8330A	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	EPA 8330A	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	EPA 8330A	2,4-Dinitrotoluene (DNT)
HPLC/UV	EPA 8330A	2,6-Dinitrotoluene
HPLC/UV	EPA 8330A	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330A	2-Nitrotoluene (ONT)
HPLC/UV	EPA 8330A	3-Nitrotoluene
HPLC/UV	EPA 8330A	3,5-Dinitroaniline

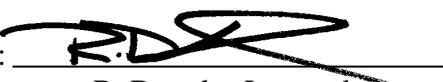
Solid and Chemical Materials		
Technology	Method	Analyte
HPLC/UV	EPA 8330A	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330A	4-Nitrotoluene (PNT)
HPLC/UV	EPA 8330A	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	EPA 8330A	Nitroglycerin
HPLC/UV	EPA 8330A	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330A	Nitrobenzene
HPLC/UV	EPA 8330A	Nitroguanidine
HPLC/UV	EPA 8330A	PETN
HPLC/UV	EPA 8330B	1,3,5-Trinitrobenzene
HPLC/UV	EPA 8330B	1,3-Dinitrobenzene
HPLC/UV	EPA 8330B	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	EPA 8330B	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	EPA 8330B	2,4-Dinitrotoluene (DNT)
HPLC/UV	EPA 8330B	2,6-Dinitrotoluene
HPLC/UV	EPA 8330B	2-Amino-4,6-dinitrotoluene
HPLC/UV	EPA 8330B	2-Nitrotoluene (ONT)
HPLC/UV	EPA 8330B	3-Nitrotoluene
HPLC/UV	EPA 8330B	3,5-Dinitroaniline
HPLC/UV	EPA 8330B	4-Amino-2,6-dinitrotoluene
HPLC/UV	EPA 8330B	4-Nitrotoluene (PNT)
HPLC/UV	EPA 8330B	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	EPA 8330B	Nitroglycerin
HPLC/UV	EPA 8330B	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	EPA 8330B	Nitrobenzene
HPLC/UV	EPA 8330B	Nitroguanidine
HPLC/UV	EPA 8330B	PETN
GC/FID	FL PRO	Petroleum Range Organics
GC/FID	EPA 8015B/C	TPH DRO
GC/FID	EPA 8015B/C	TPH ORO

Solid and Chemical Materials		
Technology	Method	Analyte
GC/FID	EPA 8015B/C	TPH GRO
HPLC/MS	EPA 6850	Perchlorate
ICP	EPA 6010B/C	Aluminum
ICP	EPA 6010B/C	Antimony
ICP	EPA 6010B/C	Arsenic
ICP	EPA 6010B/C	Barium
ICP	EPA 6010B/C	Beryllium
ICP	EPA 6010B/C	Boron
ICP	EPA 6010B/C	Cadmium
ICP	EPA 6010B/C	Calcium
ICP	EPA 6010B/C	Chromium, total
ICP	EPA 6010B/C	Cobalt
ICP	EPA 6010B/C	Copper
ICP	EPA 6010B/C	Iron
ICP	EPA 6010B/C	Lead
ICP	EPA 6010B/C	Magnesium
ICP	EPA 6010B/C	Manganese
ICP	EPA 6010B/C	Molybdenum
ICP	EPA 6010B/C	Nickel
ICP	EPA 6010B/C	Potassium
ICP	EPA 6010B/C	Selenium
ICP	EPA 6010B/C	Silver
ICP	EPA 6010B/C	Sodium
ICP	EPA 6010B/C	Strontium
ICP	EPA 6010B/C	Tin
ICP	EPA 6010B/C	Titanium
ICP	EPA 6010B/C	Thallium
ICP	EPA 6010B/C	Vanadium
ICP	EPA 6010B/C	Zinc
CVAA	EPA 7471A/B	Mercury

Solid and Chemical Materials		
Technology	Method	Analyte
IC	EPA 9056A	Bromide
IC	EPA 9056A	Chloride
IC	EPA 9056A	Fluoride
IC	EPA 9056A	Nitrate
IC	EPA 9056A	Nitrite
IC	EPA 9056A	Sulfate
Colorimetric	EPA 9012A/B	Cyanide
UV/Vis	EPA 7196A	Hexavalent Chromium
Physical	EPA 1010A	Ignitability/Flashpoint
Colorimetric	EPA 353.2 MOD	Nitrocellulose
Probe	EPA 9045C/D	pH (Corrosivity)
Titration	Chap.7, Sect. 7.3.4 Mod.	Reactive Sulfide
Titration	EPA 9034	Sulfide
TOC	Lloyd Kahn	Total Organic Carbon
Preparation	Method	Type
Preparation	EPA 1311	TCLP
Preparation	EPA 1312	SPLP
Preparation	NJ Modified 3060A	Hexavalent Chromium
Preparation	EPA 3050B	Metals Digestion
Preparation	EPA 3546	Organics Microwave Extraction
Preparation	EPA 3550B/C	Organics Sonication
Preparation	SM 2540 B-1997	Percent Solids (Percent Moisture)
Preparation	EPA 5035 /A	Purge and Trap Solid

Notes:

- 1) This laboratory offers commercial testing service.

Approved by: 
 R. Douglas Leonard
 Chief Technical Officer

Date: April 16, 2014

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