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FINAL REVISED SAMPLING AND ANALYSIS PLAN REMEDIAL INVESTIGATION SITE 31
NWS YORKTOWN VA
11/1/2012
CH2M HILL



Final
Revised

Sampling and Analysis Plan Site 31 Remedial Investigation

Naval Weapons Station Yorktown
Yorktown, Virginia

November 2012

SAP Worksheet #1—Title and Approval Page

FINAL

Revised

**Sampling and Analysis Plan
Site 31 Remedial Investigation**

**Naval Weapons Station Yorktown
Yorktown, Virginia**

**Contract Task Order WE 02 and WE 51
November 2012**

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

Under the
**NAVFAC CLEAN 1000 Program
Contract N62470-08-D-1000**

and

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

Prepared by



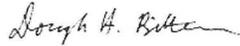
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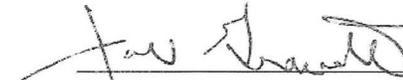
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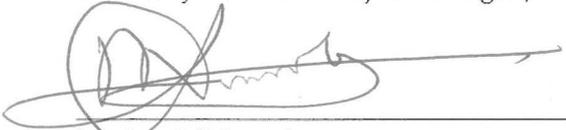
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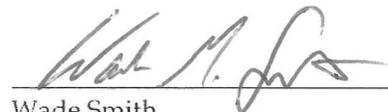


16 Nov 2012

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VDEQ Remedial Project Manager / Date

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Executive Summary

This Sampling and Analysis Plan (SAP) is prepared to support the proposed Remedial Investigation (RI) field activities at Site 31 (formerly Area of Concern [AOC] 23), Barracks Road Industrial Area, at Naval Weapons Station (WPNSTA) Yorktown, Yorktown, Virginia. The purpose of this RI is to collect additional data to allow for adequate characterization of the nature and extent of contamination and an assessment of risks at Site 31.

Site 31 consists of the industrial area located along Barracks Road, upgradient of the Site 12 Landfill. Groundwater associated with this site was characterized as part of the site assessment conducted in 2008. This study is documented in *Final Site Assessment Report, AOC 23, Naval Weapons Station Yorktown, Yorktown, Virginia* (CH2M HILL, 2008). Seeps, sediment, and surface water were also collected as part of the site assessment, and the conclusions of the site assessment report indicated no additional investigation or evaluation would be necessary for these media. However, during the development of this SAP, it was determined that additional investigation would be necessary to address potential contamination in surface water and sediment from an outfall pipe sampled as a seep during the site assessment. Data from the site assessment will be utilized to support the Human Health Risk Assessment (HHRA) and Ecological Risk Assessment (ERA) to be completed as part of this RI. However, additional samples are necessary to characterize soil and vapor in the Site 31 Area and to assess potential risks associated with these media, as no samples of these media were collected during the site assessment. Additional surface water and sediment samples will also be collected in the vicinity of the outfall to evaluate contamination in this area and to aid in completion of the ERA. This work plan provides the sampling strategy for soil, vapor, and the additional surface water and sediment samples to be collected at the site.

This United States Navy (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. This SAP was developed in accordance with two guidance documents:

- *Guidance for Quality Assurance Project Plans, EPA QA/G-5, QAMS* (USEPA, 2002)
- *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP)* (USEPA, 2005)

The Data Quality Objectives (DQOs) were prepared using the United States Environmental Protection Agency (USEPA) seven-step DQO process.

The Navy, Naval Facilities Engineering Command (NAVFAC), Mid-Atlantic Division, is conducting this RI under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). USEPA Region 3 is the lead regulatory agency. This SAP will help ensure that environmental data collected or compiled are scientifically sound, of known and documented quality, and are suitable for intended uses.

Proposed soil sampling for the RI field event consists of collection of 20 surface and 20 subsurface soil samples for analysis of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), explosives, metals, and cyanide (CN). Proposed vapor samples consist of 29 sub-slab samples to be collected beneath the seven buildings within

the area of impacted groundwater, ten indoor air samples to be collected within Sheds 3 and 6 above the soil source area discovered during the site assessment, and ambient and background air samples to be collected for comparison to site data. All air samples will be analyzed for VOCs determined to be potential vapor risks based on modeling completed using groundwater and subsurface soil data collected during the site assessment. Additional co-located surface water and sediment samples will be collected upgradient of the outfall (one set of co-located samples), at the point of discharge (one set of samples), and downstream of the discharge (three sets of samples). Data to be collected as part of this RI field event will be used in conjunction with the data collected during the site assessment to support risk assessments for current and future receptors. The ERA to be completed will consider surface water, sediment, and seeps samples only, because there is no complete exposure pathway to soil for ecological receptors due to the industrial nature of the site.

This SAP consists of 37 worksheets, and all tables are embedded within the worksheets. Figures are included at the end of worksheets. Field standard operating procedures (SOPs) are included as **Appendix A**, groundwater data collected during previous investigations to be used in the risk assessment is included as **Appendix B**, the laboratory Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) letters are included as **Appendix C**, and data management documentation is included as **Appendix D**.

Executive Summary Update

Upon review of the initial RI investigation results, additional data was recommended to fully characterize the site and support the RI and FS reports.

During the vapor intrusion (VI) sampling, subslab soil vapor and indoor air concentrations of VOCs exceeded the screening levels. A potential source area in the vicinity of Sheds 3 and 6 was suspected based on high subslab soil vapor results. Concentrations of VOCs were identified in surface water samples collected downstream of the site. As a result of the initial investigation, the following associated work is required:

- Characterize the source area. This work will be accomplished utilizing a membrane interface probe (MIP) investigation. This investigation will include up to 20 MIP locations and collection of up to 10 subsurface soil samples. Like the initial RI, soil samples will be analyzed for VOCs, SVOCs, explosives, metals, and CN. Additionally, samples will be analyzed for pesticides and polychlorinated biphenyls (PCBs) because these contaminants have not previously been evaluated in soil.
- Better delineate the groundwater plume. This work will be accomplished by installing one new shallow monitoring well near the source area once it is identified, installing two new shallow monitoring wells to confirming the plume boundary (near Buildings 371 and 687), and collection of another round of groundwater samples from these three new shallow monitoring wells and 24 existing shallow monitoring wells. All samples will be analyzed for VOCs, the main contaminant at the site, as well as pesticides and PCBs since these contaminants have not yet been evaluated in groundwater. Samples collected from the three new wells will also be analyzed for explosives, metals, and CN to confirm, as was previously confirmed from sampling existing monitoring wells, that these contaminants are not an issue at the site.

- Determine the downgradient extent of VOCs in a nearby unnamed tributary to Ballard Creek. This work will be accomplished by collecting up to six surface water and sediment samples where previous sampling identified impacts from site related VOCs. Samples will be analyzed for select VOCs.

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17	Supplemental RI Surface Water and Sediment Sampling Locations
18	Supplemental RI Groundwater Sample Locations

Abbreviations and Acronyms

3R	recognize, retreat, report
AM	Activity Manager
amu	atomic mass unit
AOC	area of concern
AQM	Activity Quality Manager
BFB	bromofluorobenzene
bgs	below ground surface
°C	degrees Celsius
CA	corrective action
CAS	chemical abstract service
CCC	calibration check compound
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLEAN	Comprehensive Long-term Environmental Action – Navy
CLP	Contract Laboratory Program
CN	cyanide
COC	contaminant of concern
COD	coefficient of determination
COPC	contaminant of potential concern
CSM	conceptual site model
CTO	contract task order
CVAA	cold vapor atomic absorption
DCA	dichloroethane
DCE	dichloroethene
DL	detection limit
DNAPL	dense non-aqueous phase liquid
DNB	dinitrobenzene
DNT	dinitrotoluene
DO	dissolved oxygen
DoD	Department of Defense
DPT	direct push technology
DQI	data quality indicator
DQO	data quality objective
DV	data validator
ECD	electron capture detector
EDD	electronic data deliverable
ELAP	Environmental Laboratory Accreditation Program
ERA	Ecological Risk Assessment

ERP	Environmental Restoration Program
FID	flame ionization detector
FS	feasibility study
FTL	Field Team Leader
FUDS	formerly used defense site
g	gram
GC/MS	gas chromatography/mass spectrometer
GPS	global positioning system
H&S	health and safety
Hg	mercury
HHRA	Human Health Risk Assessment
HMX	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine
HPLC	high performance liquid chromatography
HQ	hazard quotient
HSO	Health and Safety Officer
HSP	Health and Safety Plan
ICAL	initial calibration
ICP	inductively-coupled plasma
ICP-MS	inductively-coupled plasma mass spectrometer
ICS	Interference Check Sample
ICV	initial calibration verification
ID	identification
IDW	investigation-derived waste
IS	internal standard
L	liter
LC/MS/MS	liquid chromatography-mass spectrometry
LCS	laboratory control sample
LIMS	Laboratory Information Management Systems
LOD	limit of detection
LOQ	limit of quantitation
µg/kg	microgram per kilogram
µg/L	micrograms per liter
µg/m ³	micrograms per square meter
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
MIP	membrane interface probe
ml	milliliter
MPC	measurement performance criteria
MS/MSD	matrix spike/matrix spike duplicate
MTBE	methyl-tert-butyl ether
N/A	not applicable
NAVFAC	Naval Facilities Engineering Command
Navy	United States Navy

NC	no criteria
NIRIS	Naval Installation Restoration Information System
NT	nitrotoluene
NTR	Navy Technical Representative
ORP	oxidation reduction potential
oz	ounce
PAL	project action limit
PC	Project Chemist
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PDM	Project Data Manager
PETN	pentaerythritol tetranitrate
PID	photoionization detector
PM	Project Manager
POC	point of contact
ppm	parts per million
PQL	project quantitation limit
PT	proficiency test
QA	quality assurance
QAO	Quality Assurance Officer
QC	quality control
QL	quantitation limit
RDX	hexahydro-1,3,5-trinitro-1,3,5-triazine
RF	response factor
RI	Remedial Investigation
ROD	Record of Decision
RPD	relative percent difference
RPM	Remedial Project Manager
RRT	relative retention time
RSL	regional screening level
RT	retention time
SAP	Sampling and Analysis Plan
SCV	Calibration Verification
SNEDD	Supplemental NIRIS Electronic Data Deliverable
SOP	standard operating procedure
SPCC	system performance check compound
SSA	site screening area
SSL	soil screening level
STP	standard temperature and pressure
SVOC	semivolatile organic compound
TBD	to be determined
TCA	tetrachloroethane
TCE	trichloroethene

UFP	Uniform Federal Policy
USEPA	United States Environmental Protection Agency
UTL	upper tolerance limit
UU/UE	unlimited use and unrestricted exposure
VC	vinyl chloride
VDEQ	Virginia Department of Environmental Quality
VOA	volatile organic analyte
VOC	volatile organic compound
VSP	Visual Sampling Plan
VTSR	Verified Time of Sample Receipt
WPNSTA	Naval Weapons Station

SAP Worksheet #2—SAP Identifying Information

Site Name/Number: Naval Weapons Station (WPNSTA) Yorktown, Site 31
Operable Unit: Not applicable (N/A)
Contractor Name: CH2M HILL
Contract Number: RI: N62470-08-D-1000, Contract Task Order (CTO) WE-02
 Supplemental RI: N62470-11-D-8012, CTO WE-51
Contract Title: RI: Comprehensive Long-term Environmental Action—Navy
 (CLEAN) 1000
 Supplemental RI: CLEAN 8012

1. **This Sampling and Analysis Plan (SAP) was prepared in accordance with the requirements of the following documents:**
 - *Uniform Federal Policy for Quality Assurance Plans* (USEPA, 2005)
 - *Guidance for Quality Assurance Project Plans, EPA QA/G-5, QAMS* (USEPA, 2002)
2. **Identify regulatory program:**
 - Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)
3. **This is a project-specific SAP.**
4. **List dates of scoping sessions that were held:**

Scoping Session	Date
Internal kickoff meeting	3/26/2009
Joint scoping session with stakeholders	4/29/2009
Vapor intrusion technical discussion	6/3/2009
Risk assessment technical discussion	6/8/2009
Ecological Sampling Approach Discussion	4/7/2011
Post RI Field Investigation Partnering Meeting and Path Forward Discussion	2/22/2012

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

Title	Author/Date
<i>Final Work Plan Site Assessment, Area Upgradient of Site 12, Naval Weapons Station Yorktown, Yorktown, Virginia</i>	CH2M HILL, 2007
<i>Sampling and Analysis Plan Site 31 Remedial Investigation, Naval Weapons Station Yorktown, Yorktown, Virginia</i>	CH2M HILL, 2011

6. **List organizational partners (stakeholders) and connection with lead organization:**
 - Lead Organization – Naval Facilities Engineering Command (NAVFAC), Mid-Atlantic Division
 - Lead Regulatory Agency – United States Environmental Protection Agency (USEPA) Region 3
 - State Regulatory Agency – Virginia Department of Environmental Quality (VDEQ)
 - Land Owner – Department of Defense (DoD).

SAP Worksheet #2—SAP Identifying Information (continued)

- 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 herein on the 37 Uniform Federal Policy- (UFP)-SAP Worksheets. Therefore, the crosswalk table is not necessary for this project.

SAP Worksheet #3—Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address	Document Control Number
Jim Gravette	Remedial Project Manager (RPM)	NAVFAC Mid-Atlantic	(757) 341-0477	james.gravette@navy.mil	(An administrative record number will be assigned when the final document is being prepared.)
Moshood Oduwole	RPM	USEPA Region 3	(215) 814-3362	Oduwole.Moshood@epamail.epa.gov	
Wade Smith	RPM	VDEQ	(804) 698-4125	wade.smith@deq.virginia.gov	
Bonnie Capito	Librarian	NAVFAC Atlantic	(757) 322-4785	bonnie.capito@navy.mil	
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Doug Bitterman	Activity Quality Manager (AQM)	CH2M HILL	(757) 671-6209	Doug.Bitterman@ch2m.com	
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Angela Petree	Field Team Leader (FTL)	CH2M HILL	(757) 671-6248	angela.petree@ch2m.com	
To be determined (TBD)	Field Staff	CH2M HILL	TBD	TBD	
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William Kappleman	Project Ecological Risk Assessor	CH2M HILL	(703) 376-5152	william.kappleman@ch2m.com	
Roni Warren	Project Human Health Risk Assessor	CH2M HILL	(814) 364-2454	roni.warren@ch2m.com	
Ronnie Wambles	PM	ENCO Orlando	407-826-5314	rwambles@encolabs.com	
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Ann Skradski	PM	GEL Laboratories	843-556-8171	ann.skradski@gel.com	

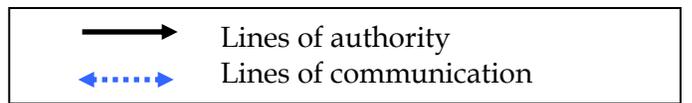
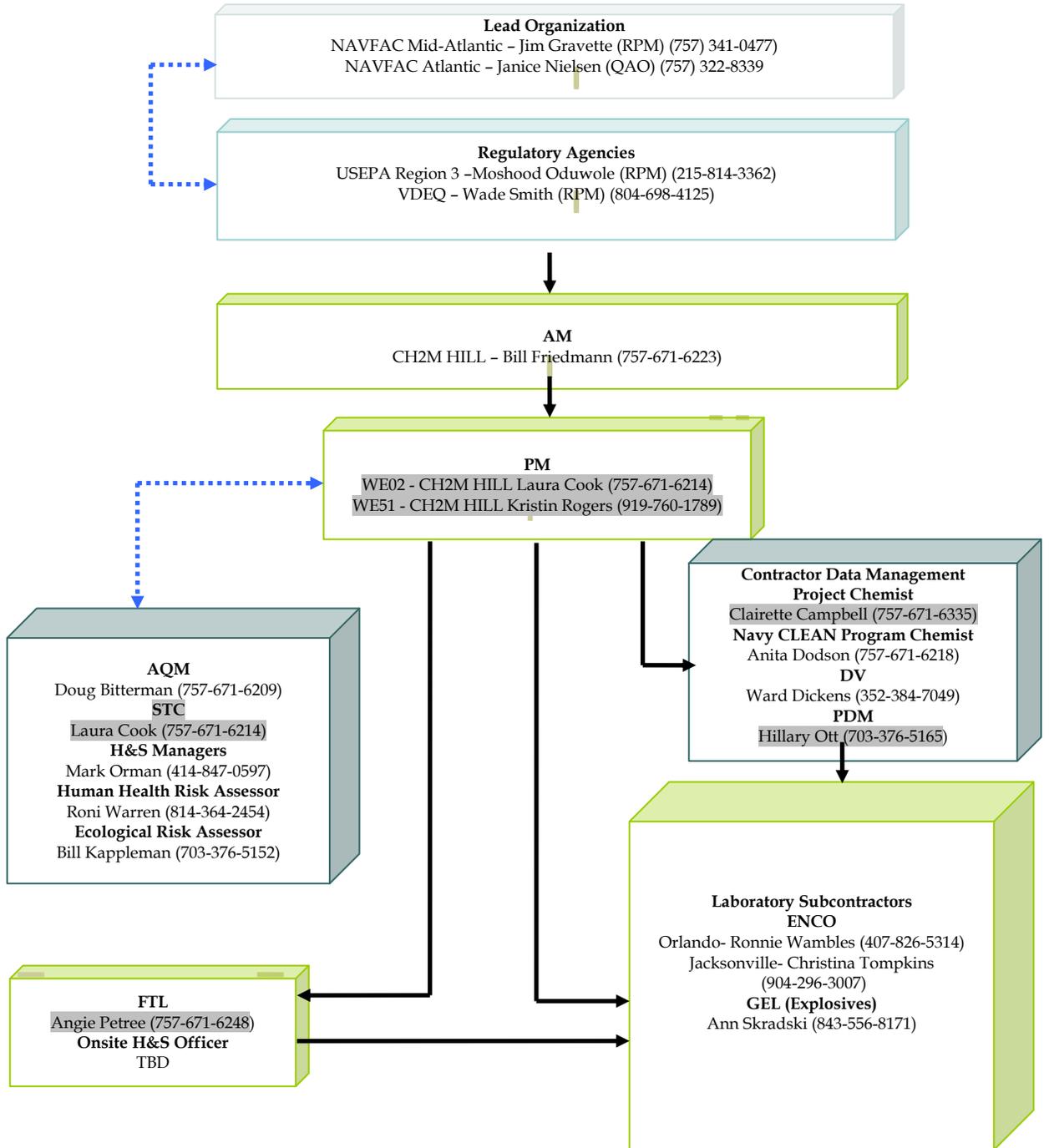
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SAP Worksheet #4—Project Personnel Sign-Off Sheet

Name	Organization/Title/Role	Telephone Number (optional)	Signature/E-mail Receipt	SAP Section Reviewed	Date SAP Read
Jim Gravette	United States Navy (Navy) RPM	757-341-0477			
Moshood Oduwole	USEPA RPM	(215) 814-3362			
Wade Smith	VDEQ RPM	(804) 698-4125			
Bill Friedmann	CH2M HILL/AM	757-671-6223			
Laura Cook	CH2M HILL/PM (CTO-WE02)/STC (CTO-WE51)	757-671-6214			
Kristin Rogers	CH2M HILL/PM (CTO-WE51)	919-760-1789			
Anita Dodson	CH2M HILL/Navy CLEAN Program Chemist	757-671-6218			
Doug Bitterman	CH2M HILL/AQM	(757) 671-6209			
Clairette Campbell	CH2M HILL/PC	757-671-6335			
Ward Dickens	CH2M HILL/ DV	352-384-7049			
Hillary Ott	CH2M HILL/PDM	(703) 376-5165			
Mark Orman	CH2M HILL/HSO	414-847-0597			
Angela Petree	CH2M HILL/FTL	757-671-6248			
William Kappleman	CH2M HILL/Project Ecological Risk Assessor	703-376-5152			
Roni Warren	CH2M HILL/Project Human Health Risk Assessor	814-364-2454			
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Christina Tompkins	ENCO Jacksonville/PM	904-296-3007			
Ann Skradski	GEL/ PM	843-556-8171			

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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
Point of Contact (POC) with USEPA Region 3 and VDEQ PMs	RPM, NAVFAC Mid-Atlantic	Jim Gravette	(757) 341-0477	All Materials and information pertaining to the project will be forwarded to Wade Smith within two business days by the RPM following review.
Oversight on all projects at WPNSTA Yorktown; AM	CH2M HILL AM	Bill Friedmann	(757) 671-6223	Issues are to be reported to the RPM immediately and followed up in writing within 2 business days.
Implement SAP and manage all phases of this project	CH2M HILL PM	Laura Cook (WE02) Kristin Rogers (WE51)	(757) 671-6214 (919) 760-1789	Communicate directly (verbal and/or in writing) with the AM and NAVFAC as necessary.
Technical communications for project implementation, and data interpretation	CH2M HILL STC	Laura Cook	(757) 671-6214	POC regarding quality questions/issues encountered in the field, input on data interpretation, as needed. STC will have 24 hours to respond to technical field questions as necessary. Additionally, STC will review the data as necessary prior to partnering team discussion and reporting review.
SAP changes in the field	CH2M HILL FTL	Angela Petree	(757) 671-6248	Communicate directly (verbal and/or in writing) with CH2M HILL AM or PM with daily meetings. Documentation of deviations from the UFP-SAP made in field logbooks; deviations made only with approval of PM, who will communicate with the AM, Navy and regulators. The FTL will ensure SAP requirements are met by field staff.
Data tracking from collection through upload to database	CH2M HILL PDM	Hillary Ott	(703) 376-5165	The PDM tracks the data and informs the PM and PC of potential problems or issues. The PM and AM are informed within 24 hours to pass on communications to Navy and regulators as appropriate.
Reporting Data Validation Issues	CH2M HILL DV	Ward Dickens	(352-384-7049)	All completeness and data issues will be addressed with the laboratory. The DV should copy the CH2M HILL PDM on all communications to the laboratory. The validated data package will be due within 14 calendar days of data receipt by the validator.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure
Reporting Analytical Lab Data Quality Issues	Laboratory PMs	Ronnie Wambles Christina Tompkins Ann Skradski	407-8265314 904-296-3007 843-556-8171	All quality assurance (QA)/quality control (QC) issues with project field samples will be reported by the subcontracted lab, who will relay them to the PDM, PC, and Contractor Quality Assurance Officer (QAO) within 2 days of discovery.
Field and Analytical Corrective Actions (CAs)	CH2M HILL Program Chemist PC FTL	Anita Dodson Clairette Campbell Angela Petree	(757) 671-6218 (757) 671-6335 (757) 671-6248	The need for CA for field and analytical issues will be determined by the FTL, PC, senior support staff, and/or Contractor QAO as necessary. The Sr. support will ensure SAP requirements are met by field staff. The PC will ensure QAPP requirements are met by the laboratory. The FTL will notify the PM of any needed field CAs. The PM will have 24 hours to respond to the request for field CA. CA with laboratories will be coordinated by PC. The PC will notify the Program Chemist, who will in turn notify the Navy Chemist of any lab issues that render data quality objective (DQOs) unattainable or cause delivery issues such that project schedule cannot be met. Should analytical laboratory issues affect data usability by rendering a significant amount of rejectable or unusable data such that the project completeness goal cannot be obtained, the PC will notify the project team including the Navy RPM and Navy QAO.

SAP Worksheet #7—Personnel Responsibilities Table

Name	Title/Role	Organizational Affiliation	Responsibilities
Jim Gravette	RPM	NAVFAC	Coordinates all environmental activities at WPNSTA Yorktown.
Bill Friedmann	AM	CH2M HILL	Responsible for the Environmental Restoration Program (ERP) at WPNSTA Yorktown.
Doug Bitterman	AQM	CH2M HILL	Provides senior technical oversight;
Laura Cook Kristin Rogers	PM (WE02) PM (WE51)	CH2M HILL	Directs and oversees staff
Laura Cook	STC	CH2M HILL	Provides technical oversight and review of technical work products and approaches
Brett Doerr	Program Quality Manager	CH2M HILL	Program-level review of UFP-SAP
Anita Dodson	Navy CLEAN Program Chemist	CH2M HILL	Program-level review of UFP-SAP
Clairette Campbell	PC	CH2M HILL	Performs oversight of laboratory and DVs, releases analytical data
Ward Dickens	DV	CH2M HILL	Performs data validation
Angela Petree	FTL	CH2M HILL	Supervises field sampling and coordinates all field activities
Mark Orman	HSO	CH2M HILL	Oversees health and safety (H&S) for field activities
Hillary Ott	PDM	CH2M HILL	Manages sample tracking, coordinates with laboratory and data-validator, data management
Ronnie Wambles	Laboratory PM	ENCO Orlando	Manages analytical projects from initiation to completion. Manages and is responsible for second-tier subcontracted laboratory (GEL).
Christina Tompkins	Laboratory PM	ENCO Jacksonville	Manages analytical projects from initiation to completion.
Ann Skradski	Laboratory PM	GEL	Manages analytical projects from initiation to completion.

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SAP Worksheet #8—Special Personnel Training Requirements Table

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records / Certificates
Environmental Field Work	3R (Recognize, Retreat, Report) Training	Internal to CH2M HILL	Project-specific	All field crew members	FTL and Field Staff CH2M HILL	Document in personal Health and Safety Plan (HSP) file

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

Project Name: Site 31 Remedial Investigation (RI) Projected Date(s) of Sampling: Late 2009 PM: Laura Cook			Site Name: 31 Site Location: WPNSTA Yorktown, Yorktown, Virginia		
Date of Session: 3/26/2009 Scoping Session Purpose: To discuss the Site 31 RI project and field approach and obtain internal consensus on the approach prior to the partnering meeting.					
Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Laura Cook	PM	CH2M HILL	757-671-6214	laura.cook@ch2m.com	PM
Bill Friedmann	AM	CH2M HILL	757-671-6223	william.friedmann@ch2m.com	AM
Brett Doerr	AQM (at the time of the meeting)	CH2M HILL	757-671-6219	brett.doerr@ch2m.com	AQM
Megan Morrison	PC	CH2M HILL	703-376-5053	megan.morrison@ch2m.com	PC
Rebekah Klyukin	Project Scientist	CH2M HILL	757-671-6235	rebekah.ives@ch2m.com	Scientist

Comments/Decisions:

- Brett requested the Visual Sampling Plan (VSP) software not be used to place locations since there are areas of the site more likely to be contaminated based on past disposal practices. He instead suggested we only use the VSP software to select the number of locations.

Consensus Decisions:

- The team discussed a schedule for developing the SAP.
- The team discussed roles and responsibilities.
- The team thought that a vapor and soil approach only would be reasonable for the site because groundwater data collected during the site assessment are adequate to support the risk assessment.
- The team decided that Rebekah would visit the site to evaluate accessible locations for sampling.

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

Date of Session: 4/29/2009					
Scoping Session Purpose: To obtain Partnering Team consensus on the proposed sampling approach.					
Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Laura Cook	PM	CH2M HILL	757-671-6214	laura.cook@ch2m.com	PM
Bill Friedmann	AM	CH2M HILL	757-671-6223	william.friedmann@ch2m.com	AM
Tom Kowalski	Navy Technical Representative (NTR)	NAVFAC MIDLANT	757-444-3826	tom.kowalski@navy.mil	NTR
Wade Smith	VDEQ RPM	VDEQ	804-698-4125	wmsmith@deq.virginia.gov	VDEQ
Rob Thomson	USEPA RPM (at the time of the meeting)	USEPA	215-814-3051	thomson.bob@epamail.epa.gov	USEPA

Comments/Decisions:

- Rob requested that a plume diagram be included in the Work Plan to ease review.
- Rob requested that more information be provided regarding the former tank locations.

Action Items:

- Create plume map.
- Research tank background and locations.

Consensus Decisions:

- The team agreed that it would be acceptable to not use the soil for ecological risk as there are no ecological receptors because the site is entirely paved and no potential risks to surface water bodies located downgradient of the site were identified during the risk screening included in the site assessment.
- The team agreed to standard QA/QC for the soil samples.
- The team agreed to use existing 2007 data for the groundwater at the site in the RI.

SAP Worksheet #9-3—Project Scoping Session Participants Sheet

Date of Session: 6/3/2009					
Scoping Session Purpose: To discuss vapor the intrusion approach with USEPA technical expert.					
Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Laura Cook	PM	CH2M HILL	757-671-6214	laura.cook@ch2m.com	PM
Loren Lund	CH2M HILL Vapor Intrusion Lead	CH2M HILL	208-357-5351	loren.lund@ch2m.com	Vapor Intrusion Support
Patricia Flores- Brown	Vapor Intrusion Technical Support	USEPA	215-814-2193	flores.patricia@epamail.epa.gov	Vapor Intrusion Support

Comments/Decisions:

- Laura described the proposed sampling approach, which included sub-slab vapor and background vapor samples to be collected for onsite buildings.
- Patricia requested that the use of Building 1803 be evaluated. If the building is regularly worked in, consider taking indoor air samples in addition to the sub-slab samples.
- Patricia requested that language be added in the decision portion of the air sampling decision tree to add a step to allow the team to agree on exposure concentrations to be used in the risk assessment

Action Items:

- Laura to check on the building use and add indoor air samples if the building was regularly used
- Laura to add a step to the decision tree to allow the team to agree on exposure concentrations.

Consensus Decisions:

- The team agreed that the vapor intrusion approach would be updated as previously described, and the Work Plan would be ready to send out as a draft with respect to vapor intrusion.

SAP Worksheet #9-4—Project Scoping Session Participants Sheet

Date of Session: 6/8/2009					
Scoping Session Purpose: To discuss the risk assessment approach with the partnering team.					
Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Laura Cook	PM	CH2M HILL	757-671-6214	laura.cook@ch2m.com	PM
Bill Friedmann	AM	CH2M HILL	757-671-6223	william.friedmann@ch2m.com	AM
Tom Kowalski	NTR	NAVFAC MIDLANT	757-444-3826	tom.kowalski@navy.mil	NTR
Wade Smith	VDEQ RPM	VDEQ	804-698-4125	wmsmith@deq.virginia.gov	VDEQ
Rob Thomson	USEPA RPM	USEPA	215-814-3051	thomson.bob@epamail.epa.gov	USEPA

Comments/Decisions:

- The team discussed the risk assessment approach for both human health and ecological receptors.

Action Items:

- None

Consensus Decisions:

- The team decided to assess the future residential pathway for human receptors exposed to soil at the site, but not to assess any unknown future ecological pathways since the site is currently paved and will be for the foreseeable future.

SAP Worksheet #9-5—Project Scoping Session Participants Sheet

Date of Session: 4/7/2011					
Scoping Session Purpose: To discuss the risk assessment approach with the partnering team.					
Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Laura Cook	PM	CH2M HILL	757-671-6214	laura.cook@ch2m.com	PM
Bill Friedmann	AM	CH2M HILL	757-671-6223	william.friedmann@ch2m.com	AM
Tom Kowalski	NTR	CH2M HILL	757-444-3826	tom.kowalski@navy.mil	NTR
Wade Smith	VDEQ RPM	VDEQ	804-698-4125	wade.smith@deq.virginia.gov	VDEQ
Moshood Oduwole	Current USEPA RPM	USEPA	215-814-3362	Oduwole.Moshood@epamail.epa.gov	USEPA
Rob Thomson	Former USEPA RPM	USEPA	215-814-3051	thomson.bob@epamail.epa.gov	USEPA

Comments/Decisions:

The team discussed ongoing comment resolution related to the outfall pipe sampled during the site assessment, at which trichloroethene (TCE) was detected at a concentration of 130 micrograms per liter ($\mu\text{g/L}$). USEPA had previously requested additional sediment and surface water sampling and evaluation of risk related to this sample, while the Navy requested to proceed forward in accordance with the conclusions of the site assessment, which required no additional action for these media. The team agreed to add surface water and sediment samples to this SAP sampling approach and to reassess ecological risks. Additionally, because sediment and surface water in the vicinity of the outfall has the potential to be more contaminated than previously sampled sediment and surface water at the site, the team also agreed to reassess human health risks associated with these media.

Action Items:

- None

Consensus Decisions:

The team agreed to add an ecological component to this SAP and collect additional surface water and sediment samples upstream, at the point of the outfall discharge, as well as downstream of the discharge, and to reevaluate ecological risk associated with discharging volatile organic compounds (VOCs). The team agreed to analyze samples for TCE and its daughter products only.

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

Date of Session: 2/22/2012					
Scoping Session Purpose: Discuss preliminary RI sample results and path forward					
Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Jim Gravette	NTR	NAVFAC MIDLANT	757-341-0477	James.gravette@navy.mil	NTR
Bill Friedmann	AM	CH2M HILL	757-671-6223	william.friedmann@ch2m.com	AM
Wade Smith	VDEQ RPM	VDEQ	804-698-4125	wade.smith@deq.virginia.gov	VDEQ
Moshood Oduwole	Current USEPA RPM	USEPA	215-814-3362	Oduwole.Moshood@epamail.epa.gov	USEPA

Comments/Decisions:

The team discussed subslab and indoor air sampling results from the first round of sampling. Analytical results exceeded screening levels and risk hazard quotients triggering a time-critical removal action and/or evacuation of the occupied buildings where exceedances were reported. The Navy wanted to be able to make a recommendation to the facility operators and CO commands regarding current worker status and path forward for VI considerations. Pre-partnering action was for EPA to meet to provide a recommendation to the Navy so that the Team can make a recommendation and brief the COs/Base.

Path Forward: The team discussed the VI path forward based on the discussion and outcome. A second round of samples will be collected in Sheds 3, 4, 5, and 6, and Buildings 371, 1803, and 1804 as per the decision tree in Figures 13 and 14.

The surface water, sediment, and soil sampling approaches were discussed; however, results had not been received at the time of the meeting. The team agreed to review these results, along with groundwater data, to support the vapor intrusion path forward and support removal action selection and design.

Post Partnering: Results from the most recent round of surface water, sediment, and soil samples were reviewed along with groundwater samples collected during the 2008 Site Assessment. Additionally, a time-critical follow-up vapor investigation was completed in Shed 6, Building 371 and 687 in March 2012 to evaluate worker safety for building occupancy and results of this investigation were discussed. The team coordinated via e-mail and phone on a path forward for all media as follows:

- Surface water/sediment: the farthest downstream surface water sample exceeded the ecological screening value for TCE; it was proposed that the four samples collected during the initial sampling be re-collected to obtain seasonal variability and two

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

additional samples farther downstream be collected to refine the extent of surface water and sediment impacts.

- Soil - The surface and shallow subsurface soil analytical results did not indicate a surface source of VOCs to the groundwater or indoor air. However, based on the groundwater results, the existing MIP results (two samples at sustained max ECD in unsaturated zone) and the SSV results under the building slabs at Sheds 3 and 6, it appears that there is an incompletely defined soil source between the buildings. A focused membrane interface probe (MIP) investigation with confirmatory soil sample analysis was proposed in unsaturated soils to refine the likely source near Sheds 3 and 6.
- Groundwater - The existing groundwater monitoring well network was reviewed along with the 2008 Site Assessment data. Additional well installation was proposed to further refine the plume in areas near occupied buildings and collect data in the source area identified during the MIP investigation. The new wells will be sampled for a full suite of analyses. An updated round of VOC samples were recommended from all existing shallow groundwater monitoring wells. Additionally, sampling for pesticides/polychlorinated biphenyls (PCBs) was recommended since they had not been previously sampled for in groundwater at Site 31.

Based on the additional vapor samples collected from Shed 6, Building 371, and Building 687 in March 2012, the team agreed that no additional sampling of Building 687 would be completed unless a boundary monitoring well located east of the building indicated contamination was migrating toward the building. Shed 6 and Building 371 will be sampled to assess seasonal variability of vapors.

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SAP Worksheet #10—Problem Definition Overview

Site Description and History

Site 31, Barracks Road Industrial Area, is located in the eastern portion of WPNSTA Yorktown (**Figure 1**). Site 31 consists of four large buildings (Sheds 3 through 6) and several smaller buildings within the industrial area located northwest of the Site 12 landfill and the Site Screening Area (SSA) 15 former sewage treatment plant (**Figure 2**). The ground surface is generally flat with paved parking lots, loading docks, and multiple industrial buildings. The area to the west of the industrial area slopes down to a ravine containing an intermittent stream that leads to Roosevelt Pond. East of Site 31, the topography is rolling with some ravines containing feeder streams to Ballard Creek.

Shed 3 houses a paint booth, blast booth, satellite accumulation area for aerosol paint cans, and a parts washer. It is currently used for wing and fin repair. The building was also historically used as a missile component rework facility and a boiler plant. Shed 4 is currently used as a storage warehouse. The building was historically used for container repair and testing. Shed 5 is currently used for administrative and training purposes and was historically used for mine and depth charge rework. Shed 6 is currently used to support public works and utilities maintenance and was historically used for missile component rework and equipment maintenance.

Geology, Hydrogeology, Surface Water Drainage

Boring data indicate unsaturated sand, silt, and clay, lithologically consistent with the Columbia aquifer, is present from the ground surface to a depth of approximately 25 to 30 feet below ground surface (bgs), where a 15-foot clay layer, lithologically consistent with the Cornwallis Cave confining unit, is encountered. This unit is not continuous across the site, allowing a migration pathway for contaminants into the Cornwallis Cave aquifer, which underlies this clay layer (where present) and represents the shallow aquifer at the site. The Cornwallis Cave aquifer is composed of fine to medium sand and shell fragments. The Yorktown confining unit, which is continuous across the site, lies beneath the Cornwallis Cave aquifer and is composed of greenish gray clay and silt. The Yorktown confining unit overlies the Yorktown-Eastover aquifer, which consists of fine to coarse sands and shell fragments. Depth to shallow (Cornwallis Cave aquifer) groundwater at the site is between 25 and 40 feet bgs.

Site 31 lies on a drainage divide. Surface runoff and groundwater at the site flow to the northeast (to an unnamed tributary to Roosevelt Pond) and the southeast (to Ballard Creek and its tributaries). A groundwater contour map is provided on **Figure 3**.

Previous Investigations

Site 31 was initially investigated during the studies of Site 12, the Barracks Road Landfill, which lies east of the site. During investigations of the landfill, wells were installed within the landfill boundary and upgradient, and VOCs were detected at concentrations greater than the maximum contaminant levels (MCLs). However, based on the contaminant distribution, it was determined that the contaminants were not likely to be associated with the landfill, and the WPNSTA Yorktown Partnering Team

SAP Worksheet #10—Problem Definition Overview (continued)

agreed, through a consensus statement signed on October 3, 2006 (statement 9-1-06-45), to investigate the area upgradient of the landfill as a separate, potential source area. Consequently, the site was designated as Area of Concern (AOC) 23, and a Site Assessment was completed between April 2007 and March 2008. The Site Assessment consisted of a Membrane Interface Probe (MIP) study to identify the groundwater source area(s), direct push technology (DPT) groundwater and deep soil sampling, well installation and sampling, seeps sampling, and surface water and sediment sampling.

The Site Assessment Report (CH2M HILL, 2008) included human health and ecological risk screenings. Results of the Site Assessment are summarized below.

- MIP results:
 - Two potential VOC source areas were identified. One in the vicinity of Shed 3 and the other in the vicinity of Shed 5 (these are the areas of red shown in **Figure 4**).
 - MIP instrumentation responses were noted in the vicinity of Shed 3, which indicated the possible presence of dense non-aqueous phase liquid (DNAPL) in the 25- to 60-foot bgs range.
 - The source area in the vicinity of Building 3 was also noted in the area appearing to be above the water table, indicating possible unsaturated soil contamination.
 - The highest concentrations in the vicinity of Shed 3 were at the water table interface.
 - The highest concentrations in the vicinity of Shed 5 were at approximately 45 feet bgs but consisted of a single “spike” on the MIP response, followed by an immediate decline, possibly indicating equipment malfunction.
 - A possible third, lower concentration source area was noted northeast of Sheds 4 and 5 (shown in green on **Figure 4** by MIP point 12_C4)
- DPT results:
 - The potential source area in the vicinity of Shed 3 was confirmed. TCE was detected at a concentration of 7,300 µg/L in this area (**Figure 5**).
 - Contamination in the unsaturated soil near Shed 3 was confirmed. The concentration of TCE in deep (just above the water table) unsaturated soil in this area was 9,700 micrograms per kilogram (µg/kg)
 - The concentrations in the possible source area near Shed 4 were considerably lower (max = 190 µg/L), consistent with the notion of a MIP equipment malfunction.
 - The concentration in the third possible source area located northeast of Sheds 4 and 5 was 40 µg/L.

SAP Worksheet #10—Problem Definition Overview (continued)

- Monitoring well analytical results:
 - Chlorinated VOC (tetrachloroethene [PCE], TCE, cis-dichloroethene [cis-DCE], trans-DCE, and vinyl chloride [VC]) results were similar to DPT sample results, indicating a source area near Shed 3 and a lower concentration source area northeast of Shed 4 (**Figure 6**).
 - Freon-113 and Freon-11 were also detected at concentrations not exceeding any screening values.
 - Concentrations of xylene and chloroform slightly exceeded regional screening levels (RSLs).
 - Explosives and semivolatile organic compounds (SVOCs) were detected at concentrations below or slightly greater than RSLs in groundwater downgradient of the Site 12 landfill, but not within the upgradient industrial area of Site 31.
 - Total metals were detected in a number of samples at concentrations exceeding RSLs, but manganese was the only dissolved metals that exceeded its RSL (**Figure 7**).
 - Geochemical conditions at the site indicate the potential for reductive dechlorination.
- Seeps results:
 - Chlorinated VOCs were detected in seeps samples, indicating migration of chlorinated volatiles to adjacent surface water bodies to the east and west of the site. The one seep sample (YS12-SP03) in which VOCs were detected east of the site is a stormwater outfall pipe that may be leaking and receiving site groundwater. (**Figure 8**). Seep results were used to evaluate transport pathways at the site only and were not used for evaluation of risks.
- The following human health contaminants of potential concern (COPCs) were identified during the human health risk screening process:
 - Groundwater COPCs – Chromium, cobalt, manganese, nickel, chloroform, PCE, TCE, VC, cis-1,2-DCE, carbazole, 2,4,6-dinitrotoluene (2,4,6-DNT), 2-amino-4,6-DNT, 4-amino-2,6-DNT, Freon-11, and hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
 - Deep subsurface soil (considering indoor air pathway only) COPCs – Methylene chloride and TCE
 - Surface water and sediment COPCs – No COPCs were identified
- Ecological Risk Screening
 - There were no screening level exceedances identified for ecological receptors exposed to VOCs in site surface water and sediment (2008 samples); however, the concentration of TCE in the 2008 outfall sample (included as a seeps sample) exceeded the screening value for TCE. The concentration in this sample was 130 µg/L.

SAP Worksheet #10—Problem Definition Overview (continued)

- Site Assessment Report Conclusions and Recommendations for Site 31
 - A groundwater VOC plume (**Figure 9**) is present at the site as a result of two potential sources. In some places, groundwater contamination is migrating into seeps but does not appear to persist in surface water
 - Potential unacceptable risks exist from exposure to groundwater and vapor intrusion from deep subsurface soils based on vapor intrusion modeling using conservative assumptions and screening.
 - No Further Action was originally concluded for site surface water and sediment, but in April 2011, as part of comment resolution on this SAP, the team agreed to reevaluate these media in the vicinity of the outfall sample in which TCE was detected at levels greater than the corresponding ecological screening value.
 - An RI should be conducted and should include:
 - Collection of soil samples in the industrial area to evaluate any additional sources remaining in the soil.
 - Quantification of human health risks from potential exposure to soil and groundwater
 - A vapor intrusion evaluation in Sheds 3 through 6 and all other occupied buildings within 100 feet of known contaminant plumes.

A conceptual site model (CSM) based on the current understanding of the site from information collected during the Site Assessment is included as **Figure 10**. Based on existing site data, possible contaminant release and transport mechanisms from VOC source areas include leaching from soil to groundwater as a result of rainwater infiltration and volatilization of contaminants from groundwater and soil into air. Contaminants are also transported to the surface water by groundwater seeps.

Problem Definition

On the basis of existing data, the primary contaminants at Site 31 are chlorinated VOCs. During the Site Assessment, other potential contaminants were identified based on site use. These include SVOCs, explosives, cyanide (CN), and metals. The Site Assessment concluded that characterization of the nature and extent of these chemicals and VOCs in groundwater was adequate, and additional action for groundwater is only necessary to address VOCs. In addition, releases of all potential contaminants to shallow soils (between 0 and 3 feet bgs) have not yet been evaluated. Additionally, the vapor intrusion pathway has not been evaluated. Comment resolution on the approach for this SAP also identified a need to collect additional surface water and sediment samples adjacent to the outfall pipe at the site that was previously sampled as a seep. These surface water and sediment samples would only require analysis of TCE and its daughter products (cis-1,2-DCE, 1,1-DCE, trans-1,2-DCE, and VC) because TCE was the only VOC detected in an historical outfall sample above its ecological screening level.

SAP Worksheet #10—Problem Definition Overview (continued)

The purpose of this RI is to collect additional soil, indoor air, surface water, and sediment data to supplement the current dataset required to adequately characterize the site and assess human health and ecological risks. No further groundwater sampling is required to characterize the site or assess risks; therefore, the existing groundwater data collected in 2007 will be used for the quantitative human health risk assessment (HHRA) in the RI. This RI will identify any other potential sources areas within site soils, identify any vapor intrusion pathways, and allow for inclusion of these media in the HHRA.

This RI will also further evaluate impacts to surface water and sediment from potential TCE (and daughter products) contamination discharging from the outfall pipe at the site. Surface water and sediment was previously investigated in Ballard Creek and streams discharging into Ballard Creek during the Site 12 RI (Baker, 1996). During this investigation, samples were analyzed for a full suite of analyses (VOCs, SVOCs, explosives, pesticides, PCBs, metals, and CN). The ecological risk assessment indicated that there were minimal risks to receptors from Site 12 COCs (inorganics) exposure in surface water and sediment. Sediment has been sampled and analyzed for select RCRA 8 metals as part of the long-term monitoring (LTM) program at Site 12 since 1998. During the last round of LTM, concentrations of metals were below screening levels or exhibited a decreasing trend, indicating that the potential risk to ecological receptors from exposure to inorganics is also decreasing (CH2M HILL, 2008). However, since chlorinated VOCs have been detected in the outfall at concentrations exceeding screening values, surface water and sediment will be evaluated for site-related compounds (TCE and daughter products).

Because the site is gravel-covered or paved, preventing exposure to terrestrial receptors, ecological evaluation of soil will not be necessary. Additionally, vapor intrusion risks to future residential receptors will not be evaluated based on the conditions in existing industrial buildings because it is anticipated that conditions in any future residential structures would be substantially different. However, future residential vapor intrusion concerns will be addressed in the Record of Decision (ROD) for this site by stating that the residential vapor intrusion pathway must be addressed prior to construction of residential structures unless concentrations in groundwater have reached levels appropriate for unlimited use and unrestricted exposure (UU/UE).

Supplemental Remedial Investigation

Based on the recommendations from the 2008 Site Assessment and the initial version of this SAP, a field investigation to support the RI was initiated. Soil, surface water, sediment, and vapor intrusion pathways were investigated. However, based on data gaps identified during this initial RI investigation, this revision to the original work plan is being completed to propose additional sampling. The following table summarizes the initial RI, and Supplemental RI sampling strategies:

SAP Worksheet #10—Problem Definition Overview (continued)

Media	Initial RI Sampling Strategy	Initial RI Results	Supplemental RI Strategy
Source Investigation /Soil	Collect 20 surface and shallow subsurface soil samples for full suite of analyses adjacent to and beneath foundations of onsite buildings to locate a potential source from soil to groundwater. Surface and shallow subsurface soil was not previously included in the 2008 site assessment.	<p>Surface and shallow subsurface soil analytical results did not indicate a significant source area. A deeper investigation in the unsaturated soil zone was recommended to locate the source of dissolved phase VOCs in groundwater.</p> <p>Although historical site use does not indicate pesticide or PCBs were used, stored, or manufactured onsite, concerns were raised by the partnering team about a lack of pesticides and PCB analysis during previous investigations. Sampling for these analytical groups is required.</p>	<p>The previous MIP spacing in groundwater was adequate to assess groundwater impacts, however closer spacing is required to assess potential soil impacts. Complete a focused Membrane Interface Probe (MIP) investigation between Sheds 3 and 6 to investigate potential source of groundwater contamination and provide a focused area for removal. MIP will be advanced in unsaturated soil (estimated to depths up to 40 feet below ground surface). Collect up to 10 subsurface soil samples confirm MIP results.</p> <p>Soil samples will be analyzed for VOCs, SVOCs, metals, explosives, CN, pesticides, and PCBs.</p>
Groundwater	No samples collected - Site Assessment concluded that groundwater was adequately characterized and additional action was only necessary to address VOCs.	Vapor intrusion concerns identified during the initial RI sampling were raised in occupied buildings near the plume as interpolated during the Site Assessment. Additional refinement of the groundwater plume was recommended in the vicinity of Building 687 and 371, and in the source identified by MIP. A full round of VOCs was also recommended to provide updated data. Concerns were also raised about a lack of pesticides and PCB analysis during previous investigations.	<p>Install 3 shallow wells (one to delineate plume adjacent to Building 687, one to delineate plume adjacent to Building 371, and one in Source area identified by MIP).</p> <p>Sample groundwater from all existing shallow wells (24 total) for VOCs and pesticides/PCBs.</p> <p>Sample groundwater from newly installed wells for VOCs, SVOCs, metals, explosives, CN, pesticides, and PCBs.</p>
Surface water/ Sediment	Collect 5 collocated surface water and sediment samples in the vicinity of the outfall near seep with ecological exceedances of VOCs identified during 2008 Site Assessment. Analyze for select VOCs (TCE and daughter products).	Four locations were sampled in January 2012. The fifth sample was not collected because it was located outside of the Base boundary. Analytical results exceeded screening levels in the most downstream sample. Additional downstream samples were recommended.	Resample 4 locations from January 2012, collect 2 farther downstream. Samples will be analyzed for select VOCs.

SAP Worksheet #10—Problem Definition Overview (continued)

The following are the environmental questions that will be answered by this investigation:

Initial RI:

- Is there a complete and, if so, a significant (posing unacceptable risk) exposure pathway from groundwater and soil to indoor air in Sheds 3, 4, 5, and 6, and Buildings 371, 1803, and 1804?
- Are there unacceptable risks from vapor intrusion to the building occupants under current use conditions?
- Is there a source of VOCs in soil continuing to release contaminants to groundwater?
- Has there been a release of site-related contaminants to soil beneath the pavement, buildings, and gravel at the site?
- Have surface water and sediment in the vicinity of the outfall pipe been impacted by TCE (and daughter products) contamination at the site?
- What is the magnitude of the risk posed by concentrations of contaminants in groundwater at the site (samples collected during the Site Assessment [CH2M HILL, 2008])?
- Do concentrations of any site-related contaminants in soil beneath the pavement and gravel have the potential to pose unacceptable risks to current and future human receptors at the site?
- Are there human health and/or ecological risks associated with TCE and its daughter products in surface water (including seeps) and/or sediment at the site?

Supplemental RI:

In support of the RI report, the results from the Supplemental RI activities will be used to answer the applicable questions from the initial investigation above, and to answer the following additional environmental questions:

- Is there a source of CVOC contamination in the unsaturated soil zone located in the vicinity of Sheds 3 and 6 and what is the extent of the suspected source of TCE-contamination in that area?
- Are pesticides or PCBs present in subsurface soil or groundwater and, if so, are concentrations indicative of a release or application (pesticides only)?
- What is the extent of TCE and its daughter products in surface water and sediment?
- What is the current extent of contaminant concentrations in groundwater at Site 31?

The following work is proposed to answer these environmental questions:

Initial RI:

- Completion of building surveys in accordance with the CH2M HILL building survey standard operating procedure (SOP) (**Appendix A**) at Buildings 3, 4, 5, 6, 371, 1803, and 1804 to identify current preferential pathways, record pressure measurements, and compile an inventory of chemicals used in the building to identify the presence of possible indoor sources of VOC contamination unrelated to the subsurface.

SAP Worksheet #10—Problem Definition Overview (continued)

- Collection of sub-slab vapor samples and indoor and ambient air samples (as necessary) at the buildings to determine whether or not a vapor intrusion pathway is present.
- Collection of surface and subsurface soil samples for analysis of VOCs, SVOCs, metals, explosives, and CN.
- Collection of co-located surface water and sediment samples for analysis of TCE and its daughter products (cis-1,2-DCE, 1,1-DCE, trans-1,2-DCE, and VC); upstream of the outfall pipe, adjacent to the outfall, and downstream from the pipe.
- Completion of a vapor intrusion risk assessment.
- Completion of a quantitative risk assessment for human receptors exposure to soil, indoor air, surface water, sediment and groundwater.
- Completion of a quantitative ecological risk assessment (ERA) for exposure of aquatic organisms to VOCs in seeps (sampled during the Site Assessment) and surface water and sediment (TCE and daughter products only).

Supplemental RI:

- Completion of a MIP investigation in the vicinity of Buildings 3 and 6 to delineate the source of TCE contamination in soil. Borings will be advanced to depths where sensor readings indicate a source is present or, if no response is recorded, to groundwater or up to 40 feet bgs.
- Collection of subsurface soil samples for analysis of VOCs, SVOCs, metals, CN, explosives, and pesticides/PCBs.
- Installation of shallow monitoring wells to delineate the plume in the vicinity of Buildings 371 and 687 and in the source area as determined by the MIP investigation.
- Collection of groundwater samples from all existing shallow monitoring wells (24 total) for VOCs and pesticides/PCBs. Collection of groundwater samples from newly installed wells for VOCs, SVOCs, metals, CN, explosives, and pesticides/PCBs.
- Collection of co-located surface water and sediment samples for analysis of TCE and its daughter products (cis-1,2-DCE, 1,1-DCE, trans-1,2-DCE, and VC); upstream of the outfall pipe, adjacent to the outfall, and downstream from the pipe.
- The samples collected during the supplemental investigation will be used to support the HHRA and ERA and will be incorporated into the conceptual site model in the RI report.

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

Who will use the data?

- The data will be used by the Navy (and its contractors) and the other stakeholder agencies to ensure that the site is adequately characterized and to assess potential human health and ecological risks. If appropriate, the information will be used to evaluate actions to be taken to provide adequate protection of human health and ecological receptors. Engineers and scientists will evaluate the data for decision making and a chemist will evaluate laboratory data quality.
- The data and final report of the findings will also be available to the public.

What are the Project Action Limits (PALs)?

The following sections provide the PALs that will be used for this RI. Both the Initial and Supplemental investigation data will be screened against the most up-to-date screening criteria in the RI report.

Sub-slab Vapor and Air Samples

PALs have been established based on the RSLs for industrial air, released by USEPA in March 2012. PALs have not been established for cis-1,2-DCE because an inhalation toxicity value does not exist for it, and, consequently, an associated RSL does not exist since USEPA (2008) no longer supports route-to-route extrapolations.

The industrial indoor air PALs for the carcinogenic COPCs (TCE, chloroform, methylene chloride, VC, and 1,2-dichloroethane [DCA]) are the industrial air RSL values. The industrial indoor air PALs for the non-carcinogenic COPCs (chloromethane, cis, 1-2-DCE, trans-1,2-DCE, 1,1-DCE, Freon 11, and Freon 113) are the industrial air RSLs adjusted by a hazard quotient (HQ) of 0.1 (divided by 10) to account for additive effects.

The industrial sub-slab PALs for the carcinogenic contaminants of concern (COCs) are the industrial air RSLs multiplied by 10 in order to adjust for a conservative attenuation factor of 0.1 (that is, assumed 1 in 10 attenuation as shallow soil gas VOCs intrude into the indoor air). Refer to the USEPA 2011 RSL technical support document for a description of the methods used to derive these risk-based screening levels. The industrial sub-slab PALs for the non-carcinogenic COCs are the industrial air RSLs adjusted by a HQ of 0.1 (divided by 10) to account for additive effects and multiplied by 10 in order to adjust for a conservative attenuation factor of 0.1 (resulting in a number equivalent to the original RSL). PALs are tabulated as follows and discussed in more detail in **Worksheet #15**.

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

Constituent	Industrial Indoor Air (micrograms per square meter [$\mu\text{g}/\text{m}^3$])	Industrial Sub-slab Vapor ($\mu\text{g}/\text{m}^3$)
TCE	3	30
cis-1,2-DCE	An inhalation toxicity value does not exist for cis-1,2-DCE. Consequently, an associated RSL does not exist for cis-1,2-DCE since USEPA (2008) no longer supports route-to-route extrapolations. The uncertainties associated with the lack of an RSL will be addressed as part of the vapor intrusion assessment. Note that concentrations of cis-1,2-DCE would likely need to be significantly higher than the other chlorinated VOCs (e.g., trans-1,2-DCE) for this to result in a significant uncertainty.	
trans-1,2-DCE	26	260
Chloroform	0.53	5.3
Methylene chloride	1200	12000
Chloromethane	39	390
Freon-11	310	3,100
Freon-113	13,000	130,000
VC	2.8	28
1,1-DCE	88	880
1,2-DCA	0.47	4.7

Soil Samples

For carcinogenic compounds in soils, the PALs will be USEPA RSLs for residential soil and WPNSTA Yorktown station-wide background levels. For non-carcinogenic compounds in soils, the PALs will be USEPA RSLs for residential soil divided by 10 to account for cumulative effects and WPNSTA Yorktown station-wide background levels. A comparison the soil screening levels (SSLs) for the protection of groundwater from the RSL Table will also be conducted to evaluate the potential for leaching of contaminants from soil to groundwater. There are no ecological PALs for soil because there are no complete exposure pathways for ecological receptors to soil at the site due to the area being mostly paved or gravel covered. PALs are discussed in more detail on **Worksheet #15**.

Surface Water and Sediment Samples

Human Health – for carcinogenic compounds, the surface water PALs will be the tap water RSLs multiplied by 10 and the sediment PALs will be the residential soil RSLs multiplied by 10, in order to account for lower exposure to surface water and sediment than groundwater and soil. For non-carcinogenic compounds, the tap water and residential soil RSLs will be divided by 10 to account for cumulative effects and then multiplied by 10 to account for the lower exposure to surface water and sediment. Consequently, PALs for surface water and

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

sediment based on human health risk for non-carcinogens are the RSLs because the adjustments for exposure counter the adjustment for cumulative effects.

Ecological – screening values are derived from multiple sources compiled for use at WPNSTA Yorktown (multiple sources accepted for other Yorktown site ERAs).

Groundwater Samples (Supplemental RI)

For carcinogenic compounds, the groundwater PALs will be the Federal MCLs, USEPA tap water RSLs, and WPNSTA Yorktown station-wide background levels. For non-carcinogenic compounds in groundwater, the PALs will be the same as carcinogens with the exception of the USEPA tap water RSLs which will be divided by 10 to account for cumulative effects of multiple compounds. Ecological pathways will be evaluated based on direct exposure to seeps, surface water and sediment. Therefore, no ecological evaluation of groundwater will be necessary. PALs are discussed in more detail on **Worksheet #15**.

PAL Considerations

There are those instances where a laboratory limit of detection (LOD) for a specific constituent will be above its PAL. For the purposes of evaluating nature and extent, an undetected value will be considered as the analyte not being present. For risk assessment purposes and when samples have other detected constituents and an undetected analyte with the LOD above the PAL, the non-detect reporting limit will be compared to background values, and the PC, risk assessors, and Tier I team will be consulted and a decision rendered on how to treat the constituent.

For what will the data be used?

Initial RI:

- The results from the soil samples will be used to determine if a release of hazardous substances to soil (other than VOC contaminants) has occurred at the site and to define the nature and extent of soil contamination. Additionally, soil data will be used to identify any unacceptable risks to future human receptors associated with the detected contaminants.
- Groundwater results from the Site Assessment (included in **Appendix B**) will be used to quantify risks to human receptors from exposure to groundwater.
- The results of sub-slab air samples will be used to determine if there is a potential soil or groundwater to indoor air pathway and, in buildings where no indoor air sampling is conducted, whether additional indoor air sampling is warranted to assess risks to potential receptors.
- The results of indoor air samples will be used to determine if there are unacceptable risks to human receptors from exposure to contaminants in indoor air. Sample results will be used in conjunction with ambient and sub-slab samples to determine if contamination in air is the result of a groundwater or soil to indoor air pathway or a result of sources in the building.

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

- The results of surface water and sediment sampling will be used in conjunction with existing surface water, sediment, and seeps data to evaluate potential human health and ecological risks associated with these media at the site.

Supplemental RI:

- The results from the Supplemental RI MIP investigation will be used to further define the suspected source area between Sheds 3 and 6 and to assist in placement of a new monitoring well in the source area.
- The results from the soil samples will be used to confirm the MIP results and determine if a release of hazardous substances to soil (other than VOC contaminants) has occurred at the site and to define the nature and extent of soil contamination. Additionally, soil data collected during this and previous investigations will be used to identify any unacceptable risks to future human receptors associated with the detected contaminants.
- Groundwater results from this investigation will be used to assess the extent of COC concentrations in groundwater and quantify risks to human receptors from exposure to groundwater.

The vapor intrusion decision trees for Site 31 are discussed in the “if/then” portion of this worksheet.

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

The following bullets provide a summary of the data to be collected. Refer to **Worksheet #10** and **Worksheet #15** for further information.

Initial RI:

- Soil samples will be collected using a stainless steel hand auger or DPT; details will be recorded in the fieldwork logbook.
- Surface water samples will be collected directly into laboratory prepared unpreserved bottles and transferred, as necessary, into laboratory prepared preserved bottles for offsite analysis of TCE and its daughter products (cis-1,2-DCE, 1,1-DCE, trans-1,2-DCE and VC).
- Sediment samples will be collected using a trowel, hand auger or dredge for offsite analysis of TCE and its daughter products (cis-1,2-DCE, 1,1-DCE, trans-1,2-DCE and VC).
- Sub-slab vapor samples and air samples will be collected using 6-liter (L) SUMMA™ canisters equipped with flow controllers set to collect samples over an 8-hour time period, corresponding to the length of time per day people are generally occupying the buildings at Site 31. Details will be recorded in a field log book.

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

- Soil samples will be analyzed for metals, CN, VOCs, SVOCs, and explosives, consistent with the list of potential analytes based on site-use identified in the Site Assessment. Two samples in the vicinity of the former drainage ditch will also be analyzed for nitroglycerin, 3,5-dinitroaniline, and pentaerythritol tetranitrate (PETN) because the potential for a release of these chemicals exists and the drainage ditch area is the most likely location for accumulation of chemicals.
- Air and sub-slab vapor samples will be analyzed for VOCs identified as COPCs during the Site Assessment, which include TCE, cis-1,2-DCE, trans-1,2-DCE, chloroform, methylene chloride, chloromethane, Freon-11, Freon 113, VC, 1,1-DCE, and 1,1-DCA.

Supplemental RI:

- The MIP investigation will be completed using a flame ionization detector (FID), photoionization detector (PID), and electron capture detector (ECD) sensor configuration delivered to the subsurface using a DPT rig. Up to 20 samples may be collected.
- Soil samples will be collected using a stainless steel hand auger or DPT; details such as grain size, color, moisture content, relative density, consistency, soil structure, mineralogy and other relevant information such as possible evidence of contamination will be recorded in the fieldwork logbook.
- Soil samples will be analyzed for metals, CN, VOCs, SVOCs, pesticides, PCBs, and explosives, consistent with the list of potential analytes based on site-use identified in the Site Assessment.
- Groundwater samples will be collected from all existing shallow groundwater monitoring wells and three newly installed wells. Samples from existing wells will be analyzed for VOCs to provide updated data on the groundwater CVOC contamination, and pesticides and PCBs since they had not been analyzed for in the past. Groundwater from newly installed monitoring wells will be analyzed for VOCs, SVOCs, pesticides, PCBs, TAL Metals, mercury, CN, and explosives.
- Surface water, sediment, and air samples will be collected as outlined in the Initial RI sampling approach.

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

- The offsite analytical data will be of the quantity and quality necessary to provide technically sound and defensible assessments of potential risks to human and ecological receptors posed by the contaminants identified. For risk assessment and risk management decisions, laboratory methods will meet CERCLA, USEPA Region 3, and Navy guidance, and the data will be validated by a CH2M HILL validator using the procedures in **Worksheet #36**.

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

- QA/QC samples will be collected. Since human health and ERAs will be conducted, full QA/QC protocol, which comprises the collection of equipment, field, and trip blanks, as well as matrix spike and matrix spike duplicate (MS/MSD) samples and field duplicates (see Worksheet 20 for frequency), will be followed to support the usability of the results of these assessments (**Worksheet #17** [footnotes] and **Worksheet #20**).

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

Initial RI Sampling:

- Twenty surface (0 to 6 inches bgs) and 20 sub-surface (1 to 3 feet bgs) samples will be collected at Site 21 (**Figure 11**). The number of samples selected was based on the recommended number of samples from VSP software for comparison to a single value (the background upper tolerance limit [UTL]). The dataset of 20 samples is also sufficient to support a population to population background comparison, if there is a slight exceedance of the background screening value in one or more samples, but the data still may be statistically comparable to the background dataset. Samples will be analyzed for the parameters previously described.
- Twenty-nine sub-slab vapor samples will be collected initially. Five samples each will be collected in Sheds 3-6. Three samples each will be collected in Building 371, Building 1803, and Building 1804 (**Figure 12**). Samples will be analyzed for the parameters previously described. The need for additional sub-slab samples will be determined based on the decision trees in **Figures 13 and 14**.
- Initially, 10 indoor air samples will be collected in Sheds 3 and 6. The need for additional indoor air samples will be determined as specified in the decision trees in **Figures 13 and 14**.
- Five co-located surface water and sediment samples will be collected for VOC analysis; one upstream of the outfall, one adjacent to the outfall, and three downstream of the outfall (**Figure 15**).

Supplemental RI Sampling

- Based on MIP results, 10 subsurface soil samples will be collected to confirm the presence of a potential source of groundwater contamination within the unsaturated soil. Soil samples will be collected in the location and depth of the highest FID, PID, and/or ECD response indicating elevated concentrations of CVOCs (no deeper than the water table estimated at 15 to 40 feet bgs). The proposed locations of MIP borings are shown on **Figure 16**.
- Six co-located surface water and sediment samples will be collected for VOC analysis; one upstream of the outfall, one adjacent to the outfall, and four downstream of the outfall (**Figure 17**).

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

- Twenty seven groundwater samples will be collected from newly installed and existing monitoring wells screened within the Cornwallis Cave Aquifer. The proposed sample locations are shown on **Figure 18**.

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

Initial RI:

- Samples will be collected at Site 31 in locations shown on Figures 11, 12, 15, and 16. Soil sample locations were selected in areas where contamination was most probable (along the railroad tracks, beneath the buildings that appeared to be VOC source areas based on the MIP study, along the former drainage ditch, and outside doorways where workers may have exited buildings and dumped chemicals in the past). Sub-slab vapor samples will be located beneath the floors of all buildings in the area of the VOC plume at Site 31. Sample locations were placed evenly throughout the buildings; however, sample locations may be moved following the building survey if preferential pathways are identified. Surface water and sediment samples will be collected upstream, downstream, and in the vicinity of the outfall pipe. The initial field investigation is planned to occur in the autumn of 2011 (Worksheet #16). Additional field events may be necessary to collect sub-slab vapor and indoor air samples, in accordance with **Figures 13 and 14**.
- Data will be collected and generated in accordance with the procedures outlined in this UFP-SAP. Specifically, see the SOPs in **Appendices A, B, and C** for more details.

Supplemental RI:

- Samples will be collected during the Supplemental RI at locations shown on **Figure 16, 17, 18, and 19**. MIP sampling will be conducted prior to all soil and groundwater sampling activities. One monitoring well will be installed in the source area identified during this MIP investigation and two wells will be installed to refine the plume near Buildings 687 and 371. All existing monitoring wells screened in the Cornwallis Cave Aquifer will be sampled to provide temporal plume data. Previously sampled surface water and sediment locations will be resampled and two locations downstream will also be sampled to assess the extent of TCE and its daughter products in those media.
- The Supplemental RI field event is planned to occur in the summer/fall of 2012.

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

- CH2M HILL field staff will collect the samples.
- Laboratory analysis will be performed by ENCO Orlando and Jacksonville and GEL.
- The data report will include a Contract Laboratory Program (CLP) Level IV- equivalent package including all raw data. This will include a Supplemental Naval Installation Restoration Information System (NIRIS) Electronic Data Deliverable (SNEDD) in Microsoft Excel format and a hardcopy of the raw data.

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

How will the data be archived?

- The data will be archived in accordance with the contract requirements of the Navy CLEAN contract.

Following the collection of information during the investigation, the following decisions will be made:

The results of this investigation will be used to determine whether or not further investigations or CAs are necessary at Site 31. The following decision steps will be made following receipt of the data:

- If concentrations in site soils exceed PALs as previously described, the data will be qualitatively evaluated to determine the potential for unacceptable risks. A quantitative HHRA for soils will be completed. If the quantitative HHRA indicates an unacceptable risk to humans from soils, an additional population to population background evaluation may be completed and the need for remedial action may be considered in a feasibility study (FS) (or comparable document). Soil concentrations will also be compared to SSLs to determine the potential for leaching because there are VOCs in groundwater that may possibly be related to contamination remaining in soil. If the potential for leaching to groundwater is identified at levels above potential levels of concern (that is, above the SSLs), the need for a remedial action for soil will be considered, regardless of whether there are risks from direct exposure to soil. If it is determined that a remedial action is warranted to address soil at this site and additional soil samples are necessary to refine the area requiring remediation, they will be collected under this SAP
- If groundwater contaminants posing unacceptable risk to human health are identified during the quantitative HHRA or are otherwise at unacceptable levels (for example, exceed MCLs), these contaminants will be addressed via an FS for groundwater at the site.
- If unacceptable risks to ecological and/or human receptors from exposure to VOCs in surface water and/or sediment are identified, these contaminants will be addressed in an FS for the site.
- Decision steps for evaluating the sub-slab vapor and air samples are defined in Figures 12 and 13.

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

The decision steps for the Supplemental RI are the same as the initial RI with the following addition:

- MIP data will be collected at each point shown on **Figure 16**. The MIP boring will be advanced to depths where ECD, PID, and FID sensors indicating a potential source of VOCs in the unsaturated soil have dropped to *de minimis* levels¹. If MIP sensor readings indicate a potential source, confirmatory soil samples will be collected at the location and depth of the highest sensor readings. If sensors do not indicate presence of VOCs in soil, the MIP boring will be terminated at groundwater or approximately 40 feet bgs and no soil sample will be collected.

¹ Current MIP ECD detection limits for chlorinated solvents range from 100 to 250 parts per billion.

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

See Worksheet #20 for a summary of QC samples.

Matrix: Surface Soil, Subsurface Soil, Sediment

Analytical Group: VOCs

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria (MPC)	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field duplicates	VOCs	One per 10 field samples	Precision	Relative Percent Difference (RPD) < 35%	S&A
Equipment rinsate blank		One per day of sampling per type of equipment used	Contamination/bias	All target compounds < ½ limit of quantitation (LOQ) except common laboratory/field contaminants (acetone, 2-butanone, methylene chloride) <5x LOQ	S&A
Trip blank		One per cooler to the laboratory containing VOCs	Contamination/bias		S&A
Cooler temperature blank		One per cooler to the laboratory	Accuracy / representativeness	≤ 6 degrees Celsius (°C)	S

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

Matrix: Surface Soil, Subsurface Soil

Analytical Group: SVOCs and SIM PAHs

Concentration Level: Medium and Low (SIM)

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field duplicates	SVOCs	One per 10 field samples	Precision	RPD < 35%	S&A
Equipment rinsate blank		One per day of sampling per type of equipment used	Contamination/bias	All target compounds < ½ LOQ	S&A
Cooler temperature indicator		One per cooler	Accuracy / representativeness	≤6°C	S

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

Matrix: Surface Soil, Subsurface Soil

Analytical Group: Metals plus Mercury

Concentration Level: Medium

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field duplicates	Metals	One per 10 field samples	Precision	RPD < 35%	S&A
Equipment blank		One per day of sampling per type of equipment used	Contamination/bias	All target compounds < ½ LOQ	S&A
Cooler temperature indicator		One per cooler	Accuracy / representativeness	≤6°C	S

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

Matrix: Surface Soil, Subsurface Soil

Analytical Group: Cyanide

Concentration Level: Medium

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field duplicates	CN	One per 10 field samples	Precision	RPD < 35%	S&A
Equipment blank		One per day of sampling per type of equipment used	Contamination/bias	All target compounds < 1/2 LOQ	S&A
Cooler temperature indicator		One per cooler	Accuracy / representativeness	≤6°C	S

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

Matrix: Surface Soil, Subsurface Soil

Analytical Group: Explosives including PETN, 3,5-Dinitroaniline, and Nitroglycerin

Concentration Level: Medium

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field duplicates	Explosives	One per 10 field samples	Precision	RPD < 35%	S&A
Equipment blank		One per day of sampling per type of equipment used	Contamination/bias	All target compounds < 1/2 LOQ	S&A
Cooler temperature indicator		One per cooler	Accuracy / representativeness	≤6°C	S

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

Matrix: Surface Soil, Subsurface Soil

Analytical Group: Pesticides, PCBs

Concentration Level: Low

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field duplicates	Pesticides, PCBs	One per 10 field samples	Precision	RPD < 35%	S&A
Equipment rinsate blank		One per day of sampling per type of equipment used	Contamination/bias	All target compounds < ½ LOQ	S&A
Cooler temperature indicator		One per cooler	Accuracy / representativeness	≤6°C	S

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

Matrix: Surface Water, Seeps, Groundwater (Supplemental RI only)

Analytical Group: VOCs

Concentration Level: Low

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field duplicates	VOCs	One per 10 field samples	Precision	RPD < 25%	S&A
Equipment rinsate blank		One per day of sampling per type of equipment used	Contamination/bias	All target compounds < ½ LOQ except common laboratory/field contaminants (acetone, 2-butanone, methylene chloride) <5x LOQ	S&A
Trip blank		One per cooler to the laboratory containing VOCs	Contamination/bias		S&A
Cooler temperature blank		One per cooler to the laboratory	Accuracy / representativeness	≤ 6 °C	S

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

Matrix: Indoor Air, Ambient Air, Sub-slab vapor

Analytical Group: VOCs

Concentration Level: Low

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field duplicates	VOCs	One per 10 field samples	Precision	RPD < 35%	S&A

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

Matrix: Groundwater

Analytical Group: SVOCs and SIM PAHs

Concentration Level: Medium or Low (SIM)

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field duplicates	SVOCs	One per 10 field samples	Precision	RPD < 25%	S&A
Equipment rinsate blank		One per day of sampling per type of equipment used	Contamination/bias	All target compounds < ½ LOQ.	S&A
Cooler temperature blank		One per cooler to the laboratory	Accuracy / representativeness	≤ 6 °C	S

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

Matrix: Groundwater

Analytical Group: Pesticides, PCBs

Concentration Level: Low

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field duplicates	Pesticides, PCBs	One per 10 field samples	Precision	RPD < 25%	S&A
Equipment rinsate blank		One per day of sampling per type of equipment used	Contamination/bias	All target compounds < ½ LOQ.	S&A
Cooler temperature blank		One per cooler to the laboratory	Accuracy / representativeness	≤ 6 °C	S

SAP Worksheet #12-11—Measurement Performance Criteria Table – Field QC Samples

Matrix: Groundwater

Analytical Group: Explosives

Concentration Level: Low

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field duplicates	Explosives	One per 10 field samples	Precision	RPD < 25%	S&A
Equipment rinsate blank		One per day of sampling per type of equipment used	Contamination/bias	All target compounds < ½ LOQ.	S&A
Cooler temperature blank		One per cooler to the laboratory	Accuracy / representativeness	≤ 6 °C	S

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

Matrix: Groundwater

Analytical Group: Metals

Concentration Level: Low

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field duplicates	Metals	One per 10 field samples	Precision	RPD < 25%	S&A
Equipment rinsate blank		One per day of sampling per type of equipment used	Contamination/bias	All target compounds < ½ LOQ.	S&A
Cooler temperature blank		One per cooler to the laboratory	Accuracy / representativeness	≤ 6 °C	S

SAP Worksheet #13—Secondary Data Criteria and Limitations Table

Secondary Data	Data Source	Data Generator(s)	How Data Will Be Used	Limitations on Data Use
Groundwater, surface water, sediment and seeps data from Site Assessment	<i>Site Assessment Report, AOC 23, Naval Weapons Station Yorktown, Yorktown, Virginia</i>	CH2M HILL, 2008	Groundwater data will be used to support a quantitative risk assessment for this media because concentrations were greater than risk screening values during the site assessment. Seeps results also exceeded ecological screening values and will be used in conjunction with existing and new surface water and sediment data to assess ecological risks at the site.	None known

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SAP Worksheet #14—Summary of Project Tasks

Major tasks associated with the Site 31 sampling effort:

Field Tasks

Initial RI:

SOPs for all field tasks to be completed at Site 31 are included in **Appendix A** and tabulated on **Worksheet #21**. These field tasks include:

- **Log book documentation** – A log book will be kept to document all field activities to be conducted at Site 31.
- **Utility location** – Utility clearance by a third party subcontractor and Virginia Miss Utility will be obtained before the any intrusive work commences
- Collection of surface soil samples and subsurface soil samples using a hand auger or DPT rig.
- Collection of surface water and sediment samples using a trowel, auger, or dredge.
- **Decontamination** – Decontamination of non-disposable sampling equipment such as hand augers, DPT rig, DPT sampling equipment, will be completed.
- Disposal of investigation-derived waste (IDW) comprising decontamination fluids will be completed.
- Completion of a building survey
- Collection of sub-slab, indoor air, near-building ambient, and upwind background air samples using SUMMA™ canisters with flow controllers.
- Chain-of-custody Documentation for all samples
- Collection of QC samples (See **Worksheet #20** for more details)

Supplemental RI:

All activities listed above, with the exception of surface soil sample collection, will also be completed during the Supplemental RI with the following additions:

- Collect real-time qualitative data from MIP sensors using a DPT probing system.
- Collection of subsurface soil samples for laboratory analysis using a DPT rig, and collection of soil samples for lithologic characterization using split spoon methods during well installation.
- Installation of monitoring wells using hollow stem auger (HSA) drilling methods (Appendix A, SOP #16).
- Collection of water levels from all existing and newly installed monitoring wells using an electronic water level measuring device (Appendix A, SOP #17).
- Collection of groundwater samples using low-flow sampling protocol (Appendix A, SOP #18).

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

- **Decontamination** – Decontamination of non-disposable sampling equipment such as hand augers, DPT rig, DPT sampling equipment, and HSA rig and augers will be completed.

Analytical and Validation Tasks

SOPs for all laboratory analytical tasks are included in **Appendix C** and tabulated on **Worksheet #23**.

- Analysis of surface soil and subsurface soil samples for VOCs, SVOCs, CN, and metals by ENCO Orlando. ENCO will subcontract explosives and 3,5-dinitroaniline analysis to GEL Laboratories.
- Analysis of sub-slab vapor, indoor air, outdoor ambient air, and upwind background air samples for VOCs by ENCO Jacksonville.
- Analysis of surface water and sediment samples for TCE and its daughter products (cis-1,2-DCE, 1,1-DCE, trans-1,2-DCE and VC) by ENCO Orlando.
- Validation of VOCs, SVOCs, explosives, and inorganic data by a CH2M HILL DV. See **Worksheet #36** for more details.

Supplemental RI:

Supplemental RI laboratory analytical and data validation tasks will be completed for soil, air, surface water, and sediment as listed above with the following additions:

- Analysis of subsurface soil samples for Pesticides and PCBs by ENCO Orlando.
- Analysis of groundwater samples for VOCs, SVOCs, Pesticides, PCBs, explosives, and inorganic data by ENCO Orlando.
- Validation of all additional soil analytes (pesticides and PCBs) and groundwater data by a CH2M HILL DV.

Data Management Tasks

- Management of data by CH2M HILL according to the Navy CLEAN Data Management Plan (**Appendix D**)

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

Matrix: Surface Soil, Subsurface Soil

Analytical Group: VOCs

Analyte	Chemical abstract service (CAS) Number	Adjusted Residential Soil RSLs ¹ (µg/kg)	project quantitation limit (PQL) Goal ² (µg/kg)	Laboratory-Specific			MS/MSD and laboratory control sample (LCS) Recovery Limits		
				LOQ (µg/kg)	LOD (µg/kg)	Detection limit (DL) (µg/kg)	Lower Limit (%)	Upper Limit (%)	RPD (%)
Dichlorodifluoromethane (Freon-12)	75-71-8	9400	4700	1	1	0.6	35	135	30
Chloromethane	74-87-3	12000	6000	1	1	0.6	50	130	30
VC	75-01-4	60	30	1	1	0.4	60	125	30
Bromomethane	74-83-9	730	365	1	1	0.8	30	160	30
Chloroethane	75-00-3	1500000	750000	1	1	0.5	40	155	30
Trichlorofluoromethane (Freon-11)	75-69-4	79000	39500	1	1	0.5	25	185	30
1,1-DCE	75-35-4	24000	12000	1	1	0.6	65	135	30
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	76-13-1	910000	455000	1	1	0.6	70	130	30
Acetone	67-64-1	6100000	3050000	25	12	0.8	20	160	30
Carbon disulfide	75-15-0	82000	41000	5	5	1.4	45	160	30
Methyl acetate	79-20-9	7800000	3900000	10	5	1.6	70	130	30
Methylene chloride	75-09-2	36000	18000	10	5	0.64	55	140	30
trans-1,2-DCE	156-60-5	15000	7500	1	1	0.7	65	135	30
Methyl-tert-butyl ether (MTBE)	1634-04-4	43000	21500	1	1	0.3	58	123	19
1,1-DCA	75-34-3	3300	1650	1	1	0.6	75	125	30
cis-1,2-DCE	156-59-2	16000	8000	1	1	0.5	65	125	30
2-Butanone	78-93-3	2800000	1400000	5	2.5	1.4	30	160	30
Bromochloromethane	74-97-5	16000	8000	1.0	1.0	0.30	70	125	30
Chloroform	67-66-3	290	145	1	1	0.4	70	125	30
1,1,1-Trichloroethane	71-55-6	640000	320000	1	1	0.4	70	135	30
Cyclohexane	110-82-7	120000	60000	2	1	0.5	70	130	30
Carbon tetrachloride	56-23-5	610	305	1	1	0.6	65	135	30
Benzene	71-43-2	1100	550	1	1	0.4	75	125	30
1,2-DCA	107-06-2	430	215	1	1	0.3	70	135	30
TCE	79-01-6	440	220	1	1	0.5	75	125	30
Methylcyclohexane	108-87-2	NC	Lab LOD	2	1	0.3	70	130	30
1,2-Dichloropropane	78-87-5	940	470	1	1	0.6	70	120	30
Bromodichloromethane	75-27-4	270	135	1	1	0.4	70	130	30
cis-1,3-Dichloropropene	10061-01-5	1700	850	1	1	0.3	70	125	30
4-Methyl-2-pentanone	108-10-1	530000	265000	5	2.5	1.4	45	145	30
Toluene	108-88-3	500000	20000	1	1	0.5	70	125	30
trans-1,3-Dichloropropene	10061-02-6	1700	850	1	1	0.3	65	125	30
1,1,2-Trichloroethane	79-00-5	160	80	1	1	0.6	60	125	30
PCE	127-18-4	8600	4300	1	1	0.3	65	140	30

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

Matrix: Surface Soil, Subsurface Soil

Analytical Group: VOCs

Analyte	CAS Number	Adjusted Residential Soil RSLs ¹ (µg/kg)	PQL Goal ² (µg/kg)	Laboratory-Specific			MS/MSD and LCS Recovery Limits		
				LOQ (µg/kg)	LOD (µg/kg)	DL (µg/kg)	Lower Limit (%)	Upper Limit (%)	RPD (%)
2-Hexanone	591-78-6	21000	10500	5	2.5	0.9	45	145	30
Dibromochloromethane	124-48-1	680	340	1	1	0.2	65	130	30
1,2-Dibromoethane	106-93-4	34	17	1	1	0.3	70	125	30
Chlorobenzene	108-90-7	29000	14500	1	1	0.5	75	125	30
Ethylbenzene	100-41-4	5400	2700	1	1	0.6	75	125	30
o-Xylene	95-47-6	69000	34500	1.0	1.0	0.50	75	125	30
m- and p-Xylene	m&pXYLENE	59000	29500	2.0	2.0	1.00	80	125	30
Styrene	100-42-5	630000	32000	1	1	0.4	75	125	30
Bromoform	75-25-2	62000	31000	1	1	0.3	55	135	30
Isopropylbenzene	98-82-8	210000	105000	1	1	0.5	75	130	30
1,1,2,2-Tetrachloroethane (TCA)	79-34-5	560	280	1	1	0.3	55	130	30
1,3-Dichlorobenzene	541-73-1	NC	Lab LOD	1	1	0.4	70	125	30
1,4-Dichlorobenzene	106-46-7	2400	1200	1	1	0.4	70	125	30
1,2-Dichlorobenzene	95-50-1	190000	95000	1	1	0.4	75	120	30
1,2-Dibromo-3-chloropropane	96-12-8	5.4	2.7	1	1	0.3	40	135	30
1,2,4-Trichlorobenzene	120-82-1	6200	3100	1	1	0.6	65	130	30
1,2,3-Trichlorobenzene	87-61-6	4900	2450	1.0	1.00	0.80	60	135	30

¹ PALs were developed to be protective of human health and the environment. Refer to **Worksheet#11** for a discussion on PAL development

² PQL Goals were determined on a case by case basis and in most cases are at least half of the PAL. If no PALs are available, the PQL Goal is equivalent to the laboratory's LOD.

NC = No Criteria

Adjusted RSLs are from the USEPA RSLs for Residential Soil, (**May 2012**) adjusted for noncancerous effects by dividing RSLs based on non-cancer by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver). Analytical data will be compared to the most recent version of the RSLs at the time that analytical data is available for use. **Bold italic** RSLs and PQLs are updated from the initial RI PALs (June 2011) to reflect the current PALs.

Eco PALs are based upon available Ecological Screening Values for Soil from literature compiled for use at WPNSTA Yorktown. They will be compared to surface soil results only.

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

Matrix: Sediment

Analytical Group: VOCs

Analyte	CAS Number	PALs ¹		PQL Goal ² (µg/kg)	Laboratory-Specific			MS/MSD and LCS Recovery Limits		
		Adjusted Residential Soil RSLs x 10 for Sediment (µg/kg)	Eco PAL (µg/kg)		LOQ (µg/kg)	LOD (µg/kg)	DL (µg/kg)	Lower Limit (%)	Upper Limit (%)	RPD (%)
VC	75-01-4	600	NC	300	1	1	0.4	60	125	30
1,1-DCE	75-35-4	2400000	31	15.5	1	1	0.6	65	135	30
trans-1,2-DCE	156-60-5	1500000	400	200	1	1	0.7	65	135	30
cis-1,2-DCE	156-59-2	1600000	400	200	1	1	0.5	65	125	30
TCE	79-01-6	4400	1600	800	1	1	0.5	75	125	30

¹ PALs were developed to be protective of human health and the environment. Refer to **Worksheet#11** for a discussion on PAL development

² PQL Goals were determined on a case by case basis and in most cases are at least half of the PAL. If no PALs are available, the PQL Goal is equivalent to the laboratory's LOD.

NC = No Criteria

Adjusted RSLs are from the USEPA RSLs for Residential Soil, **May 2012**, adjusted for noncancerous effects by dividing RSLs based on noncancer by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver). Additionally RSLs are multiplied by 10 to account for sediment. Analytical data will be compared to the most recent version of the RSLs at the time that analytical data is available for use. ***Bold italic*** RSLs and PQLs are updated from the initial RI PALs (June 2011) to reflect the current PALs.

Eco PALs are based upon available Ecological Screening Values for Freshwater Sediment (at 1% TOC) from literature compiled for use at WPNSTA Yorktown.

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

Matrix: Surface Soil, Subsurface Soil

Analytical Group: SVOCs

Analyte	CAS Number	Adjusted Residential Soil RSLs ¹ (µg/kg)	PQL Goal ² (µg/kg)	Laboratory-Specific			MS/MSD and LCS Recovery Limits		
				LOQ (µg/kg)	LOD (µg/kg)	DL (µg/kg)	Lower Limit (%)	Upper Limit (%)	RPD (%)
Benzaldehyde	100-52-7	780000	390000	330	200	48	0	150	30
Phenol	108-95-2	1800000	900000	330	200	64	40	100	30
bis(2-Chloroethyl)ether	111-44-4	210	105	330	200	43	40	105	30
2-Chlorophenol	95-57-8	39000	19500	330	200	74	45	105	30
2-Methylphenol	95-48-7	310000	155000	330	200	33	40	105	30
2,2'-Oxybis(1-chloropropane)	108-60-1	4600	2300	330	200	45	20	115	30
Acetophenone	98-86-2	780000	390000	330	200	84	70	130	30
3/4-Methylphenol	106-44-5	610000	305000	800	400	79	40	105	30
n-Nitroso-di-n-propylamine	621-64-7	69	34.5	330	200	44	40	115	30
Hexachloroethane	67-72-1	4300	2150	330	200	45	35	110	30
Nitrobenzene	98-95-3	4800	2400	330	200	45	40	115	30
Isophorone	78-59-1	510000	255000	330	200	42	45	110	30
2-Nitrophenol	88-75-5	39000	19500	330	200	71	40	110	30
2,4-Dimethylphenol	105-67-9	120000	60000	330	200	49	30	105	30
bis(2-Chloroethoxy)methane	111-91-1	18000	9000	330	200	40	45	110	30
2,4-Dichlorophenol	120-83-2	18000	9000	330	200	73	45	110	30
Naphthalene	91-20-3	3600	1800	33	17	17	40	105	30
4-Chloroaniline	106-47-8	2400	1200	330	200	29	10	100	30
Hexachlorobutadiene	87-68-3	6100	3050	330	200	44	40	115	30
Caprolactam	105-60-2	3100000	1550000	330	200	41	0	150	30
4-Chloro-3-methylphenol	59-50-7	610000	305000	330	200	80	45	115	30
2-Methylnaphthalene	91-57-6	23000	11500	33	17	15	45	105	30
Hexachlorocyclopentadiene	77-47-4	37000	18500	330	200	45	24	120	30
2,4,6-Trichlorophenol	88-06-2	6100	3050	330	200	62	45	110	30
2,4,5-Trichlorophenol	95-95-4	610000	305000	330	200	37	50	110	30
1,1-Biphenyl	92-52-4	5100	2550	330	200	56	0	150	30
2-Chloronaphthalene	91-58-7	180000	90000	330	200	43	45	105	30
2-Nitroaniline	88-74-4	61000	30500	330	200	55	45	120	30
Dimethyl phthalate	131-11-3	NC	Lab LOD	330	200	52	50	110	30
2,6-DNT	606-20-2	6100	3050	330	200	56	50	110	30
Acenaphthylene	208-96-8	340000	170000	33	17	12	45	105	30
3-Nitroaniline	99-09-2	NC	Lab LOD	330	200	56	25	110	30
Acenaphthene	83-32-9	340000	170000	33	17	13	45	110	30

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

Matrix: Surface Soil, Subsurface Soil

Analytical Group: SVOCs

Analyte	CAS Number	Adjusted Residential Soil RSLs ¹ (µg/kg)	PQL Goal ² (µg/kg)	Laboratory-Specific			MS/MSD and LCS Recovery Limits		
				LOQ (µg/kg)	LOD (µg/kg)	DL (µg/kg)	Lower Limit (%)	Upper Limit (%)	RPD (%)
2,4-Dinitrophenol	51-28-5	12000	6000	330	200	36	15	130	30
4-Nitrophenol	100-02-7	4800	2400	330	200	76	15	140	30
Dibenzofuran	132-64-9	7800	3900	330	200	55	50	105	30
2,4-DNT	121-14-2	1600	800	330	200	56	50	115	30
Diethylphthalate	84-66-2	4900000	2450000	330	200	66	50	115	30
Fluorene	86-73-7	230000	115000	33	17	12	50	110	30
4-Chlorophenyl-phenylether	7005-72-3	31000	15500	330	200	56	45	110	30
4-Nitroaniline	100-01-6	24000	12000	330	200	49	35	115	30
4,6-Dinitro-2-methylphenol	534-52-1	490	245	330	200	76	30	135	30
n-Nitrosodiphenylamine	86-30-6	99000	49500	330	200	11	50	115	30
1,2,4,5-Tetrachlorobenzene	95-94-3	1800	900	330	200	42	70	130	30
4-Bromophenyl-phenylether	101-55-3	NC	Lab LOD	330	200	47	45	115	30
Hexachlorobenzene	118-74-1	300	150	330	200	38	45	120	30
Atrazine	1912-24-9	2100	1050	330	200	77	0	150	30
Pentachlorophenol	87-86-5	890	445	330	200	89	25	120	30
Phenanthrene	85-01-8	1700000	850000	33	17	11	50	110	30
Anthracene	120-12-7	1700000	850000	33	17	10	55	105	30
Carbazole	86-74-8	NC	Lab LOD	330	200	47	45	115	30
Di-n-butylphthalate	84-74-2	610000	305000	330	200	73	55	110	30
Fluoranthene	206-44-0	230000	115000	33	17	16	55	115	30
Pyrene	129-00-0	170000	85000	33	17	13	45	125	30
Butylbenzylphthalate	85-68-7	260000	130000	330	200	85	50	125	30
3,3'-Dichlorobenzidine	91-94-1	1100	550	330	200	63	10	130	30
Benzo(a)anthracene	56-55-3	150	75	33	17	11	50	110	30
Chrysene	218-01-9	15000	7500	33	17	13	55	110	30
bis(2-Ethylhexyl)phthalate	117-81-7	35000	17500	330	200	78	45	125	30
Di-n-octylphthalate	117-84-0	35000	17500	330	200	75	40	130	30
Benzo(b)fluoranthene	205-99-2	150	75	33	17	14	45	115	30
Benzo(k)fluoranthene	207-08-9	1500	750	33	17	13	45	125	30
Benzo(a)pyrene	50-32-8	15	7.5	33	17	9.4	50	110	30
Indeno(1,2,3-cd)pyrene	193-39-5	150	75	33	17	13	40	120	30
Dibenz(a,h)anthracene	53-70-3	15	7.5	33	17	14	40	125	30
Benzo(g,h,i)perylene	191-24-2	170000	85000	33	17	14	40	125	30
2,3,4,6-Tetrachlorophenol	58-90-2	180000	90000	330	200	100	70	130	30

¹ PALs were developed to be protective of human health and the environment. Refer to **Worksheet#11** for a discussion on PAL development

² PQL Goals were determined on a case by case basis and in most cases are at least half of the PAL. If no PALs are available, the PQL Goal is equivalent to the laboratory's LOD.

NC = No Criteria

Adjusted RSLs are from the USEPA RSLs for Residential Soil, (**May 2012**), adjusted for noncancerous effects by dividing RSLs based on non-cancer by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver).

Analytical data will be compared to the most recent version of the RSLs at the time that analytical data is available for use. **Bold italic** RSLs and PQLs are updated from the initial RI PALs (June 2011) to reflect the current PALs.

Shading of an entire cell represents cases where the PAL is lower than the laboratory LOD.

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

Matrix: Subsurface Soil

Analytical Group: Pesticides (Supplemental RI only)

Analyte	CAS Number	Adjusted Residential Soil RSLs ¹ (µg/kg)	Project Quantitation Limit Goal ² (µg/kg)	Laboratory-Specific (µg/kg)			LCS, MS, and MSD %R and RPD Limits ³		
				LOQ	LOD	DL	LCL	UCL	%RPD
alpha-BHC	319-84-6	77	38.5	1.7	1	0.49	60	125	30
beta-BHC	319-85-7	270	135	1.7	1	1.0	60	125	
delta-BHC	319-86-8	270	135	1.7	1	0.48	55	130	
gamma-BHC (Lindane)	58-89-9	520	260	1.7	1	0.45	60	125	
Heptachlor	76-44-8	110	55	1.7	1	0.53	50	140	
Aldrin	309-00-2	29	14.5	1.7	1	0.49	45	140	
Heptachlor epoxide	1024-57-3	53	26.5	1.7	1	0.48	65	130	
Endosulfan I	959-98-8	37000	18500	1.7	1	0.39	15	135	
Dieldrin	60-57-1	30	15	1.7	1	0.45	65	125	
4,4'-DDE	72-55-9	1400	700	1.7	1	0.52	70	125	
Endrin	72-20-8	1800	900	1.7	1	0.74	60	135	
Endosulfan II	33213-65-9	37000	18500	1.7	1	0.48	35	140	
4,4'-DDD	72-54-8	2000	1000	1.7	1	0.48	30	135	
Endosulfan sulfate	1031-07-8	37000	18500	1.7	1	0.49	60	135	
4,4'-DDT	50-29-3	1700	850	1.7	1	0.66	45	140	
Methoxychlor	72-43-5	31000	15500	1.7	1	0.86	55	145	
Endrin ketone	53494-70-5	1800	900	1.7	1	0.45	65	135	
Endrin aldehyde	7421-93-4	1800	900	1.7	1	0.50	35	145	
alpha-Chlordane	5103-71-9	1600	800	1.7	1	0.45	65	120	
gamma-Chlordane	5103-74-2	1600	800	1.7	1	0.45	65	125	
Toxaphene	8001-35-2	440	220	33	20	8	60	140	40

¹ PALs were developed to be protective of human health and the environment. Refer to **Worksheet#11** for a discussion on PAL development
 Adjusted RSLs are from the USEPA RSLs for Residential Soil, (*May 2012*) adjusted for noncancerous effects by dividing RSLs based on non-cancer by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver). Analytical data will be compared to the most recent version of the RSLs at the time that analytical data is available for use.

² PQL Goals were determined on a case by case basis and in most cases are at least half of the PAL. If no PALs are available, the PQL Goal is equivalent to the laboratory's LOD.

³ DoD QSM v.4.1 is the basis for LCS and MS/MSD limits: values are bolded to indicate instances where in-house limits are used.

NC = No Criteria

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

Matrix: Subsurface Soil

Analytical Group: PCBs (Supplemental RI Only)

Analyte	CAS Number	Adjusted Residential Soil RSLs ¹ (µg/kg)	Project Quantitation Limit Goal ² (µg/kg)	Laboratory-Specific (µg/kg)			LCS, MS, and MSD %R and RPD Limits ³		
				LOQ	LOD	DL	LCL	UCL	%RPD
Aroclor-1016	12674-11-2	390	195	40	20	6.9	40	140	16
Aroclor-1221	11104-28-2	140	70	40	20	12	NA	NA	NA
Aroclor-1232	11141-16-5	140	70	40	20	13			
Aroclor-1242	53469-21-9	220	110	40	20	10			
Aroclor-1248	12672-29-6	220	110	40	20	5.5			
Aroclor-1254	11097-69-1	110	55	40	20	12			
Aroclor-1260	11096-82-5	220	110	40	20	3.0	60	130	12

¹ PALs were developed to be protective of human health and the environment. Refer to **Worksheet#11** for a discussion on PAL development

Adjusted RSLs are from the USEPA RSLs for Residential Soil, (**May 2012**) adjusted for noncancerous effects by dividing RSLs based on non-cancer by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver). Analytical data will be compared to the most recent version of the RSLs at the time that analytical data is available for use.

² PQL Goals were determined on a case by case basis and in most cases are at least half of the PAL. If no PALs are available, the PQL Goal is equivalent to the laboratory's LOD.

³ DoD QSM v.4.1 is the basis for LCS and MS/MSD limits: values are bolded to indicate instances where in-house limits are used.

NC = No Criteria

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

Matrix: Surface Soil, Subsurface Soil

Analytical Group: Metals

Analyte	CAS Number	Adjusted Residential Soil RSLs ¹ milligrams per kilogram (mg/kg)	Yorktown Background for Subsurface Soil ¹ (mg/kg)	PQL Goal ² (mg/kg)	Laboratory-Specific			MS/MSD and LCS Recovery Limits		
					LOQ (mg/kg)	LOD (mg/kg)	DL (mg/kg)	Lower Limit (%)	Upper Limit (%)	RPD (%)
Aluminum	7429-90-5	7700	13,000	3850	40	20	5.2	80	120	20
Antimony	7440-36-0	3.1	NC	1.55	0.5	0.3	0.2	80	120	20
Arsenic	7440-38-2	0.39	5.54	0.195	20	10	0.51	80	120	20
Barium	7440-39-3	1500	84.5	7500	10	3.5	1.1	80	120	20
Beryllium	7440-41-7	16	0.52	8	2	0.3	0.1	80	120	20
Cadmium	7440-43-9	7	NC	3.5	8	4	0.13	80	120	20
Calcium	7440-70-2	NC	2,380	Lab LOD	600	300	18	80	120	20
Chromium	7440-47-3	0.29	33.7	0.145	10	5	0.55	80	120	20
Cobalt	7440-48-4	2.3	5.18	1.15	1	0.6	0.14	80	120	20
Copper	7440-50-8	310	3.17	155	2	1	0.22	80	120	20
Iron	7439-89-6	5500	32,000	2750	14	7	1.7	80	120	20
Lead	7439-92-1	400	8.79	200	5	1	0.24	80	120	20
Magnesium	7439-95-4	NC	1,120	Lab LOD	220	110	28	80	120	20
Manganese	7439-96-5	180	176	90	2.4	1.2	0.28	80	120	20
Mercury (Hg)	7439-97-6	2.3	0.14	1.15	0.0162	0.0081	0.0019	80	120	20
Nickel	7440-02-0	150	17.6	75	1.2	0.6	0.25	80	120	20
Potassium	7440-09-7	NC	901	Lab LOD	1000	500	29	80	120	20
Selenium	7782-49-2	39	0.64	19.5	7	3.5	0.91	80	120	20
Silver	7440-22-4	39	1.1	19.5	0.5	0.08	0.033	80	120	20
Sodium	7440-23-5	NC	811	Lab LOD	400	200	47	80	120	20
Thallium	7440-28-0	0.078	NC	0.039	1	0.15	0.037	80	120	20
Vanadium	7440-62-2	39	48.3	19.5	2	1	0.22	80	120	20
Zinc	7440-66-6	2300	28	1150	10	5	1.3	80	120	20
CN	57-12-5	4.7	2.7	2.3	0.48	0.24	0.095	85	115	20

¹ PALs were developed to be protective of human health and the environment. Refer to **Worksheet#11** for a discussion on PAL development. Yorktown Background concentrations for metals were not previously included in Worksheet 15 of the initial RI UFP-SAP.

² PQL Goals were determined on a case by case basis and in most cases are at least half of the PAL. If no PALs are available, the PQL Goal is equivalent to the laboratory's LOD.

NC = No Criteria

Adjusted RSLs are from the USEPA RSLs for Residential Soil, **May 2012**, adjusted for noncancerous effects by dividing RSLs based on non-cancer by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver). Analytical data will be compared to the most recent version of the RSLs at the time that analytical data is available for use. **Bold italic** RSLs and PQLs are updated from the initial RI PALs (June 2011) to reflect the current PALs.

Shading of an entire cell represents cases where the PAL is lower than the laboratory LOD.

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

Matrix: Surface Soil, Subsurface Soil

Analytical Group: Explosives

Analyte	CAS Number	Adjusted Residential Soil RSLs ¹ (µg/kg)	PQL Goal ² (µg/kg)	Laboratory-Specific			MS/MSD and LCS Recovery Limits		
				LOQ (µg/kg)	LOD (µg/kg)	DL (µg/kg)	Lower Limit (%)	Upper Limit (%)	RPD (%)
cyclotetramethylenetetranitramine (HMX)	2691-41-0	380000	190000	500	300	100	51	132	30
RDX	121-82-4	5600	2800	500	200	100	65	136	30
1,3,5-Trinitrobenzene	99-35-4	220000	110000	500	200	100	56	120	30
1,3-Dinitrobenzene (DNB)	99-65-0	610	305	500	300	150	80	120	30
Methyl-2,4,6-trinitrophenylnitramine	479-45-8	24000	12000	500	200	100	32	111	30
Nitrobenzene	98-95-3	4800	2400	500	300	150	65	123	30
2,4,6-Trinitrotoluene	118-96-7	3600	1800	500	200	100	70	130	30
4-Amino-2,6-DNT	1946-51-0	15000	7500	500	200	100	72	130	30
2-Amino-4,6-DNT	35572-78-2	15000	7500	500	300	150	71	135	30
2,4-DNT	121-14-2	1600	800	500	200	100	77	123	30
2,6-DNT	606-20-2	6100	3050	500	200	100	80	120	30
2-Nitrotoluene (NT)	88-72-2	2900	1450	500	200	100	63	128	30
3-NT	99-08-1	610	305	500	200	100	63	124	30
4-NT	99-99-0	24000	12000	500	200	100	64	129	30
3,5-Dinitroaniline	618-87-1	610 ³	305	1000	500	250	76	126	30
PETN	78-11-5	12000	6000	2000	1460	730	58	150	30
Nitroglycerin	55-63-0	6200	3100	1000	500	250	49	135	30

¹ PALs were developed to be protective of human health and the environment. Refer to **Worksheet#11** for a discussion on PAL development

² PQL Goals were determined on a case by case basis and in most cases are at least half of the PAL. If no PALs are available, the PQL Goal is equivalent to the laboratory's LOD.

³ Surrogate value derived from Adjusted Residential Soil RSL for 1,2-DNB divided by ten.

NC = No Criteria

Adjusted RSLs are from the USEPA RSLs for Residential Soil, **May 2012**, adjusted for noncancerous effects by dividing RSLs based on non-cancer by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver). Analytical data will be compared to the most recent version of the RSLs at the time that analytical data is available for use.

SAP Worksheet #15-8—Reference Limits and Evaluation Table

Matrix: Surface Water

Analytical Group: VOCs

Analyte	CAS Number	PALs ¹		PQL Goal ² (µg/L)	Laboratory-Specific			MS/MSD and LCS Recovery Limits		
		Adjusted Tap Water RSLs x 10 for Surface Water (µg/L)	Eco PAL (µg/L)		LOQ (µg/L)	LOD (µg/L)	DL (µg/L)	Lower Limit (%)	Upper Limit (%)	RPD (%)
VC	75-01-4	<i>0.15</i>	930	0.08	1	1	0.71	50	145	30
1,1-DCE	75-35-4	<i>260</i>	25	<i>12.5</i>	1	1	0.94	70	130	30
trans-1,2-DCE	156-60-5	<i>86</i>	590	<i>43</i>	1	1	0.72	60	140	30
cis-1,2-DCE	156-59-2	<i>28</i>	590	<i>14</i>	1	1	0.49	70	125	30
TCE	79-01-6	<i>2.6</i>	47	<i>1.3</i>	1	1	0.55	70	125	30

¹ PALs were developed to be protective of human health and the environment. Refer to **Worksheet#11** for a discussion on PAL development

² PQL Goals were determined on a case by case basis and in most cases are at least half of the PAL. If no PALs are available, the PQL Goal is equivalent to the laboratory's LOD.

NC = No Criteria

Adjusted RSLs are from the USEPA RSLs for Tap Water, **May 2012**, adjusted for noncancerous effects by dividing RSLs based on non-cancer by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver). Additionally RSLs are multiplied by 10 to account for surface water. Analytical data will be compared to the most recent version of the RSLs at the time that analytical data is available for use. ***Bold italic*** RSLs and PQLs are updated from the initial RI PALs (June 2011) to reflect the current PALs.

Eco PALs are based upon available Ecological Screening Values for Fresh Surface Water from literature compiled for use at WPNSTA Yorktown.

Shading of an entire cell represents cases where the PAL is lower than the laboratory LOD.

SAP Worksheet #15-9—Reference Limits and Evaluation Table

Matrix: Subslab Vapor

Analytical Group: VOCs

Analyte	CAS Number	Industrial Air RSLs ¹ (µg/m ³)	PQL Goal ² (µg/m ³)	Laboratory-specific			LCS Recovery Limits	
				LOQ (µg/m ³)	LOD (µg/m ³)	DL (µg/m ³)	LCL (%)	UCL (%)
Chloromethane	74-87-3	390	195	5.16	5.16	1.26	58	141
VC	75-01-4	28	14	6.39	6.39	1.53	68	148
Trichlorofluoromethane (Freon-11)	75-69-4	3100	1550	14.04	14.04	2.92	64	158
1,1-DCE	75-35-4	880	440	9.91	9.91	1.74	53	175
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	76-13-1	130000	65000	19.15	19.15	5.13	48	178
Methylene chloride	75-09-2	12000	130	8.68	8.68	8.33	10	200
trans-1,2-DCE	156-60-5	260	130	9.91	9.91	2.38	69	156
cis-1,2-DCE	156-59-2	NC	9.91	9.91	9.91	1.94	63	144
Chloroform	67-66-3	5.3	2.65	12.2	12.2	2.25	56	165
1,2-DCA	107-06-2	4.7	2.35	10.11	10.11	1.46	66	156
TCE	79-01-6	30	22	13.43	13.43	1.67	59	133

¹ PALs were developed to be protective of human health and the environment. Refer to **Worksheet#11** for a discussion on PAL development

² PQL Goals were determined on a case by case basis and in most cases are at least half of the PAL. If no PALs are available, the PQL Goal is equivalent to the laboratory's LOD.

NC = No Criteria

Industrial Air RSLs are from the USEPA RSLs for Industrial Air, **May 2012**. RSLs were adjusted by an attenuation factor of 0.1 for subslab vapor. **Bold italic** RSLs and PQLs are updated from the initial RI PALs (June 2011) to reflect the current PALs.

Shading of an entire cell represents cases where the PAL is lower than the laboratory LOD.

SAP Worksheet #15-10—Reference Limits and Evaluation Table

Matrix: Indoor Air, Ambient Air

Analytical Group: VOCs

Analyte	CAS Number	Industrial Air RSLs ¹ (µg/m ³)	PQL Goal ² (µg/m ³)	Laboratory-specific			LCS Recovery Limits	
				LOQ (µg/m ³)	LOD (µg/m ³)	DL (µg/m ³)	LCL (%)	UCL (%)
Chloromethane	74-87-3	39	13.00	5.16	5.16	1.26	58	141
VC	75-01-4	2.8	0.93	6.39	6.39	1.53	68	148
Trichlorofluoromethane(Freon-11)	75-69-4	310	103.33	14.04	14.04	2.92	64	158
1,1-DCE	75-35-4	88	29.33	9.91	9.91	1.74	53	175
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	76-13-1	13000	4333.33	19.15	19.15	5.13	48	178
Methylene chloride	75-09-2	1200	8.67	8.68	8.68	8.33	10	200
trans-1,2-DCE	156-60-5	26	8.67	9.91	9.91	2.38	69	156
cis-1,2-DCE	156-59-2	NC	0.00	9.91	9.91	1.94	63	144
Chloroform	67-66-3	0.53	0.18	12.2	12.2	2.25	56	165
1,2-DCA	107-06-2	0.47	0.16	10.11	10.11	1.46	66	156
TCE	79-01-6	3	2.4	13.43	13.43	1.67	59	133

¹ PALs were developed to be protective of human health and the environment. Refer to **Worksheet#11** for a discussion on PAL development

² PQL Goals were determined on a case by case basis and in most cases are at least half of the PAL. If no PALs are available, the PQL Goal is equivalent to the laboratory's LOD.

NC = No Criteria

Industrial Air RSLs are from the USEPA RSLs for Industrial Air, **May 2012. Bold italic** RSLs and PQLs are updated from the initial RI PALs (June 2011) to reflect the current PALs.

Shading of an entire cell represents cases where the PAL is lower than the laboratory LOD.

SAP Worksheet #15-11—Reference Limits and Evaluation Table

Matrix: Groundwater (Supplemental RI Only)

Analytical Group: VOCs

Analyte	CAS Number	Adjusted Tap Water RSLs ¹ (µg/L)	MCL ¹ (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
Dichlorodifluoromethane (Freon-12)	75-71-8	19	NC	9.5	2	1	0.74	30	155	30
Chloromethane	74-87-3	19	NC	9.5	2	1	0.82	40	125	
Vinyl chloride	75-01-4	0.015	2	0.0075	2	1	0.71	50	145	
Bromomethane	74-83-9	0.7	NC	0.35	2	1	0.95	30	145	
Chloroethane	75-00-3	2100	NC	1050	2	1	0.98	60	135	
Trichlorofluoromethane(Freon-11)	75-69-4	110	NC	55	2	1	0.94	60	145	
1,1-Dichloroethene	75-35-4	26	7	3.5	2	1	0.94	70	130	
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	76-13-1	5300	NC	2650	2	1	0.73	47	173	
Acetone	67-64-1	1200	NC	600	25	12	1.8	40	140	
Carbon disulfide	75-15-0	72	NC	36	10	5	2.6	35	160	
Methyl acetate	79-20-9	1600	NC	800	2	1	0.95	24	129	
Methylene chloride	75-09-2	8.4	5	2.5	10	5	0.71	55	140	
trans-1,2-Dichloroethene	156-60-5	8.6	100	4.3	2	1	0.73	60	140	
Methyl-tert-butyl ether (MTBE)	1634-04-4	12	NC	6	2	1	0.6	65	125	
1,1-Dichloroethane	75-34-3	2.4	NC	1.2	2	1	0.62	70	135	
cis-1,2-Dichloroethene	156-59-2	2.8	70	1.4	2	1	0.53	70	125	
2-Butanone	78-93-3	490	NC	245	25	12	4.5	30	150	
Bromochloromethane	74-97-5	8.3	NC	4.15	2	1	0.94	65	130	
Chloroform	67-66-3	0.19	80	0.095	2	1	0.8	65	135	
1,1,1-Trichloroethane	71-55-6	750	200	100	2	1	0.8	65	130	
Cyclohexane	110-82-7	1300	NC	650	2	1	0.93	45	147	
Carbon tetrachloride	56-23-5	0.39	5	0.195	2	1	0.94	65	140	
Benzene	71-43-2	0.39	5	0.195	2	1	0.71	80	120	
1,2-Dichloroethane	107-06-2	0.15	5	0.075	2	1	0.63	70	130	
Trichloroethene	79-01-6	0.26	5	0.13	2	1	0.89	70	125	
Methylcyclohexane	108-87-2	NC	NC	Lab LOD	2	1	0.64	55	121	
1,2-Dichloropropane	78-87-5	0.38	5	0.19	2	1	0.8	75	125	
Bromodichloromethane	75-27-4	0.12	80	0.06	2	1	0.52	75	120	
cis-1,3-Dichloropropene	10061-01-5	0.41	NC	0.205	2	1	0.59	70	130	
4-Methyl-2-pentanone	108-10-1	100	NC	50	5	2.5	0.79	60	135	
Toluene	108-88-3	86	1000	43	2	1	0.72	75	120	
trans-1,3-Dichloropropene	10061-02-6	0.41	NC	0.205	2	1	0.73	55	140	

SAP Worksheet #15-11—Reference Limits and Evaluation Table (continued)

Matrix: Groundwater (Supplemental RI Only)

Analytical Group: VOCs

Analyte	CAS Number	Adjusted Tap Water RSLs ¹ (µg/L)	MCL ¹ (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
1,1,2-Trichloroethane	79-00-5	0.041	5	0.0205	2	1	0.76	75	125	30
Tetrachloroethene	127-18-4	3.5	5	1.75	2	1	0.76	45	150	
2-Hexanone	591-78-6	3.4	NC	1.7	5	2.5	1.4	55	130	
Dibromochloromethane	124-48-1	0.15	80	0.075	2	1	0.44	60	135	
1,2-Dibromoethane	106-93-4	0.0065	0.05	0.00325	2	1	0.78	80	120	
Chlorobenzene	108-90-7	7.2	100	3.6	2	1	0.72	80	120	
Ethylbenzene	100-41-4	1.3	700	0.65	2	1	0.69	75	125	
o-Xylene	95-47-6	19	NC	9.5	2	1	0.53	80	120	
m- and p-Xylene	m&pXYLENE	19	NC	9.5	4	2	1.3	75	130	
Styrene	100-42-5	110	100	50	2	1	0.61	65	135	
Bromoform	75-25-2	7.9	80	3.95	2	1	0.75	70	130	
Isopropylbenzene	98-82-8	39	NC	19.5	2	1	0.67	75	125	
1,1,1,2-Tetrachloroethane	79-34-5	0.066	NC	0.033	2	1	0.54	65	130	
1,3-Dichlorobenzene	541-73-1	NC	NC	Lab LOD	2	1	0.77	75	125	
1,4-Dichlorobenzene	106-46-7	0.42	75	0.21	2	1	0.76	75	125	
1,2-Dichlorobenzene	95-50-1	28	600	14	2	1	0.73	70	120	
1,2-Dibromo-3-chloropropane	96-12-8	0.00032	0.2	0.00016	10	5	0.96	50	130	
1,2,4-Trichlorobenzene	120-82-1	0.39	70	0.195	2	1	0.7	65	135	
1,2,3-Trichlorobenzene	87-61-6	0.52	NC	0.26	2	1	0.86	65	135	

¹ PALs were developed to be protective of human health and the environment. Refer to **Worksheet#11** for a discussion on PAL development

Adjusted RSLs are from the USEPA RSLs for Residential Soil, (May 2012) adjusted for noncancerous effects by dividing RSLs based on non-cancer by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver). Analytical data will be compared to the most recent version of the RSLs at the time that analytical data is available for use.

² PQL Goals were determined on a case by case basis and in most cases are at least half of the PAL. If no PALs are available, the PQL Goal is equivalent to the laboratory's LOD.

³ DoD QSM v.4.1 is the basis for LCS and MS/MSD limits: values are bolded to indicate instances where in-house limits are used.

NC = No Criteria

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

SAP Worksheet #15-12—Reference Limits and Evaluation Table

Matrix: Groundwater (Supplemental RI Only)

Analytical Group: SVOCs

Analyte	CAS Number	Full Scan or SIM	Adjusted Tap Water RSLs ¹ (µg/L)	MCL ¹ (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
Benzaldehyde	100-52-7	Full Scan	150	NC	75	10	6	5.4	43	87	30
Phenol	108-95-2	Full Scan	450	NC	225	10	3	1.4	0	115	
bis(2-Chloroethyl)ether	111-44-4	Full Scan	0.012	NC	0.006	10	6	3.2	35	110	
2-Chlorophenol	95-57-8	Full Scan	7.1	NC	3.55	10	6	2.8	35	105	
2-Methylphenol	95-48-7	Full Scan	72	NC	36	10	3	2.3	40	110	
2,2'-Oxybis(1-chloropropane)	108-60-1	Full Scan	0.31	NC	0.155	10	6	3.1	25	130	
Acetophenone	98-86-2	Full Scan	150	NC	75	10	3	3	41	92	
3 & 4-Methylphenol	106-44-5	Full Scan	140	NC	70	10	6	4.5	30	110	
n-Nitroso-di-n-propylamine	621-64-7	Full Scan	0.0093	NC	0.00465	10	6	3.4	35	130	
Hexachloroethane	67-72-1	Full Scan	0.51	NC	0.255	10	3	2.9	30	100	
Nitrobenzene	98-95-3	Full Scan	0.12	NC	0.06	10	6	3.1	45	110	
Isophorone	78-59-1	Full Scan	67	NC	33.5	10	3	2.9	50	110	
2-Nitrophenol	88-75-5	Full Scan	7.1	NC	3.55	10	6	3.1	40	115	
2,4-Dimethylphenol	105-67-9	Full Scan	27	NC	13.5	10	6	2.7	30	110	
bis(2-Chloroethoxy)methane	111-91-1	Full Scan	4.7	NC	2.35	10	6	2.7	45	105	
2,4-Dichlorophenol	120-83-2	Full Scan	3.5	NC	1.75	10	6	3.3	50	105	
Naphthalene	91-20-3	SIM	0.14	NC	0.07	0.1	0.08	0.045	40	100	
4-Chloroaniline	106-47-8	Full Scan	0.32	NC	0.16	10	6	2.7	15	110	
Hexachlorobutadiene	87-68-3	Full Scan	0.26	NC	0.13	10	6	3.6	25	105	
Caprolactam	105-60-2	Full Scan	770	NC	385	10	3	2.7	14	31	
4-Chloro-3-methylphenol	59-50-7	Full Scan	110	NC	55	10	6	2.6	45	110	
2-Methylnaphthalene	91-57-6	SIM	2.7	NC	1.35	0.1	0.08	0.046	45	105	
Hexachlorocyclopentadiene	77-47-4	Full Scan	2.2	50	1.1	10	6	3.8	13	120	
2,4,6-Trichlorophenol	88-06-2	Full Scan	0.9	NC	0.45	10	6	3.7	50	115	
2,4,5-Trichlorophenol	95-95-4	Full Scan	89	NC	44.5	10	6	3.6	50	110	
1,1-Biphenyl	92-52-4	Full Scan	0.083	NC	0.0415	10	9	7	46	83	
2-Chloronaphthalene	91-58-7	Full Scan	55	NC	27.5	10	3	3	50	105	
2-Nitroaniline	88-74-4	Full Scan	15	NC	7.5	10	3	2.8	50	115	
Dimethyl phthalate	131-11-3	Full Scan	NC	NC	Lab LOD	10	3	2.9	25	125	
2,6-Dinitrotoluene	606-20-2	Full Scan	1.5	NC	0.75	10	3	2.7	50	115	
Acenaphthylene	208-96-8	SIM	40	NC	20	0.1	0.08	0.052	50	105	
3-Nitroaniline	99-09-2	Full Scan	NC	NC	Lab LOD	10	3	2.8	25	125	

SAP Worksheet #15-12—Reference Limits and Evaluation Table (continued)

Matrix: Groundwater (Supplemental RI Only)
Analytical Group: SVOCs

Analyte	CAS Number	Full Scan or SIM	Adjusted Tap Water RSLs ¹ (µg/L)	MCL ¹ (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
Acenaphthene	83-32-9	SIM	40	NC	20	0.1	0.08	0.049	45	110	30
2,4-Dinitrophenol	51-28-5	Full Scan	3	NC	1.5	10	6	5.2	15	140	
4-Nitrophenol	100-02-7	Full Scan	0.12	NC	0.06	10	3	2.3	0	125	
Dibenzofuran	132-64-9	Full Scan	0.58	NC	0.29	10	3	2.8	55	105	
2,4-Dinitrotoluene	121-14-2	Full Scan	0.2	NC	0.1	10	6	2.8	50	120	
Diethylphthalate	84-66-2	Full Scan	1100	NC	550	10	3	3	40	120	
Fluorene	86-73-7	SIM	22	NC	11	0.1	0.08	0.049	50	110	
4-Chlorophenyl-phenylether	7005-72-3	Full Scan	2.7	NC	1.35	10	6	3.2	50	110	
4-Nitroaniline	100-01-6	Full Scan	3.3	NC	1.65	10	3	2.7	35	120	
4,6-Dinitro-2-methylphenol	534-52-1	Full Scan	0.12	NC	0.06	10	6	6	40	130	
N-nitrosodiphenylamine/Diphenylamine	86-30-6	Full Scan	10	NC	5	10	6	5.4	50	110	
1,2,4,5-Tetrachlorobenzene	95-94-3	Full Scan	0.12	NC	0.06	10	6	3.2	24	69	
4-Bromophenyl-phenylether	101-55-3	Full Scan	NC	NC	Lab LOD	10	6	3.3	50	115	
Hexachlorobenzene	118-74-1	Full Scan	0.042	1	0.021	10	3	3	50	110	
Atrazine	1912-24-9	Full Scan	0.26	3	0.13	10	3	2.9	57	88	
Pentachlorophenol	87-86-5	Full Scan	0.17	1	0.085	10	9	6.3	40	115	
Phenanthrene	85-01-8	SIM	130	NC	65	0.1	0.08	0.044	50	115	
Anthracene	120-12-7	SIM	130	NC	65	0.1	0.08	0.044	55	110	
Carbazole	86-74-8	Full Scan	NC	NC	Lab LOD	10	3	2.5	50	115	
Di-n-butylphthalate	84-74-2	Full Scan	67	NC	33.5	10	3	2.7	55	115	
Fluoranthene	206-44-0	SIM	63	NC	31.5	0.1	0.08	0.054	55	115	
Pyrene	129-00-0	SIM	8.7	NC	4.35	0.1	0.08	0.053	50	130	
Butylbenzylphthalate	85-68-7	Full Scan	14	NC	7	10	3	2.8	45	115	
3,3'-Dichlorobenzidine	91-94-1	Full Scan	0.11	NC	0.055	10	6	3.2	20	110	
Benzo(a)anthracene	56-55-3	SIM	0.029	NC	0.0145	0.1	0.08	0.049	55	110	
Chrysene	218-01-9	SIM	2.9	NC	1.45	0.1	0.08	0.04	55	110	
bis(2-Ethylhexyl)phthalate	117-81-7	Full Scan	0.071	6	0.0355	10	6	3.5	40	125	
Di-n-octylphthalate	117-84-0	Full Scan	0.071	NC	0.0355	10	6	3.4	35	135	
Benzo(b)fluoranthene	205-99-2	SIM	0.029	NC	0.0145	0.1	0.08	0.051	45	120	
Benzo(k)fluoranthene	207-08-9	SIM	0.29	NC	0.145	0.1	0.08	0.054	45	125	
Benzo(a)pyrene	50-32-8	SIM	0.0029	0.2	0.00145	0.1	0.08	0.058	55	110	
Indeno(1,2,3-cd)pyrene	193-39-5	SIM	0.029	NC	0.0145	0.1	0.08	0.067	45	125	

SAP Worksheet #15-12—Reference Limits and Evaluation Table (continued)

Matrix: Groundwater (Supplemental RI Only)

Analytical Group: SVOCs

Analyte	CAS Number	Full Scan or SIM	Adjusted Tap Water RSLs ¹ (µg/L)	MCL ¹ (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
Dibenz(a,h)anthracene	53-70-3	SIM	0.0029	NC	0.00145	0.1	0.08	0.069	40	125	
Benzo(g,h,i)perylene	191-24-2	SIM	8.7	NC	4.35	0.1	0.08	0.063	40	125	
2,3,4,6-Tetrachlorophenol	58-90-2	Full Scan	17	NC	8.5	10	6	4.7	61	94	

¹ PALs were developed to be protective of human health and the environment. Refer to **Worksheet#11** for a discussion on PAL development

Adjusted RSLs are from the USEPA RSLs for Residential Soil, (May 2012) adjusted for noncancerous effects by dividing RSLs based on non-cancer by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver). Analytical data will be compared to the most recent version of the RSLs at the time that analytical data is available for use.

² PQL Goals were determined on a case by case basis and in most cases are at least half of the PAL. If no PALs are available, the PQL Goal is equivalent to the laboratory's LOD.

³ DoD QSM v.4.1 is the basis for LCS and MS/MSD limits: values are bolded to indicate instances where in-house limits are used.

NC = No Criteria

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

SAP Worksheet #15-13—Reference Limits and Evaluation Table

Matrix: Groundwater (Supplemental RI Only)

Analytical Group: Pesticides

Analyte	CAS Number	Adjusted Tap Water RSLs ¹ (µg/L)	MCL ¹ (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
alpha-BHC	319-84-6	0.0062	NC	0.0031	0.1	0.05	0.032	60	130	30
beta-BHC	319-85-7	0.022	NC	0.011	0.1	0.05	0.028	65	125	
delta-BHC	319-86-8	0.022	NC	0.011	0.1	0.05	0.043	45	135	
gamma-BHC (Lindane)	58-89-9	0.036	0.2	0.018	0.1	0.05	0.03	25	135	
Heptachlor	76-44-8	0.0018	0.4	0.0009	0.1	0.05	0.038	40	130	
Aldrin	309-00-2	0.00021	NC	0.000105	0.1	0.05	0.033	25	140	
Heptachlor epoxide	1024-57-3	0.0033	0.2	0.00165	0.1	0.05	0.027	60	130	
Endosulfan I	959-98-8	7.8	NC	3.9	0.1	0.05	0.025	50	110	
Dieldrin	60-57-1	0.0015	NC	0.00075	0.1	0.05	0.031	60	130	
4,4'-DDE	72-55-9	0.2	NC	0.1	0.1	0.05	0.023	35	140	
Endrin	72-20-8	0.17	2	0.085	0.1	0.05	0.019	55	135	
Endosulfan II	33213-65-9	7.8	NC	3.9	0.1	0.05	0.023	30	130	
4,4'-DDD	72-54-8	0.28	NC	0.14	0.1	0.05	0.023	25	150	
Endosulfan sulfate	1031-07-8	7.8	NC	3.9	0.1	0.05	0.02	55	135	
4,4'-DDT	50-29-3	0.2	NC	0.1	0.1	0.05	0.015	45	140	
Methoxychlor	72-43-5	2.7	40	1.35	0.1	0.05	0.014	55	150	
Endrin ketone	53494-70-5	0.17	2	0.085	0.1	0.05	0.012	75	125	
Endrin aldehyde	7421-93-4	0.17	2	0.085	0.1	0.05	0.024	55	135	
alpha-Chlordane	5103-71-9	0.027	NC	0.0135	0.1	0.05	0.027	65	125	
gamma-Chlordane	5103-74-2	0.027	NC	0.0135	0.1	0.05	0.038	60	125	
Toxaphene	8001-35-2	0.013	3	0.0065	1.3	0.64	0.18	60	140	40

¹ PALs were developed to be protective of human health and the environment. Refer to **Worksheet#11** for a discussion on PAL development

Adjusted RSLs are from the USEPA RSLs for Residential Soil, (May 2012) adjusted for noncancerous effects by dividing RSLs based on non-cancer by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver). Analytical data will be compared to the most recent version of the RSLs at the time that analytical data is available for use.

² PQL Goals were determined on a case by case basis and in most cases are at least half of the PAL. If no PALs are available, the PQL Goal is equivalent to the laboratory's LOD.

³ DoD QSM v.4.1 is the basis for LCS and MS/MSD limits: values are bolded to indicate instances where in-house limits are used.

NC = No Criteria

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

SAP Worksheet #15-14—Reference Limits and Evaluation Table

Matrix: Groundwater (Supplemental RI Only)

Analytical Group: PCBs

Analyte	CAS Number	Adjusted Tap Water RSLs ¹ (µg/L)	MCL ¹ (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
Aroclor-1016	12674-11-2	0.11	0.5	0.055	1	0.5	0.32	25	145	20
Aroclor-1221	11104-28-2	0.0043	0.5	0.00215	1	0.5	0.46	NA	NA	NA
Aroclor-1232	11141-16-5	0.0043	0.5	0.00215	1	0.5	0.45	NA	NA	NA
Aroclor-1242	53469-21-9	0.034	0.5	0.017	1	0.5	0.49	NA	NA	NA
Aroclor-1248	12672-29-6	0.034	0.5	0.017	1	0.5	0.24	NA	NA	NA
Aroclor-1254	11097-69-1	0.031	0.5	0.0155	1	0.5	0.46	NA	NA	NA
Aroclor-1260	11096-82-5	0.034	0.5	0.017	1	0.5	0.48	30	145	19

¹ PALs were developed to be protective of human health and the environment. Refer to **Worksheet#11** for a discussion on PAL development

Adjusted RSLs are from the USEPA RSLs for Residential Soil, (May 2012) adjusted for noncancerous effects by dividing RSLs based on non-cancer by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver). Analytical data will be compared to the most recent version of the RSLs at the time that analytical data is available for use.

² PQL Goals were determined on a case by case basis and in most cases are at least half of the PAL. If no PALs are available, the PQL Goal is equivalent to the laboratory's LOD.

³ DoD QSM v.4.1 is the basis for LCS and MS/MSD limits: values are bolded to indicate instances where in-house limits are used.

NC = No Criteria

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

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

Matrix: Groundwater (Supplemental RI Only)

Analytical Group: Total and Dissolved Metals

Analyte	CAS Number	Adjusted Tap Water RSLs ¹ (µg/L)	MCL ¹ (µg/L)	Yorktown, Cornwallis Cave Aquifer Background ¹ (µg/L)		Project Quantitation Limit Goal ² (µg/L)	Laboratory-Specific (µg/L)			LCS, MS, and MSD %R and RPD Limits ³		
				Total	Dissolved		LOQ	LOD	DL	LCL	UCL	% RPD
Aluminum	7429-90-5	1600	NC	2230	100	50	500	250	68	80	120	20
Antimony	7440-36-0	0.6	6	18.8	9.7	0.3	200	44	11			
Arsenic	7440-38-2	0.045	10	2.28	1.37	0.0225	20	10	61			
Barium	7440-39-3	290	2000	118	127	59	10	8	200			
Beryllium	7440-41-7	1.6	4	2.45	NC	0.8	0.74	0.37	9.4			
Cadmium	7440-43-9	0.69	5	0.605	0.177	0.0885	8	4	11			
Calcium	7440-70-2	NC	NC	158000	113000	56500	24000	12000	360			
Chromium	7440-47-3	0.031	100	15.1	6.04	0.0155	600	300	45			
Cobalt	7440-48-4	0.47	NC	20.6	0.7	0.235	10	8.4	2.1			
Copper	7440-50-8	62	1300	12.2	3	1.5	10	8.8	2.2			
Iron	7439-89-6	1100	NC	3590	275	137.5	300	150	38			
Lead	7439-92-1	NC	15	21.3	1.7	0.85	12	6	1.6			
Magnesium	7439-95-4	NC	NC	3600	11200	1800	2400	1200	300			
Manganese	7439-96-5	32	NC	57.9	49.5	16	26	13	3.2			
Mercury	7439-97-6	0.43	2	0.081	0.1	0.0405	2	0.69	0.23			
Nickel	7440-02-0	30	NC	11.4	12.2	5.7	24	12	3.2			
Potassium	7440-09-7	NC	NC	3490	12600	1745	35000	17500	480			
Selenium	7782-49-2	7.8	50	NC	9.1	3.9	52	26	6.5			
Silver	7440-22-4	7.1	NC	NC	NC	3.55	2.4	1.2	0.29			
Sodium	7440-23-5	NC	NC	9920	62800	4960	2400	1200	320			
Thallium	7440-28-0	0.016	2	NC	NC	0.008	4.6	2.3	0.58			
Vanadium	7440-62-2	7.8	NC	26.2	4.3	2.15	10	8	2			
Zinc	7440-66-6	470	NC	4.52	NC	2.26	120	60	16			
Cyanide ⁴	57-12-5	0.93	200	NC	NC	0.465	22	11	3.8	80	120	20

¹ PALs were developed to be protective of human health and the environment. Refer to **Worksheet#11** for a discussion on PAL development

Adjusted RSLs are from the USEPA RSLs for Residential Soil, (May 2012) adjusted for noncancerous effects by dividing RSLs based on non-cancer by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver). Analytical data will be compared to the most recent version of the RSLs at the time that analytical data is available for use.

² PQL Goals were determined on a case by case basis and in most cases are at least half of the PAL. If no PALs are available, the PQL Goal is equivalent to the laboratory's LOD.

³ DoD QSM v.4.1 is the basis for LCS and MS/MSD limits: values are bolded to indicate instances where in-house limits are used.

⁴ Cyanide will not be analyzed as a dissolved metal.

NC = No Criteria

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

SAP Worksheet #15-16—Reference Limits and Evaluation Table

Matrix: Groundwater (Supplemental RI Only)

Analytical Group: Explosives

Analyte	CAS Number	Adjusted Tap Water RSLs ¹ (µg/L)	MCL ¹ (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
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	2691-41-0	78	NC	39	0.325	0.208	0.104	80	115	30
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	121-82-4	0.61	NC	0.305	0.325	0.208	0.104	50	160	
1,3,5-Trinitrobenzene (1,3,5-TNB)	99-35-4	46	NC	23	0.325	0.208	0.104	65	140	
1,3-Dinitrobenzene (1,3-DNB)	99-65-0	0.15	NC	0.075	0.325	0.208	0.104	45	160	
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	479-45-8	6.3	NC	3.15	0.65	0.208	0.104	20	175	
Nitrobenzene (NB)	98-95-3	0.12	NC	0.06	0.325	0.208	0.104	50	140	
2,4,6-Trinitrotoluene (2,4,6-TNT)	118-96-7	0.76	NC	0.38	0.325	0.208	0.104	50	145	
4-Amino-2,6-dinitrotoluene (4-Am-DNT)	19406-51-0	3	NC	1.5	0.325	0.208	0.104	55	155	
2-Amino-4,6-dinitrotoluene (2-Am-DNT)	35572-78-2	3	NC	1.5	0.325	0.208	0.104	50	155	
2,4-Dinitrotoluene (2,4-DNT)	121-14-2	0.2	NC	0.1	0.325	0.208	0.104	60	135	
2,6-Dinitrotoluene (2,6-DNT)	606-20-2	1.5	NC	0.75	0.325	0.208	0.104	60	135	
2-Nitrotoluene (2-NT)	88-72-2	0.27	NC	0.135	0.325	0.213	0.107	45	135	
3-Nitrotoluene (3-NT)	99-08-1	0.13	NC	0.065	0.325	0.208	0.104	50	130	
4-Nitrotoluene (4-NT)	99-99-0	3.7	NC	1.85	0.65	0.39	0.195	50	130	
3,5-Dinitroaniline	618-87-1	NC	NC	Lab LOD	1.3	0.78	0.39	76	126	

¹ PALs were developed to be protective of human health and the environment. Refer to **Worksheet#11** for a discussion on PAL development

Adjusted RSLs are from the USEPA RSLs for Residential Soil, (May 2012) adjusted for noncancerous effects by dividing RSLs based on non-cancer by 10 to account for exposure to multiple constituents that effect the same target organ (i.e., liver). Analytical data will be compared to the most recent version of the RSLs at the time that analytical data is available for use.

² PQL Goals were determined on a case by case basis and in most cases are at least half of the PAL. If no PALs are available, the PQL Goal is equivalent to the laboratory's LOD.

³ DoD QSM v.4.1 is the basis for LCS and MS/MSD limits: values are bolded to indicate instances where in-house limits are used.

NC = No Criteria

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

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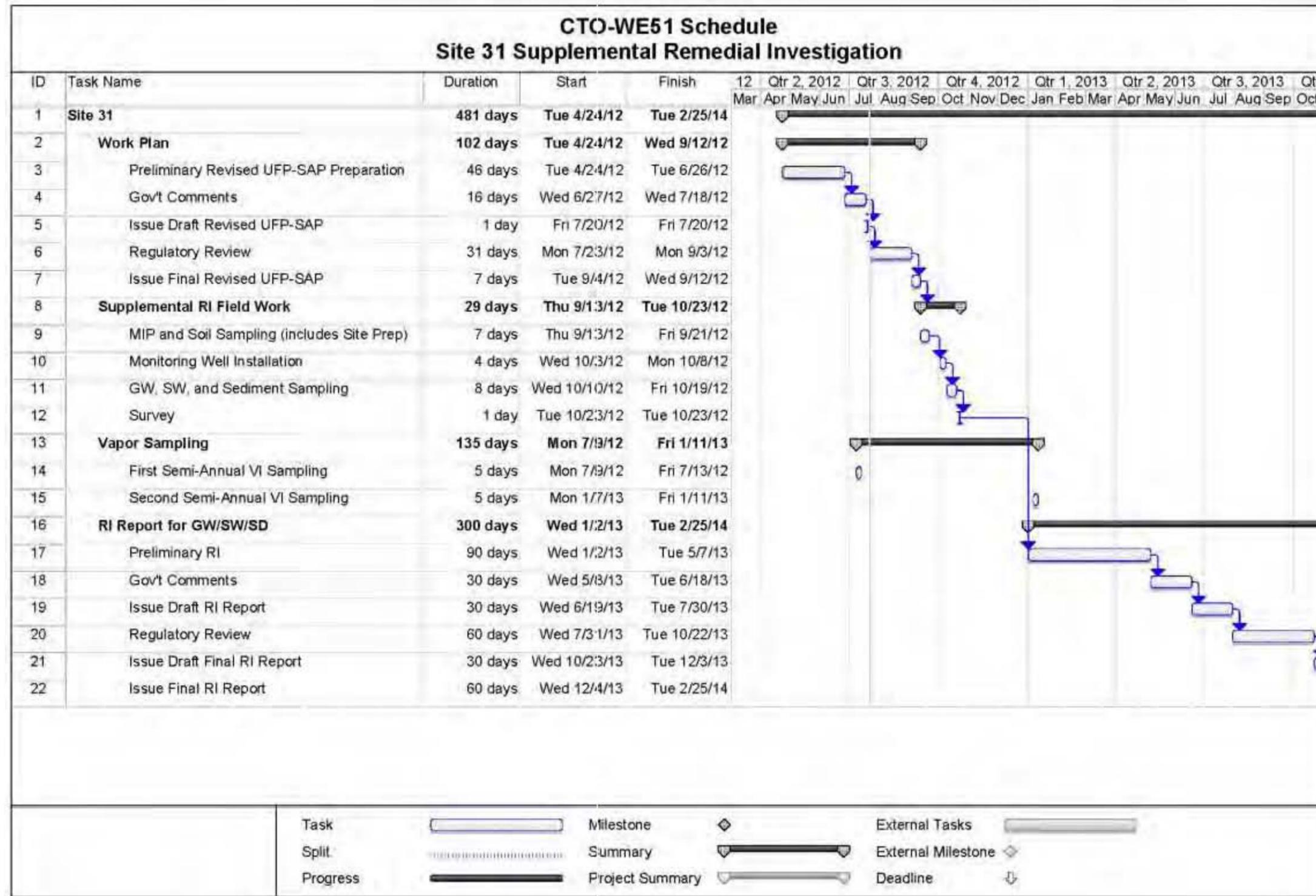
SAP Worksheet #16-1—Project Schedule / Timeline Table for Initial RI

ID	Task Name	Duration	Start	Finish	Predecessors	2009				2010				2011				2012			
						Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	Qtr 3	Qtr 4	Qtr 1	Qtr 2	
1	Site 31 NWS Yorktown	728 days	Fri 3/27/09	Tue 1/10/12																	
2	Preliminary Work Plan	90 days	Fri 3/27/09	Thu 7/30/09																	
3	Government Comments	15 days	Mon 8/3/09	Fri 8/21/09	2																
4	Draft Work Plan	14 days	Mon 8/24/09	Thu 9/10/09	3																
5	Regulator Comments	60 days	Fri 9/11/09	Thu 12/3/09	4																
6	Draft Final Work Plan	14 days	Fri 12/4/09	Wed 12/23/09	5																
7	Final Work Plan	30 days	Thu 12/24/09	Wed 2/3/10	6																
8	Preliminary RI Report	120 days	Thu 2/4/10	Wed 7/21/10	7																
9	Government Comments	14 days	Thu 7/22/10	Tue 8/10/10	8																
10	Draft RI Report	14 days	Wed 8/11/10	Mon 8/30/10	9																
11	Regulator Comments	60 days	Tue 8/31/10	Mon 11/22/10	10																
12	Draft Final RI Report	14 days	Tue 11/23/10	Fri 12/10/10	11																
13	Final RI Report	30 days	Mon 12/13/10	Fri 1/21/11	12																
14	Preliminary FS	120 days	Mon 1/24/11	Fri 7/8/11	13																
15	Government Comments	14 days	Mon 7/11/11	Thu 7/28/11	14																
16	Draft FS	14 days	Fri 7/29/11	Wed 8/17/11	15																
17	Regulator Comments	60 days	Thu 8/18/11	Wed 11/9/11	16																
18	Draft Final FS Report	14 days	Thu 11/10/11	Tue 11/29/11	17																
19	Final FS Report	30 days	Wed 11/30/11	Tue 1/10/12	18																

Project: Site 31 NWS Yorktown.mpp Date: Thu 7/16/09	Task		Milestone		External Tasks	
	Split		Summary		External Milestone	
	Progress		Project Summary		Deadline	

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SAP Worksheet #16-2—Project Schedule / Timeline Table for Supplemental RI



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SAP Worksheet #17-1—Initial RI Sampling Design and Rationale

Matrix	Depth of Samples	Analysis	Method	Number of Samples	Rationale	Sampling Strategy
Surface soil	0 to 6 inches	VOC	SW-846 8260B	20	Surface soil has never been evaluated in the Site 31 area. Deep subsurface soil (above the water table) was collected during the site assessment, and VOCs were detected. Samples are being analyzed for VOCs, SVOCs, metals, CN, and explosives, because these were the chemicals determined to be the most likely possible contaminants at the site based on former site use. Samples to be collected under the building will also help determine if a soil source to groundwater is present at the site. Soil samples will also be collected in other areas most likely to be contaminated based on historical use, such as near building exits where chemicals may have been dumped and in drainage ditches where contaminants may have accumulated.	Twenty samples are proposed across the site, consistent with the recommended number of samples obtained using VSP. Sample locations were selected in areas most likely to be impacted by site contaminants (see Worksheet #11 and Figure 11)
		SVOC	SW-846 8270D and 8270D SIM	20		
		Metals and CN	SW-846 6020A/ 7471B/ 9014	20		
		Explosives	SW-846 8330A	20		
Subsurface soil	1 to 3 feet bgs	VOC	SW-846 8260B	20	Shallow Subsurface soil has never been evaluated in the Site 31 area. Deep subsurface soil (above the water table) was collected during the site assessment, and VOCs were detected. Samples are being analyzed for VOCs, SVOCs, metals, CN, and explosives, because these were the chemicals determined to be the most likely possible contaminants at the site based on former site use. Sample locations will be co-located with surface soil locations to capture the areas most likely to receive contaminants and provide vertical distribution information, if necessary.	Twenty samples are proposed across the site, consistent with the recommended number of samples obtained using VSP software. Sample locations were selected in areas most likely to be impacted by site contaminants (see Worksheet #11 and Figure 11)
		SVOC	SW-846 8270D and 8270D SIM	20		
		Metals and CN	SW-846 6020A/ 7471B/ 9014	20		
		Explosives	SW-846 8330A	20		

SAP Worksheet #17-1—Initial RI Sampling Design and Rationale (continued)

Matrix	Depth of Samples	Analysis	Method	Number of Samples	Rationale	Sampling Strategy
Indoor Air	At an elevation consistent with the breathing zone.	VOC	TO-15	10	Samples will be collected from Sheds 3, 5, and 6, and Building 371 because soil contamination has been detected in this area and groundwater concentrations are consistent with a soil source. Consequently, sub-slab vapor concentrations are likely and indoor air sampling is likely to be necessary. Therefore, indoor air samples will be collected during the first round to eliminate the need to collect two additional rounds of indoor air and sub-slab samples if sub-slab vapor concentrations in exceedance of screening values are detected	Samples are evenly spaced along the buildings with 5 samples in each building. Sample locations may be moved based on any preferential pathways or possible source areas identified during the building survey. Tentative sample locations are included on Figure 12 and described on Worksheet #11 .
Air Intake Ambient Air	Field-determined based on air intake height			4	Samples will be collected from the air intake for Sheds 3, 5, and 6 and Building 371 to assess the air entering the building through the HVAC system.	Samples are based on air intakes observed during the building survey. Tentative sample locations are included on Figure 12 and described on Worksheet #11 .
Between-building Ambient Air	At an elevation consistent with the breathing zone.			2	Two samples will be collected between the buildings at Site 31 to evaluate outdoor air quality. These concentrations will be used in the evaluation to determine whether sub-slab concentrations maybe impacting indoor air.	Samples will be placed between buildings 3 and 6 and 4 and 5, respectively unless the building survey indicates air intakes in other areas where sampling may be beneficial. Tentative sample locations are included on Figure 12 and described on Worksheet #11 .
Upwind Background Air	At an elevation consistent with the breathing zone.			2	Two samples will be collected upwind of the Site 31 to evaluate background air concentrations. These background concentrations will be used in the evaluation to determine whether sub-slab concentrations maybe impacting indoor air.	Samples will be placed upwind of the site. Tentative locations are shown on Figure 12 . These locations were based on the prevailing wind direction for this area, but may be changed based on the wind direction at the time of sampling.

SAP Worksheet #17-1—Initial RI Sampling Design and Rationale (continued)

Matrix	Depth of Samples	Analysis	Method	Number of Samples	Rationale	Sampling Strategy
Sub-slab vapor	Beneath building foundation	VOC	TO-15	29	The sub-slab vapor samples are being collected to determine if a potentially complete pathway exists between groundwater and soil contamination and indoor air. Samples will be collected in Buildings 3, 4, 5, 6, 371, 1803, and 1804. For Buildings 3 and 6, results will be used to determine if any indoor air concentrations detected during the air sampling may be a result of vapor intrusion. For the remaining buildings, sub-slab samples will be used to determine if vapor intrusion sampling is necessary in accordance with Figure 12 .	Five samples each will be collected from the larger buildings (3 through 6), while three samples each will be collected from the smaller buildings (371, 1803, and 1804). Tentative sample locations are shown on Figure 12 , but these may be moved based on the results of the building survey.
Surface water	NA	TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE and VC	SW-846 8260B	5	Outfall discharge seep sample exceeded ecological screening value during the site assessment. Additional sampling adjacent to the outfall is warranted to evaluate the potential for ecological risks. Additionally, because the new surface water locations are biased toward the area most likely to receive contaminated discharge, samples will be used to reassess human health risks.	One sample will be collected upstream of the outfall to evaluate background sources, one will be taken at the point of discharge and three will be collected at 150 ft intervals downstream of the discharge.
Sediment	NA	TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE and VC	SW-846 8260B	5	Outfall discharge seep sample exceeded ecological screening value during the site assessment. Additional sampling adjacent to the outfall is warranted to evaluate the potential for ecological risks. Additionally, because the new sediment locations are biased toward the area most likely to receive contaminated discharge, samples will be used to reassess human health risks.	One sample will be collected upstream of the outfall to evaluate background sources, one will be taken at the point of discharge and three will be collected at 150 ft intervals downstream of the discharge.

Note: The final number and placement of samples is subject to the field team's professional opinion of where potential contamination may accumulate within the investigation area.

The actual number of equipment blanks, field blanks, and trip blanks may vary. One equipment blank will be collected each day of sampling; one field blank will be collected each week of sampling.

One MS and one MSD will be collected at a frequency of one per 20 samples collected per matrix.

One field duplicate will be collected at a frequency of one per 10 samples collected per matrix.

One trip blank will be collected at a frequency of one per cooler containing VOC samples.

SAP Worksheet #17-2—Supplemental RI Sampling Design and Rationale

Matrix	Depth of Samples	Analysis	Method	Number of Samples	Rationale	Sampling Strategy
Subsurface soil	Up to 40 feet bgs	VOC	SW-846 8260B	10	Samples are being analyzed for VOCs, SVOCs, metals, CN, and explosives, because these were the chemicals determined to be the most likely possible contaminants at the site based on former site use. Sample locations will be selected to confirm MIP responses indicating a source of groundwater contamination.	Ten samples are proposed in the MIP investigation area (see Worksheet #11 and Figure 16)
		SVOC	SW-846 8270D and 8270D SIM	10		
		Metals and CN	SW-846 6020A/ 7471B/ 9014	10		
		Pesticides/PCBs	SW846 8081/8082	10		
		Explosives	SW-846 8330A	10		
Groundwater	Middle of well screen	VOC	SW-846 8260B	27	Vapor intrusion concerns identified during the initial RI sampling were raised in occupied buildings near the plume as interpolated during the Site Assessment. Additional refinement of the groundwater plume was recommended in the vicinity of Building 687 and 371, and in the source identified by MIP. A full round of VOCs was also recommended to provide updated data. Concerns were also raised about a lack of pesticides and PCB analysis during previous investigations.	Install 3 shallow wells (one to delineate plume adjacent to Building 687, one to delineate plume adjacent to Building 371, and one in Source area identified by MIP). Sample groundwater from all existing shallow wells (24 total) for VOCs to provide updated plume data, and pesticides/PCBs. (see Worksheet #11 and Figure 18)
		SVOC	SW-846 8270D and 8270D SIM	3		
		Metals and CN	SW-846 6020A/ 7471B/ 9014	3		
		Pesticides/PCBs	SW846 8081/8082	27		
		Explosives	SW-846 8330A	3		
Surface water	NA	TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE and VC	SW-846 8260B	6	Farthest downstream sample exceeded screening levels. Additional sampling adjacent to, and downstream of, the outfall is warranted to evaluate the potential for ecological risks. Samples will also be used to reassess human health risks.	Four samples will be collected from the same locations as the initial RI, two additional samples will be collected at 150 ft intervals downstream of the last sample (Figure 17).
Sediment	NA	TCE, cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE and VC	SW-846 8260B	6	Farthest downstream sample exceeded screening levels. Additional sampling adjacent to, and downstream of, the outfall is warranted to evaluate the potential for ecological risks. Samples will also be used to reassess human health risks.	Four samples will be collected from the same locations as the initial RI, two additional samples will be collected at 150 ft intervals downstream of the last sample (Figure 17).

Note: The final number and placement of samples is subject to the field team's professional opinion of where potential contamination may accumulate within the investigation area.

The actual number of equipment blanks, field blanks, and trip blanks may vary. One equipment blank will be collected each day of sampling; one field blank will be collected each week of sampling.

One MS and one MSD will be collected at a frequency of one per 20 samples collected per matrix.

One field duplicate will be collected at a frequency of one per 10 samples collected per matrix.

One trip blank will be collected at a frequency of one per cooler containing VOC samples.

SAP Worksheet #18-1—Initial RI Sampling Locations and Methods/SOP Requirements Table

Sampling Location / Identification (ID) Number	Matrix	Depth (units)	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference ¹
YS31-SS01-MMY	Surface soil from Industrial Area	0 - 0.5 feet	VOC, SVOC, metals and CN, explosives, and two samples located in the location of the former drainage ditch will also be analyzed for nitroglycerin, 3,5-dinitroaniline, and PETN	1 + duplicate	004_DPSoil 005_ShallowSoil 007_Soils
YS31-SS02-MMY				1	
YS31-SS03-MMY				1	
YS31-SS04-MMY				1	
YS31-SS05-MMY				1	
YS31-SS06-MMY				1	
YS31-SS07-MMY				1	
YS31-SS08-MMY				1	
YS31-SS09-MMY				1	
YS31-SS10-MMY				1 + duplicate	
YS31-SS11-MMY				1	
YS31-SS12-MMY				1	
YS31-SS13-MMY				1	
YS31-SS14-MMY				1	
YS31-SS15-MMY				1	
YS31-SS16-MMY				1	
YS31-SS17-MMY				1	
YS31-SS18-MMY				1	
YS31-SS19-MMY				1 + duplicate	
YS31-SS20-MMY				1	

SAP Worksheet #18-1—Initial RI Sampling Locations and Methods/SOP Requirements Table (continued)

Sampling Location / ID Number	Matrix	Depth (units)	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference ¹
YS31-SV01-MMY	Sub-slab soil vapor co-located with indoor air sampling locations in Building 3		VOC	1 + duplicate	011_Subslab Sampling
YS31-SV02-MMY				1	
YS31-SV03-MMY				1	
YS31-SV04-MMY				1	
YS31-SV05-MMY				1	
YS31-SV11-MMY	Sub-slab soil vapor in Building 4		VOC	1 + duplicate	011_Subslab Sampling
YS31-SV12-MMY				1	
YS31-SV13-MMY				1	
YS31-SV14-MMY				1	
YS31-SV15-MMY				1	
YS31-SV16-MMY	Sub-slab soil vapor in Building 5		VOC	1	011_Subslab Sampling
YS31-SV17-MMY				1	
YS31-SV18-MMY				1	
YS31-SV19-MMY				1	
YS31-SV20-MMY				1	
YS31-SV06-MMY	Sub-slab soil vapor co-located with indoor air sampling locations in Building 6	Below building foundation	VOC	1	011_Subslab Sampling
YS31-SV07-MMY				1	
YS31-SV08-MMY				1	
YS31-SV09-MMY				1	
YS31-SV10-MMY				1	
YS31-SV21-MMY	Sub-slab soil vapor in Building 371	Below building foundation	VOC	1 + duplicate	011_Subslab Sampling
YS31-SV22-MMY				1	
YS31-SV23-MMY				1	
YS31-SV24-MMY	Sub-slab soil vapor in Building 1803	Below building foundation	VOC	1	011_Subslab Sampling
YS31-SV25-MMY				1	
YS31-SV26-MMY				1	

SAP Worksheet #18-1—Initial RI Sampling Locations and Methods/SOP Requirements Table (continued)

Sampling Location / ID Number	Matrix	Depth (units)	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference ¹
YS31-SV27-MMY	Sub-slab soil vapor in Building 1804	Below building foundation	VOC	1	011_Subslab Sampling
YS31-SV28-MMY				1	
YS31-SV29-MMY				1	
YS31-IA01-MMY	Indoor Air co-located with sub-slab soil vapor sampling locations in Building 3	Breathing zone	VOC	1 + duplicate	012_Ambient Air Sampling
YS31-IA02-MMY				1	
YS31-IA03-MMY				1	
YS31-IA04-MMY				1	
YS31-IA05-MMY				1	
YS31-IA06-MMY	Indoor Air co-located with sub-slab soil vapor sampling locations in Building 6	Breathing Zone	VOC	1	012_Ambient Air Sampling
YS31-IA07-MMY				1	
YS31-IA08-MMY				1	
YS31-IA09-MMY				1	
YS31-IA10-MMY				1	
YS31-IA11-MMY	Indoor Air co-located with sub-slab soil vapor sampling locations in Shed 5	Breathing Zone	VOC	1 + duplicate	
YS31-IA12-MMY				1	
YS31-IA13-MMY				1	
YS31-IA14-MMY				1	
YS31-IA15-MMY				1	
YS31-IA16-MMY	Indoor Air locations in Building 371	Breathing Zone	VOC	1	
YS31-IA17-MMY				1	
YS31-IA18-MMY				1	
YS31-OA01-MMY	Air Intake for Shed 3	Respective Air Intake height	VOC	1 + duplicate	012_Ambient Air Sampling
YS31-OA02-MMY	Air Intake for Shed 5			1	
YS31-OA03-MMY	Air Intake for Shed 6			1	

SAP Worksheet #18-1—Initial RI Sampling Locations and Methods/SOP Requirements Table (continued)

Sampling Location / ID Number	Matrix	Depth (units)	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference1
YS31-OA04-MMY	Air Intake for Building 371			1	
YS31-OA05-MMY	Upwind Background Air	Breathing Zone	VOC	1	
YS31-OA06-MMY	Background Air			1	
YS31-OA07-MMY	Between-building Ambient Air			1	
YS31-OA08-MMY	Ambient Air			1	
YS31-SD08-MMY	Sediment	0-4 inches below top of sediment	TCE and daughter products (cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, and VC)	1 + duplicate	013_SedSamp
YS31-SD09-MMY				1	
YS31-SD10-MMY				1	
YS31-SD11-MMY				1	
YS31-SD12-MMY				1	
YS31-SW08-MMY	Surface water	NA	TCE and daughter products (cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, and VC)	1 + duplicate	014_SWSamp 015_HoribaU22
YS31-SW09-MMY				1	
YS31-SW10-MMY				1	
YS31-SW11-MMY				1	
YS31-SW12-MMY				1	

SOP or worksheet listed in **Worksheet #21** that describes the sample collection procedures.

SAP Worksheet #18-2—Supplemental RI Sampling Locations and Methods/SOP Requirements Table

Sampling Location/ID Number ¹	Matrix	Depth	Analytical Group	Number of Samples	Sampling SOP Reference ¹
YS31-SB21-MMY	Subsurface soil from MIP Area	1 to 3 feet bgs	VOC, SVOC, metals and CN, explosives including 3,5-dinitroaniline.	1 + duplicate	004_DPSoil 005_ShallowSoil 007_Soils
YS31-SB22-MMY				1	
YS31-SB23-MMY				1	
YS31-SB24-MMY				1	
YS31-SB25-MMY				1	
YS31-SB26-MMY				1	
YS31-SB27-MMY				1	
YS31-SB28-MMY				1	
YS31-SB29-MMY				1	
YS31-SB30-MMY				1	
YS12-GW01-MMY	Groundwater	middle of well screen	VOCs, Pesticides, PCBs	1	18_LowFlow-EPA Reg I&III
YS12-GW04-MMY		middle of well screen		1	
YS12-GW05-MMY		middle of well screen		1 + duplicate	
YS12-GW06-MMY		middle of well screen		1	
YS12-GW07-MMY		middle of well screen		1	
YS12-GW08-MMY		middle of well screen		1	
YS12-GW09-MMY		middle of well screen		1	
YS12-GW10-MMY		middle of well screen		1	
YS12-GW11-MMY		middle of well screen		1	
YS12-GW13-MMY		middle of well screen		1	
YS12-GW14-MMY		middle of well screen		1	
YS12-GW15-MMY		middle of well screen		1	
YS12-GW16-MMY		middle of well screen		1 + duplicate	
YS12-GW17-MMY		middle of well screen		1	
YS12-GW18-MMY		middle of well screen		1	
YS12-GW19-MMY		middle of well screen		1	
YS12-GW20-MMY		middle of well screen		1	
YS12-GW21-MMY		middle of well screen		1	

SAP Worksheet #18-2—Supplemental RI Sampling Locations and Methods/SOP Requirements Table (continued)

Sampling Location/ID Number ¹	Matrix	Depth	Analytical Group	Number of Samples	Sampling SOP Reference ¹
YS12-GW22-MMY	Groundwater (continued)	middle of well screen	VOCs, Pesticides, PCBs	1	18_LowFlow-EPA Reg I&III
YS12-GW23-MMY		middle of well screen		1	
YS12-GW24-MMY		middle of well screen		1	
YS12-GW25-MMY		middle of well screen		1	
YS12-GW26-MMY		middle of well screen		1	
YS12-GW27-MMY		middle of well screen		1	
YS31-GW28-MMY		middle of well screen (TBD)	VOCs, SVOCs, Pesticides, PCBs, Total and Dissolved Metals, Cyanide, Explosives including 3,5-Dinitroaniline	1	
YS31-GW29-MMY		middle of well screen (TBD)		1 + duplicate	
YS31-GW30-MMY		middle of well screen (TBD)		1	
YS31-SD08-MMY	Sediment	0-4 inches below top of sediment	Select VOCs (SW/SD List)	1	013_SedSamp
YS31-SD09-MMY				1	
YS31-SD10-MMY				1 + duplicate	
YS31-SD11-MMY				1	
YS31-SD12-MMY				1	
YS31-SD13-MMY				1	
YS31-SW08-MMY	Surface Water	NA	Select VOCs (SW/SD List)	1	014_SWSamp 015_HoribaU22
YS31-SW09-MMY				1	
YS31-SW10-MMY				1 + duplicate	
YS31-SW11-MMY				1	
YS31-SW12-MMY				1	
YS31-SW13-MMY				1	

Notes:

1 Additional nomenclature instructions are as follows.

- duplicates will have "P" added after the station indicator, for example: YS31-SB21P-MMY
- for all sample IDs, "MMYY" will be replaced with the two-digit month and year in which the sample was collected
- equipment blanks will be identified with the two digit month, day and year, and what matrix it is relevant to, for example: YS31-EBMMDDYY
- trip blanks will be identified with the two digit month, day and year, and whether it is the first or other trip blank of the day, for example: YS31-TB01-MMDDYY

SAP Worksheet #19-1—Initial RI Analytical SOP Requirements Table

Matrix		Analytical and Preparation Method/ SOP Reference ¹	Containers (Number, Size, and Type)	Sample Volume	Preservation Requirements (Chemical, Temperature, Light Protected)	Maximum Holding Time (Preparation/Analysis) ²
Surface Soil, Subsurface Soil, Sediment ³	VOCs	SW-846 8260B, 5035/ VGCMS-05	3, 40 milliliter (ml), glass (Use Terracores for Soil)	5 grams (g)	MeOH, Freeze at - 10°C	14 days
	SVOCs	SW-846 8270D, 8270D SIM, 3550C/ SVGCMS-03	1, 4 ounce (oz), glass	100g	Cool to ≤ 6° C	14 days/40 days
	Metals and Hg	SW-846 6020A, 7471B, 3050B/ MET-15, MET-16	1, 4oz, glass	100g		180 days, 28 days (Hg)
	CN	SW-846 9014/ WETS-27	1, 4oz, glass	50g		14 days
	Explosives including PETN, 3,5- Dinitroaniline, and Nitroglycerin	SW-846 8330/ GL-OA-E- 068	1- 4oz, wide mouth glass jar	60g		14 days/40 days
Surface Water	VOCs	SW-846 8260B, 5030B/ VGCMS-05	3, 40ml, glass	5ml	HCL to pH<2; Cool to ≤ 6° C	14 days
SubSlab Vapor, Indoor Air, Ambient Air	Select VOCs	TO-15/VGCMS-07	(1) 6 L SUMMA canister	1L	Store at Standard Temperature and Pressure (STP)	30 days

¹ See Worksheet 23

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

³ Refer to Worksheets #17 and #18 for details regarding which media are analyzed for particular analytical groups.

SAP Worksheet #19-2—Supplemental RI Analytical SOP Requirements Table

Matrix		Analytical and Preparation Method/ SOP Reference ¹	Containers (Number, Size, and Type)	Sample Volume	Preservation Requirements (Chemical, Temperature, Light Protected)	Maximum Holding Time (Preparation/Analysis) ²
Surface Soil, Subsurface Soil, Sediment ³	VOCs	SW-846 8260B, 5035/ VGCMS-05	3, 40 milliliter (ml), glass (Use Terracores for Soil and sediment)	5 grams (g)	2 vials with water, 1 vial with MeOH Cool to ≤ 6° C	48hrs / 14 days
	SVOCs	SW-846 8270D, 8270D SIM, 3550C/ SVGCMS-03	1, 4 ounce (oz), glass	100g	Cool to ≤ 6° C	14 days/40 days
	Pesticides	SW-846 8081B / SVGC-04	2, 4 oz, glass	100g		14 days/40 days
	PCBs	SW-846 8082A / SVGC-07		100g		14 days/40 days
	Metals and Hg	SW-846 6020A, 7471B, 3050B/ MET-15, MET-16	1, 4oz, glass	100g		180 days, 28 days (Hg)
	CN	SW-846 9014/ WETS-27	1, 4oz, glass	50g		14 days
	Explosives including PETN, 3,5- Dinitroaniline, and Nitroglycerin	SW-846 8330/ GL-OA-E- 068	1- 4oz, wide mouth glass jar	60g		14 days/40 days

SAP Worksheet #19-2— Supplemental RI Analytical SOP Requirements Table (continued)

Matrix	Parameter	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
Aqueous samples (surface water, groundwater and/or aqueous blanks) ³	VOCs	SW-846 8260B, 5030B/ VGCMS-05	3, 40ml, glass	5ml	HCL to pH<2; Cool to ≤ 6° C	14 days
	SVOCs	SW-846 8270D, 8270D SIM, 3550C/ SVGCMS-03	2L amber glass	1 Liter	Cool to ≤ 6° C	7 days/14 days
	Pesticides	SW-846 8081B / SVGC-04	3 Liter Amber Glass	1 Liter	Cool to ≤ 6° C	7 days/14 days
	PCBs	SW-846 8082A / SVGC-07		1 Liter	Cool to ≤ 6° C	7 days/14 days
	Total Metals and Hg	SW-846 6020A, 7471B, 3050B/ MET-15, MET-16	250mL plastic	NA	Nitric acid to pH of ≤2; Cool to ≤ 6° C	180 days, 28 days (Hg)
	Dissolved Metals and Hg	SW-846 6020A, 7471B, 3050B/ MET-15, MET-16	250mL plastic	NA	Field-filter; Nitric acid to pH of ≤2; Cool to ≤ 6° C	180 days, 28 days (Hg)
	CN	SW-846 9014/ WETS-27	250mL plastic	NA	NaOH; Cool to ≤ 6° C	14 days
	Explosives including PETN, 3,5-Dinitroaniline, and Nitroglycerin	SW-846 8330/ GL-OA-E-068	2, 2L amber	NA	Cool to ≤ 6° C	7 days

¹ See Worksheet 23

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

³ Refer to Worksheets #17 and #18 for details regarding which media are analyzed for particular analytical groups.

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SAP Worksheet #20-1—Initial RI Field Quality Control Sample Summary Table

Matrix	Analytical Group	Number of Sampling Locations	Number of Field Duplicates	Number of MS/MSD	Number of Field Blanks ¹	Number of Equip. Blanks ¹	Number of Volatile Organic Analyte (VOA) Trip Blanks ¹	Number of Proficiency Test (PT) Samples	Total Number of Samples to Laboratory
Surface soil	VOCs	20	2	1/1	1	4	8	0	37
Subsurface soil	VOCs	20	2	1/1	0	0	0	0	24
Soil vapor	VOCs	29	0	0	0	0	0	0	29
Indoor air	VOCs	10	0	0	0	0	0	0	10
Surface soil	SVOCs	20	2	1/1	1	4	0	0	29
Subsurface soil	SVOCs	20	2	1/1	0	0	0	0	24
Surface soil	Metals and CN	20	2	1/1	1	4	0	0	29
Subsurface soil	Metals and CN	20	2	1/1	0	0	0	0	24
Surface soil	Explosives	20	2	1/1	1	4	0	0	29
Subsurface soil	Explosives	20	2	1/1	0	0	0	0	24
Surface water	Select VOCs	5	1	1/1	1	1	1	0	11
Sediment	Select VOCs	5	1	1/1	1	1	1	0	11

¹ QA/QC (EB, FB, TB) will be combined for surface soil and subsurface soil samples.

SAP Worksheet #20-2—Supplemental RI Field Quality Control Sample Summary Table

Matrix	Analytical Group	Number of Sampling Locations	Number of Field Duplicates	Number of MS/MSD	Number of Field Blanks	Number of Equip. Blanks ¹	Number of VOA Trip Blanks ¹	Number of Proficiency Test (PT) Samples	Total Number of Samples to Laboratory
Subsurface Soil	VOCs	10	1	1/1	-	1	1	-	15
	SVOCs	10	1	1/1	-	1	-	-	14
	Pesticides	10	1	1/1	-	1	-	-	14
	PCBs	10	1	1/1	-	1	-	-	14
	Explosives including 3,5-dinitroaniline	10	1	1/1	-	1	-	-	14
	Metals including mercury	10	1	1/1	-	1	-	-	14
	Cyanide	10	1	1/1	-	1	-	-	14
Groundwater	VOCs	27	3	2/2	-	2	3	-	39
	SVOCs	3	1	1/1	-	1	-	-	7
	Pesticides	27	3	2/2	-	2	-	-	36
	PCBs	27	3	2/2	-	2	-	-	36
	Explosives including 3,5-dinitroaniline	3	1	1/1	-	1	-	-	7
	Total Metals including mercury	3	1	1/1	-	1	-	-	7
	Dissolved Metals including mercury	3	1	1/1	-	1	-	-	7
	Cyanide	3	1	1/1	-	1	-	-	7
Sediment	Select VOCs	6	1	1/1	-	-	1	-	10
Surface Water	Select VOCs	6	1	1/1	-	-	-	-	9

Notes:

¹The number of field QC samples to be collected is dependent on the number of parent samples and the number of days of the sampling event.

- Field duplicates are collected at a frequency of 1 per 10 field samples per matrix.
- MS/MSD pairs are collected at a frequency of 1 per 20 samples per matrix sent to the laboratory (including duplicates).
- Field Blanks will not be collected as part of this investigation.
- Equipment Blanks for deconned equipment are collected once per day of sampling, per type of equipment. Equipment Blanks for disposable equipment are collected once per lot.

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
001_Decon	Decontamination of Personnel and Equipment, May 2011	CH2M HILL	Deionized water, distilled water, potable water, 2.5 percent Liquinox® and water solution, methanol, plastic pails, 55-gallon drum for waste, gloves, decontamination pad, steam cleaner	N	
002_Dispose	Disposal of Waste Fluids and Solids, May 2011	CH2M HILL	Fluids: 55-gallon drum, tools to secure drum, funnel, labels, marking pen, seals for drum Solids: 55-gallon drum, tools to secure drum, plastic sheets, labels, marking pen	N	
003_DeconRig	Decontamination of Drilling Rigs and Equipment, May 2011	CH2M HILL	Steam cleaner, potable water, Liquinox®, buckets, brushes, distilled water, methanol, deionized water, aluminum foil	N	
004_DPSoil	Direct-Push Soil Sample Collection, May 2011	CH2M HILL	Drill rig, hydraulic percussion hammer, sampling rods, acetate liners, sample containers, gloves	N	
005_Shallow Soil	Shallow Soil Sampling, May 2011	CH2M HILL	Sample jars, hand auger, stainless steel spatula, global positioning system (GPS) unit	N	
006_Log Books	Preparing Field Log Books, May 2011	CH2M HILL	Log book, black indelible pen	N	
007_Soils	Soil Sampling, May 2011	CH2M HILL	Drill rig, hydraulic percussion hammer, sampling rods, acetate liners, sample containers, gloves, hand auger, trowel	N	
008_Utility	Locating and Clearing Underground Utilities, May 2011	CH2M HILL	Utility location subcontractor to provide all equipment, phone number for Miss Utility	N	
009_COC	Chain-of-Custody, May 2011	CH2M HILL	Chain-of-custody, indelible pen	N	

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

Reference Number	Title, Revision Date and / or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
010_Building Survey	Conducting Building Surveys for Vapor Intrusion Investigations, August 2011	CH2M HILL	Building survey form, flashlight, microanemometer, measuring tape, camera, photoionization detector (PID).	N	
011_Subslab Sampling	SOP for Installing Sub-slab probes and Collecting Sub-slab Soil Gas Samples Using SUMMA Canisters, August 2011	CH2M HILL	Hammer drill and drill bits, vacuum cleaner, stainless steel tubing, nuts and ferrules, probe unions, probe seals, tube cutter, wax melter, cotton swabs, paper towels, tape measure, sampling union, vacuum pump,	N	
012_Ambient Air Sampling	Integrated Ambient Indoor and Crawl Space Air Sampling Method for Trace VOCs using SUMMA Canisters, August 2011	CH2M HILL	SUMMA canister, flow controller, wrenches, negative pressure gauge, flow controller	N	
013_SedSamp	Sediment Sampling, May 2011	CH2M HILL	Trowel, auger or dredge, gloves, sample containers	N	
014_SWSamp	Surface water sampling, May 2011	CH2M HILL	Unpreserved bottles for transfer, preserved bottles, gloves, water quality meter	N	
015_HoribaU22	Field Measurement of pH, Specific Conductance, Turbidity, dissolved oxygen (DO), oxidation reduction potential (ORP), and Temperature using the Horiba U-22 with Flow-through cell, 3/2010, July 2011	CH2M HILL	Horiba U-22 water quality checker with flow-through cell, distilled water, Horiba U-22 auto-calibration standard solution	N	
16_MWInstal	General Guidance for Monitoring Well Installation, May 2011	CH2M HILL	Drilling rig (HSA), well construction materials (surface casings, screens, riser, casing, caps, bottom plugs, sand, bentonite, grout, and surface finish materials), development materials	N	Supplemental RI

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

Reference Number	Title, Revision Date and / or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
17_WaterLevels	Water-Level Measurements, May 2011	CH2M HILL	Electronic water-level meter with appropriate length of tape or interface probe.	N	Supplemental RI
18_LowFlow-EPA Reg I&III	Low-Flow Groundwater Sampling from Monitoring Wells – EPA Region I and III, October 2011	CH2M HILL	Adjustable-rate positive displacement pump, submersible pump, or peristaltic pump. Horiba U-22, flow-through cell, power source, water level indicator, disposable tubing, sample containers	N	Supplemental RI

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

Field Equipment	Activity ¹	Frequency	Acceptance Criteria	CA	Resp. Person	SOP Reference ²	Comments
MiniRAE 2000® PID	Maintenance- Check mechanical and electronic parts, verify system continuity, check battery, and clean filter (change if clogged or dirty). Calibration check	Daily before use, at the end of the day, and when unstable readings occur.	Fresh air calibration reads 0.0 parts per million (ppm) ±3.0 ppm, span gas calibration (isobutylene) reads 100.0 ppm ±3.0 ppm	Replace filter, clean airway and check for obstructions. Use external filter if there is high humidity or if it is raining. Do not use instrument if not able to calibrate properly.	Angela Petree	MiniRAE 2000®	
Horiba U-22	Check mechanical and electronic parts, verify system continuity, check battery, and clean probes. Calibration check.	Daily or if reading appear suspect	Stable readings after 3 minutes. pH reads 4.0 ±3 percent conductivity reads 4.49 ± 3 percent turbidity reads 0 ± 3%	Clean probe with deionized water and calibrate again. Do not use instrument if not able to calibrate properly.	Angela Petree	Horiba U-22 Manual	

¹ Activities may include: calibration, verification, testing, and/or maintenance.

² References from **Worksheet #21**.

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SAP Worksheet #23-1— Initial RI Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and/or Number	Date Reviewed if not Revised	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work (Y/N)
VGCMS-07	Analysis of VOCs in Ambient Air by gas chromatography/mass spectrometer (GC/MS) (Rev. 2 3/26/09)	4/21/2011	Definitive	Air/ VOCs	GC/MS	ENCO Jacksonville	N
VGCMS-05	Analysis of VOCs by GC/MS, Nov.5, 2010, Rev.16		Definitive	Water, soil /VOC	GC/MS	ENCO - Orlando	N
SVGCMS-03	Analysis of SVOCs by GC/MS, Nov. 29, 2010, Rev.16		Definitive	Soil/SVOC	GC/MS		N
MET-15	Metals Analysis using inductively-coupled plasma mass spectrometer (ICP-MS), Jan. 4, 2010, Rev. 4	1/10/2011	Definitive	Soil/Metals	ICP-MS		N
MET-16	Hg in Soils by Digestion/ cold vapor atomic absorption (CVAA), Mar. 1, 2010, Rev. 4	12/1/2010	Definitive	Soil/Hg	CVAA		N
WETS-027	Total CN, Jan. 12, 2010, Rev. 11	4/21/2011	Definitive	Soil/CN	Spectrophotometer		N
EXMT-09	Acid Digestion of Soil and Waste Samples for Analysis by ICP and ICP-MS, Dec. 4, 2009, Rev. 5	3/30/2011	NA	Soil/Metals Prep	NA		N
EXSV-16	Extraction of Soil/Solid Samples Using Sonication, Mar 23, 2010, Rev. 6	4/14/2011	NA	Soils/Metals Prep	NA		N
LOGINS-03	Receiving Samples, Jan. 23, 2010, Rev.10	4/20/2011	NA	NA	NA		N
ADMIN-14	Waste Disposal and Characterization, Jan. 1, 2010, Rev. 5	1/4/2011	NA	NA	NA	ENCO - Orlando and Jacksonville	N
GL-OA-E-033	Nitroaromatics and Nitramines by high performance liquid chromatography (HPLC), 29 Sept. 2010, Rev. 18 (For sample extraction only)		Definitive	Soil/HPLC	Liquid chromatography–mass spectrometry (LC/MS/MS)	GEL Laboratories LLC	N
GL-OA-E-068	The Processing, Extraction, and Analysis of Nitroaromatics, Nitroamines, and Nitrate Esters by SW-846 8330B (Sample analysis method only- no 8330B prep), Revision 3, October, 2010		Definitive	Soil/LC/MS/MS	LC/MS/MS		N
GL-SR-E-001	Sample Acceptance Policy, Sample Login and Storage, Revision 32, March 2011		NA	NA	NA		N

SAP Worksheet #23-2—Supplemental RI Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and/or Number	Date Reviewed if not Revised	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to QSM	Modified for Project Work (Y/N)
VGCMS-07	Analysis of VOCs in Ambient Air by gas chromatography/mass spectrometer (GC/MS) (Rev. 2 3/26/09)	in review	Definitive	Air/ VOCs	GC/MS	ENCO Jacksonville	None	N
VGCMS-05	Analysis of VOCs by GC/MS, Nov.5, 2010, (Rev. 17, 08/26/2011)	NA	Definitive	Water, soil /VOC	GC/MS	ENCO - Orlando	None	N
SVGCMS-03	Analysis of SVOCs by GC/MS, Nov. 29, 2010, (Rev. 17, 08/15/2011)	NA	Definitive	Water, Soil/SVOC	GC/MS		ICAL Acceptance criteria: lab routinely uses criteria from SW-846 8270D (20%)	N
SVGC-04	Organochlorine Pesticides by GC/ECD (Rev. 10, 9/21/2011)	NA	Definitive	Water, Solids/ Pesticides	GC-ECD		Lab will use internal standard procedures, except for Toxaphene	N
SVGC-07	Polychlorinated Biphenyls by GC/ECD (Rev. 5, 3/22/2012)	NA	Definitive	Water, Solids/ PCBs	GC-ECD		None	N
MET-03	Mercury in Waters by Digestion/CVAA (Rev. 5, 2/20/2012)	NA	Definitive	Water/ Hg	CVAA		Lab will not perform Method of Standard Additions (MSA)	N
MET-15	Metals Analysis using inductively-coupled plasma mass spectrometer (ICP-MS), (Rev. 5, 2/14/2011)	NA	Definitive	Water, Soil/Metals	ICP-MS			N
MET-16	Hg in Soils by Digestion/ cold vapor atomic absorption (CVAA), (Rev. 5, 03/12/2012)	NA	Definitive	Soil/Hg	CVAA			N

SAP Worksheet #23-2—Supplemental Analytical SOP References Table (continued)

Lab SOP Number	Title, Revision Date, and/or Number	Date Reviewed if not Revised	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to QSM	Modified for Project Work (Y/N)
WETS-027	Total CN, Jan. 12, 2010, Rev. 11	4/30/2012	Definitive	Water, Soil/CN	Spectrophotometer		None	N
EXMT-07	Acid Digestion of Aqueous Samples and Extracts for Analysis by ICP or ICP-MS (Rev. 7, 8/23/2011)	NA	NA	Aqueous, Metals Prep	NA		None	N
EXMT-09	Acid Digestion of Soil and Waste Samples for Analysis by ICP and ICP-MS (Rev. 6, 08/31/2012)	NA	NA	Soil/Metals Prep	NA		None	N
EXSV-16	Extraction of Soil/Solid Samples Using Sonication, (Rev. 7, 03/16/2012)	NA	NA	Soils/Metals Prep	NA		None	N
EXSV-27	Extraction of Samples Using Separatory Funnel Techniques (Rev. 5, 9/15/2011)	NA	NA	Aqueous Extraction, Semivolatiles, Pesticides, PCBs	NA		None	N
LOGINS-03	Receiving Samples, Jan. 23, 2010, Rev.10	in review	NA	NA	NA	ENCO - Orlando and Jacksonville	None	N
ADMIN-14	Waste Disposal and Characterization, (Rev. 6, 09/16/2011)	NA	NA	NA	NA		None	N
GL-OA-E-033	Nitroaromatics and Nitramines by high performance liquid chromatography (HPLC), January 2012, Rev. 21 (For sample extraction only)	NA	Definitive	Water, Soil/HPLC	Liquid chromatography–mass spectrometry (LC/MS/MS)	GEL Laboratories LLC	None	N
GL-OA-E-068	The Processing, Extraction, and Analysis of Nitroaromatics, Nitroamines, and Nitrate Esters by SW-846 8330B (Sample analysis method only- no 8330B prep), Revision 5, February, 2012	NA	Definitive	Water, Soil/LC/MS/MS	LC/MS/MS		None	N
GL-SR-E-001	Sample Acceptance Policy, Sample Login and Storage, Revision 37, April 2012	NA	NA	NA	NA		None	N

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SAP Worksheet #24—Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
GC-MS	Tuning	Prior to initial calibration (ICAL) and at the beginning of each 12-hour period.	Refer to method for specific ion criteria.	Retune instrument and verify. Rerun affected samples.	Analyst	VGCMS-05 and SVGCMS-03
	Breakdown check (DDT Method 8270 only)	At the beginning of each 12-hour period, prior to analysis of samples.	Degradation <20% for DDT. Benzidine and Pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.	Correct problem then repeat breakdown check.		
	Minimum five-point ICAL for all analytes	ICAL prior to sample analysis.	1. Average response factor (RF) for system performance check compounds (SPCCs): VOCs ≥0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; VOCs ≥0.1 for chloromethane, bromoform, and 1,1-DCA. SVOCs ≥ 0.050. 2. RSD for RFs for calibration check compounds (CCCs): VOCs and SVOCs ≤ 30% and one option below: Option 1: RSD for each analyte ≤ 15%; Option 2: linear least squares regression R ≥ 0.995; Option 3: non-linear regression, coefficient of determination (COD) R ² ≥ 0.990 (6 points shall be used for second order, 7 points shall be used for third order).	Correct problem then repeat ICAL.		
	Second source initial calibration verification (ICV)	Once after each ICAL.	All project analytes within ± 20% of true value.	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.		
	Retention time (RT) window position establishment for each analyte and surrogate.	Once per ICAL.	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 continuing calibration verification (CCV) is used.	NA.		
	Evaluation of relative retention times (RRT)	With each sample.	RRT of each target analyte within ± 0.06 RRT units.	Correct problem, then rerun ICAL.		
	CCV	Daily before sample analysis and every 12 hours of analysis time.	1. Average RF for SPCCs: VOCs ≥ 0.30 for chlorobenzene and 1,1,2,2-tetrachloroethane; ≥ 0.1 for chloromethane, bromoform, and 1,1-DCA. SVOCs ≥ 0.050. 2. %Difference/Drift for all target compounds and surrogates: VOCs and SVOCs ≤ 20%D (Note: D = difference when using RFs or drift when using least squares regression or non-linear calibration).	DoD project level approval must be obtained for each of the failed analytes or CA must be taken. Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.		
CVAA	ICAL : minimum 5 standards and a calibration blank	Daily ICAL prior to sample analysis.	If more than one calibration standard is used, R ≥ 0.995.	Correct problem, then repeat ICAL.	Analyst	MET-16
	Second source ICV	Once after each ICAL, prior to beginning a sample run.	Value of second source for all analyte(s) within ± 10% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		
	CCV	After every 10 field samples and at the end of the analysis sequence.	20% of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.		
	Calibration blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence.	No analytes detected > LOD.	Correct problem. Re-prepare and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.		
	Interference check solutions (ICS) (ICP only)	At the beginning of an analytical run.	Interference Check Sample (ICS)-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within ± 20% of true value.	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze all samples.		

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

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
ICP-MS	Tuning	Prior to ICAL.	Mass calibration ≤ 0.1 (atomic mass unit) amu from the true value; Resolution < 0.9 amu full width at 10% peak height; For stability, RSD $\leq 5\%$ for at least four replicate analyses.	Retune instrument then reanalyze tuning solutions.		MET-15
	ICAL for all analytes (minimum one high standard and a calibration blank)	Daily ICAL prior to sample analysis.	If more than one calibration standard is used, $R \geq 0.995$.	Correct problem, then repeat ICAL.		
	Second source calibration verification	Once after each ICAL, prior to beginning a sample run.	Value of second source for all analytes within $\pm 10\%$ of true value.	Verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.		
	CCV	After every 10 field samples and at the end of the analysis sequence.	All analytes within $\pm 10\%$ of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.		
	Calibration blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence.	No analytes detected $> LOD$.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.		
	Interference check solutions (ICS-A and ICS-AB)	At the beginning of an analytical run and every 12 hours.	ICS-A: Absolute value of concentration for all non-spiked analytes $< LOD$ (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within $\pm 20\%$ of true value.	Terminate analysis, locate and correct problem, reanalyze ICS, reanalyze all samples.		
Spectrophotometer	ICAL with eight standards plus blank	Annually	Correlation coefficient ≥ 0.995	Correct problem, then repeat ICAL.		WETS-27
	Second-source ICV	Once per ICAL	Within $\pm 10\%$ of the true value for all target analytes	Correct problem, then repeat. If still fails, repeat ICAL.		
	CCV	Following SCV, after every 15 samples and the end of the sequence	Within $\pm 10\%$ of the true value for all target analytes	Correct problem, then repeat. If still fails, repeat ICAL.		
	Distilled standards	Once per multipoint calibration.	Within $\pm 15\%$ of true value.	Correct problem, then repeat distilled standards.		
LC/MS/MS	ICAL (minimum of 5 calibration standards to establish linearity at method set-up and after major maintenance). Re-analyze the lowest calibration standard once linearity has been established	ICAL prior to sample analysis and when continuing calibration criteria cannot be met.	$r \geq 0.995$ or RSD $\leq 15\%$; The concentration corresponding to the absolute value of the calibration curve's Y-intercept must be $< LOD$	Correct the problem, then repeat ICAL	Analyst	GL-OA-E-068
	Second Source ICV	Immediately following the ICAL	All target analytes and surrogates within $\pm 20\%$ of the expected value from the ICAL	Correct the problem and verify second source standard. Re-analyze ICV. If that fails, correct problem and repeat ICAL		
	CCV	Prior to sample analysis, and after every 10 field samples, and at the end of the analysis sequence	All target analytes and surrogates within $\pm 20\%$ of the expected value from the ICAL	Correct the problem and re-analyze the CCV. If that fails, then repeat ICAL. Re-analyze all samples since the last successful calibration verification.		
	RT window position establishment for each analyte and surrogate.	Once per ICAL.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.		

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

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
GC/MS w/ air concentrator	Tuning	Prior to ICAL and at the beginning of each 12-hour period.	Refer to method for specific ion criteria.	Re-tune instrument and verify. Re-run affected samples.	Analyst	VGCMS-07
	Minimum five-point ICAL for target analytes; lowest concentration standard at or near the reporting limit. (ICAL)	ICAL prior to sample analysis	RSD for each analyte \leq 30%, or linear least squares regression where $R \geq 0.99$.	Correct problem, then repeat ICAL.		
	Second-source calibration verification	Once after each ICAL.	All project analytes within \pm 25% of true value.	Correct problem, and verify second source standard. Re-run verification. If still fails, repeat ICAL.		
	RT window position establishment	Once per ICAL, for each analyte and surrogate.	The RTs for each analyte are \pm 0.33 minutes of the RTs in the ICAL.	Re-analyze, unless there is objective evidence of matrix interference.		
	Daily calibration verification	Daily, prior to sample analysis and every 12 hours of analysis time.	The percent recovery for each analyte is \pm 30%.	Correct problem; then repeat calibration. If still failing, then repeat ICAL. Re-analyze all samples since last successful calibration verification.		
Supplemental RI only						
GC/ECD (Pesticides) ¹	Breakdown Check	At the beginning of each 12 hour sequence, prior to analysis of samples.	Degradation \leq 15% for both DDT and Endrin.	Correct the problem, repeat breakdown check.	Analyst	SVGC-04
	Minimum five-point initial calibration (ICAL) for all analytes	ICAL prior to sample analysis.	One of the following options: Option 1: RSD for each analyte \leq 20% Option 2: Linear regression fit, $r \geq 0.995$.	Correct the problem, repeat ICAL.		
	Retention time window position establishment	Once per ICAL and at the beginning of the analytical shift.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.		
	Second Source Calibration Verification (SCV)	Immediately following the ICAL.	Within 80-120% of true value.	Correct the problem: rerun SCV. If that fails, repeat ICAL.		
	Continuing Calibration Verification (CCV)	At the beginning of every 12-hour sequence, after the pesticide breakdown check.	Within 80-120% of true value.	Correct the problem, then rerun CCV. If that fails, repeat ICAL. Re-analyze all samples since the last successful calibration verification.		
GC/ECD (PCBs) ¹	Minimum five-point initial calibration (ICAL) for all analytes	ICAL prior to sample analysis.	One of the following options: Option 1: RSD for each analyte \leq 20% Option 2: Linear regression fit, $r \geq 0.990$.	Correct the problem, repeat ICAL.	Analyst	SVGC-07
	Retention time window position establishment	Once per ICAL and at the beginning of the analytical shift.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA.		
	Second Source Calibration Verification (SCV)	Immediately following the ICAL.	Within 80-120% of true value.	Correct the problem, rerun SCV. If that fails, repeat ICAL.		
	Continuing Calibration Verification (CCV)	Prior to any samples in sequences that do not include ICAL, after every 10th sample, and at the end of the sequence.	Within 80-120% of true value.	Correct the problem, then rerun CCV. If that fails, repeat ICAL. Re-analyze all samples since the last successful calibration verification.		

¹Pesticide/PCB analytical instrument calibration is for Supplemental RI samples.

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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	CA	Responsible Person	SOP Reference
ICP-MS	Clean, Inspect, Change Cones	Monitor internal standard (IS) counts for variation	Instrument performance and sensitivity	As needed	Monitor IS counts for variation	Recalibrate	Analyst	MET-15
	Clean, Inspect, Change spray chamber injector torch	Monitor IS counts for variation	Instrument performance and sensitivity	As needed	Monitor IS counts for variation	Recalibrate	Analyst	
	Replace pump windings	Monitor IS counts for variation	Instrument performance and sensitivity	As needed	Monitor IS counts for variation	Replace windings, recalibrate and reanalyze	Analyst	
CVAA	Replace disposables, flush lines	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	CCV pass criteria	Recalibrate	Analyst	MET-16
	Clean Lens	Sensitivity check	Instrument performance and sensitivity	Daily or as needed	Method Blank pass criteria	Recalibrate	Analyst	
	Replace Pump tubings	Flow Rate Check	Instrument performance and sensitivity	As needed	Monitor flow rate for variation	Replace windings, recalibrate and reanalyze	Analyst	
GC/MS	Clean sources, maintain vacuum pumps.	Tuning	Instrument performance and sensitivity	Service vacuum pumps twice per year, other maintenance as needed.	Tune and CCV pass criteria.	Recalibrate instrument.	Analyst	VGCMS-05/SVGCMS-03
	Change septum, clean injection port, change or clip column, install new liner, change trap.	Sensitivity check	Instrument performance and sensitivity	Daily or as needed.	Tune and CCV pass criteria.	Re-inspect injector port, cut additional column, reanalyze CCV, and recalibrate instrument.	Analyst	
LC/MS/MS	Check solvent levels, pump, and lines. Check syringe.	Explosives	Instrument performance and sensitivity	Daily	Acceptable instrument QC and sensitivity.	Fill solvent reservoirs, prime pump and lines. Calibrate syringe placement.	Analyst	GL-OA-E-068
GC/MS	Clean sources, maintain vacuum pumps.	Tuning	Instrument performance and sensitivity	Service vacuum pumps twice per year, other maintenance as needed.	Tune and CCV pass criteria.	Recalibrate instrument.	Analyst	VGCMS-07
	Change septum, clean injection port, change or clip column, install new liner, change trap.	Sensitivity check	Instrument performance and sensitivity	Daily or as needed.	Tune and CCV pass criteria.	Re-inspect injector port, cut additional column, reanalyze CCV, and recalibrate instrument.	Analyst	
Supplemental RI only								
GC-ECD (Pesticides) ¹	Injection port maintenance.	Degradation check run every 12 hrs	DDT and Endrin breakdown <15%.	Beginning of each 12 hour 8081 sequence.	DDT and Endrin breakdown <15%.	Clip the guard column, replace the injection port liner, replace the gold seal, clean the injection port and repeat degradation check.	Analyst	SVGC-04
GC-ECD (PCBs) ¹	Injection port maintenance.	NA.	Evaluate baseline and peak shapes.	As needed.	Analyst judgment of excessive tailing or baseline fluctuation.	Clip the guard column, replace the injection port liner, replace the gold seal, clean the injection port	Analyst	SVGC-07

¹Pesticide/PCB analytical instrument calibration is for Supplemental RI samples.

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SAP Worksheet #26—Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Angela Petree, FTL/CH2M HILL. Field SOPs are in Appendix A and Worksheet #21 of this SAP.
Sample Packaging (Personnel/Organization): Angela Petree, FTL/CH2M HILL. Field SOPs are in Appendix A and Worksheet #21 of this SAP.
Coordination of Shipment (Personnel/Organization): Angela Petree, FTL/CH2M HILL
Type of Shipment/Carrier: FedEx Priority Overnight
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): ENCO and GEL employees
Sample Custody and Storage (Personnel/Organization): ENCO and GEL employees
Sample Preparation (Personnel/Organization): ENCO and GEL employees
Sample Determinative Analysis (Personnel/Organization): ENCO and GEL employees
SAMPLE ARCHIVING
Field Sample Storage (Number of days from sample collection): See Worksheet #19
Sample Extract/Digestate Storage (Number of days from extraction/digestion): See Worksheet #19
Biological Sample Storage (Number of days from sample collection): N/A
SAMPLE DISPOSAL
Personnel/Organization: ENCO and GEL 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

<p>Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory):</p> <p>Samples will be collected by field team members under the supervision of the FTL. As samples are collected, they will be placed into containers and labeled. Labels will be taped to the jar to ensure they do not separate. Samples will be cushioned with packaging material and placed into coolers containing enough ice to keep the samples $\leq 6^{\circ}\text{C}$ until they are received by the laboratory.</p> <p>The chain-of-custody will be placed into the cooler in a Ziploc® bag. Coolers will be taped up and shipped to the laboratories via FedEx overnight, with the air bill number indicated on the chain-of-custody (to relinquish custody). Upon delivery, the laboratory will log in each cooler and report the status of the samples to CH2M HILL.</p> <p>See Worksheet #21 for SOPs containing sample custody guidance.</p> <p>The CH2M HILL field team will ship all environmental samples to ENCO Orlando (soil, surface water, sediment, groundwater samples) and ENCO Jacksonville (air samples). ENCO will send all explosives samples to GEL.</p>
<p>Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal):</p> <p>Laboratory custody procedures can be found in the following SOPs, which are referenced in Worksheet #23 and can be found in Appendix C of this SAP: LOGINS03 and GL-SR-E-001</p>
<p>Sample ID Procedures:</p> <p>Sample labels will include, at a minimum, client name, site, sample ID, date/time collected, analysis group or method, and sampler's initials. The field logbook will identify the sample ID with the location and time collected and the parameters requested. The laboratory will assign each field sample a laboratory sample ID based on information in the chain-of-custody. The laboratory will send sample login forms to the PDM to check that sample IDs and parameters are correct.</p>
<p>Chain-of-custody Procedures:</p> <p>Chains-of-custody will include, at minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information. Sample information will include sample ID. Date/time collected, number and type of containers, preservative information, analysis method, and comments. The chain-of-custody will link location of the sample from the field logbook to the laboratory receipt of the sample. The laboratory will use the sample information to populate the Laboratory Information Management Systems (LIMS) database for each sample.</p>

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SAP Worksheet #28-1—Laboratory QC Samples Table

Matrix: Surface Soil, Subsurface Soil, Sediment

Analytical Group: VOCs

Analytical Method/ SOP Reference: SW846-8260B/ VGCMS-05

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method blank	One per preparatory batch	No target analytes > 1/2 LOQ; no common laboratory contaminants > LOQ	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/ contamination	No target analytes > 1/2 LOQ; no common laboratory contaminants > LOQ
LCS		See Worksheet 15	LCS is reanalyzed; if still fails samples along with QC is reprep and reanalyzed. Client will be contact for guidance about whether to reprep samples, in the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	See Worksheet 15
MS/MSD		See Worksheet 15	In absence of client specific requirements, flag the data		Precision and Accuracy/Bias	See Worksheet 15
IS	Spiked in Every Sample	For VOA IS CA: Areas within -50% to +100% of last ICAL mid-point for each CCV	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.		Precision and Accuracy	For VOA IS CA: Areas within -50% to +100% of last ICAL mid-point for each CCV
Surrogates	Spiked in Every Sample	<u>Solids:</u> Dibromofluoromethane 74-133%, Toluene-d8 85-115%, 1,2-DCA-d4 59-133%, 4-Bromofluorobenzene (BFB) 85-120%	Re-prep and reanalyze sample unless objective evidence of suspected or confirmed sample matrix effects are available. If insufficient sample exists for reanalysis, client will be contacted for instructions. In the absence of client instruction, data will be qualified.		Precision and Accuracy/Bias	Dibromofluoromethane 74-133%, Toluene-d8 85-115%, 1,2-DCA-d4 59-133%, 4-Bromofluorobenzene (BFB) 85-120%

SAP Worksheet #28-2—Laboratory QC Samples Table

Matrix: Surface Soil, Subsurface Soil

Analytical Group: SVOCs

Analytical Method/ SOP Reference: SW846 8270D / SVGCMS-03

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch	No target analytes > 1/2 LOQ; no common laboratory contaminants > LOQ	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/ contamination	No target analytes > 1/2 LOQ; no common laboratory contaminants > LOQ
LCS		See Worksheet # 15	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. Client will be contact for guidance about whether to re-prepare samples. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	See Worksheet # 15
MS/ MSD	One per preparatory batch	See Worksheet # 15	In the absence of client specific requirements, flag the data		Precision and Accuracy/Bias	See Worksheet # 15
IS	Spiked in Every Sample	RT Within 30 sec of ICAL reference standard, and % recovery 50-200% of ICAL reference standard	Inspect GC/MS for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.		Precision and Accuracy	RT Within 30 sec of ICAL reference standard, and % recovery 50-200% of ICAL reference standard
Surrogates	Spiked in Every Sample	<u>Solid:</u> 2-Fluorophenol 35-105%, Phenol-d5 40-100%, Phenol-d5 35-100%, 2-Fluorobiphenyl 45-105%, 2,4,6-Tribromophenol 35-125%, Terphenyl-d14 30-125%	Re-prepare and reanalyze samples unless objective evidence of suspected or confirmed sample matrix effects are available. If insufficient sample exists for reanalysis, client will be contacted for instructions. In the absence of client instruction, data will be qualified.		Precision and Accuracy/Bias	2-Fluorophenol 35-105%, Phenol-d5 40-100%, Phenol-d5 35-100%, 2-Fluorobiphenyl 45-105%, 2,4,6-Tribromophenol 35-125%, Terphenyl-d14 30-125%

SAP Worksheet #28-3—Laboratory QC Samples Table

Matrix: Surface Soil, Subsurface Soil, Groundwater (Supplemental RI)

Analytical Group: SIM PAHs

Analytical Method/ SOP Reference: SW846 8270D / SVGCMS-03

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch	No target analytes > 1/2 LOQ	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/ contamination	No target analytes > 1/2 LOQ
LCS		See Worksheet # 15	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. Client will be contact for guidance about whether to re-prepare samples. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	See Worksheet # 15
MS/ MSD	One per preparatory batch	See Worksheet # 15	In absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	See Worksheet # 15
IS	Spiked in Every Sample	RT Within 30 sec of ICAL reference standard, and % recovery 50-200% of ICAL reference standard	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.		Precision and Accuracy	RT Within 30 sec of ICAL reference standard, and % recovery 50-200% of ICAL reference standard
Surrogates	Spiked in Every Sample	Solid: p-Terphenyl 53-170%	Reprep and reanalyze sample unless objective evidence of suspected or confirmed sample matrix effects are available. If insufficient sample exists for reanalysis, client will be contacted for instructions. In absence of client instruction, data will be qualified.		Precision and Accuracy/Bias	p-Terphenyl 53-170%

SAP Worksheet #28-4—Laboratory QC Samples Table

Matrix: Surface Soil, Subsurface Soil

Analytical Group: Metals and Hg

Analytical Method/ SOP Reference: EPA 6020A/ MET-15 and EPA 7471B/ MET-16

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch	No target analytes > 1/2 LOQ	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/ contamination	No target analytes > 1/2 LOQ
LCS		See Worksheet # 15	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. Client will be contact for guidance about whether to re-prepare samples. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	See Worksheet # 15
MS/ MSD	One per preparatory batch	See Worksheet # 15	Perform a dilution test to evaluate matrix effects. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	See Worksheet # 15
Dilution Test (6020A only)		±10% of true value	Perform post spike		Precision and Accuracy/Bias	±10% of true value
Post Spike (PS) (6020A only)		± 25% of true value	Re-prepare and reanalyze samples		Precision and Accuracy/Bias	± 25% of true value
Internal Standard (IS) (6020A only)	Spiked in Every Sample	6020A IS limits: IS intensity within 30-120% of intensity of IS in ICAL	Reanalyze sample at 5x dilution with the addition of appropriate amounts of IS		Precision and Accuracy	6020A IS limits: IS intensity within 30-120% of intensity of IS in ICAL

SAP Worksheet #28-5—Laboratory QC Samples Table

Matrix: Surface Soil, Subsurface Soil

Analytical Group: CN

Analytical Method/ SOP Reference: SW846 9014/ WETS- 27

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch	No target analytes > 1/2 LOQ	Correct problem. If required, re-prep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/ contamination	No target analytes > 1/2 LOQ
LCS		See Worksheet 15	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. Client will be contact for guidance about whether to re-prep samples. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	See Worksheet 15
MS/MSD	One per preparatory batch	See Worksheet 15	In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	See Worksheet 15

SAP Worksheet #28-6—Laboratory QC Samples Table

Matrix: Surface Soil, Subsurface Soil

Analytical Group: Explosives including PETN, 3,5-Dinitroaniline, and Nitroglycerin

Analytical Method/ SOP Reference: SW846 8330B / GL-OA-E-068

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch	No target analytes > 1/2 LOQ	Correct the problem. Reprep and reanalyze method blank and all associated sample processed with the contaminated blank.	Laboratory analysts	Contamination originating in the laboratory and not from field activities	No target analytes > 1/2 LOQ
LCS		See Worksheet 15	Correct the problem. Reprep and reanalyze method blank and all associated sample processed with the contaminated blank.	Laboratory analysts	Precision and Accuracy in a non-matrix sample	See Worksheet 15
MS/ MSD	One per preparatory batch	See Worksheet 15	Examine project specific DQOs. Contact client for additional measures to be taken.	Laboratory analysts	Precision and Accuracy in a matrix sample	See Worksheet 15
Surrogate	All field and QC samples	50-150%	Correct problem and then reprep and reanalyze samples for failed recoveries in the associated preparation batch, if sufficient volume is available.	Laboratory analysts	Accuracy/Bias	50-150%

SAP Worksheet #28-7—Laboratory QC Samples Table

Matrix: Surface Water

Analytical Group: Select VOCs

Analytical Method/ SOP Reference: SW846-8260B/ VGCMS-05

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method blank	One per preparatory batch	No target analytes > 1/2 LOQ; no common laboratory contaminants > LOQ	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/ contamination	No target analytes > 1/2 LOQ; no common laboratory contaminants > LOQ
LCS		See Worksheet 15	LCS is reanalyzed; if still fails, samples along with QC is reprep and reanalyzed. Client will be contact for guidance about whether to reprep samples, in the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	See Worksheet 15
MS/MSD		See Worksheet 15	In absence of client specific requirements, flag the data		Precision and Accuracy/Bias	See Worksheet 15
IS	Spiked in Every Sample	For VOA IS CA: Areas within -50% to +100% of last ICAL mid-point for each CCV	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.		Precision and Accuracy	For VOA IS CA: Areas within -50% to +100% of last ICAL mid-point for each CCV
Surrogates	Spiked in Every Sample	Dibromofluoromethane 85-115%, Toluene-d8 85-120%, 1,2-DCA-d4 70-120%, 4-BFB 75-120%	Re-prep and reanalyze sample unless objective evidence of suspected or confirmed sample matrix effects are available. If insufficient sample exists for reanalysis, client will be contacted for instructions. In the absence of client instruction, data will be qualified.		Precision and Accuracy/Bias	Dibromofluoromethane 85-115%, Toluene-d8 85-120%, 1,2-DCA-d4 70-120%, 4-BFB 75-120%

SAP Worksheet #28-8—Laboratory QC Samples Table

Matrix: Sub-slab Vapor, Indoor Air, Ambient Air

Analytical Group: VOCs

Analytical Method/ SOP Reference: TO-15/ VGCMS-07

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method blank	1 per 20 samples	No target analytes > 1/2 LOQ	Correct problem; then repeat. If the method blank still fails; repeat ICAL.	Analyst	Accuracy/Bias Contamination	No target analytes > 1/2 LOQ
LCS		See Worksheet #15	LCS is reanalyzed. If the LCS still fails, all samples, along with QC, are re-prepared and re-analyzed. The laboratory will contact the client. In the absence of client specific requirements, the data is flagged.		Precision and Accuracy/Bias	See Worksheet #15
Surrogates	Spiked in every sample	4-BFB 64-124% recovery	If surrogates fail, all affected samples are re-analyzed unless there is objective evidence of suspected or confirmed matrix effects.		Accuracy/Bias	4-BFB 64-124% recovery
IS	All samples (field and QC)	60% to 140% of the response in the reference ICAL standard (typically equivalent to mid-point in curve); The RT of IS may not vary by more than ± 0.33 minutes from the reference ICAL standard.	Samples with internal standard recoveries or RTs not meeting criteria must be reanalyzed unless there is objective evidence of matrix interferences.		Accuracy/Bias	60% to 140% of the response in the reference ICAL standard (typically equivalent to mid-point in curve); The RT of IS may not vary by more than ± 0.33 minutes from the reference ICAL standard.

SAP Worksheet #28-9—Laboratory QC Samples Table

Matrix: Subsurface Soil

Analytical Group: Pesticides (Supplemental)

Analytical Method/SOP Reference: SW-846 8081B / SVGC-04

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch of similar matrix	No analytes detected > 1/2 LOQ, > 1/10 amount measured in any sample, or regulatory limit (whichever is greater).	Correct problem. If required, re-prepare and re-analyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/Contamination	Same as Method/QC Acceptance Limits.
LCS		See Worksheet 15 .	Correct problem, then re-prepare and re-analyze the LCS and all samples in the associated preparatory batch for failed analytes.		Precision and Accuracy/Bias	
MS		Same as LCS.	In absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	
MSD		Same as MS and refer to Worksheet 15 .			Precision and Accuracy/Bias	
Surrogates	Spiked in every sample	Soils: 2,4,5,6-Tetrachloro-meta-xylene (TCMX), 70-125%R; Decachlorobiphenyl 55-130%R	For QC and field samples, correct problem then re-prepare and re-analyze all failed samples for failed surrogates in the associated preparatory batch.		Precision and Accuracy/Bias	
Internal Standards (IS)		RT within 30 seconds of ICAL reference standard; %R = 50 - 200% of ICAL reference standard.	In absence of matrix interference evidence, re-analyze the sample.		Precision and Accuracy	

Note: Addition of this analytical group is for Supplemental RI samples only.

SAP Worksheet #28-10—Laboratory QC Samples Table

Matrix: Subsurface Soil, Groundwater

Analytical Group: PCBs (Supplemental RI)

Analytical Method/SOP Reference: SW-846 8082A / SVGC-07

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch	No analytes detected > 1/2 LOQ, > 1/10 amount measured in any sample, or regulatory limit (whichever is greater).	Correct problem. If required, re-prepare and re-analyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/Contamination	Same as Method/QC Acceptance Limits.
LCS		See Worksheet #15 .	Correct problem, then re-prepare and re-analyze the LCS and all samples in the associated preparatory batch for failed analytes.		Precision and Accuracy/Bias	
MS		Same as LCS.	In absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	
MSD		Same as MS, and see Worksheet #15 .			Precision and Accuracy/Bias	
Surrogates	Spiked in every sample	Solids: Decachlorobiphenyl 60 - 125% Waters: Decachlorobiphenyl 40-135%	For QC and field samples, correct problem then re-prepare and re-analyze all failed samples for failed surrogates in the associated preparatory batch.		Precision and Accuracy/Bias	

Note: Addition of this analytical group is for Supplemental RI samples only.

SAP Worksheet #28-11—Laboratory QC Samples Table

Matrix: Groundwater (Supplemental RI)

Analytical Group: VOCs

Analytical Method/ SOP Reference: SW846-8260B/ VGCMS-05

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method blank	One per preparatory batch	No target analytes > 1/2 LOQ; no common laboratory contaminants > LOQ	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/ contamination	Same as Method/QC Acceptance Limits
LCS		See Worksheet 15	LCS is reanalyzed; if still fails samples along with QC is reprep and reanalyzed. Client will be contact for guidance about whether to reprep samples, in the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	
MS/MSD	One per 20 sample of similar matrix	See Worksheet 15	In absence of client specific requirements, flag the data		Precision and Accuracy/Bias	
IS	Spiked in Every Sample	For VOA IS CA: Areas within -50% to +100% of last ICAL mid-point for each CCV	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.		Precision and Accuracy	
Surrogates	Spiked in Every Sample	Waters: Dibromofluoromethane 85-115%, Toluene-d8 85-120%, 1,2-Dichloroethane-d4 70-120%, 4-Bromofluorobenzene 75-120%	Re-prep and reanalyze sample unless objective evidence of suspected or confirmed sample matrix effects are available. If insufficient sample exists for reanalysis, client will be contacted for instructions. In the absence of client instruction, data will be qualified.		Precision and Accuracy/Bias	

SAP Worksheet #28-12—Laboratory QC Samples Table

Matrix: Groundwater (Supplemental RI)

Analytical Group: SVOCs

Analytical Method/ SOP Reference: SW846 8270D / SVGCMS-03

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch	No target analytes > 1/2 LOQ; no common laboratory contaminants > LOQ	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/ contamination	Same as Method/SOP Acceptance Limits.
LCS		See Worksheet # 15	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. Client will be contact for guidance about whether to re-prepare samples. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	
MS/MSD	One per 20 samples of similar matrix	See Worksheet # 15	In the absence of client specific requirements, flag the data		Precision and Accuracy/Bias	
IS	Spiked in Every Sample	RT Within 30 sec of ICAL reference standard, and % recovery 50-200% of ICAL reference standard	Inspect GC/MS for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.		Precision and Accuracy	
Surrogates	Spiked in Every Sample	Water: 2-Fluorobiphenyl 50-110%, Terphenyl-d14 50-135%, Nitrobenzene-d5, 40-110%.	Re-prepare and reanalyze samples unless objective evidence of suspected or confirmed sample matrix effects are available. If insufficient sample exists for reanalysis, client will be contacted for instructions. In the absence of client instruction, data will be qualified.		Precision and Accuracy/Bias	

SAP Worksheet #28-13—Laboratory QC Samples Table

Matrix: Groundwater (Supplemental RI)

Analytical Group: SIM PAHs

Analytical Method/ SOP Reference: SW846 8270D / SVGCMS-03

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch	No target analytes > 1/2 LOQ	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/ contamination	Same as Method/QC Acceptance Criteria
LCS		See Worksheet # 15	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. Client will be contact for guidance about whether to re-prepare samples. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	
MS/ MSD	One per 20 samples of similar matrix.	See Worksheet # 15	In absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	
IS	Spiked in Every Sample	RT Within 30 sec of ICAL reference standard, and % recovery 50-200% of ICAL reference standard	Inspect mass spectrometer and GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.		Precision and Accuracy	
Surrogates	Spiked in Every Sample	Waters: same as for full scan	Reprep and reanalyze sample unless objective evidence of suspected or confirmed sample matrix effects are available. If insufficient sample exists for reanalysis, client will be contacted for instructions. In absence of client instruction, data will be qualified.		Precision and Accuracy/Bias	

SAP Worksheet #28-14—Laboratory QC Samples Table

Matrix: Groundwater

Analytical Group: Pesticides (Supplemental)

Analytical Method/SOP Reference: SW-846 8081B / SVGC-04

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch of similar matrix	No analytes detected > 1/2 LOQ, > 1/10 amount measured in any sample, or regulatory limit (whichever is greater).	Correct problem. If required, re-prepare and re-analyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/Contamination	Same as Method/QC Acceptance Limits.
LCS		See Worksheet 15 .	Correct problem, then re-prepare and re-analyze the LCS and all samples in the associated preparatory batch for failed analytes.		Precision and Accuracy/Bias	
MS		Same as LCS.	In absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	
MSD		Same as MS and refer to Worksheet 15 .			Precision and Accuracy/Bias	
Surrogates	Spiked in every sample	Waters: TCMX, 25-140%R; Decachlorobiphenyl, 30-135%R	For QC and field samples, correct problem then re-prepare and re-analyze all failed samples for failed surrogates in the associated preparatory batch.		Precision and Accuracy/Bias	
Internal Standards (IS)		RT within 30 seconds of ICAL reference standard; %R = 50 - 200% of ICAL reference standard.	In absence of matrix interference evidence, re-analyze the sample.		Precision and Accuracy	

Note: Addition of this analytical group is for Supplemental RI samples only.

SAP Worksheet #28-15—Laboratory QC Samples Table

Matrix: Groundwater

Analytical Group: PCBs (Supplemental RI)

Analytical Method/SOP Reference: SW-846 8082A / SVGC-07

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch	No analytes detected > 1/2 LOQ, > 1/10 amount measured in any sample, or regulatory limit (whichever is greater).	Correct problem. If required, re-prepare and re-analyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/Contamination	Same as Method/QC Acceptance Limits.
LCS		See Worksheet #15 .	Correct problem, then re-prepare and re-analyze the LCS and all samples in the associated preparatory batch for failed analytes.		Precision and Accuracy/Bias	
MS		Same as LCS.	In absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	
MSD		Same as MS, and see Worksheet #15 .			Precision and Accuracy/Bias	
Surrogates	Spiked in every sample	<u>Waters:</u> Decachlorobiphenyl 40-135%	For QC and field samples, correct problem then re-prepare and re-analyze all failed samples for failed surrogates in the associated preparatory batch.		Precision and Accuracy/Bias	

Note: Addition of this analytical group is for Supplemental RI samples only.

SAP Worksheet #28-16—Laboratory QC Samples Table

Matrix: Groundwater (Supplemental RI)

Analytical Group: Metals and Hg (total and dissolved for groundwater)

Analytical Method/ SOP Reference: EPA 6020A/ MET-15 and EPA 7471B/ MET-16

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch	No target analytes > 1/2 LOQ	Correct problem. If required, reprep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/ contamination	Same as Method / SOP QC Acceptance Limits
LCS		See Worksheet # 15	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. Client will be contact for guidance about whether to re-prepare samples. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	
MS/ MSD	One per 20 samples of similar matrix	See Worksheet # 15	Perform a dilution test to evaluate matrix effects. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	
Dilution Test (6020A only)		±10% of true value	Perform post spike		Precision and Accuracy/Bias	
Post Spike (PS) (6020A only)		± 25% of true value	Re-prepare and reanalyze samples		Precision and Accuracy/Bias	
Internal Standard (IS) (6020A only)	Spiked in Every Sample	6020A IS limits: IS intensity within 30-120% of intensity of IS in ICAL	Reanalyze sample at 5x dilution with the addition of appropriate amounts of IS		Precision and Accuracy	

SAP Worksheet #28-17—Laboratory QC Samples Table

Matrix: Groundwater (Supplemental RI)

Analytical Group: CN

Analytical Method/ SOP Reference: SW846 9014/ WETS- 27

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch	No target analytes > 1/2 LOQ	Correct problem. If required, re-prep and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Bias/ contamination	Same as Method / SOP QC Acceptance Limits
LCS		See Worksheet 15	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. Client will be contact for guidance about whether to re-prep samples. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	
MS/MSD		See Worksheet 15	In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	

SAP Worksheet #28-18—Laboratory QC Samples Table

Matrix: Surface Soil, Subsurface Soil, Groundwater (Supplemental RI)

Analytical Group: Explosives including PETN, 3,5-Dinitroaniline, and Nitroglycerin

Analytical Method/ SOP Reference: SW846 8330B / GL-OA-E-068

QC Sample	Frequency / Number	Method / SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQI	MPC
Method Blank	One per preparatory batch	No target analytes > 1/2 LOQ	Correct the problem. Reprep and reanalyze method blank and all associated sample processed with the contaminated blank.	Laboratory analysts	Contamination originating in the laboratory and not from field activities	Same as Method / SOP QC Acceptance Limits
LCS		See Worksheet 15	Correct the problem. Reprep and reanalyze method blank and all associated sample processed with the contaminated blank.	Laboratory analysts	Precision and Accuracy in a non-matrix sample	
MS/MSD	One per 20 samples of similar matrix	See Worksheet 15	Examine project specific DQOs. Contact client for additional measures to be taken.	Laboratory analysts	Precision and Accuracy in a matrix sample	
Surrogate	All field and QC samples	50-150%	Correct problem and then reprep and reanalyze samples for failed recoveries in the associated preparation batch, if sufficient volume is available.	Laboratory analysts	Accuracy/Bias	

SAP Worksheet #29—Project Documents and Records Table

Document	Where Maintained
<ul style="list-style-type: none"> • Field Notebooks • Chain-of-Custody Records • Air Bills • Custody Seals • CA Forms • Electronic Data Deliverables (EDDs) • ID of QC Samples • Meteorological Data from Field • Sampling instrument calibration logs • Sampling locations and sampling plan • Sampling notes and drilling logs • Water quality parameters • Sample Receipt, Chain-of-Custody, and Tracking Records • Standard Traceability Logs • Equipment Calibration Logs • Sample Prep Logs • Run Logs • Equipment Maintenance, Testing, and Inspection Logs • CA Forms • 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 • CA Forms • Laboratory QA Plan • 	<ul style="list-style-type: none"> • Field data deliverables (such as 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 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 Data Warehouse and NIRIS • Hardcopy data will be archived in accordance with the CLEAN contract at: Iron Mountain headquarters: 745 Atlantic Avenue Boston, MA 02111 <p style="text-align: center;">2012 Updated Document Storage Information</p> <ul style="list-style-type: none"> • Following project completion, hardcopy deliverables including chain of custodies and raw data will be archived at the Washington National Records Center: <p style="margin-left: 40px;">Washington National Records Center 4205 Suitland Road Suitland, Maryland 20746-8001 301-778-1550</p>

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SAP Worksheet #30-1—Initial RI Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID Number	Analytical Method	Data Package Turnaround Time	Laboratory / Organization	Backup Laboratory / Organization ¹
Indoor Air, Sub-slab Vapor, Ambient Air	VOCs	See Worksheet #18	TO-15	28 calendar days	ENCO Christina Tompkins 4810 Executive Park Ct, Suite 111 Jacksonville, FL 32216 904-296-3007	TBD
Surface Soil, Subsurface Soil,	Explosives plus nitroglycerin, PETN, and 3,5-Dinitroaniline		SW-846 8330A	28 calendar days	GEL Laboratories 2040 Savage Road Charleston, SC 29407 843-556-8171	
Surface Soil, Subsurface Soil, Surface Water, Sediment,	VOCs		SW-846 8260B		ENCO Ronnie Wambles 10775 Central Port Drive Orlando, FL 32824 407-826-5314	
Surface Soil, Subsurface Soil,	Metals		SW-846 6020A/ 7471B			
	SVOCs		SW846 8270D, 8270D SIM			
	CN	SW-846 9014				

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.

SAP Worksheet #30-2—Supplemental RI Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID Number	Analytical Method	Data Package Turnaround Time	Laboratory / Organization	Backup Laboratory / Organization¹
Surface Soil, Subsurface Soil, Soil, groundwater ²	Explosives plus nitroglycerin, PETN, and 3,5-Dinitroaniline, and/or plus only 3,5-dinitroaniline	See Worksheet #18	SW-846 8330A	28 calendar days	GEL Laboratories 2040 Savage Road Charleston, SC 29407 843-556-8171	TBD
Surface Soil, Subsurface Soil, Surface Water, Sediment, groundwater ²	VOCs		SW-846 8260B			
Surface Soil, Subsurface Soil, Soil, groundwater ²	Metals (total and dissolved for groundwater) ²		SW-846 6020A/ 7471B/7470A ²			
	SVOCs		SW846 8270D, 8270D SIM			
	Pesticides ²		SW846 8081B ²			
	PCBs ²		SW846 8082A ²			
	CN	SW-846 9014	ENCO Ronnie Wambles 10775 Central Port Drive Orlando, FL 32824 407-826-5314			

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.

² addition of pesticides, PCBs, and all aqueous parameters in this table are specific to the Supplemental RI sampling

SAP Worksheet #31—Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person Responsible for Performing Assessment	Person Responsible for Responding to Assessment Findings	Person Responsible for Identifying and Implementing CA	Person Responsible for Monitoring Effectiveness of CA
Field Performance Audit	Once	Internal	CH2M HILL	Stephen Brand	FTL and Field Staff	Laura Cook (WE02) Kristin Rogers (WE51)	Brett Doerr
Third Party Laboratory Technical Systems Audit	Laboratories must have current DoD Environmental Laboratory Accreditation Program (ELAP) accreditation which will identify the period of performance.	External	Third party accrediting body	TBD, Third party accrediting body	ENCO and GEL QA Officers	ENCO and GEL QA Officers	Anita Dodson, Program Chemist, CH2M HILL

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SAP Worksheet #32—Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response	Timeframe for Response
Field Performance Audit	Checklist and Written Audit Report	Laura Cook, PM, CH2M HILL	Within 1 week of audit	Memorandum	Angie Petree FTL CH2M HILL Doug Bitterman, AQM CH2M HILL	Within 1 week of receipt of CA Form
Laboratory Performance and Systems Audits	Written Audit Report	ENCO and GEL QA Officers	Within 2 months of audit	Memorandum	TBD, third party accrediting body	Within 2 months of receipt of initial notification.

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SAP Worksheet #32-1—Laboratory 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	Projected Delivery Date	Person Responsible for Report Preparation	Report Recipient(s)
RI Report	Post-field Event	August 2013 (updated from initial RI projected delivery date of January 2012)	Laura Cook/ CH2M HILL (WE02 PM) Kristin Rogers/CH2M HILL (WE51 PM)	Stakeholders, see Worksheet #4

The RI Report will address the following:

- Summary of project QA/QC requirements/procedures
- Conformance of project to UFP-SAP requirements/procedures
- Status of project schedule
- Deviations from the UFP-SAP and approved amendments that were made
- Results of data review activities (how much usable data was generated)
- CAs if needed and their effectiveness
- Data usability with regards to: precision, accuracy, representativeness, completeness, comparability, and sensitivity
- Limitations on data use

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

Verification Input	Description	Internal / External	Responsible for Verification (name, organization)
Planning Documents	Evidence of approval and completeness of UFP-SAP.	Internal	Laura Cook (WE02), Kristin Rogers (WE51) CH2M HILL
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 site file, and the original and remaining copies taped inside the cooler for shipment. See Chain-of-custody SOP (on CD) for further details.	Internal	FTL and PDM CH2M HILL
Field Log Notebooks	Field notes will be reviewed to ensure completeness of field data parameters, shipping information, sample collection times, and so forth. The logbook will also be used to document, explain, and justify all deviations from the approved work plan and UFP-SAP.	Internal	Laura Cook (WE02), Kristin Rogers (WE51) CH2M HILL
Sample Login/ Receipt	Upon their arrival at the laboratory, the samples will be cross-referenced against the chain-of-custody records. All sample labels will be checked against the chain-of-custody, and any mislabeling will be identified, investigated, and corrected. The samples will be logged in at every storage area and workstation required by the designated analyses. Individual analysts will verify the completeness and accuracy of the data recorded on the forms.	Internal	ENCO and GEL employees
QC Summary Report	A summary of all QC sample results will be verified for completeness once the data is received from the laboratory.	External	PDM or PC CH2M HILL

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

Step IIa / IIb ¹	Validation Input	Description	Responsible for Validation (name, organization)
IIa	SOPs	Review field logbooks, laboratory case narratives, data deliverables for compliance to methods and signatures.	Angela Petree, Laura Cook CH2M HILL
IIa	QC Results	Establish that all QC samples were run and compliant with method-required limits as specified in Worksheet #12 .	Ward Dickens CH2M HILL
IIb	QC Results	Verify that QC samples were run and compliant with limits established in the UFP-SAP.	Clairette Campbell CH2M HILL Ward Dickens CH2M HILL
IIb	PQLs	Ensure all sample results met the project quantification and action limits specified in Worksheet #15 .	Laura Cook, Kristin Rogers, Clairette Campbell CH2M HILL
IIb	Raw data	10% review of raw data to confirm laboratory calculations.	Ward Dickens CH2M HILL

¹ IIa=compliance with methods, procedures, and contracts
 IIb=comparison with MPC in the SAP

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SAP Worksheet #36-1—Initial RI Analytical Data Validation (Steps IIa and IIb) Summary Table

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	DV
IIa	Indoor Air Sub-slab Vapor Sediment Surface Water Surface Soil Subsurface Soil,	VOCs	Analytical methods and laboratory SOPs as presented in this SAP will be used to evaluate compliance against QA/QC criteria. Should adherence to QA/QC criteria yield deficiencies, data may be qualified. The data qualifiers used are those presented in <i>Region 3 Modifications to the National Functional Guidelines for Organic Data Review, Multi-Media, Multi-Concentration</i> , (USEPA, 1994). National Functional Guidelines will not be used for data validation; however, the specific qualifiers listed therein may be applied to data should non-conformances against the QA/QC criteria as presented in this SAP be identified.	Ward Dickens CH2M HILL
	Surface Soil Subsurface Soil,	Explosives, SVOCs		
IIb	Indoor Air Sub-slab Vapor Surface Soil Subsurface Soil	VOCs, Explosives, Metals, CN, SVOCs,	See PALs in Worksheet #15 ; See Method calibration and QC criteria in Worksheets #24 and 28 .	Laura Cook
	Surface Water Sediment			

SAP Worksheet #36-2—Supplemental RI Analytical Data Validation (Steps IIa and IIb) Summary Table

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	DV
IIa	Sediment Surface Water Surface Soil Subsurface Soil, Groundwater ¹	VOCs	Analytical methods and laboratory SOPs as presented in this SAP will be used to evaluate compliance against QA/QC criteria. Should adherence to QA/QC criteria yield deficiencies, data may be qualified. The data qualifiers used are those presented in <i>Region 3 Modifications to the National Functional Guidelines for Organic Data Review, Multi-Media, Multi-Concentration</i> , (USEPA, 1994). National Functional Guidelines will not be used for data validation; however, the specific qualifiers listed therein may be applied to data should non-conformances against the QA/QC criteria as presented in this SAP be identified.	Ward Dickens CH2M HILL
	Surface Soil Subsurface Soil, Groundwater ¹	Explosives, SVOCs Pesticides ¹ , PCBs ¹	Analytical methods and laboratory SOPs as presented in this SAP will be used to evaluate compliance against QA/QC criteria. Should adherence to QA/QC criteria yield deficiencies, data may be qualified. The data qualifiers used are those presented in <i>Region 3 Modifications to the National Functional Guidelines for Inorganic Analyses</i> , (USEPA, 1993). National Functional Guidelines will not be used for data validation; however, the specific qualifiers listed therein may be applied to data should non-conformances against the QA/QC criteria as presented in this SAP be identified.	
IIb	Surface Soil Subsurface Soil Surface Water Sediment	VOCs, Explosives, Metals, CN, SVOCs, Pesticides ¹ , PCBs ¹	See PALs in Worksheet #15 ; See Method calibration and QC criteria in Worksheets #24 and 28 .	Laura Cook, Kristin Rogers, Clairette Campbell/ CH2M HILL

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 PQL goals in **Worksheet #15** were achieved. If PQLs were achieved and the verification and validation steps yielded acceptable data, then the data are 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 are not considered usable for project decisions. If R-qualified data are used in evaluations and, ultimately, project decisions, the rationale for their use will be included in the RI Report.
 - J = Analyte present. Reported value may or may not be accurate or precise.
 - UJ = Analyte not detected. Quantitation limit (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.
- For statistical comparisons non-detect values will be represented by a concentration equal to one-half the sample reporting limit. For duplicate sample results, the most conservative value will be used for project decisions.
- Additional qualifiers that may be given by the validator are:
 - B = Not detected substantially above the level reported in laboratory or field blanks. 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.

SAP Worksheet #37—Usability Assessment (continued)

- 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 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 DQIs.
- If significant biases are detected with laboratory QA/QC samples, they will be evaluated to assess impact on decision-making. Low biases will be described in 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.

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

- Data tables will be produced to reflect detected and non-detected analytes. Data qualifiers will be reflected in the tables and discussed in the data quality evaluation.
- Graphical representations will be produced to reflect increasing and/or decreasing concentrations of COPCs and geochemical parameters.
- A data quality evaluation will be provided as part of the technical memorandum prepared to assess remedy effectiveness.
- The technical memorandum will identify any data usability limitations and make recommendations for CA if necessary.

Identify the personnel responsible for performing the usability assessment:

- The PM, PC, and other team members will be responsible for compiling the data. The data will then be presented to the Partnering Team, who, as a whole, will evaluate the data usability according to project objectives.

References

CH2M HILL. 2007. *Final Work Plan Site Assessment, Area Upgradient of Site 12, Naval Weapons Station Yorktown, Yorktown, Virginia.*

CH2M HILL. 2008. *Final Site Assessment Report, AOC 23, Naval Weapons Station Yorktown, Yorktown, Virginia.*

United States Environmental Protection Agency (USEPA). 1993. *Region 3 Modifications to National Functional Guidelines for Evaluating Inorganics Analyses.* April.

USEPA. 1994. *Region III Modification to National Functional Guidelines for Organic Data Review, MultiMedia, Multi Concentration.* September.

USEPA. 2002. *Guidance for Quality Assurance Project Plans, EPA QA/G-5, QAMS.*

USEPA. 2005. *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP).*

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Figures



Legend

- ■ ■ Camp Peary Scarp
- ▭ Study Area
- ▭ Buildings and Structures
- ▭ Naval Weapons Station Yorktown Boundary
- ▬ Interstate 64

- ▭ Kings Creek Commerce Center
- County Lines

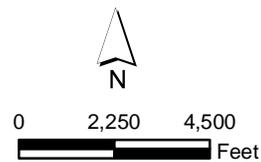
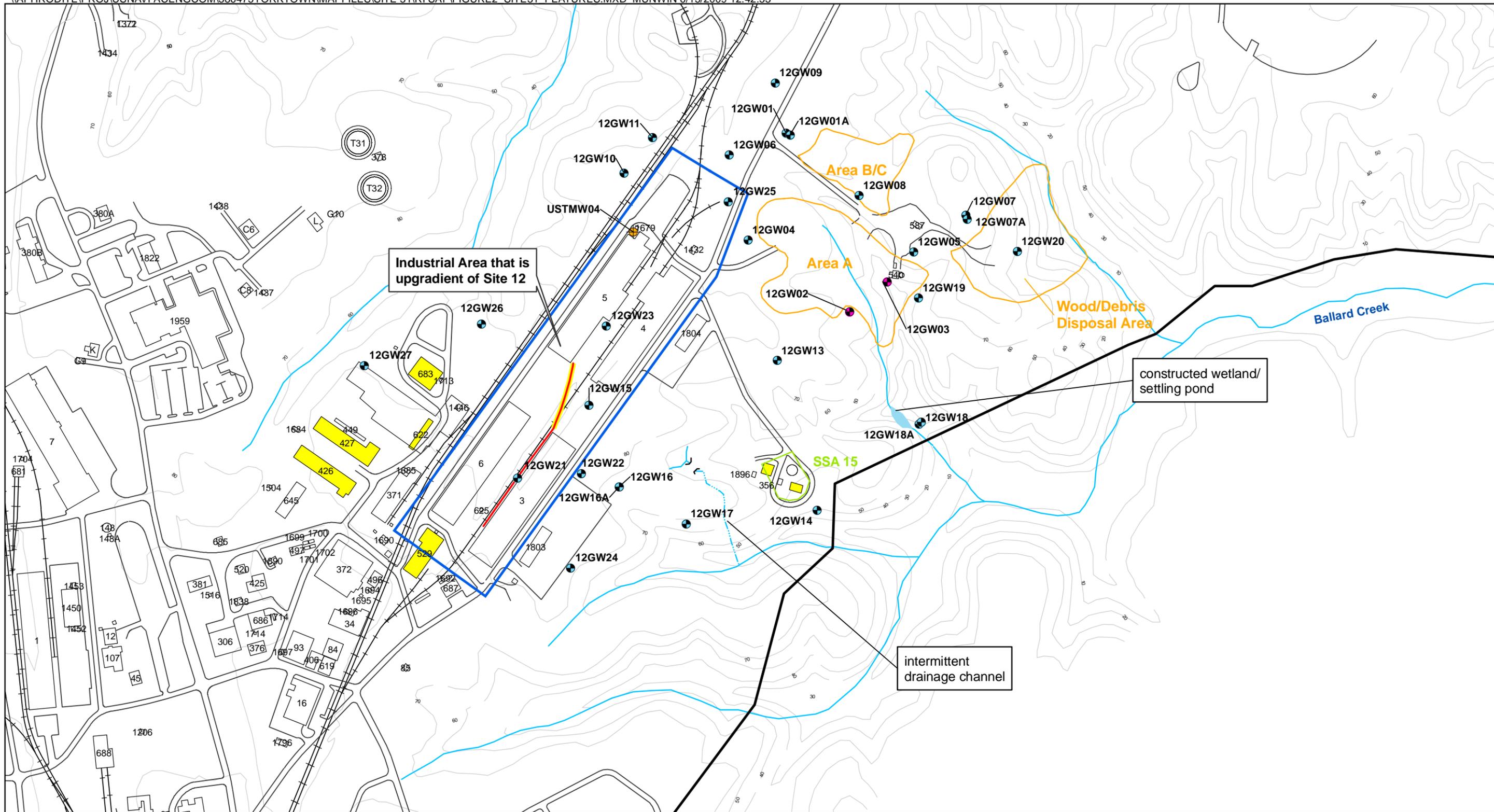


Figure 1
 Site 31 Location
 Site 31 RI Sampling and Analysis Plan
 Naval Weapons Station Yorktown
 Yorktown, Virginia



- Legend**
- IRP Monitoring Well
 - Underground Storage Tank Monitoring Well
 - Former location of well removed during remedy implementation
 - SSA 15 Boundary
 - Approximate IR Site 12 Boundary
 - Buildings and Structures
 - Demolished Building Locations
 - Industrial Area
 - Drainage Ditch Location
 - Former Drainage Ditch Location - not graded over
 - Roads and Paved Areas
 - Railroad
 - Yorktown Base Boundary
 - Topographic Contours

Note:
 "Industrial Area" referred to during this investigation consists of Buildings 3, 4, 5, and 6 and the surrounding area that is upgradient of Site 12.

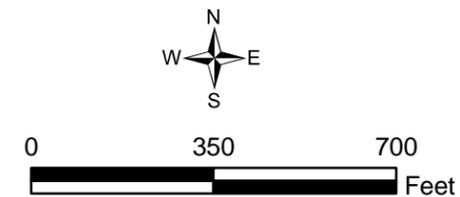
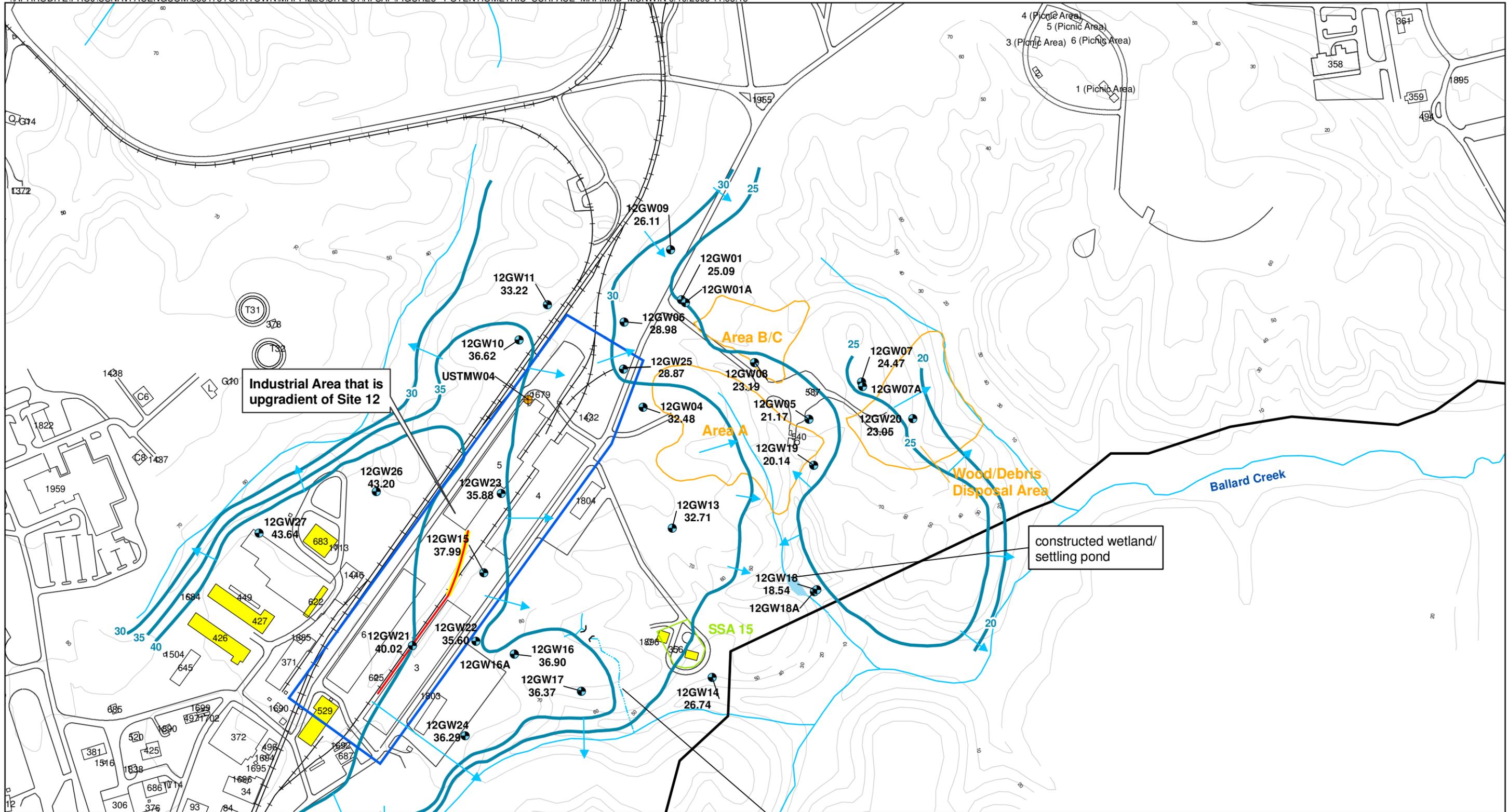


Figure 2
 Site 31 Layout
 Site 31 RI Sampling and Analysis Plan
 Naval Weapons Station Yorktown
 Yorktown, Virginia



Legend

- IRP Monitoring Well
- Underground Storage Tank Monitoring Well
- Former location of well removed during remedy implementation
- SSA 15 Boundary
- Approximate IR Site 12 Boundary
- Buildings and Structures
- Demolished Building Locations
- Industrial Area
- Drainage Ditch Location
- Former Drainage Ditch Location - not graded over
- Roads and Paved Areas
- Railroad
- Yorktown Base Boundary
- Topographic Contours
- Groundwater Potentiometric Surface
- Groundwater Flow

Note:
 "Industrial Area" referred to during this investigation consists of Buildings 3, 4, 5, and 6 and the surrounding area that is upgradient of Site 12.



Figure 3
 Potentiometric Surface Map: Cornwallis Cave Aquifer
 Site 31 RI Sampling and Analysis Plan
 Naval Weapons Station Yorktown
 Yorktown, Virginia

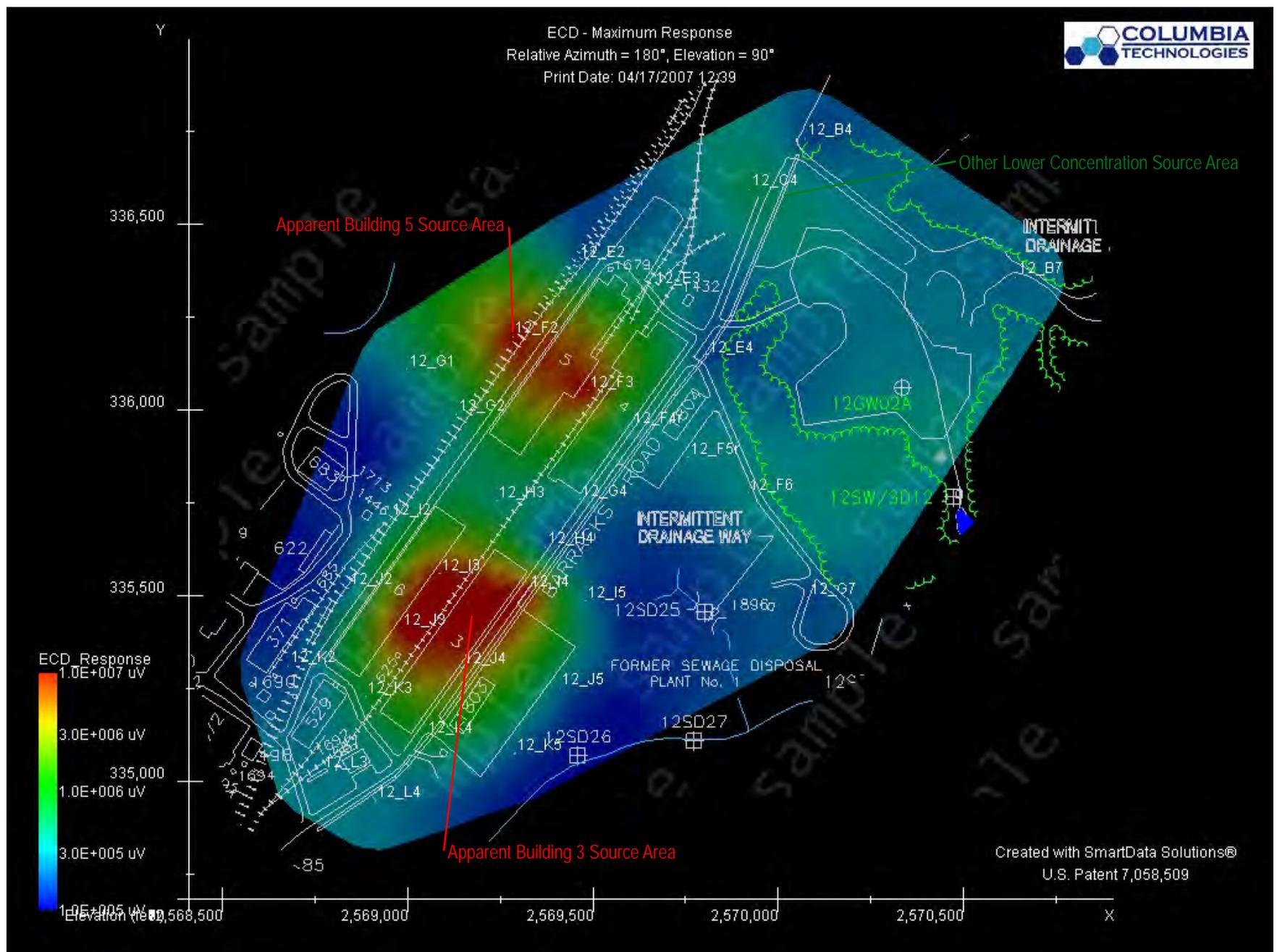
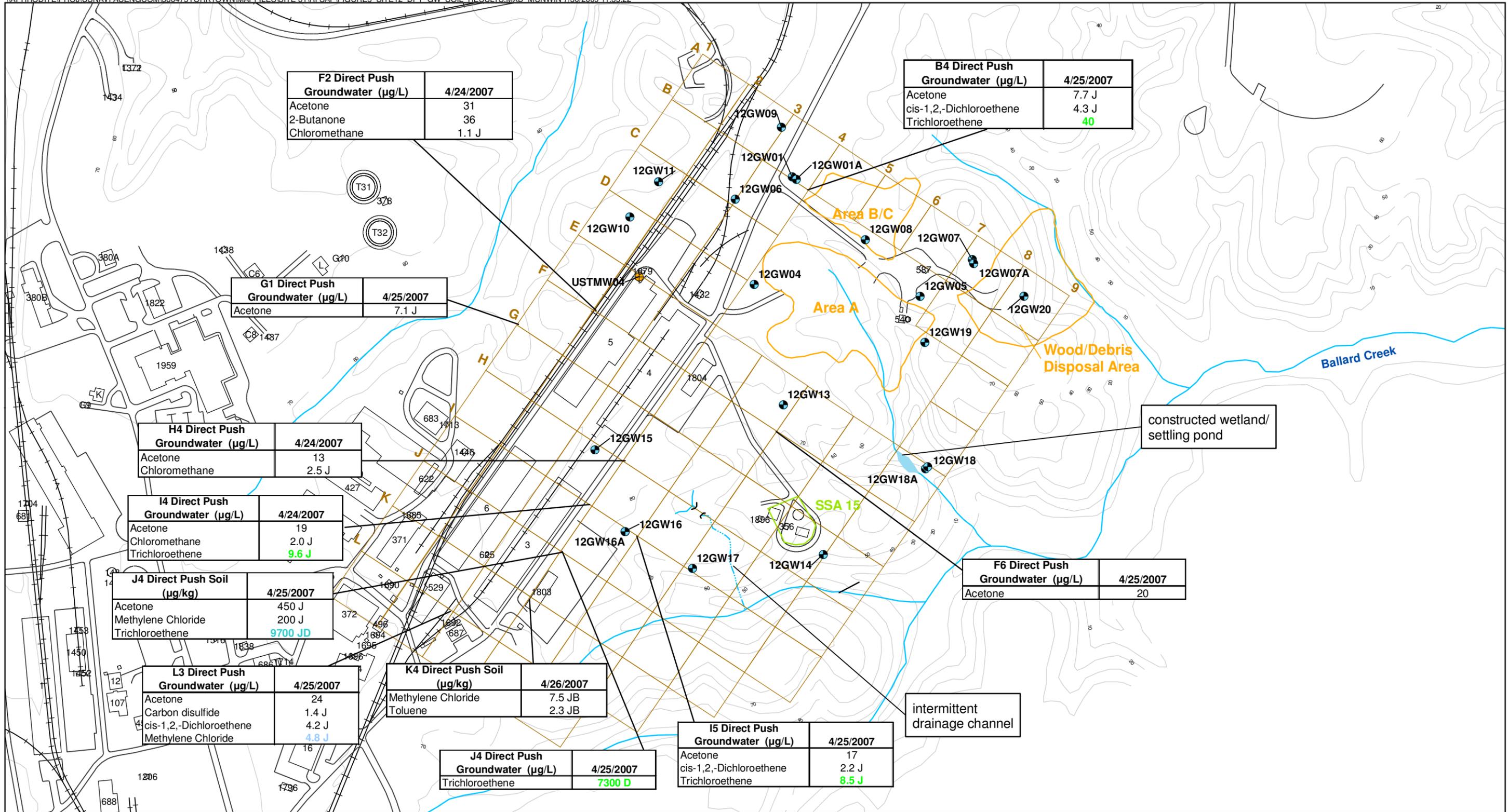


Figure 4
 Source Areas as Identified by MIP Results
 Site 31 RI Sampling and Analysis Plan
 Naval Weapons Station Yorktown
 Yorktown, Virginia



F2 Direct Push Groundwater (µg/L)		4/24/2007
Acetone		31
2-Butanone		36
Chloromethane		1.1 J

G1 Direct Push Groundwater (µg/L)		4/25/2007
Acetone		7.1 J

H4 Direct Push Groundwater (µg/L)		4/24/2007
Acetone		13
Chloromethane		2.5 J

I4 Direct Push Groundwater (µg/L)		4/24/2007
Acetone		19
Chloromethane		2.0 J
Trichloroethene		9.6 J

J4 Direct Push Soil (µg/kg)		4/25/2007
Acetone		450 J
Methylene Chloride		200 J
Trichloroethene		9700 JD

L3 Direct Push Groundwater (µg/L)		4/25/2007
Acetone		24
Carbon disulfide		1.4 J
cis-1,2,-Dichloroethene		4.2 J
Methylene Chloride		4.8 J

K4 Direct Push Soil (µg/kg)		4/26/2007
Methylene Chloride		7.5 JB
Toluene		2.3 JB

J4 Direct Push Groundwater (µg/L)		4/25/2007
Trichloroethene		7300 D

I5 Direct Push Groundwater (µg/L)		4/25/2007
Acetone		17
cis-1,2,-Dichloroethene		2.2 J
Trichloroethene		8.5 J

B4 Direct Push Groundwater (µg/L)		4/25/2007
Acetone		7.7 J
cis-1,2,-Dichloroethene		4.3 J
Trichloroethene		40

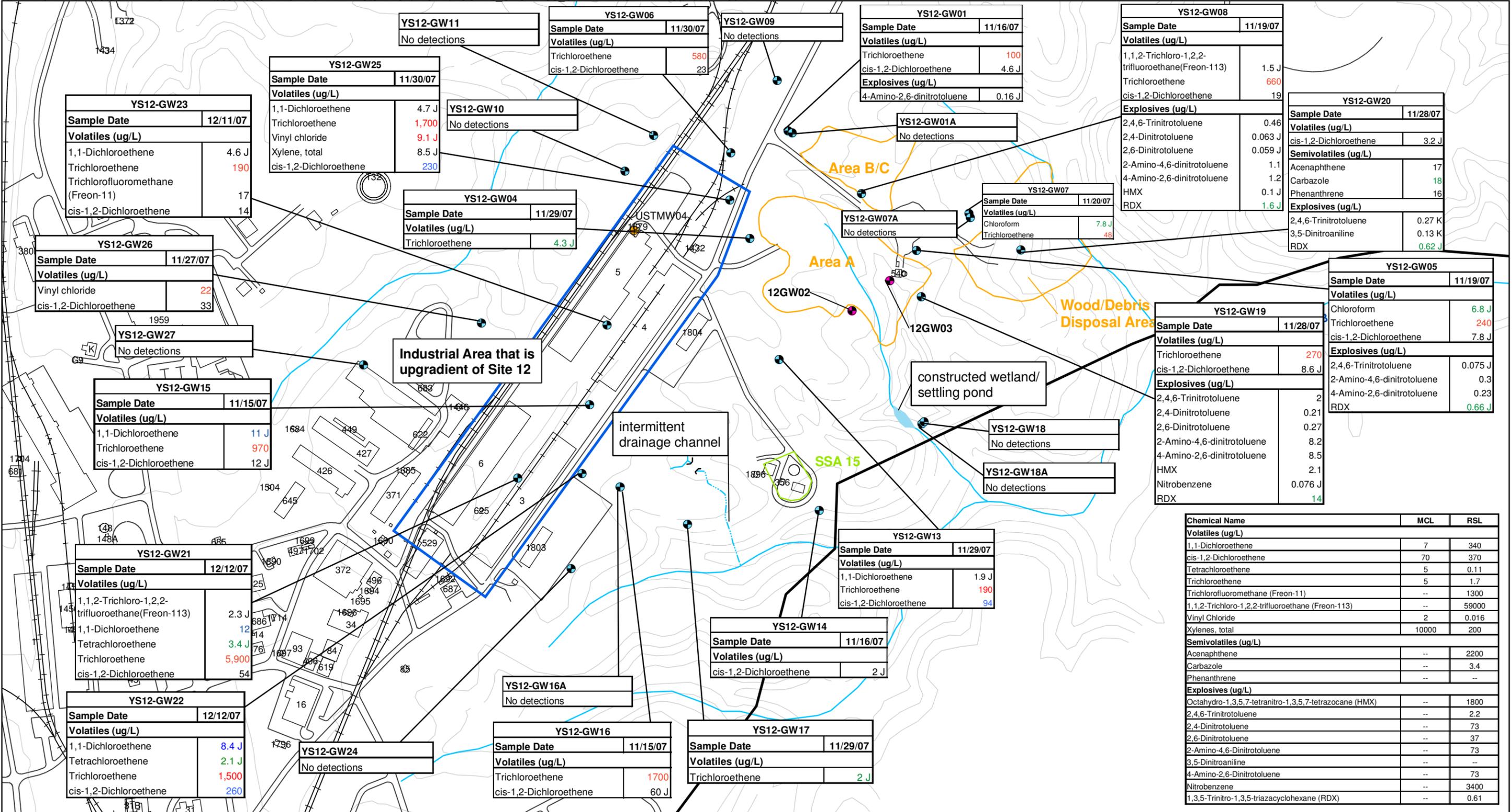
F6 Direct Push Groundwater (µg/L)		4/25/2007
Acetone		20

- Legend**
- IRP Monitoring Well
 - ⊙ Underground Storage Tank Monitoring Well
 - SSA 15 Boundary
 - Approximate IR Site 12 Boundary
 - Buildings and Structures
 - Roads and Paved Areas
 - Railroad
 - Yorktown Base Boundary
 - Topographic Contours
 - MIP Grid

Notes:
 Number of actual sample locations to be determined by MIP results and Team decisions.
 Grid is placed as a guide for field crew.
 Sample locations will be adjusted as necessary for utility and access issues.
 New monitoring wells locations to be determined by Team.
 Groundwater seep locations will be determined with BTAG input.
 Exceeds RSL Criteria Only
 Exceeds both MCL and RSL Criteria



Figure 5
 Site Assessment DPT Groundwater and Soil Results
 Site 31 RI Sampling and Analysis Plan
 Naval Weapons Station Yorktown
 Yorktown, Virginia



Chemical Name	MCL	RSL
Volatiles (ug/L)		
1,1-Dichloroethene	7	340
cis-1,2-Dichloroethene	70	370
Tetrachloroethene	5	0.11
Trichloroethene	5	1.7
Trichlorofluoromethane (Freon-11)	--	1300
1,1,2-Trichloro-1,2,2-trifluoroethane (Freon-113)	--	59000
Vinyl Chloride	2	0.016
Xylenes, total	10000	200
Semivolatiles (ug/L)		
Acenaphthene	--	2200
Carbazole	--	3.4
Phenanthrene	--	--
Explosives (ug/L)		
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocane (HMX)	--	1800
2,4,6-Trinitrotoluene	--	2.2
2,4-Dinitrotoluene	--	73
2,6-Dinitrotoluene	--	37
2-Amino-4,6-Dinitrotoluene	--	73
3,5-Dinitroaniline	--	--
4-Amino-2,6-Dinitrotoluene	--	73
Nitrobenzene	--	3400
1,3,5-Trinitro-1,3,5-triazacyclohexane (RDX)	--	0.61

- Legend**
- IRP Monitoring Well
 - Underground Storage Tank Monitoring Well
 - Former location of well removed during remedy implementation
 - SSA 15 Boundary
 - Approximate IR Site 12 Boundary
 - Buildings and Structures
 - Roads and Paved Areas
 - Railroad
 - Yorktown Base Boundary
 - Topographic Contours
 - Industrial Area

Note:
 "Industrial Area" referred to during this investigation consists of Buildings 3, 4, 5, and 6 and the surrounding area that is upgradient of Site 12.
 Concentrations shaded blue exceed MCLs
 Concentrations shaded green exceed RSLs
 Concentrations shaded red exceed both MCLs and RSLs
 J - Analyte present, reported value may not be accurate or precise
 K - Analyte present, value may be biased high, actual value may be lower
 Where duplicate samples taken, most conservative concentration value given

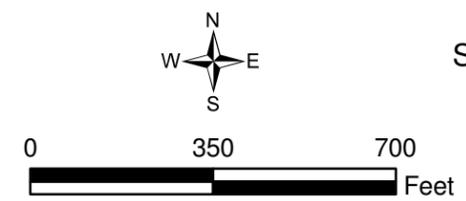
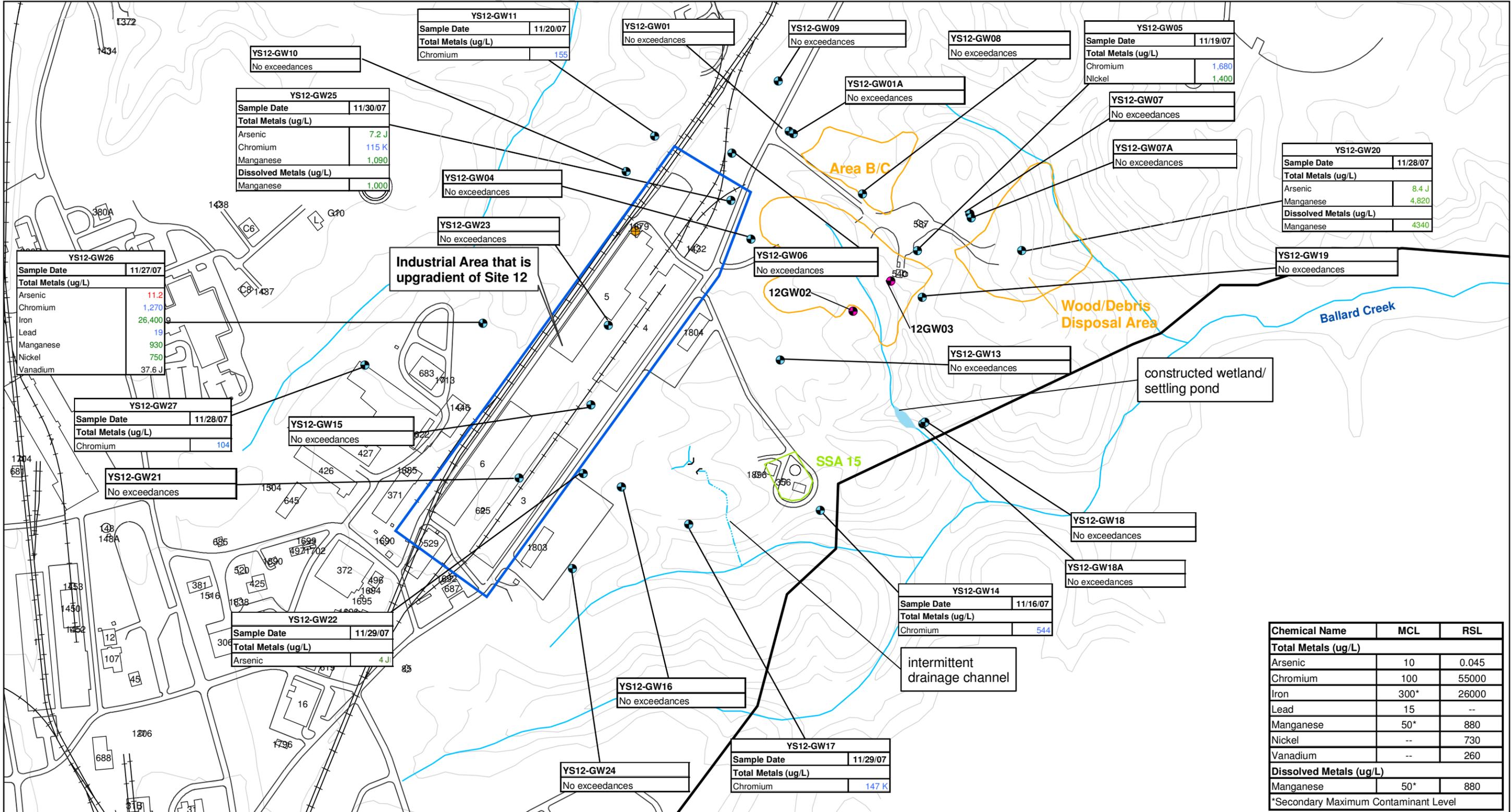


Figure 6
 Organics in Groundwater
 Site 31 RI Sampling and Analysis Plan
 Naval Weapons Station Yorktown
 Yorktown, Virginia



- Legend**
- IRP Monitoring Well
 - Underground Storage Tank Monitoring Well
 - Former location of well removed during remedy implementation
 - ▭ SSA 15 Boundary
 - ▭ Approximate IR Site 12 Boundary
 - ▭ Buildings and Structures
 - Roads and Paved Areas
 - Railroad
 - Yorktown Base Boundary
 - Topographic Contours
 - ▭ Industrial Area

Note:
 "Industrial Area" referred to during this investigation consists of Buildings 3, 4, 5, and 6 and the surrounding area that is upgradient of Site 12.
 Concentrations shaded **blue** exceed MCLs
 Concentrations shaded **green** exceed RSLs
 Concentrations shaded **red** exceed both MCLs and RSLs
 J - Analyte present, reported value may not be accurate or precise
 K - Analyte present, value may be biased high, actual value may be lower
 Where duplicate samples taken, most conservative concentration value given

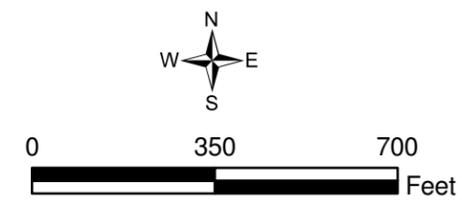
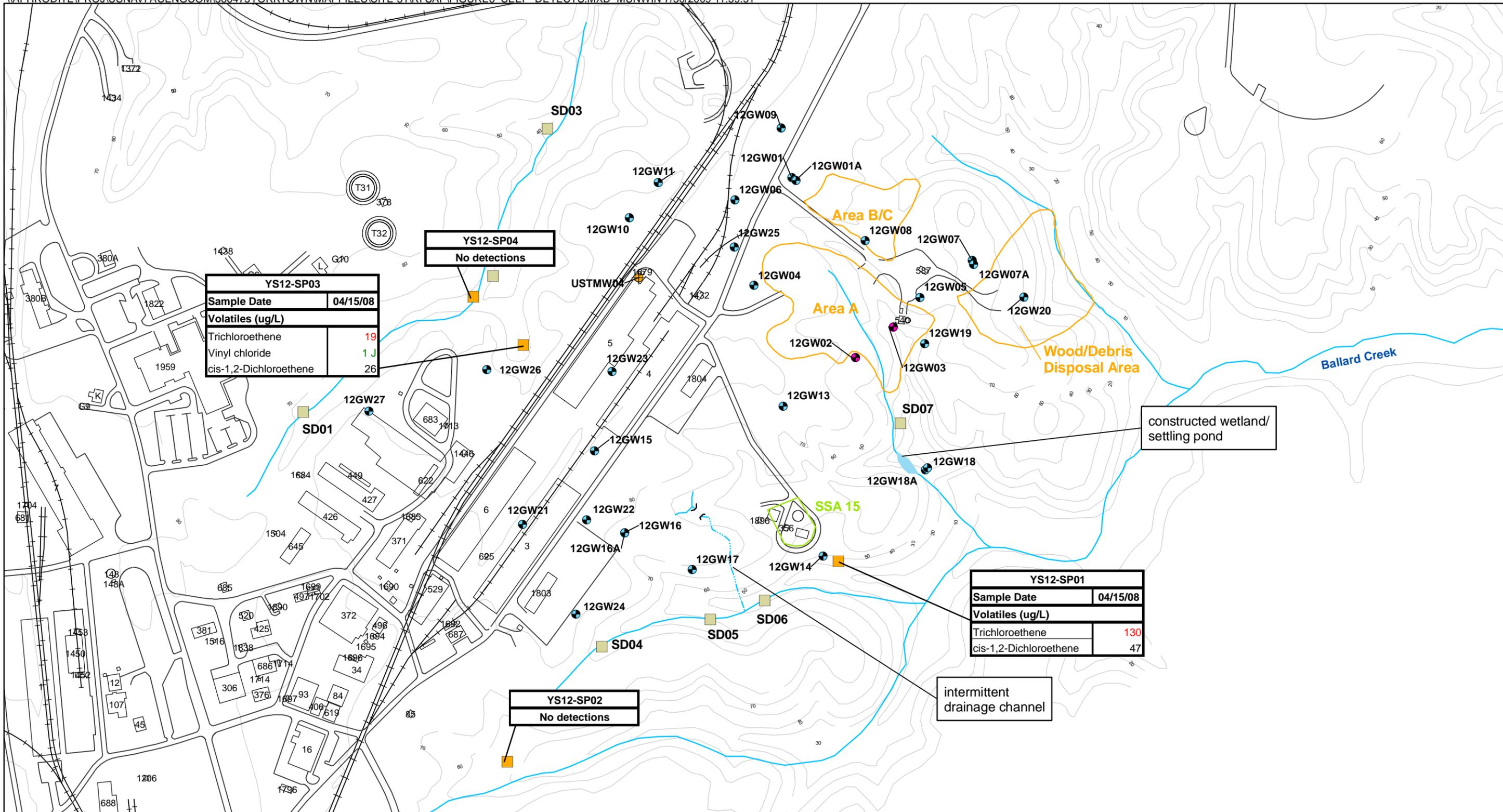


Figure 7
 Inorganics in Groundwater
 Site 31 RI Sampling and Analysis Plan
 Naval Weapons Station Yorktown
 Yorktown, Virginia



YS12-SP03	
Sample Date	04/15/08
Volatiles (ug/L)	
Trichloroethene	19
Vinyl chloride	1 J
cis-1,2-Dichloroethene	26

YS12-SP04
No detections

YS12-SP01	
Sample Date	04/15/08
Volatiles (ug/L)	
Trichloroethene	130
cis-1,2-Dichloroethene	47

YS12-SP02
No detections

- Legend**
- IRP Monitoring Well
 - ⊕ Underground Storage Tank Monitoring Well
 - Former location of well removed during remedy implementation
 - SSA 15 Boundary
 - Approximate IR Site 12 Boundary
 - Buildings and Structures

- Roads and Paved Areas
- Railroad
- Yorktown Base Boundary
- Topographic Contours
- Seep Sample Locations
- Surface Water and Sediment Sample Locations

Key:
■ Exceeds MCL
■ Exceeds RSL
■ Exceeds Both

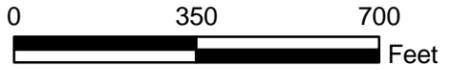
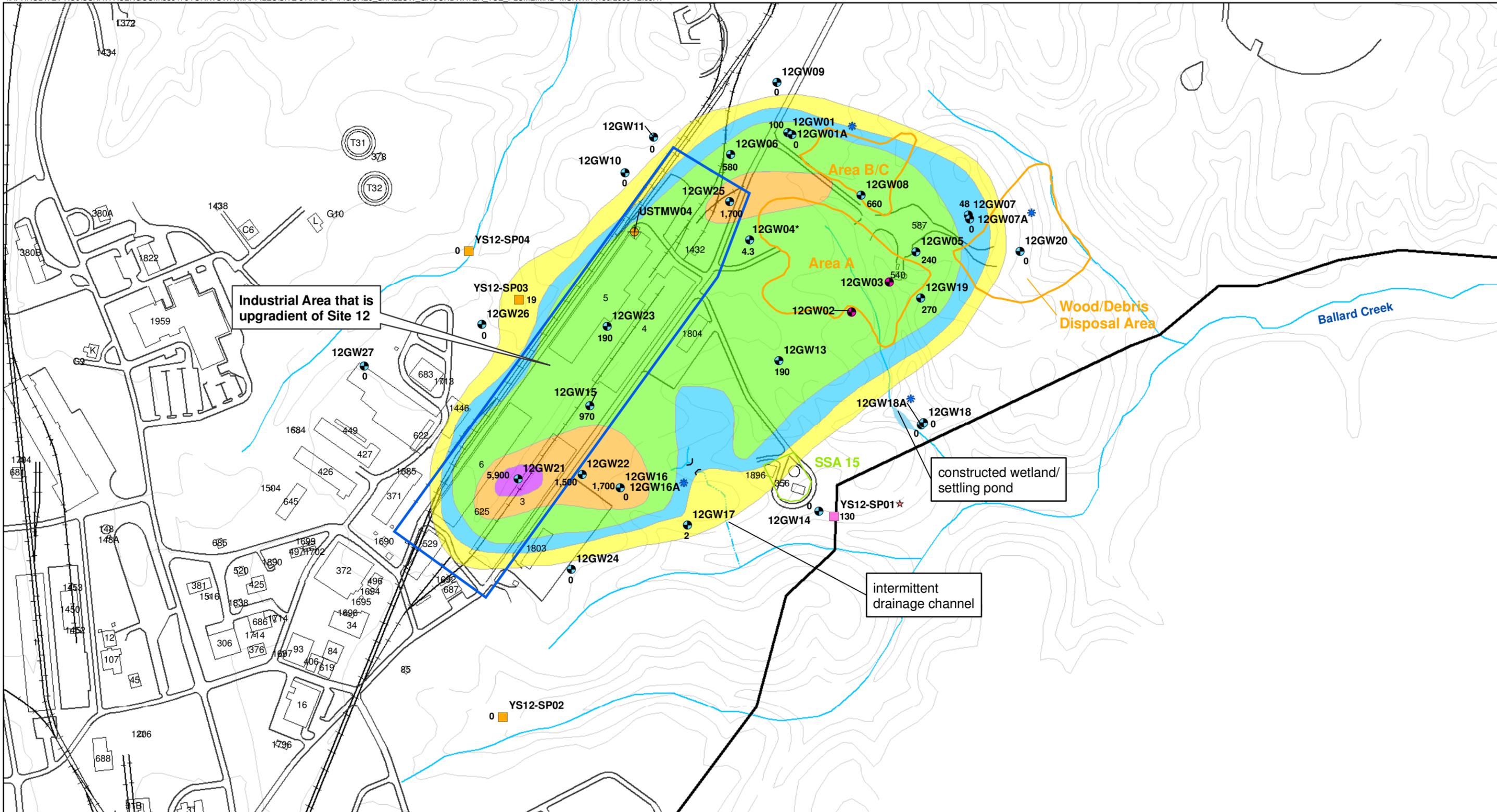


Figure 8
 Seep Detections
 Site 31 RI Sampling and Analysis Plan
 Naval Weapons Station Yorktown
 Yorktown, Virginia



Legend

- IRP Monitoring Well
- Underground Storage Tank Monitoring Well
- Former location of well removed during remedy implementation
- Seep Sample Location
- Outfall pipe samples as seep
- Roads and Paved Areas
- Railroad
- Yorktown Base Boundary
- Topographic Contours
- Industrial Area
- SSA 15 Boundary
- Approximate IR Site 12 Boundary
- Buildings and Structures
- TCE Concentration 1 - 25
- TCE Concentration 26 - 49
- TCE Concentration 50 - 999
- TCE Concentration 1000 - 4999
- TCE Concentration > 5000

Note: All results are reported in ug/L
 ☆ Outfall pipe - receives GW from unknown area, result not used for isocontouring
 * Concentrations from deep GW monitoring wells denoted with "A"; not used to delineate the plume
 * Anomalous data point - not included in contouring

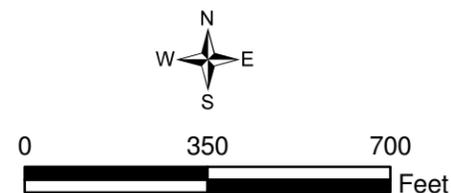


Figure 9
 Shallow Groundwater TCE Plume
 Site 31 RI Sampling and Analysis Plan
 Naval Weapons Station Yorktown
 Yorktown, Virginia

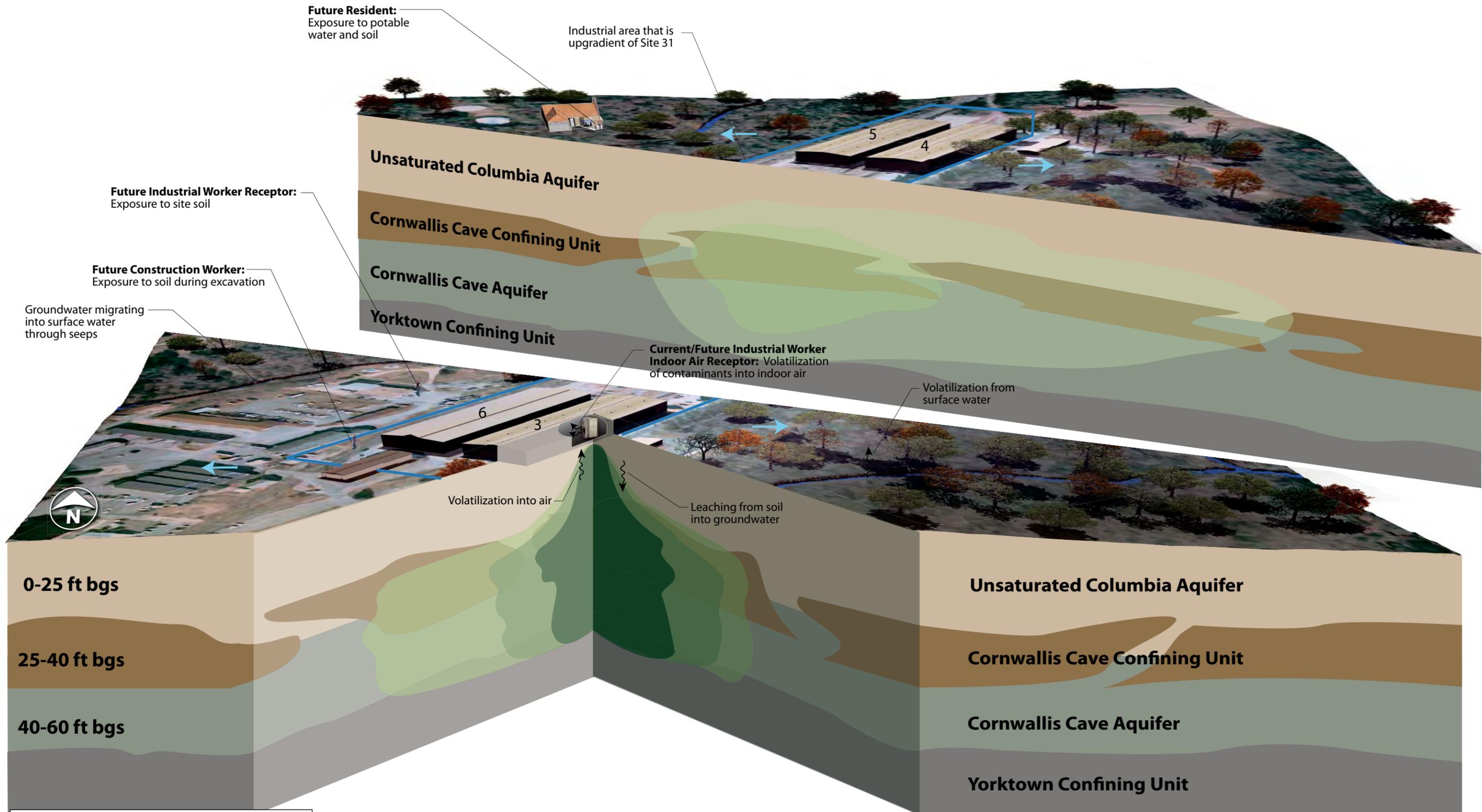
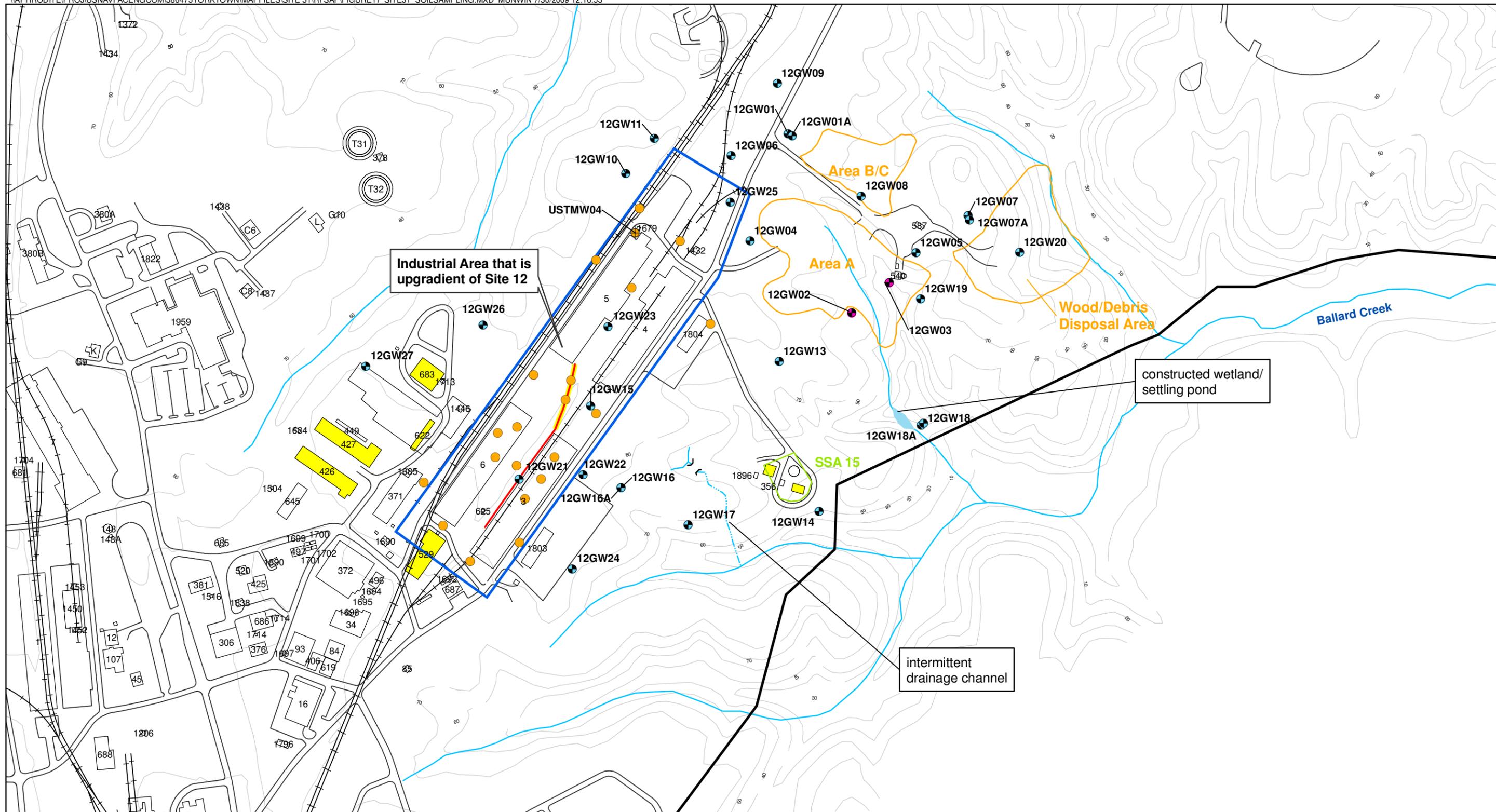


FIGURE 10
 Site 31 Conceptual Site Model
 Site 31 RI Sampling and Analysis Plan
 Naval Weapons Station Yorktown
 Yorktown, Virginia



Legend

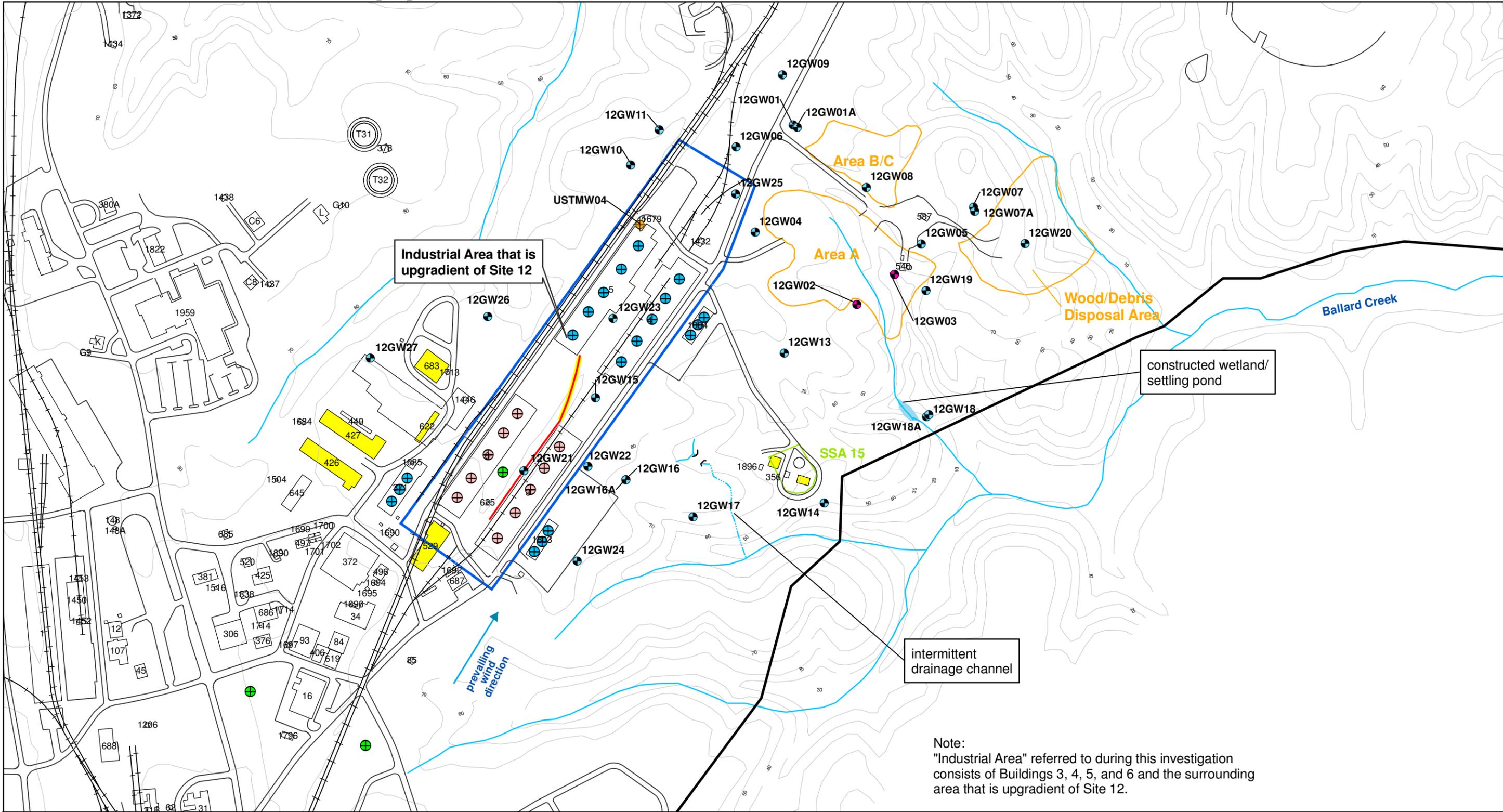
- IRP Monitoring Well
- Underground Storage Tank Monitoring Well
- Former location of well removed during remedy implementation
- SSA 15 Boundary
- Approximate IR Site 12 Boundary
- Buildings and Structures
- Demolished Building Locations
- Industrial Area
- Drainage Ditch Location
- Former Drainage Ditch Location - not graded over
- Roads and Paved Areas
- Railroad
- Yorktown Base Boundary
- Topographic Contours

Note:
 "Industrial Area" referred to during this investigation consists of Buildings 3, 4, 5, and 6 and the surrounding area that is upgradient of Site 12.

● Proposed Soil Sample Locations



Figure 11
 Proposed Soil Sampling Locations
 Site 31 RI Sampling and Analysis Plan
 Naval Weapons Station Yorktown
 Yorktown, Virginia



Note:
 "Industrial Area" referred to during this investigation consists of Buildings 3, 4, 5, and 6 and the surrounding area that is upgradient of Site 12.

- Legend**
- IRP Monitoring Well
 - Underground Storage Tank Monitoring Well
 - Former location of well removed during remedy implementation
 - SSA 15 Boundary
 - Approximate IR Site 12 Boundary
 - Buildings and Structures
 - Demolished Building Locations
 - Industrial Area
 - Drainage Ditch Location
 - Former Drainage Ditch Location - not graded over
 - Roads and Paved Areas
 - Railroad
 - Yorktown Base Boundary
 - Topographic Contours

- ⊕ Proposed co-located indoor air and sub-slab sample locations
- ⊕ Proposed sub-slab sample locations
- ⊕ Proposed tentative ambient air sample locations - actual locations will be field determined based on wind direction during sampling and building air intake locations.

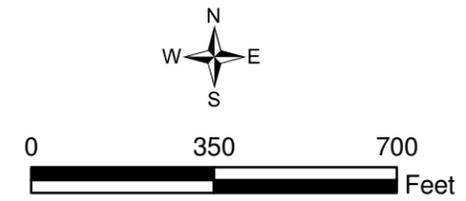
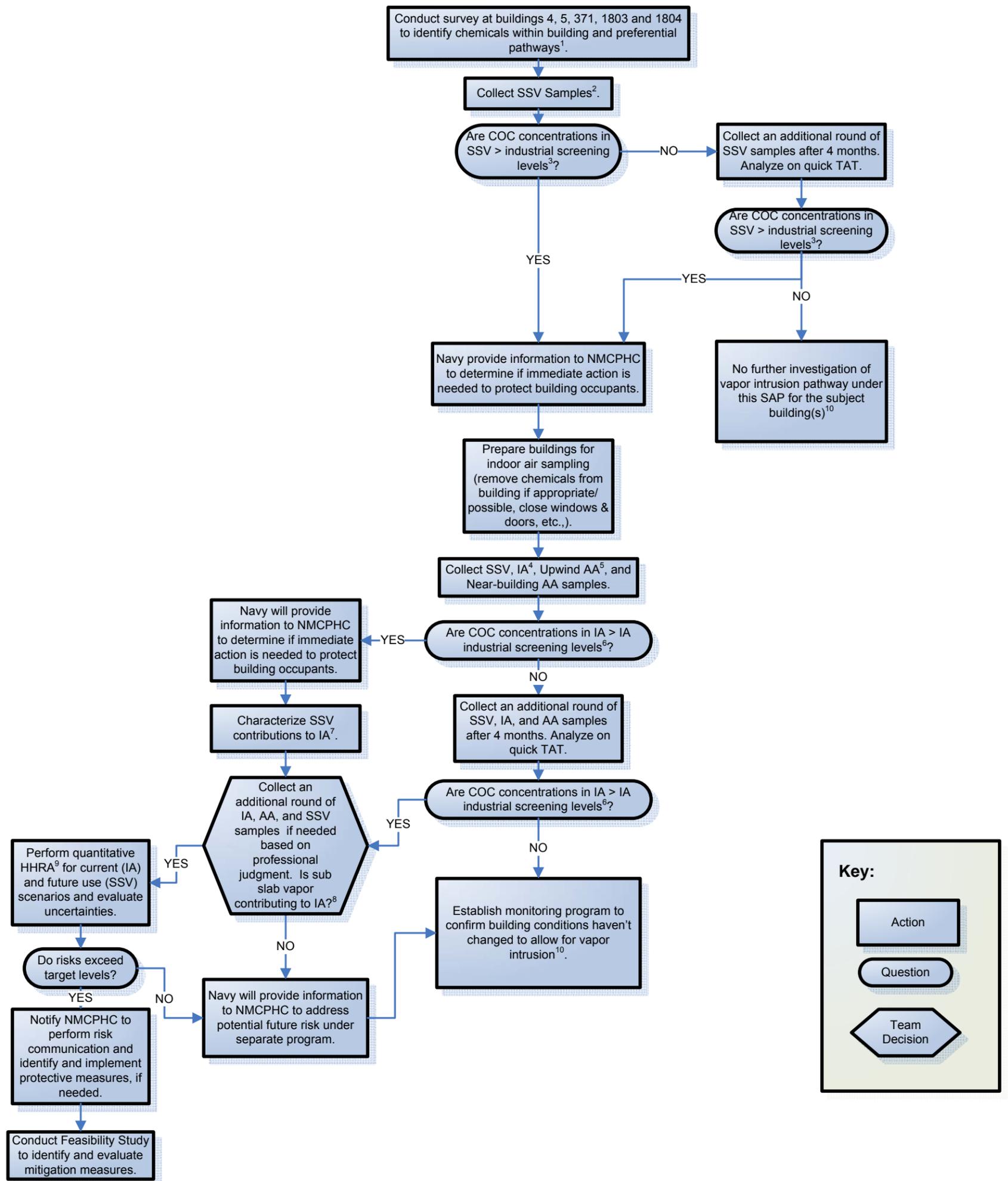


Figure 12
 Proposed Vapor Sampling Locations
 Site 31 RI Sampling and Analysis Plan
 Naval Weapons Station Yorktown
 Yorktown, Virginia



Notes:

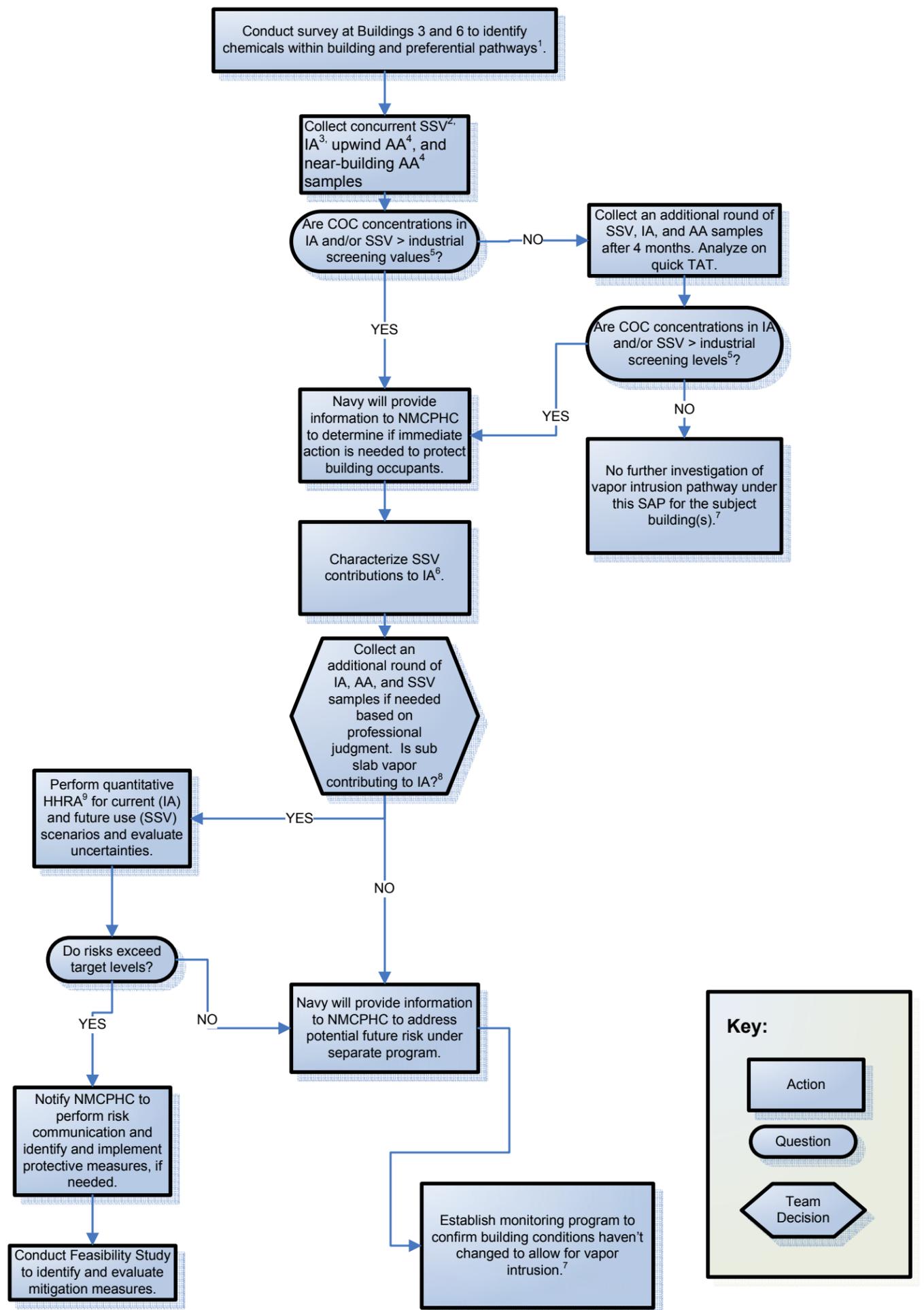
- 1 - Per USEPA (www.iavi.rti.org) , and ITRC (2007), if appropriate and available, additional lines of evidence will be considered throughout the decision process.
- 2 - SSV sample: vapor samples collected immediately under the building foundation.
- 3 - SSV industrial screening levels are the USEPA Regional Screening Levels (industrial) multiplied by 10, based on the conservative attenuation factor of 0.1, for which shallow soil gas is conservatively assumed to intrude into indoor air spaces.
- 4 - IA sample: indoor air sample collected at 3- to 5-ft above the floor.
- 5 - Upwind AA samples should be collected upwind and away from the contaminant plume. Near-building AA samples should be collected near air intakes to the extent feasible.
- 6 - For carcinogenic compounds, the industrial screening levels are the USEPA Regional Screening Levels (indoor air, industrial). For noncancer compounds, the industrial screening levels are the USEPA Regional Screening Levels (indoor air, industrial) divided by 10 to account for additive effects.
- 7 - Use of: tracer compounds to develop building specific attenuation factors, constituent ratios within each sample (SSV Ratio, IA Ratio, Upwind AA Ratio, Near-building AA Ratio), national background levels for indoor air, national background levels for outdoor air, clean water layer, magnitude of exceedance of RSL in comparison to IA/AA concentrations, and building survey information
- 8 - If a risk assessment is required on the basis of this step, the team will also agree on exposure concentrations to be included in the risk assessment.
- 9 - Where feasible and appropriate, a building specific attenuation factor will be used. If a building specific attenuation factor is not feasible, then the direct IA or a default attenuation factor will be used in the risk assessment.
- 10 - Additional SSV/IA samples may be needed to evaluate future land use, develop the groundwater feasibility study, and/or to monitor remedy effectiveness.

Acronyms:

AA - ambient air
 CERCLA - Comprehensive Response, Compensation, and Liability Act
 COC - chemical of concern
 HHRA - Human Health Risk Assessment

IA - indoor air
 NMCPHC - Navy and Marine Corps Public Health Center
 SAP - Sampling and Analysis Plan
 SSV - sub slab vapor
 TAT - turn-around-time

Figure 13
 Vapor Intrusion Strategy for Buildings
 4, 5, 371, 1803 and 1804
 Site 31 RI Sampling and Analysis Plan
 Naval Weapons Station Yorktown
 Yorktown, Virginia



Notes:

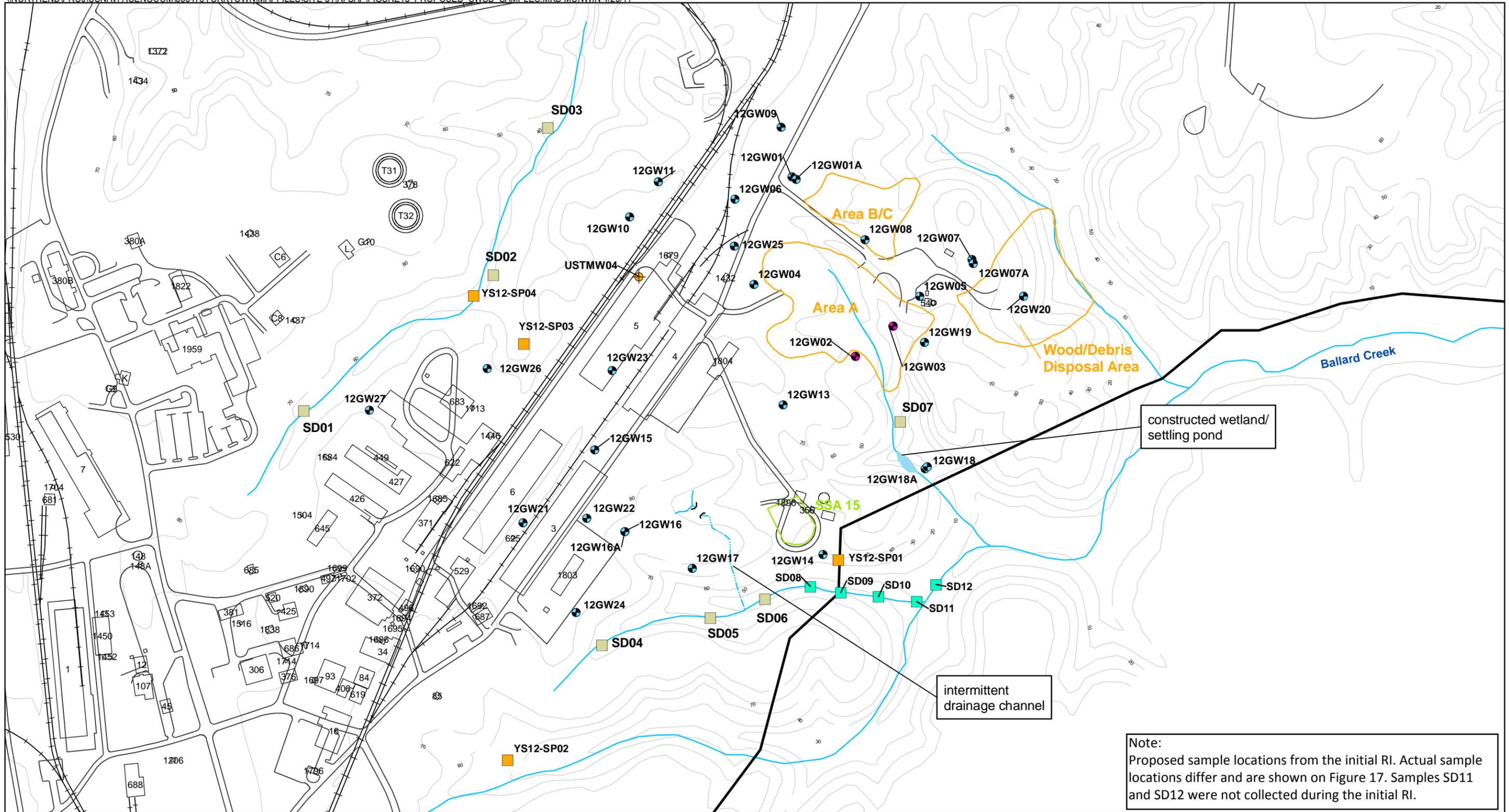
- 1 - Per USEPA (www.iavi.rti.org) , and ITRC (2007), if appropriate and available, additional lines of evidence will be considered throughout the decision process.
- 2 - SSV sample: vapor samples collected immediately under the building foundation.
- 3 - IA sample: indoor air sample collected at 3- to 5-ft above the floor.
- 4 - Upwind AA samples should be collected upwind and away from the contaminant plume. Near-building AA samples should be collected near air intakes to the extent feasible.
- 5 – For carcinogenic compounds, industrial screening levels for IA are the USEPA Regional Screening Levels. For noncancer compounds, industrial IA screening levels are divided by 10 to account for potential additive effects. SSV screening levels are the IA screening levels multiplied by 10 to account for an attenuation factor of 0.1.
- 6 - Use of: tracer compounds to develop building specific attenuation factors, constituent ratios within each sample (SSV Ratio, IA Ratio, Upwind AA Ratio, Near-building AA Ratio), national background levels for indoor air, national background levels for outdoor air, clean water layer, magnitude of exceedance of RSL in comparison to IA/AA concentrations, and building survey information
- 7 - Additional SSV/IA samples may be needed to evaluate future land use, develop the groundwater feasibility study, and/or to monitor remedy effectiveness.
- 8 – If a risk assessment is required on the basis of this step, the team will also agree on exposure concentrations to be included in the risk assessment.
- 9 – Where feasible and appropriate, a building-specific attenuation factor will be used. If a building-specific attenuation factor is not feasible, then the direct IA or a default attenuation factor will be used in the risk assessment

Acronyms:

AA - ambient air
 CERCLA - Comprehensive Response, Compensation, and Liability Act
 COC - chemical of concern
 HHRA - Human Health Risk Assessment

IA - indoor air
 NMCPHC - Navy and Marine Corps Public Health Center
 SAP - Sampling and Analysis Plan
 SSV - sub slab vapor
 TAT - turn-around-time

Figure 14
 Vapor Intrusion Strategy for Buildings 3 and 6
 Site 31 RI Sampling and Analysis Plan
 Naval Weapons Station Yorktown
 Yorktown, Virginia



Note:
Proposed sample locations from the initial RI. Actual sample locations differ and are shown on Figure 17. Samples SD11 and SD12 were not collected during the initial RI.

- Legend**
- IRP Monitoring Well
 - Underground Storage Tank Monitoring Well
 - Former location of well removed during remedy implementation
 - SSA 15 Boundary
 - Approximate IR Site 12 Boundary
 - Buildings and Structures
 - Roads and Paved Areas
 - Railroad
 - Yorktown Base Boundary
 - Topographic Contours
 - Site Assessment/Outfall Seep Sample Locations
 - Site Assessment Surface Water and Sediment Sample Locations
 - Proposed Surface Water and Sediment Sample Locations

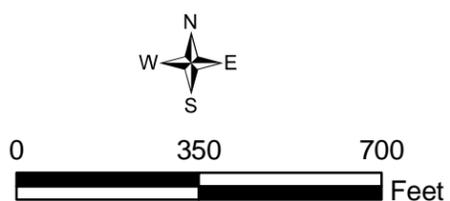
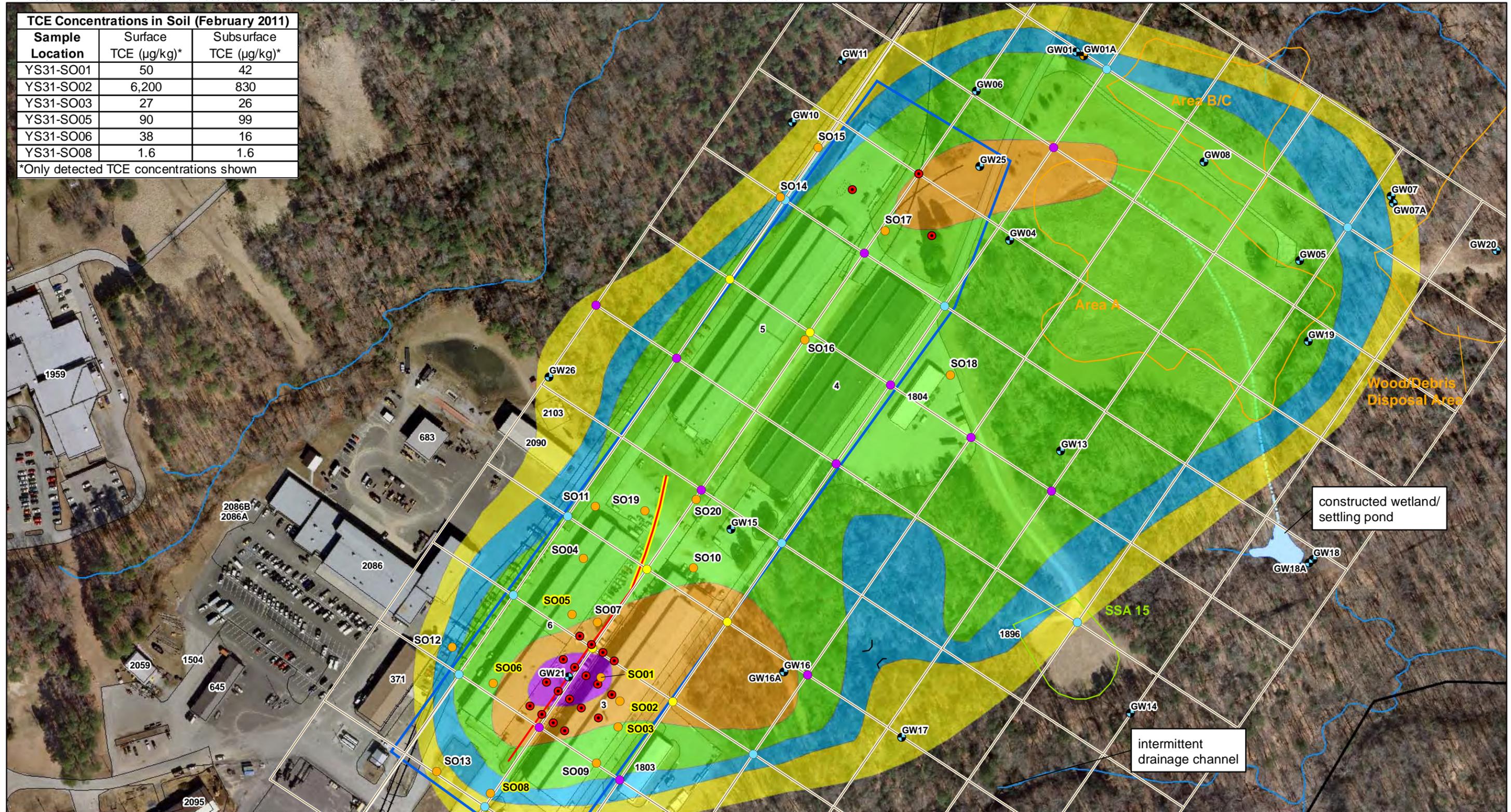


Figure 15
Proposed Surface Water and Sediment Sample Locations
Site 31 RI Sampling and Analysis Plan
Naval Weapons Station Yorktown
Yorktown, Virginia

TCE Concentrations in Soil (February 2011)

Sample Location	Surface TCE (µg/kg)*	Subsurface TCE (µg/kg)*
YS31-SO01	50	42
YS31-SO02	6,200	830
YS31-SO03	27	26
YS31-SO05	90	99
YS31-SO06	38	16
YS31-SO08	1.6	1.6

*Only detected TCE concentrations shown



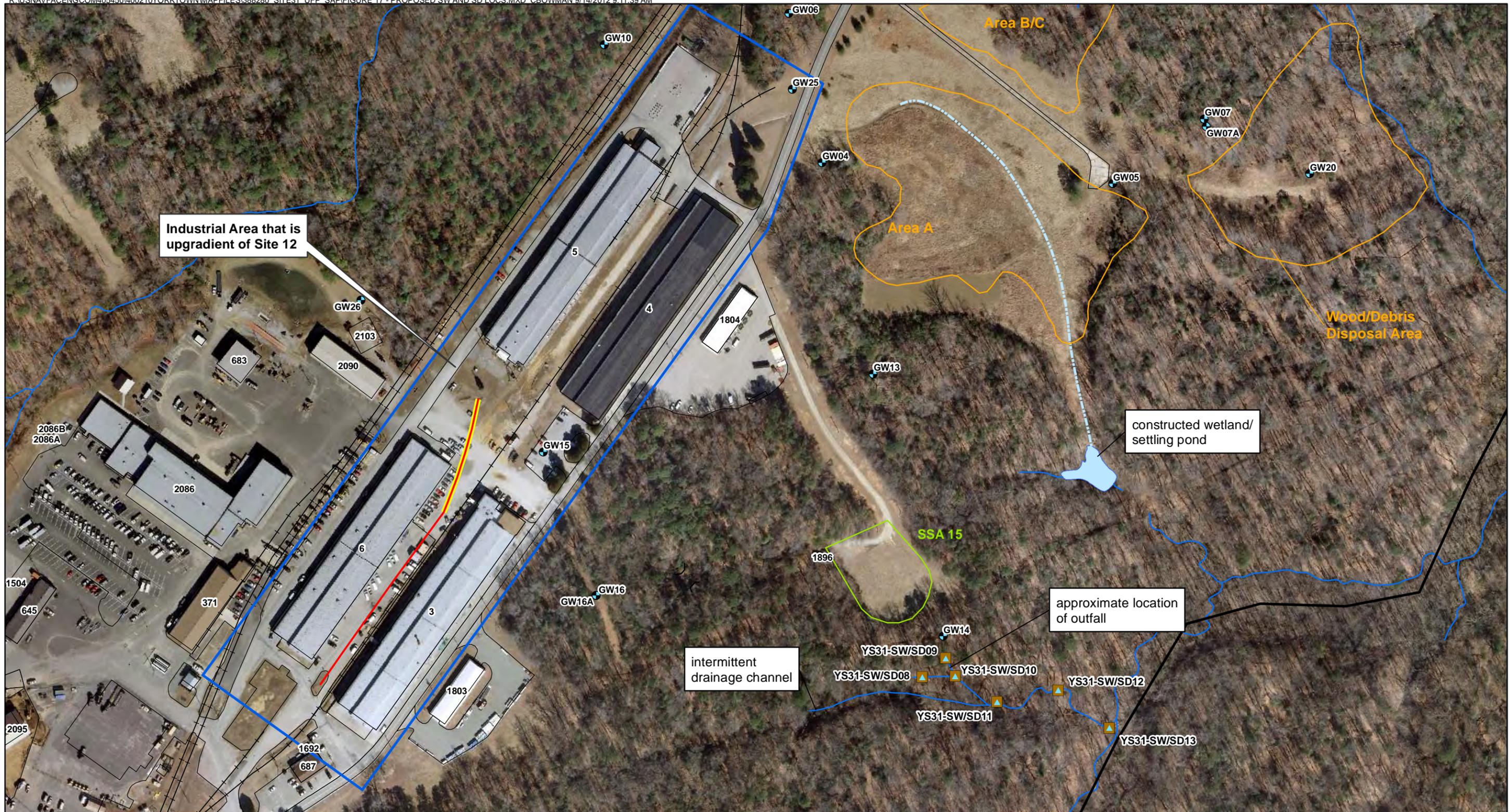
- Legend**
- Yorktown-Eastover Monitoring Well
 - Cornwallis-Cave Monitoring Well
 - Initial RI Soil Sample Location
 - Proposed MIP Location
 - Previous MIP Response (UV)
 - ECD < 2.5x10⁵
 - ECD between 2.5x10⁵ and 10⁶
 - ECD between 2.5x10⁶ and 10⁸
 - MIP grid
 - Former Drainage Ditch Location - not graded over
 - Railroad
 - Drainage Ditch Location
 - Trilock Block Drainage Ditch
 - Drainage
 - Industrial Area
 - SSA 15 Boundary
 - Approximate IR Site 12 Boundary
 - Driveway
 - Parking Lot
 - Roads and Paved Areas
 - Buildings and Structures
 - Yorktown Base Boundary
 - TCE Concentration 1 - 25
 - TCE Concentration 26 - 49
 - TCE Concentration 50 - 999
 - TCE Concentration 1000 - 4999
 - TCE Concentration > 5000
 - Highlighted Sample - TCE detected in soil

Notes:
 -Ten soil samples will be collected in locations to be determined based on MIP results.



Figure 16
 Proposed Supplemental RI MIP and Soil Sampling Locations
 Site 31 UFP SAP
 Naval Weapons Station Yorktown
 Yorktown, Virginia





- Legend**
- ▲ Proposed Surface Water and Sediment Sample Locations
 - Drainage Ditch Location
 - Former Drainage Ditch Location - not graded over
 - Railroad
 - Drainage
 - - - Trilock Block Drainage Ditch
 - Approximate IR Site 12 Boundary
 - Industrial Area
 - SSA 15 Boundary
 - Driveway
 - Parking Lot
 - Roads and Paved Areas
 - Buildings and Structures
 - Yorktown Base Boundary

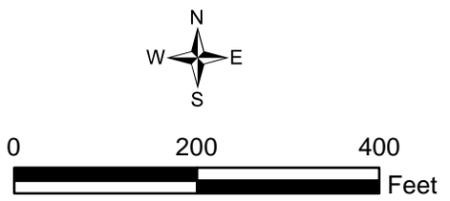
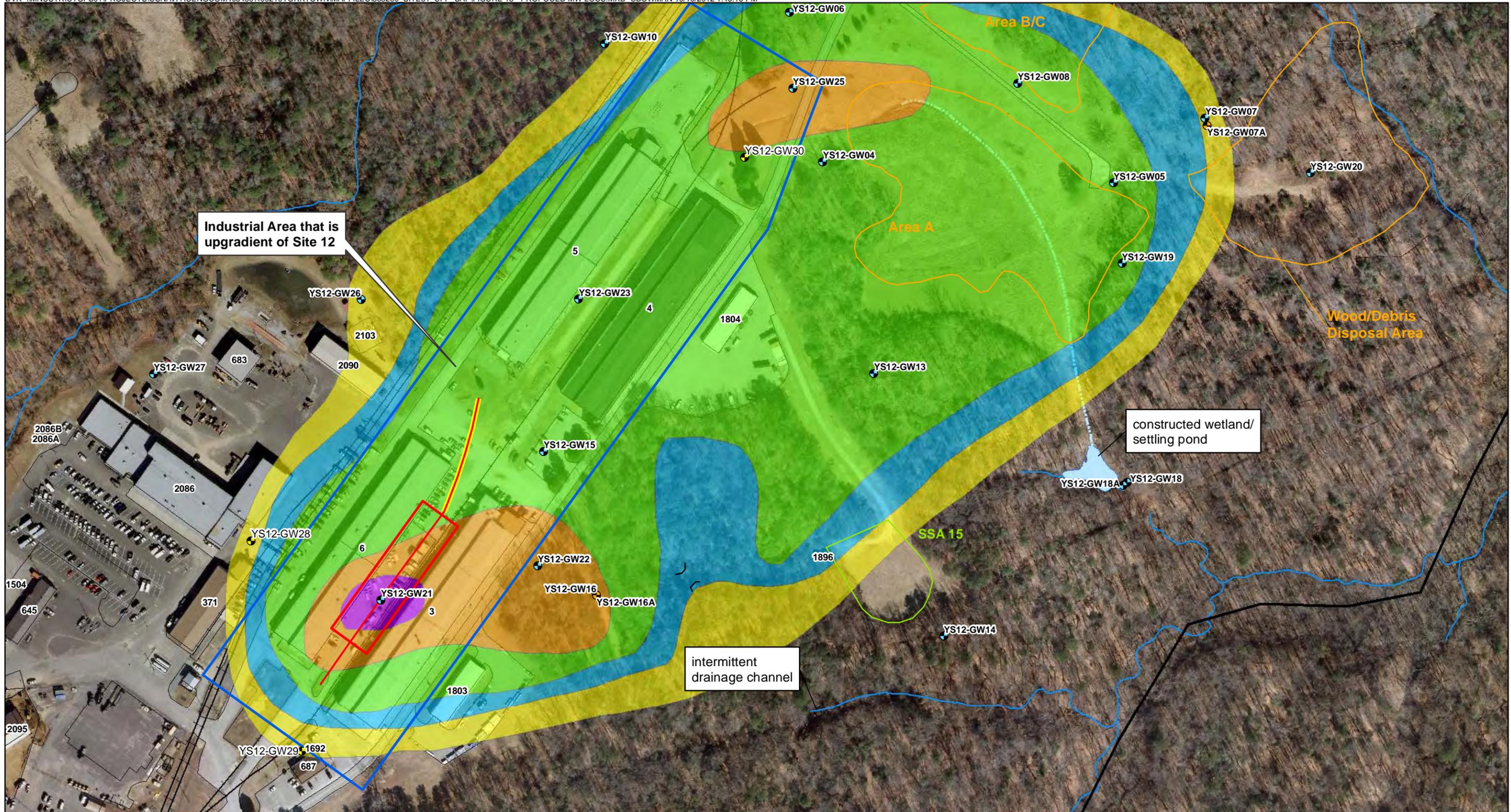


Figure 17
 Proposed Supplemental RI Surface Water and Sediment Sampling Locations
 Site 31 UFP SAP
 Naval Weapons Station Yorktown
 Yorktown, Virginia



Legend	
	Yorktown-Eastover Monitoring Well
	Cornwallis-Cave Monitoring Well
	Proposed Monitoring Well Location
	Drainage Ditch Location
	Former Drainage Ditch Location - not graded over
	Approximate IR Site 12 Boundary
	Industrial Area
	SSA 15 Boundary
	Driveway
	Parking Lot
	Roads and Paved Areas
	Buildings and Structures
	MIP Area
	Yorktown Base Boundary
	Railroad
	Drainage
	Trilock Block Drainage Ditch
	TCE Concentration 1 - 25
	TCE Concentration 26 - 49
	TCE Concentration 50 - 999
	TCE Concentration 1000 - 4999
	TCE Concentration > 5000

Note:
The source area well location will be determined based on the MIP and confirmatory soil sample results.



Figure 18
Proposed Supplemental RI Groundwater Sample Locations
Site 31 UFP SAP
Naval Weapons Station Yorktown
Yorktown, 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[®] (or Alconox[®]) and water solution
- Concentrated (V/V) pesticide grade methanol (DO NOT USE ACETONE)
- Large plastic pails or tubs for Liquinox[®] and water, scrub brushes, squirt bottles for Liquinox[®] solution, methanol and water, plastic bags and sheets
- DOT approved 55-gallon drum for disposal of waste
- 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% methanol solution pumped through the pump. (DO NOT USE ACETONE).
6. Rinse with 1 gallon of tap water.
7. Rinse with 1 gallon of deionized water.
8. Keep decontaminated pump in decontamination tube or remove and wrap in aluminum foil or clean plastic sheeting.
9. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.
10. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in 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 methanol solution (DO NOT USE ACETONE).
7. Air dry.
8. Rinse with deionized water.
9. Completely air dry and wrap exposed areas with aluminum foil (shiny side out) for transport and handling if equipment will not be used immediately.
10. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.
11. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums 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[®], methanol, and distilled water.
- Do not use acetone for decontamination.
- Drum all contaminated rinsate and materials.
- Decontaminate filled sample bottles before relinquishing them to anyone.

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 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 rollofs 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.

Decontamination of Drilling Rigs and Equipment

I. Purpose and Scope

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

II. Equipment and Materials

- Portable steam cleaner and related equipment
- Potable water
- Phosphate-free detergent such as Liquinox[®]
- Buckets
- Brushes
- Methanol, pesticide grade
- Personal Protective Equipment as specified by the Health and Safety Plan
- ASTM-Type II grade water or Lab Grade DI Water
- Aluminum foil

III. Procedures and Guidelines

A. Drilling Rigs and Monitoring Well Materials

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

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

B. Downhole Drilling Tools

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

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

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

C. Field Analytical Equipment

1. Water Level Indicators

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

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

2. Probes

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

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

- The effectiveness of field cleaning procedures may be monitored by rinsing decontaminated equipment with organic-free water and submitting the rinse water in standard sample containers for analysis.

Direct-Push Soil Sample Collection

I. Purpose

To provide a general guideline for the collection of soil samples using direct-push (e.g., Geoprobe[®]) sampling methods.

II. Scope

Standard direct-push (e.g., Geoprobe[®]) soil sampling methods.

III. Equipment and Materials

- Truck-mounted hydraulic percussion hammer
- Sampling rods
- Sampling tubes and acetate liners
- Pre-cleaned sample containers and stainless-steel sampling implements
- Personal Protective Equipment as specified by the Health and Safety Plan

IV. Procedures and Guidelines

1. Decontaminate sampling tubes and other non-dedicated downhole equipment in accordance with *SOP Decontamination of Personnel and Equipment*.
2. Drive sampling tube to the desired sampling depth using the truck-mounted hydraulic percussion hammer. If soil above the desired depth is not to be sampled, first drive the lead rod, without a sampling tube, to the top of the desired depth.
3. Remove the rods and sampling tube from the borehole and remove the sampling tube from the lead rod.
4. Cut open the acetate liner using a specific knife designed to slice the acetate liners (see below).



5. Fill all sample containers, beginning with the containers for VOC analysis, using a decontaminated or dedicated sampling implement. For the VOC samples, place the sample into a pre-preserved VOA vial or direct sample container such as an **En Core®** sampler and seal the cap tightly. Ideally, the operation should be completed in one minute. Label the vials and place on ice for shipment to the laboratory.
6. Decontaminate all non-dedicated downhole equipment (rods, sampling tubes, etc.) in accordance with SOP *Decontamination of Personnel and Equipment*.
7. Backfill borehole at each sampling location with grout or bentonite and repair the surface with like material (bentonite, asphalt patch, concrete, etc.), as required.

V. Key Checks and Items

1. Verify that the hydraulic percussion hammer is clean and in proper working order.
2. Ensure that the direct-push operator thoroughly completes the decontamination process between sampling locations.
3. Verify that the borehole made during sampling activities has been properly backfilled.

Shallow Soil Sampling

I. Purpose

To provide general guidelines for the collection and handling of surface soil samples during field operations.

II. Scope

The method described for surface soil sampling is applicable for loosely packed earth and is used to collect disturbed-soil samples.

III. Equipment and Materials

- Sample jars.
- A hand auger or other device that can be used to remove the soil from the ground. Only stainless steel, Teflon, or glass materials should be used. The only exception is split spoons, which are most commonly available in carbon steel; these are acceptable for use only if they are not rusty.
- A stainless steel spatula or disposable plastic scoop should be used to remove material from the sampling device.
- Unpainted wooden stakes or pin flags
- Fiberglass measuring tape (at least 200 feet in length)
- GPS Unit (if available)

IV. Procedures and Guidelines

- A. Wear protective gear, as specified in the Health and Safety Plan.
- B. To locate samples, identify the correct location using the pin flags or stakes. Proceed to collect a sample from the undisturbed soil adjacent to the marker following steps C and D. If markers are not present, the following procedures will be used.
 1. For samples on a grid:
 - a. Use measuring tape to locate each sampling point on the first grid line as prescribed in the sampling plan. As each point is located, drive a numbered stake in the ground and record its location on the site map and in the logbook.

- b. Proceed to sample the points on the grid line.
 - c. Measure to location where next grid line is to start and stake first sample. For subsequent samples on the line take two orthogonal measurements: one to the previous grid line, and one to the previous sample on the same grid line.
 - d. Proceed to sample the points on the grid line as described in Section C below.
 - e. Repeat 1c and 1d above until all samples are collected from the area.
 - f. Or, a GPS unit can be used to identify each location based on map coordinated, if available.
2. For non-grid samples:
- a. Use steel measuring tape to position sampling point at location described in the sampling plan by taking two measurements from fixed landmarks (e.g., corner of house and fence post).
 - b. Note measurements, landmarks, and sampling point on a sketch in the field notebook, and on a site location map.
 - c. Proceed to sample as described in Section C below.
 - d. Repeat 2a through 2c above until all samples are collected from the area.
 - e. Or, a GPS unit can be used to identify each location based on map coordinated, if available.
- C. To the extent possible, differentiate between fill and natural soil. If both are encountered at a boring location, sample both as prescribed in the field sampling plan. Do not locate samples in debris, tree roots, or standing water. In residential areas, do not sample in areas where residents' activities may impact the sample (e.g., barbecue areas, beneath eaves of roofs, driveways, garbage areas). If an obstacle prevents sampling at a measured grid point, move as close as possible, but up to a distance of one half the grid spacing in any direction to locate an appropriate sample. If an appropriate location cannot be found, consult with the Field Team Leader (FTL). If the FTL concurs, the sampling point will be deleted from the program. The FTL will contact the CH2M HILL project manager (PM) immediately. The PM and Navy Technical Representative (NTR) will discuss whether the point should be deleted from the program. If it is deleted, the PM will follow-up with the NTR in writing.
- D. To collect samples:
- 1. Use a decontaminated stainless steel scoop/trowel or disposable plastic scoopto scrape away surficial organic material (grass, leaves, etc.) adjacent to

the stake. New disposable scoops or trowels may also be used to reduce the need for equipment blanks.

2. If sampling:
 - a. Surface soil: Obtain soil sample by scooping soil using the augering scoop/trowel, starting from the surface and digging down to a depth of about 6 inches, or the depth specified in the workplan.
 - b. Subsurface soil: Obtain the subsurface soil sample using an auger down to the depths prescribed in the field sampling plan.
3. Take a photoionization detector (PID) reading of the sampled soil if organics are anticipated to be present and record the response in the field notebook. Also record lithologic description and any pertinent observations (such as discoloration) in the logbook.
4. Empty the contents of the scoop/trowel into a decontaminated stainless steel pan or dedicated sealable bag.
5. Repeat this procedure until sufficient soil is collected to meet volume requirements.
6. For TCL VOC and field GC aliquots, fill sample jars directly with the trowel/scoop or specialized sampling equipment (i.e. Encore® or Terra Core® sampler) and cap immediately upon filling. DO NOT HOMOGENIZE.
7. For TCL pesticides/PCBs and SVOCs, TAL metals, and field XRF aliquots, homogenize cuttings in the pan using a decontaminated stainless steel utensil in accordance with SOP *Decontamination of Drilling Rigs and Equipment*.
8. Transfer sample for analysis into appropriate containers with a decontaminated utensil.
9. Backfill the hole with soil removed from the borehole. To the extent possible, replace topsoil and grass and attempt to return appearance of sampling area to its pre-sampled condition. For samples in non-residential, unmowed areas, mark the sample number on the stake and leave stake in place. In mowed areas, remove stake.

V. Attachments

None.

VI. Key Checks and Items

- Use phthalate-free latex or surgical gloves and other personal protective equipment.
- Transfer volatiles first, avoid mixing.
- Decontaminate utensils before reuse, or use dedicated, disposable utensils.

Preparing Field Log Books

I. Purpose

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

II. Scope

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

III. Equipment and Materials

- Log book
- Indelible pen

IV. Procedures and Guidelines

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

A. PROCEDURES FOR COMPLETING FIELD LOG BOOKS

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

- Project name
 - Project manager's name
 - Phone numbers of the company, supervisors, emergency response, etc.
3. All lines of all pages should be used to prevent later additions of text, which could later be questioned. Any line not used should be marked through with a line and initialed and dated. Any pages not used should be marked through with a line, the author's initials, the date, and the note "Intentionally Left Blank."
 4. If errors are made in the log book, cross a single line through the error and enter the correct information. All corrections shall be initialed and dated by the personnel performing the correction. If possible, all corrections should be made by the individual who made the error.
 5. Daily entries will be made chronologically.
 6. Information will be recorded directly in the field log book during the work activity. Information will not be written on a separate sheet and then later transcribed into the log book.
 7. Each page of the log book will have the date of the work and the note takers initials.
 8. The final page of each day's notes will include the note-takers signature as well as the date.
 9. Only information relevant to the subject project will be added to the log book.
 10. The field notes will be copied and the copies sent to the Project Manager or designee in a timely manner (at least by the end of each week of work being performed).

B. INFORMATION TO BE INCLUDED IN FIELD LOG BOOKS

1. Entries into the log book should be as detailed and descriptive as possible so that a particular situation can be recalled without reliance on the collector's memory. Entries must be legible and complete.
2. General project information will be recorded at the beginning of each field project. This will include the project title, the project number, and project staff.
3. Scope: Describe the general scope of work to be performed each day.
4. Weather: Record the weather conditions and any significant changes in the weather during the day.
5. Tail Gate Safety Meetings: Record time and location of meeting, who was present, topics discussed, issues/problems/concerns identified,

and corrective actions or adjustments made to address concerns/problems, and other pertinent information.

6. Standard Health and Safety Procedures: Record level of personal protection being used (e.g., level D PPE), record air monitoring data on a regular basis and note where data were recording (e.g., reading in borehole, reading in breathing zone, etc). Also record other required health and safety procedures as specified in the project specific health and safety plan.
7. Instrument Calibration; Record calibration information for each piece of health and safety and field equipment.
8. Personnel: Record names of all personnel present during field activities and list their roles and their affiliation. Record when personnel and visitors enter and leave a project site and their level of personal protection.
9. Communications: Record communications with project manager, subcontractors, regulators, facility personnel, and others that impact performance of the project.
10. Time: Keep a running time log explaining field activities as they occur chronologically throughout the day.
11. Deviations from the Work Plan: Record any deviations from the work plan and document why these were required and any communications authorizing these deviations.
12. Health and Safety Incidents: Record any health and safety incidents and immediately report any incidents to the Project Manager.
13. Subcontractor Information: Record name of company, record names and roles of subcontractor personnel, list type of equipment being used and general scope of work. List times of starting and stopping work and quantities of consumable equipment used if it is to be billed to the project.
14. Problems and Corrective Actions: Clearly describe any problems encountered during the field work and the corrective actions taken to address these problems.
15. Technical and Project Information: Describe the details of the work being performed. The technical information recorded will vary significantly between projects. The project work plan will describe the specific activities to be performed and may also list requirements for note taking. Discuss note-taking expectations with the Project Manager prior to beginning the field work.
16. Any conditions that might adversely affect the work or any data obtained (e.g., nearby construction that might have introduced excessive amounts of dust into the air).

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

C. SUGGESTED FORMAT FOR RECORDING FIELD DATA

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

V. Attachments

Example field notes.

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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
 SCORE: • Collect Groundwater
 SAMPLES for LTM work at SITE 14
 • SUPERVISE SURVEY CREW

AT SITE 17
 BB ~~arr~~ (SS) Calibrates
 PID: 101 ppm/100 ppm OK
 PID Model #, SERIAL #
 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
 IS + Survey crew attend
 No H+S issues identified as concerns. All work is in "Level D,"

0755 IS conducts site-wide Air Monitoring
 All readings = 0.0 ppm in

TS
5-12-03

MAY 12, 2003

EXAMPLE

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0805 BREATHING ZONE (BZ)
 Mobilize to well MW-22 to sample, surveyors setting up
 AT SITE 17

0815 PM (Paul PAPER PUSHER) calls and informs IS to collect GUD sample
 AT well MW-44 today for 24 hr TAT ANALYSIS OF VOCs

0820 Purging MW-22
 → RECORD WATER QUALITY DATA

0843 Collect sample at MW-22 for total TA Metals and VOCs. No dissolved metals needed per PPL

0905 IS + BB Mobilize to site 17 to show surveyors wells to survey.
 Mobilize to well MW-22 to collect sample

0942 Collect sample
 Can not access well MW-22 due to BASE OPERATIONS; CONTACT Paul PAPER PUSHER and he started he will check on GAINWAY ACCESS with BASE CONTACT

0955 Mobilize to well MW-19

TS
5-12-03

TS
5-12-03

Soil Sampling

I. Purpose and Scope

The purpose of this procedure is to provide guidelines for obtaining samples of surface and subsurface soils using hand and drilling-rig mounted equipment.

II. Equipment and Materials

- Stainless-steel trowel, shovel, scoop, coring device, hand auger, or other appropriate hand tool
- Stainless-steel, split-spoon samplers
- Thin-walled sampling tubes
- Drilling rig or soil-coring rig
- Stainless-steel pan/bowl or disposable sealable bags
- Sample bottles

III. Procedures and Guidelines

Before sampling begins, equipment will be decontaminated using the procedures described in SOP *Decontamination of Drilling Rigs and Equipment*. The sampling point is located and recorded in the field logbook. Debris should be cleared from the sampling location.

A. Surface and Shallow Subsurface Sampling

A shovel, post-hole digger, or other tool can be used to remove soil to a point just above the interval to be sampled. A decontaminated sampling tool will be used to collect the sample when the desired sampling depth has been reached. Soil for semivolatile organic and inorganic analyses is placed in the bowl and mixed; soil for volatile organic analysis is not mixed or composited but is placed directly into the appropriate sample bottles. A stainless-steel or dedicated wooden tongue depressor is used to transfer the sample from the bowl to the container.

The soils removed from the borehole should be visually described in the field log book, including approximated depths.

When sampling is completed, photo-ionization device (PID) readings should be taken directly above the hole, and the hole is then backfilled.

More details are provided in the SOP *Shallow Soil Sampling*.

B. Split-Spoon Sampling

Using a drilling rig, a hole is advanced to the desired depth. For split-spoon sampling, the samples are then collected following the ASTM D 1586 standard (attached). The sampler is lowered into the hole and driven to a depth equal to the total length of the sampler; typically this is 24 inches. The sampler is driven in 6-inch increments using a 140-pound weight ("hammer") dropped from a height of 30 inches. The number of hammer blows for each 6-inch interval is counted and recorded. To obtain enough volume of sample for subsequent laboratory analysis, use of a 3-inch ID sampler may be required. Blow counts obtained with a 3-inch ID spoon would not conform to ASTM D 1586 and would therefore not be used for geotechnical evaluations.

Once retrieved from the hole, the sampler is carefully split open. Care should be taken not to allow material in the sampler to fall out of the open end of the sampler. To collect the sample, the surface of the sample should be removed with a clean tool and disposed of. Samples collected for volatiles analysis should be placed directly into the sample containers from the desired depth in the split spoon. Material for samples for all other parameters should be removed to a decontaminated stainless steel tray or disposable sealable bag. The sample for semivolatile organic and inorganic analyses should be homogenized in the field by breaking the sample into small pieces and removing gravel. The homogenized sample should be placed in the sample containers. If sample volume requirements are not met by a single sample collection, additional sample volume may be obtained by collecting a sample from below the sample and compositing the sample for non-volatile parameters only.

Split-spoon samples also will be collected using a tripod rig. When using a tripod rig the soil samples are collected using an assembly similar to that used by the drilling rig.

C. Thin-Walled Tube Sampling

Undisturbed fine grained samples may be collected for analysis for geotechnical parameters such as vertical hydraulic conductivity. These samples will be collected using thin-walled sampling tubes (sometimes called Shelby tubes) according to ASTM D 1587 (attached). Tubes will be 24- to 36 inches long and 3- to 4-inches in diameter, depending upon the quantity of sample required. Undisturbed samples will be obtained by smoothly pressing the sampling tube through the interval to be sampled using the weight of the drilling rig. Jerking the sample should be avoided. Once the sample is brought to the surface, the ends will be sealed with bees wax and then sealed with end caps and heavy tape. The sample designation, data and time of sampling, and the up direction will be noted on the sampling tube. The tube shall be kept upright as much as possible and will be protected from freezing, which could disrupt the undisturbed nature of the sample. Samples for geochemical analysis normally are not collected from thin-walled tube samples.

IV. Attachments

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

ASTM D 1587 Standard Practice for Thin-Walled Tube Sampling of Soils (ASTM D1587.pdf)

V. Key Checks and Preventative Maintenance

- Check that decontamination of equipment is thorough.
- Check that sample collection is swift to avoid loss of volatile organics during sampling.

Locating and Clearing Underground Utilities

I. Purpose

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

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

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

II. Scope

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

Scenario 1

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

Scenario 2

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

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

Scenario 1 is preferred because under this scenario the Navy tends to assume the responsibility if the location is improperly cleared, a utility is struck, and property damage results. However, our experience has been that the clearance services provided

by the Navy do not meet the standards that we consider to be adequate, in that they often simply rely on available base maps to mark utilities and do not verify locations using field geophysics. And if they do use locating tools, they do not provide adequate documentation or marking to confirm that a location has been cleared. So while the Navy's process may protect us from liability for property damage, it does not adequately protect our staff and subcontractors from health risks nor does it compensate us for down time, should a utility be hit.

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

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

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

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

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

III. Services and Equipment

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

Services

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

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

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

Equipment

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

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

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

IV. Procedures and Guidelines

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

Activity Notification and Dig Permit Procedures

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

Activity Specific: To be provided by Activity or Project Manager

CH2M HILL Utility Clearance Procedures

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

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

- **Ground Penetrating Radar (GPR)**, which can detect pipes, including gas pipes, tanks, conduits, cables etc, both metallic and non-metallic at depths up to 30 feet depending on equipment. Sensitivity for both minimum object size and maximum depth detectable depends on equipment selected, soil conditions, etc.
- **Radio Frequency (RF)**, involves inducing an RF signal in the pipe or cable and using a receiver to trace it. Some electric and telephone lines emit RF naturally and can be

detected without an induced signal. This method requires knowing where the conductive utility can be accessed to induce RF field if necessary.

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

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

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

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

IV. Attachments

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

Attachment A – Example SOW for Subcontracting Underground Utilities Locating Services

CTO-**XXX**

Scope of Work

Subsurface Utility Locating

Site **XX**

Navy Activity

City, State

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

Proposed Scope of Work

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

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

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

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

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

Field Marking and Documentation

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

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

Bid Sheet/Payment Units

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

Health and Safety Requirements

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

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

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

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

Security

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

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

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

Quality Assurance

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

Subcontractor Standby Time

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

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

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

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

Down Time

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

Schedule

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

Attachment B - Services Available for Identifying and Marking Underground Utilities

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

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

Each are discussed below.

Navy Public Works Department

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

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

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

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

Miss Utility or "One Call" service centers are information exchange centers for excavators, contractors and property owners planning any kind of excavation or digging. The "One Call" center notifies participating public utilities of the upcoming excavation work so they can locate and mark their underground utilities in advance to prevent possible damage to underground utility lines, injury, property damage and service outages. In some instances, such with southeastern Virginia bases, the Navy has entered into agreement with Ms. Utilities and is part of the response process for Miss

Utilities. Generally, a minimum of 48 hours is required for the public utility mark-outs to be performed. The "One Call" services are free to the public. Note that the "One Call" centers only coordinate with participating public utilities. There may be some public utilities that do NOT participate in the "One Call" center which may need to be contacted separately. For example, in Washington, DC, the Miss Utility "One Call" center does not locate and mark public sewer and water lines. Therefore, the municipal water and sewer authority must be contacted separately to have the sewer and water lines marked out. The AM should contact the appropriate one-call center to determine their scope of services.

A national listing of the "One Call" service centers for each state is presented on the web at <http://www.underspace.com/refs/ocdir.htm>. For the Mid-Atlantic region, the following "One Call" service centers are available.

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

Private Subcontractors

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

The level of service required from the subcontractor will vary depending on the nature of the site. At sites where utility locations are well defined on the maps and

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

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

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

Notes:

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

¹Equipment types are:

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

²Other services include:

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

Attachment C – Equipment Used for Identifying Underground Utilities

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

CH2M HILL In-house Utility Location Experts

Tamir Klaff/WDC

Home Office Phone – 703-669-9611

Electromagnetic Induction (EMI) Methods

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

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

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

receiver. Whether hunting for unknown, or confirming known, utilities, this method will only detect continuous lengths of metallic conductors.

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

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

Ground Penetrating Radar (GPR)

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

Magnetic Field Methods

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

ferrous metal, primarily iron and steel for utility location applications. Some utility detector combine magnetic and EMI methods into a single hand-held unit.

Optical Methods

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

Attachment D – Utility Clearance Documentation Form

Attachment E – Utility Marking Color Codes

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

White – Proposed excavations and borings

Pink – Temporary survey markings

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

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

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

Blue – Potable water

Purple – Reclaimed water, irrigation and slurry lines

Green – Sewer and storm drain lines

Chain-of-Custody

I Purpose

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

II Scope

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

III Definitions

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

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

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

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

IV Responsibilities

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

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

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

V Procedures

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

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

V.1 Sample Identification

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

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

- Field Sampler(s),
- Contract Task Order (CTO) Number,
- Project Sample Number,
- Sample location or sampling station number,
- Date and time of sample collection and/or measurement,

- Field observations,
- Equipment used to collect samples and measurements, and
- Calibration data for equipment used

Measurements and observations shall be recorded using waterproof ink.

V.1.1 Sample Label

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

- Project - CTO Number.
- Station Location - The unique sample number identifying this sample.
- Date - A six-digit number indicating the day, month, and year of sample collection (e.g., 01/21/08).
- Time - A four-digit number indicating the 24-hour time of collection (for example: 0954 is 9:54 a.m., and 1629 is 4:29 p.m.).
- Medium - Water, soil, sediment, sludge, waste, etc.
- Sample Type - Grab or composite.
- Preservation - Type and quantity of preservation added.
- Analysis - VOA, BNAs, PCBs, pesticides, metals, cyanide, other.
- Sampled By - Printed name of the sampler.
- Remarks - Any pertinent additional information.

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

V.2 Chain-of-Custody Procedures

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

V.2.1 Field Custody Procedures

- Samples are collected as described in the site Sampling and Analysis Plan. Care must be taken to record precisely the sample location and to ensure that the sample number on the label matches the Chain-of-Custody Record exactly.
- A Chain-of-Custody Record will be prepared for each individual cooler shipped and will include *only* the samples contained within that particular cooler. The Chain-of-Custody Record for that cooler will then be sealed in a zip-log bag and placed in the cooler prior to sealing. This ensures that the laboratory properly attributes trip blanks with the correct cooler and allows for easier tracking should a cooler become lost during transit.
- The person undertaking the actual sampling in the field is responsible for the care and custody of the samples collected until they are properly transferred or dispatched.
- When photographs are taken of the sampling as part of the documentation procedure, the name of the photographer, date, time, site location, and site description are entered sequentially in the site logbook as photos are taken. Once downloaded to the server or developed, the electronic files or photographic prints shall be serially numbered, corresponding to the logbook descriptions; photographic prints will be stored in the project files. To identify sample locations in photographs, an easily read sign with the appropriate sample/ location number should be included.
- Sample labels shall be completed for each sample, using waterproof ink unless prohibited by weather conditions (e.g., a logbook notation would explain that a pencil was used to fill out the sample label if the pen would not function in freezing weather.)

V.2.2 Transfer of Custody and Shipment

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

- Enter header information (CTO number, samplers, and project name).
- Enter sample specific information (sample number, media, sample analysis required and analytical method grab or composite, number and type of sample containers, and date/time sample was collected).
- Sign, date, and enter the time under “Relinquished by” entry.

- Have the person receiving the sample sign the “Received by” entry. If shipping samples by a common carrier, print the carrier to be used in this space (i.e., Federal Express).
- If a carrier is used, enter the airbill number under “Remarks,” in the bottom right corner;
- Place the original (top, signed copy) of the Chain-of-Custody Record Form in a plastic zipper-type bag or other appropriate sample-shipping package. Retain the copy with field records.
- Sign and date the custody seal, a 1-inch by 3-inch white paper label with black lettering and an adhesive backing. Attachment C is an example of a custody seal. The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field. Custody seals shall be provided by the analytical laboratory.
- Place the seal across the shipping container opening (front and back) so that it would be broken if the container were to be opened.
- Complete other carrier-required shipping papers.

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

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

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

VI Quality Assurance Records

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

VII Attachments

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

VIII References

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

Sediment Sampling

I. Purpose

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

II. Scope

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

III. Equipment and Materials

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

IV. Procedures and Guidelines

1. Field personnel will start downstream and work upstream to prevent contamination of unsampled areas. In surface water bodies that are tidally influenced, sampling will be performed at low tide and under low flow conditions to minimize the dilution of possible contaminants. Sediment sampling activities will not occur immediately after periods of heavy rainfall.
2. Make a sketch of the sample area that shows important nearby river features and permanent structures that can be used to locate the sample points on a map. Whenever possible, include measured distances from such identifying features. Also include depth and width of waterway, rate of flow, type and consistency of sediment, and point and depth of sample removal (along shore, mid-channel, etc).

3. Note in the field book any possible outside sources of contamination. For example, the outlet to a drainage culvert in the water body near your sampling location.
4. Transfer sample into appropriate sample jars with a stainless steel utensil or plastic disposable scoop. Be especially careful to avoid the loss of the very fine clay/silt particles when collecting the sample. The fine particles have a higher adsorption capacity than larger particles. Minimize the amount of water that is collected within the sample matrix. Decant the water off of the sample slowly and carefully to maximize retention of the very fine particles. The sampler's fingers should never touch the sediment since gloves may introduce organic interference into the sample. Classify the soil type of the sample using the Unified Soil Classification System, noting particularly the percentage of silt and clay.
5. Samples for volatile organics should immediately be placed in jars. Rocks and other debris should be removed before placement in jars.
6. For channel sampling, be on the alert for submerged hazards (rocks, tree roots, drop-offs, loss silt and muck) which can make wading difficult.
7. Sample sediment for TOC and pH also, to give context to organic and inorganic data during the risk assessment.
8. Follow the site safety plan designed for the specific nature of the site's sampling activities and locations.
9. Decontaminate all sampling implements and protective clothing according to prescribed procedures.

V. Attachments

None.

VI. Key Checks and Items

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

Surface Water Sampling

I. Purpose and Scope

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

II. Materials and Equipment

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

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

III. Procedures and Guidelines

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

A. Manual Sampling

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

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

A sample is taken with the following specific steps:

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

IV. Attachments

None.

V. Key Checks and Items

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

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

I. Purpose and Scope

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

II. Equipment and Materials

- Horiba® U-22 Water Quality Monitoring System 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
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. 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.

C. Sample Measurement:

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

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.

General Guidance for Monitoring Well Installation

I. Purpose

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

II. Scope

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

III. Equipment and Materials

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

IV. Procedures and Guidelines

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

5. A record of the finished well construction will be compiled.
6. All soils and liquids generated during well installations will be drummed for proper disposal.

Monitoring Well Installation

- 2" monitoring wells in unconsolidated materials will be installed in at least 6-inch-diameter boreholes to accommodate well completion materials in designated locations.
- All monitoring wells penetrating a confining layer will be surface-cased from the ground surface to approximately 5 feet into the confining layer. Exceptions to this may be allowed under certain circumstances (e.g., evidence of significant natural gaps in the confining layer).
- Monitoring wells in unconsolidated materials will be constructed of 2-inch-diameter, factory manufactured, flush-jointed, Schedule 40 PVC (or stainless steel) screen with threaded bottom plug and riser.
- Screens will be filter packed with a properly sized and graded, thoroughly washed, sound, durable, well-rounded basalt or siliceous sand. When using hollow-stem augers, the filter pack will be installed by slowly pouring the sand into the annular space while simultaneously raising the augers and using a weighted tape to sound for the sand surface. For rotary-drilled wells, the height of the sand pack also will be sounded with a weighted tape.
- The primary filter sand pack (typically Morie #00 or DSI #1 for a 10-slot screen) will extend from 1 to 2 feet below the base to 2 feet above the top of the screen; filter pack will be allowed to settle before final measurement is taken. For wells deeper than 30 feet, the filter pack will be placed using a tremie pipe and flowing water.
- A secondary filter sand pack (typically a fine sand seal) 1-foot thick may be placed above the primary sand pack.
- Annular well seals will consist of 2 feet of pelletized, chip, or granular bentonite clay placed above the filter pack. If necessary the pellets will be hydrated using potable water. For wells installed using hollow-stem augers, the bentonite will be poured into the annular space while slowly raising the augers and sounding for the top of the bentonite with a weighted tape. A high-solids bentonite slurry using powdered bentonite introduced with a side-discharging tremie pipe will be used for the bentonite seals in wells greater than 30 feet deep. For rotary-drilled wells, the height of the well seal also will be sounded with a weighted tape. High-solids slurries will have solids content of at least 20 percent.
- The top of the annular seal will be measured after the bentonite seal has been allowed to hydrate and before the grout is applied. The seal will be allowed to hydrate for at least 30 minutes before work in the well continues.

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

Well Development

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

V. Attachments

None.

VI. Key Check and Items

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

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.

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

Appendix B
Site Assessment Groundwater Data

Appendix B
 Site Assessment Groundwater Data
 Site 31 RI Sampling and Analysis Plan
 Naval Weapons Station Yorktown
 Yorktown, Virginia

Station ID	MCL- Groundwater	RSLs Tap for GW (no Sur)	YS12-GW01	YS12-GW01A	YS12-GW04	YS12-GW05	YS12-GW06	YS12-GW07	YS12-GW07A	YS12-GW08	YS12-GW09	YS12-GW10	YS12-GW11	YS12-GW13	YS12-GW14	YS12-GW15	YS12-GW16	YS12-GW16A	YS12-GW17	YS12-GW18	YS12-GW18A	YS12-GW19	YS12-GW20			
Sample Date			YS12-GW01-1107	YS12-GW01A-1107	YS12-GW04-1107	YS12-GW05-1107	YS12-GW06-1107	YS12-GW07-1107	YS12-GW07A-1107	YS12-GW08-1107	YS12-GW09-1107	YS12-GW10-1107	YS12-GW11-1107	YS12-GW11P-1107	YS12-GW13-1107	YS12-GW14-1107	YS12-GW15-1107	YS12-GW16-1107	YS12-GW16A-1107	YS12-GW17-1107	YS12-GW18-1107	YS12-GW18A-1107	YS12-GW19-1107	YS12-GW20-1107		
Sample Date			11/16/07	11/19/07	11/19/07	11/29/07	11/19/07	11/30/07	11/20/07	11/20/07	11/15/07	11/26/07	11/20/07	11/20/07	11/20/07	11/16/07	11/15/07	11/15/07	11/16/07	11/20/07	11/26/07	11/26/07	11/28/07	11/28/07		
Chemical Name																										
Volatiles Organic Compounds (UGL)																										
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	--	59,000	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1.5 J	10 U	10 U	10 U	10 U	10 U	50 U	100 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U		
1,1-Dichloroethene	7	340	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	1.9 J	10 U	11 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U		
Chloroform	80	0.19	10 U	10 U	10 U	10 U	6.8 J	10 U	7.8 J	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U						
Tetrachloroethene	5	0.11	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U		
Trichloroethene	5	1.7	100	10 U	10 U	4.3 J	240	580	48	10 U	660	10 U	10 U	190	10 U	970	1,700	10 U	2 J	10 U	10 U	270	10 U			
Trichlorofluoroethane(Freon-11)	--	1,300	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	100 U	10 U	10 U	10 U	10 U	10 U	10 U			
Vinyl chloride	2	0.016	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	100 U	10 U	10 U	10 U	10 U	10 U	10 U			
Xylene, total	10,000	200	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	50 U	100 U	10 U	10 U	10 U	10 U	10 U	10 U			
cis-1,2-Dichloroethene	70	370	4.6 J	10 U	10 U	10 U	7.8 J	23	10 U	10 U	19	10 U	10 U	94	2 J	12 J	60 J	10 U	10 U	10 U	10 U	8.6 J	3.2 J			
Semivolatile Organic Compounds (UGL)																										
Acenaphthene	--	2,200	9.7 U	9.8 U	9.8 U	9.7 U	9.5 U	9.7 U	9.4 U	9.7 U	9.4 U	9.6 U	9.7 U	9.4 U	9.8 U	9.4 U	9.7 U	10 U	9.7 U	9.8 U	9.7 U	9.7 U	17			
Carbazole	--	3.4	9.7 U	9.8 U	9.8 U	9.7 U	9.5 U	9.7 U	9.4 U	9.7 U	9.4 U	9.6 U	9.7 U	9.4 U	9.8 U	9.4 U	9.7 U	10 U	9.7 U	9.8 U	9.7 U	9.7 U	16			
Phenanthrene	--	--	9.7 U	9.8 U	9.8 U	9.7 U	9.5 U	9.7 U	9.4 U	9.7 U	9.4 U	9.6 U	9.7 U	9.4 U	9.8 U	9.4 U	9.7 U	10 U	9.7 U	9.8 U	9.7 U	9.7 U	16			
Explosives (UGL)																										
2,4,6-Trinitrotoluene	--	2.2	0.15 U	0.15 U	0.15 U	0.15 U	0.075 J	0.17 U	0.15 U	0.15 U	0.46	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.14 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	2	0.27 K		
2,4-Dinitrotoluene	--	73	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.17 U	0.15 U	0.063 J	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.14 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.21	0.15 U		
2,6-Dinitrotoluene	--	37	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.17 U	0.15 U	0.059 J	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.14 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.27	0.15 U		
2-Amino-4,6-dinitrotoluene	--	73	0.3 U	0.3 U	0.3 U	0.29 U	0.3	0.33 U	0.29 U	1.1	0.3 U	0.29 U	0.31 U	0.29 U	0.3 U	0.29 U	0.3 U	0.29 U	0.3 U	0.3 U	0.3 U	0.29 U	8.2	0.29 U		
3,5-Dinitroanisole	--	--	1 U	0.99 U	0.97 U	1 U	1.1 U	0.97 U	1 U	1 U	0.97 U	1 U	0.98 U	1 U	0.98 U	0.99 U	0.98 U	1 U	1 U	1 U	0.98 U	0.99 U	0.99 U	0.13 K		
4-Amino-2,6-dinitrotoluene	--	73	0.15 U	0.15 U	0.15 U	0.23	0.17 U	0.15 U	0.15 U	1.2	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.14 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	8.5	0.15 U		
RDX	--	1,800	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.17 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.14 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	2.1	0.15 U		
Nitrobenzene	--	3.4	0.15 U	0.15 U	0.15 U	0.15 U	0.17 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.14 U	0.15 U	0.15 U	0.15 U	0.15 U	0.15 U	0.076 J	0.15 U		
RDX	--	0.61	0.25 U	0.25 U	0.25 U	0.24 U	0.66 J	0.28 U	0.24 U	0.25 U	1.6 J	0.25 U	0.24 U	0.24 U	0.25 U	0.25 U	0.24 U	0.25 U	0.25 U	0.25 U	0.25 U	0.24 U	14	0.62 J		
Total Metals (UGL)																										
Aluminum	--	37,000	134 L	103 J	102 J	200 U	507	331	1,650	2,230	200 U	1,450 L	400	2,650	2,130	127 J	522 L	326 L	200 UL	139 L	158 J	478	200 U	200 U	6,350	
Antimony	6	15	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	
Arsenic	10	0.045	10 U	10 U	10 U	10 U	10 U	10 U	4.5 B	10 U	10 U	4.3 B	10 U	3.7 B	10 U	10 U	10 U	10 U	10 U	8.4 J						
Barium	2,000	7,300	34.3 J	147 J	149 J	62.4 J	57.7 J	47.7 J	54.5 J	56.8 J	25.7 J	35.6 J	48.8 J	43.5 J	45.5 J	55.1 J	22.8 J	38 J	200 U	34.8 J	48.9 J	47 J	59.5 B	115 B		
Beryllium	4	73	5 U	5 U	5 U	0.2 J	5 U	5 U	5 U	0.17 J	5 U	5 U	0.46 J	0.35 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.27 J	5 U		
Cadmium	5	18	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.4 J	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	5 U	0.71 J		
Calcium	--	94,800	76,400	75,000	90,000	170,000	63,500	176,000	125,000	148,000	68,800	49,300	64,200	62,900	129,000	161,000	131,000	131,000	53,400	173,000	171,000	105,000	143,000	274,000		
Chromium	100	--	12.5	1.2 J	0.94 B	10.4 K	1,680	6.3 K	38.9	15.9	1.8 J	47.3	6.4 J	155	146	14.5 K	544	3.3 J	0.74 L	147 K	2.1 J	0.43 J	2.4 B	29.6 B		
Cobalt	--	730	50 U	50 U	50 U	17.5 J	50 U	50 U	1.5 J	50 U	50 U	50 U	2.9 J	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	50 U	32.1 J		
Copper	1,300	1,500	25 U	25 U	25 U	42.4	25 U	8.9 L	11.4 L	25 UL	25 U	25 UL	5.5 J	4.6 J	25 U	14.8 J	25 U	25 U	25 U	5.2 J	25 UL	25 UL	25 UL	6 L		
Iron	--	26,000	376 L	462	408	323 K	8,980	690 B	2,880	5,320	101	3,080 L	899	6,430	5,090	356 K	3,400 L	613 L	453 L	125 L	1,190 K	1,310	65.4 L	62.2 B	10,500	
Lead	15	--	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	10 U	4.8 B		
Magnesium	--	--	1,860 J	2,640 J	2,570 J	2,650 J	2,940 J	1,620 J	3,410 J	3,590 J	3,460 J	1,830 J	831 J	1,520 J	1,430 J	6,770	3,020 J	9,370	5,280	930 J	3,390 J	5,000 J	2,110 J	8,310	18,100	
Manganese	--	880	34.3	17.4	16.2	60	196	44.4	40.9	65.5	2.5 J	37.2	43.6	62.4	8.1 J	76	28.7 J	79.8	1.8 J	21.5	126	2.4 J	15.3 B	4,820		
Nickel	--	730	10.2 J	1.2 B	1.4 B	6.9 J	1,040	5.1 B	22.6 J	9.1 J	2.4 B	26.8 J	4 J	91	86.2	359	2.8 J	1.6 J	40 U	93.8	2.5 J	40 U	3.5 B	27.5 J		
Potassium	--	--	1,120 J	1,690 J	1,570 J	5,000	1,720 J	1,990 J	1,950 J	2,160 J	2,100 J	1,800 J	1,340 J	1,940 J	1,740 J	1,950 J	1,410 J	1,640 J	2,250 J	1,340 J	1,740 J	2,750 J	1,520 J	4,090 J		
Sodium	--	--	6,890	6,720	6,470	24,100	8,480	6,400	21,500	10,400	9,340	10,900	11,900	7,020	7,050	9,920	5,990	9,790	10,600	5,480	12,100	10,300	7,830	13,500	29,300	
Vanadium	--	260	50 U	50 UL	50 U	5.7 L	50 U	4.2 L	5.8 L	50 UL	4.4 J	2.1 B	6.9 J	5.4 J	50 U	2.3 J	50 U	50 U	50 U	1.1 B	1.5 B	50 U	50 U	15.5 J		
Zinc	--	11,000	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U	60 U		
Dissolved Metals (UGL)																										
Aluminum	--	37,000	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	200 U	185 J	112 J	200 U	200 U	200 U	200 U	104 J		
Barium	2,000	7,300	35.6 J	134 J	139 J	59.2 J	52.3 J	46 J	82.6 J	48.5 J	54.3 J	20.6 J	200 U	34.6 J	31.6 J	42.1 J	51.4 J	21.9 J	36.6 J	13.9 J	42.4 J	51.4 J	46.2 J	58.7 J	101 J	
Calcium	--	94,800	71,200	70,600	90,300	155,000	63,300	177,000	118,000	145,000	62,400	50,200	56,900	55,000	132,000	158,000	128,000	132,000	57,000	194,000	168,000	102,000	144,000	289		

Appendix B
 Site Assessment Groundwater Data
 Site 31 RI Sampling and Analysis Plan
 Naval Weapons Station Yorktown
 Yorktown, Virginia

Station ID	MCL- Groundwater	RSLs Tap for GW (no Sur)	YS12-GW21	YS12-GW22	YS12-GW23	YS12-GW24	YS12-GW25	YS12-GW26	YS12-GW27	
Sample ID			YS12-GW21-1207	YS12-GW22-1207	YS12-GW23-1207	YS12-GW24-1107	YS12-GW25-1107	YS12-GW26-1107	YS12-GW27-1107	
Sample Date			12/12/07	12/12/07	12/11/07	11/27/07	11/30/07	11/27/07	11/28/07	
Chemical Name										
Volatile Organic Compounds (UGL)										
1,1,2-Trichloro-1,2,2-trifluoroethane(Freon-113)	--	59,000	2.3 J	10 U	10 U					
1,1-Dichloroethene	7	340	12	8.4 J	4.6 J	10 U	4.7 J	10 U	10 U	10 U
Chloroform	80	0.19	10 U	2.1 J	10 U	10 U				
Tetrachloroethene	5	0.11	3.4 J	10 U	10 U					
Trichloroethene	5	1.7	5,900	1,500	190	10 U	1,700	10 U	10 U	10 U
Trichlorofluoromethane(Freon-11)	--	1,300	10 U	10 U	17	10 U	10 U	10 U	10 U	10 U
Vinyl chloride	2	0.016	10 U	10 U	10 U	10 U	9.1 J	22	10 U	10 U
Xylene, total	10,000	200	10 U	10 U	10 U	10 U	8.5 J	10 U	10 U	10 U
cis-1,2-Dichloroethene	70	370	54	260	14	10 U	230	33	10 U	10 U
Semivolatile Organic Compounds (UGL)										
Acenaphthene	--	2,200	9.7 U	9.4 U	9.8 U	9.8 U	9.7 U	9.8 U	9.4 U	9.7 U
Carbazole	--	3.4	9.7 U	9.4 U	9.8 U	9.8 U	9.7 U	9.8 U	9.4 U	9.7 U
Phenanthrene	--	--	9.7 U	9.4 U	9.8 U	9.8 U	9.7 U	9.8 U	9.4 U	9.7 U
Explosives (UGL)										
2,4,6-Trinitrotoluene	--	2.2	0.15 U	0.16 U	0.15 U	0.15 U				
2,4-Dinitrotoluene	--	73	0.15 U	0.16 U	0.15 U	0.15 U				
2,6-Dinitrotoluene	--	37	0.15 U	0.16 U	0.15 U	0.15 U				
2-Amino-4,6-dinitrotoluene	--	73	0.3 U	0.29 U	0.3 U	0.29 U	0.31 U	0.32 U	0.31 U	0.31 U
3,5-Dinitroaniline	--	--	1 U	0.97 U	0.99 U	0.98 U	1 U	1 U	1 U	1 U
4-Amino-2,6-dinitrotoluene	--	73	0.15 U	0.16 U	0.15 U	0.15 U				
HMX	--	1,800	0.15 U	0.16 U	0.15 U	0.15 U				
Nitrobenzene	--	3.4	0.15 U	0.15 U						
RDX	--	0.61	0.25 U	0.24 U	0.25 U	0.24 U	0.26 U	0.26 U	0.26 U	0.26 U
Total Metals (UGL)										
Aluminum	--	37,000	261 B	236 B	530	114 J	5,210	13,100	204	269
Antimony	6	15	60 U	2.1 J	60 U					
Arsenic	10	0.045	10 U	4 J	4.3 B	10 U	7.2 J	11.2	10 U	10 U
Barium	2,000	7,300	25.8 J	67.2 J	34.6 J	47.5 J	113 J	134 J	57.4 B	57.2 B
Beryllium	4	73	5 U	5 U	5 U	5 U	0.29 J	0.6 J	0.17 B	5 U
Cadmium	5	18	5 U	5 U	5 U	5 U	0.29 J	0.6 J	0.17 B	5 U
Calcium	--	--	103,000	113,000	95,300	245,000	168,000	187,000	150,000	152,000
Chromium	100	--	1.3 B	0.79 B	1.9 J	1.6 B	115 K	1,270	89.4	104
Cobalt	--	730	50 U	50 U	50 U	50 U	10.5 J	19.1 J	1.5 B	1.8 J
Copper	1,300	1,500	25 U	25 U	25 U	25 UL	5.3 J	40	4.2 L	3.5 L
Iron	--	26,000	338	548	125 K	748	12,100 K	26,400	3,420	3,700
Lead	15	--	10 U	10 U	10 U	2.8 J	3.3 J	19	10 U	2.8 B
Magnesium	--	--	4,860 J	5,590	3,510 J	6,050	5,240	6,120	5,920	5,920
Manganese	--	880	48.5	89.3	11 J	181	1,090	930	82.3	83.3
Nickel	--	730	40 U	0.94 J	40 U	2.1 J	71.9	750	65.5	68.3
Potassium	--	--	2,140 J	2,730 J	10,200 J	3,430 J	4,050 J	4,660 J	2,080 J	2,140 J
Sodium	--	--	9,430	16,600	27,700	6,910	9,140	17,500	20,500	20,600
Vanadium	--	260	1.8 B	50 U	3.1 B	50 U	13.8 J	37.6 J	50 U	50 U
Zinc	--	11,000	7.2 L	60 UL	7.2 J	60 U	24.3 J	75.4	60 UL	60 UL
Dissolved Metals (UGL)										
Aluminum	--	37,000	200 U	200 U	434	200 U	612	158 J	200 U	200 U
Barium	2,000	7,300	23.6 J	57.2 J	32.3 J	49.3 J	93.9 J	97.9 J	59.7 J	57.6 J
Calcium	--	--	108,000	104,000	94,200	240,000	149,000	179,000	154,000	153,000
Chromium	100	--	0.23 B	0.28 B	1 J	0.27 B	8.5 K	7.1 B	0.44 B	0.44 B
Cobalt	--	730	50 U	50 U	50 U	50 U	6 J	1.3 B	50 U	50 U
Copper	1,300	1,500	25 U	25 U	25 U	25 UL	25 U	25 UL	25 UL	25 UL
Iron	--	26,000	56.8 B	281	100 U	663	1,840 K	232	2,490	2,490
Lead	15	--	10 U	10 U						
Magnesium	--	--	5,070	5,240	3,550 J	5,910	3,720 J	4,480 J	6,000	5,950
Manganese	--	880	48.5	80.8	9.9 B	178	1,090	407	70	69.7
Mercury	2	0.63	0.2 UL	0.2 UL	0.2 UL	0.2 UL	0.2 U	0.2 UL	0.2 UL	0.2 UL
Nickel	--	730	40 U	40 U	40 U	10.6 J	21.8 J	3.8 J	3.5 J	3.5 J
Potassium	--	--	2,280 J	2,580 J	10,000 J	3,360 J	2,720 J	3,400 J	2,150 J	2,100 J
Silver	--	180	10 U	10 U	10 U	10 UL	10 U	10 UL	10 UL	10 UL
Sodium	--	--	9,940	15,600	27,500	6,740	8,800	18,600	21,200	21,000
Zinc	--	11,000	60 UL	60 UL	60 U	60 U	4.8 J	60 U	60 UL	60 UL
Wet Chemistry (MGL)										
Alkalinity	--	--	280	300	220	620	390	470	390	NA
Chloride	--	--	14	13	48	7	12	23	37	NA
Ethane	--	--	3.50E-04 U	3.50E-04 U	3.50E-04 U	3.50E-04 U	4.00E-04	3.50E-04 U	3.50E-04 U	NA
Ethene	--	--	3.30E-04 U	3.30E-04 U	3.30E-04 U	3.30E-04 U	0.0059	3.30E-04 U	3.30E-04 U	NA
Methane	--	--	1.90E-04 U	1.90E-04 U	1.90E-04 U	0.08	0.0045	1.90E-04 U	0.011	NA
Nitrate	10	58	0.1	0.006 U	0.5	0.006 U	0.006 U	0.006 U	0.006 U	NA
Sulfate	--	--	13	19	32	27	33	27	27	NA
Sulfide	--	--	1 U	1 U	1 U	1 U	7	1	1 U	NA
Dissolved Wet Chemistry (MGL)										
Dissolved organic carbon	--	--	1 U	1 U	1 U	1	1 U	2	2	NA

Notes:
 Exceeds one or more criteria
 B - Analyte not detected above the level reported in blanks
 J - Analyte present, value may or may not be accurate or precise
 K - Analyte present, value may be biased high, actual value may be lower
 L - Analyte present, value may be biased low, actual value may be higher
 MGL - Milligrams per liter
 NA - Not analyzed
 R - Unreliable Result
 U - The material was analyzed for, but not detected
 UGL - Micrograms per liter
 UL - Analyte not detected, quantitation limit may be inaccurate
 UL - Analyte not detected, quantitation limit is probably higher

Appendix C
Laboratory DoD ELAP Letters



SCOPE OF ACCREDITATION TO ISO/IEC 17025-2005

ENVIRONMENTAL CONSERVATION LABORATORIES – JACKSONVILLE

4810 Executive Park Court, Suite 111

Jacksonville, FL 32216

Denise K. Stern Phone: 904 296 3007

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ENVIRONMENTAL

Valid To: April 30, 2014

Certificate Number: 3000.02

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

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

<u>Parameter/Analyte</u>	<u>Non-Potable Water</u>	<u>Solid Hazardous Waste</u>	<u>Air</u>
Propionic acid (Propanoic acid)	ENCO VGC-13	NA	NA
Pyruvic acid	ENCO VGC-13	NA	NA
Propylene glycol	ENCO VGC-18	NA	NA
Ethyl acetate	EPA 8015C	NA	ENCO VGCMS-07
Ethylene glycol	EPA 8015C	NA	NA
Diesel range organics (DRO)	EPA 8015C	EPA 8015C	NA
Gasoline range organics (GRO)	EPA 8015C	EPA 8015C	NA
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8015C, 8260B	EPA 8260B	NA
Methanol	EPA 8015C	EPA 8015C	NA
n-Butyl alcohol	EPA 8015C	NA	NA
n-Propanol	EPA 8015C	NA	NA
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504, 504.1, 8011, 8260B	EPA 8260B	NA
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 504, 504.1, 8011, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,2-Dichlorobenzene	EPA 624, 8260B, 8270D	EPA 8260B, 8270D	EPA TO-14A, EPA TO-15
1,2-Dichloroethane	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,2-Dichloropropane	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,3-Dichlorobenzene	EPA 624, 8260B, 8270D	EPA 8260B, 8270D	EPA TO-14A, EPA TO-15
1,4-Dichlorobenzene	EPA 624, 8260B, 8270D	EPA 8260B, 8270D	EPA TO-14A, EPA TO-15
2-Chloroethyl vinyl ether	EPA 624, 8260B	EPA 8260B	NA
Acrolein (Propenal)	EPA 624, 8260B	EPA 8260B	NA
Acrylonitrile	EPA 624, 8260B	EPA 8260B	NA
Benzene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Bromodichloromethane	EPA 624, 8260B	EPA 8260B	ENCO VGCMS-07
Bromoform	EPA 624, 8260B	EPA 8260B	EPA TO-15
Carbon tetrachloride	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Chlorobenzene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Chloroethane	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Chloroform	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
cis-1,3-Dichloropropene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Dibromochloromethane	EPA 624, 8260B	EPA 8260B	ENCO VGCMS-07
Ethylbenzene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Methyl bromide (Bromomethane)	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Methyl chloride (Chloromethane)	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Methylene chloride	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Tetrachloroethylene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Toluene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
trans-1,2-Dichloroethylene	EPA 624, 8260B	EPA 8260B	EPA TO-15
trans-1,3-Dichloropropylene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Trichloroethene	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Trichlorofluoromethane	EPA 624, 8260B	EPA 8260B	EPA-TO-14A
Vinyl chloride	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Xylene (total)	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,1,1,2-Tetrachloroethane	EPA 8260B	EPA 8260B	NA
1,1-Dichloropropene	EPA 8260B	EPA 8260B	NA
1,2,3-Trichlorobenzene	EPA 8260B	EPA 8260B	NA

<u>Parameter/Analyte</u>	<u>Non-Potable Water</u>	<u>Solid Hazardous Waste</u>	<u>Air</u>
1,2,3-Trichloropropane	EPA 8260B	EPA 8260B	NA
1,2,4-Trichlorobenzene	EPA 8260B, 625, 8270D	EPA 8260B, 8270D	EPA TO-14A, EPA TO-15
1,2,4-Trimethylbenzene	EPA 8260B	EPA 8260B	EPA TO-14A
1,3,5-Trimethylbenzene	EPA 8260B	EPA 8260B	EPA TO-14A
1,3-Dichloropropane	EPA 8260B	EPA 8260B	NA
2,2-Dichloropropane	EPA 8260B	EPA 8260B	NA
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260B, 8015C	EPA 8260B	EPA TO-15
2-Chlorotoluene	EPA 8260B	EPA 8260B	NA
2-Hexanone	EPA 8260B	EPA 8260B	ENCO VGCMS-07
4-Chlorotoluene	EPA 8260B	EPA 8260B	NA
4-Methyl-2-pentanone (MIBK)	EPA 8260B, 8015C	EPA 8260B	EPA TO-15
Acetone	EPA 8260B	EPA 8260B	ENCO VGCMS-07
Acetonitrile	EPA 8260B	EPA 8260B	NA
Allyl chloride (3-Chloropropene)	EPA 8260B	EPA 8260B	EPA TO-15
Bromobenzene	EPA 8260B	EPA 8260B	NA
Bromochloromethane	EPA 8260B	EPA 8260B	NA
Carbon disulfide	EPA 8260B	EPA 8260B	EPA TO-15
Chloroprene	EPA 8260B	EPA 8260B	NA
cis-1,2-Dichloroethylene	EPA 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Dibromomethane	EPA 8260B	EPA 8260B	NA
Dichlorodifluoromethane	EPA 8260B	EPA 8260B	EPA TO-14A
Diethyl ether	EPA 8260B	EPA 8260B	NA
Ethanol	EPA 8260B, 8015C	EPA 8260B	NA
Ethyl methacrylate	EPA 8260B	EPA 8260B	NA
Hexachlorobutadiene	EPA 8260B, 625, 8270D	EPA 8260B, 8270D	EPA TO-14A, EPA TO-15
Iodomethane (Methyl iodine)	EPA 8260B	EPA 8260B	NA
Isopropylbenzene	EPA 8260B	EPA 8260B	NA
Isopropyl ether	EPA 8260B	EPA 8260B	NA
Methacrylonitrile	EPA 8260B	EPA 8260B	NA
Methyl Acetate	EPA 8260B	EPA 8260B	NA
Methyl Cyclohexane	EPA 8260B	EPA 8260B	NA
Methyl methacrylate	EPA 8260B	EPA 8260B	NA
Methyl tert-butyl ether (MTBE)	EPA 8260B	EPA 8260B	EPA TO-15
m.p-Xylene	EPA 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Naphthalene	EPA 8260B, 625 Scan-Sim, 8270D Scan-Sim	EPA 8260B, 8270D Scan-Sim	NA
n-Butyl benzene	EPA 8260B	EPA 8260B	NA
n-Propyl benzene	EPA 8260B	EPA 8260B	NA
o-Xylene	EPA 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
p-Isopropyltoluene	EPA 8260B	EPA 8260B	NA
Propionitrile (Ethyl cyanide)	EPA 8260B	EPA 8260B	NA
sec-Butylbenzene	EPA 8260B	EPA 8260B	NA
Styrene	EPA 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
tert-Butylbenzene	EPA 8260B	EPA 8260B	NA
trans-1,4-Dichloro-2-butene	EPA 8260B	EPA 8260B	NA
Vinyl acetate	EPA 8260B	EPA 8260B	EPA TO-15
4,4'-DDD	EPA 608, 8081B	EPA 8081B	NA
4,4'-DDE	EPA 608, 8081B	EPA 8081B	NA

<u>Parameter/Analyte</u>	<u>Non-Potable Water</u>	<u>Solid Hazardous Waste</u>	<u>Air</u>
4,4'-DDT	EPA 608, 8081B	EPA 8081B	NA
Aldrin	EPA 608, 8081B	EPA 8081B	NA
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 608, 8081B	EPA 8081B	NA
Aroclor-1016(PCB-1016)	EPA 608, 8082A	EPA 8082A	NA
Aroclor-1221(PCB-1221)	EPA 608, 8082A	EPA 8082A	NA
Aroclor-1232(PCB-1232)	EPA 608, 8082A	EPA 8082A	NA
Aroclor-1242(PCB-1242)	EPA 608, 8082A	EPA 8082A	NA
Aroclor-1248(PCB-1248)	EPA 608, 8082A	EPA 8082A	NA
Aroclor-1254(PCB-1254)	EPA 608, 8082A	EPA 8082A	NA
Aroclor-1260(PCB-1260)	EPA 608, 8082A	EPA 8082A	NA
beta-BHC (beta-Hexachlorocyclohexane)	EPA 608, 8081B	EPA 8081B	NA
Chlordane(tech.)	EPA 608, 8081B	EPA 8081B	NA
delta-BHC	EPA 608, 8081B	EPA 8081B	NA
Dieldrin	EPA 608, 8081B	EPA 8081B	NA
Endosulfan I	EPA 608, 8081B	EPA 8081B	NA
Endosulfan II	EPA 608, 8081B	EPA 8081B	NA
Endosulfan sulfate	EPA 608, 8081B	EPA 8081B	NA
Endrin	EPA 608, 8081B	EPA 8081B	NA
Endrin aldehyde	EPA 608, 8081B	EPA 8081B	NA
gamma-BHC (Lindane,gamma-Hexachlorocyclohexane)	EPA 608, 8081B	EPA 8081B	NA
Heptachlor	EPA 608, 8081B	EPA 8081B	NA
Heptachlor epoxide	EPA 608, 8081B	EPA 8081B	NA
Toxaphene (Chlorinated camphene)	EPA 608, 8081B	EPA 8081B	NA
alpha-Chlordane	EPA 8081B	EPA 8081B	NA
Endrin ketone	EPA 8081B	EPA 8081B	NA
gamma-Chlordane	EPA 8081B	EPA 8081B	NA
Isodrin	EPA 8081B, 8270D	EPA 8081B, 8270D	NA
Methoxychlor	EPA 8081B	EPA 8081B	NA
Mirex	EPA 8081B	EPA 8081B	NA
Kepone	EPA 8270D	EPA 8270D	NA
o,o,o-Triethylphosphorothioate	EPA 8270D	EPA 8270D	NA
Parathion,ethyl	EPA 8270D	EPA 8270D	NA
Phorate	EPA 8270D	EPA 8270D	NA
Sulfotepp	EPA 8270D	EPA 8270D	NA
Thionazin (Zinophos)	EPA 8270D	EPA 8270D	NA
Dalapon	EPA 615, 8151A	EPA 8151A	NA
3,5-DCBA	EPA 615, 8151A	EPA 8151A	NA
4-Nitrophenol	EPA 615, 8151A, 625, 8270D	EPA 8270D, 8151A	NA
Dicamba	EPA 615, 8151A	EPA 8151A	NA
MCPD	EPA 615, 8151A	EPA 8151A	NA
MCPA	EPA 615, 8151A	EPA 8151A	NA
Dichlorprop	EPA 615, 8151A	EPA 8151A	NA
2,4-D	EPA 615, 8151A	EPA 8151A	NA
Pentachlorophenol	EPA 615, 8151A, 625, 8270D	EPA 8151A, 8270D	NA

<u>Parameter/Analyte</u>	<u>Non-Potable Water</u>	<u>Solid Hazardous Waste</u>	<u>Air</u>
2,4,5-TP (Silvex)	EPA 615, 8151A	EPA 8151A	NA
Chloramben	EPA 615, 8151A	EPA 8151A	NA
2,4,5-T	EPA 615, 8151A	EPA 8151A	NA
2,4-DB	EPA 615, 8151A	EPA 8151A	NA
Bentazon	EPA 615, 8151A	EPA 8151A	NA
Picloram	EPA 615, 8151A	EPA 8151A	NA
Dinoseb	EPA 615, 8151A, 625, 8270D	EPA 8151A, 8270D	NA
Dacthal	EPA 615, EPA 8151A	EPA 8151A	NA
Acifluorfen	EPA 615, EPA 8151A	EPA 8151A	NA
2,4-DCAA	EPA 615, EPA 8151A	EPA 8151A	NA
Total coliforms	SM9222B	NA	NA
Fecal coliforms	SM9222D	NA	NA
Aluminum	EPA 200.7, 6010C	EPA 6010C	NA
Antimony	EPA 200.7, 6010C	EPA 6010C	NA
Arsenic	EPA 200.7, 6010C	EPA 6010C	NA
Barium	EPA 200.7, 6010C	EPA 6010C	NA
Beryllium	EPA 200.7, 6010C	EPA 6010C	NA
Boron	EPA 200.7, 6010C	EPA 6010C	NA
Cadmium	EPA 200.7, 6010C	EPA 6010C	NA
Calcium	EPA 200.7, 6010C	EPA 6010C	NA
Chromium	EPA 200.7, 6010C	EPA 6010C	NA
Cobalt	EPA 200.7, 6010C	EPA 6010C	NA
Copper	EPA 200.7, 6010C	EPA 6010C	NA
Hardness (calc.)	SM2340B	NA	NA
Iron	EPA 200.7, 6010C, SM18 3500-Fe D	EPA 6010C	NA
Lead	EPA 200.7, 6010C	EPA 6010C	NA
Lithium	EPA 200.7, 6010C	EPA 6010C	NA
Magnesium	EPA 200.7, 6010C	EPA 6010C	NA
Manganese	EPA 200.7, 6010C	EPA 6010C	NA
Molybdenum	EPA 200.7, 6010C	EPA 6010C	NA
Nickel	EPA 200.7, 6010C	EPA 6010C	NA
Potassium	EPA 200.7, 6010C	EPA 6010C	NA
Selenium	EPA 200.7, 6010C	EPA 6010C	NA
Silver	EPA 200.7, 6010C	EPA 6010C	NA
Sodium	EPA 200.7, 6010C	EPA 6010C	NA
Strontium	EPA 200.7, 6010C	EPA 6010C	NA
Thallium	EPA 200.7, 6010C	EPA 6010C	NA
Tin	EPA 200.7, 6010C	EPA 6010C	NA
Titanium	EPA 200.7, 6010C	EPA 6010C	NA
Vanadium	EPA 200.7, 6010C	EPA 6010C	NA
Zinc	EPA 200.7, 6010C	EPA 6010C	NA
Mercury	EPA 245.1, 7470A	EPA 7471B	NA
Sulfate	ASTM D516-90	NA	NA
Ignitability	EPA 1010A	EPA 1010A, EPA 1030	NA
Conductivity	EPA 120.1, SM18 2510B	NA	NA
Turbidity	EPA 180.1, SM18 2130B	NA	NA
Orthophosphate as P	EPA 365.3	NA	NA
Color	SM2120B	NA	NA
Alkalinity as CaCO3	SM2320B	NA	NA

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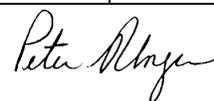
<u>Parameter/Analyte</u>	<u>Non-Potable Water</u>	<u>Solid Hazardous Waste</u>	<u>Air</u>
Hardness	SM2340C	NA	NA
Residue-nonfilterable (TSS)	SM2540D	NA	NA
Residue-total	SM2540B	NA	NA
Residue-filterable (TDS)	SM2540C	NA	NA
Chromium VI	SM3500-CrD(18th/19th Ed.)/UV-VIS	NA	NA
Chloride	SM4500-Cl-C	NA	NA
Total residual chlorine	SM4500-Cl-G	NA	NA
pH	SM18 4500-H+-B, EPA 9040C	EPA 9040C, 9045D	NA
Corrosivity (pH)	NA	EPA 9040C	NA
Paint Filter Liquids Test	NA	EPA 9095B	NA
Nitrite	SM4500-NO2 B	NA	NA
Biochemical oxygen demand	SM5210B	NA	NA
Carbonaceous BOD(CBOD)	SM5210B	NA	NA
Chemical oxygen demand	SM5220D, EPA 410.4	NA	NA
Total Organic Carbon	SM18 5310B, EPA 9060A	NA	NA
Total Petroleum Hydrocarbons (TPH)	FL-PRO	FL-PRO	NA
Oil & Grease (HEM)	EPA 1664A	EPA 9071B	NA
Total Petroleum Hydrocarbons (TPH) (HEM-SGT)	EPA 1664A	NA	NA
Carbon dioxide	RSK-175	NA	NA
Ethane	RSK-175	NA	NA
Ethylene	RSK-175	NA	NA
Methane	RSK-175	NA	NA
2,4,6-Trichlorophenol	EPA 625, 8270D	EPA 8270D	NA
2,4-Dichlorophenol	EPA 625, 8270D	EPA 8270D	NA
2,4-Dimethylphenol	EPA 625, 8270D	EPA 8270D	NA
2,4-Dinitrophenol	EPA 625, 8270D	EPA 8270D	NA
2,4-Dinitrotoluene (2,4-DNT)	EPA 625, 8270D	EPA 8270D	NA
2,6-Dinitrotoluene (2,6-DNT)	EPA 625, 8270D	EPA 8270D	NA
2-Chloronaphthalene	EPA 625, 8270D	EPA 8270D	NA
2-Chlorophenol	EPA 625, 8270D	EPA 8270D	NA
2-Methyl-4,6-dinitrophenol	EPA 625, 8270D	EPA 8270D	NA
2-Nitrophenol	EPA 625, 8270D	EPA 8270D	NA
3,3'-Dichlorobenzidine	EPA 625, 8270D	EPA 8270D	NA
4-Bromophenyl phenylether	EPA 625, 8270D	EPA 8270D	NA
4-Chloro-3-methylphenol	EPA 625, 8270D	EPA 8270D	NA
4-Chlorophenyl phenylether	EPA 625, 8270D	EPA 8270D	NA
Acenaphthene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Acenaphthylene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Aniline	EPA 625, 8270D	EPA 8270D	NA
Anthracene	EPA 625 Scan-Sim, 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Benzidine	EPA 625, 8270D	EPA 8270D	NA

<u>Parameter/Analyte</u>	<u>Non-Potable Water</u>	<u>Solid Hazardous Waste</u>	<u>Air</u>
Benzo(a)anthracene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Benzo(a)pyrene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Benzo(b)fluoranthene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Benzo(g,h,i)perylene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Benzo(k)fluoranthene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
bis(2-Chloroethoxy)methane	EPA 625, 8270D	EPA 8270D	NA
bis(2-Chloroethyl) ether	EPA 625, 8270D	EPA 8270D	NA
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane)	EPA 625, 8270D	EPA 8270D	NA
bis(2-Ethylhexyl) phthalate(DEHP)	EPA 625, 8270D	EPA 8270D	NA
Butylbenzylphthalate	EPA 625, 8270D	EPA 8270D	NA
Chrysene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Dibenzo(a,h)anthracene	EPA 625 Scan-Sim, 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Diethyl phthalate	EPA 625, 8270D	EPA 8270D	NA
Dimethyl phthalate	EPA 625, 8270D	EPA 8270D	NA
Di-n-butyl phthalate	EPA 625, 8270D	EPA 8270D	NA
Di-n-octyl phthalate	EPA 625, 8270D	EPA 8270D	NA
Fluoranthene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Fluorene	EPA 625 Scan-Sim, 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Hexachlorobenzene	EPA 625, 8270D	EPA 8270D	NA
Hexachlorocyclopentadiene	EPA 625, 8270D	EPA 8270D	NA
Hexachloroethane	EPA 625, 8270D	EPA 8270D	NA
Indeno(1,2,3-cd)pyrene	EPA 625 Scan-Sim, 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Isophorone	EPA 625, 8270D	EPA 8270D	NA
Nitrobenzene	EPA 625, 8270D	EPA 8270D	NA
n-Nitrosodimethylamine	EPA 625, 8270D	EPA 8270D	NA
n-Nitrosodi-n-propylamine	EPA 625, 8270D	EPA 8270D	NA
n-Nitrosodiphenylamine	EPA 625, 8270D	EPA 8270D	NA
Phenanthrene	EPA 625 Scan-Sim , 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Phenol	EPA 625, 8270D	EPA 8270D	NA
Pyrene	EPA 625 Scan-Sim, 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
Pyridine	EPA 625, 8270D	EPA 8270D	NA
1,1-Biphenyl	EPA 8270D	EPA 8270D	
1,2,4,5-Tetrachlorobenzene	EPA 8270D	EPA 8270D	NA
1,2-Diphenylhydrazine	EPA 8270D	EPA 8270D	NA
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270D	EPA 8270D	NA

<u>Parameter/Analyte</u>	<u>Non-Potable Water</u>	<u>Solid Hazardous Waste</u>	<u>Air</u>
1,3-Dinitrobenzene (1,3-DNB)	EPA 8270D	EPA 8270D	NA
1,4-Naphthoquinone	EPA 8270D	EPA 8270D	NA
1,4-Phenylenediamine	EPA 8270D	EPA 8270D	NA
1-Methylnaphthalene	EPA 625 Scan-Sim, 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
1-Naphthylamine	EPA 8270D	EPA 8270D	NA
2,3,4,6-Tetrachlorophenol	EPA 8270D	EPA 8270D	NA
2,4,5-Trichlorophenol	EPA 8270D	EPA 8270D	NA
2,6-Dichlorophenol	EPA 8270D	EPA 8270D	NA
2-Acetylaminofluorene	EPA 8270D	EPA 8270D	NA
2-Methylnaphthalene	EPA 625 Scan-Sim, 8270D Scan-Sim	EPA 8270D Scan-Sim	NA
2-Methylphenol (o-Cresol)	EPA 8270D	EPA 8270D	NA
2-Naphthylamine	EPA 8270D	EPA 8270D	NA
2-Nitroaniline	EPA 8270D	EPA 8270D	NA
2-Picoline (2-Methylpyridine)	EPA 8270D	EPA 8270D	NA
3,3'-Dimethylbenzidine	EPA 8270D	EPA 8270D	NA
3-Methylcholanthrene	EPA 8270D	EPA 8270D	NA
3-Methylphenol (m-Cresol)	EPA 8270D	EPA 8270D	NA
3-Nitroaniline	EPA 8270D	EPA 8270D	NA
4-Aminobiphenyl	EPA 8270D	EPA 8270D	NA
4-Chloroaniline	EPA 8270D	EPA 8270D	NA
4-Dimethyl aminoazobenzene	EPA 8270D	EPA 8270D	NA
4-Methylphenol (p-Cresol)	EPA 8270D	EPA 8270D	NA
4-Nitroaniline	EPA 8270D	EPA 8270D	NA
4-Nitroquinoline-n-oxide	EPA 8270D	EPA 8270D	NA
5-Nitro-o-toluidine	EPA 8270D	EPA 8270D	NA
7,12-Dimethylbenz(a)anthracene	EPA 8270D	EPA 8270D	NA
a-a-Dimethylphenethylamine	EPA 8270D	EPA 8270D	NA
Acetophenone	EPA 8270D	EPA 8270D	NA
Aramite	EPA 8270D	EPA 8270D	NA
Atrazine	EPA 8270D	EPA 8270D	NA
Benzaldehyde	EPA 8270D	EPA 8270D	NA
Benzoic acid	EPA 8270D	EPA 8270D	NA
Benzyl alcohol	EPA 8270D	EPA 8270D	NA
Caprolactam	EPA 8270D	EPA 8270D	NA
Carbazole	EPA 8270D	EPA 8270D	NA
Chlorobenzilate	EPA 8270D	EPA 8270D	NA
Cresol, Total	EPA 8270D	EPA 8270D	NA
Diallate	EPA 8270D	EPA 8270D	NA
Dibenzo(a,h)pyrene	EPA 8270D	EPA 8270D	NA
Dibenzofuran	EPA 8270D	EPA 8270D	NA
Dimethoate	EPA 8270D	EPA 8270D	NA
Diphenylamine	EPA 8270D	EPA 8270D	NA
Disulfoton	EPA 8270D	EPA 8270D	NA
DPH (as Azobenzene)	EPA 8270D	EPA 8270D	NA
Ethyl methanesulfonate	EPA 8270D	EPA 8270D	NA
Famphur	EPA 8270D	EPA 8270D	NA

<u>Parameter/Analyte</u>	<u>Non-Potable Water</u>	<u>Solid Hazardous Waste</u>	<u>Air</u>
Hexachlorophene	EPA 8270D	EPA 8270D	NA
Hexachloropropene	EPA 8270D	EPA 8270D	NA
Isosafrole	EPA 8270D	EPA 8270D	NA
Methapyrilene	EPA 8270D	EPA 8270D	NA
Methyl methane sulfonate	EPA 8270D	EPA 8270D	NA
Methyl parathion (Parathion,methyl)	EPA 8270D	EPA 8270D	NA
Nitroquinoline-1-oxide	EPA 8270D	EPA 8270D	NA
n-Nitrosodiethylamine	EPA 8270D	EPA 8270D	NA
n-Nitroso-di-n-butylamine	EPA 8270D	EPA 8270D	NA
n-Nitrosomethylethylamine	EPA 8270D	EPA 8270D	NA
n-Nitrosomorpholine	EPA 8270D	EPA 8270D	NA
n-Nitrosopiperidine	EPA 8270D	EPA 8270D	NA
n-Nitrosopyrrolidine	EPA 8270D	EPA 8270D	NA
o-Toluidine	EPA 8270D	EPA 8270D	NA
Pentachlorobenzene	EPA 8270D	EPA 8270D	NA
Pentachloroethane	EPA 8270D	EPA 8270D	NA
Pentachloronitrobenzene	EPA 8270D	EPA 8270D	NA
Phenacetin	EPA 8270D	EPA 8270D	NA
Pronamide (Kerb)	EPA 8270D	EPA 8270D	NA
Safrole	EPA 8270D	EPA 8270D	NA
C9-C18 Aliphatic Hydrocarbons	MAEPH	MAEPH	NA
C19-C36 Aliphatic Hydrocarbons	MAEPH	MAEPH	NA
C11-C22 Aromatic Hydrocarbons	MAEPH	MAEPH	NA
C5-C8 Aliphatic Hydrocarbons	MAVPH	MAVPH	NA
C9-C12 Aliphatic Hydrocarbons	MAVPH	MAVPH	NA
C9-C10 Aromatic Hydrocarbons	MAVPH	MAVPH	NA
Toxicity Characteristic Leaching Procedure (TCLP)	EPA 1311	EPA 1311	NA
Synthetic Precipitation Leaching Procedure (SPLP)	EPA 1312	EPA 1312	NA

<u>Analytical method</u>	<u>Prep Method</u>			
	<u>Soil</u>	<u>Water</u>	<u>Air</u>	<u>Waste</u>
EPA 8260B	EPA 5035	EPA 5030B	NA	EPA 5035
EPA 624	NA	EPA 5030B	NA	NA
EPA 625	NA	EPA 3510C	NA	NA
EPA 8270D	EPA 3545A	EPA 3510C	NA	EPA 3580A
EPA 200.7	NA	EPA 200.7	NA	NA
EPA 6010C	EPA 3050B	EPA 3005A	NA	EPA 3050B
EPA 608	NA	EPA 3510C	NA	NA
EPA 8081B	EPA 3545A	EPA 3510C	NA	EPA 3580A
EPA 8082A	EPA 3545A, EPA 3540C	EPA 3510C	NA	EPA 3580A
EPA 615	NA	EPA 615	NA	NA



<u>Analytical method</u>	<u>Prep Method</u>			
EPA 8151A	EPA 8151A	EPA 8151A	NA	EPA 8151A
MA VPH, May 2004 Revision 1.1	EPA 5035	EPA 5030B	NA	NA
MA EPH, May 2004 Revision 1.1	EPA 3545A	EPA 3510C	NA	NA
FLPRO	EPA 3545A	EPA 3510C	NA	NA
8015C – GRO	EPA 5035	EPA 5030B	NA	NA
8015C – DRO	EPA 3545A	EPA 3510C	NA	NA
TO14A	NA	NA	TO14A	NA
TO15	NA	NA	TO15	NA
SPLP	EPA 1312	EPA 1312	NA	EPA 1312
TCLP	EPA 1311	EPA 1311	NA	EPA 1311



World Class Accreditation

The American Association for Laboratory Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

ENVIRONMENTAL CONSERVATION LABORATORIES - JACKSONVILLE

Jacksonville, FL

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (QSM v4.1); accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).



Presented this 1st day of May 2012.

A handwritten signature in black ink, appearing to read "Peter Meyer".

President & CEO
For the Accreditation Council
Certificate Number 3000.02
Valid to April 30, 2014

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



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

ENVIRONMENTAL CONSERVATION LABORATORIES – ORLANDO

10775 Central Port Drive
 Orlando, FL 32824
 Lori Mangrum Phone: 407 826 5314
 lmangrum@encolabs.com

ENVIRONMENTAL

Valid To: June 30, 2012

Certificate Number: 3000.01

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

Testing Technologies

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

Lori Mangrum

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Titanium	EPA 6020A/200.8	EPA 6020A
Vanadium	EPA 6020A/200.8	EPA 6020A
Zinc	EPA 6020A/200.8	EPA 6020A
<u>Microbiology</u>		
Total Coliforms	SM 9222B	-----
Fecal Coliforms	SM 9222D	-----
<u>General Chemistry</u>		
Acidity, as CaCO ₃	EPA 305.1/SM 2310 B (4A)	-----
Alkalinity as CaCO ₃	EPA 310.1/SM 2320 B	EPA 310.1/SM 2320 B
Alkalinity as CaCO ₄	EPA 310.2	EPA 310.2
Ammonia as N	-----	EPA 350.1
Biochemical oxygen demand	EPA 405.1/SM 5210 B	-----
Bromide	EPA 300.0/9056A	EPA 9056A
Carbonaceous BOD (CBOD)	SM 5210 B	-----
Chemical oxygen demand	EPA 410.4	-----
Chloride	EPA 300.0/9056A	EPA 9056A
Chromium VI	EPA 7196/ SM 3500-Cr D	EPA 7196
Conductivity	EPA 120.1	-----
Cyanide	EPA 335.2/SM 4500-CN E	EPA 9014
Ferric iron (calculated)	SM 3500-Fe D	-----
Ferrous iron	SM 3500-Fe D	-----
Fluoride	EPA 300.0/9056A	EPA 9056A
Hardness	EPA 130.2/SM 2340 C	-----
Kjeldahl nitrogen -total	EPA 351.2	EPA351.2
Nitrate as N	EPA 300.0/353.1/9056A	EPA 353.1/9056A
Nitrate-nitrite	EPA 300.0/353.1/9056A	EPA 353.1/9056A
Nitrite as N	EPA 300.0/354.1/9056A/SM 4500-NO ₂ B	EPA 9056A/ SM 4500-NO ₂ B
Organic nitrogen	EPA 351.2/350.1	EPA 351.2/350.1
Orthophosphate as P	EPA 365.1	-----
Orthophosphate as P	EPA 365.3	-----
pH	EPA 150.1/9040C/SM 4500-H ⁺ -B	EPA 9040C
Phosphorus, total	EPA 365.4	EPA 365.4
Residue-filterable (TDS)	SM 2540 C	-----
Residue-nonfilterable (TSS)	SM 2540 D	-----
Residue-total	SM 2540 B/SM 2540 G/EPA 160.3	SM 2540G/EPA 160.3
Residue-volatile	EPA 160.4	EPA 160.4
Sulfate	EPA 300.0/9056A	EPA 9056A
Sulfide	EPA 376.1/SM 4500-S E	-----
Surfactants -MBAS	SM 5540 C	-----
Total nitrate-nitrite	EPA 9056 A/SM 4500-NO ₃ H	EPA 9056 A/SM 4500-NO ₃ H
Total cyanide	EPA 9014	EPA 9014
Total nitrogen	TKN + Total nitrate-nitrite	TKN + Total nitrate-nitrite
Total Organic Carbon	EPA 9060A/SM 5310B	TOC Walkley Black
Total phenolics	EPA 420.1	EPA 420.1
Total, fixed, and volatile residue	SM 2540 G	SM 2540 G
Turbidity	EPA 180.1	-----
Un-ionized ammonia	DEP SOP 10/03/83	DEP SOP 10/03/83
<u>Extractable Organics</u>		

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

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270D/625	EPA 8270D
Butyl benzyl phthalate	EPA 8270D/625	EPA 8270D
Caprolactam	EPA 8270D/625	EPA 8270D
Carbazole	EPA 8270D/625	EPA 8270D
Chrysene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Dibenz(a,h)anthracene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Dibenzofuran	EPA 8270D/625	EPA 8270D
Diethyl phthalate	EPA 8270D/625	EPA 8270D
Dimethyl phthalate	EPA 8270D/625/ Scan-Sim	EPA 8270D
Di-n-butyl phthalate	EPA 8270D/625	EPA 8270D
Di-n-octyl phthalate	EPA 8270D/625	EPA 8270D
Fluoranthene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Fluorene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Hexachlorobenzene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Hexachlorobutadiene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Hexachlorocyclopentadiene	EPA 8270D/625	EPA 8270D
Hexachloroethane	EPA 8270D/625	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 8270D/625/ Scan-Sim	EPA 8270D Scan-Sim
Isodrin	EPA 8270D/625	EPA 8270D
Isophorone	EPA 8270D/625	EPA 8270D
Naphthalene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Nitrobenzene	EPA 8270D/625	EPA 8270D
n-Nitrosodimethylamine	EPA 8270D/625	EPA 8270D
n-Nitrosodi-n-propylamine	EPA 8270D/625	EPA 8270D
n-Nitrosodiphenylamine	EPA 8270D/625	EPA 8270D
n-Nitrosopyrrolidine	EPA 8270D/625	EPA 8270D
Pentachlorophenol	EPA 8270D/625/ Scan-Sim	EPA 8270D
Phenanthrene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Phenol	EPA 8270D/625	EPA 8270D
Pyrene	EPA 8270D/625 Scan-Sim	EPA 8270D Scan-Sim
Total Petroleum Hydrocarbons (TPH)	FL-PRO	FL-PRO
<u>Volatile Organics</u>		
1,1,1,2-Tetrachloroethane	EPA 8260B/624	EPA 8260B
1,1,1-Trichloroethane	EPA 8260B/624	EPA 8260B
1,1,2,2-Tetrachloroethane	EPA 8260B/624	EPA 8260B
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 8260B/624	EPA 8260B
1,1,2-Trichloroethane	EPA 8260B/624	EPA 8260B
1,1-Dichloroethane	EPA 8260B/624	EPA 8260B
1,1-Dichloroethene	EPA 8260B/624	EPA 8260B
1,1-Dichloropropene	EPA 8260B/624	EPA 8260B
1,2,3-Trichlorobenzene	EPA 504.1/8260B/624	EPA 8260B
1,2,3-Trichloropropane	EPA 8260B/624	EPA 8260B
1,2,4-Trichlorobenzene	EPA 8260B/624	EPA 8260B
1,2,4-Trimethylbenzene	EPA 8260B/624	EPA 8260B
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504 /504.1/8011/8260B	EPA 8260B
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 504 /504.1/8011/8260B	EPA 8260B

Peter M. Meyer

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

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Methylcyclohexane	EPA 8260B/624	EPA 8260B
Methylene chloride	EPA 8260B/624	EPA 8260B
Naphthalene	EPA 8260B/624	EPA 8260B
n-Butylbenzene	EPA 8260B/624	EPA 8260B
n-Propylbenzene	EPA 8260B/624	EPA 8260B
o-Xylene	EPA 8260B/624	EPA 8260B
Pentachloroethane	EPA 8260B/624	EPA 8260B
p-Isopropyltoluene	EPA 8260B/624	EPA 8260B
Propionitrile (Ethyl cyanide)	EPA 8260B/624	EPA 8260B
sec-Butylbenzene	EPA 8260B/624	EPA 8260B
Styrene	EPA 8260B/624	EPA 8260B
tert-Butylbenzene	EPA 8260B/624	EPA 8260B
Tetrachloroethene (Perchloroethylene)	EPA 8260B/624	EPA 8260B
Toluene	EPA 8260B/624	EPA 8260B
trans-1,2-Dichloroethene	EPA 8260B/624	EPA 8260B
trans-1,3-Dichloropropene	EPA 8260B/624	EPA 8260B
trans-1,4-Dichloro-2-butene	EPA 8260B/624	EPA 8260B
Trichloroethene (Trichloroethylene)	EPA 8260B/624	EPA 8260B
Trichlorofluoromethane	EPA 8260B/624	EPA 8260B
Vinyl acetate	EPA 8260B/624	EPA 8260B
Vinyl chloride	EPA 8260B/624	EPA 8260B
Xylene (total)	EPA 8260B/624	EPA 8260B
<u>Pesticides-Herbicides-PCBs</u>		
2,4,5-T	EPA 8151A /615	EPA 8151A
2,4-D	EPA 8151A /615	EPA 8151A
2,4-DB	EPA 8151A /615	EPA 8151A
3,5-Dichlorobenzoic acid	EPA 8151A /615	EPA 8151A
4,4'-DDD	EPA 8081B/608	EPA 8081B
4,4'-DDE	EPA 8081B/608	EPA 8081B
4,4'-DDT	EPA 8081B/608	EPA 8081B
4-Nitrophenol	EPA 8151A/615	EPA 8151A
Acifluorfen	EPA 8151A/615	EPA 8151A
Aldrin	EPA 8081B/608	EPA 8081B
alpha-BHC (alpha- Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
alpha-Chlordane	EPA 8081B/608	EPA 8081B
Aroclor-1016(PCB-1016)	EPA 8082A/608	EPA 8082A
Aroclor-1221 (PCB-1221)	EPA 8082A/608	EPA 8082A
Aroclor-1232 (PCB-1232)	EPA 8082A/608	EPA 8082A
Aroclor-1242 (PCB-1242)	EPA 8082A/608	EPA 8082A
Aroclor-1248 (PCB-1248)	EPA 8082A/608	EPA 8082A
Aroclor-1254 (PCB-1254)	EPA 8082A/608	EPA 8082A
Aroclor-1260 (PCB-1260)	EPA 8082A/608	EPA 8082A
Aroclor-1262 (PCB-1262)	EPA 8082A/608	EPA 8082A
Aroclor-1268 (PCB-1268)	EPA 8082A/608	EPA 8082A
Azinphos-methyl (Guthion)	EPA 8141B/614	EPA 8141B
Bentazon	EPA 8151A/615	EPA 8151A
beta-BHC (beta- Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
Bolstar (Sulprofos)	EPA 8141B/614	EPA 8141B

Peter M. Meyer

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Chloramben	EPA 8151A/615	EPA 8151A
Chlordane (tech.)	EPA 8081B/608	EPA 8081B
Chlorpyrifos	EPA 8141B/614	EPA 8141B
Coumaphos	EPA 8141B/614	EPA 8141B
Dacthal (DCPA)	EPA 8151A/615	EPA 8151A
Dalapon	EPA 8151A/615	EPA 8151A
delta-BHC	EPA 8081B/608	EPA 8081B
Demeton-o	EPA 8141B/614	EPA 8141B
Demeton-s	EPA 8141B/614	EPA 8141B
Diazinon	EPA 8141B/614	EPA 8141B
Dicamba	EPA 8151A/615	EPA 8151A
Dichlorofenthion	EPA 8141B/614	EPA 8141B
Dichloroprop (Dichlorprop)	EPA 8151A/615	EPA 8151A
Dlchlorovos (DDVP, Dichtovos)	EPA 8141B/614	EPA 8141B
Dieldrin	EPA 8081B/608	EPA 8081B
Dimethoate	EPA 8141B/614	EPA 8141B
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNB P)	EPA 8151A/615	EPA 8151A
Disulfoton	EPA 8141B/614	EPA 8141B
Endosulfan I	EPA 8081B/608	EPA 8081B
Endosulfan II	EPA 8081B/608	EPA 8081B
Endosulfan sulfate	EPA 8081B/608	EPA 8081B
Endrin	EPA 8081B/608	EPA 8081B
Endrin aldehyde	EPA 8081B/608	EPA 8081B
Endrin ketone	EPA 8081B/608	EPA 8081B
EPN	EPA 8141B/614	EPA 8141B
Ethion	EPA 8141B/614	EPA 8141B
Ethoprop	EPA 8141B/614	EPA 8141B
fensulfothion	EPA 8141B/614	EPA 8141B
fenthion	EPA 8141B/614	EPA 8141B
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
gamma-Chlordane	EPA 8081B/608	EPA 8081B
Heptachlor	EPA 8081B/608	EPA 8081B
Heptachlor epoxide	EPA 8081B/608	EPA 8081B
Isodrin	EPA 8081B/608	EPA 8081B
Malathion	EPA 8141B/614	EPA 8141B
MCPA	EPA 8151A/615	EPA 8151A
MCPP	EPA 8151A/615	EPA 8151A
Merphos	EPA 8141B/614	EPA 8141B
Methoxychlor	EPA 8081B/608	EPA 8081B
Methyl parathion (Parathion, methyl)	EPA 8141B/614	EPA 8141B
Mevinphos	EPA 8141B/614	EPA 8141B
Mirex	EPA 8081B/608	EPA 8081B
Monocrotophos	EPA 8141B/614	EPA 8141B
Naled	EPA 8141B/614	EPA 8141B
Parathion, ethyl	EPA 8141B/614	EPA 8141B
Pentachlorophenol	EPA 8151A/615	EPA 8151A
Phorate	EPA 8141B/614	EPA 8141B
Picloram	EPA 8151A/615	EPA 8151A
Ronnel	EPA 8141B/614	EPA 8141B
Silvex (2A.5-TP)	EPA 8151B/615	EPA 8151B



Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Stirofos	EPA 8141B/614	EPA 8141B
Sulfotepp	EPA 8141B/614	EPA 8141B
Tetraethyl pyrophosphate (TEPP)	EPA 8141B/614	EPA 8141B
Tokuthion (Prothiophos)	EPA 8141B/614	EPA 8141B
Toxaphene (Chlorinated camphene)	EPA 8081B/608	EPA 8081B
Trichloronate	EPA 8141B/614	EPA 8141B

Preparation Methods

Fraction	Analytical Method	Preparation Method
Cyanide	EPA 9014 EPA 335.2 /SM 4500-CN E	EPA 9010C
TX	EPA 9056A	EPA 5050
Metal water prep	EPA 6020A/200.8	EPA 3005A
Metals soil prep	EPA 6020A	EPA 3050B
Metals TCLP prep	EPA 6020A/200.8	EPA 3010A
Extractable organics and Pesticides water prep	EPA 8270D/625/8081B/8082A/ 608/ 8141B/ 614	EPA 3510C
Extractable organics and Pesticides waste prep	EPA 8270D/625/8081B/8082A/ 608/ 8141B/ 614	EPA 3580A
Extractable organics and Pesticides soil prep	EPA 8270D/625/8081B/8082A/ 608/ 8141B/ 614	EPA 3550C
Organics water and mid-level soil prep	EPA 8260B/624	EPA 5030B
Organics low-level soil prep	EPA 8260B/624	EPA 5035
Soil/water leachate	Wets	ENCO WETS-88
SPLP	Wets, Organics, and Metals	EPA 1312
TCLP	Wets, Organics, and Metals	EPA 1311



World Class Accreditation

The American Association for Laboratory Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

ENVIRONMENTAL CONSERVATION LABORATORIES - ORLANDO

Orlando, FL

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (QSM v4.1); accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).



Presented this 29th day of March 2010.

President & CEO
For the Accreditation Council
Certificate Number 3000.01
Valid to June 30, 2012
Revised March 16, 2012

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



The American Association for Laboratory Accreditation

World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

GEL LABORATORIES, LLC

Charleston, SC

for technical competence in the field of

Environmental Testing

In recognition of the successful completion of the A2LA evaluation process that includes an assessment of the laboratory's compliance with ISO/IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (QSM v4.1); accreditation is granted to this laboratory to perform recognized EPA methods as defined on the associated A2LA Environmental Scope of Accreditation. This accreditation demonstrates technical competence for this defined scope and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Presented this 22nd day of August 2011.





President & CEO
For the Accreditation Council
Certificate Number 2567.01
Valid to June 30, 2013

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



*Joint IAF-ILAC-ISO Communiqué
on the
Management Systems Requirements of ISO/IEC 17025:2005,
General requirements for the competence of testing and calibration
laboratories*

A laboratory's fulfilment of the requirements of ISO/IEC 17025:2005 means the laboratory meets both the technical competence requirements and **management system requirements** that are necessary for it to consistently deliver technically valid test results and calibrations. The **management system requirements** in ISO/IEC 17025:2005 (Section 4) are written in language relevant to laboratory operations and meet the principles of ISO 9001:2008 **Quality Management Systems — Requirements** and are aligned with its pertinent requirements.

A handwritten signature in black ink, appearing to read "Th. Gode".

A handwritten signature in black ink, appearing to read "Ruy".

A handwritten signature in black ink, appearing to read "Rob Steele".

IAF Chair

ILAC Chair

ISO Secretary General



SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

GEL LABORATORIES, LLC
 2040 Savage Road
 Charleston, SC 29414
 Robert L. Pullano Phone: (843) 556-8171
 rlp@gel.com

ENVIRONMENTAL

Valid To: June 30, 2013

Certificate Number: 2567.01

In recognition of the successful completion of the A2LA evaluation process, (including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.1)) accreditation is granted to this laboratory to perform the following radiochemical tests in various matrices, including soils, drinking water, wastewater, groundwater, fiber air filters, vegetation, animal tissues and milk.

	<u>Preparation SOP</u>	<u>Analytical SOP</u>
<u>Alpha Spectrometry:</u> Alpha: Am-241, Am-243, Cf-252, Cm-242, Cm-243/244, Cm-245/246, Np-237, Po-208, Po-209, Po-210, Pu-236, Pu-238, Pu-239/240, Pu-242, Pu-244, Th-228, Th-229, Th-230, Th-232, U-232, U-233/234, U-235/236, U-238	GL-RAD-A-011, GL-RAD-A-016, GL-RAD-A-032, GL-RAD-A-036, GL-RAD-A-038	GL-RAD-I-009
<u>Radon Emanation:</u> Ra-226	GL-RAD-A-008, GL-RAD-A-028	GL-RAD-I-007
<u>Gamma Spectrometry:</u> Gamma: 46 to 1836 keV, I-129, I-131, Ni-59	GL-RAD-A-006, GL-RAD-A-013, GL-RAD-A-022	GL-RAD-I-001
<u>Kinetic Phosphorescence Analyzer</u> Total Uranium	GL-RAD-A-023	GL-RAD-B-018

	<u>Preparation SOP</u>	<u>Analytical SOP</u>
<u>Gas Flow Proportional Counting:</u> Beta: Cl-36, I-131, Pb-210, Ra-228, Sr-89, Sr-90, Total Radium	GL-RAD-A-004, GL-RAD-A-009, GL-RAD-A-010, GL-RAD-A-017, GL-RAD-A-018, GL-RAD-A-029, GL-RAD-A-030, GL-RAD-A-033, GL-RAD-A-044, GL-RAD-A-054	GL-RAD-I-006, GL-RAD-I-015, GL-RAD-I-016
Gross Alpha/Gross Beta:	GL-RAD-A-001, GL-RAD-A-001B, GL-RAD-A-001C, GL-RAD-A-056	GL-RAD-I-006, GL-RAD-I-015, GL-RAD-I-016
48 hour Gross Alpha	GL-RAD-A-047	GL-RAD-I-006, GL-RAD-I-015, GL-RAD-I-016
<u>Liquid Scintillation Spectrometry:</u> Beta: C-14, Ca-45, Fe-55, H-3, Ni-63, P-32, Pm-147, Pu-241, S-35, Se-79, Tc-99 Alpha: Rn-222	GL-RAD-A-002, GL-RAD-A-003, GL-RAD-A-005, GL-RAD-A-007, GL-RAD-A-019, GL-RAD-A-020, GL-RAD-A-022, GL-RAD-A-031, GL-RAD-A-035, GL-RAD-A-040, GL-RAD-A-048, GL-RAD-A-049, GL-RAD-A-050	GL-RAD-I-004, GL-RAD-I-014, GL-RAD-I-017
ICP-MS Uranium Isotopes Tc-99	GL-MA-E-008 GL-RAD-A-005, GL-RAD-A-055	GL-MA-E-014 GL-RAD-B-034

Additionally, in recognition of the successful completion of the A2LA evaluation process, including an assessment of the laboratory's compliance with ISO IEC 17025:2005, the 2003 NELAC Chapter 5 Standard, and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.1), accreditation is granted to this laboratory to perform recognized EPA, Standard Methods for the Examination of Water and Wastewater, ASTM, Department of Energy (DOE), California and Connecticut test methods using the following testing technologies and in the analyte categories identified below:

Testing Technologies

Atomic Absorption/ICP-AES Spectrometry, ICP/MS, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Gravimetry, High Performance Liquid Chromatography, Ion Chromatography, Methylene Blue Active Substances, Misc.- Electronic Probes (pH, O₂), Oxygen Demand, Hazardous Waste Characteristics Tests, Spectrophotometry (Visible), Spectrophotometry (Automated), IR Spectrometry, Titrimetry, Total Organic Carbon, Total Organic Halide, Turbidity, Liquid Chromatography/Mass Spectrometer/Mass Spectrometer and Various Radiochemistry Techniques

<u>Parameter/Analyte</u>	<u>Nonpotable Water</u>	<u>Solid Hazardous Waste (Liquids and Solids)</u>
<u>Metals</u>		
Aluminum	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Antimony	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C
Arsenic	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Barium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Beryllium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Boron	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Cadmium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Calcium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Chromium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Cobalt	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Copper	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Iron	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Lead	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Lithium	EPA 200.8/6020/6020A	EPA 6020/6020A
Magnesium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Manganese	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Mercury	EPA 1631E/7470/7470A/245.1/245.2	EPA 7470/7470A/7471A/7471B
Molybdenum	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Nickel	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Phosphorous	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Potassium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A

<u>Parameter/Analyte</u>	<u>Nonpotable Water</u>	<u>Solid Hazardous Waste (Liquids and Solids)</u>
Selenium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Silicon ¹	EPA 200.7/6010B/6010C modified	EPA 6010B/6010C modified
Silica as SiO ₂	EPA 200.7/6010B/6010C	EPA 6010B/6010C
Silver	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C
Sodium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Strontium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Thallium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Tin	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C
Titanium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Tungsten	-----	EPA 6020/6020A
Vanadium	EPA 200.7/6010B/6010C	EPA 6010B/6010C
Zinc	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
<u>General Chemistry</u>		
Acidity	SM 2310 B/EPA 305.1	-----
Adsorbable Organic Halogens (AOX)	EPA 1650	-----
Alkalinity	SM 2320B/EPA 310.1	-----
Ammenable Cyanide	EPA 9012A/9012B/EPA 335.1	EPA 9012A/9012B
Ammonia Nitrogen	EPA 350.1	-----
Biochemical oxygen demand	SM 5210 B/EPA 405.1	-----
Bromide	EPA 9056A/EPA 300.0	EPA 9056A ³
Carbonaceous BOD	SM 5210 B	-----
Chemical Oxygen Demand (COD)	EPA 410.4	-----
Chloride	EPA 9056A/EPA 300.0	EPA 9056A ³
Chlorine (residual)	SM 4500Cl-G/EPA 330.5	-----
Chromium VI	EPA 7196A/SM 3500Cr-B	EPA 7196A
Color	SM 2120B/EPA 110.2	-----
Corrosivity toward Steel	-----	EPA 1110/1110A
Cyanide	EPA 9012A/9012B/335.3/335.4	EPA 9012A/9012B
Density	-----	ASTM D 5057
Extractable Organic Halides (EOX)	-----	EPA 9023
Filterable residue	SM 2540C	-----
Fluoride	EPA 9056A/EPA 300.0	EPA 9056A ³
Ignitability	EPA 1010/1020A/1020B	EPA 1010/1020A/1020B
Hardness	SM 2340B/SM 2340C/EPA 130.2	-----
Kjeldahl Nitrogen	EPA 351.2	-----
MBAS/Surfactants	SM 5540C/EPA 425.1	-----
Nitrate (as N)	EPA 9056A/EPA 300.0	EPA 9056A ³
Nitrate-nitrite (as N)	EPA 9056A/EPA 300.0	EPA 9056A ³

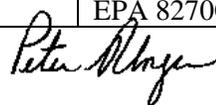
<u>Parameter/Analyte</u>	<u>Nonpotable Water</u>	<u>Solid Hazardous Waste (Liquids and Solids)</u>
Nitrite (as N)	EPA 9056A/EPA 300.0	EPA 9056A ³
Nonfilterable residue	SM 2540D	-----
Oil & Grease	EPA 1664A	EPA 1664A
Organic Nitrogen	TKN – Ammonia EPA 351.2 – EPA 350.1	-----
Orthophosphate (as P)	EPA 9056A/EPA 300.0	EPA 9056A ³
Paint Filter Liquids Test	-----	EPA 9095A/9095B
Perchlorate	EPA 314.0/6850	EPA 6850
pH	SM 4500-H ⁺ B/ EPA 9040B /9040C/9041A/ EPA 150.1	EPA 9040B/9040C/9045C/9045D
Reactive Cyanide	Sec 7.3.3 SW846	Sec 7.3.3 SW846
Reactive Sulfide	Sec 7.3.4 SW846	Sec 7.3.4 SW846
Residue-Volatile	SM 2540E/EPA 160.4	-----
Residue-Settleable	SM 2540F	-----
Specific conductance	EPA 9050A/EPA 120.1	-----
Sulfate	EPA 9056A/EPA 300.0	EPA 9056A ³
Sulfite	SM 4500-SO ₃ B	-----
Sulfide	EPA 9030B/9034	EPA 9030B/9034
Total, fixed, and volatile residue	SM 2540G	-----
Total Nitrate-Nitrite	EPA 353.2	-----
Total Organic Carbon (TOC)	EPA 9060/9060A/ SM 5310D/415.1	EPA 9060/9060A ²
Total Organic Halides (TOX)	EPA 9020B	EPA 9020B ²
Total Petroleum Hydrocarbons	EPA 1664A	EPA 1664A
Total Phenolics	EPA 9066/EPA 420.4	-----
Total Phosphorous	EPA 365.4	-----
Total residue	SM 2540B	-----
Turbidity	EPA 180.1/SM 2130	EPA 180.1/SM 2130
<u>Organic Analytes</u>		
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504.1/8011/8260B	EPA 8260B
1,2 Dibromoethane (EDB)	EPA 504.1/8011/8260B	EPA 8260B
<u>Purgeable Organics (Volatiles)</u>		
Acetone	EPA 624/8260B	EPA 8260B
Acetonitrile	EPA 624/8260B	EPA 8260B
Acrolein (Propenal)	EPA 624/8260B	EPA 8260B
Acrylonitrile	EPA 624/8260B	EPA 8260B
Allyl Chloride	EPA 624/8260B	EPA 8260B
Benzene	EPA 624/8260B	EPA 8260B
Benzyl chloride	EPA 624/8260B	EPA 8260B
Bromobenzene	EPA 624/8260B	EPA 8260B
Bromochloromethane	EPA 624/8260B	EPA 8260B
Bromodichloromethane	EPA 624/8260B	EPA 8260B
Bromoform	EPA 624/8260B	EPA 8260B
Bromomethane	EPA 624/8260B	EPA 8260B
2-Butanone (Methyl Ethyl Ketone)	EPA 8015B/8015C/624/8260B	EPA 8260B

<u>Parameter/Analyte</u>	<u>Nonpotable Water</u>	<u>Solid Hazardous Waste (Liquids and Solids)</u>
n-Butyl alcohol	EPA 8015B/8015C/624/8260B	EPA 8260B
n-Butylbenzene	EPA 624/8260B	EPA 8260B
Sec-Butylbenzene	EPA 624/8260B	EPA 8260B
Tert-Butylbenzene	EPA 624/8260B	EPA 8260B
Carbon disulfide	EPA 624/8260B	EPA 8260B
Carbon tetrachloride	EPA 624/8260B	EPA 8260B
Chlorobenzene	EPA 624/8260B	EPA 8260B
Chloroethane	EPA 624/8260B	EPA 8260B
2-Chloroethyl vinyl ether	EPA 624/8260B	EPA 8260B
Chloroform	EPA 624/8260B	EPA 8260B
Chloromethane	EPA 624/8260B	EPA 8260B
Chloroprene	EPA 624/8260B	EPA 8260B
2-Chlorotoluene	EPA 624/8260B	EPA 8260B
4-Chlorotoluene	EPA 624/8260B	EPA 8260B
Dibromochloromethane	EPA 624/8260B	EPA 8260B
Dibromomethane	EPA 624/8260B	EPA 8260B
1,2-Dichlorobenzene	EPA 624/8260/625/8270C/8270D	EPA 8260/8270C/8270D
1,3-Dichlorobenzene	EPA 624/8260/625/8270C/8270D	EPA 8260/8270C/8270D
1,4-Dichlorobenzene	EPA 624/8260/625/8270C/8270D	EPA 8260/8270C/8270D
Dichlorodifluoromethane	EPA 624/8260B	EPA 8260B
1,1-Dichloroethane	EPA 624/8260B	EPA 8260B
1,2-Dichloroethane	EPA 624/8260B	EPA 8260B
1,1-Dichloroethene	EPA 624/8260B	EPA 8260B
cis-1,2-Dichloroethene	EPA 624/8260B	EPA 8260B
trans-1,2-Dichloroethene	EPA 624/8260B	EPA 8260B
1,2-Dichloropropane	EPA 624/8260B	EPA 8260B
1,3-Dichloropropane	EPA 624/8260B	EPA 8260B
2,2-Dichloropropane	EPA 624/8260B	EPA 8260B
1,1-Dichloropropene	EPA 624/8260B	EPA 8260B
cis-1,3-Dichloropropene	EPA 624/8260B	EPA 8260B
trans-1,3-Dichloropropene	EPA 624/8260B	EPA 8260B
cis-1,4-Dichloro-2-butene	EPA 624/8260B	EPA 8260B
trans-1,4-Dichloro-2-butene	EPA 624/8260B	EPA 8260B
Diethyl ether	EPA 624/8260B	EPA 8260B
1,4-Dioxane	EPA 624/8260B	EPA 8260B
Ethyl Acetate	EPA 8015B/8015C/624/8260B	EPA 8015B/8015C/8260B
Ethyl Benzene	EPA 624/8260B	EPA 8260B
Ethyl methacrylate	EPA 624/8260B	EPA 8260B
2-Hexanone	EPA 624/8260B	EPA 8260B
Hexachlorobutadiene	EPA 624/8260/625/8270C/8270D	EPA 8260/8270C/8270D
Isopropylbenzene	EPA 624/8260B	EPA 8260B
4-Isopropyltoluene	EPA 624/8260B	EPA 8260B
Iodomethane	EPA 624/8260B	EPA 8260B
Isobutyl Alcohol	EPA 8015B/8015C/624/8260B	EPA 8260B
Methacrylonitrile	EPA 624/8260B	EPA 8260B
Methylene chloride	EPA 624/8260B	EPA 8260B
Methyl methacrylate	EPA 624/8260B	EPA 8260B
4-Methyl-2-pentanone	EPA 624/8260B	EPA 8260B
Methyl tert butyl ether (MTBE)	EPA 624/8260B	EPA 8260B
Naphthalene	EPA 624/8260B/625/8270C/8270D/8310	EPA 8260B/8270C/8270D/8310

<u>Parameter/Analyte</u>	<u>Nonpotable Water</u>	<u>Solid Hazardous Waste (Liquids and Solids)</u>
2-Nitropropane	EPA 624/8260B	EPA 8260B
n-Propylbenzene	EPA 624/8260B	EPA 8260B
Pentachloroethane	EPA 624/8260B	EPA 8260B
Propionitrile	EPA 624/8260B	EPA 8260B
Styrene	EPA 624/8260B	EPA 8260B
1,1,1,2-Tetrachloroethane	EPA 624/8260B	EPA 8260B
1,1,2,2-Tetrachloroethane	EPA 624/8260B	EPA 8260B
Tetrachloroethene	EPA 624/8260B	EPA 8260B
Toluene	EPA 624/8260B	EPA 8260B
1,1,1-Trichloroethane	EPA 624/8260B	EPA 8260B
1,1,2-Trichloroethane	EPA 624/8260B	EPA 8260B
Trichloroethene	EPA 624/8260B	EPA 8260B
Trichlorofluoromethane	EPA 624/8260B	EPA 8260B
1,2,3-Trichlorobenzene	EPA 624/8260B	EPA 8260B
1,2,3-Trichloropropane	EPA 624/8260B	EPA 8260B
1,2,4-Trichlorobenzene	EPA 624/8260B/625/8270C/8270D	EPA 8260B/8270C/8270D
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 624/8260B	-----
1,2,4-Trimethylbenzene	EPA 624/8260B	EPA 8260B
1,3,5-Trimethylbenzene	EPA 624/8260B	EPA 8260B
Trihalomethanes	EPA 624/8260B	EPA 8260B
Vinyl acetate	EPA 624/8260B	EPA 8260B
Vinyl chloride	EPA 624/8260B	EPA 8260B
Xylenes, total	EPA 624/8260B	EPA 8260B
o-Xylene	EPA 624/8260B	EPA 8260B
m+p-Xylene	EPA 624/8260B	EPA 8260B
<u>Semivolatile Compounds</u>		
Acenaphthene	EPA 625/8270C/8270D/8310	EPA 8270C/8270D/8310
Acenaphthylene	EPA 625/8270C/8270D/8310	EPA 8270C/8270D/8310
Acetophenone	EPA 625/8270C/8270D	EPA 8270C/8270D
2-Acetylaminofluorene	EPA 625/8270C/8270D	EPA 8270C/8270D
4-Aminobiphenyl	EPA 625/8270C/8270D	EPA 8270C/8270D
Aniline	EPA 625/8270C/8270D	EPA 8270C/8270D
Anthracene	EPA 625/8270C/8270D/8310	EPA 8270C/8270D/8310
Aramite	EPA 625/8270C/8270D	EPA 8270C/8270D
Atrazine	EPA 625/8270C/8270D	EPA 8270C/8270D
Benzidine	EPA 625/8270C/8270D	EPA 8270C/8270D
Benzoic acid	EPA 625/8270C/8270D	EPA 8270C/8270D
Benzo (a) anthracene	EPA 625/8270C/8270D/8310	EPA 8270C/8270D/8310
Benzo (b) fluoranthene	EPA 625/8270C/8270D/8310	EPA 8270C/8270D/8310
Benzo (k) fluoranthene	EPA 625/8270C/8270D/8310	EPA 8270C/8270D/8310
Benzo (ghi) perylene	EPA 625/8270C/8270D/8310	EPA 8270C/8270D/8310
Benzo (a) pyrene	EPA 625/8270C/8270D/8310	EPA 8270C/8270D/8310
p-Benzoquinone	EPA 625/8270C/8270D	EPA 8270C/8270D
Benzyl alcohol	EPA 625/8270C/8270D	EPA 8270C/8270D
Bis (2-chloroethoxy) methane	EPA 625/8270C/8270D	EPA 8270C/8270D
Bis (2-chloroethyl) ether	EPA 625/8270C/8270D	EPA 8270C/8270D
Bis (2-chloroisopropyl) ether	EPA 625/8270C/8270D	EPA 8270C/8270D
Bis (2-ethylhexyl) phthalate	EPA 625/8270C/8270D	EPA 8270C/8270D
4-Bromophenyl phenyl ether	EPA 625/8270C/8270D	EPA 8270C/8270D

<u>Parameter/Analyte</u>	<u>Nonpotable Water</u>	<u>Solid Hazardous Waste (Liquids and Solids)</u>
Butyl benzyl phthalate	EPA 625/8270C/8270D	EPA 8270C/8270D
Carbazole	EPA 625/8270C/8270D	EPA 8270C/8270D
4-Chloroaniline	EPA 625/8270C/8270D	EPA 8270C/8270D
Chlorobenzilate	EPA 625/8270C/8270D	EPA 8270C/8270D
4-Chloro-3-methylphenol	EPA 625/8270C/8270D	EPA 8270C/8270D
2-Chloronaphthalene	EPA 625/8270C/8270D	EPA 8270C/8270D
2-Chlorophenol	EPA 625/8270C/8270D	EPA 8270C/8270D
4-Chlorophenyl phenyl ether	EPA 625/8270C/8270D	EPA 8270C/8270D
Chrysene	EPA 625/8270C/8270D/8310	EPA 8270C/8270D/8310
n-Decane	EPA 625/8270C/8270D	-----
Diallate	EPA 625/8270C/8270D	EPA 8270C/8270D
Dibenzo (a,h) anthracene	EPA 625/8270C/8270D/8310	EPA 8270C/8270D/8310
Dibenzofuran	EPA 625/8270C/8270D	EPA 8270C/8270D
Dibenzo (a,e) pyrene	EPA 625/8270C/8270D	EPA 8270C/8270D
1,2-Dichlorobenzene	EPA 624/8260B/625/8270C/8270D	EPA 8260B/8270C/8270D
1,3-Dichlorobenzene	EPA 624/8260B/625/8270C/8270D	EPA 8260B/8270C/8270D
1,4-Dichlorobenzene	EPA 624/8260B/625/8270C/8270D	EPA 8260B/8270C/8270D
3,3'-Dichlorobenzidine	EPA 625/8270C/8270D	EPA 8270C/8270D
2,4-Dichlorophenol	EPA 625/8270C/8270D	EPA 8270C/8270D
2,6-Dichlorophenol	EPA 625/8270C/8270D	EPA 8270C/8270D
3,3'-Dimethylbenzidine	EPA 625/8270C/8270D	EPA 8270C/8270D
Diethyl phthalate	EPA 625/8270C/8270D	EPA 8270C/8270D
Dimethoate	EPA 625/8270C/8270D	EPA 8270C/8270D
1,3-Dinitrobenzene	EPA 625/8270C/8270D/8330A/8330B	EPA 8270C/8270D/8330A/8330B
1,4-Dinitrobenzene	EPA 625/8270C/8270D	EPA 8270C/8270D
Disulfoton	EPA 625/8270C/8270D	EPA 8270C/8270D
p-Dimethylaminoazobenzene	EPA 625/8270C/8270D	EPA 8270C/8270D
7,12-Dimethylbenz(a)anthracene	EPA 625/8270C/8270D	EPA 8270C/8270D
Alpha-,alpha-Dimethylphenethylamine	EPA 625/8270C/8270D	EPA 8270C/8270D
2,4-Dimethylphenol	EPA 625/8270C/8270D	EPA 8270C/8270D
Dimethyl phthalate	EPA 625/8270C/8270D	EPA 8270C/8270D
Di-n-butyl phthalate	EPA 625/8270C/8270D	EPA 8270C/8270D
Di-n-octyl phthalate	EPA 625/8270C/8270D	EPA 8270C/8270D
2,4-Dinitrophenol	EPA 625/8270C/8270D	EPA 8270C/8270D
2,4-Dinitrotoluene	EPA 625/8270/8330A/8330B	EPA 8270/8330A/8330B
2,6-Dinitrotoluene	EPA 625/8270/8330A/8330B	EPA 8270/8330A/8330B
Diphenylamine	EPA 625/8270C/8270D	EPA 8270C/8270D
1,2-Diphenylhydrazine	EPA 625/8270C/8270D	EPA 8270C/8270D
Ethyl methanesulfonate	EPA 625/8270C/8270D	EPA 8270C/8270D
Famphur	EPA 625/8270C/8270D	EPA 8270C/8270D
Fluoroanthene	EPA 625/8270C/8270D/8310	EPA 8270C/8270D/8310
Fluorene	EPA 625/8270C/8270D/8310	EPA 8270C/8270D/8310
Hexachlorobenzene	EPA 625/8270C/8270D	EPA 8270C/8270D
Hexachlorobutadiene	EPA 624/8260B/625/8270C/8270D	EPA 8260B/8270C/8270D
Hexachlorophene	EPA 625/8270C/8270D	EPA 8270C/8270D
Hexachloropropene	EPA 625/8270C/8270D	EPA 8270C/8270D
Hexachlorocyclopentadiene	EPA 625/8270C/8270D	EPA 8270C/8270D
Hexachloroethane	EPA 625/8270C/8270D	EPA 8270C/8270D
Indeno (1,2,3-cd) pyrene	EPA 625/8270C/8270D/8310	EPA 8270C/8270D/8310

<u>Parameter/Analyte</u>	<u>Nonpotable Water</u>	<u>Solid Hazardous Waste (Liquids and Solids)</u>
Isodrin	EPA 625/8270C/8270D	EPA 8270C/8270D
Isophorone	EPA 625/8270C/8270D	EPA 8270C/8270D
Isosafrole	EPA 625/8270C/8270D	EPA 8270C/8270D
Kepon	EPA 625/8270C/8270D	EPA 8270C/8270D
Methapyrilene	EPA 625/8270C/8270D	EPA 8270C/8270D
3-Methylcholanthrene	EPA 625/8270C/8270D	EPA 8270C/8270D
2-Methyl-4,6-Dinitrophenol	EPA 625/8270C/8270D	EPA 8270C/8270D
Methyl methanesulfonate	EPA 625/8270C/8270D	EPA 8270C/8270D
1-Methylnaphthalene	EPA 625/8270C/8270D	EPA 8270C/8270D
2-Methylnaphthalene	EPA 625/8270C/8270D	EPA 8270C/8270D
Methyl Parathion	EPA 625/8270C/8270D	EPA 8270C/8270D
2-Methylphenol (o-cresol)	EPA 625/8270C/8270D	EPA 8270C/8270D
3/4-Methylphenols(m/p cresols)	EPA 625/8270C/8270D	EPA 8270C/8270D
Naphthalene	EPA 624/8260B/625/8270C/8270D/8310	EPA8260B/8270C/8270D/8310
1,4-Naphthoquinone	EPA 625/8270C/8270D	-----
1-Naphthylamine	EPA 625/8270C/8270D	EPA 8270C/8270D
2-Naphthylamine	EPA 625/8270C/8270D	EPA 8270C/8270D
2-Nitroaniline	EPA 625/8270C/8270D	EPA 8270C/8270D
3-Nitroaniline	EPA 625/8270C/8270D	EPA 8270C/8270D
4-Nitroaniline	EPA 625/8270C/8270D	EPA 8270C/8270D
Nitrobenzene	EPA 625/8270C/8270D/8330A/8330B	EPA 8270C/8270D/8330A/8330B
5-Nitro-o-toluidine	EPA 625/8270C/8270D	EPA 8270C/8270D
2-Nitrophenol	EPA 625/8270C/8270D	EPA 8270C/8270D
4-Nitrophenol	EPA 625/8270C/8270D	EPA 8270C/8270D
Nitroquinoline-1-oxide	EPA 625/8270C/8270D	EPA 8270C/8270D
N-Nitrosodiethylamine	EPA 625/8270C/8270D	EPA 8270C/8270D
N-Nitrosodimethylamine	EPA 625/8270C/8270D	EPA 8270C/8270D
N-Nitrosodi-n-butylamine	EPA 625/8270C/8270D	EPA 8270C/8270D
N-Nitrosodi-n-propylamine	EPA 625/8270C/8270D	EPA 8270C/8270D
N-Nitrosodiphenylamine	EPA 625/8270C/8270D	EPA 8270C/8270D
N-Nitrosodimethylethylamine	EPA 625/8270C/8270D	EPA 8270C/8270D
N-Nitrosomorpholine	EPA 625/8270C/8270D	EPA 8270C/8270D
N-Nitrosopiperidine	EPA 625/8270C/8270D	EPA 8270C/8270D
N-Nitrosopyrrolidine	EPA 625/8270C/8270D	EPA 8270C/8270D
n-Octadecane	-----	EPA 8270C/8270D
o,o,o-Triethyl phosphorothioate	EPA 625/8270C/8270D	EPA 8270C/8270D
o-Toluidine	EPA 625/8270C/8270D	EPA 8270C/8270D
Parathion, ethyl	EPA 625/8270C/8270D	EPA 8270C/8270D
Pentachlorobenzene	EPA 625/8270C/8270D	EPA 8270C/8270D
Pentachloronitrobenzene	EPA 625/8270C/8270D	EPA 8270C/8270D
Pentachlorophenol	EPA 8270C/8270D/8151A	EPA 8270C/8270D/8151A
Phenacetin	EPA 625/8270C/8270D	EPA 8270C/8270D
Phenanthrene	EPA 625/8270C/8270D/8310	EPA 8270C/8270D/8310
Phenol	EPA 625/8270C/8270D	EPA 8270C/8270D
1,4-Phenylenediamine	EPA 625/8270C/8270D	-----
Phorate	EPA 625/8270C/8270D	EPA 8270C/8270D
2-Picoline (2-Methylpyridine)	EPA 625/8270C/8270D	EPA 8270C/8270D
Pronamide (Kerb)	EPA 625/8270C/8270D	EPA 8270C/8270D
Pyrene	EPA 625/8270C/8270D/8310	EPA 8270C/8270D/8310
Pyridine	EPA 625/8270C/8270D	EPA 8270C/8270D
Safrole	EPA 625/8270C/8270D	EPA 8270C/8270D



<u>Parameter/Analyte</u>	<u>Nonpotable Water</u>	<u>Solid Hazardous Waste (Liquids and Solids)</u>
Sulfotepp	EPA 625/8270C/8270D	EPA 8270C/8270D
1,2,4,5-Tetrachlorobenzene	EPA 625/8270C/8270D	EPA 8270C/8270D
2,3,4,6-Tetrachlorophenol	EPA 625/8270C/8270D	EPA 8270C/8270D
Thionazin (Zinophos)	EPA 625/8270C/8270D	EPA 8270C/8270D
1,2,4-Trichlorobenzene	EPA 624/8260B/625/8270C/8270D	EPA 8260B/8270C/8270D
2,4,5-Trichlorophenol	EPA 625/8270C/8270D	EPA 8270C/8270D
2,4,6-Trichlorophenol	EPA 625/8270C/8270D	EPA 8270C/8270D
1,3,5-Trinitrobenzene	EPA 625/8270C/8270D/8330A/8330B	EPA 8270C/8270D/8330A/8330B
<u>Pesticides & PCBs</u>		
Aldrin	EPA 608/8081A/8081B	EPA 8081A/8081B
alpha-BHC	EPA 608/8081A/8081B	EPA 8081A/8081B
alpha-Chlordane	EPA 608/8081A/8081B	EPA 8081A/8081B
beta-BHC	EPA 608/8081A/8081B	EPA 8081A/8081B
Chlordane (technical)	EPA 608/8081A/8081B	EPA 8081A/8081B
delta-BHC	EPA 608/8081A/8081B	EPA 8081A/8081B
gamma-BHC	EPA 608/8081A/8081B	EPA 8081A/8081B
gamma-Chlordane	EPA 608/8081A/8081B	EPA 8081A/8081B
4,4'-DDD	EPA 608/8081A/8081B	EPA 8081A/8081B
4,4'-DDE	EPA 608/8081A/8081B	EPA 8081A/8081B
4,4'-DDT	EPA 608/8081A/8081B	EPA 8081A/8081B
Dieldrin	EPA 608/8081A/8081B	EPA 8081A/8081B
Endosulfan I	EPA 608/8081A/8081B	EPA 8081A/8081B
Endosulfan II	EPA 608/8081A/8081B	EPA 8081A/8081B
Endosulfan sulfate	EPA 608/8081A/8081B	EPA 8081A/8081B
Endrin	EPA 608/8081A/8081B	EPA 8081A/8081B
Endrin aldehyde	EPA 608/8081A/8081B	EPA 8081A/8081B
Endrin ketone	EPA 608/8081A/8081B	EPA 8081A/8081B
Heptachlor	EPA 608/8081A/8081B	EPA 8081A/8081B
Heptachlor epoxide	EPA 608/8081A/8081B	EPA 8081A/8081B
Methoxychlor	EPA 608/8081A/8081B	EPA 8081A/8081B
Toxaphene	EPA 608/8081A/8081B	EPA 8081A/8081B
PCB-1016 (Aroclor)	EPA 608/8082/8082A	EPA 8082/8082A
PCB-1221	EPA 608/8082/8082A	EPA 8082/8082A
PCB-1232	EPA 608/8082/8082A	EPA 8082/8082A
PCB-1242	EPA 608/8082/8082A	EPA 8082/8082A
PCB-1248	EPA 608/8082/8082A	EPA 8082/8082A
PCB-1254	EPA 608/8082/8082A	EPA 8082/8082A
PCB-1260	EPA 608/8082/8082A	EPA 8082/8082A
PCB-1262	EPA 608/8082/8082A	EPA 8082/8082A
PCB-1268	EPA 608/8082/8082A	EPA 8082/8082A
Total Aroclors	EPA 608/8082/8082A	EPA 8082/8082A
<u>FID Compounds</u>		
Ethyl acetate	EPA 8015B/8015C/624/8260B	EPA 8015B/8015C/8260B
Ethylene Glycol	EPA 8015B/8015C	EPA 8015B/8015C
Isobutyl Alcohol	EPA 8015B/8015C/624/8260B	EPA 8260B
Isopropyl Alcohol (2-Propanol)	EPA 8015B/8015C	-----
Methanol	EPA 8015B/8015C	EPA 8015B/8015C
Diesel Range Organics (DRO)	EPA 8015B/8015C/CA-LUFT/ CT-ETPH	EPA 8015B/8015C/CA-LUFT/ CT-ETPH

<u>Parameter/Analyte</u>	<u>Nonpotable Water</u>	<u>Solid Hazardous Waste (Liquids and Solids)</u>
Gas Range Organics (GRO)	EPA 8015B/8015C/CA-LUFT	EPA 8015B/8015C/CA-LUFT
<u>Herbicides</u>		
2,4-D	EPA 8151A	EPA 8151A
2,4-DB	EPA 8151A	EPA 8151A
Dalapon	EPA 8151A	EPA 8151A
Dicamba	EPA 8151A	EPA 8151A
Dichloroprop	EPA 8151A	EPA 8151A
Dinoseb	EPA 8151A	EPA 8151A
MCPA	EPA 8151A	EPA 8151A
MCPP	EPA 8151A	EPA 8151A
2,4,5-T	EPA 8151A	EPA 8151A
2,4,5-TP (Silvex)	EPA 8151A	EPA 8151A
Pentachlorophenol	EPA 8151A	EPA 8151A
<u>Nitrosamines, Nitroaromatics</u>		
1,3-Dinitrobenzene	EPA 625/8270C/8270D/8330A/8330B	EPA 8270C/8270D/8330A/8330B
2,4-Dinitrotoluene	EPA 625/8270C/8270D/8330A/8330B	EPA 8270C/8270D/8330A/8330B
2,6-Dinitrotoluene	EPA 625/8270C/8270D/8330A/8330B	EPA 8270C/8270D/8330A/8330B
2,4,6-Trinitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B
2-Amino-4,6-Dinitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B
2-Nitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B
3-Nitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B
3,5-Dinitroaniline		EPA 8330B (Solids Only)
4-Amino-2,6-Dinitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B
4-Nitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B
Nitrobenzene	EPA 625/8270C/8270D/8330A/8330B	EPA 8270C/8270D/8330A/8330B
Nitroglycerine	EPA 8330A/8330B	EPA 8330A/8330B
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330A/8330B	EPA 8330A/8330B
Pentaerythritoltetranitrate (PETN)	EPA 8330A/8330B	EPA 8330A/8330B
hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	EPA 8330A/8330B	EPA 8330A/8330B
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	EPA 8330A/8330B	EPA 8330/8330B
<u>Radiochemistry</u>		
Barium 133	DOE 4.5.2.3	DOE 4.5.2.3
Cesium 134	DOE 4.5.2.3/EPA 901.1	DOE 4.5.2.3
Cesium 137	DOE 4.5.2.3/EPA 901.1	DOE 4.5.2.3
Cobalt-60	DOE 4.5.2.3/EPA 901.1	DOE 4.5.2.3
Gamma Emitters	DOE 4.5.2.3/EPA 901.1	DOE 4.5.2.3
Gross Alpha	EPA 900.0/9310	EPA 9310
Gross Beta	EPA 900.0/9310	EPA 9310
Radioactive Iodine	DOE 4.5.2.3/EPA 901.1/902.0	DOE 4.5.2.3
Radium-226	EPA 903.1/DOE Ra-04	DOE Ra-04
Radium-228	EPA 904.0/9320/DOE 4.5.2.3	DOE 4.5.2.3/EPA9320
Total Radium	EPA 9315	EPA 9315
Radon	SM7500 Rn-B	-----
Strontium-89	EPA 905.0	DOE Sr-01
Strontium-90	EPA 905.0/DOE Sr-02	DOE Sr-02

<u>Parameter/Analyte</u>	<u>Nonpotable Water</u>	<u>Solid Hazardous Waste (Liquids and Solids)</u>
Thorium	EMSL-LV	EMSL-LV
Tritium	EPA 906.0	-----
Uranium	ASTM D5174-02/D5174-97/DOE U-02/EPA 6020/6020A	DOE U-02/EPA 6020/6020A
Zinc-65	EPA 901.1/DOE 4.5.2.3	DOE 4.5.2.3
<u>Preparatory and Clean-up Methods</u>		
Toxicity Characteristic Leaching Procedure (Inorganics, Extractable Organics, Volatile Organics)	-----	EPA 1311
Synthetic Precipitation Leaching Procedure	-----	EPA 1312
Waste Extraction Test (W.E.T.)	-----	CCR Chapter 11, Article 5, Appendix II
Anion Preparation	-----	EPA 9056A ³
Cyanide Distillation	EPA 9010B/9010C	EPA 9010B/9010C ³
Sulfide Distillation	EPA 9030B	EPA 9030B
Metals Digestion	EPA 200.2, 3005A, 3010A	EPA 3050B
Alkaline Digestion for Hexavalent Chromium	-----	EPA 3060A
Bomb Preparation for Solid Waste	-----	EPA 5050
Mercury Preparation	EPA 245.1/245.2/7470/7470A	EPA 7471A/7471B
Separatory Funnel Liquid-Liquid Extraction	EPA 3510C	-----
Continuous Liquid-Liquid Extraction	EPA 3520C	-----
Solid Phase Extraction	EPA 3535A	-----
Automated Soxhlet Extraction	-----	EPA 3541
Ultrasonic Extraction	-----	EPA 3550C
Waste Dilution	-----	EPA 3580A
Waste Dilution for Volatile Organics	-----	EPA 3585
Purge and Trap for Volatile Organics	EPA 5030A/5030B/5030C	EPA 5035/5035A
Alumina Clean-up	-----	EPA 3610B/3611B
Florisil Clean-up	-----	EPA 3620B/3620C
Silica Gel Clean-up	-----	EPA 3630C
Gel Permeation Clean-up	-----	EPA 3640A
Sulfur Clean-up	-----	EPA 3660B
Sulfuric Acid/Permanganate Clean-up	-----	EPA 3665A

Additionally, in recognition of the successful completion of the A2LA evaluation process (including an assessment of the laboratory's compliance with the 2003 NELAC Chapter 5 Requirements), accreditation is granted to this laboratory to perform the following bioassay analyses on bone, tissue, urine, fecal, and nasal swabs.

	<u>Preparation SOP</u>	<u>Analytical SOP</u>
--	------------------------	-----------------------

Peter Abney

<u>Bioassay Analysis</u>		
<u>Alpha Spectrometry:</u> Alpha: Am-241, Cm-242, Cm-243/244, Cm 245/246, Cf-252, Np-237, Po-208, Po- 209, Po-210, Pu-236, Pu-238, Pu-239/240, Pu-242, Pu-244, Th-228, Th-229, Th-230, Th-232, U-232, U-233/234, U-235/236, U-238	GL-RAD-B-001, GL-RAD-B-002, GL-RAD-B-003, GL-RAD-B-010, GL-RAD-B-012, GL-RAD-B-013, GL-RAD-B-017	GL-RAD-B-009
<u>Liquid Scintillation Spectrometry:</u> C-14, Gross Alpha, H-3, Ni-63, Pu-241, Tc-99	GL-RAD-B-001, GL-RAD-B-008, GL-RAD-B-011, GL-RAD-B-012, GL-RAD-B-013, GL-RAD-B-016, GL-RAD-B-020, GL-RAD-B-023	GL-RAD-I-004, GL-RAD-I-014, GL-RAD-I-017
<u>Gas Flow Proportional Counting:</u> Beta: Sr-90	GL-RAD-B-001	GL-RAD-I-006, GL-RAD-I-015, GL-RAD-I-016
Gross Alpha/Gross Beta	GL-RAD-B-022	GL-RAD-I-006
<u>Kinetic Phosphorescence Analyzer</u> Total Uranium	GL-RAD-B-019	GL-RAD-B-018
<u>Radon Emanation:</u> Ra-226	GL-RAD-B-002	GL-RAD-I-007
<u>Refractometer</u> Specific Gravity	GL-RAD-B-027	GL-RAD-B-027
<u>ICP-MS</u> Uranium Isotopes	GL-RAD-B-035	GL-RAD-B-027
<u>Gamma Spectrometry:</u> Gamma: Ni-59, 46 to 1836 keV	GL-RAD-B-020, GL-RAD-A-013	GL-RAD-I-001

Finally, accreditation is also granted to this laboratory to perform the following tests on children's toys:

<u>Chemical</u>	
Lead in Paint by ICP	16 CFR part 1303 (using GL-MA-E-009 and GL-MA-E-013)

¹ - Calculated from silica determination



² – Applicable only to liquid ‘Solid Hazardous Waste’, where liquids may include aqueous, non-aqueous, and oily wastes. Solids may include soils, sediments, sludges, tissues, filters and any matrix deemed non-liquid.

³ – The referenced method is modified to include a simple prep for non-aqueous and/or solid matrix samples.

Appendix D
Data Management Process

DRAFT

**DATA MANAGEMENT PROCESS OVERVIEW
FOR THE
NAVY CLEAN PROGRAM**

Prepared 5 May 2006

Prepared by



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1.0 Introduction

This Data Management Process Overview summarizes CH2M HILL's data management protocol in support of the Navy Clean Program.

The Overview is broadly applicable to the management and dissemination of data generated during environmental investigations. It is intended to be a living document and will be amended or revised to accommodate changes in the scope of environmental investigation or data management requirements.

During field investigations for the Navy Clean Program, CH2M HILL will collect a variety of environmental information that will support data analysis, reporting, and presentation. To ensure quality assurance/quality control (QA/QC) and meet current regulatory requirements, a complete audit trail of the information flow must be established. Each step in the data management process (data collection, storage, and analysis) must be adequately planned, executed, and documented. This Overview will describe in detail the specific processes that will be used by the Data Management team to capture, perform QA/QC reviews, manage/track and report the data associated with the Navy Clean Program.

This DMP is composed of 8 sections. Section 1 of this document introduces the Data Management Process. Section 2 discusses the organization of the CH2M HILL EIMS team. Section 3 discusses the data management role in Project Planning and Setup. Section 4 describes the data management role in Sample Collection and Management. Section 5 discusses the data management activities involved in Lab Analysis. Section 6 describes the data management role in Data Validation. Section 7 discusses the activities involved in Data Management. Section 8 describes Data Evaluation and Reporting procedures. Appendix A presents tables summarizing and assessing current data management materials.

2.0 Data Management Team Organization

The CH2M HILL data management team will work together to properly execute the data management process. The team model presented here is based on a Project Manager supported directly by key technology staff. The functional responsibilities of the team are described below. The responsibilities are identified by titles but not necessarily individual staff positions. The workflow among the members of the data management team is shown in Figure 1.

The Activity Manager (AM) and the Project Manager (PM) are responsible for preparing the work plan, schedule, milestones, and coordinating efforts with the client. The AM/PM may or may not have adequate skills to guide the data management driven aspects of their project. While the AM/PM must be willing to accept guidance from the technology leaders, they do not need to possess the technology skills as a background. The PM also responsible for ensuring

data quality and is brought into the team to perform data QA/QC at various times during the data management process.

The Environmental Information Specialist (EIS) assigned to the project team is responsible for the coordination of new or existing data generated by field activities or provided by laboratory analyses. The EIS oversees contracted analytical and data validation services, ensures that analytical data are complete and consistent, enters field data results into the **Field Data Entry Tool (FDETool)**, and assists the Database Specialist in resolving any data ambiguities. The EIS will conduct verification activities following receipt of electronic data and participate in QA/QC activities to resolve inconsistencies as necessary. The EIS acts as a liaison between the Database Specialist, the PM, and the Project Chemist.

Database Specialists load data into the Environmental database. This includes analytical results from laboratory electronic data deliverables and field data results that have been entered by the EIS into the **FDETool**. The Database Specialists work with the EIS, Program Database Coordinator, and Program Data Management Coordinator to ensure that the data are loaded successfully and following established program standards and procedures.

The Field Team Leaders (FTLs) help prepare the work plan and implement the plan in the field. FTLs assign staff members to sampling teams; assign responsibilities to team members; prepare for and coordinate sampling activities; oversee the collection, recording, and documentation of the field data; and ensure that the chain-of-custody form is completed correctly.

The Project Chemist prepares the laboratory and data validation subcontracts, ensures that the electronic data deliverable was provided in accordance with the contract, assists the EIS in communicating with laboratories and data validators as needed, assists the EIS in interpreting analytical results, assists in designating CAS Numbers to new analytes, and maintains the regulatory criteria in the database.

A Program Database Coordinator (DBC) has overall responsibility for the design, operation, and maintenance of the Environmental Database. The DBC is responsible for the implementation, and evaluation of standard operating procedures to ensure integrity of the enterprise-wide database system. The DBC works directly with the Database Specialist to coordinate the different activity data and to enhance the database tools, and structure as required to increase performance and efficiency for the entire program

The Program Data Management Coordinator (DMC) is responsible for the CH2M HILL data management process at all Navy bases. The DMC manages and tracks data management personnel schedules and deliverables for the Navy program; interacts with the EIS on all aspects of data management activities; provides guidance and coordination to the EIS during resolution of data inconsistencies; coordinates completion of data queries for reports; coordinates database modification efforts with the DBC; is responsible for designing, developing, and implementing standard data entry and data retrieval tools; and leads the data management continuous process improvement investigation.

The IS Operations Lead monitors workload across all IS activities (GIS, Web, and Database) for resource and schedule conflicts, and works with IS resources to make recommendations for process change and improvement.

The **IS Program Lead** serves as the primary point of contact for the Navy regarding IS issues, coordinates resource requirements with regional the IS Staffing Lead, and provides direction and management to the DBC, DMC, and IS Operations Lead.

3.0 Project Planning & Setup

3.1 Attend the Kick-Off Meeting

Review the **Project Instructions**, assign sample nomenclature, go over the EIS level of effort needed and budget with the PM. Complete the **EIS Questions to Ask at Start of Project Form** and **EIS DM Budget Tracking Form**. Enter project information into the **Projects Currently in DM Tracking Table** at the link

\\orion\proj\CLEANII\DATAMGMT\EIS\Projects_Currently_in_DM.xls. This tracking table should be updated/verified daily throughout the data management process.

3.2 Aid in Lab and Data Validator Acquisition

As requested, assist with the creation of the Lab Engineers Estimate, Lab Bidsheet, Lab RFP, Lab Statement of Work (SOW), and the Data Validation Engineers Estimate, Data Validation Bidsheet, Data Validation RFP, and Data Validation SOW based on the **BOA Rates Spreadsheet** and **Established Document Templates**. Submit these documents to the site Project Chemist for review and approval before they are submitted to Contracts.

3.3 Aid in Field Preparation

Inform the lab of sampling schedule. Coordinate with the lab how and when samples will be delivered to the lab (pick up, overnight, drop off). Ensure that the lab is aware of the required turn around times. If requested, order bottle ware and create sample labels. If requested, once the bottles have arrived, review the order to ensure the proper amount and type of equipment has arrived.

Tools Involved in Project Planning and Setup
BOA Rates Spreadsheet
EIS Questions to Ask at Start of Project Form
EIS DM Budget Tracking Form
Established Document Templates
Project Instructions
Projects Currently in DM Tracking Table

4.0 Sample Collection & Management

4.1 Communication with Field Staff and Lab

Communicate with field staff daily during the field event. Help resolve issues that arise in the field (bottle ware shortage, equipment failure, etc). Inform the lab of the shipment dates and the number of coolers or samples being sent. Ensure samples were received in good condition (no breakage, within holding time, within designated temperature). Notify field crew and PM if there were problems with shipment.

4.2 Sample and Documentation Tracking

Create a **Sample Tracking Sheet** and update it as samples are collected using Project Instruction Tables, Chains of Custody (COC), and Lab Login Reports. The **Sample Tracking Sheet** should be updated and kept current throughout the data management process. Perform a 100% Quality Check (QC) on COCs received from the field crew. Inform field crew and/or lab if corrections need to be made. Verify that confirmation sheets/login reports from the lab contain correct information. Coordinate efforts with the lab if information needs to be corrected. As needed, create and file a **Corrections-To-File Letter**. Track samples throughout the data management process. Ensure that labs and validators deliver the Sample Delivery Groups (SDG) on time. Inform the PM if SDGs are late, and remind the lab of late penalties (if any are in place).

All documentation acquired during the data management process, including SOWs, Bids, COCs, Field Notes, **Sample Tracking Sheets**, Login Reports, **Corrections-to-File Letters**, FDETool QC tables, **Post Load Reports**, Invoices, and Communication Logs shall be compiled throughout the process and stored in the appropriate Activity's Project Notebook.

4.3 Field Data Entry Tool

The **FDETool** can be completed at any time during the sampling event timeline, and will be turned in with the data load. After the lab has received the samples and submitted login reports, complete the **Data Request/Needs Form** and email it to the Database Specialist and copy the DMC and back-up Database Specialist to request the **FDETool**. Enter data into the **FDETool** using the **Sample Tracking Sheet**, field log books and COCs. Be as specific as possible with the information entered (check with the PM and/or FTLs if information to be entered is unclear). Once all field data has been entered, run the **FDETool** output reports and QC them according to the **FDET Instructions for Data QC Form** (\\orion\proj\CLEANII\DATAMGMT\EIS\EIS_Reference_Documents). Send the reports to another EIS or PM to review for accuracy.

Northing and Easting information should be requested from the PM, if it is missing in the **FDETool**. This data should be entered into the **FDETool**. **However, if the FDETool is not**

being utilized, the Northing and Easting data can be formatted into a spreadsheet format, which can be sent along with the load. All stations that have coordinates must be loaded into EnDat, even if GIS has received the coordinates. See the **Survey Coordinates Flowchart** at \\orion\proj\CLEANII\DATAMGMT\EIS\EIS_Forms.

4.4 Track EIS Budget

Use the **EIS DM Budget Tracking Form** to track the number of hours spent on each task as they are performed. Inform the PM if the budget may be exceeded.

Tools Involved in Sample Collection & Management
Corrections to File Letter
Data Request/Needs Form
EIS DM Budget Tracking Form
FDET Instructions for Data QC Form
Field Data Entry Tool (FDETool)
Sample Tracking Sheet
Survey Coordinates Flowchart

5.0 Lab Analysis

5.1 QC Lab Data

Verify that the hard copy data and **Electronic Data Deliverables (EDDs)** are complete and acceptable as outlined in the **EIS QC Checklist for Unvalidated and Validated EDDs and Hard Copy Data Form**. Run a quality check on the EDD columns to ensure basic quality. Perform a 10% check of the analysis results. Ensure that the hard copy data matches the EDD. If errors are found, inform the PM and request corrected data from the lab.

5.2 Communicate with the Lab

Should the EDD be missing data, contact the PM and coordinate efforts with the lab to receive the missing data.

5.3 Run Tables

Communicate with the PM to determine if preliminary raw and detects tables are needed. Should tables be desired, verify the requirements and formatting (i.e. headers, footers, or other

special needs) to be included on the table. Run the **Raw & Detects Tables from Unvalidated or Validated EDD Macro** on data in the EDD to create tables to assist the PM with a preliminary data analysis. A separate table must be created for EACH matrix (solid/aqueous) and sample purpose (Normal, Blanks). Ask the PM how the tables should be run before beginning.

5.4 Hard Copy Management

If data are to be validated, follow the instructions for Hard Copy Management in the Data Validation section, below. If data are not to be validated, hold on to the hard copies until project closeout/completion. After all corrections identified through the data management process have been completed (if any), the final report written, and the project determined complete, gain approval from the PM to archive the hard copy. Note, skip to section 7.0, Data Management, for EDDs that are not to be validated.

5.5 Hard Copy Archiving

If data will not be validated, fill out the **Data Archiving (List of Contents) Form**, located at the link \\Orion\PROJ\CLEANII\DATAMGMT\EIS\Data_Archiving, for each SDG, and attach it to the data packages. Once the PM has granted approval for hard copy archiving at project completion, give the boxes of data to the Data Archiving Specialist. The data will be prepped for archiving and filed within the building until the Data Archiving Specialist has received authorization to send the data to storage.

Tools Involved in Lab Analysis
Data Archiving (List of Contents) Form
EDD
EIS QC Checklist for Unvalidated and Validated EDDs and Hard Copy Data Form
Raw & Detects Tables from Unvalidated or Validated EDD Macro

6.0 Data Validation

6.1 Hard Copy Management

If data are to be validated, the hard copy data, EDDs, and a **QC Association Table** will need to be mailed or emailed to the data validator. Photo copy the Form I Summary Package (which should be provided by the lab) before mailing the hard copy, to keep on file while the complete packages is with the validator. Fill out the **Data Archiving (List of Contents) Form** for each SDG, and attach it to the data packages. The **QC Association Table** is created using the COCs, field notes, and the field crew to ensure accuracy. Further instructions on the QC table are located in the form “**QC Association Table**”, under

[\\orion\proj\CLEANII\DATAMGMT\EIS\EIS_Forms](#). The **QC Association Table** can be emailed to the data validator along with the EDD. If sending more than one EDD, prepare the EDDs to the validator's preference (i.e. one large file or divided by SDG).

6.2 Communicate with Validator

Let the data validator know ahead of time when to expect data. Inform the validator of any samples or analyses that should not be validated. (i.e. grain size should not be validated). Work with the data validator to coordinate the return of the data package to CH2M HILL for archiving. Once the data package has been returned to CH2M HILL, follow the Hard Copy Archiving procedure above.

6.3 Post-Validation

Review and QC the validated data according to the **EIS QC Checklist for Unvalidated and Validated EDDs and Hard Copy Data Form**. Verify that the validated hard copy data and EDDs are complete and acceptable. Data validators should have added qualifiers to the DV_QUAL and DV_QUAL_CODE fields only. Check the values in the DV_QUAL field against the valid value choices. Perform a 100% check of the DV_QUAL and DV_QUAL_CODE fields. Ensure that the hard copy values match the EDD. Ensure that every record requiring a data validation qualifier has one (i.e. if the Lab_Qual field has a U qualifier then there MUST be a qualifier in the DV_QUAL field).

Run raw and detects tables of the combined EDD using the **Raw & Detects Tables from Unvalidated or Validated EDD Macro**. Check to make sure there are no duplicate results for any of the samples. Send the raw and detects tables, validation report, and validated EDD to the Project Chemist for a "Pre-Load Check."

Tools Involved in Data Validation
Data Archiving (List of Contents) Form EDD EIS QC Checklist for Unvalidated and Validated EDDs and Hard Copy Data Form QC Association Table

7.0 Data Management

7.1 Load Preparation

Compile the validated SDG EDDs into one Excel file, if they are not formatted as such already. Add in and populate the additional columns CTO, Lab, and Validated at the end of the EDD. Add in a column before Prep_Method called Preparation. Copy and paste the data from Analysis_Method into the Preparation column. Rename the Prep_Method to CH2M_Code, and populate with appropriate valid values. Save the Excel file as an 'Archive EDD' under a new name with the project or event and the date sampling (i.e. "3_CP_CTO-244_GW&SO_103103_ARCHIVE.xls"). Be as specific as possible when saving the file, as it will become the Archive EDD file.

Create a duplicate copy of the Archive EDD file and save it as the Load EDD (i.e. "3_CP_CTO-244_GW&SO_103103_LOAD.xls"). In the Load EDD, delete out the surrogate records by deleting ALL records that have a value in the "Result_Type" column. Delete Lab QC Records by deleting ALL records that have a value in the "Lab_QC_Type" column. Remember to save the Load EDD once the modifications are complete.

After the data has been loaded, incorporate any corrections made to the Load EDD by the Database Specialist into the Archive EDD. Mail a copy of the Archive EDD to the DMC to be stored in the archive file ([\\orion\proj\CLEANII\DATAMGMT\EDD_Archive](#)).

7.2 Run a Pivot Table

As needed, follow the **Analyte Pivot Table Instructions** file to determine if any analytes are classified under more than one analysis group in the Load EDD. (This step is considered a backup check, as a 'Preferred Analysis Group Check' was performed on the unvalidated EDD, as specified on the **EIS QC Checklist for Unvalidated and Validated EDD and Hard Copy Data Form**.) Use the **Preferred Analysis Group Form** as a reference to assign UNREJECTED results to the correct analysis group for these analytes. If an analyte is not on this list then ask a chemist for assistance and update the **Preferred Analysis Group Form** accordingly.

7.3 PM Review of Data Load

Provide the PM with the cross-tabulated raw and detects tables created from the validated data above, and the Load EDD file. Also ask the PM if they would like a copy of the **Sample Tracking Sheet** or **Project Instructions** to assist with the review.

7.4 Email Data Load

Send the QC'd Load EDD file (the version WITHOUT the surrogate and QC data) and **FDETool** in an email to the Database Specialist for loading into EnDat, and copy the DMC and back-up Database Specialist. In the email, attach an electronic copy of the completed **Data Request/Needs Form** with the following information completed:

- Program Name (ex: Clean II)
- Activity (ex: Little Creek)
- Contract Task Order (CTO)
- Prime Contractor (company responsible for providing a product to the Navy)

- Field Contractor (company who performed the field work)
- Was the data upload scheduled with the DB staff?
- Is the data validated?
- Data Validator Name (If no DV then who within CH2M HILL evaluated the data?)
- Number of samples
- Dates of the sampling event
- Number of records in EDD
- Requested Due Date
- Any Reports Requested?

The Database specialist will then conduct any additional formatting modifications to the EDD as needed to load the data into EnDat.

7.5 Post Load

The Database Specialist shall generate **Post Load Reports** and provide them to the EIS for review and QC. Once the **Post Load Reports** have been QC'd by the EIS, the EIS will then send the reports to the PM for review. Inform the PM of any corrections that need to be made, and coordinate these changes with the Database Specialist. Any changes made to the data by the Database Specialist prior to load, or that will be completed after the load should be tracked, and incorporated into the hard copy and EDD files that are to be archived after project completion.

Tools Involved in Data Management
Data Request/Needs Form EDD
Field Data Entry Tool (FDETool) Pivot Table Instructions
Preferred Analysis Group Form Project Instructions
Raw & Detects Tables from Unvalidated or Validated EDD Macro Sample Tracking Sheet Post Load Reports

8.0 Data Evaluation & Reporting

8.1 Run Tables

Meet with the PM to verify table requirements and formatting (i.e. headers, footers, or other special needs). Raw and detects tables must be created for EACH matrix (solid/aqueous). Pull the data from **EnStat**. There are three macro templates that can be utilized to assist with the

formatting of EnStat output files. These include the **Raw, Detects, & Exceedance Tables from EnStat Output Macro**, **HHRA Tables from EnStat Output Macro**, and **EcoRisk Tables from EnStat Output Macro**.

Run the **Raw, Detects & Exceedance Tables from EnStat Macro**, and send the completed tables to the Project Chemist for a final quality check. Provide the completed, QC'd tables to the PM. Other tables can be generated from the remaining macros as requested.

8.2 Review Laboratory and Validator Invoices

Laboratory invoices should be submitted once the laboratory has completed requested analyses, and submitted all results and requested corrections. Data validation invoices should be submitted shortly after the validation has been completed, and the report submitted to CH2M HILL. Invoices will be submitted to the PM through AP Workflow for approval. The PM should then consult the EIS for invoice review before submitting approval. The EIS should review the invoices, and noting any late charges, etc, and update the **Sample Tracking Sheet** accordingly.

8.3 Complete EIS DM Budget Tracking Form

Meet with the PM and the DMC to review the **EIS DM Budget Tracking Form** and discuss lessons learned.

Tools Involved in Data Evaluation & Reporting
EcoRisk Tables from EnStat Output Macro
EIS DM Budget Tracking Form
EnStat
HHRA Tables from EnStat Output Macro
Raw, Detects, & Exceedance Tables from EnStat Output Macro
Sample Tracking Sheet

Appendix A

Summary & Assessment of Data Management Materials

Summary Of Tools Involved In The Data Management Process

Tools	Assessment
BOA Rates Spreadsheet	This is only updated every 5 years. We need an SOP to remind EISs to add a 10% increase for each year after the update year until it is updated again.
Corrections to File Letter	
Data Archiving (List of Contents) Form	Kevin McGarvey, the Archiving Expert will be working in the WDC office through June, and will be stopping by here. He could be tasked to write up an SOP. We might have some mini-SOPs to work from too.
Data Request/Needs Form	Good
EcoRisk Tables from EnStat Output Macro	Good
EDD	Good, though primary keys need revision.
EIS QC Checklist for Unvalidated and Validated EDDs and Hard Copy Data Form	This is a good procedure checklist, and could easily be made into a formal SOP.
EIS Questions to Ask at Start of Project Form	This could use a few formatting tweaks, but is generally good as is.
EIS DM Budget Tracking Form	This should be updated to incorporate all the aspects of the data management process for more accurate tracking
EnDat Post Load Reports	Good. Used to assess and QC data loaded into EnDat to ensure data load accuracy and completeness
EnStat	This needs work to get it running better/correctly. There is a ppt presentation on using this that could serve as a SOP.
Established Document Templates	Currently we work off of pre-existing docs, which vary. Templates must be established.
FDET Instructions for Data QC Form	Needs evaluation
Field Data Entry Tool (FDETool)	Could use a bulk upload function, and built in QC checks

Tools	Assessment
HHRA Tables from EnStat Output Macro	Needs evaluation
Pivot Table Instructions	Could easily be made into a good SOP
Preferred Analysis Group Form	Good
Project Instructions	From PM
Projects Currently in DM Tracking Table	Good
QC Association Table	The example on the server is intended to use as a template, and could use a little tweaking
Raw & Detects Tables from Unvalidated or Validated EDD Macro	This macro could use formatting updates. There is no SOP for this, but I do have a rough mini-SOP that Felicia wrote up.
Raw, Detects, & Exceedance Tables from EnStat Output Macro	Needs evaluation
Sample Tracking Sheet	Need to develop template
Survey Coordinates Flowchart	Good

Summary of Documentation in the Reference Manuals

Document	Assessment for Current DMP	Assessment for NIRIS
IS Personnel 11-2006	Current	Good
Load Process Step by Step	Generic overview, not SOP. Need Bhavana to write a formal SOP if desired	Need New Document
Navy Clean IS Organization	Out of Date	Need New Document
Reference Manual Binder Covers	Current	Good
Ref Manual Page Dividers	Current	Good
Project Manager Role in IS-DM Process	Current	Good
Environmental Information Specialist Role 1	Current	Good
Data Management Coordinator Role	Current	Good
Navy Clean Data Management Process Flowchart	Current	Good
Survey Coordinates Flowchart	Good	Needs Revision
Life of a Sample Flowchart	Needs Revision	Needs Revision
Chemicals in EnDat 010306	Needs periodic updates	Need New Document
Chemical Synonyms in EnDat	Needs periodic evaluation	Need New Document
Common Chemical Synonyms & Abbreviations	Good	Good
Analyses and Methods Commonly Used	Needs periodic updates	Needs periodic updates
FDET Valid Values	Good	Need New Document
Lab Valid Values	Good	Need New Document
DV Valid Values	Good	Need New Document
Field Sample Naming Scheme	Needs Revision (to Sample Nomenclature Protocol for all Bases)	Uncertain
Field Station Naming Scheme	Needs Revision (to Station Nomenclature Protocol for all Bases)	Uncertain
EDD Format CH2M Navy 120605	Needs Updates	Need New Document

Document	Assessment for Current DMP	Assessment for NIRIS
DCLT Manual	None - This is no longer used, as the Tool is broken	Delete
STS Example	Need to develop template	Need to develop template
Corrections To File	Good	Uncertain
Corrections to File Example	Good	Uncertain
FDET Instructions	Good	Delete
FDET Screen Shot	Good	Delete
FDET Stations Report Example	File does not exist	Delete
FDET Sample Report Example	File does not exist	Delete
FDET Field Results Report Example	File does not exist	Delete
FDET Full Detail Report Example	File does not exist	Delete
FDET Result Report in XL Example	Good	Delete
FDET Instructions for Data QC	Needs Evaluation	Delete
Data Management Checklist _rev0306	Needs Revision	Needs Total Revision/Rewrite
Analyte Pivot Table Instructions	Good	Uncertain
Analyte Pivot Table Example	Can not locate file	Uncertain
Preferred Analysis Group	Needs evaluation - have older version (ABL) too	Uncertain
Ex of Pre-Load QC Raw & Detects Tables	Good	Need new document
Ex of Post-Load Station Check Confirmation Rpt from DB Specialist	Cannot locate file	Uncertain
Ex of Post-Load Sample Check Confirmation Rpt from DB Specialist	Cannot locate file	Uncertain
Ex of Post-Load Field Result Check Confirmation Rpt from DB Specialist	Cannot locate file	Uncertain
Ex of Post-Load Analysis Check Confirmation Rpt from DB Specialist	Cannot locate file	Uncertain
EnStat Tool Instructions	PPT, not SOP. Could easily be made into SOP	Need New Tool
EnDat Threshold Criteria	Needs Evaluation	Need New Document
Definitions of RBC & MCL Threshold Variations	Unable to locate Email Doc	Uncertain

Document	Assessment for Current DMP	Assessment for NIRIS
Ex of Unformatted EnStat Post-Load Tables	Good	Need New Document
Ex of Formatted EnStat Post-Load Tables	Good	Need New Document
IS Costing Template 2006Rates 042506	Needs to be Updates	Needs Updating
IS Data Request-Needs Form	Good	Needs Update/New Document
Quarterly Sampling Projection Forms Example	Good	Good
EIS Project Startup Questions_rev0905	Good	Needs Revision
EIS DM Budget Tracking Form	This should be updated to incorporate all the aspects of the data management process for more accurate tracking	Needs Revision
EIS QC Checklist for Unval & Val EDD & Hard Copy Data	Unable to locate document	Needs Revision
EIS Training Checklist	Good	Needs Revision

Appendix E
Response to Comment Letters



CH2MHILL

May 3, 2010

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Subject: Response to Comments *Draft Remedial Investigation Sampling and Analysis Plan, Site 31, Barracks Road Industrial Area, Naval Weapons Station Yorktown, Yorktown, Virginia*

Dear Mr. Thomson

This letter is in response to comments on the subject document provided in your letter dated 10 March 2010. Comments are shown followed by responses in italics.

- 1) Comment 1: SAP Worksheet #10 on page 35 states that chlorinated VOCs were detected in seep samples indicating migration to adjacent surface water bodies to the east and west of the site. The worksheet further states that seep results were used to evaluate transport pathways at the site only and were not used for evaluation of risks because no screening values are available for groundwater seeps. Because concentrations in seeps were measured in the creeks, it is appropriate to screen against surface water criteria. Therefore, seep concentrations should be compared against BTAG screening values for surface water to evaluate ecological risk in these receiving water bodies.

Response 1: There were no detections of VOCs in surface water samples collected as part of the SI. The groundwater seeps were not located within the creeks, but rather on the banks of the surface water bodies.

- 2) Comment 2: SAP Worksheet #10 on page 35 states that there were no screening level exceedances identified for ecological receptors exposed to surface water and sediment. As stated above, seep concentrations should be compared to surface water values. The current BTAG screening value for trichloroethene is 21 micrograms per Liter ($\mu\text{g/L}$). The concentration in Ballard Creek (130 $\mu\text{g/L}$) exceeds this concentration. Therefore, the potential for ecological risk is present and the statement that no screening level exceedances were identified is not supported. All chemicals detected in seeps should be compared with BTAG screening values for surface water as appropriate.

Response: The sample described as exceeding the screening value is a seep sample and is not location in Ballard Creek. The language in the text will be clarified to better describe the location of seeps relative to Ballard Creek. The Navy does not agree that direct screening of seep samples against surface water values is appropriate. Surface water screening values are based on specific exposure scenarios which are inconsistent with the sporadic nature of seeps (only flowing a few weeks of the year) and their location (on steel hillsides and not within surface water bodies). The USEPA has not issued any official guidance on evaluating risks from exposure to seeps and has not provided any guidance related to remediating seeps.

- 3) Comment 3: Worksheet #10 on page 36 states that a groundwater VOC plume is present at the site. In some places, groundwater contamination is migrating into seeps, but does not persist in surface water. Based on SAP Figure 8, there were no surface water samples collected downstream of YS12-SP01 to determine the downstream extent of VOCs in surface water. This represents a data gap and the downstream extent of VOCs in surface water will need to be determined so that the area of ecological risk can be delineated. This should be added to the list of issues that should be addressed found on page 6 of the SAP. This list should also include an evaluation of ecological risk from constituents found in seep samples as noted above.

Response: Surface water samples were collected downstream of YS12-SP01 during the Round Two RI for Yorktown Site 12 (Baker 1996). Concentrations of trichloroethene in these samples were estimated values less than 10 µg/L. However, because the samples were not collected in the creek immediately adjacent to the seep, the Navy will collect one additional surface water sample in the creek adjacent to the seep to supplement the surface water data collected during the SI. As stated above, USEPA has provided no guidance related to how to evaluate risk related to seeps or how to remediate seeps contamination. Consequently, it is not possible to adequately address risks to ecological receptors from seeps except through remediating groundwater contamination. A groundwater remedy will be necessary at Site 31. Cleanup goals for the groundwater remedy will, at a minimum, be required to meet the maximum contaminant levels (MCLs). The MCL for trichloroethene is 5 µg/L, which is more conservative than ecological screening value of 21 µg/L.

- 4) Comment 4: Worksheet #10 on page 36 states that contaminants are transported to the surface water by groundwater seeps; however, because these constituents were not detected in surface water, they are volatilizing. Seeps are at the surface water/groundwater interface, and therefore, they represent surface water. Aquatic organisms are exposed to the concentrations found in the seeps. Sampling should be performed downstream of the seeps to determine the distance that VOCs persist in surface water before volatilizing. This will help determine the downstream extent of ecological risk.

Response: The Navy disagrees that aquatic organisms are exposed directly to the concentrations found in seeps. The seeps at Site 31 discharge from hillsides above surface water bodies and run down the hillside before they encounter surface water. While they represent a transport pathway to surface water, they are not representative of surface water and concentrations only come into contact with aquatic organisms once they have reached surface water and therefore are impacted by fate and transport mechanisms which differ from those in pore water. The seeps at Site 31 are more representative of groundwater than surface water. Additionally, while surface water bodies are generally present year-round, seeps are ephemeral, may flow at various times throughout the year, and therefore, do not represent a sustainable ecological habitat. As described above in its response to Comment 3, the Navy agrees to collect one surface water sample in Ballard Creek adjacent to the seep discharge of YS12-SP01.

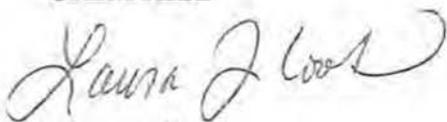
- 5) Comment 5: Worksheet #10 on pages 36 and 37 states that because there was no unacceptable risk identified to ecological receptors in surface water and sediment during the risk screening performed in the Site Assessment, further ecological evaluation will not be necessary. Based on the concentration in seeps exceeding BTAG screening values for surface water, ecological evaluations of this exposure pathway are needed as part of this RI.

Response: The Navy agrees to collect one additional surface water sample in Ballard Creek adjacent to YS12-SP01 and reevaluate ecological risks from surface water. The Navy will consider any official guidance issued by the USEPA related to risk screening values for seeps data and remediation of groundwater seeps.

If you have any questions or concerns regarding this response, you may contact me at (757) 671-6214 or Bill Friedmann at (757) 671-6223. Upon acceptance of this response letter, the Navy will submit a final UFP-SAP.

Sincerely,

CH2M HILL



Laura J. Cook
Project Manager

cc: Mr. Tom Kowalski/NAVFAC
Mr. Wade Smith/VDEQ
Mr. William Friedmann/CH2M HILL
Mr. Adam Forshey/CH2M HILL

January XX, 2010

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Mr. Wade Smith
Remedial Project Manager
Virginia Department of Environmental Quality
629 East Main Street, 4th Floor
Richmond, VA 23219

Subject: Response to Comments *Draft Sampling and Analysis Plan for Site 31 Remedial Investigation*
WPNSTA Yorktown
Yorktown, Virginia

Dear Mr. Smith

This letter is in response to your comments on the subject document provided in your comment letter dated XX December 2009. All requested editorial comments and comments with regards to figures and tables will be incorporated as requested.

1. **Page 9 (Table of Contents):**
Please include Figure 10.

Figure 10 will be added to the Table of Contents.

2. **Page 33 (Site Description and History):**
Please include a figure that shows an aerial layout.

An aerial layout will be added as an inset to Figure 1.

3. **Page 68 (Between- building Ambient Air):**
Please include a tentative sampling location between buildings 4 and 5 on Figure 5.

A tentative sampling location between buildings 4 and 5 will be added to Figure 5.

Please feel free to contact me should you have any additional questions.

Sincerely,

CH2M HILL

Laura Cook
Project Manager

cc: Mr. Tom Kowalski/NAVFAC Mid- Atlantic
Mr. Jonathon Tucker/NAVFAC Atlantic
Mr. Robert Thomson/USEPA
Mr. Bill Friedmann/CH2M HILL
Ms. Laura Cook/CH2M HILL

Appendix F
Health and Safety Plan

Appendix F will be provided in a subsequent version of this report.