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FINAL SITE 5 SUPPLEMENTAL REMEDIAL INVESTIGATION SAMPLING AND ANALYSIS PLAN ST JULIENS CREEK ANNEX VA

04/01/2014

CH2M HILL

SAP Worksheet #1—Title and Approval Page

Final

Site 5 Supplemental Remedial Investigation Sampling and Analysis Plan

St. Juliens Creek Annex
Chesapeake, Virginia

Task Order No. WE20

April 2014

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

AGVIQ–CH2M HILL Constructors Inc. JVIII Program
Contract N62470-08-D-1006

Prepared by:

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

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Karen Doran/VDEQ – Remedial Project Manager

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Executive Summary

This Sampling and Analysis Plan (SAP) presents the technical approach for a Supplemental Remedial Investigation (RI) at St. Juliens Creek Annex (SJCA) Installation Restoration Site 5. Site 5 encompasses an area of approximately 23 acres in the northeastern portion of SJCA. The site consists of an open field with a wetland in the central portion, and a forested area in the southern portion. Blows Creek and a wetland border the site to the south. Although the site historically was used to dispose of munitions and other general refuse, currently the site is seldom used; use is primarily associated with radar testing. Groundwater is not used as a potable resource at SJCA; public water is supplied to SJCA and the surrounding area by the City of Chesapeake Waterworks. Although groundwater is not currently used as a potable water supply, it could be used in the future if the site is closed with no further action.

Potential unacceptable risks were identified at Site 5 from exposure to shallow aquifer groundwater (hypothetical future potable use of the groundwater), waste, surface soil, and sediment during the RI and ERI (ERI) (CH2M HILL, 2003 and 2006). In 2007, the SJCA Environmental Restoration Program Partnering Team (consisting of representatives from the Navy, U.S. Environmental Protection Agency [USEPA], and Virginia Department of Environmental Quality [VDEQ]) agreed to risk manage shallow groundwater at Site 5 with no further action (NFA) based on several lines of evidence provided in the ERI Addendum (CH2M HILL, 2007). A non-time-critical removal action to mitigate the potential unacceptable risks associated with waste, soil, and sediment was initiated in 2007 and completed in July 2012. Following completion of the removal action, a NFA Proposed Plan was drafted in 2012 and submitted to USEPA and VDEQ for review. During the review, concerns were raised about potential non-carcinogenic hazards from exposure to cobalt in shallow aquifer groundwater if used as a potable water supply, because they were much higher than the non-carcinogenic hazards calculated during the ERI because a more conservative (lower) provisional toxicity value is now available for cobalt. Additionally, concerns were raised regarding the lines of evidence used to risk manage some of the other chemicals of potential concern (COPCs) (select metals) that had been identified in the groundwater. Based on further review of the Site 5 groundwater data, the monitoring wells where the highest concentrations of the COPCs were detected (SJS05-MW02S and SJS05-MW03S) also had relative low pH measurements in comparison to other areas of the site. The low pH has been identified as a potential contributing factor for the elevated COPC concentrations, in particular cobalt, since low pH can cause metals to mobilize. However, the cause of the low pH in the groundwater is unknown. Based on these concerns, it was deemed necessary to collect additional groundwater samples and re-evaluate risk using these additional data to determine if there are any risks above acceptable levels based on current concentrations of select metals in the groundwater.

The overall objective of the Site 5 supplemental RI is to determine whether the current concentrations of the shallow aquifer groundwater COPCs identified in the 2007 ERI Addendum human health risk assessment (HHRA) and updated 2013 risk calculations pose unacceptable risk, and if so, whether they are the result of a Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) release that requires remedial action. The general approach for the investigation is as follows:

- Conduct a primary sampling event, which will consist of groundwater and surface water data collection. One round of groundwater samples will be collected from the four existing shallow aquifer monitoring wells at Site 5 and four of the SJCA background monitoring wells that were selected because they are nearest to the site, reflect upgradient conditions, and/or are in locations that have similar characteristics to Site 5. The groundwater samples will be analyzed for the total and dissolved select metals that were identified as COPCs in the shallow aquifer groundwater in the 2007 ERI Addendum HHRA (aluminum, arsenic, beryllium, cadmium, iron, lead, manganese, thallium, and vanadium) and the additional COPCs identified in the updated 2013 risk calculations (chromium and cobalt). Chromium will be speciated (analyzed for total and hexavalent chromium). In order to help determine the cause of any elevated metals, the samples will also be analyzed for the following wet chemistry parameters: pH, acidity, anions (sulfate, chloride, total phosphorus, and nitrate),

and dissolved organic carbon. Water quality parameters, including pH and specific conductivity, will be field-measured at each monitoring well that will be sampled. A field pH measurement will be collected from one location in the wetland area adjacent to the low pH groundwater area and one location downgradient of the low pH groundwater area to aid in determination of the cause of the low pH in groundwater.

- Calculate human health risks using the metals data collected during the primary event to determine if current metals concentrations pose potential unacceptable risks. If any unacceptable risks are identified, an evaluation using multiple lines of evidence will be conducted to determine if the risks are the result of a CERCLA release. The multiple lines of evidence evaluation will include consideration of background data, Site 5 soil data (pre- and post-removal action), indicator parameters, surface water pH from the adjacent wetlands, and Site 5 shallow aquifer hydraulic conductivity.
- If there are unacceptable risks that warrant further action (taking into consideration multiple lines of evidence evaluation) and data are not adequate to define the extent of the impacted groundwater or support development and evaluation of remedial action options, then a contingency sampling event will be conducted. The types of data that will be collected during the contingency sampling event will be dependent on the results of the primary sampling event data evaluation. The contingency event is expected to include the installation of temporary monitoring wells to delineate the horizontal extent of the area of concern in the shallow aquifer groundwater. The sample locations will be determined based on the results of the primary event. Additionally, any of the existing Site 5 shallow aquifer monitoring wells may be sampled and additional surface water pH measurements may be collected during the contingency event if it is determined the data may be useful in delineating the area or supporting a treatability or feasibility study. The groundwater samples will be analyzed for the metals that were determined to pose unacceptable risk based on the results of the primary event data evaluation and/or any of the wet chemistry parameters analyzed for in the primary event if it is deemed the data may be useful in delineating the area or support a treatability or feasibility study.

This monitoring is being conducted for the Department of the Navy (Navy), Naval Facilities Engineering Command Mid-Atlantic, under the AGVIQ-CH2M HILL Constructors Inc. Joint Venture III Program in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986, and, to the extent practicable, the National Oil and Hazardous Substances Contingency Plan.

This SAP has been completed under contract number N62470-08-D-1006, Contract Task Order WE20, in accordance with the Navy's Uniform Federal Policy Sampling and Analysis Plan policy guidance to ensure that environmental data collected are scientifically sound, of known and documented quality, and suitable for the intended purposes. The objectives and technical approach included in this SAP were jointly scoped by the members of the SJCA Tier I Partnering Team.

The laboratory information cited in this work plan is specific to Environmental Conservation Laboratories and EMAX Laboratories. If additional laboratory services are requested requiring modification to the existing SAP, revised SAP worksheets will be submitted to the Navy and regulatory agencies for approval.

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1 Concentrations of Chemicals of Potential Concern and pH in Site 5 Shallow Aquifer Monitoring Wells
2 Problem Definition and Objective, Environmental Questions, and Project Quality Objectives
3 Concentrations of Chemicals of Potential Concern and pH in Background Monitoring Wells Included in the Primary Event
4 Project Indicator Limits

Figures

1 St. Juliens Creek Annex and Site 5 Location
2 Site 5 Layout
3 Site 5 Supplemental Remedial Investigation Primary Sampling Locations
4 Site 5 Supplemental Remedial Investigation Decision Tree

Attachments

A Scoping Session References
B 2013 Site 5 Shallow Aquifer Groundwater Risk Calculations
C Field Standard Operating Procedures
D Laboratory Department of Defense Environmental Laboratory Accreditation Program Letter

Acronyms and Abbreviations

°C	degree Celsius
µg/L	microgram per liter
AGVIQ-CH2M HILL	AGVIQ-CH2M HILL Constructors Inc. Joint Venture III
AM	Activity Manager
amls	above mean sea level
amu	atomic mass unit
AQM	Activity Quality Manager
bgs	below ground surface
CA	corrective action
CAS	Chemical Abstracts Service
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	chemical of concern
COPC	chemical of potential concern
DL	detection limit
DO	dissolved oxygen
DoD	Department of Defense
DPT	direct push technology
DQI	data quality indicator
EDD	electronic data deliverable
ELAP	Environmental Laboratory Accreditation Program
ENCO	Environmental Conservation Laboratories
ERI	Expanded RI
ERP	Environmental Restoration Program
FTL	Field Team Leader
GPS	global positioning system
H&S	Health and Safety
HDPE	high density polyethylene
HHRA	human health risk assessment
HI	hazard index
ICAL	initial calibration
ICP	inductively coupled plasma
ICP-AES	inductively coupled plasma-atomic emission spectrometry
ICP-MS	inductively coupled plasma-mass spectrometry
ICS	interference check solution
ICV	second source calibration verification
ID	identification
IR	Installation Restoration
IS	Internal Standard
LCS	laboratory control sample
LOD	limit of detection

LOQ	limit of quantitation
MCL	maximum contaminant level
mg/L	milligram per liter
mL	milliliter
MS/MSD	matrix spike/matrix spike duplicate
N/A	not applicable
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NFA	no further action
NIRIS	Naval Installation Restoration Information Solution
ORP	oxidation-reduction potential
OU	operable unit
PAL	project action limit
PIL	project indicator limit
PM	Project Manager
POC	point of contact
PP	Proposed Plan
PQL	project quantitation limit
PQO	project quality objective
PVC	polyvinyl chloride
QA	quality assurance
QC	quality control
QL	quantitation limit
QSM	Quality Systems Manual
RfD	reference dose
RI	Remedial Investigation
ROD	Record of Decision
RPD	relative percent difference
RPM	Remedial Project Manager
SAP	Sampling and Analysis Plan
SJCA	St. Juliens Creek Annex
SME	Subject Matter Expert
SOP	standard operating procedure
SSC	Site Safety Coordinator
STC	Senior Technical Consultant
TBD	to –be-determined
UFP-SAP	Uniform Federal Policy Sampling and Analysis Plan
USEPA	U.S. Environmental Protection Agency
UTL	upper tolerance level
VDEQ	Virginia Department of Environmental Quality

SAP Worksheet #2—SAP Identifying Information

Site Name/Number: Installation Restoration (IR) Program Site 5—Burning Grounds
Operable Unit (OU): OU-5
Contractor Name: CH2M HILL
Contract Number: N62470-08-D-1006, Task Order No. WE20
Contract Title: AGVIQ-CH2M HILL Joint Venture III (AGVIQ-CH2M HILL) Small Business Remedial Action Contract

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

   U.S. Environmental Protection Agency (USEPA) *QA/G-5, Quality Assurance Management System* (USEPA, 2002)

   USEPA *Uniform Federal Policy – Quality Assurance Project Plans* (USEPA, 2005)

   USEPA *Guidance for Quality Assurance Project Plans*

   USEPA *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA, 2006).

2. **Identify regulatory program:**

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

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

   St. Juliens Creek Annex (SJCA) Site 5 supplemental remedial investigation (RI)

4. **List organizational partners (stakeholders) and connection with lead organization:**

   Virginia Department of Environmental Quality (VDEQ) – regulatory stakeholder

   USEPA Region 3 – regulatory stakeholder

5. **Lead organization:**

   Department of the Navy (Navy), Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic

6. **If any required SAP elements or required information are not applicable (N/A) to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion as follows:**

   All SAP elements required for this project are described herein on the 37 Uniform Federal Policy Sampling and Analysis Plan (UFP-SAP) worksheets.

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SAP Worksheet #3—Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number (Optional)	E-mail Address or Mailing Address
Krista Parra	Lead Organization Remedial Project Manager (RPM)	NAVFAC Mid-Atlantic	757-341-0395	krista.parra@navy.mil
Robert Stroud	Regulatory RPM	USEPA Region 3	410-305-2748	stroud.robert@epa.gov
Karen Doran	Regulatory RPM	VDEQ	804-698-4594	kmdoran@deq.virginia.gov
Janna Staszak, P.E.	Activity Manager (AM)	AGVIQ-CH2M HILL	757-671-6256	janna.staszak@ch2m.com
Craig Miller	Project Manager (PM)	AGVIQ-CH2M HILL	757.213.8584	cmiller@tikigaq.com
Paul Favara	Activity Quality Manager (AQM)/Senior Technical Consultant (STC)	AGVIQ-CH2M HILL	352-384-7067	paul.favara@ch2m.com
To be determined (TBD)	Field Team Leader (FTL)	AGVIQ-CH2M HILL	TBD	TBD
TBD	Field Team Member	AGVIQ-CH2M HILL	TBD	TBD
Juliana Dean	Project Chemist	AGVIQ-CH2M HILL	757-671-6232	juliana.dean@ch2m.com
Herb Kelly	Data Validator	AGVIQ-CH2M HILL	352-384-7100	herb.kelly@ch2m.com
Marcia Colon	Laboratory PM	Environmental Conservation Laboratories (ENCO)	407-826-5314	mcolon@encolabs.com
Molly Nguyen	Laboratory PM	EMAX Laboratories	310-618-8889, ext. 119	mnguyen@emaxlabs.com

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SAP Worksheet #4—Project Personnel Sign-Off Sheet

Name	Title/Role	Telephone Number	Signature/E-mail Receipt	Date SAP Read
Janna Staszak, P.E.	AM	757-671-6256		
Craig Miller	PM	757.213.8584		
TBD	FTL	TBD		
TBD	Field Team Member	TBD		
Juliana Dean	Project Chemist	757-671-6232		
Herb Kelly	Data Validator	352-384-7100		
Marcia Colon	ENCO Laboratory PM	407-826-5314		
Molly Nguyen	EMAX Laboratories PM	310-618-8889		

Once the SAP is finalized, AGVIQ-CH2M HILL will send copies to all parties on the distribution list in **Worksheet #3** and request signatures. If signatures are returned, copies will be kept on internal AGVIQ-CH2M HILL project folders.

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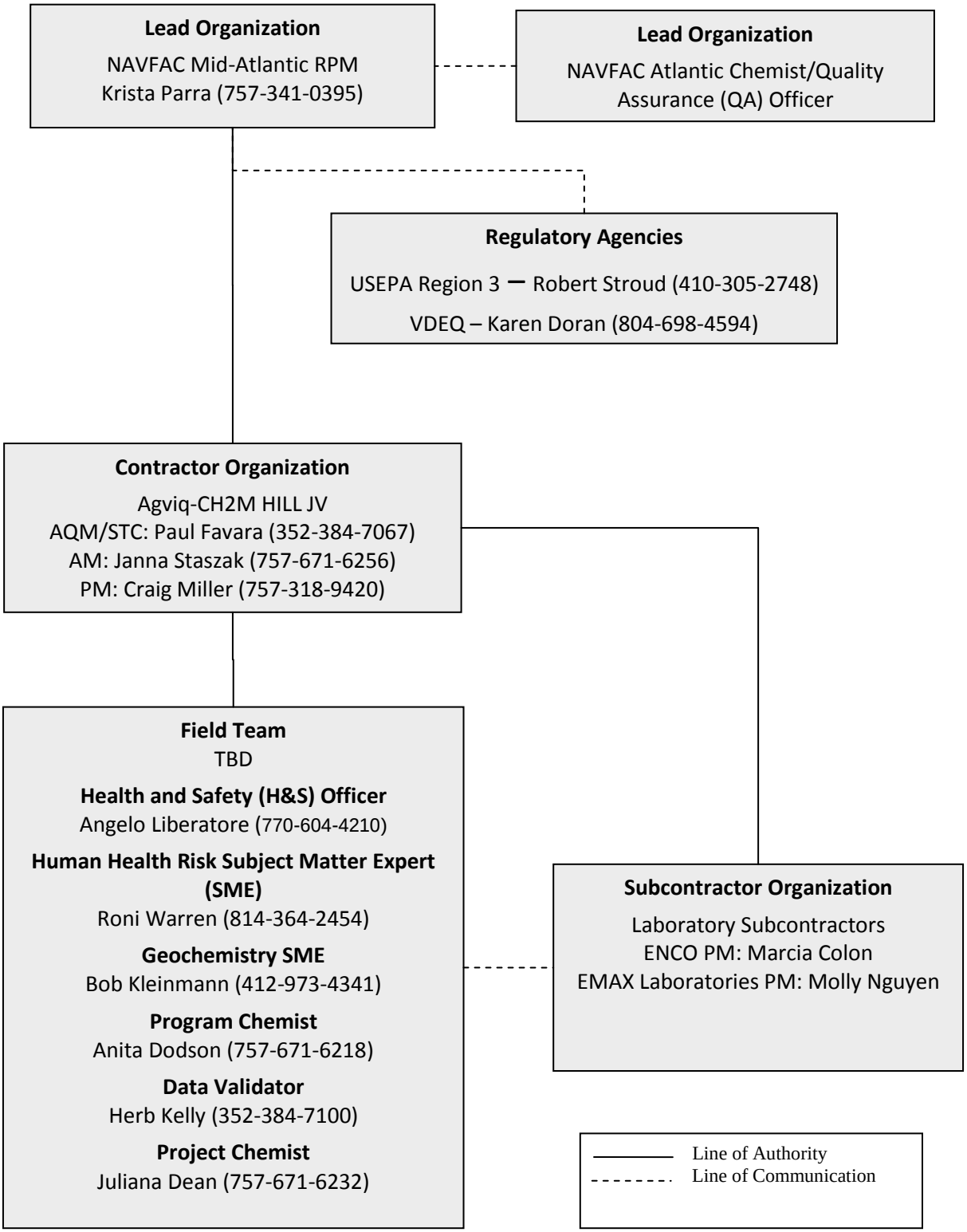
SAP Worksheet #5—Project Organizational Chart



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SAP Worksheet #6—Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Phone Number	Procedure
Communication with Navy (lead agency)	RPM/NAVFAC Mid-Atlantic	Krista Parra	757-341-0395	Primary point of contact (POC) for Navy; can delegate communication to other internal or external POCs. Any issue that may impact project work should be reported to Krista Parra immediately.
Communication with USEPA (regulatory agency)	RPM/USEPA	Robert Stroud	410-305-2748	Primary POC for USEPA; can delegate communication to other internal or external POCs. Upon notification of field changes, USEPA will have 24 hours to approve or comment on the field changes.
Communication with VDEQ (regulatory agency)	RPM/VDEQ	Karen Doran	804-698-4594	Primary POC for VDEQ; can delegate communication to other internal or external POCs. Upon notification of field changes, VDEQ will have 24 hours to approve or comment on the field changes.
Oversight of Environmental Restoration Program (ERP) implementation	AM/ AGVIQ-CH2M HILL	Janna Staszak	757-671-6256	Primary POC for stakeholder and agency managers; can delegate communication to other contract staff as appropriate. Issues reported to the Navy RPM immediately and followed up in writing within 2 business days.
Management of ERP Implementation	PM/ AGVIQ-CH2M HILL	Craig Miller	757.213.8584	Primary modes of communication are phone, e-mail, letter, and document submittal; timing dependent on nature of communication and predefined schedules as applicable and as requested by stakeholder agencies. All information and materials about the project will be forwarded to the AM on a daily basis.
Calculation of human health risk	Human Health Risk SME/AGVIQ-CH2M HILL	Roni Warren	814-364-2454	The PM is responsible for coordinating the human health risk assessment with the human health risk SME. The PM will contact the human health risk SME following receipt of validated data. The human health risk SME will respond to the PM concerning the human health risk assessment.
Geochemical data interpretation	Geochemistry SME/AGVIQ-CH2M HILL	Bob Kleinmann	412-973-4341	The PM is responsible for coordinating review and interpretation of the geochemical data with the geochemistry SME. The PM will contact the geochemistry SME following receipt of the validated data. The geochemistry SME will respond to the PM concerning the interpretation of the geochemical data.
Technical communications for project implementation and data interpretation	AQM & STC/ AGVIQ-CH2M HILL	Paul Favara	352-384-7067	Contact AQM/STC regarding questions/issues encountered in the field, input on data interpretation, as needed. AQM/STC will have 24 hours to respond to technical field questions as necessary. Responses will be communicated to the PM via e-mail or phone.

Communication Drivers	Responsible Affiliation	Name	Phone Number	Procedure
Health and Safety (H&S)	Site Safety Coordinator (SSC)/AGVIQ-CH2M HILL	TBD	TBD	Responsible for team members' adherence to the site safety requirements described in the H&S Plan. Will report H&S incidents and near losses to PM.
SAP Field Changes	FTL/AGVIQ-CH2M HILL	TBD	TBD	Notify the PM by phone and e-mail of changes to the SAP made in the field and the reasons within 24 hours. Documentation of deviations from the work plan will be kept in the field logbook; deviations made only with the approval of the contractor PM. The Navy RPM will be notified of any field data quality issues as soon as possible.
Data Tracking from collection through upload to database	Project Chemist/ AGVIQ-CH2M HILL	Juliana Dean	757-671-6232	The project chemist will track data from sample collection through upload to the database ensuring Work Plan requirements are met by laboratory and field staff. The project chemist will act as main POC for laboratory QA officer. Laboratory issues will be reported to the PM.
Stop Work Order	AM/AGVIQ-CH2M HILL	Janna Staszak	757-671-6256	Any field member can immediately stop work if an unsafe condition that is immediately threatening to human health is observed. The field staff, FTL, or SSC should notify the CH2M HILL PM and AM immediately, along with the Navy RPM. Ultimately, the FTL, PM, and AM can stop work for a period of time. NAVFAC Mid-Atlantic can stop work at any time.
	PM/AGVIQ-CH2M HILL	Craig Miller	757-213-8584	
	Field Team Members/ AGVIQ-CH2M HILL	TBD	TBD	
Field Corrective Action (CA)	FTL/AGVIQ -CH2M HILL	TBD	TBD	The need for CA for field and analytical issues will be determined by the FTL and/or senior support. The senior support will ensure SAP requirements are met by field staff. 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.
Analytical CA	Project Chemist/AGVIQ-CH2M HILL	Juliana Dean	757-671-6232	The need for CA by the analytical laboratory will be determined by the project chemist. The project chemist will ensure SAP requirements are met by the laboratory. 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 project chemist will notify the project team including the Navy RPM and Navy Chemist.
Reporting Laboratory Data Quality Issues	Laboratory PM/ENCO	Marcia Colon	407-826-5314	All QA/quality control (QC) issues with project field samples will be reported by the laboratory to the data manager and/or project chemist within 1 business day. The second-tier subcontracted laboratory will report all data quality issues to the primary subcontracted laboratory PM as soon as any QA/QC issues are identified.
	Laboratory PM/ EMAX	Molly Nguyen	310-618-8889, ext. 119	

Communication Drivers	Responsible Affiliation	Name	Phone Number	Procedure
Reporting Data Quality Issues	Data Validator/ AGVIQ-CH2M HILL	Herb Kelly	352-384-7100	The data validator reviews and qualifies analytical data as necessary. The data, along with a validation narrative, are returned to the CH2M HILL project chemist within 14 calendar days.

SAP Worksheet #7—Personnel Responsibilities Table

Name	Title/Role	Organizational Affiliation	Responsibilities
Krista Parra	Lead Organization RPM	NAVFAC Mid-Atlantic	Coordinate the work of Navy resources to accomplish ERP goals and policies at SJCA
Janna Staszak, P.E.	AM	AGVIQ-CH2M HILL	Oversee ERP activities at SJCA for NAVFAC
Craig Miller	PM	AGVIQ-CH2M HILL	Manage project; direct and oversee project staff
Paul Favara, P.E.	AQM	AGVIQ-CH2M HILL	Provide senior support for, oversight, and QC for all deliverables and processes for this project
	Senior Technical Consultant		Provide senior technical support on project
Roni Warren	Human Health Risk SME	AGVIQ-CH2M HILL	Conduct human health risk assessment
Bob Kleinmann	Geochemistry SME	AGVIQ-CH2M HILL	Review and interpret data
Anita Dodson	UFP-SAP Reviewer	AGVIQ-CH2M HILL	Provide program-level chemistry review of SAP
Juliana Dean	Project Chemist	AGVIQ-CH2M HILL	Prepare chemistry-specific SAP worksheets; manage data through sample tracking and communication with laboratory and data validator
TBD	FTL	AGVIQ-CH2M HILL	Coordinate all field activities and sampling; track, store, and retrieve all laboratory and field supplies
Angelo Liberatore	H&S Officer	AGVIQ-CH2M HILL	Prepare H&S Plan; manage H&S for all field activities
TBD	SSC	AGVIQ-CH2M HILL	Oversee H&S for all field activities
Marcia Colon	Laboratory PM	ENCO	Manage samples being analyzed and maintain communication with project chemist
Molly Nguyen	Laboratory PM	EMAX Laboratories	Manage samples being analyzed and maintain communication with project chemist
Herb Kelly	Data Validator	AGVIQ-CH2M HILL	Validate laboratory data prior to data use

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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
No special training is required for this investigation.						

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

Project Name: Site 5 Supplemental RI **Projected Date(s) of Sampling:** March 2014 **PM:** Craig Miller - AGVIQ	**Site Name:** Site 5, Burning Grounds **Site Location:** SJCA, Chesapeake, Virginia

Date of Session: March 28, 2013

Scoping Session Purpose: A Proposed Plan (PP) for Site 5 documenting no further action (NFA) for all site media was submitted to USEPA and VDEQ for review in October 2012. In March 2013, USEPA submitted a comment on the PP that indicated groundwater needed to be sampled before USEPA would concur with NFA for the site (see Attachment A-1). USEPA indicated the sampling was needed in order to confirm that current cobalt concentrations in groundwater were lower than they were before the removal action was conducted at the site because the hazard index (HI) for cobalt using the groundwater data collected before the removal action was 20 based on the latest toxicity values. This scoping session was scheduled to discuss how additional cobalt groundwater data would be used and what the path forward would be in the event the cobalt concentrations were not lower than they were before the removal action.

Name	Title	Affiliation	Phone #	E-mail Address
Krista Parra	Lead Agency RPM	NAVFAC Mid-Atlantic	757-341-0395	krista.parra@navy.mil
Robert Stroud	Regulator RPM	USEPA Region 3	410-305-2748	stroud.robert@epa.gov
Karen Doran	Regulator RPM	VDEQ	804-698-4594	kmdoran@deq.virginia.gov
Janna Staszak	Contractor AM	CH2M HILL	757-671-6256	janna.staszak@ch2m.com
Adrienne Jones	Contractor Deputy AM	CH2M HILL	757-671-6236	adrienne.jones@ch2m.com

Summary of Decisions, Action Items, and Consensus Statements

Robert Stroud reiterated USEPA's stance that, because the removal action had been completed and the contaminant source had been removed, confirmation that metals in groundwater had been reduced needed to be addressed. Janna Staszak explained that potential source removal was just one of the lines of evidence for determining that NFA was necessary for groundwater following the removal action. She clarified that the removal action did not have an objective to reduce metals in groundwater since no chemicals of concern (COCs) were identified in groundwater.

Ms. Staszak explained that there appeared to be a correlation between pH and cobalt concentrations in the groundwater at the site; when pH was low, cobalt was high. Therefore, one pH measurement of the groundwater in each monitoring well in the area of historically-low groundwater pH at Site 5 was collected the week before the scoping session. The pH levels were still low, which indicated that the cobalt concentrations may be consistent with what they were before the removal action. Ms. Staszak explained that since USEPA indicated that additional sampling should be conducted to demonstrate that the cobalt concentrations in the groundwater have decreased following the removal action, the team should take into consideration that there is a probability that the concentrations are similar to the pre-removal action concentrations when discussing the path forward for groundwater.

The team discussed the uncertainty with the provisional reference dose (RfD) for cobalt; the Navy agreed that the 2002 RfD was too high but views the 2008 RfD as too conservative because it factored in many uncertainties. Ms. Staszek asked the team if risk management was still possible when taking into consideration the RfD uncertainty along with the other lines of evidence. Navy and Marine Corp Public Health Center suggested using both the 2002 and 2008 values as a risk management tool. Mr. Stroud suggested developing a new response to the USEPA comment highlighting those uncertainties but that does not include low quality and low yield of the aquifer as

lines of evidence; he would consult with his technical support using the updated comment response. The team agreed.

Karen Doran requested that USEPA define its expectations on the path forward in the event that additional groundwater samples were collected and the cobalt concentrations were not lower than they were before the removal action. Mr. Stroud indicated he would further discuss the approach with his technical support.

The team scheduled a conference call to discuss the new comment response and the path forward for Site 5. The following “if” portions of the “if/then” statements were developed:

- If cobalt concentrations in the groundwater after the removal action are lower than the cobalt concentrations in groundwater prior to the removal action, then…
  - Is a decreasing trend in the cobalt concentrations adequate, or does the HI need to be ≤1?
- If cobalt concentrations in the groundwater after the removal action are similar to the cobalt concentrations in the groundwater prior to the removal action, then…
- If cobalt concentrations in the groundwater after the removal action are higher than the cobalt concentrations in the groundwater prior to the removal action, then…

Action Krista Parra/Janna Staszak - Submit a new response to the USEPA comment expressing concern with cobalt concentrations in Site 5 groundwater.

Action Robert Stroud - Discuss potential additional groundwater sampling at Site 5 to develop the "then" portions of the "if/then" statements that would be associated with the sampling.

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

Project Name: Site 5 Supplemental RI **Projected Date(s) of Sampling:** March 2014 **PM:** Craig Miller - AGVIQ	**Site Name:** Site 5, Burning Grounds **Site Location:** SJCA, Chesapeake, Virginia

Date of Session: April 29, 2013

Scoping Session Purpose: Following the March 2013 scoping session, the Navy submitted a revised response to the USEPA comment concerning cobalt concentrations in groundwater (see Attachment A-2). The response provided additional information to support why additional groundwater sampling was not needed to achieve NFA at the site. The USEPA provided a response via email that they did not agree with the revised response and additional groundwater sampling was necessary (see Attachment A-3).The purpose of this scoping session was to agree on a path forward for the site.

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Summary of Decisions, Action Items, and Consensus Statements

The existing Site 5 shallow aquifer groundwater data and risk management considerations used to risk manage shallow aquifer groundwater in the Expanded RI (ERI) Addendum (CH2M HILL, 2007) were discussed. USEPA indicated that the justification being used to risk manage the groundwater needed to be stronger and more specific, especially the line of evidence stating the shallow aquifer would not be used for potable use because it is located in dredge fill and has low yield. Additionally, if there is no contaminant plume in the groundwater, that should be included as a line of evidence. USEPA suggested calculating central tendency exposure (CTE) risk numbers for groundwater. USEPA indicated that it would further review the ERI Addendum and provide a response concerning whether they agreed with NFA for groundwater without additional sampling.

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

Project Name: Site 5 Supplemental RI **Projected Date(s) of Sampling:** March 2014 **PM:** Craig Miller - AGVIQ	**Site Name:** Site 5 – Burning Grounds **Site Location:** SJCA, Chesapeake, Virginia

Date of Session: May 23, 2013

Scoping Session Purpose: Following the April scoping session, the USEPA indicated via email that, after reviewing the ERI Addendum, its stance had not changed and additional groundwater sampling for cobalt was necessary to determine whether cobalt concentrations were lower following completion of the removal action at the site (Attachment A-4). The purpose of this scoping session was to discuss the results of the Site 5 shallow aquifer groundwater risk calculations that were updated following the April scoping session (Attachment B) and develop the approach for conducting the groundwater sampling.

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Summary of Decisions, Action Items, and Consensus Statements

In preparation for the scoping session, CH2M HILL re-calculated human health risk using the most recent groundwater data (2006) and the current (2013) toxicity values. The updated Site 5 shallow aquifer groundwater human health risk calculation identified arsenic, chromium, cobalt, iron, manganese, and thallium as chemicals of potential concern (COPCs). Arsenic, iron, manganese, and thallium were identified as COPCs in the ERI Addendum human health risk assessment (HHRA) and risk managed, and the risk management considerations are still applicable. As recommended during the April 2013 conference call, the CTE risk for cobalt was calculated, and the CTE HI for cobalt was greater than 1 for the future adult resident and future child resident. Because chromium at Site 5 was not speciated, the HHRA assumed it was present in the hexavalent form, resulting in its identification as a COPC. However, chromium is usually present in the trivalent form, which is much less toxic. The maximum concentration of chromium (58.7 micrograms per liter [µg/L]) is below the maximum contaminant Level (MCL) (100 µg/L). The team agreed that chromium could be risk managed since it is below the MCL and developed the following consensus statement:

Consensus: The team agrees that no further action or investigation for chromium in shallow aquifer groundwater at Site 5 is required. Although the cancer risk for chromium (2.6×10^{-4} for ingestion by future adult/child residents, and 1.3×10^{-4} for dermal exposure by future adult/child residents conservatively assuming hexavalent chromium) is outside of the acceptable risk range of 10^{-4} to 10^{-6} based on the risk calculations updated in May 2013, the maximum detected concentration (58.7 µg/L) is less than the MCL (100 µg/L). [1]

Janna Staszak asked for team consensus that additional investigation could be limited to cobalt due to the risk management considerations and chromium consensus statement. Robert Stroud indicated that groundwater should be analyzed for all metals to have a complete newer set of data. Krista Parra indicated that since the

[1] This consensus was superseded by subsequent discussions.

concern is limited to cobalt, the additional sampling should be limited to cobalt and that analysis for all metals is not in line with the decision process set forth in the SAP.

The team discussed what type of monitoring was needed: confirmation of whether cobalt had increased or decreased, or a cobalt source and extent investigation. The Team discussed whether there was a way to determine whether cobalt in the groundwater was site-related. Ms. Staszak explained that additional data could be collected to help make that decision, but the data might not be conclusive. Ms. Parra indicated that if groundwater sampling is needed, the objective of the sampling should be to determine the presence/absence of cobalt, but additional information that could help with making decisions should also be collected. Karen Doran indicated that VDEQ agreed with NFA for groundwater and does not require additional sampling. Mr. Stroud indicated that it could be helpful to have VDEQ put its stance on groundwater (i.e., NFA is needed) in writing to USEPA.

Ms. Doran indicated she would provide a written summary of VDEQ's position on the path forward for groundwater at Site 5 to EPA. Ms. Doran and Mr. Stroud indicated they would participate in a call to determine the EPA/VDEQ position on the path forward for groundwater at Site 5 and notify the team of the regulatory conclusions/path forward so that, if needed, scoping could be conducted during the July partnering meeting.

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

Project Name: Site 5 Supplemental RI **Projected Date(s) of Sampling:** March 2014 **PM:** Craig Miller - AGVIQ	**Site Name:** Site 5 – Burning Grounds **Site Location:** SJCA, Chesapeake, Virginia

Date of Session: July 31, 2013

Scoping Session Purpose: Prior to this scoping session, USEPA and VDEQ discussed the path forward for Site 5 during a conference call. Following the conference call, USEPA indicated via email that because the risk number for cobalt changed in 2009, after the risk management decision that had been made for groundwater, they could not agree with NFA without an additional round of sampling at this time. The purpose of this scoping session was to develop the approach for the Site 5 groundwater investigation.

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Summary of Decisions, Action Items, and Consensus Statements

The team agreed to include in the SAP collection of the data that would be needed to conduct a treatability study if the results of the groundwater sampling indicate further action is needed.

The team agreed that the problem driving the investigation was that cobalt concentrations in shallow groundwater at Site 5 present an unacceptable risk to potential receptors based on current toxicity values. The Team developed the following objectives for the investigation:

- Confirm or deny the continued presence of elevated cobalt in groundwater.
- Determine if the burning and disposal operations that occurred at Site 5 are the likely cause of the elevated cobalt.
- Determine if additional monitoring or action is required, and if so, what action is appropriate.

The team discussed what types of data should be collected. Collection of groundwater data from the remaining Site 5 shallow aquifer monitoring wells SJS05-MW02S, SJS05-MW03S, SJS05-MW04S, and SJS05-MW05S was proposed for total and dissolved cobalt, pH (field and laboratory measurement), and conductivity (field measurement). Additionally, it was proposed that samples from SJS05-MW02S and SJS05-MW03S, located in the low pH groundwater area, be analyzed for anions to help determine the nature of the acidity at the wells.
Karen Doran asked why anions would not be needed at another monitoring well for comparison.
Robert Kleinmann indicated that analyzing for anions at another monitoring well could help in data evaluation; therefore, the Team decided to collect anion data at all of the Site 5 monitoring wells. Ms. Doran asked why conductivity data would be useful for the evaluation; Mr. Kleinmann responded that it provides information on total dissolved solids and could help determine the cause of the acidity if there is a difference in conductivity between locations, and it would help to identify where to apply control materials, if needed. Ms. Doran asked if iron and manganese analysis should be added. Mr. Kleinmann responded that the usefulness of that information would be limited; the primary advantage would be if a treatability study is needed, since iron would consume

some phosphate. The team agreed to add total and dissolved iron and manganese to the list of analytes for the Site 5 monitoring wells. The team discussed whether additional data were needed in the event that a treatability study needed to be conducted, and concluded that the same data (cobalt and anions) should be adequate.

Collection of groundwater samples from SJCA shallow aquifer background monitoring wells SJSBK-MW01S, SJSBK-MW02S, and SJSBK-MW03S and analysis of those samples for total and dissolved cobalt, pH (field and laboratory measurement), anions, and conductivity (field measurement) was proposed. The wells were selected because they have low pH levels. Ms. Doran expressed concern that there were not any background wells to sample that have the same hydraulic setting (in dredge fill and adjacent to a wetland) as the two Site 5 wells with elevated cobalt. The team agreed to the proposed data set and included background well SJSBK-MW06S in the well network and added total and dissolved iron and manganese to the list of analytes for the background wells. Ms. Doran asked if it would be useful to collect pH in the surface water in the area; Mr. Kleinmann indicated that organic acids from wetlands could cause a low pH, but that the groundwater pH may be too low for that to be the cause. The team decided to include field measurement of pH of surface water in the wetland area adjacent to, and downgradient of, SJS05-MW02S/MW03S.

Ms. Doran asked if any data were needed to reduce uncertainty associated with the groundwater flow velocity. Bob K responded that a monitoring well could be installed closer to the existing monitoring wells and a tracer test be conducted, or slug tests could be conducted using the existing wells to refine transient time. The team discussed whether installation of additional wells was needed, and concluded that the existing well network was adequate for the initial sampling event. The team agreed to make the SAP wording flexible to include slug tests and installation of additional wells if deemed necessary.

The team discussed the Project Action Limits (PALs) for the investigation. The team agreed that the PAL for cobalt would be the tapwater Regional Screening Level (4.7 µg/L) and the SJCA 95 percent upper tolerance level (UTL) groundwater background value (15.8 µg/L) for cobalt. The team established the followings Project Indicator Limits (PILs) for the indicator parameters:

- pH – correlation with cobalt concentrations
- Complete anion analysis (sulfate, chloride, phosphate, nitrate, and nitrite) – determining which of the anions are elevated can identify nature of the acidity, which may point to the source and would support remediation strategy (if remediation is needed)
- Iron and manganese – correlation with pH and cobalt concentrations, design of treatability study

The team decided that the data will be used to:

- Determine if elevated cobalt concentrations in shallow groundwater persist
- Determine the likely cause of cobalt in shallow groundwater
- Support an NFA decision for the site, if possible
  - If not possible, to support a final decision for the site

The team developed the following environmental questions to be addressed by the investigation and the corresponding if/then project quality objectives, as follows:

- Are current cobalt concentrations consistent with the most recent (2006) data?
  - If different (that is, less), then determine if potential risk is unacceptable.
  - If no risk, then stop investigation and submit NFA Record of Decision (ROD).
  - If risk, then further evaluate (other questions).
  - If different (that is, more), then further evaluate (other questions).

  - If consistent, then further evaluate (other questions).
- If current cobalt concentrations are different than 2006 concentrations, are increasing/decreasing trends evident?
  - If decreasing, then burning and disposal operations could have been the source. If other data do not identify another source, removal will address over time, so proceed with NFA ROD.
  - If increasing or no evident trend, then evaluate further to determine cause.
- If possible, determine if the historical waste disposal/burning operations can be linked to the elevated cobalt concentrations in Site 5 groundwater, or is another cause more likely?
  - If evaluation of lines of evidence indicates it is, and concentrations are decreasing, removal will address over time, so proceed with NFA ROD.
  - If evaluation of lines of evidence indicates it is, concentrations are not decreasing, and time since removal indicates expected effects, then plan treatability study.
  - If evaluation of lines of evidence indicates it is not, then proceed with NFA ROD.
- If cobalt is a result of historical waste disposal/burning operations, how can it be remediated?
  - If evaluation indicates that the presence of cobalt in groundwater is likely a result of waste disposal/burning operations and that removal has not yet addressed it, then evaluate potential remedial strategies in bench-scale tests.

Mr. Stroud indicated he would work with Mindi Snoparsky/USEPA to review the Site 5 supplemental RI scoping partnering presentation and provide feedback to the team on the proposed approach.

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

Project Name: Site 5 Supplemental RI **Projected Date(s) of Sampling:** March 2014 **PM:** Craig Miller - AGVIQ	**Site Name:** Site 5, Burning Grounds **Site Location:** SJCA, Chesapeake, Virginia

Date of Session: September 3, 2013

Scoping Session Purpose: Following the July 2013 scoping session, USEPA reviewed the approach the team had developed and indicated that the sampling should not be limited to cobalt; the full suite of metals should be analyzed for. The Navy issued a response that they disagreed with analyzing for full suite and provided rationale for not needing to collect full suite metals (Attachment A-5). The purpose of this scoping session was to agree on the path forward for the Site 5 shallow groundwater sampling.

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Summary of Decisions, Action Items, and Consensus Statements

Krista Parra asked USEPA to explain their position that full suite metals analysis should be performed for groundwater samples. Mindi Snoparsky indicated that the primary reason USEPA believes full suite metals is needed is because no confirmation sampling was conducted after the removal action. Linda Watson indicated that having full suite metals would give a better understanding of what is happening at the site. Bruce Beach noted he understands Navy's concern since pH was low in the groundwater before the removal action and the other metals were not an issue then so they should not be an issue now. He suggested that analyzing for full suite metals could be justified because having that data could help determine how remediation would affect other metals in groundwater. Janna Staszak clarified that all metals would not be needed for a benchscale or treatability study, if that path is necessary. Ms. Snoparsky indicated that the remedial action (RA) vendor would need more information than just cobalt data and that if it is determined that pH is the concern in groundwater, the source of the low pH should be determined. Ms. Snoparsky and Ms. Watson indicated that their technical recommendation to the RPMs is to analyze groundwater samples for full suite metals. The team noted the recommendation and scheduled a follow-up discussion without technical support.

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

Project Name: Site 5 Supplemental RI **Projected Date(s) of Sampling:** March 2014 **PM:** Craig Miller - AGVIQ	**Site Name:** Site 5, Burning Grounds **Site Location:** SJCA, Chesapeake, Virginia

Date of Session: September 4, 2013

Scoping Session Purpose: Team follow-up discussion to determine how to apply the USEPA technical input provided during the September 3, 2013, conference call.

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Summary of Decisions, Action Items, and Consensus Statements

Krista Parra indicated that NAVFAC was not comfortable returning to full-suite metals analysis at this stage of investigation. As a compromise, she proposed analyzing for all of the metals that had been identified as COPCs during the ERI and risk-managed in the ERI Addendum technical memorandum plus the new COPCs based on the updated 2013 risk calculations. Karen indicated that VDEQ supports the proposed compromise. Robert Stroud indicated that he would need to present the compromise to USEPA technical support for agreement. Janna Staszak indicated she would summarize the proposed NAVFAC compromise and email it to the team for use in soliciting technical support.

SAP Worksheet #9-7—Project Scoping Session Participants Sheet

Project Name: Site 5 Supplemental RI **Projected Date(s) of Sampling:** March 2014 **PM:** Craig Miller - AGVIQ	**Site Name:** Site 5, Burning Grounds **Site Location:** SJCA, Chesapeake, Virginia

Date of Session: November 14, 2013

Scoping Session Purpose: Following the September 4, 2013 scoping session, the proposed NAVFAC compromise approach was sent to the team to solicit technical support with the approach (Attachment A-6). VDEQ provided an email agreeing with the proposed approach (Attachment A-7). USEPA requested that the basis for the analyte list being proposed and sampling approach be provided in SAP format for review (Attachment A-8). USEPA also provided an email suggesting that the USEPA Ground Water Issue: Behavior of Metals in Soil guidance document (USEPA, 1992) be reviewed to support the analysis of additional metals (Attachment A-9).The purpose of this scoping session was to re-define the investigation objectives and approach based on the NAVFAC compromise approach.

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Summary of Decisions, Action Items, and Consensus Statements

The team agreed that the problem that needed to be addressed by the investigation is that it is not known whether the current concentrations of shallow aquifer groundwater COPCs identified in the 2007 ERI Addendum HHRA and the updated 2013 risk calculations pose unacceptable risk, and if so, whether they are the result of a CERCLA release that requires RA. The team determined that the environmental question to be answered by the investigation is, “Do current concentrations of shallow aquifer groundwater COPCs identified in the 2007 ERI Addendum HHRA and the updated 2013 risk calculations pose unacceptable risks that warrant further action?” The following Project Quality Objectives (PQOs) were identified:

- If no unacceptable risk (taking into consideration risk calculation, background, indicator parameters, soil data, etc.) is identified, then submit NFA PP and ROD.
- If unacceptable risk (taking into consideration risk calculation, background, indicator parameters, soil data, etc.) is identified and data are adequate to define the extent of the impacted groundwater or support development and evaluation of remedial alternative options, then conduct a treatability or feasibility study.
- If unacceptable risk (taking into consideration risk calculation, background, indicator parameters, soil data, etc.) is identified and data are not adequate to define the extent of the impacted groundwater or support development and evaluation of remedial alternative options, then collect contingency data and conduct a treatability or feasibility study.

The team decided to conduct a primary event and, based on the results of the primary event, determine if additional data should be collected during a contingency event. The primary event would consist of collection of groundwater samples and pH surface water measurements from the locations identified in the July 2013 scoping

session. The groundwater samples would be analyzed for the shallow aquifer groundwater COPCs identified in the 2007 ERI Addendum HHRA and the updated 2013 risk calculations and the following wet chemistry parameters: acidity, pH, anions (sulfate, chloride, total phosphorus, and nitrate), and dissolved organic carbon. Krista Parra indicated that the Navy reviewed the guidance document USEPA provided in the email they sent in response to the proposed compromise approach but did not think that it justified adding any metals to the analyte list being proposed.

The contingency event, if needed, would include installation of temporary monitoring wells to delineate the horizontal extent of the area of concern in the shallow aquifer groundwater. The sample locations would be determined based on the results of the primary event. Additionally, any of the existing Site 5 shallow aquifer monitoring wells may be sampled and additional surface water pH measurements may be collected during the contingency event if it is determined the data may be useful in delineating the area or supporting a treatability or feasibility study[2]. The groundwater samples would be analyzed for the metals that were determined to pose unacceptable risk based on the results of the primary event data evaluation and/or any of the wet chemistry parameters analyzed for in the primary event if it is deemed the data may be useful in delineating the area or support a treatability or feasibility study.

[2] The team also discussed collecting slug test data at the site during the contingency event and decided to collect it during the primary event as a line of evidence supporting that any CERCLA-related release to groundwater that may have occurred at the site would no longer be present due to groundwater flow rate. However, during development of the SAP, the team decided slug test data did not need to be collected during the Supplemental RI because slug test data for the shallow aquifer at the site had been collected during the RI and there was no reason to believe the results would be any different at this time.

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SAP Worksheet #10—Conceptual Site Model

Site 5 encompasses an area of approximately 23 acres in the northeastern portion of SJCA (**Figure 1**). Currently, the site is seldom used; use is primarily associated with radar testing. Operations began at the Burning Grounds in the 1930s when waste ordnance materials were disposed by open burning on three main pads. Additional debris, such as large steel plates and metal from buildings, were also disposed at the site. In mid-1977, the site was used for facility-wide ordnance equipment and material decontamination, which included filling equipment with oil and straw and burning it. After the decontamination process, the ground was covered with oil and straw, burned, disced, and burned again; samples were then collected to certify decontamination was complete. Historical aerial photographs indicated that prior to its use as a burning ground and disposal area, Site 5 and much of the adjacent area had been used for placement of dredge spoil material that reportedly originated from Blows Creek and the Southern Branch of the Elizabeth River. Site 6, a former ERP site that was closed under a NFA ROD in September 2003, is located within the east-central portion of Site 5 (**Figure 2**).

Site 5 consists of mixed land cover including a forested area in the southern portion, a wetland in the central portion, and open fields. The wetland area extends beyond the border of Site 5 to Blows Creek (**Figure 2**). The wetland area within Site 5 is predominantly supported by surface water runoff and does not typically maintain standing water, except during and after storm events. The topography is generally level and slopes gently towards Blows Creek, with elevations ranging from 8 feet above mean sea level (amsl) in the northern portion of the site to 0 feet amsl in the southern portion of the site at Blows Creek. Surface water at Site 5 drains either naturally via overland flow or through unlined man made drainage ditches to Blows Creek. Vegetated drainage ditches (1 to 3 feet deep) reduce runoff onto the site from adjacent areas.

The groundwater within the unconfined Columbia aquifer beneath Site 5 (referred to in this report as the shallow aquifer) is encountered at relatively shallow depths (e.g., 2 to 6 feet below the ground surface [bgs]) and extends to the Yorktown confining unit at a depth ranging between 14 and 22 feet bgs. Groundwater at the site discharges primarily to Blows Creek (**Figure 2**). Based on slug tests conducted at the site, the average hydraulic conductivity is approximately 8 feet/day with a standard deviation of 4 feet/day (CH2M HILL, 2003). Groundwater is not used as a potable resource at SJCA; public water is supplied to SJCA and the surrounding area by the City of Chesapeake Waterworks. Although groundwater is not currently used as a potable water supply, it could be used in the future if the site is closed with no further action.

Based on mapping from the 1983 U.S. Department of Agriculture, the Site 5 area is located in the Dredge Fill and Munden-Tetotum (east of Cradock Street only) soil types (CH2M HILL, 2001). The Munden-Tetotum soils are defined as moderately well-drained soils that have a subsoil of sandy loam or clayey loam. Dredge fill consists of poorly sorted silt and clay with thin lenses of fine sand. Based on uncertainty in mapping and dredge filling suspected over the entire site area, the SJCA Project Management Team (representatives from the Navy, USEPA, and VDEQ) agreed to classify soils east of Cradock Street as Dredge Fill soils (CH2M HILL, 2006) (**Figure 3**).

Potential human health risks from future hypothetical exposure to groundwater from potable use at Site 5 were evaluated and documented in the RI for Sites 3, 4, 5, and 6 (CH2M HILL, 2003), ERI for Site 5 (CH2M HILL, 2006), and Addendum to the ERI for Site 5 (CH2M HILL, 2007). Potential unacceptable risks were identified from exposure to metals (aluminum, arsenic, beryllium, cadmium, iron, lead, manganese, thallium, and vanadium) in shallow aquifer groundwater. The SJCA ERP Partnering Team agreed to risk manage shallow groundwater at Site 5 with NFA based on several lines of evidence provided in the ERI Addendum.

Potential human health and ecological risks from exposure to soil, sediment, and surface water at Site 5 were evaluated and documented in the RI for Sites 3, 4, 5, and 6 (CH2M HILL, 2003) and ERI for Site 5 (CH2M HILL, 2006). Potential unacceptable human health and ecological risks were identified from exposure to buried waste and metals, volatile organic compounds, semi-volatile organic compounds, pesticides/ polychlorinated biphenyls,

explosives, and dioxins and furans in surface soil and sediment. A non-time-critical removal action to mitigate the potential unacceptable risks associated with waste, soil, and sediment was initiated in 2007 and completed in July 2012. Documentation that the cleanup goals were achieved and the removal action was conducted to the extent that is protective of human health is provided in the confirmation sampling report (CH2M HILL, 2012). The construction closeout report, documenting the activities completed during the removal action and that the objectives of the removal action were met, was completed in December 2012 (AGVIQ-CH2M HILL, 2012). A total of 32,960 tons of soil and sediment was removed and sent offsite for disposal, and excavated areas were backfilled with sand and topsoil and graded to provide positive storm water drainage and prevent ponding.

Following completion of the removal action, which mitigated the unacceptable risks at the site that had required action, a NFA PP was drafted and submitted to USEPA and VDEQ for review. During the review, concerns were raised concerning the HI for exposure to cobalt in the groundwater, which was much higher than the HI calculated in the ERI Addendum because of a more conservative toxicity value that had been established for cobalt. Additionally concerns were raised concerning the lines of evidence used to risk manage some of the other COPCs that had been identified in the groundwater during the ERI Addendum. The human health risk calculations for shallow aquifer groundwater were updated in May 2013 using the current toxicity values (**Attachment B**). In addition to the metals that were identified as COPCs in the ERI Addendum (aluminum, arsenic, beryllium, cadmium, iron, lead, manganese, thallium, and vanadium), the updated risk calculations identified chromium and cobalt as COPCs. Based on further review of the Site 5 groundwater data, the monitoring wells where the highest concentrations of the COPCs were detected (SJS05-MW02S and SJS05-MW03S) are the same wells where low pH has been measured (pH levels as low as 2). The COPCs concentrations and pH detected at the Site 5 shallow aquifer monitoring wells are shown in **Table 1**. The low pH could be the reason cobalt is elevated in the groundwater, since low pH can cause metals to mobilize. However, the cause of the low pH in the groundwater is unknown. Therefore, additional groundwater data are needed to determine if the metals that were identified as COPCs in the ERI Addendum and May 2013 risk calculations are currently present in the shallow aquifer groundwater at the site at concentrations that pose unacceptable risks and if they are, whether they are the result of a CERCA release.

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

Table 2 identifies the problem and investigation objective, defines the environmental question to be answered, and lists the PQOs.

Table 2 - Problem Definition/Objective, Environmental Question, and PQOs

Problem Definition/ Objective	Environmental Question	PQOs
It is not known whether the current concentrations of shallow aquifer groundwater COPCs identified in the 2007 ERI Addendum HHRA and the updated 2013 risk calculations pose unacceptable risk, and if so, whether they are the result of a CERCLA release that requires RA.	Do current concentrations of the shallow aquifer groundwater COPCs identified in the 2007 ERI Addendum HHRA and the updated 2013 risk calculations pose unacceptable risks that warrant further action?	– If there are no unacceptable risks that warrant further action (considering multiple lines of evidence*), then submit NFA PP and ROD. – If there are unacceptable risks that warrant further action (considering multiple lines of evidence*) and data are adequate to define the extent of the impacted groundwater or support development and evaluation of RA options, then conduct a treatability or feasibility study. – If there are unacceptable risks that warrant further action (considering multiple lines of evidence*) and data are not adequate to define the extent of the impacted groundwater or support development and evaluation of RA options, then collect contingency data and conduct a treatability or feasibility study.

***** Lines of evidence include background data, Site 5 soil data, indicator parameters, surface water pH from the adjacent wetlands, and Site 5 shallow aquifer hydraulic conductivity.

Investigation Approach and Types of Data Needed

The general investigation approach is shown in the decision tree on **Figure 4** and additional details are provided below.

The primary sampling event will be conducted as soon as reasonably possible after this SAP is finalized. The sampling event will consist of groundwater and surface water data collection. One round of groundwater samples will be collected from the four existing Site 5 shallow aquifer monitoring wells (SJS05-MW02S, SJS05-MW03S, SJS05-MW04S, and SJS05-MW05S)[3] and four of the SJCA background monitoring wells[4] that are closest to the site, reflect upgradient conditions, and/or are in locations that have similar characteristics (SJSBK-MW01S, SJSBK-MW02S, SJSBK-MW03S, and SJSBK-MW06S) (**Figure 3**). The COPCs concentrations and pH at the background wells that will be sampled are provided in **Table 3**. The groundwater samples will be analyzed at an offsite laboratory for the total and dissolved metals that were identified as COPCs in the shallow aquifer groundwater in the 2007 ERI Addendum HHRA and the updated 2013 risk calculations (aluminum, arsenic, beryllium, cadmium, chromium, cobalt, iron, manganese, lead, thallium, and vanadium). In order to help determine the cause of any elevated metals, the samples will also be analyzed by an offsite laboratory for pH, acidity, anions (sulfate, chloride, total phosphorus, and nitrate), and dissolved organic carbon; and field measurements of pH and specific conductivity

[3] Shallow aquifer monitoring well SJS05-MW01S was abandoned during the removal action.

[4] The background data collected during the Supplemental RI will be qualitatively evaluated during the multiple lines of evidence evaluation. The data will not be used to update the SJCA 95 percent groundwater background UTLs, which were established in the Final Background Investigation Report Addendum for Groundwater (CH2M HILL, 2004).

will be collected at each monitoring well that will be sampled. A field pH measurement will be collected from one location in the wetland area adjacent to the low pH groundwater area and one location downgradient of the low pH groundwater area to aid in determining the cause of the low pH in groundwater.

Human health risks will be calculated using the metals data collected during the primary event to determine if current metals concentrations pose potential unacceptable risk. If any unacceptable risks are identified, a multiple lines of evidence will be evaluated to determine if the risks are the result of a CERCLA release. The multiple lines of evidence evaluation will include consideration of background data, Site 5 soil data, indicator parameters, surface water pH from the adjacent wetlands, and Site 5 shallow aquifer hydraulic conductivity.

A contingency sampling event will be conducted if the results of the primary sampling event identify additional data is needed. The types of data that will be collected during the contingency sampling event will be based on the results of the primary sampling event data evaluation. The contingency event may include installation of temporary monitoring wells to delineate the horizontal extent of the area of concern in the shallow aquifer groundwater. The sample locations will be determined based on the results of the primary event. Additionally, any of the existing Site 5 shallow aquifer monitoring wells may be sampled and additional surface water pH measurements may be collected during the contingency event if it is determined that the data may be useful in delineating the area or supporting a treatability or feasibility study. The groundwater samples will be analyzed for the metals that were determined to pose unacceptable risk based on the results of the primary event data evaluation and/or any of the wet chemistry parameters analyzed for in the primary event if it is deemed that the data may be useful in delineating the area or support a treatability or feasibility study.

Samples will be collected in accordance with the AGVIQ-CH2M HILL standard operating procedures (SOPs) (see **Worksheet #14**). There are no special data quality needs, field or laboratory, to support environmental decisions.

Project Action Limits

The PALs for the select total and dissolved metals have been established as the higher value between the residential RSLs (USEPA, 2013) and the SJCA 95% UTL background values. The PALs are provided on **Worksheet #15**. The PILs and an explanation of how they will be used are presented in **Table 4**. The evaluation of the data and determination of the path forward will be in accordance with the PQOs (**Table 2**).

Table 4 - PILs

Parameter	PIL	Justification
Dissolved Iron, Manganese, Aluminum	> 2 milligram per liter (mg/L)	Indicates iron, manganese, aluminum can be contributing mineral acidity to groundwater
pH	≤ 4.5	Indicates groundwater is acidic enough to potentially be mobilizing metals
Acidity	N/A	Could indicate source of low pH, when considered along with the other parameters
Specific Conductivity	N/A	Indicates salinity (total dissolved solids) of the water; could indicate source of low pH, when considered along with the other parameters
Sulfate	> 250 mg/L	Indicates dredged materials are potential source of low pH because sulfate is commonly associated with acid water generated by the natural process of pyrite oxidation
Chloride	> 250 mg/L	Indicates elevated electrical conductivity readings could be associated with the coastal environment

Nitrate	>10 mg/L	Indicates there may be an unnatural source for nitrate, which may be reducing pH
Total Phosphorus	N/A	Establishes baseline concentration to support potential evaluation of remedial alternatives
Dissolved Organic Carbon	>10 mg/L	Potentially indicative of organic acids that could, for instance, have been generated in the wetland areas and could be reducing pH

Worksheet #15 presents analytical methodology and limits. In addition to listing the particular analytes, PALs, and limits, it also identifies where limits of detection (LODs) are greater than PALs. Although this information was considered when planning the analytical protocol for the site and may lead to some uncertainty, it does not prevent conclusions from being drawn with respect to the objectives of the Supplemental RI. Even though some LODs are greater than their respective PALs, detection limits (DLs) are closer to and may be less than the applicable PALs. The laboratory instrumentation would likely detect a constituent if present at a concentration greater than its DL; such a result would be reported as estimated (J-qualified) because it is less than the limit of quantitation (LOQ). Non-detects greater than the PALs will not be treated as exceedances, but will be included in the uncertainty evaluation section of the risk assessment.

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

Matrix: Groundwater
Analytical Group: Select Total and Dissolved Metals[1]

QC Sample[2]	Analytical Group	Frequency	Data Quality Indicators	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Total and Dissolved Metals	1 per 10 field samples of similar matrix	Precision	Relative Percent Difference (RPD) ≤ 25 percent	S&A
Equipment Rinseate Blank		1 per week of sampling	Bias / Contamination	No target analytes detected > 1/2 Limit of Quantitation (LOQ)	S&A
Cooler Temperature Indicator		1 per cooler to the laboratory	Representativeness	Temperature ≤ 6 °C, not frozen	S

[1]Refer to **Worksheet #15** for complete list of metals.

[2]Matrix spike/matrix spike duplicates (MS/MSDs) are described in **Worksheet #28.**

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

Matrix: Groundwater
Analytical Group: Wet Chemistry[1]

QC Sample[2]	Analytical Group	Frequency	Data Quality Indicators	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Cooler Temperature Indicator	Wet Chemistry	1 per cooler to the laboratory	Representativeness	Temperature ≤6 °C, not frozen	S
Field Duplicate[3]	Wet Chemistry	1 per 10 field samples of similar matrix	Precision	Relative Percent Difference (RPD) ≤25 percent	S&A

[1]Refer to **Worksheet #15** for a complete list of analytes.
[2]MS/MSDs are described in **Worksheet #28.**
[3]Field duplicates for wet chemistry will be analyzed for pH only.

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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
Existing SJCA background groundwater data	*Background Investigation Report Addendum for Groundwater (CH2M HILL, 2004)*	CH2M HILL	Help determine whether metals that pose unacceptable risk may be the result of something other than a CERCLA release at the site.	None

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SAP Worksheet #14—Summary of Project Tasks

The field activities will be conducted in accordance with the SOPs listed on **Worksheet #21** and provided in **Attachment C**. Relevant site-specific observations, onsite conditions, and sampling activities will be logged in the field notebook, as detailed in SOP-001. Additional details are provided as follows.

Fieldwork Preparation

Project instructions and a project-specific H&S Plan for the primary and contingency, if needed, field events will be prepared. The field team, PM, AM, AQM, and project chemist will conduct a project kickoff meeting to discuss logistics and review the project instructions and H&S Plan prior to mobilization. Prior to any intrusive activities, the site will be marked for utilities by Miss Utility and a separate utilities subcontractor will be procured to ensure the accuracy of the utility markings (SOP-002).

Monitoring Well Redevelopment

All the monitoring wells that will be sampled (**Figure 3**) will be redeveloped during the primary sampling event prior to sampling because they have not been sampled for almost 10 years. Redevelopment will consist of removing water from each well using a submersible Whale pump and a surge block. Development will continue until at least three well volumes of water have been removed and the water quality parameters have stabilized and the turbidity of the discharge water is substantially reduced. Water quality information, including turbidity, pH, specific conductivity, and temperature will be measured using a YSI meter during development and recorded in the field logbook (SOP-003). The groundwater levels and total well depth will be measured to the nearest 0.01 foot from the top of the polyvinyl chloride (PVC) casing using a water level indicator (SOP-004), prior to and after development. The development water will be contained in 55-gallon drums for offsite disposal.

Temporary Monitoring Well Installation and Abandonment

If the results of the primary field event indicate that additional data is needed, temporary monitoring wells may be installed during the contingency event to horizontally delineate the area of impacted groundwater at Site 5. The locations of the temporary wells will be based on the results of the primary sampling event and will be established by the SJCA ERP Partnering Team. A global positioning system (GPS) will be used to collect coordinates for the temporary monitoring wells (SOP-005).

The temporary monitoring wells will be installed using direct push technology (DPT), extending from the ground surface to the Yorktown confining unit. Two-inch rods with disposable end points will be driven to the total well depth. A 1-inch PVC well with a 10-foot screen pre-packed with #1 silica sand will be installed in the casing and subsequently the rods will be removed, leaving only the well and disposable endpoint in the ground. Soil will be allowed to collapse around the well casing. Any remaining annular space will be filled with #1 silica pack sand.

The temporary wells will be abandoned upon determination that additional data is not needed. The abandonment will be conducted following sampling (SOP-006). The PVC portion of the well will be removed using a winch attached to the DPT rig. Once the PVC is removed, the remaining void will be filled with bentonite chips or pellets.

Groundwater Sampling

Groundwater samples will be collected from the eight monitoring wells shown on **Figure 3** during the primary sampling event. Additionally, groundwater samples may be collected from temporary monitoring wells if a contingency sampling event is conducted. Water levels will be measured in all of the monitoring wells using a water level indicator prior to sampling (SOP-004). The groundwater samples will be collected using a peristaltic pump following low-flow sampling protocol (SOP-007). Groundwater quality parameters (pH, specific conductivity, turbidity, dissolved oxygen [DO], temperature, salinity, and oxidation-reduction potential [ORP]) will be measured during purging using a YSI (SOP-003). The DO measurement will be confirmed using a CHEMetrics test kit in accordance with the manufacturer's instructions. Dissolved metal samples will be field-filtered. The samples will be collected in laboratory-prepared sampling containers, packed on ice, and shipped overnight with a chain of custody to an offsite laboratory every evening (SOP-008 and SOP-009).

Quality Control Sampling

The QC samples that will be collected are outlined in **Worksheet #20**. The QC samples will be collected in laboratory-prepared sampling containers, packed on ice, and shipped overnight to an offsite laboratory every evening (SOP-008, SOP-009, and SOP-010).

Equipment Decontamination

All non-disposable sampling equipment and the DPT rig (if used) will be decontaminated before use and immediately after each use (SOP-011 and SOP-012, respectively). The water level indicator will be scrubbed with deionized water between each measurement. Decontamination water will be collected and handled as investigation-derived waste .

Sample Analysis

The laboratory will maintain, test, inspect, and calibrate analytical instruments (**Worksheets #24 and #25**). The laboratory will analyze samples as shown on **Worksheet #18**. All analysis will be conducted at a laboratory that possesses a Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) accreditation letter (see **Worksheet #31**). A signed certificate of analysis will be provided in the narrative section of each laboratory data package. The laboratory will submit the data in hard copy and electronic format.

Data Management

The AGVIQ-CH2M HILL project chemist will track the samples from collection through analysis and data validation. The validated data will be uploaded to the Navy Installation Restoration Information Solution (NIRIS) database. For more details on the data management process, see **Worksheets #34 through 36.**

Data Validation

The analytical data will be validated in accordance with the procedures established in **Worksheets #35 and #36.**

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

Matrix: Groundwater
Analytical Group: Select Total Metals

Analyte	Chemical Abstracts Service (CAS)	RSL Tapwater (µg/L)	SJCA 95 percent UTL Background (µg/L)[1]	PAL (µg/L)[2]	Project Quantitation Limit (PQL) Goal[3] (µg/L)	Laboratory Limits (µg/L)			Laboratory Control Sample (LCS) and Matrix Spike (MS)/MS Duplicate (MSD) Recovery Limits and RPD[4](percent)		
						LOQ	LOD	DL	LCL	UCL	RPD
Aluminum	7429-90-5	1,600	1,710	1,710	570	400	200	38.0	80	120	20
Arsenic	7440-38-2	0.045	8	8	2.66	15.0	10.0	0.610	80	120	
Beryllium	7440-41-7	1.6	1.4	1.6	0.533	1.00	0.500	0.150	80	120	
Cadmium	7440-43-9	0.69	0.74	0.74	0.246	8.00	4.00	0.11	80	120	
Chromium (total)	7440-47-3	1,600	3.2	1,600	1.07	5.00	3.00	0.450	80	120	
Chromium (hexavalent)	18540-29-9	0.031	NC	0.031	0.010	0.05	0.025	0.017	**80**	**120**	
Cobalt	7440-48-4	0.47	15.8	15.8	5.27	1.00	0.840	0.210	80	120	
Iron	7439-89-6	1,100	107,000	107,000	35,666	100	50.0	10.0	80	120	
Lead	7439-92-1	15	3.5	15	5	40.0	20.0	2.30	80	120	
Manganese	7439-96-5	32	13,700	13,700	4,566	20.0	10.0	0.150	80	120	
Thallium	7440-28-0	0.016	7.6	7.6	2.53	0.400	0.230	0.058	80	120	
Vanadium	7440-62-2	6.3	13.7	13.7	4.57	20.0	10.0	0.830	80	120	

Notes:

Shading indicates instances where the laboratory LOD is greater than the screening level. Refer to **Worksheet #11** for a discussion on data usability when the LOD is above the PAL.

[1]The SJCA 95 percent UTL Background values were established in the Final Background Investigation Report Addendum for Groundwater (CH2M HILL, 2014).

[2]The PAL is the higher of the RSL (based on hazard quotient of 0.1 for noncarcinogens and cancer risk of $1x10^{-6}$ for carcinogens) and Background values for each constituent.

[3]PQL goals are equal to one-third of the minimum applicable criteria (PAL).

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

Bolded values represent in-house limits when DOD QSM v4.2 limits do not exist.

NC indicates that there is no criterion for an analyte.

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

Matrix: Groundwater
Analytical Group: Select Dissolved Metals

Analyte	CAS	RSL Tapwater (µg/L)	SJCA 95 percent UTL Background[1] (µg/L)	PAL (µg/L)[2]	PQL Goal[3] (µg/L)	Laboratory Limits (µg/L)			LCS and MS/MSD Recovery Limits and RPD[4] (percent)		
						LOQ	LOD	DL	LCL	UCL	RPD
Aluminum	7429-90-5	1,600	399	1,600	533	400	200	38.0	80	120	20
Arsenic	7440-38-2	0.045	2.4	2.4	0.8	15.0	10.0	0.610	80	120	
Beryllium	7440-41-7	1.6	0.31	1.6	0.533	1.00	0.500	0.150	80	120	
Cadmium	7440-43-9	0.69	0.78	0.78	0.26	8.00	4.00	0.11	80	120	
Chromium (total)	7440-47-3	1,600	5.8	1,600	1.93	5.00	3.00	0.450	80	120	
Chromium (hexavalent)	18540-29-9	0.031	NC	0.031	0.010	0.05	0.025	0.017	**80**	**120**	
Cobalt	7440-48-4	0.47	15	15	5	1.00	0.840	0.210	80	120	
Iron	7439-89-6	1,100	94,000	94,000	31,333	100	50.0	10.0	80	120	
Lead	7439-92-1	15	2.1	15	5	40.0	20.0	2.30	80	120	
Manganese	7439-96-5	32	11,800	11,800	3,933	20.0	10.0	0.150	80	120	
Thallium	7440-28-0	0.016	7.9	7.9	2.63	0.400	0.230	0.058	80	120	
Vanadium	7440-62-2	6.3	7.1	7.1	2.37	20.0	10.0	0.830	80	120	

Notes:

Shading indicates instances where the laboratory LOD is greater than the screening level. Refer to **Worksheet #11** for a discussion on data usability when the LOD is above the PAL.

[1]The SJCA 95 percent UTL Background values were established in the Final Background Investigation Report Addendum for Groundwater (CH2M HILL, 2014).

[2]The PAL is the higher of the RSL (based on hazard quotient of 0.1 for noncarcinogens and cancer risk of $1x10^{-6}$ for carcinogens) and Background values for each constituent.

[3]PQL goals are equal to one-third of the minimum applicable criteria (PAL).

[4]DoD QSM v.4.2 is the basis for LCS and MS/MSD limits.

Bolded values represent in-house limits when DOD QSM v4.2 limits do not exist.

NC indicates that there is no criterion for an analyte.

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

Matrix: Groundwater
Analytical Group: Wet Chemistry

Analyte	CAS[1]	PIL (mg/L)[2]	Laboratory Limits (µg/L)			LCS and MS/MSD Recovery Limits and RPD[3] (percent)		
			LOQ	LOD	DL	LCL	UCL	RPD
Acidity	-16	NA	5	5	5	**90**	**110**	**10**
Chloride	16887-00-6	250	5.0	1.2	0.29	**90**	**110**	**10**
Dissolved Organic Carbon	DOC	10	1	0.64	0.32	**85**	**115**	**21**
Nitrate	14797-55-8	10	1.00	0.21	0.052	**80**	**120**	**10**
pH	PH	NA	NA	NA	NA	**99**	**102**	**25**
Sulfate	14808-79-8	250	5.0	0.26	0.066	**90**	**110**	**10**
Total Phosphorus	7723-14-0	NA	0.078	0.039	0.02	**90**	**110**	**10**

Notes:
[1]Some CAS numbers are contractor-specific.
[2]PILs were established to assist with determining the cause of any elevated metals detected at the site. Refer to **Worksheet #11** for discussion on the development of PILs.
[3]DoD QSM v.4.2 is the basis for LCS and MS/MSD limits. **Bolded values represent in-house limits when DOD QSM v4.2 limits do not exist.**

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SAP Worksheet #16—Project Schedule/Timeline Table

Activities	Organization	Dates		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Primary Sampling Event					
Field Work Preparation/Field Sampling[1]	AGVIQ-CH2M HILL	April 2014	April 2014	None	None
Laboratory Analysis	ENCO, EMAX	April 2014	May 2014	Electronic data deliverables (EDDs) and data hardcopies	7 calendar days after sample receipt for Level IV package and EDD
Data Management	AGVIQ-CH2M HILL	May 2014	June 2014	None	None
Data Validation and Usability Assessment	AGVIQ-CH2M HILL	May 2014	May 2014	Data Validation Report and Data Usability Assessment	14 days following receipt of data
Reporting[2]	AGVIQ-CH2M HILL	May 2014	September 2014	Site 5 Supplemental RI Report	September 2014 (final report date)

[1]The dates are based on the current partnering team schedule; however, the primary sampling event will be conducted as soon as possible and may be conducted before April 2014, if possible.

[2]Reporting schedule assumes contingency event is not needed. If the contingency sampling event is needed, it will be conducted as soon as possible following determination that it is needed and reporting of the primary sampling event will be conducted with the contingency sampling reporting.

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SAP Worksheet #17—Sampling Design and Rationale

Primary Sampling Location (see Figure 3)	Matrix	Depth of Samples		Analysis and Analysis Method	Primary Number of Samples	Rationale	Sampling Strategy
SJS05-MW02S	Groundwater	Middle of monitoring well screen interval:	3.5 – 13.5 feet bgs	Total and dissolved select metals (SW-846 6010C/6020A, SW-846 7199_Low Level), and Wet Chemistry (EPA 300.0, EPA 365.4, EPA 305.1, SW-846 9060, SW-846 9040C)	1	One round of groundwater samples will be collected from the four existing Site 5 shallow aquifer monitoring wells (SJS05-MW02S, SJS05-MW03S, SJS05-MW04S, and SJS05-MW05S) and four of the SJCA background monitoring wells that are closest to the site, reflect upgradient conditions, and/or are in locations that have similar characteristics (SJSBK-MW01S, SJSBK-MW02S, SJSBK-MW03S, and SJSBK-MW06S). The groundwater samples will be analyzed for the total and dissolved metals that were identified as COPCs in the shallow aquifer groundwater in the 2007 ERI Addendum HHRA and the updated 2013 risk calculations. In order to help determine the cause of any elevated metals, the samples will also be analyzed for the following wet chemistry parameters: pH, acidity, anions (sulfate, chloride, total phosphorus, and nitrate), and dissolved organic carbon. Water quality parameters, including pH and specific conductivity, will be field-measured at each monitoring well that will be sampled. See **Worksheet #11.**	See **Worksheets #11** and **#14.**
SJS05-MW03S			3.2 – 13.2 feet bgs		1		
SJS05-MW04S			3 - 13 feet bgs		1		
SJS05-MW05S			4 -14 feet bgs		1		
SJSBK-MW01S			3 – 13 feet bgs		1		
SJSBK-MW02S			3 – 13 feet bgs		1		
SJSBK-MW03S			3 – 13 feet bgs		1		
SJSBK-MW06S			5 – 15 feet bgs		1		

Note: Sample locations and associated sampling information included in table is for the primary sampling event because the contingency sample locations, analyses, and depth for each location will be dependent upon the results of the primary sampling event. If the contingency sampling event is required because the primary event indicates there are risks above target levels that are the result of a CERCLA-related release, the sample locations (including potential temporary monitoring well locations) will be selected in order to horizontally delineate the extent of the metals that were analyzed for in the primary sampling event that pose unacceptable risk and warrant further action. The samples may also be analyzed for any of the wet chemistry parameters that were analyzed for in the primary event.

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

Primary Sampling Event Location/ Identification Number	Matrix	Depth	Analytical Group	Number of Samples	Sampling SOP Reference
SJS05-MW02S-YYQ	Groundwater	Middle of monitoring well screen (See **Worksheet # 17** for monitoring well screen intervals)	Total and Dissolved Select Metals and Wet Chemistry	1	See **Worksheet #21.**
SJS05-MW03S-YYQ				1	
SJS05-MW04S-YYQ				1	
SJS05-MW05S-YYQ				1	
SJS05-MWXXSP-YYQ				1	
SJS05-MWXXS-YYQ-MS				1	
SJS05-MWXXS-YYQ-SD				1	
SJSBK-MW01-YYQ				1	
SJSBK-MW02-YYQ				1	
SJSBK-MW03-YYQ				1	
SJSBK-MW06-YYQ				1	
SJS05-EBMMDDYY	Equipment Blank	N/A		1 per week	

Notes:

Sample locations and associated sampling information included in table is for the primary sampling event because the contingency sample locations, analyses, and depth for each location will be dependent upon the results of the primary sampling event. If the contingency sample event is required, the same nomenclature will be used for the samples collected from monitoring wells. Samples collected from temporary monitoring wells will use the following nomenclature: SJS05-TW01-YYQ, and so forth sequentially.

DD = Day of sampling

MM = Month of sampling

YY = Last two digits of the year of sampling

Q = Quarter of sampling (example: January-March = A, and so forth)

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SAP Worksheet #19—Analytical SOP Requirements Table

Matrix	Analytical Group[1]	Analytical and Preparation Method / SOP Reference	Containers	Minimum Sample Amount Required for Analysis	Preservation Requirements	Maximum Holding Time[2] (Preparation/Analysis)
Groundwater	Total Metals	SW-846 3010, 6010C, 6020A / EXMT-07, EXMT-12, MET-05, MET-15	250 milliliter (mL) HDPE	200 mL	HN03 to pH <2, cool to <6 degrees Celsius (°C)	6 months
		SW-846 7199 Low Level / EMAX-7199	125 mL HDPE	20 mL	cool to <6°C	24 hours. Samples may be preserved in the field with ammonium hydroxide-ammonium sulfate buffer solution (pH = 9-9.5) to extend holding time to 28 days.
	Dissolved Metals (field filtered)	SW-846 3010, 6010C, 6020A / EXMT-07, EXMT-12, MET-05, MET-15	250 mL HDPE	200 mL	Filter through a 0.45 um membrane, $HN0_3$ to pH <2, cool to <6°C	6 months
		SW-846 7199 Low Level / EMAX-7199	125 mL HDPE	20 mL	Filter through a 0.45 um membrane, cool to <6°C	24 hours. Samples may be preserved in the field with ammonium hydroxide-ammonium sulfate buffer solution (pH = 9-9.5) to extend holding time to 28 days.
	Wet Chemistry	EPA 300.0 / WETS-092	250 mL HDPE	150 mL	cool to <6°C	48 hours (NO_3) 28 days (SO_4, Chloride)
		EPA 365.4 / WETS-063	250 mL HDPE	50 mL	H_2SO_4 to pH <2, cool to <6°C	28 days
		SW-846 9040C / WETS-014	250 mL HDPE	50 mL	cool to <6°C	As soon as possible
		EPA 305.1/ WETS-003		50 mL	cool to <6°C	14 days
		SW-846 9060 / WETS-066	40 mL Vial	40 mL	Filter through a 0.45 um membrane, H_3PO_4 to pH <2, cool to <6°C	28 days

Notes:
[1] Refer to **Worksheet #18** for details regarding analytical groups to be tested for each media.
[2] Holdtime is from the time of sample collection, not the time of sample receipt.
HDPE = high density polyethylene

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SAP Worksheet #20—Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates	No. of MS/ MSDs	No. of Equip. Blanks	No. of Trip Blanks	Total No. of Samples to Lab[1]
Groundwater	Total Metals	8	1	1/1	1	-	12
	Dissolved Metals	8	1	1/1	1	-	12
	Wet Chemistry[2]	8	1	-	-	-	9

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

[2] Wet chemistry field dup is for pH only.

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SAP Worksheet #21—Project Sampling SOP References Table

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for ProjectWork? (Y/N)	Comments
SOP-001	Preparing Field Log Books, QC and reviewed 08/2013	AGVIQ-CH2M HILL	N/A	N	N/A
SOP-002	Locating and Clearing Underground Utilities, QC and reviewed 08/2013	AGVIQ-CH2M HILL	TBD	N	N/A
SOP-003	Field Measurement of pH, Specific Conductance, Turbidity, DO, ORP, and Temperature Using a Water Quality Parameter Meter with Flow-through Cell, QC and reviewed 08/2013	AGVIQ-CH2M HILL	Water Quality Parameter Meter such as a YSI with flow-through cell, distilled water in squirt bottle, and Calibration Standard Solution	N	N/A
SOP-004	Water-Level Measurements, QC and reviewed 08/2013	AGVIQ-CH2M HILL	Electronic water-level meter with 100-foot tape, interface probe	N	N/A
SOP-005	Global Positioning System, QC and reviewed 08/2013	AGVIQ-CH2M HILL	GPS Unit	N	N/A
SOP-006	Monitoring Well and Borehole Abandonment, QC and reviewed 08/2013	AGVIQ-CH2M HILL	DPT rig and tremie pipe	N	N/A
SOP-007	Low-Flow Groundwater Sampling from Monitoring Wells – EPA Region I and III, QC and revised 08/2013	AGVIQ-CH2M HILL	Adjustable-rate positive-displacement pump, submersible pump, or peristaltic pump, YSI water quality meter, flow-through cell, generator, water-level indicator, disposable Teflon tubing, plastic sheeting, well-construction information, calibrated container and stopwatch, sample containers, in-line disposable 0.45-micrometer filters, shipping supplies, and field book	N	N/A
SOP-008	Chain-of-Custody, QC and reviewed 08/2013	AGVIQ-CH2M HILL	N/A	N	N/A
SOP-009	Packaging and Shipping Procedures for Low-Concentration Samples, reviewed 08/2013	AGVIQ-CH2M HILL	Coolers	N	N/A
SOP-010	Equipment Blank and Field Blank Preparation, QC and reviewed 08/2013	AGVIQ-CH2M HILL	Peristaltic pump	N	N/A
SOP-011	Decontamination of Drilling Rigs and Equipment, QC and revised 08/2013	AGVIQ-CH2M HILL	DPT rig, portable steam cleaner, buckets, and brushes	N	N/A

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

Field Equipment	Activity1	Frequency	Acceptance Criteria	CA	Resp. Person	SOP Reference2
YSI 6820 pH probe	Calibration	Daily, before use and when unstable readings occur	pH reads 4.0 ±3percent	Clean probe with deionized water and calibrate again. Do not use instrument if not able to calibrate properly; order replacement.	FTL	**Worksheet #21**
YSI 6820 specific conductance probe	Calibration		Conductivity reads 4.49 ±3percent			
YSI 6820 turbidity probe	Calibration		Turbidity reads 0 ±3percent			
YSI 6820 DO and temperature probes	Testing		Consistent with the current atmospheric pressure and ambient temperature			
YSI 6820	Maintenance: Check mechanical and electronic parts, verify system continuity, check battery charge, and clean probes. Calibration check.		Stable readings after 3 minutes. pH reads 4.0 ±3percent Conductivity reads 4.49 ±3percent Turbidity reads 0 ±3percent			
Groundwater sampling pumps and tubing	Inspection: pumps, tubing, and air/sample line quick-connects	Daily, before use	Maintained in good working order per manufacturer's recommendations	Do not use instrument/equipment if not in good working condition; order replacement.		

Notes:

[1] – Activities may include calibration, verification, testing, and maintenance.

[2] – References from **Worksheet #21**

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SAP Worksheet #23-1—Analytical SOP References Table

Laboratory: ENCO, 10775 Central Port Drive, Orlando, FL 32824
Point of Contact: Marcia Colon
Phone Number: (407) 826-5314

Lab SOP Number	Title, Revision Date, and Number	Date Reviewed with No Revision Necessary	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM	Modified for Project Work? (Y/N)
LOGIN-03	Receiving Samples; July 31, 2012; Rev. 11	06/11/2013	N/A (Receiving)	Groundwater / Total and Dissolved Metals, Wet Chemistry	N/A (Receiving)	N/A (Receiving)	N
EXMT-07	3010 Acid Digestion by ICP/ICP-MS; August 10, 2012; Rev. 08	Under review (December 2013)	Definitive	Groundwater / Total and Dissolved Metals	N/A (Digestion)	None	N
EXMT-12	Acid Digestion of Aqueous Samples for Analysis; February 17, 2012; Rev. 05	Under review (December 2013)	Definitive	Groundwater / Total and Dissolved Metals	N/A (Digestion)	None	N
MET-05	Metals Analysis by ICP-AES; Jan 1, 2013; Rev. 11	N/A	Definitive	Groundwater / Total and Dissolved Metals	ICP-AES	Y - Do not Perform Method of Standard Additions (MSA)[1]	N
MET-15	Metals Analysis Using ICP-MS; August 1, 2013; Rev. 06	N/A	Definitive	Groundwater / Total and Dissolved Metals	ICP-MS	Y - Do not Perform MSA[1]	N
WETS-092	Ion Chromatrography; April 5, 2013; Rev. 03	N//A	Screening	Groundwater / Wet Chemistry	IC	None	N
WETS-014	pH (Electrometric, Aqueous Samples); January 15, 2013; Rec. 09	N/A	Screening	Groundwater / Wet Chemistry	pH meter	None	N
WETS-003	Acidity (Titrimetric); August 15, 2013; Rev. 08	N/A	Screening	Groundwater / Wet Chemistry	N/A (Titration)	None	N
WETS-063	Total Phosphorus (Colorimetric, Automated Ascorbic Acid); April 19, 2013; Rev. 08	N/A	Screening	Groundwater / Wet Chemistry	Flow Injection Analyzer (FIA)	None	N

SAP Worksheet #23-1—Analytical SOP References Table (continued)

Lab SOP Number	Title, Revision Date, and Number	Date Reviewed with No Revision Necessary	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM	Modified for Project Work? (Y/N)
WETS-066	Total Organic Carbon; EPA 415.1, SW-846 9060 (Modified for Soils); April 15, 2013; Rev. 05	N/A	Screening	Groundwater / Wet Chemistry	TOC Analyzer	None	N
ADMIN-14	Waste Disposal and Characterization; September 16, 2011; Rev. 06	05/30/2013	N/A (Disposal)	N/A (Disposal)	N/A (Disposal)	N//A (Disposal)	N

[1] MSA will not be used if post digestion spike is outside acceptance limits. This will increase the likelihood of data being flagged due to matrix interference.

Required Laboratory Accreditation: DoD ELAP

Expiration Date: March 31, 2014 (Prior to commencement of sample collection, CH2M HILL will confirm a current DoD ELAP certification.)

SAP Worksheet #23-2—Analytical SOP References Table

Laboratory: EMAX, 1835 W/ 205th Street, Torrance, CA 90501
Point of Contact: Molly Nguyen
Phone Number: (310) 618-8889, ext. 119

Lab SOP Number	Title, Revision Date, and Number	Date Reviewed with No Revision Necessary[1]	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM	Modified for Project Work? (Y/N)
EMAX-SM01	Sample Management; May 1, 2012; Rev. 06		N/A (Sample Management)	Groundwater / Total and Dissolved Metals	N/A (Sample Management)	None	N
EMAX-SM02	Sample Receiving; June 18, 2012; Rev. 07		N/A (Receiving)	Groundwater / Total and Dissolved Metals	N/A (Receiving)	None	N
EMAX SM03	Waste Disposal; January 23, 2012; Rev. 05	N/A	N/A (Disposal)	Groundwater / Total and Dissolved Metals	N/A (Disposal)	N/A (Disposal)	N
EMAX-SM05	Sample Containers Handling and Shipping; May 13, 2013; Rev. 03		N/A (Sample Management)	Groundwater / Total and Dissolved Metals	N/A (Sample Management)	None	N
EMAX-7199	Hexavalent Chromium; November 20, 2012; Rev. 03	12/06/2013	Definitive	Groundwater / Total and Dissolved Metals	IC	None	N

Required Laboratory Accreditation: DoD ELAP
Expiration Date: January 10, 2017

[1]Non-Analytical SOPs do not require an annual review cycle.

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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
ICP-AES	Initial calibration (ICAL) -minimum one high standard and a calibration blank for all analytes	Daily, prior to sample analysis	More than one calibration standard is used, R ≥ 0.995	Correct problem, then repeat ICAL	Analyst	MET-05
	Low-level calibration check standard	Daily, after one-point ICAL	Within ±20 percent of true value	Correct problem, then reanalyze		
	Second source calibration verification (ICV)	Once after each ICAL, prior to beginning a sample run	Value of second source for all analytes within ±10 percent of true value	Verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		
	Continuing calibration verification (CCV)	After every 10 field samples and at the end of the analysis sequence	All analytes within ±10 percent of true value	Correct problem, rerun CCV. If that fails, repeat ICAL. Reanalyze all samples since the last successful CCV.		
	Calibration blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence	No analytes detected > LOD	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.		
	Interference check solutions (ICS-A and ICS-AB)	At the beginning of an analytical run and every 12 hours	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within ± 20 percent of true value	Terminate analysis, locate and correct problem, reanalyze ICS, reanalyze all samples.		

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 percent peak height; For stability, RSD ≤5 percent for at least four replicate analyses.	Retune instrument then reanalyze tuning solutions.	Analyst	MET-15
	ICAL for all analytes (minimum 2 point calibration)	Daily ICAL prior to sample analysis	More than one calibration standard is used, R≥0.995.	Correct problem, then repeat ICAL.		
	ICV	Once after each ICAL, prior to beginning a sample run	Value of second source for all analytes within ± 10 percent 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 ±10 percent of true value	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.		
	Calibration blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence	No analytes detected > LOD	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.		
	Interference check solutions (ICS-A and ICS-AB)	At the beginning of an analytical run and every 12 hours	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spiked analytes); ICS-AB: Within ±20 percent of true value	Terminate analysis, locate and correct problem, reanalyze ICS, reanalyze all samples.		

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
IC	ICAL (minimum of three standards and a calibration blank)	Every 6 months, ICAL prior to sample analysis	R ≥ 0.995	Correct problem then repeat ICAL.	Analyst	WETS-092
	ICV	Once after each ICAL	All analytes within ±10 percent of true value and retention times within appropriate windows	Verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.		
	CCV	After every 10 field samples and at the end of the analysis sequence	All project analytes within established retention time windows. Within ±10 percent of true value.	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.		
	Retention Time Windows	One per multipoint calibration	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	N/A		
IC	ICAL	Prior to sample analysis and as needed	R >0.995	Locate the source of the problem. Check for standard degradation or perform instrument adjustment and/or maintenance to correct the problem then repeat ICAL	Analyst	EMAX-7199
	ICV	After each ICAL	All analytes within ±10 percent of true value	Prepare fresh standard and re-analyze ICV to rule out standard degradation. If problem persist perform instrument adjustment and/or maintenance to correct the problem and repeat ICAL.		
	CCV	Daily, before sample analysis, after every 10 field samples, and at the end of analysis sequence	All analytes within ±10 percent of true value	Diagnose problem. Prepare fresh standard and reanalyze CCV to rule out standard degradation. If problem persist perform instrument adjustment and/or maintenance to correct the problem. Reanalyze all samples since last successful CCV. If problem persists, repeat ICAL.		

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
pH Buffer Check	The pH meter is calibrated daily using 4.0 (± 0.1) and 10.0 (±0.1) buffers.	Deviation within 99 – 101 percent of true value.	Recalibrate, re-analyze all samples analyzed since the last pH buffer that met criteria.	Correct problem then repeat ICAL.	Analyst	WETS-056
TOC Analyzer	ICAL (minimum of five standards and a calibration blank)	Annually, ICAL prior to sample analysis.	R ≥0.995	Correct problem then repeat ICAL.	Analyst	WETS-066
	ICV	Once after each ICAL.	All analytes within ±15 percent of true value and retention times within appropriate windows	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.	All analytes within ±15 percent of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.		
FIA	ICAL (minimum of five standards and a calibration blank)	Weekly ICAL prior to sample analysis	R ≥0.995	Correct problem then repeat ICAL.	Analyst	WETS-063
	ICV	Once after each ICAL	All analytes within ±20 percent of true value.	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.	All analytes within ±10 percent of true value.	Correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.		

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

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
ICP-AES	Change tubing	None	None	Every other run	None	None	Analyst	MET-05
	Clean air filter	Inspect air filters	Visual	Monthly	Air Filters are clean	Clean, replace air filters		
	Clean lenses	Inspect lenses for cleanliness		As needed	Lenses are clean	None		
	Clean injector	Inspect injector for cleanliness			Verify injector is clean			
ICP-MS	Clean, inspect, change cones	Monitor ISTD counts for variation	Instrument performance and sensitivity	As needed	Monitor ISTD counts for variation	Re-calibrate	Analyst	MET-15
	Clean, inspect, change spray chamber, injector, torch							
	Replace pump windings					Replace windings, re-calibrate and re-analyze		
IC	Check pump for leaks and spills; check air lines for crimping or discoloration.	Instrument performance checks	Visual inspection.	Initially, prior to each use.	No defects	Replace areas as needed	Analyst/ Supervisor	EMAX-7199
	Preventive Maintenance	System cleaning	Remove dust from fans and vent covers, inspect and clean inlet and detector.	Every 6 months or as needed	No defects	Clean as needed		
	Parameter Set-up	Physical check	Various - Check Autosampler, Check pressure, effluent, detector, flow rate as set per SOP	Initially, prior to each use	Set-up in accordance to SOP guides	Reset to SOP requirements		

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
IC	Fill eluent bottles and fill reservoir water bottle	N/A	Visual	Weekly or as needed	N/A	Fill bottle as needed	Analyst	WETS-057
	Check back pressure is below 2300 PSI		Visual			Clean or replace guard column and frit		
	Check IC for leaks		Visual check for liquid or pressure fluctuation			Fix leak		
TOC Analyzer	Inspect/Clean TOC syringe	N/A	Visual	Monthly	N/A	Clean as needed	Analyst	WETS-066
	Inspect Permeation Dryer		Visual			Replace if humidity observed		
	Test fittings on 8 port valve		Visual check for leaks			Replace or tight fittings as needed		
	Replace Injection Line		Peak shape and uniformity between injection replicas	As needed	CCV pass criteria	Replace line		
	Replace Corrosive Scrubber (Tin and Copper)		Color discoloration			Replace Tin and Copper		
	Replace/wash and condition Catalyst and Combustion Tube		CCV passing			Replace and condition		
pH Meter	Clean and change probe fluid	N/A	Fluid is low or crystals have formed	As needed	N/A	N/A	Analyst	WETS-056

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
FIA	Replace sample line and water reservoir	N/A	Visual	Weekly or as needed	N/A	Fill bottle as needed	Analyst	WETS-063
	Apply oil to pump rollers		None	Weekly or as needed		N/A		
	Replace valve O-rings			Monthly or as needed				
	Replace reagent lines			Monthly or as needed				
	Re-wrap manifold			Yearly or as needed				

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SAP Worksheet #26—Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Project Field Team, FTL/ AGVIQ-CH2M HILL JV IIIa
Sample Packaging (Personnel/Organization): Project Field Team, FTL/ AGVIQ-CH2M HILL JV IIIa
Coordination of Shipment (Personnel/Organization): FTL/ AGVIQ-CH2M HILL JV IIIa
Type of Shipment/Carrier: FedEx Priority Overnight
SAMPLE RECEIPT AND ANALYSIS[1]
Sample Receipt (Personnel/Organization): ENCO personnel/EMAX personnel
Sample Custody and Storage (Personnel/Organization): ENCO personnel/EMAX personnel
Sample Preparation (Personnel/Organization): ENCO personnel/EMAX personnel
Sample Determinative Analysis (Personnel/Organization): ENCO personnel/EMAX personnel
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): 90 days from receipt
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 1 year
Biological Sample Storage (No. of days from sample collection): N/A
SAMPLE DISPOSAL
Personnel/Organization: ENCO personnel/EMAX personnel
Number of Days from Analysis: After submission, the laboratory will keep samples 90 days and the sample extracts for a minimum of 60 days.

[1]All samples will be shipped to ENCO with the exception of hexavalent chromium fractions, which will be shipped to EMAX.

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SAP Worksheet #27—Sample Custody Requirements Table

Sample Labeling Procedures

Sample labels will include, at a minimum, client name, site, sample identification, date and time collected, analysis group or method, and sampler's initials. A standardized numbering system will be used to identify all samples collected. The numbering system will provide a tracking procedure to ensure accurate data retrieval of all samples collected. Each sample will be designated by an alphanumeric code that will identify the facility, site, station identification, matrix sampled, and/or date and depth sampled. QA/QC samples will have a unique sample designation. The sample identification scheme for all samples collected during the investigation will use the format shown in **Worksheet #18**. The field logbook will identify the sample identification with the location, date and time collected, and the parameters requested.

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

Field samples will be collected by the field team members under the supervision of the FTL. After samples are collected, they will immediately be placed in the appropriate containers for shipment and labeled, as previously outlined. The labels will be filled out in the field by the field crew at the time of sample collection and checked for quality before being placed into the shipping container, at which time the sample will be logged in on the chain-of-custody form and field logbook

Samples will be cushioned with packaging material and placed into shipping containers. Shipping containers will be packed on ice and shipped to the laboratory via FedEx overnight, with the airbill number indicated on the chain of custody (to relinquish custody). The FTL is responsible for the care and custody of samples until they are shipped or otherwise delivered to the laboratory custodian. Upon delivery, the laboratory will log in each sample and report the status of the samples as follows.

Chain-of-Custody Procedures

Chains-of-custody will include, at a minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information. Example chain-of-custodies for ENCO and EMAX are provided as attachments to SOP-008 in **Attachment C**. Sample information will include sample identification, date and time collected, number and type of containers, analysis method, and comments. The chain-of-custody will also have the sampler's name and signature. The chain-of-custody will link location of the sample from the field logbook to the laboratory receipt of the sample. The laboratory will use the sample information to populate the laboratory information management system database for each sample.

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

The laboratory receiving samples will comply with all sample custody requirements outlined in the laboratory SOPs.

Sample Integrity

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

The project chemist is responsible for checking the chain-of-custody forms against the field logbook and field project instructions to verify the sample identification, times, analyses, and methods are correct on each form. Any discrepancies will be resolved with the field team and relayed to the laboratory. These actions will be documented by both the laboratory and the project chemist. The laboratory is responsible for providing the

project chemist with sample log-in sheets the day of sample receipt in order for the project chemist to verify the laboratory has accounted for all samples shipped and has correctly logged the samples into its software system.

SAP Worksheet #28-1—Laboratory QC Samples Table

Matrix: Groundwater
Analytical Group: Total and Dissolved Metals
Analytical Method/SOP Reference: SW-846 6010C / MET-05

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. Blank result must not otherwise affect sample results.	Correct problem; then repeat. If the method blank still fails; redigest and analyze all affected samples.	Analyst	Bias/ Contamination	Same as Method / SOP QC Acceptance Limits.
Laboratory Control Sample (LCS)		Refer to **Worksheet #15**.	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch.		Precision and Accuracy/Bias	
Matrix Spike (MS)		Refer to **Worksheet #15**.	If matrix spike falls outside of QC acceptance limits, additional quality control tests are required to evaluate matrix effects (dilution test, post-digestion spike).		Precision and Accuracy/Bias	
Matrix Spike Duplicate (MSD)		Refer to **Worksheet #15**.			Precision and Accuracy/Bias	
Dilution Test		Recovery within ±10% of true value.	Perform Post Spike		Precision and Accuracy/Bias	
Post Spike	One is performed when dilution test fails or analyte concentration for all samples < 50x LOD.	Recovery within ± 25% of true value.	If dilution test recoveries are outside of QC acceptance limits but post spike meets QC acceptance criteria, and matrix effects are not confirmed, reprep and reanalyze sample.		Precision and Accuracy/Bias	

Notes:
The specifications in this table meet the requirements of DoD QSM 4.2.

SAP Worksheet #28-2—Laboratory QC Samples Table

Matrix: Groundwater
Analytical Group: Total and Dissolved Metals
Analytical Method/SOP Reference: SW-846 6020A / MET-15

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. Blank result must not otherwise affect sample results.	Correct problem; then repeat. If the method blank still fails; redigest and analyze all affected samples.	Analyst	Bias/Contamination	Same as Method / SOP QC Acceptance Limits.
LCS		Refer to **Worksheet #15**.	LCS is re-analyzed. If still fails, samples, along with QC, are re-prepped and re-analyzed.Client will be contacted for guidance about whether to re-prep samples. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	
MS		Refer to **Worksheet #15**.	Perform a dilution test and/or post spike to evaluate matrix effects.		Precision and Accuracy/Bias	
MSD		Refer to **Worksheet #15**.			Precision and Accuracy/Bias	
Dilution Test		Recovery within ±10% of true value.	Perform post spike.		Precision and Accuracy/Bias	
Post Spike	When dilution test fails or analyte concentration for all samples < 50x LOD.	Recovery within ±25% of true value.	If dilution test recovers outside of QC acceptance limits but post spike meets QC acceptance criteria, matrix effects are not confirmed, reprep and reanalyze sample.		Precision and Accuracy/Bias	
Internal Standard (IS)	Spiked in every sample.	IS intensity within 30-120% of intensity of IS in ICAL.	Re-analyze sample at 5x dilution with the addition of appropriate amounts of IS.		Precision and Accuracy	

Notes:
The specifications in this table meet the requirements of DoD QSM 4.2.

SAP Worksheet #28-3—Laboratory QC Samples Table

Matrix: Groundwater
Analytical Group: Total and Dissolved Metals
Analytical Method/SOP Reference: SW-846 7199 Low Level / EMAX7199

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 > ½LOQ. Blank result must not otherwise affect sample results.	Determine cause of contamination and re-prep and reanalyze method blank and all samples processed with the non-conforming method blank.	Analyst	Bias/Contamination	Same as Method/SOP QC Acceptance Limits
LCS	One per preparatory batch	Refer to **Worksheet #15.**	Re-prep and reanalyze LCS and all samples processed with the non-conforming LCS.		Accuracy/Bias	
MS or Duplicate	Project designated sample in matrix QC. In general 1:20 project samples.	Recovery of 75-125%; RPD 20%.	If result is indicative of matrix interference, discuss in case narrative. Otherwise check for possible source of error, and extract/reanalyze the sample.		Accuracy/Bias/Precision	

SAP Worksheet #28-4—Laboratory QC Samples Table

Matrix: Groundwater
Analytical Group: Anions
Analytical Method/SOP Reference: EPA 300.0 / WETS-092

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch	No target analytes > 1/2 LOQ	Correct problem; then repeat. If the method blank still fails; repeat ICAL.	Analyst	Bias/ contamination	Same as Method/SOP QC Acceptance Limits
LCS		Refer to **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		Refer to **Worksheet #15.**	In the absence of client specific requirements, flag the data		Precision and Accuracy/Bias	

SAP Worksheet #28-5—Laboratory QC Samples Table

Matrix: Groundwater
Analytical Group: Wet Chemistry
Analytical Method/SOP Reference: SW-846 9060A / WETS-066

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch	No target analytes > 1/2 LOQ	Correct problem; then repeat. If the method blank still fails, repeat ICAL.	Analyst	Bias/ contamination	Same as Method/SOP QC Acceptance Limits
LCS		Refer to **Worksheet #15.**	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	
MS/MSD		Refer to **Worksheet #15.**	In the absence of client specific requirements, flag the data		Precision and Accuracy/Bias	

SAP Worksheet #28-6—Laboratory QC Samples Table

Matrix: Groundwater
Analytical Group: Wet Chemistry
Analytical Method/SOP Reference: EPA 365.4 / WETS-063

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No target analytes > 1/2 LOQ	Correct problem; then repeat. If the method blank still fails, repeat ICAL.	Analyst	Bias/ contamination	Same as Method/SOP QC Acceptance Limits
LCS		Refer to **Worksheet #15.**	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	
MS/MSD		Refer to **Worksheet #15.**	In the absence of client specific requirements, flag the data		Precision and Accuracy/Bias	

SAP Worksheet #28-7—Laboratory QC Samples Table

Matrix: Groundwater
Analytical Group: Wet Chemistry
Analytical Method/SOP Reference: SW-846 9040C / WETS-014

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
LCS	One per preparatory batch	Refer to **Worksheet #15.**	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. In the absence of client specific requirements, flag the data.	Analyst	Precision and Accuracy	Same as Method/SOP QC Acceptance Limits
Laboratory Replicate		Refer to **Worksheet #15.**	If precision between sample and replicate is outside of the acceptance limits, the sample and its replicate must be reanalyzed.		Precision and Accuracy	

SAP Worksheet #28-8—Laboratory QC Samples Table

Matrix: Groundwater
Analytical Group: Wet Chemistry
Analytical Method/SOP Reference: EPA 305.1/ WETS-003

QC Sample	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No target analytes > 1/2 LOQ	Correct problem; then repeat. If the method blank still fails; repeat ICAL.	Analyst	Bias/ contamination	Same as Method/SOP QC Acceptance Limits
LCS		Refer to **Worksheet #15.**	LCS is reanalyzed. If still fails, samples, along with QC, are re-prepped and reanalyzed. In the absence of client specific requirements, flag the data.		Precision and Accuracy/Bias	
MS/MSD		Refer to **Worksheet #15.**	In the absence of client specific requirements, flag the data		Precision and Accuracy/Bias	

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SAP Worksheet #29—Project Documents and Records Table

Document	Where Maintained
• Field notebooks • Chain-of-custody records • Air bills • Custody seals • CA forms • EDDs • Identification of QC samples • Release of analytical data • Sampling locations and sampling plan • Sample receipt and tracking records • Standard traceability logs • Equipment calibration logs • Sample prep logs • Run logs • Equipment maintenance, testing, and inspection logs • Reported field sample results • Reported result for standards, QC checks, and QC samples • Instrument printouts (raw data) for field samples, standards, QC checks, and QC samples • Sample disposal records • Extraction/Cleanup records • Raw data (stored on disk) • Data validation reports • MDL study information	• Field documents such as logbooks entries, chains of custody records, air bills, EDDs, and so forth will be kept on CH2M HILL's local network server. • Field parameter data will be loaded with the analytical data into CH2M HILL's Data Warehouse. • Analytical laboratory hardcopy deliverables and data validation reports will be saved on CH2M HILL's local network server. • Electronic data from the laboratory will be loaded into CH2M HILL's Data Warehouse and NIRIS. • Offsite documents except for analytical laboratory data are archived with Iron Mountain, Inc., which is headquartered at 745 Atlantic Avenue, Boston, MA 02111. Analytical laboratory data are archived with the Federal Records Center.

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SAP Worksheet #30—Analytical Services Table

Matrix	Analytical Group	Sample Locations/Identification (ID) Number	Analytical Method	Data Package Turnaround Time	Laboratory	Backup Laboratory
Groundwater	Select Total and Dissolved Metals	See **Worksheet #18**	SW-846 7199 Low Level	7 calendar-days	–EMAX Laboratories 1835 W. 205th Street Torrance, CA 90501 POC: Molly Nguyen (310) 618-8889, ext. 119	TBD
			SW-846 3010, 6010C/6020A		ENCO 10775 Central Port Dr. Orlando, FL 32824 POC: Marcia Colon 407-826-5314	
	Wet Chemistry		EPA 300.0			
			EPA 365.4			
			SW-846 9040C			
			EPA 305.1			
			SW-846 9060			

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SAP Worksheet #31—Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Response to Assessment Findings	Person(s) Responsible for Identifying and Implementing CA	Person(s) Responsible for Monitoring Effectiveness of CA
Field Performance Audit	Once per definable feature of work	Internal	AGVIQ-CH2M HILL	FTL	FTL and SSC/ AGVIQ-CH2M HILL	FTL and SSC/ AGVIQ-CH2M HILL	PM/ AGVIQ-CH2M HILL
Third-Party Laboratory Technical Systems Audit	Laboratories must have current DoD ELAP accreditation which will identify the period of performance[1]	External	Third-party accrediting body	TBD, Third-party accrediting body	QA Officer/ EMAX and ENCO	QA Officer/ EMAX and ENCO	Navy CLEAN Program Chemist/ AGVIQ-CH2M HILL

Notes:

[1]DoD ELAP accreditation is required for definitive data only. The ELAP accreditation letters are provided in **Attachment D**.

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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
Operational Readiness Review	Checklist	PM/ AGVIQ-CH2M HILL	During field event kickoff meeting	Checklist	FTL/ AGVIQ-CH2M HILL AM/ AGVIQ-CH2M HILL	As soon as possible; prior to field event mobilization
Field Performance Audit	Checklist and written audit report	PM/ AGVIQ-CH2M HILL	Verbal – immediately Written Documentation –Within 1 week of audit	Memorandum	FTL/ AGVIQ- CH2M HILL AQM/ AGVIQ-CH2M HILL	As soon as possible
Laboratory Performance and Systems Audits	Written Audit Report	QA Officer/ENCO, EMAX	Within 2 months of audit	Memorandum	Third-party accrediting body/TBD	Within 2 months of receipt of initial notification

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SAP Worksheet #32-1—Laboratory Corrective Action Form

Person initiating 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/UFP-SAP Reviewer

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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 _____

_____

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

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

Comments _____

_____

Yes __ No __ 6) Are 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(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Data Usability Assessment Report	Once, after data are validated	Submitted with final Supplemental RI report	Project Chemist / AGVIQ-CH2M HILL	AGVIQ-CH2M HILL, NAVFAC Mid-Atlantic, USEPA, and VDEQ

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

Data Review Input	Description1	Responsible for Verification/Validation	Step I/IIa/IIb1	Internal / External2
Field Notebooks	Field notebooks will be reviewed internally and placed into the project file for archival at project closeout.	FTL	Step I	Internal
Chain-of-Custody and Shipping Forms	Chain-of-custody forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the chain of custody will be initialed by the reviewer, a copy of the chain-of-custody retained in the project file, and the original and remaining copies taped inside the cooler for shipment.	FTL and Project Chemist	Step I	Internal / External
Sample Condition upon Receipt	Any discrepancies or missing or broken containers will be communicated to the chemist in the form of laboratory logins.	Project Chemist	Step I	External
Documentation of Laboratory Method Deviations	Laboratory method deviations will be discussed and approved. Documentation will be incorporated into the case narrative, which becomes part of the final hardcopy data package.	Project Chemist	Step I	Internal
EDDs	EDDs will be compared against hardcopy laboratory results (10 percent check).	Project Chemist	Step I	External
Case Narrative	Case narratives will be reviewed during the data validation process. This is verification that they were generated and applicable to the data packages.	Data Validator	Step I	External
Laboratory Data	All laboratory data packages will be verified for completeness and technical accuracy prior to submittal.	ENCO, EMAX	Step I	Internal
Laboratory Data	The data will be verified for completeness. In order to ensure completeness, EDDs will be compared to the SAP and Sample Details Table. This is verification that all samples were included in the laboratory data and that correct analyte lists were reported.	Project Chemist	Step I	External
Audit and CA Reports	Upon report completion, a copy of all audit reports will be placed in the project file. If CAs are required, a copy of the documented CA taken will be attached to the appropriate audit report in the QA project file. Periodically, and at the completion of site work, site file audit reports and CA forms will be reviewed internally to ensure that all appropriate CAs have been taken and that CA reports are attached. If CAs have not been taken, the PM will be notified to ensure action is taken.	PM and Project Chemist	Step I	Internal / External
Laboratory Methods	The EDDs will be compared to the SAP to ensure that the laboratory analyzed samples using the correct methods.	Project Chemist	Step IIa	External
Analyte lists	The EDDs will be compared to the SAP to ensure that the laboratory reported all analytes in accordance with **Worksheet #15.**	Project Chemist	Step IIa	External

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

Data Review Input	Description1	Responsible for Verification/Validation	Step I/IIa/IIb1	Internal / External2
Reporting Limits	The reporting limits in the data package will be reviewed to ensure that the laboratory met the project-designated QLs in accordance with **Worksheet #15**. If QLs were not met, the reason will be determined and documented.	Project Chemist/ AGVIQ-CH2M HILL	Step IIb	External
Laboratory SOPs	The data package will be reviewed to ensure that approved analytical laboratory SOPs were followed (**Worksheet #23**).	Data Validator/ AGVIQ-CH2M HILL	Step IIa	External
Sample Chronology	Holding times from collection to extraction or analysis and from extraction to analysis will be considered during the data validation process.	Data Validator/ AGVIQ-CH2M HILL	Step IIa/IIb	External
Raw Data	10 percent of raw data will be reviewed to confirm laboratory calculations. For a recalculated result, attempt to re-create the reported numerical value. Ask the laboratory for clarification if a discrepancy is identified which cannot reasonably be attributed to rounding (in general, this is outside 5 percent difference).	Data Validator/ AGVIQ-CH2M HILL	Step IIa	External
Onsite Screening	All non-analytical field data will be reviewed against SAP requirements for completeness and accuracy based on the field calibration records.	FTL / AGVIQ-CH2M HILL	Step IIb	Internal
Documentation of Method QC Results	The data package will be reviewed to ensure that all required QC samples were run and met limits.	Data Validator/ AGVIQ-CH2M HILL	Step IIa	External
Documentation of Field QC Sample Results	The data package will be reviewed to ensure that all required QC samples were run and met limits.	Project Chemist/ AGVIQ-CH2M HILL and Data Validator/ AGVIQ-CH2M HILL	Step IIb	External
Analytical Data Validation (Select Total and Dissolved Metals)	Analytical methods and laboratory SOPs will be evaluated against QA/QC criteria to ensure compliance, as presented in this SAP. QA/QC criteria for field QC samples are presented in **Worksheet #12**. LOQs, LODs, and DLs are presented in **Worksheet #15**. QA/QC criteria for calibrations are presented in Laboratory SOPs (referenced in **Worksheet #23**). QA/QC criteria for laboratory QC samples are presented in **Worksheet #28**. Data may be qualified if QA/QC exceedances have occurred. Data qualifiers will be those presented in Region 3 Modifications to the National Functional Guidelines for Evaluating Inorganic Analyses (USEPA, 1993). 100 percent of the data generated will undergo analytical data validation. Of the 100 percent validated, 10 percent of results will be re-calculated from the raw data to verify calculations.	Data Validator/ AGVIQ-CH2M HILL	Step IIa and IIb	External
Analytical Data Validation (Wet Chemistry)	Wet chemistry analytical data will not undergo third-party data validation. The data is subject to review by the same protocols detailed above.	Project Chemist/ AGVIQ-CH2M HILL	Step I, IIa, and IIb	External

Data Review Input	Description1	Responsible for Verification/Validation	Step I/IIa/IIb1	Internal / External2

[1] I = verification

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

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

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

[2] Internal/External are with respect to the data generator.

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 analytes will be evaluated to ensure that PQLs listed in **Worksheet #15** were achieved. If PQLs were achieved and the verification and validation steps yielded acceptable data, then the data are considered usable. If PQLs were not achieved, then the reason will be investigated and documented, and the impact on data usability will be discussed.

During verification and validation steps, data may be qualified with the following qualifiers:

- J—Analyte present. Reported value is estimated and may or may not be accurate or precise
- UJ—Analyte not detected. QL may be inaccurate or imprecise
- K—Analyte present. Reported value is estimated and may be biased high. Actual value is expected to be lower.
- L—Analyte present. Reported value is estimated and may be biased low. Actual value is expected to be higher.
- UL—Analyte not detected. QL is probably higher.
- R—Rejected result. Result is not usable.
- B— Not detected significantly greater than that in an associated blank.
- N—Tentative ID. Consider Present. Special methods may be needed to confirm its presence or absence in future sampling.
- NJ—Qualitative ID questionable due to poor resolution. Presumptively present at approximate quantity.
- U—Not detected.

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

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

Field and laboratory precision will be assessed 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.

SAP Worksheet #37—Usability Assessment (continued)

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:

A data usability assessment report will be generated and incorporated into the supplemental RI report as an appendix. The results of the assessment will be summarized in the text of the report.

Identify the personnel responsible for performing the usability assessment.

The AGVIQ-CH2M HILL project chemist will generate the data usability assessment report. The data will be provided to the Partnering Team for discussion and review, and the team as a whole will evaluate the usability and completeness[1] of the data.

Note:
[1] Completeness is defined as the percentage of measurements that are judged to be valid compared to the total number of measurements made. The objective of the overall completeness goal for this project is set at 95% valid data. This goal is inclusive of both field and laboratory analytical data.

References

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

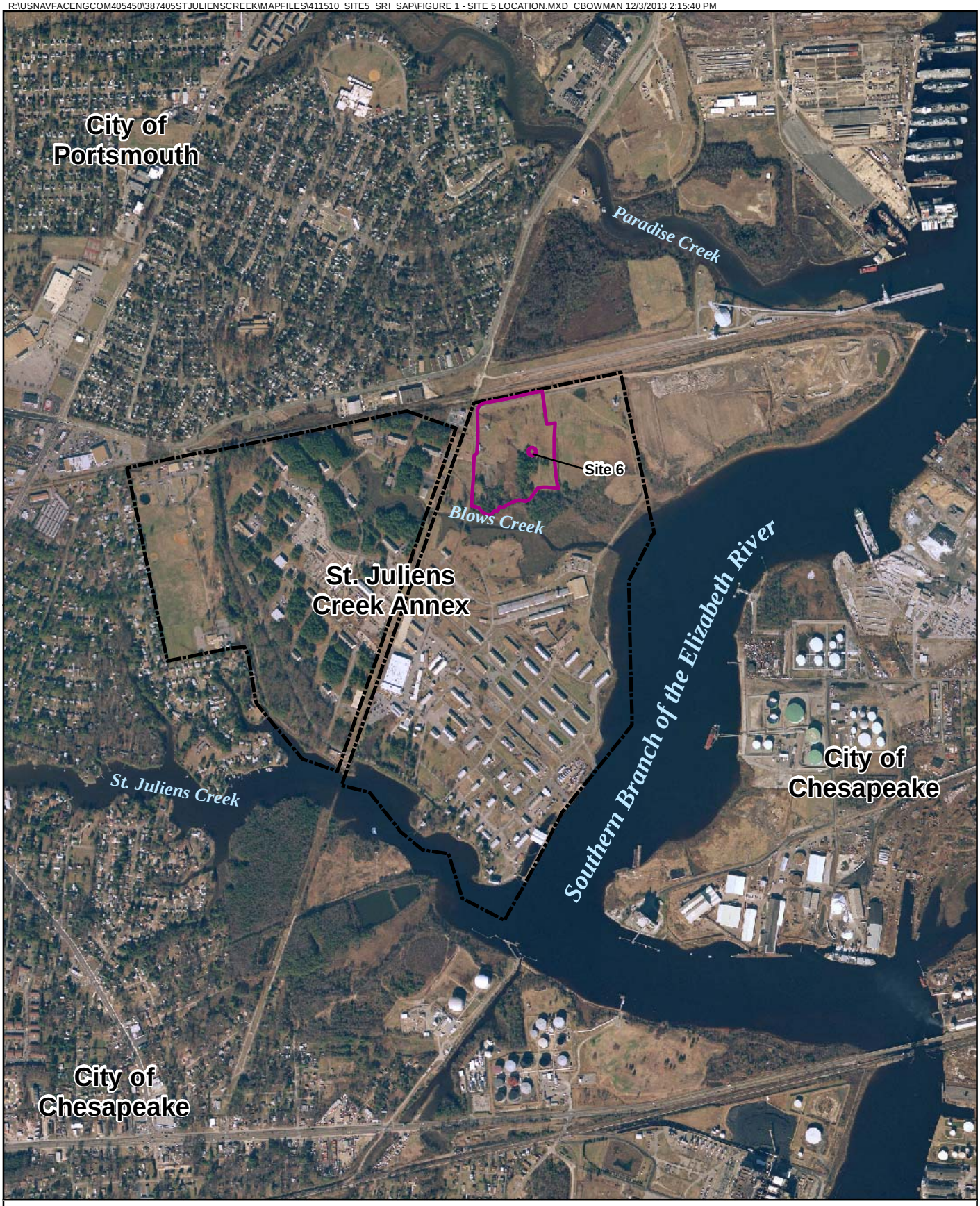
USEPA, March 2005. *Uniform Federal Policy for Quality Assurance Project Plans (UFP-QAPP).* March.

USEPA, February 2006. *Guidance on Systematic Planning Using the Data Quality Objectives Process.* EPA/240/B-06/001.

USEPA, November 2013. Regional Screening Levels.

Figures

R:\USNAVFACENGCOM405450\387405STJULIENSCREEK\MAPFILES\411510_SITE5_SRI_SAP\FIGURE 1 - SITE 5 LOCATION.MXD CBOWMAN 12/3/2013 2:15:40 PM



Legend

- Site 5 Boundary
- St. Juliens Creek Annex Boundary

N
W E
S

0 750 1,500 Feet

Figure 1
St. Juliens Creek Annex and Site 5 Location
Site 5 Supplemental Remedial Investigation
Sampling and Analysis Plan
St. Juliens Creek Annex
Chesapeake, Virginia

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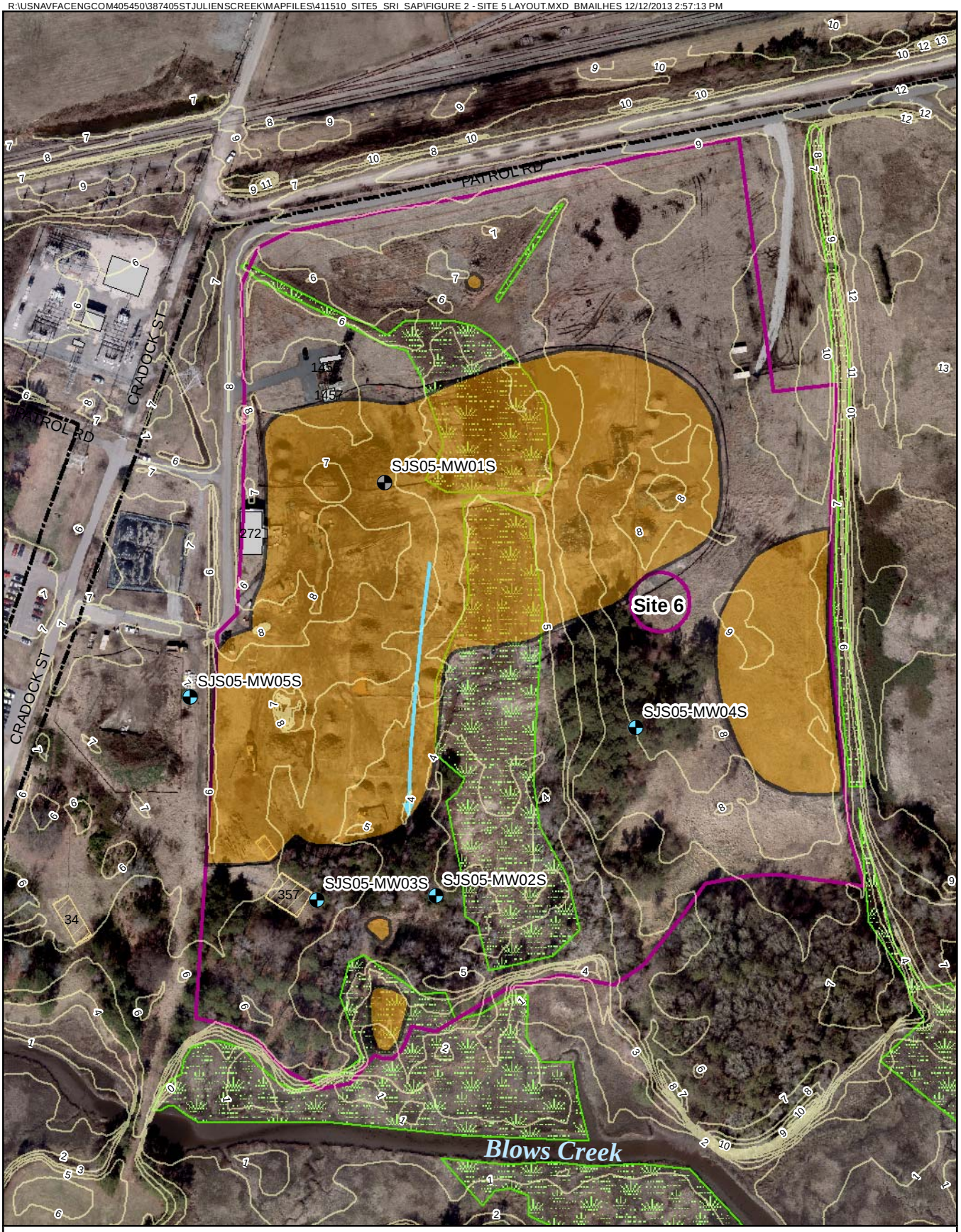
R:\USNAVFACENGCOM405450\387405STJULIENSCREEK\MAPFILES\411510_SITE5_SRI_SAP\FIGURE 2 - SITE 5 LAYOUT.MXD BMAILHES 12/12/2013 2:57:13 PM



Legend

- Shallow Monitoring Well
- Abandoned Shallow Monitoring Well
- General Direction of Shallow Aquifer Groundwater Flow in Site 5 Vicinity
- Elevation Contour
- St. Juliens Creek Annex Boundary
- Site 5 Boundary
- Delineated Wetland Boundary
- Demolished Building
- Removal Area

N W E S

0 100 200 Feet

Elevation Contour Source = U.S Navy GeoReadiness Center

Figure 2
Site 5 Layout
Site 5 Supplemental Remedial Investigation
Sampling and Analysis Plan
St. Juliens Creek Annex
Chesapeake, Virginia

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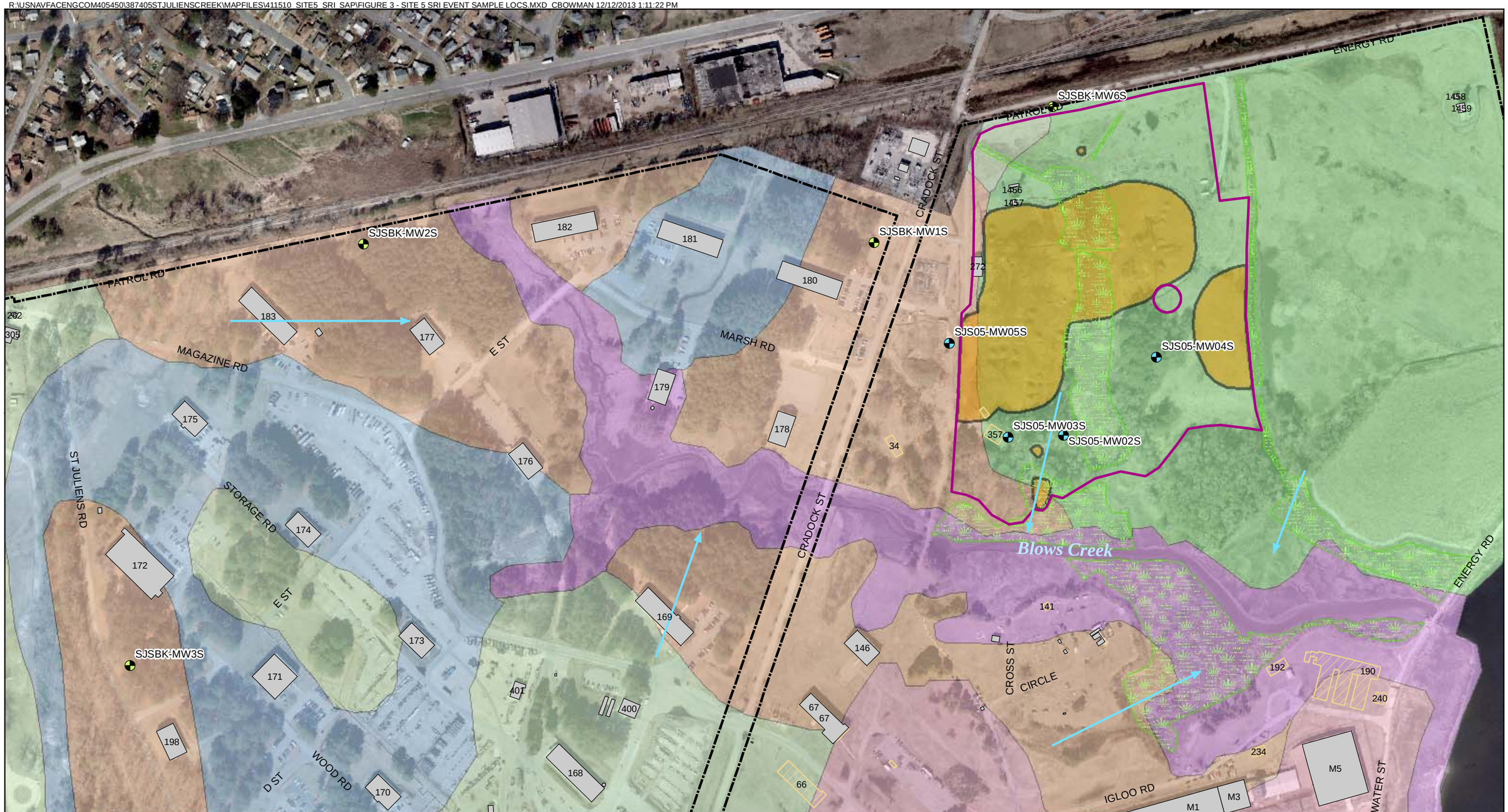
R:\USNAVFACENGCOM405450\387405STJULIENSCREEK\MAPFILES\411510_SITE5_SRI_SAP\FIGURE 3 - SITE 5 SRI EVENT SAMPLE LOCS.MXD CBOWMAN 12/12/2013 1:11:22 PM



Legend

- Background Monitoring Well
- Site 5 Monitoring Well
- Groundwater Flow Direction in Shallow Aquifer across Facility based on October 2003 Data
- Site 5 Boundary
- Building
- Demolished Building
- Delineated Wetland Boundary
- Removal Area

Soil Class

- Bohicket
- Dragston-Augusta Association
- Dredge Fill
- Munden-Tetotum
- Nimmo
- Urban-Udorthents

N
W E
S

0 150 300 600 Feet

Figure 3
Site 5 Supplemental Remedial Investigation
Primary Event Sample Locations
Site 5 Supplemental Remedial Investigation
Sampling and Analysis Plan
St. Juliens Creek Annex
Chesapeake, Virginia

CH2MHILL.

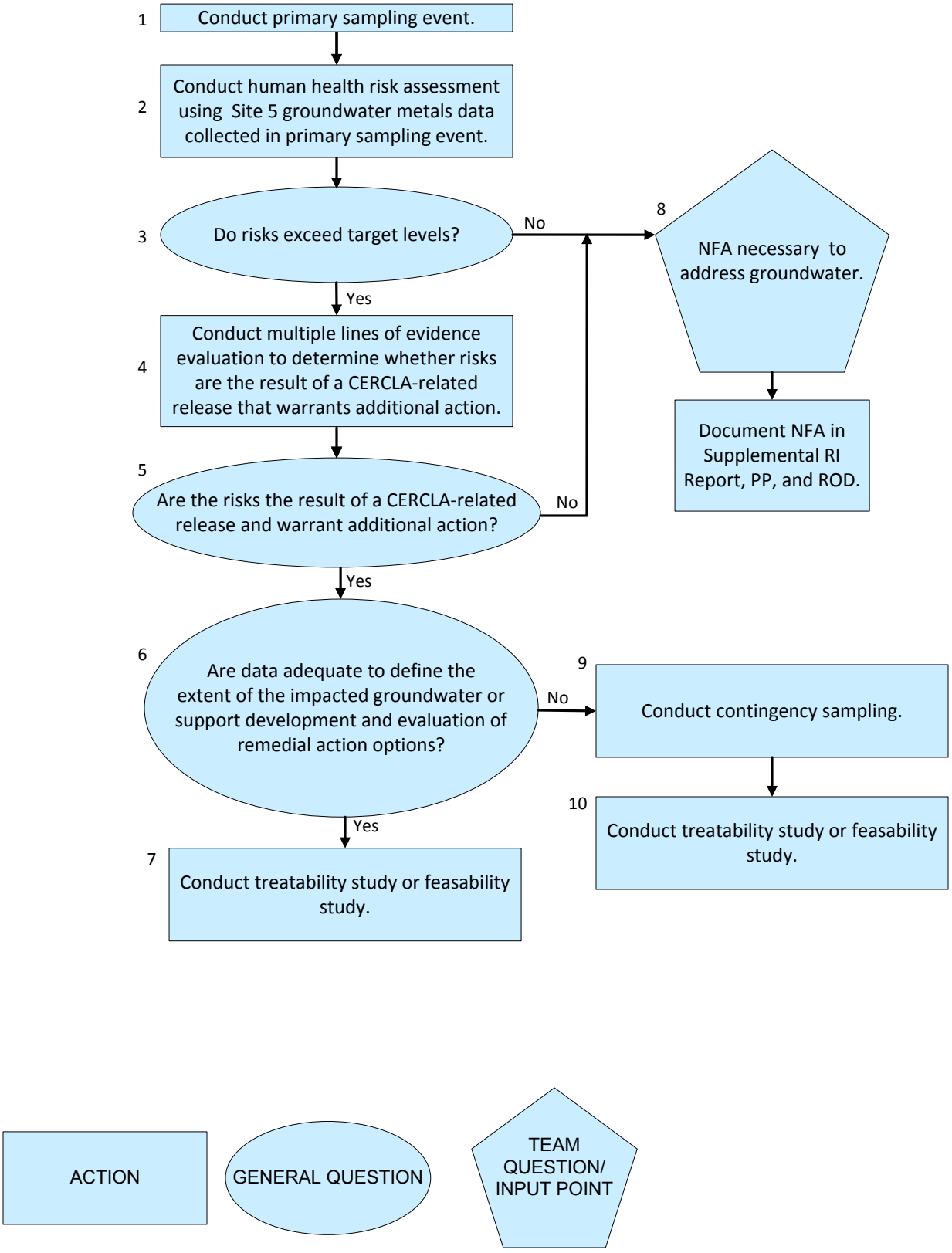


FIGURE 4
Site 5 Supplemental Remedial Investigation Decision Logic
Site 5 Supplemental Remedial Investigation Sampling and Analysis Plan
St. Juliens Creek Annex
Chesapeake, Virginia

Attachment A
Scoping Session References

Attachment A-1

Responses to Comments
Draft Proposed Plan
Site 5 – Burning Grounds (EPA Designation OU-5) and Blows Creek
St. Juliens Creek Annex
Chesapeake, Virginia

PREPARED FOR:	Robert Stroud, EPA Region 3 Karen Doran, VDEQ Krista Parra, NAVFAC Mid-Atlantic
PREPARED BY:	CH2M HILL
DATE:	March 21, 2013

Comments from EPA, provided March 7, 2013 @ 4:58 PM.

1. ***Comment:*** *Team, here is the rewrite of the shallow groundwater paragraph that EPA wants to see in the Site 5 PRAP. The only issue is that cobalt has an HI of 20 and it needs to be re-sampled. We need some indication that the gw has less cobalt in it than before the NTCRA and that the source of cobalt has been removed. The cobalt results are consistently high from the 1997 through 2006 sampling rounds. The sampling results would not need to be documented in the ROD. My tech support team just needs to know that cobalt is not an issue when it comes time for EPA to sign the ROD. There are a few minor comments that I will send in a separate e-mail. We can go to the paper with this with the new shallow groundwater language and the other minor edits.*

   Groundwater
   The 2007 human health risk assessment was updated to reflect current toxicity value changes (2013). Risk exceeding EPA's acceptable risk range was calculated for a number of metals in shallow groundwater at Site 5. Risks were associated with potential future exposure to aluminum, arsenic, cobalt, iron, lead, manganese and thallium. Comparison of metal concentrations at the site to background values for those metals eliminated iron, manganese and thallium from further consideration. Although arsenic detections exceeded the MCL in 1997 and 2006, these detections were inconsistent. Total arsenic was detected at 27.3 ug/L from well GW3S-001 in 1997; however the dissolved sample from the same location was non-detected for arsenic. Total and dissolved detections of arsenic in well GW2S-002 in 1997 were 12 ug/L and 13.3 ug/L were only slightly above the MCL of 10 ug/L. Exceedances of 12.8 ug/L and 13.2 ug/L at MW01S-06B collected in 2006 for total and dissolved arsenic occurred but sampling in 1997, 1999, 2003 and 2006 did not show exceedances of the arsenic MCL. Based on the sporadic nature of arsenic MCL exceedances geographically and over time, the data suggests there is not a plume of contaminated groundwater exceeding the MCL at Site 5.

   Total and dissolved lead concentrations were sporadically detected above the lead action level (15 ug/L) and site background at MW02S and MW03S. However, the average total (9.6 ug/L) lead concentration across the site was below the action level, and thus, no unacceptable human health risk was identified.

Aluminum and cobalt were identified as COCs based on a provisional toxicity value which has low to medium level of confidence. High confidence toxicity values are obtained from EPA's Integrated Risk Information System (IRIS), the first Tier of toxicity values recommended for use in risk assessments. For aluminum and cobalt, which lack IRIS values, Provisional Peer Reviewed Toxicity Values (PPRTVs) were used to estimate the risk at Site 5. However, PPRTVs are revised with frequency, and analysis based on PPRTVs at the time of the groundwater sampling do not result in an unacceptable risk posed by aluminum or cobalt. Moreover, a removal action conducted between 2008 and 2012 eliminated a significant source of contamination that is believed to have leached cobalt and other metals into the shallow groundwater.

Based on these multiple lines of evidence including comparison of metals concentrations to site background levels, evaluation of the sporadic nature of sample data above risk-based criteria, and consideration of previous CERCLA actions which removed the source of groundwater metals contamination, no further action is needed to address shallow groundwater at Site 5.

Response: The substantive changes to the groundwater paragraph are acceptable. However, NAVFAC is not comfortable moving forward with the Proposed Plan until EPA's concern regarding the concentrations of cobalt in groundwater has been resolved. A path forward will be discussed during the March 2013 partnering meeting. NAVFAC requests that EPA be prepared to discuss how the cobalt will be used and the path forward in the event that cobalt concentrations are similar or greater than those detected in 2006.

Comments from EPA, provided March 7, 2013 @ 5:00 PM.

2. ***Comment:*** *p. 1, the dates of the public comment period need updating – the public meeting is after the comment period if the period isn't changed*

   Response: Comment noted. The dates of the public meeting and public comment period will be updated after resolution of EPA comments.

3. ***Comment:*** *p. 3, right column, delete "decisions associated with" so the sentence reads: "While the watershed sites are not included in the scope of this…"*

   Response: The requested revision has been made.

4. ***Comment:*** *p. 10, Human Health Risk Text Box, new text misspells "assess".*

   Response: The spelling of "assess" has been corrected.

5. ***Comment:*** *p. 12, second to last paragraph, add a space between "Blows Creek" and "during" in the first line.*

   Response: The requested revision has been made.

6. ***Comment:*** *p. 13, second full paragraph, "piscivores" is misspelled twice.*

   Response: The spelling of "piscivores" has been corrected.

7. ***Comment:*** *p. 14, the dates of the public comment period need updating.*

   Response: See response to comment 1.

Attachment A-2

Responses to Comments
Draft Proposed Plan
Site 5 – Burning Grounds (EPA Designation OU-5) and Blows Creek
St. Juliens Creek Annex
Chesapeake, Virginia

PREPARED FOR:	Robert Stroud, EPA Region 3 Karen Doran, VDEQ Krista Parra, NAVFAC Mid-Atlantic
PREPARED BY:	CH2M HILL
DATE:	April 12, 2013

Comments from EPA, provided March 7, 2013 @ 4:58 PM.

1. ***Comment:*** *Team, here is the rewrite of the shallow groundwater paragraph that EPA wants to see in the Site 5 PRAP. The only issue is that cobalt has an HI of 20 and it needs to be re-sampled. We need some indication that the gw has less cobalt in it than before the NTCRA and that the source of cobalt has been removed. The cobalt results are consistently high from the 1997 through 2006 sampling rounds. The sampling results would not need to be documented in the ROD. My tech support team just needs to know that cobalt is not an issue when it comes time for EPA to sign the ROD. There are a few minor comments that I will send in a separate e-mail. We can go to the paper with this with the new shallow groundwater language and the other minor edits.*

   Groundwater
   The 2007 human health risk assessment was updated to reflect current toxicity value changes (2013). Risk exceeding EPA's acceptable risk range was calculated for a number of metals in shallow groundwater at Site 5. Risks were associated with potential future exposure to aluminum, arsenic, cobalt, iron, lead, manganese and thallium. Comparison of metal concentrations at the site to background values for those metals eliminated iron, manganese and thallium from further consideration. Although arsenic detections exceeded the MCL in 1997 and 2006, these detections were inconsistent. Total arsenic was detected at 27.3 ug/L from well GW3S-001 in 1997; however the dissolved sample from the same location was non-detected for arsenic. Total and dissolved detections of arsenic in well GW2S-002 in 1997 were 12 ug/L and 13.3 ug/L were only slightly above the MCL of 10 ug/L. Exceedances of 12.8 ug/L and 13.2 ug/L at MW01S-06B collected in 2006 for total and dissolved arsenic occurred but sampling in 1997, 1999, 2003 and 2006 did not show exceedances of the arsenic MCL. Based on the sporadic nature of arsenic MCL exceedances geographically and over time, the data suggests there is not a plume of contaminated groundwater exceeding the MCL at Site 5.
   Total and dissolved lead concentrations were sporadically detected above the lead action level (15 ug/L) and site background at MW02S and MW03S. However, the average total (9.6 ug/L) lead concentration across the site was below the action level, and thus, no unacceptable human health risk was identified.

Aluminum and cobalt were identified as COCs based on a provisional toxicity value which has low to medium level of confidence. High confidence toxicity values are obtained from EPA's Integrated Risk Information System (IRIS), the first Tier of toxicity values recommended for use in risk assessments. For aluminum and cobalt, which lack IRIS values, Provisional Peer Reviewed Toxicity Values (PPRTVs) were used to estimate the risk at Site 5. However, PPRTVs are revised with frequency, and analysis based on PPRTVs at the time of the groundwater sampling do not result in an unacceptable risk posed by aluminum or cobalt. Moreover, a removal action conducted between 2008 and 2012 eliminated a significant source of contamination that is believed to have leached cobalt and other metals into the shallow groundwater.
Based on these multiple lines of evidence including comparison of metals concentrations to site background levels, evaluation of the sporadic nature of sample data above risk-based criteria, and consideration of previous CERCLA actions which removed the source of groundwater metals contamination, no further action is needed to address shallow groundwater at Site 5.

Response: The substantive changes to the groundwater paragraph are acceptable. However, NAVFAC is not comfortable moving forward with the Proposed Plan until EPA's concern regarding the concentrations of cobalt in groundwater has been resolved. A conference call has been scheduled for April 29 to determine the path forward, with the following specific objectives:

- Determine if a no further action decision can be reached with existing data.
- If a no further action decision cannot be reached with existing data, scope additional sampling and determine how the data will be used (**EPA input required**).

Upon further review of the cobalt data for Site 5, NAVFAC expects that current cobalt concentrations in shallow groundwater are similar to those detected during the most recent sampling event (2006) because there is a strong correlation between groundwater pH and the concentrations of cobalt at Site 5 (Table 1, Figure 1, and Figure 2). The concentrations of cobalt are highest at MW02S and MW03S, where pH is the lowest. In consideration of EPA's request to collect additional groundwater samples for cobalt analysis, the pH of Site 5 groundwater was measured on March 20, 2013. The 2013 groundwater pH was consistent with the 2006 groundwater pH, indicating that if additional groundwater samples are collected the cobalt concentrations are expected to be similar to those detected in 2006.

Although the cobalt concentrations in groundwater may still be elevated, NAVFAC proposes proceeding with the no further action decision for the site without collection of additional data due to the following uncertainties:

- The concentrations of cobalt in groundwater cannot be definitively linked to the historic site activities.
- The potential unacceptable hazard index associated with cobalt is based on a Provisional Peer Reviewed Toxicity Value (PPRTV) for the reference dose (RfD) that was developed in 2008, and confidence in the study used to derive the PPRTV toxicity value was "low to medium," while overall confidence in the toxicity value was determined to be "low" by EPA.

Attachment 1 elaborates on and provides supporting details regarding these uncertainties. Based on the uncertainties, NAVFAC does not believe that additional investigation or action

is warranted based solely on the cobalt concentrations detected in shallow groundwater. As previously stated, the elevated cobalt concentrations correlate to low pH. Whether the low pH is a result of natural or site-related conditions, it can be observed that cobalt concentrations decrease as pH approaches neutral. It is likely that the presence of elevated cobalt in groundwater is due to area groundwater geochemical conditions that promote cobalt dissolution, and attenuation under neutral pH conditions make the presence of elevated cobalt likely related to site geochemistry and not to site activities. It is reasonable to conclude that cobalt will become less soluble (and less mobile) once groundwater pH return to neutral conditions downgradient of the wells where the high concentrations have been reported.

Proceeding with the NFA Proposed Plan and ROD with no additional investigation is preferred. The following revisions to the paragraph provided by EPA (above) with these comments are proposed:

> ***Groundwater***
> *The 2007 human health risk assessment was updated to reflect current toxicity value changes (2013[1]). Risk exceeding EPA's acceptable risk range was calculated for a number of metals in shallow groundwater at Site 5. Risks were associated with potential future exposure to aluminum, arsenic, cobalt, iron, lead, manganese and thallium. Comparison of metal concentrations at the site to background values for those metals eliminated iron, manganese and thallium from further consideration. Although arsenic detections exceeded the MCL in 1997 and 2006, these detections were inconsistent. Total arsenic was detected at 27.3 µg/L at monitoring well MW03S in 1997; however, dissolved arsenic was not detected in the sample from the same location. Total and dissolved detections of arsenic in the sample collected from well MW02S in 1997 were 12 µg/L and 13.3 µg/L, only slightly above the MCL of 10 µg/L. Total and dissolved arsenic concentrations of 12.8 µg/L and 13.2 µg/L, respectively, in samples collected from MW01S in 2006 exceeded the MCL, but arsenic concentrations from samples collected in 1997, 1999, 2003 and 2006 did not exceed the MCL at the same location. Based on the sporadic nature of arsenic MCL exceedances geographically and over time, the data suggests there is not a plume of contaminated groundwater exceeding the MCL at Site 5.*
>
> *Total and dissolved lead concentrations were sporadically detected above the lead action level (15 µg/L) and site background level at MW02S and MW03S. However, the average total (9.6 µg/L) lead concentration across the site was below the action level, and thus, no unacceptable human health risk was identified.*
>
> *In the 2013 risk assessment update[2], aluminum and cobalt were identified as COCs based on provisional toxicity values, which have low to medium levels of confidence, as a result of detected aluminum and cobalt concentrations at MW02S and MW03S. Preferred toxicity values are obtained from EPA's Integrated Risk Information System (IRIS), the first Tier of toxicity values recommended for use in CERCLA risk assessments. For aluminum and cobalt, which lack IRIS values, Provisional Peer*

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[1] In order to reference the 2013 risk assessment, it may need to be formalized for the administrative record file. Can EPA provide their calculation? Otherwise, a tech memo may be required to document the revised calculation. SJCA Partnering team will need to determine what documentation is acceptable.

[2] Will adjust wording based on resolution of footnote 1.

Reviewed Toxicity Values (PPRTVs) were used to estimate the risk at Site 5. However, PPRTVs are revised with frequency. Analysis based on PPRTVs at the time of the groundwater sampling did not result in an unacceptable risk posed by aluminum or cobalt. Although the aluminum and cobalt concentrations exceed the established background values for SJCA (399 µg/L and 15 µg/L, respectively), naturally-occurring metals concentrations can vary considerably based on geochemical conditions, and there is uncertainty over whether or not the background exceedances are natural or site-related. Low pH groundwater mobilizes naturally occurring metals. The highest concentrations of aluminum and cobalt are correlated to the monitoring wells with the lowest pH, indicating the elevated metals are likely a result of the low pH in groundwater. Regardless of the reasons for the low pH groundwater, it is reasonable to conclude that cobalt will become less soluble (and less mobile) once groundwater pH return to neutral conditions downgradient of the wells where the high concentrations have been reported. Moreover, a removal action conducted between 2008 and 2012 eliminated the potential source of contamination to shallow groundwater.

Based on these multiple lines of evidence including comparison of metals concentrations to site background levels, evaluation of the sporadic nature of sample data above risk-based criteria, and consideration of previous CERCLA actions which removed the source of groundwater metals contamination, no further action is needed to address shallow groundwater at Site 5.

Comments from EPA, provided March 7, 2013 @ 5:00 PM.

2. ***Comment:*** *p. 1, the dates of the public comment period need updating – the public meeting is after the comment period if the period isn't changed*

   Response: Comment noted. The dates of the public meeting and public comment period will be updated after resolution of EPA comments.

3. ***Comment:*** *p. 3, right column, delete "decisions associated with" so the sentence reads: "While the watershed sites are not included in the scope of this…"*

   Response: The requested revision has been made.

4. ***Comment:*** *p. 10, Human Health Risk Text Box, new text misspells "assess".*

   Response: The spelling of "assess" has been corrected.

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   Response: The spelling of "piscivores" has been corrected.

7. ***Comment:*** *p. 14, the dates of the public comment period need updating.*

   Response: See response to comment 1.

Table 1
Summary of Site 5 pH and Cobalt Data

	July 1997		November 1997		May 1999		June 2006		October 2006		March 2013	
	pH	Cobalt	pH	Cobalt	pH	Cobalt	pH	Cobalt	pH	Cobalt	pH	Cobalt
MW01S	6.21	ND	NM	ND	6.27	ND	6.78	1.2	6	ND	Abandoned	
MW02S	7.1	ND	2.93	257	NM	66.9	3.92	56.8	4	93.7	4.66	NM
MW03S	5.93	41.5	2.76	141	3.75	90.2	3.54	116	4	147	3.69	NM
MW04S	Not Installed		Not Installed		6.2	3.2	6.87	ND	7	0.46	7.16	NM
MS05S	Not Installed		Not Installed		5.7	5.4	5.62	5.9	5.5	7.8	7.31	NM

Cobalt concentrations in µg/L
ND – Analyte not detected
NM – Not measured

Figure 1
Correlation between Total Cobalt and pH at Site 5 Shallow Groundwater Monitoring Wells

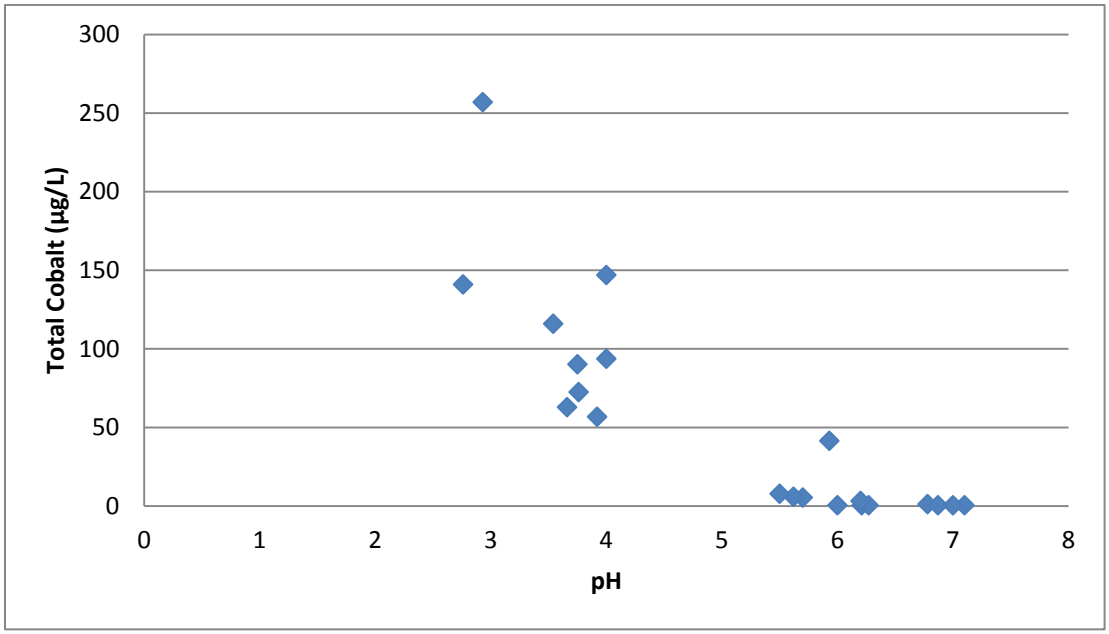
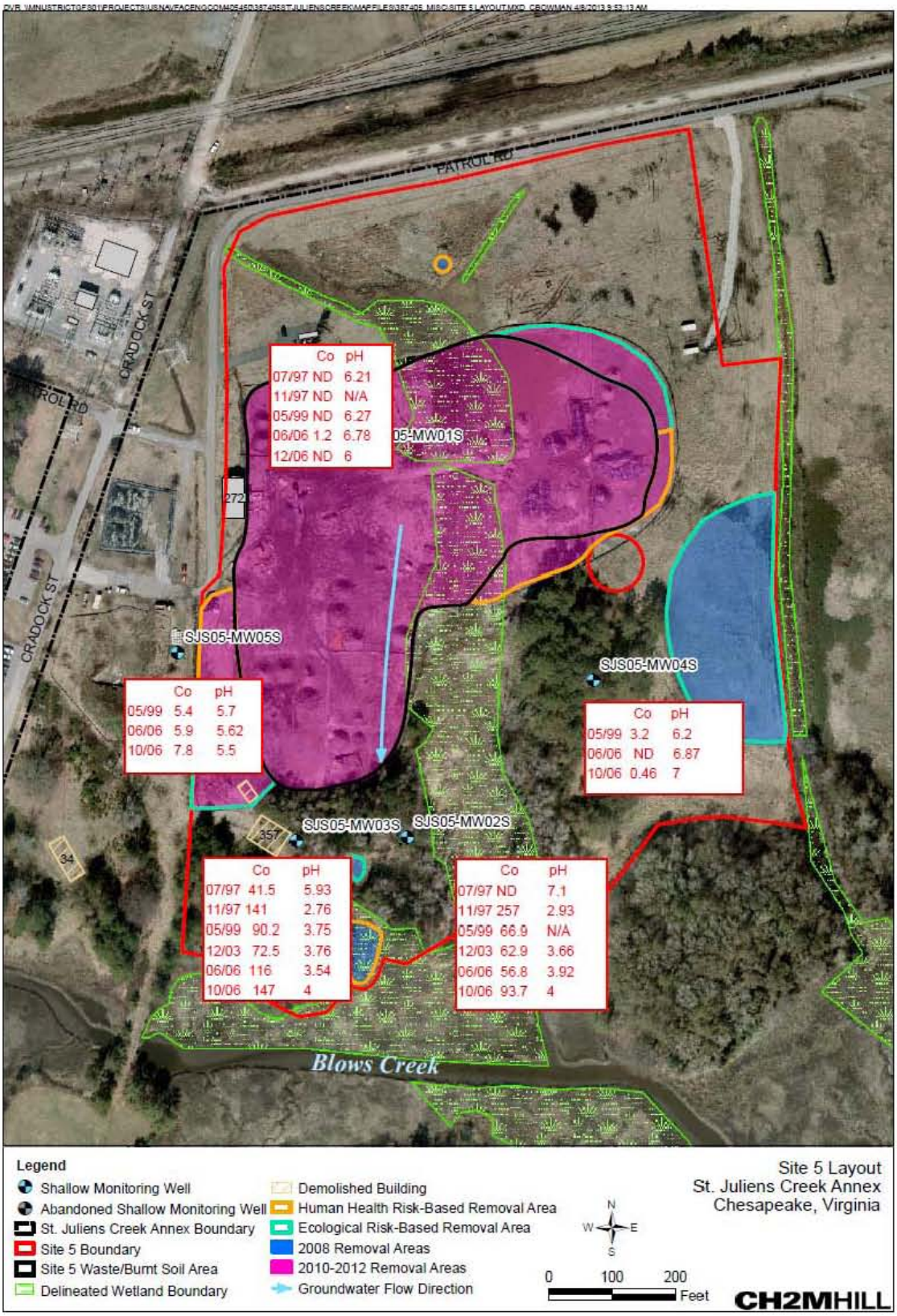


Figure 2
Site 5 Layout and pH and Cobalt Data



Attachment 1 – Uncertainties Discussion

Uncertainty 1: The concentrations of cobalt in groundwater cannot be definitively linked to the historic site activities.

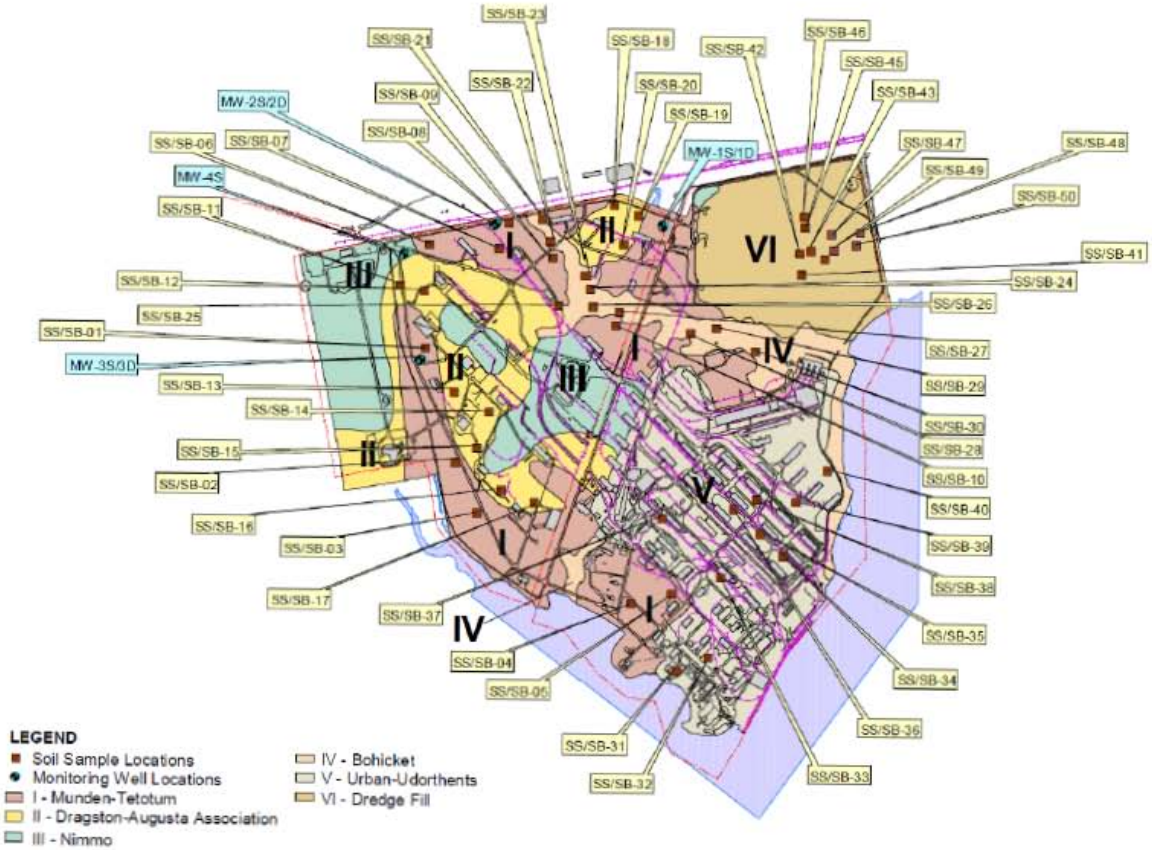
- Cobalt was not identified as a COC in soil.
- Figure 2 shows that the highest concentrations of cobalt in Site 5 groundwater are downgradient of the "waste/burnt soil area" and that elevated cobalt has not been observed at wells within or side-gradient to the "waste/burnt soil area". This shows a strong influence of groundwater pH and cobalt concentrations in the area between MW01S and MW02S/MW03S.
- The specific reasons for the low pH cannot be determined with confidence. Possibilities include:
    - Operation of Site 5 as burning ground and disposal area. However:
        - pH at the one monitoring well within the "waste/burnt soil area" has been historically neutral (MW01S)
        - literature research has not identified a link between explosives burning operations and a reduction in groundwater pH
        - site records do not document disposal of acidic waste
        - other COCs would be expected in addition to cobalt.
    - Placement of dredge fill in the northeastern area of SJCA during the 1930s, including at Site 5 (Figure A-1).
        - The groundwater pH at monitoring wells in the dredge fill area (background, Site 3, Site 4, and Site 5) are lower than other areas of SJCA; however, there is not a definitive pattern.
        - Literature research identified that some sediment has natural acidifying properties; however, it is not known if this is the case with dredged sediment placed at SJCA.
    - Proximity of Site 5 monitoring wells MW02S and MW03S to the Blows Creek wetland.
        - Both monitoring wells are within 100 feet of the wetland (Palustrine Emergent low area) on a brackish water body (Blows Creek).
        - Wetlands may cause a reduction in groundwater pH in association with the decay of organic material.

Uncertainty 2: The potential unacceptable hazard index associated with cobalt is based on a Provisional Peer Reviewed Toxicity Value (PPRTV) for the reference dose (RfD) that was developed in 2008, and confidence in the study used to derive the PPRTV toxicity value was "low to medium," while overall confidence in the toxicity value was determined to be "low" by EPA.

- This latest RfD is based on two separate toxicity effects end points, cobalt-induced polycythemia and decreased iodine uptake by the thyroid. Both are reversible conditions, thus are not considered biologically severe or irreversible effects.

- The RfD and reference concentration (RfC) are both derived based on studies conducted in 1955, 1956, and 1958, though more recent studies were reviewed, indicating these same toxicity studies also served as the basis for previously derived toxicity factors, except the methodology followed for the revised reference values include slightly modified procedures, with additional uncertainty factors (UFs) added, making the values more uncertain.
- The confidence in the study used to derive the PPRTV toxicity value was low to medium, and the confidence in the derived RfD was low because of the short exposure duration of 2 weeks evaluated in the selected studies. However, the cobalt PPRTV profile included the following statement: "One postulated temporal relationship is that chronic exposure may have no greater effect than that resulting from short-term exposure, because if the precursor event of inhibition of iodine uptake does not occur, then there may be no change in thyroid function in the short- or long-term." Thus, application of an additional UF of 10 for extrapolation of short term to long term exposures used to derive the RfD may be not needed.
- As included in Table 1 of the cobalt PPRTV profile, several other more recent studies indicated higher dose levels for the observed effects on other end points such as effects on fetus or heart, thus the most conservatively protective end points were selected even though these are based on much older studies.
- NAVFAC agrees that the 2002 PPRTV, which applies an UF of 10, may not have been sufficiently conservative. However, the 2008 PPRTV, which applies a high UF of 3,000, may be overly conservative, as elaborated in the following bullets.
- The UF of 3,000 used for RfD derivation included a UF of 10 for intra individual variability; a UF of 3 due to lack of multi-generational studies in the available toxicity studies; a UF of 10 for subchronic to chronic extrapolation; and a UF of 10 for lowest observed adverse effect level (LOAEL) to no observed adverse effect level (NOAEL) extrapolation. Of these, the intra individual variability based UF of 10 and the UF of 3 for lack of multigenerational studies can be considered overly conservative, as the available studies are based on human exposures as well as animal exposures, and the most conservatively protective toxicity factor, which is based on a reversible effects end point is selected for derivation of the RfD.
- Because of the large number of additional studies conducted since the 1950s, and because no new end points have been identified, this PPRTV based toxicity factor should be used with a total UF of 100 based RfD value, resulting in an RfD of 0.01 mg/kg/day (LOAEL of 1 mg/kg/day divided by UF of 100).
- Therefore, the estimated HIs from such an approach (using an RfD of 0.01 mg/kg/day versus the RfD of 0.0003 mg/kg-day from the 2008 cobalt PPRTV) will be reduced by a factor of 30, making the HI below 1, the acceptable level for HI.

Figure A-1
SJCA Soil Types, including Dredge Fill



Attachment A-3

Jones, Adrienne/VBO

From: Stroud, Robert [Stroud.Robert@epa.gov]
Sent: Friday, April 26, 2013 2:40 PM
To: krista.parra@navy.mil
Cc: karen.doran@deq.virginia.gov; Staszak, Janna/VBO; Jones, Adrienne/VBO
Subject: EPA response the Site 5 PP RTC's dated 4/12

Team

EPA does not concur with the "No Further Action" remedy using existing data.
With respect to the reported concentrations of cobalt and the resulting low groundwater pH, it does make a difference whether the pH is site related. If the low pH is site related and cobalt goes into solution in a low pH system, this is considered site related. A similar situation would be manganese and iron leachate emanating from a landfill due to the landfill's geochemical conditions even though the Mg and Fe were not "deposited"; or VC degraded from a TCE plume even though VC may not have been "deposited" at a site.

EPA does not agree with the use of pH as the only predictor for contamination. pH is not the only influence on contaminant release. The pH of wells MW-02S and MW-03S have significantly changed according to Table 1. This could be the result of the removal action initially having a negative effect (not uncommon) and then a positive effect? Only sampling of the entire suite can tell (see above). Although it is noted in the "Uncertainty Discussion" that wells MW-02S and MW-03S are close to a wetland, which may reduce groundwater pH, this does not mesh with the reported data from Table 1 that shows a decrease in pH from 1997. If wetlands were the only influence, it is not clear why the pH would have changed.

EPA recommends "Monitoring" - TAL/TCL. Because there has been no monitoring since the Removal action, there is no data to confirm its success. Confirmation sampling would be required to track the success of an action. If there are remaining low levels of contamination after a few years (possibly) of monitoring, there are other options depending upon the circumstances of the site. It would be very difficult to evaluate protectiveness in a Five Year review without such sampling.

Please let me know if anyone wants to talk prior to the conference call @ 1:00 on Monday. My tox (Linda) and hydro (Mindy) will be on the call.

Thanks,

Bob

Attachment A-4

Jones, Adrienne/VBO

From: Stroud, Robert [Stroud.Robert@epa.gov]
Sent: Wednesday, May 15, 2013 2:03 PM
To: Jones, Adrienne/VBO; Staszak, Janna/VBO; karen.doran@deq.virginia.gov; krista.parra@navy.mil
Subject: EPA if/then Site 5 path forward response

Team EPA has reviwed the ESI for site 5 and the consensus is to proceed with the NFA Proposed Plan with monitoring. EPA still belives that their is
not enough evidence to conclude that the cobalt is not site related. If there was confirmation samples in the shallow groundwater after the
soil excavation NFA would be okay, however, with the most recent groundwater samples being collected in 2006, the comfort level is just not there. A tech-memo
needs to be developed to determine frequency and constituents to be sampled. If low pH is indicative of higher-levels of cobalt then
pH should continue to be measured to determine when cobalt levels are decreasing.

Here is the IF/THEN format

If the cobalt concentration is lower, then groundwater monitoring can be stopped.
A decreasing trend would need to be evaluated the HI would also be evaluated during the monitoring results.
If the cobalt concentration is similar, then the monitoring would continue.
If the cobalt concentration is higher, then the monitoring program we need to be evaluated and some
thought as to why the concentration is higher would need to provided to dertermine a path forward.

So to recap EPA would like to proceed with a NFA PP and ROD, however, a tech memo needs to be
develped for monitoring plan. The monitoring does not have to begin prior to the ROD being signed.
The updated risk calculation can be provided in a tech memo.
Additional monitoring data needs to be collected and should be documented in the tech memo.
Scoping of the sampling can be done prior to the submittal of the tech memo.
EPA is only looking for the existing wells to be a part of the monitoring program at this time.
Data will be used to determine when the monitoring should stop.
A five - year review will need to be a part of the plan.

Please let me know if anyone has any questions.

Thanks,

Bob

Attachment A-5

Responses to Comments
Site 5 Groundwater Investigation Scoping Topic
St. Juliens Creek Annex July 31, 2013, Partnering Meeting
Newport News, Virginia

PREPARED FOR: Robert Stroud, EPA Region 3
Karen Doran, VDEQ
Krista Parra, NAVFAC Mid-Atlantic

PREPARED BY: CH2M HILL

DATE: August 9, 2013

Comments from EPA, provided August 7, 2013.

1. ***Comment:*** *EPA recommends sampling for the full suite of TAL metals total and dissolved. A full suite analysis will help in determining an increasing or decreasing trend in the shallow groundwater, as well as enhance the position that all metals (including cobalt) are not site related. Limiting the scope of the analysis will limit the assessment of the current groundwater conditions.*

   Response: NAVFAC respectfully disagrees with EPA's recommendation to collect full suite of TAL metals total and dissolved based on the following:

   - While the latest metals data is from 2006, no CERCLA-related activities have occurred at the site since that sampling event. Therefore, there is no reason to suspect a release occurred after that sampling event that warrants further investigation.

   - Human health risk was re-calculated using current toxicity values in 2013 to confirm the conclusions of the risk assessment remain appropriate. The results were presented in the May 2013 partnering meeting. With the exceptions of chromium and cobalt, the results were consistent with those of the 2007 Expanded Remedial Investigation Addendum, and the team agreed that the report conclusions remained true. For chromium, the team developed and agreed to the following consensus statement: "The team agrees that that no further action or investigation for chromium in shallow aquifer groundwater at Site 5 is required. Although the cancer risk for chromium ($2.6x\ 10^{-4}$ for ingestion by future adult/child residents, and $1.3x10^{-4}$ for dermal exposure by future adult/child residents conservatively assuming hexavalent chromium), is outside of the acceptable risk range of 10^{-4} to 10^{-6} based on the risk calculations updated in May 2013, the maximum detected concentration (58.7 µg/L) is less than the MCL (100 µg/L)." Therefore, cobalt was the only chemical of potential concern remaining.

     (Note, it is recognized that the calculations have not been formalized, as documentation was on hold pending a determination of a path forward. The calculation will be formalized in an upcoming deliverable.)

- It is unclear how the full suite of TAL metals data would be used, which is inconsistent with EPA and DoD policy calling for systematic planning during which the method of evaluation and use of the data are to be defined.
- Based on the environmental questions and DQOs developed by the partnering team and summarized in the presentation, only increasing and decreasing trends in cobalt concentrations will be used.

2. ***Comment:*** *Also, please explain why anions and not cations are included in the proposal.*

   Response: The anion data is proposed because only limited anion data was collected at the site during previous investigations, and it may be helpful in determining the cause of the low pH. Cations (e.g., calcium, potassium, magnesium, sodium) were included in previous phases of investigation and their data have been reviewed, but have not supported any particular theory for the cause of the low pH or slightly elevated cobalt. Therefore, because the collection of additional cation data is not expected to be conclusive and to minimize cost, analysis of cations is not proposed .

Attachment A-6

From:	Staszak, Janna/VBO
To:	stroud.robert@epa.gov; kmdoran@deq.virginia.gov
Cc:	Jones, Adrienne/VBO; "Parra, Krista R CIV NAVFAC MIDLANT, EV"
Subject:	SJCA Site 5 Scoping/Proposed Compromise
Date:	Wednesday, September 04, 2013 3:02:00 PM
Attachments:	image002.png

Bob and Karen,
To address the concerns EPA raised with the proposed analyte list during the September 3 conference call, NAVFAC proposes expanding the analyte list to include all of the ERI Addendum COPCs (aluminum, arsenic, beryllium, cadmium, iron, manganese, lead, thallium, and vanadium) and the new COPCs identified with the updated (2012) risk calculations (chromium and cobalt). (Because the potential chromium risk is based on the conservative assumption of hexavalent chromium, speciation is proposed). The samples would be collected from the 4 existing Site 5 Columbia aquifer groundwater monitoring wells.

During our call today, the team members agreed that this approach is reasonable (though we didn't specifically talk about hex chromium). Please confirm that tech support is on board and we can proceed with this approach by September 6.

Thanks!

Janna Staszak, P.E.*
Project Manager
CH2M HILL
5701 Cleveland Street, Suite 200
Virginia Beach, VA 23462
Direct - 757.671.6256
Fax - 703.376.5992
Mobile - 757.268.6136
www.ch2mhill.com
*Registered in Virginia and Maryland

Attachment A-7

From:	Doran, Karen (DEQ)
To:	Staszak, Janna/VBO; stroud.robert@epa.gov
Cc:	Jones, Adrienne/VBO; krista.parra@navy.mil
Subject:	RE: SJCA Site 5 Scoping/Proposed Compromise
Date:	Thursday, September 05, 2013 3:21:09 PM
Attachments:	image001.png

VDEQ agrees with this approach.
Thanks,

Karen M. Doran
Technical Reviewer
Federal Facilities Program
Department of Environmental Quality
629 East Main Street
Richmond, VA 23219
phone - 804.698.4594
karen.doran@deq.virginia.gov

From: Janna.Staszak@CH2M.com [mailto:Janna.Staszak@CH2M.com]
Sent: Wednesday, September 04, 2013 3:03 PM
To: stroud.robert@epa.gov; Doran, Karen (DEQ)
Cc: Adrienne.Jones@CH2M.com; krista.parra@navy.mil
Subject: SJCA Site 5 Scoping/Proposed Compromise

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To address the concerns EPA raised with the proposed analyte list during the September 3 conference call, NAVFAC proposes expanding the analyte list to include all of the ERI Addendum COPCs (aluminum, arsenic, beryllium, cadmium, iron, manganese, lead, thallium, and vanadium) and the new COPCs identified with the updated (2012) risk calculations (chromium and cobalt). (Because the potential chromium risk is based on the conservative assumption of hexavalent chromium, speciation is proposed). The samples would be collected from the 4 existing Site 5 Columbia aquifer groundwater monitoring wells.

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Attachment A-8

From:	Stroud, Robert
To:	Jones, Adrienne/VBO; Staszak, Janna/VBO; karen.doran@deq.virginia.gov; krista.parra@navy.mil
Subject:	FW: SJCA Site 5 Scoping/Proposed Compromise
Date:	Monday, September 09, 2013 9:17:04 AM
Attachments:	image001.png

Team this is the response that I have received from tech support they want to see the actual sampling plan. I think we are making progress.

Thanks,

Bob

From: Snoparsky, Mindi
Sent: Monday, September 09, 2013 9:01 AM
To: Stroud, Robert; Watson, Linda (R3)
Cc: Johnson, Eric
Subject: RE: SJCA Site 5 Scoping/Proposed Compromise

Bob-

Please send me a map with all of the wells, the wells to be sampled (in case they are not the same), the geology (logs and cross-sections), and the **sampling plan** (field parameters, sampling methods, etc.) The sampling plan should include the technical rationale for limited sampling. I prefer to comment on a legally defensible sampling plan, not by email. I am also curious regarding the cost savings associated with a limited sampling effort- perhaps this should be described in the sampling plan.

Mindi

Mindi Snoparsky, PG
US EPA Region III
Superfund Technical Support
1650 Arch Street
3HS41
Philadelphia, PA 19103
215-814-3316

From: Janna.Staszak@CH2M.com <Janna.Staszak@CH2M.com>
Sent: Wednesday, September 04, 2013 3:03 PM
To: Stroud, Robert; kmdoran@deq.virginia.gov
Cc: Adrienne.Jones@CH2M.com; krista.parra@navy.mil
Subject: SJCA Site 5 Scoping/Proposed Compromise

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Attachment A-9

From: Stroud, Robert
To: Jones, Adrienne/VBO; Staszak, Janna/VBO; karen.doran@deq.virginia.gov; krista.parra@navy.mil
Subject: FW: SJCA Site 5 Scoping/Proposed Compromise
Date: Monday, September 09, 2013 10:03:17 AM
Attachments: image001.png

Team I have received an additional comment regarding Site 5. It recommends adding some additional metals analysis.

The attached EPA guidance document speaks to the issue of the effects of pH on soils and it recommends the following metals be analyzed; lead, chromium, arsenic, cadmium, nickel, zinc, copper, mercury, silver, and selenium.
Please have the Navy review the attached EPA guidance document as this guidance will be used to determine if analysis of soils in regards to ph was appropriately assessed.

http://www.epa.gov/superfund/remedytech/tsp/download/issue14.pdf

---

From: Janna.Staszak@CH2M.com <Janna.Staszak@CH2M.com>
Sent: Wednesday, September 04, 2013 3:03 PM
To: Stroud, Robert; kmdoran@deq.virginia.gov
Cc: Adrienne.Jones@CH2M.com; krista.parra@navy.mil
Subject: SJCA Site 5 Scoping/Proposed Compromise

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Attachment B
2013 Site 5 Shallow Aquifer Groundwater Risk Calculations

LEAD MODEL FOR WINDOWS Version 1.1

==========
Model Version: 1.1 Build11
User Name:
Date:
Site Name:
Operable Unit:
Run Mode: Research
==========

****** Air ******

Indoor Air Pb Concentration: 30.000 percent of outdoor.
Other Air Parameters:

Age	Time Outdoors (hours)	Ventilation Rate (m^3/day)	Lung Absorption (%)	Outdoor Air Pb Conc (µg Pb/m^3)
.5-1	1.000	2.000	32.000	0.100
1-2	2.000	3.000	32.000	0.100
2-3	3.000	5.000	32.000	0.100
3-4	4.000	5.000	32.000	0.100
4-5	4.000	5.000	32.000	0.100
5-6	4.000	7.000	32.000	0.100
6-7	4.000	7.000	32.000	0.100

****** Diet ******

Age	Diet Intake(µg/day)
.5-1	2.260
1-2	1.960
2-3	2.130
3-4	2.040
4-5	1.950
5-6	2.050
6-7	2.220

****** Drinking Water ******

Water Consumption:

Age	Water (L/day)
.5-1	0.200
1-2	0.500
2-3	0.520
3-4	0.530
4-5	0.550
5-6	0.580
6-7	0.590

Drinking Water Concentration: 9.600 µg Pb/L

****** Soil & Dust ******

Multiple Source Analysis Used
Average multiple source concentration: 150.000 µg/g

Mass fraction of outdoor soil to indoor dust conversion factor: 0.700
Outdoor airborne lead to indoor household dust lead concentration: 100.000
Use alternate indoor dust Pb sources? No

Age	Soil (µg Pb/g)	House Dust (µg Pb/g)
.5-1	200.000	150.000
1-2	200.000	150.000
2-3	200.000	150.000
3-4	200.000	150.000
4-5	200.000	150.000
5-6	200.000	150.000
6-7	200.000	150.000

****** Alternate Intake ******

Age	Alternate (µg Pb/day)
.5-1	0.000
1-2	0.000
2-3	0.000
3-4	0.000
4-5	0.000
5-6	0.000
6-7	0.000

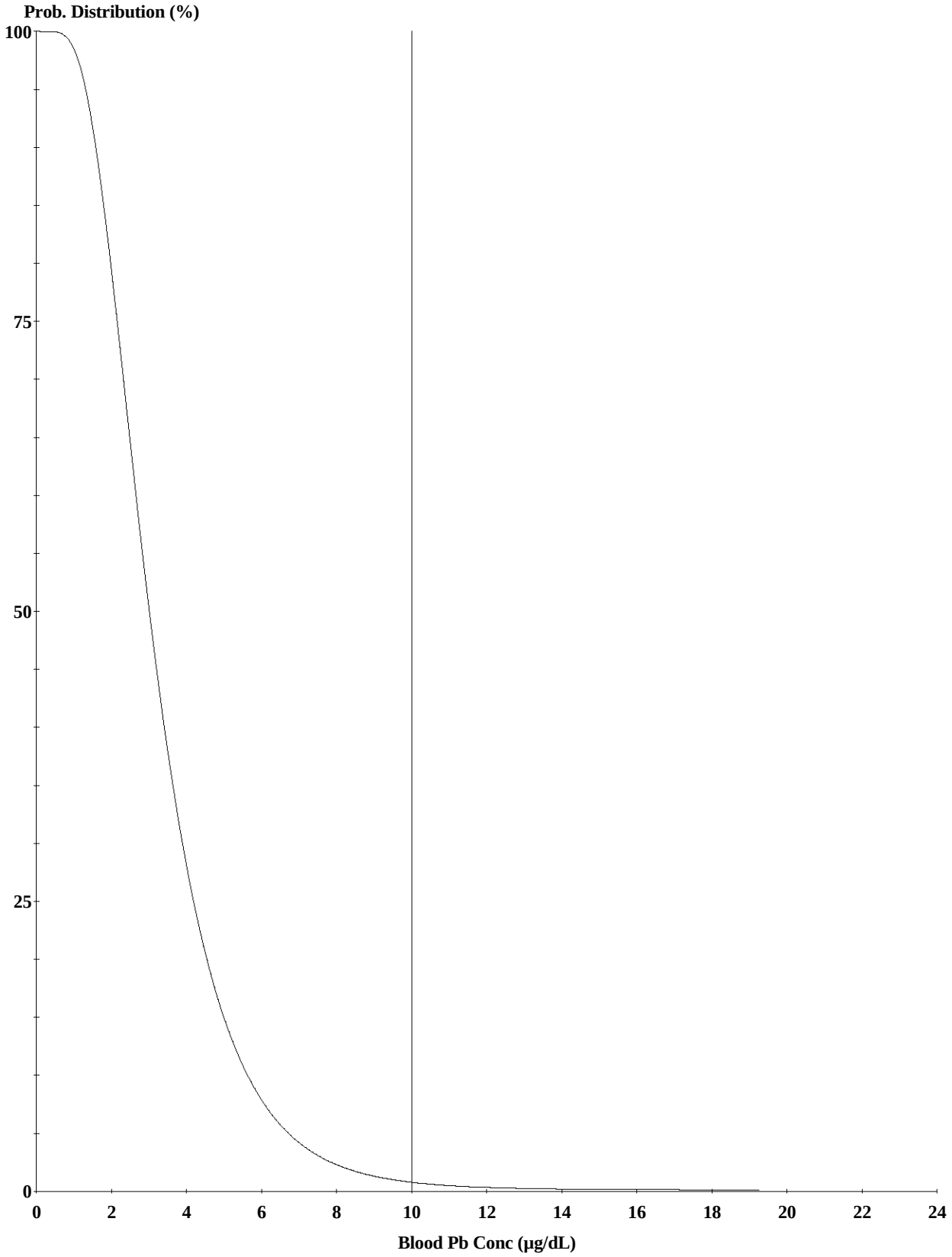
****** Maternal Contribution: Infant Model ******

Maternal Blood Concentration: 1.000 µg Pb/dL

****
CALCULATED BLOOD LEAD AND LEAD UPTAKES:
****

Year	Air (µg/day)	Diet (µg/day)	Alternate (µg/day)	Water (µg/day)
.5-1	0.021	1.055	0.000	0.896
1-2	0.034	0.901	0.000	2.207
2-3	0.062	0.990	0.000	2.320
3-4	0.067	0.958	0.000	2.388
4-5	0.067	0.931	0.000	2.521
5-6	0.093	0.985	0.000	2.676
6-7	0.093	1.071	0.000	2.732

Year	Soil+Dust (µg/day)	Total (µg/day)	Blood (µg/dL)
.5-1	4.105	6.077	3.3
1-2	6.424	9.566	3.9
2-3	6.493	9.865	3.7
3-4	6.559	9.972	3.5
4-5	4.942	8.462	3.0
5-6	4.477	8.232	2.6
6-7	4.244	8.141	2.3



Cutoff = 10.000 µg/dl
Geo Mean = 3.151
GSD = 1.600
% Above = 0.700

Age Range = 0 to 84 months

Run Mode = Research

Unidentified Matrix Raw Analytical Results
May 2013

Summary of Chemicals Detected in Unidentified Matrix: Site Site 5

	Location		SJS05-MW01S						SJS05-MW02S							SJS05-MW03S						
	Sample ID		SJS05-GW1S-001	SJS05-GW1S-002	SJS05-GW1S-003	SJS05-MW01S-06B	SJS05-MW01S-06D	SJS05-MW01S-06DP	SJS05-GW2S-001	SJS05-GW2S-002	SJS05-GW2S-003	SJS05-MW02S-03D	SJS05-MW02S-03D-P	SJS05-MW02S-06B	SJS05-MW02S-06D	SJS05-GW3S-001	SJS05-GW3S-001P	SJS05-GW3S-002	SJS05-GW3S-003	SJS05-MW03S-03D	SJS05-MW03S-06B	SJS05-MW03S-06D
	Sample Depth (ft)		999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99
	Sample Date		7/15/1997	11/6/1997	5/19/1999	6/22/2006	10/12/2006	10/12/2006	7/16/1997	11/4/1997	5/23/1999	12/15/2003	12/15/2003	6/22/2006	10/12/2006	7/16/1997	7/16/1997	11/4/1997	5/23/1999	12/15/2003	6/22/2006	10/12/2006
Analyte	**Screening Level**	**UNITS**																				
VOA (UG_L)																						
1,1,1-Trichloroethane	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
1,1,2,2-Tetrachloroethane	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
1,1,2-Trichloroethane	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
1,1-Dichloroethane	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
1,1-Dichloroethene	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
1,2,4-Trichlorobenzene	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
1,2-Dibromo-3-chloropropane	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
1,2-Dibromoethane	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
1,2-Dichlorobenzene	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
1,2-Dichloroethane	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
1,2-Dichloropropane	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
1,3-Dichlorobenzene	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
1,4-Dichlorobenzene	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
2-Butanone	--	--	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
2-Hexanone	--	--	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	NA	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
4-Methyl-2-pentanone	--	--	5 U	5 U	5 U	NA	NA	NA	5 U	5 U	5 U	NA	NA	NA	NA	5 U	5 U	5 U	5 U	NA	NA	NA
Acetone	--	--	**11 L**	NA	NA	NA	NA	NA	**8 B**	**9 B**	NA	NA	NA	NA	NA	NA	NA	**7 B**	NA	NA	NA	NA
Benzene	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Bromochloromethane	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Bromodichloromethane	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Bromoform	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Bromomethane	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Carbon disulfide	--	--	1 U	1 U	**0.4 B**	NA	NA	NA	1 U	**0.8 J**	**0.3 B**	NA	NA	NA	NA	1 U	**0.3 J**	1 U	**0.3 B**	NA	NA	NA
Carbon tetrachloride	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Chlorobenzene	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Chloroethane	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Chloroform	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Chloromethane	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
cis-1,2-Dichloroethene	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
cis-1,3-Dichloropropene	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Dibromochloromethane	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Ethylbenzene	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Methylene chloride	--	--	**3 B**	**2 B**	**0.8 B**	NA	NA	NA	**2 B**	**2 B**	**0.4 B**	NA	NA	NA	NA	**3 B**	**4 B**	**2 B**	**0.4 B**	NA	NA	NA
Styrene	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Tetrachloroethene	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Toluene	--	--	**0.2 J**	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
trans-1,2-Dichloroethene	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
trans-1,3-Dichloropropene	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Trichloroethene	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Vinyl chloride	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
Xylene, total	--	--	1 U	1 U	1 U	NA	NA	NA	1 U	1 U	1 U	NA	NA	NA	NA	1 U	1 U	1 U	1 U	NA	NA	NA
SVOA (UG_L)																						
2,2'-Oxybis(1-chloropropane)	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
2,4,5-Trichlorophenol	--	--	25 U	25 U	30 U	NA	NA	NA	25 U	25 U	26 U	NA	NA	NA	NA	25 U	25 U	25 U	28 U	NA	NA	NA
2,4,6-Trichlorophenol	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
2,4-Dichlorophenol	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
2,4-Dimethylphenol	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
2,4-Dinitrophenol	--	--	25 U	25 U	30 U	NA	NA	NA	25 U	25 U	26 U	NA	NA	NA	NA	25 U	25 U	25 U	28 U	NA	NA	NA
2,4-Dinitrotoluene	--	--	10 U	10 U	1.2 U	NA	NA	NA	10 U	10 U	1.2 U	NA	NA	NA	NA	10 U	10 U	10 U	1.2 U	NA	NA	NA
2,6-Dinitrotoluene	--	--	10 U	10 U	1.2 U	NA	NA	NA	10 U	10 U	1.2 U	NA	NA	NA	NA	10 U	10 U	10 U	1.2 U	NA	NA	NA
2-Chloronaphthalene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
2-Chlorophenol	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
2-Methylnaphthalene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
2-Methylphenol	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
2-Nitroaniline	--	--	25 U	25 U	30 U	NA	NA	NA	25 U	25 U	26 U	NA	NA	NA	NA	25 U	25 U	25 U	28 U	NA	NA	NA
2-Nitrophenol	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
3,3'-Dichlorobenzidine	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
3-Nitroaniline	--	--	25 U	25 U	30 U	NA	NA	NA	25 U	25 U	26 U	NA	NA	NA	NA	25 U	25 U	25 U	28 U	NA	NA	NA
4,6-Dinitro-2-methylphenol	--	--	25 U	25 U	30 U	NA	NA	NA	25 U	25 U	26 U	NA	NA	NA	NA	25 U	25 U	25 U	28 U	NA	NA	NA
4-Bromophenyl-phenylether	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
4-Chloro-3-methylphenol	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
4-Chloroaniline	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
4-Chlorophenyl-phenylether	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
4-Methylphenol	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
4-Nitroaniline	--	--	25 U	25 U	30 U	NA	NA	NA	25 U	25 U	26 U	NA	NA	NA	NA	25 U	25 U	25 U	28 U	NA	NA	NA
4-Nitrophenol	--	--	25 U	25 U	30 U	NA	NA	NA	25 U	25 U	26 U	NA	NA	NA	NA	25 U	25 U	25 U	28 U	NA	NA	NA
Acenaphthene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Acenaphthylene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Anthracene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Benzo(a)anthracene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Benzo(a)pyrene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Benzo(b)fluoranthene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Benzo(g,h,i)perylene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Benzo(k)fluoranthene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
bis(2-Chloroethoxy)methane	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
bis(2-Chloroethyl)ether	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
bis(2-Ethylhexyl)phthalate	--	--	10 U	**1 J**	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	**2 J**	**1 J**	10 U	11 U	NA	NA	NA
Butylbenzylphthalate	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Carbazole	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Chrysene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Dibenz(a,h)anthracene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Dibenzofuran	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Diethylphthalate	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Dimethyl phthalate	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Di-n-butylphthalate	--	--	10 U	10 U	**3 J**	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Di-n-octylphthalate	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Fluoranthene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Fluorene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Hexachlorobenzene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Hexachlorobutadiene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Hexachlorocyclopentadiene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Hexachloroethane	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Indeno(1,2,3-cd)pyrene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Isophorone	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Naphthalene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
n-Nitroso-di-n-propylamine	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
n-Nitrosodiphenylamine	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Nitrobenzene	--	--	10 U	10 U	1.2 U	NA	NA	NA	10 U	10 U	1.2 U	NA	NA	NA	NA	10 U	10 U	10 U	1.2 U	NA	NA	NA
Pentachlorophenol	--	--	25 U	25 U	30 U	NA	NA	NA	25 U	25 U	26 U	NA	NA	NA	NA	25 U	25 U	25 U	28 U	NA	NA	NA
Phenanthrene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Phenol	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA
Pyrene	--	--	10 U	10 U	12 U	NA	NA	NA	10 U	10 U	11 U	NA	NA	NA	NA	10 U	10 U	10 U	11 U	NA	NA	NA

Unidentified Matrix Raw Analytical Results
May 2013

Summary of Chemicals Detected in Unidentified Matrix: Site Site 5

PEST/PCB (UG_L)																						
4,4'-DDD	--	--	0.1 U	0.1 U	0.11 U	NA	NA	NA	0.1 U	0.1 U	0.12 U	NA	NA	NA	NA	0.1 U	0.1 U	0.1 U	0.11 U	NA	NA	NA
4,4'-DDE	--	--	0.1 U	0.1 U	0.11 U	NA	NA	NA	0.1 U	0.1 U	0.12 U	NA	NA	NA	NA	0.1 U	0.1 U	0.1 U	0.11 U	NA	NA	NA
4,4'-DDT	--	--	0.1 U	0.1 U	0.11 U	NA	NA	NA	0.1 U	0.1 U	0.12 U	NA	NA	NA	NA	0.1 U	0.1 U	0.1 U	0.11 U	NA	NA	NA
Aldrin	--	--	0.05 U	0.05 U	0.055 U	NA	NA	NA	0.05 U	0.05 U	0.062 U	NA	NA	NA	NA	0.05 U	0.05 U	0.05 U	0.057 U	NA	NA	NA
alpha-BHC	--	--	0.05 U	0.05 U	0.055 U	NA	NA	NA	0.05 U	0.05 U	0.062 U	NA	NA	NA	NA	0.05 U	0.05 U	0.05 U	0.057 U	NA	NA	NA
alpha-Chlordane	--	--	0.05 U	0.05 U	0.055 U	NA	NA	NA	0.05 U	0.05 U	0.062 U	NA	NA	NA	NA	0.05 U	0.05 U	0.05 U	0.057 U	NA	NA	NA
Aroclor-1016	--	--	1 U	1 U	1.1 U	NA	NA	NA	1 U	1 U	1.2 U	NA	NA	NA	NA	1 U	1 U	1 U	1.1 U	NA	NA	NA
Aroclor-1221	--	--	2 U	2 U	2.2 U	NA	NA	NA	2 U	2 U	2.5 U	NA	NA	NA	NA	2 U	2 U	2 U	2.3 U	NA	NA	NA
Aroclor-1232	--	--	1 U	1 U	1.1 U	NA	NA	NA	1 U	1 U	1.2 U	NA	NA	NA	NA	1 U	1 U	1 U	1.1 U	NA	NA	NA
Aroclor-1242	--	--	1 U	1 U	1.1 U	NA	NA	NA	1 U	1 U	1.2 U	NA	NA	NA	NA	1 U	1 U	1 U	1.1 U	NA	NA	NA
Aroclor-1248	--	--	1 U	1 U	1.1 U	NA	NA	NA	1 U	1 U	1.2 U	NA	NA	NA	NA	1 U	1 U	1 U	1.1 U	NA	NA	NA
Aroclor-1254	--	--	1 U	1 U	1.1 U	NA	NA	NA	1 U	1 U	1.2 U	NA	NA	NA	NA	1 U	1 U	1 U	1.1 U	NA	NA	NA
Aroclor-1260	--	--	1 U	1 U	1.1 U	NA	NA	NA	1 U	1 U	1.2 U	NA	NA	NA	NA	1 U	1 U	1 U	1.1 U	NA	NA	NA
beta-BHC	--	--	0.05 U	0.05 U	0.055 U	NA	NA	NA	0.05 U	0.05 U	0.062 U	NA	NA	NA	NA	0.05 U	0.05 U	0.05 U	0.057 U	NA	NA	NA
delta-BHC	--	--	0.05 U	0.05 U	0.055 U	NA	NA	NA	0.05 U	0.05 U	0.062 U	NA	NA	NA	NA	0.05 U	0.05 U	0.05 U	0.057 U	NA	NA	NA
Dieldrin	--	--	0.1 U	0.1 U	0.11 U	NA	NA	NA	0.1 U	0.1 U	0.12 U	NA	NA	NA	NA	0.1 U	0.1 U	0.1 U	0.11 U	NA	NA	NA
Endosulfan I	--	--	0.05 U	0.05 U	0.055 U	NA	NA	NA	0.05 U	0.05 U	0.062 U	NA	NA	NA	NA	0.05 U	0.05 U	0.05 U	0.057 U	NA	NA	NA
Endosulfan II	--	--	0.1 U	0.1 U	0.11 U	NA	NA	NA	0.1 U	0.1 U	0.12 U	NA	NA	NA	NA	0.1 U	0.1 U	0.1 U	0.11 U	NA	NA	NA
Endosulfan sulfate	--	--	0.1 U	0.1 U	0.11 U	NA	NA	NA	0.1 U	0.1 U	0.12 U	NA	NA	NA	NA	0.1 U	0.1 U	0.1 U	0.11 U	NA	NA	NA
Endrin	--	--	0.1 U	0.1 U	0.11 U	NA	NA	NA	0.1 U	0.1 U	0.12 U	NA	NA	NA	NA	0.1 U	0.1 U	0.1 U	0.11 U	NA	NA	NA
Endrin aldehyde	--	--	0.1 U	0.1 U	0.11 U	NA	NA	NA	0.1 U	0.1 U	0.12 U	NA	NA	NA	NA	0.1 U	0.1 U	0.1 U	0.11 U	NA	NA	NA
Endrin ketone	--	--	0.1 U	0.1 U	0.11 U	NA	NA	NA	0.1 U	0.1 U	0.12 U	NA	NA	NA	NA	0.1 U	0.1 U	0.1 U	0.11 U	NA	NA	NA
gamma-BHC (Lindane)	--	--	0.05 U	0.05 U	0.055 U	NA	NA	NA	0.05 U	0.05 U	0.062 U	NA	NA	NA	NA	0.05 U	0.05 U	0.05 U	0.057 U	NA	NA	NA
gamma-Chlordane	--	--	0.05 U	0.05 U	0.055 U	NA	NA	NA	0.05 U	0.05 U	0.062 U	NA	NA	NA	NA	0.05 U	0.05 U	0.05 U	0.057 U	NA	NA	NA
Heptachlor	--	--	0.05 U	0.05 U	0.055 U	NA	NA	NA	0.05 U	0.05 U	0.062 U	NA	NA	NA	NA	0.05 U	0.05 U	0.05 U	0.057 U	NA	NA	NA
Heptachlor epoxide	--	--	0.05 U	0.05 U	0.055 U	NA	NA	NA	0.05 U	0.05 U	0.062 U	NA	NA	NA	NA	0.05 U	0.05 U	0.05 U	0.057 U	NA	NA	NA
Methoxychlor	--	--	0.5 U	0.5 U	0.55 U	NA	NA	NA	0.5 U	0.5 U	0.62 U	NA	NA	NA	NA	0.5 U	0.5 U	0.5 U	0.57 U	NA	NA	NA
Toxaphene	--	--	5 U	5 U	5.5 U	NA	NA	NA	5 U	5 U	6.2 U	NA	NA	NA	NA	5 U	5 U	5 U	5.7 U	NA	NA	NA
EXPLO (UG_L)																						
1,3,5-Trinitrobenzene	--	--	NA	NA	1.2 U	NA	NA	NA	NA	NA	1.2 U	NA	NA	NA	NA	NA	NA	25 U	1.2 U	NA	NA	NA
1,3-Dinitrobenzene	--	--	NA	NA	1.2 U	NA	NA	NA	NA	NA	1.2 U	NA	NA	NA	NA	NA	NA	25 U	1.2 U	NA	NA	NA
2,4,6-Trinitrotoluene	--	--	NA	NA	1.2 U	NA	NA	NA	NA	NA	1.2 U	NA	NA	NA	NA	NA	NA	25 U	1.2 U	NA	NA	NA
2-Amino-4,6-dinitrotoluene	--	--	NA	NA	1.2 U	NA	NA	NA	NA	NA	1.2 U	NA	NA	NA	NA	NA	NA	25 U	1.2 U	NA	NA	NA
2-Nitrotoluene	--	--	NA	NA	2.6 U	NA	NA	NA	NA	NA	2.6 U	NA	NA	NA	NA	NA	NA	25 U	2.6 U	NA	NA	NA
3-Nitrotoluene	--	--	NA	NA	2.6 U	NA	NA	NA	NA	NA	2.6 U	NA	NA	NA	NA	NA	NA	25 U	2.6 U	NA	NA	NA
4-Amino-2,6-dinitrotoluene	--	--	NA	NA	1.2 U	NA	NA	NA	NA	NA	1.2 U	NA	NA	NA	NA	NA	NA	25 U	1.2 U	NA	NA	NA
4-Nitrotoluene	--	--	NA	NA	2.6 U	NA	NA	NA	NA	NA	2.6 U	NA	NA	NA	NA	NA	NA	25 U	2.6 U	NA	NA	NA
HMX	--	--	NA	NA	2.6 U	NA	NA	NA	NA	NA	2.6 U	NA	NA	NA	NA	NA	NA	25 U	2.6 U	NA	NA	NA
RDX	--	--	NA	NA	2.6 U	NA	NA	NA	NA	NA	2.6 U	NA	NA	NA	NA	NA	NA	25 U	2.6 U	NA	NA	NA
Tetryl	--	--	NA	NA	2.6 U	NA	NA	NA	NA	NA	2.6 U	NA	NA	NA	NA	NA	NA	25 U	2.6 U	NA	NA	NA
METAL (UG_L)																						
Aluminum	--	--	**1630**	**60 B**	**89.7 J**	**41.5 B**	**86.3 B**	**92.2 B**	**1110**	**87400**	**9880**	**21500**	**21800**	**18400**	**60500**	**27100**	**17100**	**30400**	**16400**	**11400**	**22200**	**33600**
Antimony	--	--	2 U	1.7 U	2.7 U	**0.92 B**	**0.6 B**	**0.58 B**	2 U	1.7 U	2.7 U	2 U	2 U	**0.088 B**	**0.18 B**	**3.7 J**	**6 J**	1.7 U	2.7 U	2 U	**0.2 B**	2 UJ
Arsenic	--	--	**4.8 J**	**8.8 J**	**6 B**	**12.8**	**2.7**	**2.7**	3 U	**12**	**3.6 J**	**5.9 J**	**5.9 J**	**5.3**	**6**	**27.3**	**18.4**	**5.7 J**	**3.9 J**	**5.8 J**	**0.96 J**	**3.8**
Barium	--	--	**359**	**248**	**249**	**55.4 J**	**69.8 J**	**68.5 J**	**126 J**	**14 B**	**18.4 J**	**22.4 J**	**22.8 J**	**30 J**	**60.2 J**	**77.8 J**	**64.1 J**	**22 J**	**18.5 J**	**19.8 J**	**17.6 J**	**13.6 J**
Beryllium	--	--	1 U	**1.7 J**	0.1 U	**1.7 B**	**0.37 B**	**0.44 B**	1 U	**18.3**	**4.5 J**	**5.4**	**5.5**	**6.8 B**	**12.1**	**1.2 J**	1 U	**13.5**	**9.1**	**7.6**	**13.7**	**15.9**
Cadmium	--	--	0.5 U	0.4 U	**0.69 J**	5 U	**0.16 B**	5 U	0.5 U	**9**	**0.94 J**	**2.2 J**	**2.1 J**	**1.4 B**	**5.5**	0.5 U	0.5 U	**11**	**5.7**	**4.8 J**	**9.9**	**10.1**
Calcium	--	--	**117000**	**182000**	**188000**	**45000**	**54300**	**52800**	**97800**	**66300**	**54100**	**57000**	**58200**	**56000**	**101000**	**53200**	**49700**	**40700**	**37300**	**65600**	**71600**	**87500**
Chromium	--	--	**8.5 J**	**11.4**	**2 J**	10 U	10 U	10 U	7 U	**24.6 B**	**4.4 B**	0.6 U	0.6 U	**2.6 J**	**4.4 J**	**58.7**	**36.1**	**7.6 B**	**2.2 B**	0.6 U	**3.1 J**	**4.5 J**
Cobalt	--	--	8 U	6 U	0.5 U	**1.2 J**	50 U	50 U	8 U	**257**	**66.9**	**62.6**	**62.9**	**56.8**	**93.7**	**41.5 J**	**33.4 J**	**141**	**90.2**	**72.5**	**116**	**147**
Copper	--	--	6 U	5.8 U	**9.4 B**	25 U	25 U	**3.3 J**	6 U	**124**	**9.1 B**	**19.1 J**	**20.1 J**	**6 J**	25 U	**12.8 J**	**11.2 J**	**62.2**	**25.1**	**1.4 B**	**46.2**	**14.1 J**
Cyanide	--	--	5 U	5 U	5 U	NA	10 U	10 U	5 U	5 U	5 U	3 UL	3 UL	NA	10 U	5 U	5 U	5 U	5 U	3 UL	NA	10 U
Iron	--	--	**58700**	**64400**	**74300**	**4030**	**4610**	**4460**	**13500**	**40800**	**69100**	**18400**	**18400**	**49600**	**55100**	**83700**	**65200**	**17700**	**24800**	**24800**	**8760**	**30600**
Lead	--	--	1 U	**1.6 B**	**1.1 J**	**0.87 J**	**2.8**	**3**	**1.1 J**	**16.2**	**4.7**	**9.4**	**9.8**	**10.4**	**18.4 J**	**19.2**	**13.5**	**26.1**	**18**	**6.4**	**58.3**	**23.3 J**
Magnesium	--	--	**190000**	**221000**	**278000**	**36000**	**39300**	**38300**	**156000**	**45700**	**54400**	**44800**	**45400**	**60000**	**125000**	**49600**	**45000**	**35600**	**35600**	**52400**	**52700**	**68000**
Manganese	--	--	**1300**	**2720**	**3080**	**173**	**152**	**146**	**992**	**4320**	**2640**	**2040**	**2060**	**2460**	**3620**	**2980**	**2670**	**3620**	**3400**	**3870**	**3960**	**5050**
Mercury	--	--	**0.13 B**	0.13 U	0.1 U	0.2 U	0.2 U	0.2 U	0.12 U	0.13 U	0.1 U	0.13 U	0.13 U	0.2 U	0.2 U	**0.18 B**	**0.29 B**	0.13 U	0.1 U	0.15 U	0.2 U	0.2 U
Nickel	--	--	7 U	6.3 U	0.9 U	**5.2 J**	**1.4 B**	**1.2 B**	**14.1 J**	**360**	**106**	**102**	**103**	**104**	**182**	**46.5 K**	**41.1 K**	**238**	**160**	**121**	**182**	**234**
Phosphorus	--	--	**104**	NA	**159**	NA	NA	NA	**309**	NA	20 U	NA	NA	NA	NA	**128**	**251**	NA	20 U	NA	NA	NA
Potassium	--	--	**39500**	**72300**	**96300**	**25900 J**	**28600 J**	**28200 J**	**49100**	**13000**	**23600 J**	**15100**	**15900**	**18900 J**	**35000 J**	**13200**	**11100**	**15000**	**15400 J**	**29500**	**27700 J**	**30400 J**
Selenium	--	--	3 U	6.6 U	2.6 U	**2.1 J**	**1.7 J**	**1.5 J**	3 UL	3.3 U	2.6 U	3 UL	3 UL	**5.4**	**13.9**	3 UL	3 UL	3.3 U	2.6 U	3 UL	**5 J**	**5**
Silver	--	--	**2.4 B**	**2.5 B**	0.9 U	10 U	10 U	10 U	**3.8 B**	**2.8 J**	0.9 U	**0.81 J**	**0.48 J**	10 U	10 U	**4.1 B**	**6.9 B**	**1.5 J**	0.9 U	**1.4 J**	10 U	10 U
Sodium	--	--	**1200000 B**	**1340000**	**1480000**	**225000**	**238000**	**233000**	**1340000**	**79200**	**300000**	**268000**	**269000**	**262000**	**380000**	**198000**	**186000**	**22000**	**21800**	**90200**	**67900**	**98700**
Thallium	--	--	**2.7 B**	**1.8 B**	10 U	1 U	1 U	1 U	2 U	1.5 U	3.2 U	2 U	2 U	**0.059 J**	**0.12 J**	2 U	**2.1 J**	1.5 U	3.2 U	2 U	**0.25 J**	**0.04 J**
Vanadium	--	--	**11.4 J**	6.8 U	0.6 U	**2.7 J**	**2.3 B**	**2.4 B**	9 U	**9.9 J**	**0.63 J**	**3.2 J**	**3 J**	**16.1 J**	**20.7 J**	**82.8**	**60.2**	6.8 U	0.6 U	**1.3 J**	**2.6 J**	**5.1 J**
Zinc	--	--	**46.1**	**30.8 B**	**8.8 J**	**41.2 J**	**16.3 J**	**15.2 J**	**23.5 B**	**2020**	**572**	**764**	**774**	**756**	**1380**	**153**	**109**	**1540**	**1240**	**957**	**1270**	**1510**
FMETAL (UG_L)																						
Aluminum, Dissolved	--	--	44 U	38.1 U	**167 J**	**44.3 B**	200 U	200 U	44 U	**84200**	**9130**	**22400**	**22100**	**18300**	**60700**	44 U	**72.3 B**	**30900**	**17600**	**11400**	**23300**	**35100**
Antimony, Dissolved	--	--	2 U	1.7 U	2.7 U	**0.95 B**	**0.42 B**	**0.46 B**	2 U	1.7 U	2.7 U	2 U	2 U	**0.073 B**	**0.18 B**	2 U	**3.1 B**	1.7 U	2.7 U	2 U	**0.27 B**	2 UJ
Arsenic, Dissolved	--	--	**3.1 J**	**8.3 B**	**8.2 B**	**13.2**	**2**	**2.2**	3 U	**13.3**	2 U	**6.9 J**	**6 J**	**5**	**5.7**	3 U	3 U	**5.8 J**	2 U	**6 J**	**0.89 J**	**3.2**
Barium, Dissolved	--	--	**371**	**250**	**243**	**55.1 J**	**68.4 J**	**68.9 J**	**120 J**	**14.8 B**	**17.9 J**	**25.5 J**	**27.3 J**	**29.7 J**	**60 J**	**21.5 B**	**22.9 B**	**22.5 J**	**19.7 J**	**22.1 J**	**18.4 J**	**13.5 J**
Beryllium, Dissolved	--	--	1 U	**0.58 J**	0.1 U	**1.8 B**	5 U	5 U	1 U	**17.7**	**4.4 J**	**5.8**	**5.5**	**6.8 B**	**12**	1 U	1 U	**14.1**	**9.7**	**7.5**	**14.3**	**16.4**
Cadmium, Dissolved	--	--	0.5 U	0.4 U	**0.56 J**	5 U	5 U	5 U	0.5 U	**8.5**	**1 J**	**2.4 J**	**2.3 J**	**1.4 B**	**5.8**	0.5 U	0.5 U	**11.5**	**6**	**5 J**	**10.2**	**11**
Calcium, Dissolved	--	--	**118000**	**179000**	**188000**	**44000**	**53600**	**53800**	**94800**	**63700**	**52000**	**60300**	**58800**	**55200**	**100000**	**68400**	**68500**	**41100**	**40000**	**65300**	**74300**	**89700**
Chromium, Dissolved	--	--	7 U	**9.2 J**	**2.7 J**	10 U	10 U	10 U	7 U	**33**	**4.5 J**	0.6 U	0.6 U	**2.8 J**	**4.5 J**	7 U	7 U	**21.8**	**3.4 J**	0.6 U	**3.1 J**	**4.9 J**
Cobalt, Dissolved	--	--	8 U	**36.8 J**	0.5 U	**1 B**	50 U	50 U	8 U	**270**	**65.9**	**64.4**	**64.1**	**56.8**	**94.3**	**22.3 J**	**19.2 J**	**173**	**94.9**	**71.6**	**121**	**153**
Copper, Dissolved	--	--	6 U	5.8 U	**5 B**	25 U	25 U	25 U	6 U	**149**	**2.1 B**	**22.4 J**	**25.5**	25 U	25 U	6 U	6 U	**89.6**	**37.3**	**4.8 B**	**48**	**16.6 J**
Iron, Dissolved	--	--	**65100**	**67400**	**74900**	**4010**	**4230**	**4260**	**12300**	**40500**	**65500**	**19000 J**	**18200 J**	**49300**	**54000**	**40700**	**40600**	**18000**	**26800**	**22900 J**	**9160**	**29200**
Lead, Dissolved	--	--	1 U	1.3 U	1 U	**0.45 J**	**0.9 J**	**0.92 J**	1 U	**20.2**	1 U	**12.7**	**10.6**	**9.2**	**18.1 J**	1 U	**1.3 B**	**29.3**	**20.4**	**7.8**	**66.8**	**24.9 J**
Magnesium, Dissolved	--	--	**186000**	**215000**	**276000**	**35600**	**39300**	**39600**	**153000**	**44300**	**52100**	**46600 J**	**46100 J**	**60000**	**125000**	**56900**	**57100**	**36100**	**38000**	**51700 J**	**55200**	**69900**
Manganese, Dissolved	--	--	**1290**	**2560**	**3080**	**168**	**153**	**153**	**950**	**4200**	**2500**	**2120 J**	**2090 J**	**2450**	**3630**	**3140**	**3150**	**3670**	**3640**	**3790 J**	**4140**	**5210**
Mercury, Dissolved	--	--	**0.13 B**	0.13 U	0.1 U	0.2 U	0.2 U	0.2 U	0.13 U	0.13 U	0.1 U	0.13 U	0.13 U	0.2 U	0.2 U	0.12 U	0.12 U	0.13 U	0.1 U	0.16 U	0.2 U	0.2 U
Nickel, Dissolved	--	--	7 U	**18 J**	0.9 U	**5.1 J**	**1.3 B**	**1.8 B**	**7.4 K**	**353**	**103**	**105**	**104**	**104**	**182**	**13.5 K**	**14.1 K**	**248**	**169**	**121**	**190**	**243**
Potassium, Dissolved	--	--	**37100**	**68900**	**94700**	**26900 J**	**28500 J**	**28600 J**	**47800**	**12500**	**22500 J**	**16800 J**	**16700 J**	**18900 J**	**34500 J**	**9250**	**9570**	**15000**	**16200 J**	**29100 J**	**28900 J**	**30500 J**
Selenium, Dissolved	--	--	3 U	3.3 U	2.6 U	**2 J**	**1.4 J**	**1.6 J**	3 U	3.3 U	2.6 U	3 U	3 U	**5.3**	**14.8**	3 U	3 U	3.3 U	2.6 U	3 U	**5 J**	**5.2**
Silver, Dissolved	--	--	**2.1 B**	**1.3 B**	0.9 U	10 U	10 U	10 U	**4.5 B**	1.1 U	0.9 U	**0.53 J**	**0.8 J**	10 U	10 U	**3.7 B**	**6 B**	1.1 U	0.9 U	**1.6 J**	10 U	10 U
Sodium, Dissolved	--	--	**1170000**	**1310000**	**1450000**	**225000**	**244000**	**242000**	**1290000**	**76300**	**291000**	**273000**	**270000**	**261000**	**752000**	**249000**	**250000**	**22000**	**22700**	**87700**	**71500**	**99900**
Thallium, Dissolved	--	--	**3.8 B**	**2.1 B**	10 U	1 U	1 U	1 U	2 U	1.5 U	3.2 U	2 U	2 U	**0.05 J**	**0.14 J**	2 U	2 U	1.5 U	3.2 U	2 U	**0.32 J**	**0.055 J**
Vanadium, Dissolved	--	--	9 U	6.8 U	0.6 U	**2.5 J**	**2 B**	**2 B**	9 U	**8.8 J**	**1 J**	**2.8 J**	**2.9 J**	**15.8 J**	**20 J**	9 U	9 U	**7.6 J**	**0.6 J**	**0.72 J**	**2.4 J**	**4.6 J**
Zinc, Dissolved	--	--	**36.6 B**	**60 B**	**13.9 J**	**40.8 J**	**12.4 J**	**13.6 J**	**28.5 B**	**1980**	**556**	**810**	**772**	**754**	**1380**	**39.9 B**	**41.5 B**	**1600**	**1330**	**940**	**1320**	**1570**
WCHEM (MG_L)																						
Phosphate	--	--	NA	**0.187**	NA	NA	NA	NA	NA	**0.136**	NA	NA	NA	NA	NA	NA	NA	**0.189**	NA	NA	NA	NA

Notes:
NA = Not analyzed
B = The analyte was detected in the associated method and/or calibration blank.
J = The analyte was positively identified: the associated numerical value is the approximate concentration of the analyte in the sample.
K = The analyte was positively identified, but the associated numerical value may be biased high.
L = The analyte was positively identified, but the associated numerical value may be biased low.
U = The analyte was analyzed for, but was not detected above the reported sample quantitation limit.
UJ = The analyte was below the reported sample quantitation limit. However, the reported value is approximate.
UL = The analyte was analyzed for but was not detected. The quantitation limit may be biased low.
Bold indicates the analyte was detected
Shading indicates the result exceeded screening criteria

Unidentified Matrix Raw Analytical Results
May 2013

Summary of Chemicals Detected i

	SJS05-MW04S			SJS05-MW05S			
	SJS05-GW4S-001	SJS05-MW04S-06B	SJS05-MW04S-06D	SJS05-GW5S-001	SJS05-MW05S-06B	SJS05-MW05S-06BP	SJS05-MW05S-06D
	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99	999.99 - 999.99
	5/19/1999	6/22/2006	10/12/2006	5/23/1999	6/22/2006	6/22/2006	10/12/2006
Analyte							
VOA (UG_L)							
1,1,1-Trichloroethane	1 U	NA	NA	1 U	NA	NA	NA
1,1,2,2-Tetrachloroethane	1 U	NA	NA	1 U	NA	NA	NA
1,1,2-Trichloroethane	1 U	NA	NA	1 U	NA	NA	NA
1,1-Dichloroethane	1 U	NA	NA	1 U	NA	NA	NA
1,1-Dichloroethene	1 U	NA	NA	1 U	NA	NA	NA
1,2,4-Trichlorobenzene	1 U	NA	NA	1 U	NA	NA	NA
1,2-Dibromo-3-chloropropane	1 U	NA	NA	1 U	NA	NA	NA
1,2-Dibromoethane	1 U	NA	NA	1 U	NA	NA	NA
1,2-Dichlorobenzene	1 U	NA	NA	1 U	NA	NA	NA
1,2-Dichloroethane	1 U	NA	NA	1 U	NA	NA	NA
1,2-Dichloropropane	1 U	NA	NA	1 U	NA	NA	NA
1,3-Dichlorobenzene	1 U	NA	NA	1 U	NA	NA	NA
1,4-Dichlorobenzene	1 U	NA	NA	1 U	NA	NA	NA
2-Butanone	**40.7 L**	NA	NA	NA	NA	NA	NA
2-Hexanone	5 U	NA	NA	5 U	NA	NA	NA
4-Methyl-2-pentanone	5 U	NA	NA	5 U	NA	NA	NA
Acetone	**40.4 L**	NA	NA	NA	NA	NA	NA
Benzene	1 U	NA	NA	1 U	NA	NA	NA
Bromochloromethane	1 U	NA	NA	1 U	NA	NA	NA
Bromodichloromethane	1 U	NA	NA	1 U	NA	NA	NA
Bromoform	1 U	NA	NA	1 U	NA	NA	NA
Bromomethane	1 U	NA	NA	1 U	NA	NA	NA
Carbon disulfide	**1.6 B**	NA	NA	**1 B**	NA	NA	NA
Carbon tetrachloride	1 U	NA	NA	1 U	NA	NA	NA
Chlorobenzene	1 U	NA	NA	1 U	NA	NA	NA
Chloroethane	1 U	NA	NA	1 U	NA	NA	NA
Chloroform	**0.3 B**	NA	NA	1 U	NA	NA	NA
Chloromethane	1 U	NA	NA	1 U	NA	NA	NA
cis-1,2-Dichloroethene	1 U	NA	NA	1 U	NA	NA	NA
cis-1,3-Dichloropropene	1 U	NA	NA	1 U	NA	NA	NA
Dibromochloromethane	1 U	NA	NA	1 U	NA	NA	NA
Ethylbenzene	1 U	NA	NA	1 U	NA	NA	NA
Methylene chloride	**1 B**	NA	NA	**1.6 B**	NA	NA	NA
Styrene	1 U	NA	NA	1 U	NA	NA	NA
Tetrachloroethene	1 U	NA	NA	1 U	NA	NA	NA
Toluene	1 U	NA	NA	1 U	NA	NA	NA
trans-1,2-Dichloroethene	1 U	NA	NA	1 U	NA	NA	NA
trans-1,3-Dichloropropene	1 U	NA	NA	1 U	NA	NA	NA
Trichloroethene	1 U	NA	NA	1 U	NA	NA	NA
Vinyl chloride	1 U	NA	NA	1 U	NA	NA	NA
Xylene, total	1 U	NA	NA	1 U	NA	NA	NA
SVOA (UG_L)							
2,2'-Oxybis(1-chloropropane)	12 U	NA	NA	12 U	NA	NA	NA
2,4,5-Trichlorophenol	29 U	NA	NA	29 U	NA	NA	NA
2,4,6-Trichlorophenol	12 U	NA	NA	12 U	NA	NA	NA
2,4-Dichlorophenol	12 U	NA	NA	12 U	NA	NA	NA
2,4-Dimethylphenol	12 U	NA	NA	12 U	NA	NA	NA
2,4-Dinitrophenol	29 U	NA	NA	29 U	NA	NA	NA
2,4-Dinitrotoluene	1.2 U	NA	NA	1.2 U	NA	NA	NA
2,6-Dinitrotoluene	1.2 U	NA	NA	1.2 U	NA	NA	NA
2-Chloronaphthalene	12 U	NA	NA	12 U	NA	NA	NA
2-Chlorophenol	12 U	NA	NA	12 U	NA	NA	NA
2-Methylnaphthalene	12 U	NA	NA	12 U	NA	NA	NA
2-Methylphenol	12 U	NA	NA	12 U	NA	NA	NA
2-Nitroaniline	29 U	NA	NA	29 U	NA	NA	NA
2-Nitrophenol	12 U	NA	NA	12 U	NA	NA	NA
3,3'-Dichlorobenzidine	12 U	NA	NA	12 U	NA	NA	NA
3-Nitroaniline	29 U	NA	NA	29 U	NA	NA	NA
4,6-Dinitro-2-methylphenol	29 U	NA	NA	29 U	NA	NA	NA
4-Bromophenyl-phenylether	12 U	NA	NA	12 U	NA	NA	NA
4-Chloro-3-methylphenol	12 U	NA	NA	12 U	NA	NA	NA
4-Chloroaniline	12 U	NA	NA	12 U	NA	NA	NA
4-Chlorophenyl-phenylether	12 U	NA	NA	12 U	NA	NA	NA
4-Methylphenol	**9 J**	NA	NA	12 U	NA	NA	NA
4-Nitroaniline	29 U	NA	NA	29 U	NA	NA	NA
4-Nitrophenol	29 U	NA	NA	29 U	NA	NA	NA
Acenaphthene	12 U	NA	NA	12 U	NA	NA	NA
Acenaphthylene	12 U	NA	NA	12 U	NA	NA	NA
Anthracene	12 U	NA	NA	12 U	NA	NA	NA
Benzo(a)anthracene	12 U	NA	NA	12 U	NA	NA	NA
Benzo(a)pyrene	12 U	NA	NA	12 U	NA	NA	NA
Benzo(b)fluoranthene	12 U	NA	NA	12 U	NA	NA	NA
Benzo(g,h,i)perylene	12 U	NA	NA	12 U	NA	NA	NA
Benzo(k)fluoranthene	12 U	NA	NA	12 U	NA	NA	NA
bis(2-Chloroethoxy)methane	12 U	NA	NA	12 U	NA	NA	NA
bis(2-Chloroethyl)ether	12 U	NA	NA	12 U	NA	NA	NA
bis(2-Ethylhexyl)phthalate	12 U	NA	NA	12 U	NA	NA	NA
Butylbenzylphthalate	12 U	NA	NA	12 U	NA	NA	NA
Carbazole	12 U	NA	NA	12 U	NA	NA	NA
Chrysene	12 U	NA	NA	12 U	NA	NA	NA
Dibenz(a,h)anthracene	12 U	NA	NA	12 U	NA	NA	NA
Dibenzofuran	12 U	NA	NA	12 U	NA	NA	NA
Diethylphthalate	12 U	NA	NA	12 U	NA	NA	NA
Dimethyl phthalate	12 U	NA	NA	12 U	NA	NA	NA
Di-n-butylphthalate	**4 J**	NA	NA	12 U	NA	NA	NA
Di-n-octylphthalate	12 U	NA	NA	12 U	NA	NA	NA
Fluoranthene	12 U	NA	NA	12 U	NA	NA	NA
Fluorene	12 U	NA	NA	12 U	NA	NA	NA
Hexachlorobenzene	12 U	NA	NA	12 U	NA	NA	NA
Hexachlorobutadiene	12 U	NA	NA	12 U	NA	NA	NA
Hexachlorocyclopentadiene	12 U	NA	NA	12 U	NA	NA	NA
Hexachloroethane	12 U	NA	NA	12 U	NA	NA	NA
Indeno(1,2,3-cd)pyrene	12 U	NA	NA	12 U	NA	NA	NA
Isophorone	12 U	NA	NA	12 U	NA	NA	NA
Naphthalene	12 U	NA	NA	12 U	NA	NA	NA
n-Nitroso-di-n-propylamine	12 U	NA	NA	12 U	NA	NA	NA
n-Nitrosodiphenylamine	12 U	NA	NA	12 U	NA	NA	NA
Nitrobenzene	1.2 U	NA	NA	1.2 U	NA	NA	NA
Pentachlorophenol	29 U	NA	NA	29 U	NA	NA	NA
Phenanthrene	12 U	NA	NA	12 U	NA	NA	NA
Phenol	**3 J**	NA	NA	12 U	NA	NA	NA
Pyrene	12 U	NA	NA	12 U	NA	NA	NA

Unidentified Matrix Raw Analytical Results
May 2013

Summary of Chemicals Detected i

PEST/PCB (UG_L)							
4,4'-DDD	**0.011 J**	NA	NA	**0.012 J**	NA	NA	NA
4,4'-DDE	0.12 U	NA	NA	0.11 U	NA	NA	NA
4,4'-DDT	0.12 U	NA	NA	**0.0052 J**	NA	NA	NA
Aldrin	0.059 U	NA	NA	0.057 U	NA	NA	NA
alpha-BHC	0.059 U	NA	NA	0.057 U	NA	NA	NA
alpha-Chlordane	0.059 U	NA	NA	0.057 U	NA	NA	NA
Aroclor-1016	1.2 U	NA	NA	1.1 U	NA	NA	NA
Aroclor-1221	2.4 U	NA	NA	2.3 U	NA	NA	NA
Aroclor-1232	1.2 U	NA	NA	1.1 U	NA	NA	NA
Aroclor-1242	1.2 U	NA	NA	1.1 U	NA	NA	NA
Aroclor-1248	1.2 U	NA	NA	1.1 U	NA	NA	NA
Aroclor-1254	1.2 U	NA	NA	1.1 U	NA	NA	NA
Aroclor-1260	1.2 U	NA	NA	1.1 U	NA	NA	NA
beta-BHC	0.059 U	NA	NA	0.057 U	NA	NA	NA
delta-BHC	0.059 U	NA	NA	0.057 U	NA	NA	NA
Dieldrin	0.12 U	NA	NA	0.11 U	NA	NA	NA
Endosulfan I	0.059 U	NA	NA	0.057 U	NA	NA	NA
Endosulfan II	0.12 U	NA	NA	0.11 U	NA	NA	NA
Endosulfan sulfate	0.12 U	NA	NA	0.11 U	NA	NA	NA
Endrin	0.12 U	NA	NA	0.11 U	NA	NA	NA
Endrin aldehyde	0.12 U	NA	NA	0.11 U	NA	NA	NA
Endrin ketone	0.12 U	NA	NA	0.11 U	NA	NA	NA
gamma-BHC (Lindane)	0.059 U	NA	NA	0.057 U	NA	NA	NA
gamma-Chlordane	0.059 U	NA	NA	0.057 U	NA	NA	NA
Heptachlor	0.059 U	NA	NA	0.057 U	NA	NA	NA
Heptachlor epoxide	0.059 U	NA	NA	0.057 U	NA	NA	NA
Methoxychlor	0.59 U	NA	NA	0.57 U	NA	NA	NA
Toxaphene	5.9 U	NA	NA	5.7 U	NA	NA	NA
EXPLO (UG_L)							
1,3,5-Trinitrobenzene	1.2 U	NA	NA	1.2 U	NA	NA	NA
1,3-Dinitrobenzene	1.2 U	NA	NA	1.2 U	NA	NA	NA
2,4,6-Trinitrotoluene	1.2 U	NA	NA	1.2 U	NA	NA	NA
2-Amino-4,6-dinitrotoluene	1.2 U	NA	NA	1.2 U	NA	NA	NA
2-Nitrotoluene	2.6 U	NA	NA	2.6 U	NA	NA	NA
3-Nitrotoluene	2.6 U	NA	NA	2.6 U	NA	NA	NA
4-Amino-2,6-dinitrotoluene	1.2 U	NA	NA	1.2 U	NA	NA	NA
4-Nitrotoluene	2.6 U	NA	NA	2.6 U	NA	NA	NA
HMX	2.6 U	NA	NA	2.6 U	NA	NA	NA
RDX	2.6 U	NA	NA	2.6 U	NA	NA	NA
Tetryl	2.6 U	NA	NA	2.6 U	NA	NA	NA
METAL (UG_L)							
Aluminum	**613**	200 U	**80.3 B**	**362**	**55.1 B**	**57.5 B**	200 U
Antimony	2.7 U	**0.77 B**	**0.69 B**	2.7 U	2 U	2 U	2 U
Arsenic	**4.6 J**	**0.47 J**	**0.84 J**	2 U	**1.5**	**1.6**	**1.6**
Barium	**55.2 J**	**7.4 J**	**8 J**	**47.7 J**	**23.7 J**	**25 J**	**22 J**
Beryllium	0.1 U	**1.6 B**	**0.29 B**	0.1 U	**1.9 B**	**1.9 B**	**0.34 B**
Cadmium	0.3 U	5 U	5 U	0.3 U	5 U	5 U	**0.69 J**
Calcium	**257000**	**132000**	**168000**	**174000**	**127000**	**138000**	**120000**
Chromium	**2.9 J**	10 U	10 U	1.1 U	10 U	10 U	10 U
Cobalt	**3.2 J**	50 U	**0.46 B**	**5.4 J**	**5.9 J**	**3.9 J**	**7.8 J**
Copper	**4 J**	**3.9 J**	25 U	**6.8 B**	25 U	25 U	25 U
Cyanide	5 U	NA	10 U	5 U	NA	NA	10 U
Iron	**30200**	**106**	**1210**	**20300**	**28500**	**29500**	**29400**
Lead	1 U	**0.028 B**	**0.095 J**	**1.5 J**	**0.11 B**	**0.12 B**	**0.61 J**
Magnesium	**39000**	**5230**	**7630**	**63100**	**54100**	**56400**	**53300**
Manganese	**1360**	**4.3 J**	**806**	**3320**	**2880**	**3000**	**2860**
Mercury	0.1 U	0.2 U	0.2 U	0.1 U	0.2 U	0.2 U	0.2 U
Nickel	**4.7 J**	**1.6 J**	**1.8 B**	**6.7 B**	**3.3 J**	**2.2 J**	**4 J**
Phosphorus	**153**	NA	NA	20 U	NA	NA	NA
Potassium	**21200**	**5500 J**	**6890 J**	**9460 J**	**9250 J**	**9390 J**	**10100 J**
Selenium	2.6 U	**0.45 J**	**0.46 J**	2.6 U	**4.1 J**	**4.2 J**	**2.3 J**
Silver	0.9 U	10 U	10 U	0.9 U	10 U	10 U	10 U
Sodium	**178000**	**20700**	**25600**	**467000**	**379000**	**396000**	**376000**
Thallium	2 U	1 U	1 U	3.2 U	1 U	1 U	1 U
Vanadium	0.6 U	**0.57 B**	**0.74 B**	0.6 U	**0.57 B**	**0.47 B**	50 U
Zinc	**16.5 J**	60 U	60 U	**14.2 B**	**18.9 J**	60 U	60 U
FMETAL (UG_L)							
Aluminum, Dissolved	**744**	**39 B**	200 U	**71.1 B**	200 U	200 U	200 U
Antimony, Dissolved	2.7 U	**0.88 B**	**0.64 B**	**3.8 J**	2 U	2 U	**0.3 B**
Arsenic, Dissolved	**5.3 B**	**0.44 J**	**0.51 J**	2 U	**1.3**	**1.4**	**1.4**
Barium, Dissolved	**54.6 J**	**7.3 J**	**7.8 J**	**50.1 J**	**23.2 J**	**23.8 J**	**22.1 J**
Beryllium, Dissolved	0.1 U	**1.6 B**	5 U	0.1 U	**1.8 B**	**1.9 B**	5 U
Cadmium, Dissolved	0.3 U	5 U	5 U	0.3 U	5 U	5 U	**0.84 B**
Calcium, Dissolved	**211000**	**134000**	**167000**	**172000**	**125000**	**130000**	**125000**
Chromium, Dissolved	**1.8 J**	10 U	10 U	**1.4 J**	10 U	10 U	10 U
Cobalt, Dissolved	**3.2 J**	50 U	50 U	**9.1 J**	**5.3 J**	**4.4 J**	**7.4 J**
Copper, Dissolved	**4.9 B**	**4.7 J**	**3.4 B**	**2.6 B**	25 U	25 U	25 U
Iron, Dissolved	**44100**	100 U	**278**	**16900**	**26000**	**26400**	**27000**
Lead, Dissolved	1 U	**0.14 B**	**0.054 J**	1 U	**0.037 B**	**0.035 B**	**0.043 J**
Magnesium, Dissolved	**46400**	**5380**	**7680**	**60400**	**53900**	**54600**	**53800**
Manganese, Dissolved	**1620**	**4.2 J**	**792**	**3130**	**2850**	**2900**	**2890**
Mercury, Dissolved	0.1 U	0.2 U	0.2 U	0.1 U	0.2 U	0.2 U	0.2 U
Nickel, Dissolved	**3.8 B**	**2 B**	**1.7 B**	**11.3 J**	**3.2 J**	**2.6 B**	**3.9 J**
Potassium, Dissolved	**21200**	**5950 J**	**6910 J**	**9680 J**	**9440 J**	**9160 J**	**10100 J**
Selenium, Dissolved	2.6 U	**0.59 J**	**0.49 J**	2.6 U	**3.8 J**	**4.1 J**	**3.1 J**
Silver, Dissolved	0.9 U	10 U	10 U	**1.4 J**	10 U	10 U	**0.45 J**
Sodium, Dissolved	**244000**	**21500**	**26300**	**447000**	**380000**	**384000**	**383000**
Thallium, Dissolved	2 U	1 U	1 U	3.2 U	1 U	1 U	1 U
Vanadium, Dissolved	0.6 U	**0.53 B**	50 U	0.6 U	**0.64 B**	**0.28 B**	50 U
Zinc, Dissolved	**11.5 J**	60 U	60 U	**32.6 B**	60 U	60 U	60 U
WCHEM (MG_L)							
Phosphate	NA	NA	NA	NA	NA	NA	NA

Notes:
NA = Not analyzed
B = The analyte was detected in th
J = The analyte was positively ider
K = The analyte was positively ider
L = The analyte was positively ider
U = The analyte was analyzed for,
UJ = The analyte was below the re
UL = The analyte was analyzed for
Bold indicates the analyte was d
Shading indicates the result excee

TABLE 1

SELECTION OF EXPOSURE PATHWAYS

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Medium	Exposure Medium	Exposure Point	Receptor Population	Receptor Age	Exposure Route	On-Site/ Off-Site	Type of Analysis	Rationale for Selection or Exclusion of Exposure Pathway
Groundwater	Shallow Groundwater	Tap Water	Resident	Adult	Dermal	On-Site	Quant	Although unlikely, future resident may use shallow groundwater as a potable source
					Ingestion	On-Site	Quant	Although unlikely, future resident may use shallow groundwater as a potable source
				Child	Dermal	On-Site	Quant	Although unlikely, future resident may use shallow groundwater as a potable source
					Ingestion	On-Site	Quant	Although unlikely, future resident may use shallow groundwater as a potable source
				Adult/Child	Dermal	On-Site	Quant	Although unlikely, future resident may use shallow groundwater as a potable source
					Ingestion	On-Site	Quant	Although unlikely, future resident may use shallow groundwater as a potable source
	Air	Shallow Aquifer - Water Vapors at Showerhead	Resident	Adult	Inhalation	On-site	None	Adults may inhale vapors from groundwater while showering
				Child	Inhalation	On-site	None	Children are assumed not to shower.
				Adult/Child	Inhalation	On-site	Quant	Lifetime resident will be assumed to shower since children are assumed not to shower.
	Shallow Groundwater	Excavation Pit	Construction Worker	Adult	Dermal	On-Site	Quant	Construction workers may have exposed skin surfaces come into contact with groundwater
	Air	Shallow Aquifer - Water Vapors in Excavation	onstruction Work	Adult	Inhalation	On-site	Quant	Construction workers may inhale vapors during construction activities with open excavation

Table 2.1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection
Tap Water and Excavation Pit	78-93-3	2-Butanone	4.1E+01 L	4.1E+01 L	UG/L	SJS05-GW4S-001	1/1	5 - 5	4.1E+01	NA	4.9E+02 N	NA	NA	NO	BSL
	67-64-1	Acetone	1.1E+01 L	4.0E+01 L	UG/L	SJS05-GW4S-001	2/5	5 - 5	4.0E+01	NA	1.2E+03 N	NA	NA	NO	BSL
	75-15-0	Carbon disulfide	3.0E-01 J	8.0E-01 J	UG/L	SJS05-GW2S-002	2/11	1 - 1	8.0E-01	NA	7.2E+01 N	NA	NA	NO	BSL
	108-88-3	Toluene	2.0E-01 J	2.0E-01 J	UG/L	SJS05-GW1S-001	1/11	1 - 1	2.0E-01	NA	8.6E+01 N	1000	MCL	NO	BSL
	106-44-5	4-Methylphenol	9.0E+00 J	9.0E+00 J	UG/L	SJS05-GW4S-001	1/11	10 - 12	9.0E+00	NA	1.4E+02 N	NA	NA	NO	BSL
	84-74-2	Di-n-butylphthalate	3.0E+00 J	4.0E+00 J	UG/L	SJS05-GW4S-001	2/11	10 - 12	4.0E+00	NA	6.7E+01 N	NA	NA	NO	BSL
	108-95-2	Phenol	3.0E+00 J	3.0E+00 J	UG/L	SJS05-GW4S-001	1/11	10 - 12	3.0E+00	NA	4.5E+02 N	NA	NA	NO	BSL
	117-81-7	bis(2-Ethylhexyl)phthalate	1.0E+00 J	2.0E+00 J	UG/L	SJS05-GW3S-001	2/11	10 - 12	2.0E+00	NA	4.8E+00 C	6	MCL	NO	BSL
	72-54-8	4,4'-DDD	1.1E-02 J	1.2E-02 J	UG/L	SJS05-GW5S-001	2/11	0.1 - 0.12	1.2E-02	NA	2.7E-02 C	NA	NA	NO	BSL
	50-29-3	4,4'-DDT	5.2E-03 J	5.2E-03 J	UG/L	SJS05-GW5S-001	1/11	0.1 - 0.12	5.2E-03	NA	2.0E-01 C	NA	NA	NO	BSL
	7429-90-5	Aluminum	9.0E+01 J	8.7E+04	UG/L	SJS05-GW2S-002	16/23	29 - 200	8.7E+04	1.7E+03	1.6E+03 N	50 to 200	SMCL	YES	ASL
	7440-36-0	Antimony	6.0E+00 J	6.0E+00 J	UG/L	SJS05-GW3S-001P	1/23	1 - 60	6.0E+00	2.3E+00	6.0E-01 N	6	MCL	YES	ASL
	7440-38-2	Arsenic	4.7E-01 J	2.7E+01	UG/L	SJS05-GW3S-001	20/23	1 - 10	2.7E+01	8.0E+00	4.5E-02 C	10	MCL	YES	ASL
	7440-39-3	Barium	7.4E+00 J	3.6E+02	UG/L	SJS05-GW1S-001	22/23	0.2 - 200	3.6E+02	7.7E+01	2.9E+02 N	2000	MCL	YES	ASL
	7440-41-7	Beryllium	1.2E+00 J	1.8E+01	UG/L	SJS05-GW2S-002	11/23	0.1 - 5	1.8E+01	1.4E+00	1.6E+00 N	4	MCL	YES	ASL
	7440-43-9	Cadmium	6.9E-01 J	1.1E+01	UG/L	SJS05-GW3S-002	11/23	0.3 - 5	1.1E+01	7.4E-01	6.9E-01 N	5	MCL	YES	ASL
	7440-70-2	Calcium	3.7E+04	2.6E+05	UG/L	SJS05-GW4S-001	23/23	46 - 5000	2.6E+05	5.3E+05	NA	NA	NA	NO	NUT
	7440-47-3	Chromium	2.0E+00 J	5.9E+01	UG/L	SJS05-GW3S-001	9/23	1.1 - 10	5.9E+01	3.2E+00	3.1E-02 C	100	MCL	YES	ASL
	7440-48-4	Cobalt	1.2E+00 J	2.6E+02	UG/L	SJS05-GW2S-002	16/23	0.5 - 50	2.6E+02	1.6E+01	4.7E-01 N	NA	NA	YES	ASL
	7440-50-8	Copper	3.3E+00 J	1.2E+02	UG/L	SJS05-GW2S-002	11/23	1.1 - 25	1.2E+02	6.3E+00	6.2E+01 N	1300	MCL	YES	ASL
	7439-89-6	Iron	1.1E+02	8.4E+04	UG/L	SJS05-GW3S-001	23/23	5 - 100	8.4E+04	1.1E+05	1.1E+03 N	300	SMCL	YES	ASL
	7439-92-1	Lead	9.5E-02 J	5.8E+01	UG/L	SJS05-MW03S-06B	18/23	1 - 3	5.8E+01	3.5E+00	1.5E+01 N	15	MCL	YES	ASL
	7439-95-4	Magnesium	5.2E+03	2.8E+05	UG/L	SJS05-GW1S-003	23/23	24.3 - 5000	2.8E+05	3.0E+05	NA	NA	NA	NO	NUT
	7439-96-5	Manganese	4.3E+00 J	5.1E+03	UG/L	SJS05-MW03S-06D	23/23	0.3 - 15	5.1E+03	1.4E+04	3.2E+01 N	50	SMCL	YES	ASL
	7440-02-0	Nickel	1.6E+00 J	3.6E+02	UG/L	SJS05-GW2S-002	17/23	0.9 - 40	3.6E+02	2.0E+01	3.0E+01 N	NA	NA	YES	ASL
	7440-09-7	Potassium	5.5E+03 J	9.6E+04	UG/L	SJS05-GW1S-003	23/23	13.5 - 5000	9.6E+04	8.5E+04	NA	NA	NA	NO	NUT
	7782-49-2	Selenium	4.5E-01 J	1.4E+01	UG/L	SJS05-MW02S-06D	10/23	2.6 - 6.6	1.4E+01	NA	7.8E+00 N	50	MCL	YES	ASL
	7440-22-4	Silver	8.1E-01 J	2.8E+00 J	UG/L	SJS05-GW2S-002	4/23	0.9 - 10	2.8E+00	1.9E+00	7.1E+00 N	100	SMCL	NO	BSL
	7440-23-5	Sodium	2.1E+04	1.5E+06	UG/L	SJS05-GW1S-003	22/23	28 - 5000	1.5E+06	8.1E+05	NA	NA	NA	NO	NUT
	7440-28-0	Thallium	4.0E-02 J	2.1E+00 J	UG/L	SJS05-GW3S-001P	5/23	1 - 10	2.1E+00	7.6E+00	1.6E-02 N	2	MCL	YES	ASL
	7440-62-2	Vanadium	6.3E-01 J	8.3E+01	UG/L	SJS05-GW3S-001	11/23	0.6 - 50	8.3E+01	1.4E+01	7.8E+00 N	NA	NA	YES	ASL
	7440-66-6	Zinc	8.8E+00 J	2.0E+03	UG/L	SJS05-GW2S-002	17/23	1.9 - 60	2.0E+03	2.4E+02	4.7E+02 N	5000	SMCL	YES	ASL

Table 2.1

OCCURRENCE, DISTRIBUTION AND SELECTION OF CHEMICALS OF POTENTIAL CONCERN

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Point	CAS Number	Chemical	Minimum [1] Concentration Qualifier	Maximum [1] Concentration Qualifier	Units	Location of Maximum Concentration	Detection Frequency	Range of Detection Limits	Concentration [2] Used for Screening	Background [3] Value	Screening [4] Toxicity Value	Potential ARAR/TBC Value	Potential ARAR/TBC Source	COPC Flag	Rationale for [5] Contaminant Deletion or Selection

[1] Minimum/Maximum detected concentrations.

[2] Maximum concentration is used for screening.

[3] Unfiltered background values are presented in a 2004 Final Background Investigation Report Addendum for Groundwater.

[4] Oak Ridge National Laboratory (ORNL). November, 2012. Regional Screening Levels for Chemical Contaminants at Superfund Sites. [Online].
Tap Water. Available: http://www.epa.gov/reg3hwmd/risk/human/rb-concentration_table/index.htm
Concentrations based on non-carcinogenic health effects are adjusted using HQ=0.1
The tap water value of 15 ug/L for lead is the action level provided in the Drinking Water Regulations and Health Advisories.
RSL value for Chromium(IV) used as surrogate for chromium.

[5] Rationale Codes

Selection Reason: Above Screening Levels (ASL)

Deletion Reason: No Toxicity Information (NTX)
Essential Nutrient (NUT)
Below Screening Level (BSL)

COPC = Chemical of Potential Concern
ARAR/TBC = Applicable or Relevant and Appropriate Requirement/ To Be Considered
J = Estimated Value
L = Biased Low
C = Carcinogenic
N = Noncarcinogenic
MCL = Maximum Contaminant Level
SMCL = Secondary Maximum Contaminant Level

Table 3.1.RME
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)		Maximum Concentration (Qualifier)		Exposure Point Concentration			
								Value	Units	Statistic	Rationale
Tap Water and Excavation Pit	Aluminum	UG/L	1.5E+04	2.3E+04	NP	8.7E+04		2.3E+04	UG/L	95% KM-BCA	3
	Antimony	UG/L	NA	NA		6.0E+00	J	6.0E+00	UG/L	Max	5
	Arsenic	UG/L	5.4E+00	7.9E+00	NP	2.7E+01		7.9E+00	UG/L	95% KM-BCA	1, 3
	Barium	UG/L	6.9E+01	1.9E+02	NP	3.6E+02		1.9E+02	UG/L	97.5% KM-c	1
	Beryllium	UG/L	5.1E+00	8.1E+00	NP	1.8E+01		8.1E+00	UG/L	95% Boot	1, 2, 3
	Cadmium	UG/L	3.1E+00	4.6E+00	NP	1.1E+01		4.6E+00	UG/L	95% Boot	2, 3
	Chromium	UG/L	5.9E+00	1.1E+01	NP	5.9E+01		1.1E+01	UG/L	95% KM-BCA	1
	Cobalt	UG/L	5.2E+01	7.8E+01	NP	2.6E+02		7.8E+01	UG/L	95% KM-BCA	3
	Copper	UG/L	1.7E+01	2.7E+01	NP	1.2E+02		2.7E+01	UG/L	95% KM-t	1, 3
	Iron	UG/L	3.3E+04	4.2E+04	N	8.4E+04		4.2E+04	UG/L	95% Stud-t	2, 3
	Lead	UG/L	9.6E+00	2.2E+01	NP	5.8E+01		9.6E+00	UG/L	Mean-N	6
	Manganese	UG/L	2.5E+03	3.0E+03	N	5.1E+03		3.0E+03	UG/L	95% Stud-t	2
	Nickel	UG/L	8.2E+01	3.0E+02	NP	3.6E+02		3.0E+02	UG/L	99% KM-c	4
	Selenium	UG/L	2.6E+00	3.7E+00	NP	1.4E+01		3.7E+00	UG/L	95% KM-t	1, 3
	Thallium	UG/L	2.3E-01	4.5E-01	NP	2.1E+00	J	4.5E-01	UG/L	95% KM-t	1, 3
	Vanadium	UG/L	7.4E+00	1.4E+01	NP	8.3E+01		1.4E+01	UG/L	95% KM-t	1, 3
	Zinc	UG/L	5.4E+02	1.1E+03	NP	2.0E+03		1.1E+03	UG/L	95% KM-c	3

Table 3.1.RME
MEDIUM-SPECIFIC EXPOSURE POINT CONCENTRATION SUMMARY
SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Point	Chemical of Potential Concern	Units	Arithmetic Mean	95% UCL (Distribution)	Maximum Concentration (Qualifier)	Exposure Point Concentration			
						Value	Units	Statistic	Rationale

Full statistics for data included in Appendix.
ProUCL, Version 4.1.01 used to determine distribution of data and calculate 95% UCL, following recommendations in user's guide (USEPA. July 2011. Prepared by Lockheed Martin Environmental Services).
Options: 95% Kaplan-Meier BCA (95% KM-BCA); 97.5% Kaplan-Meier Chebyshev UCL (97.5% KM-c); 95% Kaplan-Meier (t) UCL (95% KM-t); 95% Student's-T test UCL (95% Stud-t); 99% Kaplan-Meier Chebyshev UCL (99% KM-c); 95% Kaplan-Meier Chebyshev UCL (95% KM-c); 95% Kaplan-Meier Percentile Bootstrap UCL (95% Boot); Mean-Normal (Mean-N); Maximum Detected Value (Max);

UCL Rationale:
(1) Shapiro-Wilk W Test/Lilliefors test indicates data are log-normally distributed.
(2) Shapiro-Wilk W Test/Lilliefors indicates data are normally distributed.
(3) Test indicates data are gamma distributed.
(4) Distribution tests are inconclusive (data are not normal, log-normal, or gamma-distributed).
(5) Maximum detected concentration used because constituent was detected in only one sample.
(6) The arithmetic mean concentration is used for lead.

ug/L = micrograms per liter
G = Gamma distribution.
N = Normal distribution.
NP = Non-parametric distribution.
J = Estimated Value

TABLE 4.1.RME
VALUES USED FOR DAILY INTAKE CALCULATIONS
REASONABLE MAXIMUM EXPOSURE
SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME		See Table 3.1.RME	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	2	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	24	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
		Child	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME		See Table 3.1.RME	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	350	days/year	EPA, 1991	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME		See Table 3.1.RME	CDI (mg/kg-day) =
				IR-W-A	Ingestion Rate of Water, Adult	2	liters/day	EPA, 1997	CW x IR-W-Adj x EF x CF1 x 1/AT
				IR-W-C	Ingestion Rate of Water, Child	1	liters/day	EPA, 1997	
				IR-W-Adj	Ingestion Rate of Water, Age-adjusted	1.09	liter-year/kg-day	calculated	IR-W-Adj (liter-year/kd-day) =
				EF	Exposure Frequency	350	days/year	EPA, 1991	(ED-C x IR-W-C / BW-C) +
				ED-A	Exposure Duration, Adult	24	years	EPA, 1991	(ED-A x IR-W-A / BW-A)
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME		See Table 3.1.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific		EPA, 2004	Organics :
				t_{event}	Event Time	0.58	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	18,000	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	24	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	8,760	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	
		Child	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME		See Table 3.1.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific		EPA, 2004	Organics :
				t_{event}	Event Time	1.0	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,600	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	350	days/year	EPA, 2004	
				ED	Exposure Duration	6	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	15	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Child/Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.RME		See Table 3.1.RME	CDI (mg/kg-day) = DA-Adj x EF x 1/AT
				DAevent-A	Dermally Absorbed Dose per Event, Adult	calculated	mg/cm^2-event	calculated	
				DAevent-C	Dermally Absorbed Dose per Event, Child	calculated	mg/cm^2-event	calculated	DA-Adj = (Daevent-A x SA-A x ED-A x 1/BW-A)
				DA-Adj	Dermally Absorbed Dose, Age-adjusted	calculated	mg-year/event-kg	calculated	+ (Daevent-C x SA-C x ED-C x 1/BW-C)
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}-A	Event Time, Adult	0.58	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				t_{event}-C	Event Time, Child	1.0	hr/event	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				SA-A	Skin Surface Area, Adult	18,000	cm^2	EPA, 2004	x CF1 x CF2
				SA-C	Skin Surface Area, Child	6,600	cm^2	EPA, 2004	
				EV	Event Frequency	1	events/day	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				EF	Exposure Frequency	350	days/year	EPA, 2004	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				ED-A	Exposure Duration, Adult	24	years	EPA, 2004	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				ED-C	Exposure Duration, Child	6	years	EPA, 2004	
				BW-A	Body Weight, Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	ke	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	
	Construction Worker	Adult	Excavation Pit	CW	Chemical Concentration in Water	See Table 3.1.RME		See Table 3.1.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific		EPA, 2004	Organics :
				t_{event}	Event Time	8.0	hr/event	(1)	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2004, (3)	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	125	days/year	(2)	

TABLE 4.1.RME

VALUES USED FOR DAILY INTAKE CALCULATIONS

REASONABLE MAXIMUM EXPOSURE

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Construction Worker	Adult	Excavation Pit	ED	Exposure Duration	1	years	EPA, 1991	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + 3B^2)/(1+B)^2)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

(1) Professional Judgement based on construction activities that would occur 8 hrs per day for the RME.

(2) Assumed duration of construction project may be 1/2 a year.

(3) Skin surface area in contact with groundwater assumed to be hands, forearms, lower legs, and feet.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 4.1.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Ingestion	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE		See Table 3.1.RME	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1.4	liters/day	EPA, 1993	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	9	years	EPA, 1993	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	70	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
		Child	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE		See Table 3.1.CT	CDI (mg/kg-day) =
				IR-W	Ingestion Rate of Water	1	liters/day	EPA, 1997	CW x IR-W x EF x ED x CF1 x 1/BW x 1/AT
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW	Body Weight	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
		Child/Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE		See Table 3.1.CT	CDI (mg/kg-day) =
				IR-W-A	Ingestion Rate of Water, Adult	1.4	liters/day	EPA, 1993	CW x IR-W-Adj x EF x CF1 x 1/AT
				IR-W-C	Ingestion Rate of Water, Child	1	liters/day	EPA, 1997	
				IR-W-Adj	Ingestion Rate of Water, Age-adjusted	0.58	liter-year/kg-day	calculated	IR-W-Adj (liter-year/kd-day) =
				EF	Exposure Frequency	234	days/year	EPA, 1993	(ED-C x IR-W-C / BW-C) +
				ED-A	Exposure Duration, Adult	9	years	EPA, 1993	(ED-A x IR-W-A / BW-A)
				ED-C	Exposure Duration, Child	6	years	EPA, 1991	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				BW-A	Body Weight , Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	kg	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	

TABLE 4.1.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Resident	Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE		See Table 3.1.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific		EPA, 2004	Organics :
				t_{event}	Event Time	0.25	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	18,000	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	234	days/year	EPA, 1993	
				ED	Exposure Duration	9	years	EPA, 1993	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	3,285	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	
		Child	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE		See Table 3.1.CT	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}	Event Time	0.33	hr/event		t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	6,600	cm^2	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	234	days/year	EPA, 2004	
				ED	Exposure Duration	6	years	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				BW	Body Weight	15	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + $3B^2$)/$(1+B)^2$)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	2,190	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

TABLE 4.1.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal (continued)	Resident	Child/Adult	Tap Water	CW	Chemical Concentration in Water	See Table 3.1.CTE	µg/l	See Table 3.1.CT	CDI (mg/kg-day) = DA-Adj x EF x 1/AT
				DAevent-A	Dermally Absorbed Dose per Event, Adult	calculated	mg/cm^2-event	calculated	
				DAevent-C	Dermally Absorbed Dose per Event, Child	calculated	mg/cm^2-event	calculated	DA-Adj = (Daevent-A x SA-A x ED-A x 1/BW-A)
				DA-Adj	Dermally Absorbed Dose, Age-adjusted	calculated	mg-year/event-kg	calculated	+ (Daevent-C x SA-C x ED-C x 1/BW-C)
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific	dimensionless	EPA, 2004	Organics :
				t_{event}-A	Event Time, Adult	0.25	hr/event	EPA, 2004	t_{event}<t*: DAevent (mg/cm^2-event) =
				t_{event}-C	Event Time, Child	0.33	hr/event	EPA, 2004	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				SA-A	Skin Surface Area, Adult	18,000	cm^2	EPA, 2004	x CF1 x CF2
				SA-C	Skin Surface Area, Child	6,600	cm^2	EPA, 2004	
				EV	Event Frequency	1	events/day	EPA, 2004	t_{event}>t*: DAevent (mg/cm^2-event) =
				EF	Exposure Frequency	234	days/year	EPA, 1993	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				ED-A	Exposure Duration, Adult	9	years	EPA, 2001	((1 + 3B + 3B^2)/(1+B)^2)) x CF1 x CF2
				ED-C	Exposure Duration, Child	6	years	EPA, 2001	
				BW-A	Body Weight, Adult	70	kg	EPA, 1991	
				BW-C	Body Weight, Child	15	ke	EPA, 1991	
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	
	Construction Worker	Adult	Excavation Pit	CW	Chemical Concentration in Water	See Table 3.1.RME		See Table 3.1.RME	CDI (mg/kg-day) =
				DAevent	Dermally Absorbed Dose per Event	calculated	mg/cm^2-event	calculated	DAevent x SA x EV x EF x ED x 1/BW x 1/AT
				FA	Fraction absorbed water	chemical specific	dimensionless	EPA, 2004	
				Kp	Permeability Coefficient	chemical specific	cm/hr	EPA, 2004	Inorganics: DAevent (mg/cm^2-event) =
				τ	Lag Time	chemical specific	hr/event	EPA, 2004	Kp x CW x t_{event} x CF1 x CF2
				t*	Time to Reach Steady-state	chemical specific	hours	EPA, 2004	
				B	Ratio of Permeability of Stratum Corneum to Epidermis	chemical specific		EPA, 2004	Organics :
				t_{event}	Event Time	4.0	hr/event	(1)	t_{event}<t*: DAevent (mg/cm^2-event) =
				SA	Skin Surface Area Available for Contact	5,700	cm^2	EPA, 2004, (3)	2 x FA x Kp x CW x (sqrt((6 x τ x t_{event})/π))
				EV	Event Frequency	1	events/day	EPA, 2004	x CF1 x CF2
				EF	Exposure Frequency	125	days/year	(2)	

TABLE 4.1.CTE

VALUES USED FOR DAILY INTAKE CALCULATIONS

CENTRAL TENDENCY

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Medium: Groundwater
Exposure Medium: Shallow Groundwater

Exposure Route	Receptor Population	Receptor Age	Exposure Point	Parameter Code	Parameter Definition	Value	Units	Rationale/ Reference	Intake Equation/ Model Name
Dermal	Construction Worker	Adult	Excavation Pit	ED	Exposure Duration	1	years	EPA, 1991	$t_{event}>t^*$: DAevent (mg/cm^2-event) =
				BW	Body Weight	70	kg	EPA, 1991	FA x Kp x CW x (t_{event}/(1+B) + 2 x τ x
				AT-C	Averaging Time (Cancer)	25,550	days	EPA, 1989	((1 + 3B + 3B^2)/(1+B)^2)) x CF1 x CF2
				AT-N	Averaging Time (Non-Cancer)	365	days	EPA, 1989	
				CF1	Conversion Factor 1	0.001	mg/µg	- -	
				CF2	Conversion Factor 2	0.001	l/cm^3	- -	

(1) Professional judgement assuming 1/2 RME value for CTE.

(2) Assumed duration of construction project may be 1/2 a year.

(3) Skin surface area in contact with groundwater assumed to be hands, forearms, lower legs, and feet.

Sources:

EPA, 1989: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual, Part A. OERR. EPA/540/1-89/002.

EPA, 1991: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual - Supplemental Guidance, Standard Default Exposure Factors. Interim Final. OSWER Directive 9285.6-03.

EPA, 1993: Superfund's Standard Default Exposure Factors for the Central Tendency and Reasonable Maximum Exposure.

EPA, 1997: Exposure Factors Handbook. EPA/600/P-95/002Fa.

EPA, 2004: Risk Assessment Guidance for Superfund. Vol.1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment) Final. EPA/540/R/99/005.

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (3) (MM/DD/YY)
Aluminum	Chronic	1.0E+00	mg/kg-day	NA	1.0E+00	mg/kg-day	Neurotoxicity	100	PPRTV	10/23/2006
	Subchronic	1.0E+00	mg/kg-day	NA	1.0E+00	mg/kg-day	Neurotoxicity	3.0E+01	ATSDR	9/1/2008
Antimony	Chronic	4.0E-04	mg/kg-day	15%	6.0E-05	mg/kg-day	Blood	1000/1	IRIS	5/2/2013
	Subchronic	4.0E-04	mg/kg-day	15%	6.0E-05	mg/kg-day	Blood	1000	PPRTV	7/29/2008
Arsenic	Chronic	3.0E-04	mg/kg-day	95%	3.0E-04	mg/kg-day	Skin, Vascular	3/1	IRIS	5/2/2013
	Subchronic	3.0E-04	mg/kg-day	95%	3.0E-04	mg/kg-day	Skin, Vascular	3	HEAST	7/1/1997
Barium	Chronic	2.0E-01	mg/kg-day	7%	1.4E-02	mg/kg-day	Kidney	300 / 1	IRIS	5/2/2013
	Subchronic	7.0E-02	mg/kg-day	7%	4.9E-03	mg/kg-day	Cardiovascular System	100	HEAST	7/31/1997
Beryllium	Chronic	2.0E-03	mg/kg-day	0.7%	1.4E-05	mg/kg-day	Gastrointestinal	300/1	IRIS	5/2/2013
	Subchronic	5.0E-03	mg/kg-day	0.7%	3.5E-05	mg/kg-day	Lifetime	100	HEAST	7/1/1997
Cadmium (water)	Chronic	5.0E-04	mg/kg-day	5.0%	2.5E-05	mg/kg-day	Kidney	10/1	IRIS	5/2/2013
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Chromium (hexavalent)	Chronic	3.0E-03	mg/kg-day	2.5%	7.5E-05	mg/kg-day	NOE	300/1	IRIS	5/2/2013
	Subchronic	5.0E-03	mg/kg-day	2.5%	1.3E-04	mg/kg-day	Blood	100	ATSDR	9/2012
Cobalt	Chronic	3.0E-04	mg/kg-day	N/A	3.0E-04	mg/kg/day	Thyroid	3000	PPRTV	8/25/2008
	Subchronic	3.0E-03	mg/kg-day	N/A	3.0E-03	mg/kg/day	Thyroid	300	PPRTV	8/25/2008
Copper	Chronic	4.0E-02	mg/kg-day	N/A	4.0E-02	mg/kg-day	Gastrointestinal	NA	HEAST	7/1997
	Subchronic	1.0E-02	mg/kg-day	N/A	1.0E-02	mg/kg-day	Gastrointestinal	3	ATSDR	10/2004
Iron	Chronic	7.0E-01	mg/kg-day	NA	7.0E-01	mg/kg-day	Gastrointestinal	1.5	PPRTV	9/11/2006
	Subchronic	7.0E-01	mg/kg-day	NA	7.0E-01	mg/kg-day	Gastrointestinal	1.5	PPRTV	9/11/2006
Lead	Chronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Manganese (nonfood)	Chronic	2.4E-02	mg/kg-day	4%	9.6E-04	mg/kg-day	CNS	1/1	IRIS	5/2/2013
	Subchronic	NA	NA	NA	NA	NA	NA	NA	NA	NA
Nickel	Chronic	2.0E-02	mg/kg-day	4%	8.0E-04	mg/kg-day	Decreased Body and Organ Weights	300	IRIS	5/2/2013
	Subchronic	2.0E-02	mg/kg-day	4%	8.0E-04	mg/kg-day	Whole body	300	HEAST	7/1/1997
Selenium	Chronic	5.0E-03	mg/kg-day	30-80%	5.0E-03	mg/kg-day	Whole body	3 / 1	IRIS	5/2/2013
	Subchronic	5.0E-03	mg/kg-day	30-80%	5.0E-03	mg/kg-day	Whole body	3 / 1	HEAST	07/31/97
Thallium	Chronic	1.0E-05	mg/kg-day	100%	1.0E-05	mg/kg-day	Hair	3000	PPRTV	10/08/10
	Subchronic	4.0E-05	mg/kg-day	100%	4.0E-05	mg/kg-day	Hair	1000	PPRTV	10/08/10
Vanadium	Chronic	5.0E-03	mg/kg-day	2.6%	1.3E-04	mg/kg-day	Hair	300	RSL/IRIS	05/02/13
	Subchronic	7.0E-03	mg/kg-day	2.6%	1.8E-04	mg/kg-day	Whole body	100	HEAST	07/31/97
Zinc	Chronic	3.0E-01	mg/kg-day	NA	3.0E-01	mg/kg-day	Blood	3/1	IRIS	5/2/2013
	Subchronic	3.0E-01	mg/kg-day	N/A	3.0E-01	mg/kg-day	Blood	3	ATSDR	09/01/05

TABLE 5.1

NON-CANCER TOXICITY DATA -- ORAL/DERMAL

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Chemical of Potential Concern	Chronic/ Subchronic	Oral RfD Value	Oral RfD Units	Oral to Dermal Adjustment Factor (1)	Adjusted Dermal RfD (2)	Units	Primary Target Organ	Combined Uncertainty/Modifying Factors	Sources of RfD: Target Organ	Dates of RfD: Target Organ (3) (MM/DD/YY)

(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual, Part E, Supplemental Guidance for Dermal Risk Assessment (Final).
Section 4.2 and Exhibit 4-1. USEPA recommends that the oral RfD should not be adjusted to estimate the absorbed dose for compounds when the absorption efficiency is greater than 50%.
Constituents that do not have oral absorption efficiencies reported on this table were assumed to have an oral absorption efficiency of 100%.

(2) Adjusted Dermal RfD = RfD (oral) x Absorption Efficiency or ABS_{GI}

(3) For IRIS values, provided the date IRIS was searched.
For NCEA and PPTRV values, provided the date of the article provided by NCEA.
For HEAST values, provided the date of HEAST document.

CNS = Central Nervous System

IRIS = Integrated Risk Information System

HEAST= Health Effects Assessment Summary Tables

NA = Not Applicable

NCEA = National Center for Environmental Assessment

NOE = No Observed Effects

PPRTV = Provisional Peer-Reviewed Toxicity Assessment

ATSDR = Agency for Toxic Substances and Disease Registry

RSL = USEPA Regional Screening Level Table

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor	Adjusted Dermal Cancer Slope Factor (1)	Units	EPA Carcinogen Group	Source	Date (2) (MM/DD/YY)
Aluminum	NA						
Antimony	NA						
Arsenic	1.5E+00	95%	1.5E+00	$(mg/kg\text{-}day)^{-1}$	A	IRIS	5/2/2013
Barium	NA						
Beryllium	NA						
Cadmium-Water	NA						
Chromium (hexavalent) (3)	5.0E-01	2.5%	2.0E+01	$(mg/kg\text{-}day)^{-1}$	D	NJ DEP	4/8/2009
Cobalt	NA						
Copper	NA						
Iron	NA						
Lead	NA						
Manganese (nonfood)	NA						
Nickel	NA						
Selenium	NA						
Thallium	NA						
Vanadium	NA						
Zinc	NA						

TABLE 6.1

CANCER TOXICITY DATA -- ORAL/DERMAL

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Chemical of Potential Concern	Oral Cancer Slope Factor	Oral to Dermal Adjustment Factor	Adjusted Dermal Cancer Slope Factor (1)	Units	EPA Carcinogen Group	Source	Date (2) (MM/DD/YY)

(1) Source: Risk Assessment Guidance for Superfund. Volume 1: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment (Final). Section 4.2 and Exhibit 4-1. USEPA recommends that the oral RfD should not be adjusted to estimate the absorbed dose for compounds when the absorption efficiency is greater than 50%.

(2) For IRIS values, provided the date IRIS was searched.

(3) This chemical operates with a mutagenic mode of action.
Chemical-specific data are not available; therefore, default age-dependant adjustment factors (ADAF) will be applied to the slope factor as follows:

AGE	AGE ADAF
0-<2	10
2-<16	3
16-<30	1

IRIS = Integrated Risk Information System

NA = Not available

NJ DEP = New Jersey Department of Environmental Protection

EPA Group:

A - Human carcinogen

B1 - Probable human carcinogen - indicates that limited human data are available

B2 - Probable human carcinogen - indicates sufficient evidence in animals and inadequate or no evidence in humans

C - Possible human carcinogen

D - Not classifiable as a human carcinogen

E - Evidence of noncarcinogenicity

TABLE 7.1.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Shallow Groundwater	Tap Water	Ingestion	Aluminum	2.3E+04	ug/L	NA	NA	NA	NA	NA	6.3E-01	mg/kg/day	1.0E+00	mg/kg/day	6.3E-01
				Antimony	6.0E+00	ug/L	NA	NA	NA	NA	NA	1.6E-04	mg/kg/day	4.0E-04	mg/kg/day	4.1E-01
				Arsenic	7.9E+00	ug/L	NA	NA	NA	NA	NA	2.2E-04	mg/kg/day	3.0E-04	mg/kg/day	7.2E-01
				Barium	1.9E+02	ug/L	NA	NA	NA	NA	NA	5.2E-03	mg/kg/day	2.0E-01	mg/kg/day	2.6E-02
				Beryllium	8.1E+00	ug/L	NA	NA	NA	NA	NA	2.2E-04	mg/kg/day	2.0E-03	mg/kg/day	1.1E-01
				Cadmium	4.6E+00	ug/L	NA	NA	NA	NA	NA	1.3E-04	mg/kg/day	5.0E-04	mg/kg/day	2.5E-01
				Chromium (total)	1.1E+01	ug/L	NA	NA	NA	NA	NA	3.1E-04	mg/kg/day	3.0E-03	mg/kg/day	1.0E-01
				Cobalt	7.8E+01	ug/L	NA	NA	NA	NA	NA	2.1E-03	mg/kg/day	3.0E-04	mg/kg/day	7.1E+00
				Copper	2.7E+01	ug/L	NA	NA	NA	NA	NA	7.3E-04	mg/kg/day	4.0E-02	mg/kg/day	1.8E-02
				Iron	4.2E+04	ug/L	NA	NA	NA	NA	NA	1.1E+00	mg/kg/day	7.0E-01	mg/kg/day	1.6E+00
				Lead	9.6E+00	ug/L	NA	NA	NA	NA	NA	2.6E-04	mg/kg/day	NA	mg/kg/day	NA
				Manganese	3.0E+03	ug/L	NA	NA	NA	NA	NA	8.3E-02	mg/kg/day	2.4E-02	mg/kg/day	3.4E+00
				Nickel	3.0E+02	ug/L	NA	NA	NA	NA	NA	8.1E-03	mg/kg/day	2.0E-02	mg/kg/day	4.0E-01
				Selenium	3.7E+00	ug/L	NA	NA	NA	NA	NA	1.0E-04	mg/kg/day	5.0E-03	mg/kg/day	2.1E-02
				Thallium	4.5E-01	ug/L	NA	NA	NA	NA	NA	1.2E-05	mg/kg/day	1.0E-05	mg/kg/day	1.2E+00
				Vanadium	1.4E+01	ug/L	NA	NA	NA	NA	NA	3.8E-04	mg/kg/day	5.0E-03	mg/kg/day	7.6E-02
				Zinc	1.1E+03	ug/L	NA	NA	NA	NA	NA	3.1E-02	mg/kg/day	3.0E-01	mg/kg/day	1.0E-01
			Exp. Route Total								NA					1.6E+01
			Dermal	Aluminum	2.3E+04	ug/L	NA	NA	NA	NA	NA	3.3E-03	mg/kg/day	1.0E+00	mg/kg/day	3.3E-03
			Absorption	Antimony	6.0E+00	ug/L	NA	NA	NA	NA	NA	8.6E-07	mg/kg/day	6.0E-05	mg/kg/day	1.4E-02
				Arsenic	7.9E+00	ug/L	NA	NA	NA	NA	NA	1.1E-06	mg/kg/day	3.0E-04	mg/kg/day	3.8E-03
				Barium	1.9E+02	ug/L	NA	NA	NA	NA	NA	2.7E-05	mg/kg/day	1.4E-02	mg/kg/day	1.9E-03
				Beryllium	8.1E+00	ug/L	NA	NA	NA	NA	NA	1.2E-06	mg/kg/day	1.4E-05	mg/kg/day	8.3E-02
				Cadmium	4.6E+00	ug/L	NA	NA	NA	NA	NA	6.6E-07	mg/kg/day	2.5E-05	mg/kg/day	2.6E-02
				Chromium (total)	1.1E+01	ug/L	NA	NA	NA	NA	NA	3.2E-06	mg/kg/day	7.5E-05	mg/kg/day	4.3E-02
				Cobalt	7.8E+01	ug/L	NA	NA	NA	NA	NA	4.4E-06	mg/kg/day	3.0E-04	mg/kg/day	1.5E-02
				Copper	2.7E+01	ug/L	NA	NA	NA	NA	NA	3.8E-06	mg/kg/day	4.0E-02	mg/kg/day	9.6E-05
				Iron	4.2E+04	ug/L	NA	NA	NA	NA	NA	6.0E-03	mg/kg/day	7.0E-01	mg/kg/day	8.5E-03
				Lead	9.6E+00	ug/L	NA	NA	NA	NA	NA	1.4E-07	mg/kg/day	NA	mg/kg/day	NA
				Manganese	3.0E+03	ug/L	NA	NA	NA	NA	NA	4.3E-04	mg/kg/day	9.6E-04	mg/kg/day	4.5E-01
				Nickel	3.0E+02	ug/L	NA	NA	NA	NA	NA	8.4E-06	mg/kg/day	8.0E-04	mg/kg/day	1.1E-02
				Selenium	3.7E+00	ug/L	NA	NA	NA	NA	NA	5.4E-07	mg/kg/day	5.0E-03	mg/kg/day	1.1E-04
				Thallium	4.5E-01	ug/L	NA	NA	NA	NA	NA	6.4E-08	mg/kg/day	1.0E-05	mg/kg/day	6.4E-03
				Vanadium	1.4E+01	ug/L	NA	NA	NA	NA	NA	2.0E-06	mg/kg/day	1.3E-04	mg/kg/day	1.5E-02
				Zinc	1.1E+03	ug/L	NA	NA	NA	NA	NA	9.8E-05	mg/kg/day	3.0E-01	mg/kg/day	3.3E-04
			Exp. Route Total								NA					6.8E-01
		Exposure Point Total									NA					1.7E+01
	Exposure Medium Total										NA					1.7E+01
Medium Total											NA					1.7E+01
								Total of Receptor Risks Across All Media			NA		Total of Receptor Hazards Across All Media			1.7E+01

Notes-

DAevent for exposure to groundwater calculated on Table 7.1.RME Supplement A.

N/A = Not applicable.

TABLE 7.1.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURES

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Shallow Groundwater	Shallow Aquifer - Tap Water	Ingestion	Aluminum	2.3E+04	ug/L	NA	NA	NA	NA	NA	3.0E-01	mg/kg/day	1.0E+00	mg/kg/day	3.0E-01
				Antimony	6.0E+00	ug/L	NA	NA	NA	NA	NA	7.7E-05	mg/kg/day	4.0E-04	mg/kg/day	1.9E-01
				Arsenic	7.9E+00	ug/L	NA	NA	NA	NA	NA	1.0E-04	mg/kg/day	3.0E-04	mg/kg/day	3.4E-01
				Barium	1.9E+02	ug/L	NA	NA	NA	NA	NA	2.4E-03	mg/kg/day	2.0E-01	mg/kg/day	1.2E-02
				Beryllium	8.1E+00	ug/L	NA	NA	NA	NA	NA	1.0E-04	mg/kg/day	2.0E-03	mg/kg/day	5.2E-02
				Cadmium	4.6E+00	ug/L	NA	NA	NA	NA	NA	5.9E-05	mg/kg/day	5.0E-04	mg/kg/day	1.2E-01
				Chromium	1.1E+01	ug/L	NA	NA	NA	NA	NA	1.5E-04	mg/kg/day	3.0E-03	mg/kg/day	4.9E-02
				Cobalt	7.8E+01	ug/L	NA	NA	NA	NA	NA	1.0E-03	mg/kg/day	3.0E-04	mg/kg/day	3.3E+00
				Copper	2.7E+01	ug/L	NA	NA	NA	NA	NA	3.4E-04	mg/kg/day	4.0E-02	mg/kg/day	8.6E-03
				Iron	4.2E+04	ug/L	NA	NA	NA	NA	NA	5.3E-01	mg/kg/day	7.0E-01	mg/kg/day	7.6E-01
				Lead	9.6E+00	ug/L	NA	NA	NA	NA	NA	1.2E-04	mg/kg/day	NA	NA	NA
				Manganese	3.0E+03	ug/L	NA	NA	NA	NA	NA	3.9E-02	mg/kg/day	2.4E-02	mg/kg/day	1.6E+00
				Nickel	3.0E+02	ug/L	NA	NA	NA	NA	NA	3.8E-03	mg/kg/day	2.0E-02	mg/kg/day	1.9E-01
				Selenium	3.7E+00	ug/L	NA	NA	NA	NA	NA	4.8E-05	mg/kg/day	5.0E-03	mg/kg/day	9.6E-03
				Thallium	4.5E-01	ug/L	NA	NA	NA	NA	NA	5.7E-06	mg/kg/day	1.0E-05	mg/kg/day	5.7E-01
				Vanadium	1.4E+01	ug/L	NA	NA	NA	NA	NA	1.8E-04	mg/kg/day	5.0E-03	mg/kg/day	3.5E-02
				Zinc	1.1E+03	ug/L	NA	NA	NA	NA	NA	1.5E-02	mg/kg/day	3.0E-01	mg/kg/day	4.9E-02
			Exp. Route Total								NA					7.6E+00
			Dermal Absorption	Aluminum	2.3E+04	ug/L	NA	NA	NA	NA	NA	9.5E-04	mg/kg/day	1.0E+00	mg/kg/day	9.5E-04
				Antimony	6.0E+00	ug/L	NA	NA	NA	NA	NA	2.5E-07	mg/kg/day	6.0E-05	mg/kg/day	4.1E-03
				Arsenic	7.9E+00	ug/L	NA	NA	NA	NA	NA	3.3E-07	mg/kg/day	3.0E-04	mg/kg/day	1.1E-03
				Barium	1.9E+02	ug/L	NA	NA	NA	NA	NA	7.8E-06	mg/kg/day	1.4E-02	mg/kg/day	5.6E-04
				Beryllium	8.1E+00	ug/L	NA	NA	NA	NA	NA	3.3E-07	mg/kg/day	1.4E-05	mg/kg/day	2.4E-02
				Cadmium	4.6E+00	ug/L	NA	NA	NA	NA	NA	1.9E-07	mg/kg/day	2.5E-05	mg/kg/day	7.6E-03
				Chromium	1.1E+01	ug/L	NA	NA	NA	NA	NA	9.4E-07	mg/kg/day	7.5E-05	mg/kg/day	1.2E-02
				Cobalt	7.8E+01	ug/L	NA	NA	NA	NA	NA	1.3E-06	mg/kg/day	3.0E-04	mg/kg/day	4.3E-03
				Copper	2.7E+01	ug/L	NA	NA	NA	NA	NA	1.1E-06	mg/kg/day	4.0E-02	mg/kg/day	2.8E-05
				Iron	4.2E+04	ug/L	NA	NA	NA	NA	NA	1.7E-03	mg/kg/day	7.0E-01	mg/kg/day	2.5E-03
				Lead	9.6E+00	ug/L	NA	NA	NA	NA	NA	4.0E-08	mg/kg/day	NA	NA	NA
				Manganese	3.0E+03	ug/L	NA	NA	NA	NA	NA	1.2E-04	mg/kg/day	9.6E-04	mg/kg/day	1.3E-01
				Nickel	3.0E+02	ug/L	NA	NA	NA	NA	NA	2.4E-06	mg/kg/day	8.0E-04	mg/kg/day	3.0E-03
				Selenium	3.7E+00	ug/L	NA	NA	NA	NA	NA	1.5E-07	mg/kg/day	5.0E-03	mg/kg/day	3.1E-05
				Thallium	4.5E-01	ug/L	NA	NA	NA	NA	NA	1.8E-08	mg/kg/day	1.0E-05	mg/kg/day	1.8E-03
				Vanadium	1.4E+01	ug/L	NA	NA	NA	NA	NA	5.7E-07	mg/kg/day	1.3E-04	mg/kg/day	4.4E-03
				Zinc	1.1E+03	ug/L	NA	NA	NA	NA	NA	2.8E-05	mg/kg/day	3.0E-01	mg/kg/day	9.4E-05
			Exp. Route Total								NA					2.0E-01
		Exposure Point Total									NA					7.8E+00
	Exposure Medium Total										NA					7.8E+00
Medium Total											NA					7.8E+00
									Total of Receptor Risks Across All Media		NA			Total of Receptor Hazards Across All Media		7.8E+00

Notes-

DAevent for exposure to groundwater calculated on Table 7.1.CTE Supplement A.

N/A = Not applicable.

TABLE 7.2.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Shallow Groundwater	Tap Water	Ingestion	Aluminum	2.3E+04	ug/L	NA	NA	NA	NA	NA	1.5E+00	mg/kg/day	1.0E+00	mg/kg/day	1.5E+00
				Antimony	6.0E+00	ug/L	NA	NA	NA	NA	NA	3.8E-04	mg/kg/day	4.0E-04	mg/kg/day	9.6E-01
				Arsenic	7.9E+00	ug/L	NA	NA	NA	NA	NA	5.1E-04	mg/kg/day	3.0E-04	mg/kg/day	1.7E+00
				Barium	1.9E+02	ug/L	NA	NA	NA	NA	NA	1.2E-02	mg/kg/day	2.0E-01	mg/kg/day	6.0E-02
				Beryllium	8.1E+00	ug/L	NA	NA	NA	NA	NA	5.2E-04	mg/kg/day	2.0E-03	mg/kg/day	2.6E-01
				Cadmium	4.6E+00	ug/L	NA	NA	NA	NA	NA	2.9E-04	mg/kg/day	5.0E-04	mg/kg/day	5.9E-01
				Chromium (total)	1.1E+01	ug/L	NA	NA	NA	NA	NA	7.3E-04	mg/kg/day	3.0E-03	mg/kg/day	2.4E-01
				Cobalt	7.8E+01	ug/L	NA	NA	NA	NA	NA	5.0E-03	mg/kg/day	3.0E-04	mg/kg/day	1.7E+01
				Copper	2.7E+01	ug/L	NA	NA	NA	NA	NA	1.7E-03	mg/kg/day	4.0E-02	mg/kg/day	4.3E-02
				Iron	4.2E+04	ug/L	NA	NA	NA	NA	NA	2.7E+00	mg/kg/day	7.0E-01	mg/kg/day	3.8E+00
				Lead	9.6E+00	ug/L	NA	NA	NA	NA	NA	6.1E-04	mg/kg/day	NA	mg/kg/day	NA
				Manganese	3.0E+03	ug/L	NA	NA	NA	NA	NA	1.9E-01	mg/kg/day	2.4E-02	mg/kg/day	8.0E+00
				Nickel	3.0E+02	ug/L	NA	NA	NA	NA	NA	1.9E-02	mg/kg/day	2.0E-02	mg/kg/day	9.4E-01
				Selenium	3.7E+00	ug/L	NA	NA	NA	NA	NA	2.4E-04	mg/kg/day	5.0E-03	mg/kg/day	4.8E-02
				Thallium	4.5E-01	ug/L	NA	NA	NA	NA	NA	2.9E-05	mg/kg/day	1.0E-05	mg/kg/day	2.9E+00
				Vanadium	1.4E+01	ug/L	NA	NA	NA	NA	NA	8.8E-04	mg/kg/day	5.0E-03	mg/kg/day	1.8E-01
				Zinc	1.1E+03	ug/L	NA	NA	NA	NA	NA	7.3E-02	mg/kg/day	3.0E-01	mg/kg/day	2.4E-01
			Exp. Route Total								NA					3.8E+01
			Dermal Absorption	Aluminum	2.3E+04	ug/L	NA	NA	NA	NA	NA	9.9E-03	mg/kg/day	1.0E+00	mg/kg/day	9.9E-03
				Antimony	6.0E+00	ug/L	NA	NA	NA	NA	NA	2.6E-06	mg/kg/day	6.0E-05	mg/kg/day	4.3E-02
				Arsenic	7.9E+00	ug/L	NA	NA	NA	NA	NA	3.4E-06	mg/kg/day	3.0E-04	mg/kg/day	1.1E-02
				Barium	1.9E+02	ug/L	NA	NA	NA	NA	NA	8.1E-05	mg/kg/day	1.4E-02	mg/kg/day	5.8E-03
				Beryllium	8.1E+00	ug/L	NA	NA	NA	NA	NA	3.5E-06	mg/kg/day	1.4E-05	mg/kg/day	2.5E-01
				Cadmium	4.6E+00	ug/L	NA	NA	NA	NA	NA	2.0E-06	mg/kg/day	2.5E-05	mg/kg/day	7.9E-02
				Chromium (total)	1.1E+01	ug/L	NA	NA	NA	NA	NA	9.7E-06	mg/kg/day	7.5E-05	mg/kg/day	1.3E-01
				Cobalt	7.8E+01	ug/L	NA	NA	NA	NA	NA	1.3E-05	mg/kg/day	3.0E-04	mg/kg/day	4.4E-02
				Copper	2.7E+01	ug/L	NA	NA	NA	NA	NA	1.1E-05	mg/kg/day	4.0E-02	mg/kg/day	2.9E-04
				Iron	4.2E+04	ug/L	NA	NA	NA	NA	NA	1.8E-02	mg/kg/day	7.0E-01	mg/kg/day	2.5E-02
				Lead	9.6E+00	ug/L	NA	NA	NA	NA	NA	4.1E-07	mg/kg/day	NA	mg/kg/day	NA
				Manganese	3.0E+03	ug/L	NA	NA	NA	NA	NA	1.3E-03	mg/kg/day	9.6E-04	mg/kg/day	1.3E+00
				Nickel	3.0E+02	ug/L	NA	NA	NA	NA	NA	2.5E-05	mg/kg/day	8.0E-04	mg/kg/day	3.2E-02
				Selenium	3.7E+00	ug/L	NA	NA	NA	NA	NA	1.6E-06	mg/kg/day	5.0E-03	mg/kg/day	3.2E-04
				Thallium	4.5E-01	ug/L	NA	NA	NA	NA	NA	1.9E-07	mg/kg/day	1.0E-05	mg/kg/day	1.9E-02
				Vanadium	1.4E+01	ug/L	NA	NA	NA	NA	NA	5.9E-06	mg/kg/day	1.3E-04	mg/kg/day	4.5E-02
				Zinc	1.1E+03	ug/L	NA	NA	NA	NA	NA	2.9E-04	mg/kg/day	3.0E-01	mg/kg/day	9.8E-04
			Exp. Route Total								NA					2.0E+00
		Exposure Point Total									NA					4.0E+01
	Exposure Medium Total										NA					4.0E+01
Medium Total											NA					4.0E+01
									Total of Receptor Risks Across All Media		NA			Total of Receptor Hazards Across All Media		4.0E+01

Notes-

DAevent for exposure to groundwater calculated on Table 7.2.RME Supplement A.

N/A = Not applicable.

TABLE 7.2.CTE

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

CENTRAL TENDENCY EXPOSURES

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Shallow Groundwater	Shallow Aquifer - Tap Water	Ingestion	Aluminum	2.3E+04	ug/L	NA	NA	NA	NA	NA	9.9E-01	mg/kg/day	1.0E+00	mg/kg/day	9.9E-01
				Antimony	6.0E+00	ug/L	NA	NA	NA	NA	NA	2.6E-04	mg/kg/day	4.0E-04	mg/kg/day	6.4E-01
				Arsenic	7.9E+00	ug/L	NA	NA	NA	NA	NA	3.4E-04	mg/kg/day	3.0E-04	mg/kg/day	1.1E+00
				Barium	1.9E+02	ug/L	NA	NA	NA	NA	NA	8.1E-03	mg/kg/day	2.0E-01	mg/kg/day	4.0E-02
				Beryllium	8.1E+00	ug/L	NA	NA	NA	NA	NA	3.5E-04	mg/kg/day	2.0E-03	mg/kg/day	1.7E-01
				Cadmium	4.6E+00	ug/L	NA	NA	NA	NA	NA	2.0E-04	mg/kg/day	5.0E-04	mg/kg/day	3.9E-01
				Chromium	1.1E+01	ug/L	NA	NA	NA	NA	NA	4.9E-04	mg/kg/day	3.0E-03	mg/kg/day	1.6E-01
				Cobalt	7.8E+01	ug/L	NA	NA	NA	NA	NA	3.3E-03	mg/kg/day	3.0E-04	mg/kg/day	1.1E+01
				Copper	2.7E+01	ug/L	NA	NA	NA	NA	NA	1.1E-03	mg/kg/day	4.0E-02	mg/kg/day	2.9E-02
				Iron	4.2E+04	ug/L	NA	NA	NA	NA	NA	1.8E+00	mg/kg/day	7.0E-01	mg/kg/day	2.5E+00
				Lead	9.6E+00	ug/L	NA	NA	NA	NA	NA	4.1E-04	mg/kg/day	NA		NA
				Manganese	3.0E+03	ug/L	NA	NA	NA	NA	NA	1.3E-01	mg/kg/day	2.4E-02	mg/kg/day	5.4E+00
				Nickel	3.0E+02	ug/L	NA	NA	NA	NA	NA	1.3E-02	mg/kg/day	2.0E-02	mg/kg/day	6.3E-01
				Selenium	3.7E+00	ug/L	NA	NA	NA	NA	NA	1.6E-04	mg/kg/day	5.0E-03	mg/kg/day	3.2E-02
				Thallium	4.5E-01	ug/L	NA	NA	NA	NA	NA	1.9E-05	mg/kg/day	1.0E-05	mg/kg/day	1.9E+00
				Vanadium	1.4E+01	ug/L	NA	NA	NA	NA	NA	5.9E-04	mg/kg/day	5.0E-03	mg/kg/day	1.2E-01
				Zinc	1.1E+03	ug/L	NA	NA	NA	NA	NA	4.9E-02	mg/kg/day	3.0E-01	mg/kg/day	1.6E-01
			Exp. Route Total								NA					2.5E+01
			Dermal Absorption	Aluminum	2.3E+04	ug/L	NA	NA	NA	NA	NA	2.2E-03	mg/kg/day	1.0E+00	mg/kg/day	2.2E-03
				Antimony	6.0E+00	ug/L	NA	NA	NA	NA	NA	5.7E-07	mg/kg/day	6.0E-05	mg/kg/day	9.4E-03
				Arsenic	7.9E+00	ug/L	NA	NA	NA	NA	NA	7.5E-07	mg/kg/day	3.0E-04	mg/kg/day	2.5E-03
				Barium	1.9E+02	ug/L	NA	NA	NA	NA	NA	1.8E-05	mg/kg/day	1.4E-02	mg/kg/day	1.3E-03
				Beryllium	8.1E+00	ug/L	NA	NA	NA	NA	NA	7.6E-07	mg/kg/day	1.4E-05	mg/kg/day	5.4E-02
				Cadmium	4.6E+00	ug/L	NA	NA	NA	NA	NA	4.4E-07	mg/kg/day	2.5E-05	mg/kg/day	1.7E-02
				Chromium	1.1E+01	ug/L	NA	NA	NA	NA	NA	2.1E-06	mg/kg/day	7.5E-05	mg/kg/day	2.9E-02
				Cobalt	7.8E+01	ug/L	NA	NA	NA	NA	NA	2.9E-06	mg/kg/day	3.0E-04	mg/kg/day	9.8E-03
				Copper	2.7E+01	ug/L	NA	NA	NA	NA	NA	2.5E-06	mg/kg/day	4.0E-02	mg/kg/day	6.3E-05
				Iron	4.2E+04	ug/L	NA	NA	NA	NA	NA	3.9E-03	mg/kg/day	7.0E-01	mg/kg/day	5.6E-03
				Lead	9.6E+00	ug/L	NA	NA	NA	NA	NA	9.1E-08	mg/kg/day	NA		NA
				Manganese	3.0E+03	ug/L	NA	NA	NA	NA	NA	2.8E-04	mg/kg/day	9.6E-04	mg/kg/day	3.0E-01
				Nickel	3.0E+02	ug/L	NA	NA	NA	NA	NA	5.6E-06	mg/kg/day	8.0E-04	mg/kg/day	7.0E-03
				Selenium	3.7E+00	ug/L	NA	NA	NA	NA	NA	3.5E-07	mg/kg/day	5.0E-03	mg/kg/day	7.1E-05
				Thallium	4.5E-01	ug/L	NA	NA	NA	NA	NA	4.2E-08	mg/kg/day	1.0E-05	mg/kg/day	4.2E-03
				Vanadium	1.4E+01	ug/L	NA	NA	NA	NA	NA	1.3E-06	mg/kg/day	1.3E-04	mg/kg/day	1.0E-02
				Zinc	1.1E+03	ug/L	NA	NA	NA	NA	NA	6.5E-05	mg/kg/day	3.0E-01	mg/kg/day	2.2E-04
			Exp. Route Total								NA					4.5E-01
		Exposure Point Total									NA					2.6E+01
	Exposure Medium Total										NA					2.6E+01
Medium Total											NA					2.6E+01
									Total of Receptor Risks Across All Media		NA			Total of Receptor Hazards Across All Media		2.6E+01

Notes-

DAevent for exposure to groundwater calculated on Table 7.2.CTE Supplement A.

N/A = Not applicable.

TABLE 7.3.RME
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
REASONABLE MAXIMUM EXPOSURE
SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult/Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Shallow Groundwater	Tap Water	Ingestion	Aluminum	2.3E+04	ug/L	3.5E-01	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Antimony	6.0E+00	ug/L	9.0E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Arsenic	7.9E+00	ug/L	1.2E-04	mg/kg/day	1.5E+00	1/(mg/kg-day)	1.8E-04	NA	NA	NA	NA	NA
				Barium	1.9E+02	ug/L	2.8E-03	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Beryllium	8.1E+00	ug/L	1.2E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Cadmium	4.6E+00	ug/L	6.9E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Chromium[1]	1.1E+01	ug/L			5.0E-01	1/(mg/kg-day)	2.6E-04	NA	NA	NA	NA	NA
				Cobalt	7.8E+01	ug/L	1.2E-03	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Copper	2.7E+01	ug/L	4.0E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Iron	4.2E+04	ug/L	6.2E-01	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Lead	9.6E+00	ug/L	1.4E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Manganese	3.0E+03	ug/L	4.5E-02	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Nickel	3.0E+02	ug/L	4.4E-03	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Selenium	3.7E+00	ug/L	5.6E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Thallium	4.5E-01	ug/L	6.7E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Vanadium	1.4E+01	ug/L	2.1E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Zinc	1.1E+03	ug/L	1.7E-02	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								4.4E-04					0.0E+00
			Dermal Absorption	Aluminum	2.3E+04	ug/L	2.0E-03	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Antimony	6.0E+00	ug/L	5.1E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Arsenic	7.9E+00	ug/L	6.7E-07	mg/kg/day	1.5E+00	1/(mg/kg-day)	1.0E-06	NA	NA	NA	NA	NA
				Barium	1.9E+02	ug/L	1.6E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Beryllium	8.1E+00	ug/L	6.9E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Cadmium	4.6E+00	ug/L	3.9E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Chromium[1]	1.1E+01	ug/L			2.0E+01	1/(mg/kg-day)	1.3E-04	NA	NA	NA	NA	NA
				Cobalt	7.8E+01	ug/L	2.6E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Copper	2.7E+01	ug/L	2.3E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Iron	4.2E+04	ug/L	3.5E-03	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Lead	9.6E+00	ug/L	8.2E-08	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Manganese	3.0E+03	ug/L	2.6E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Nickel	3.0E+02	ug/L	5.0E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Selenium	3.7E+00	ug/L	3.2E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Thallium	4.5E-01	ug/L	3.8E-08	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Vanadium	1.4E+01	ug/L	1.2E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Zinc	1.1E+03	ug/L	5.8E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								1.3E-04					0.0E+00
		Exposure Point Total									5.7E-04					0.0E+00
	Exposure Medium Total										5.7E-04					0.0E+00
Medium Total											5.7E-04					0.0E+00
									Total of Receptor Risks Across All Media		5.7E-04			Total of Receptor Hazards Across All Media		0.0E+00

Notes-

DAevent for exposure to groundwater calculated on Tables 7.1.RME Supplement A and Table 7.2.RME Supplement A.

[1] See Table 7.3.RME Supplement A for calculation of intake and cancer risk following MMOA method.

N/A = Not applicable.

TABLE 7.3.RME Supplement A
CALCULATION OF CHEMICAL CANCER RISKS FOR COPC WITH MUTAGENIC MODE OF ACTION
REASONABLE MAXIMUM EXPOSURE
SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult/Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations										
							Intake					CSF/Unit Risk					Cancer Risk
							Value				Units	Value				Units	
					Value	Units	0-2 yrs	2-6 yrs	6-16 years	16-30 yrs		0-2 yrs (ADAF=10)	2-6 yrs (ADAF=3)	6-16 yrs (ADAF=3)	16-30 yrs (ADAF=1)		
Groundwater	Shallow Groundwater	Tap Water	Ingestion	Chromium	1.1E+01	ug/L	2.1E-05	4.1E-05	4.4E-05	6.2E-05	mg/kg/day	5.0E+00	1.5E+00	1.5E+00	5.0E-01	1/(mg/kg-day)	2.6E-04
			Dermal	Chromium	1.1E+01	ug/L	2.7E-07	5.5E-07	4.6E-07	6.5E-07	mg/kg/day	2.0E+02	6.0E+01	6.0E+01	2.0E+01	1/(mg/kg-day)	1.3E-04

Cancer risk = $(Intake_{0\text{-}2} \times CSF_{0\text{-}2}) + (Intake_{2\text{-}6} \times CSF_{2\text{-}6}) + (Intake_{6\text{-}16} \times CSF_{6\text{-}16}) + (Intake_{16\text{-}30} \times CSF_{16\text{-}30})$

TABLE 7.3.CTE
CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS
CENTRAL TENDENCY EXPOSURES
SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult/Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Shallow Groundwater	Shallow Aquifer - Tap Water	Ingestion	Aluminum	2.3E+04	ug/L	1.2E-01	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Antimony	6.0E+00	ug/L	3.2E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Arsenic	7.9E+00	ug/L	4.2E-05	mg/kg/day	1.5E+00	1/(mg/kg-day)	6.3E-05	NA	NA	NA	NA	NA
				Barium	1.9E+02	ug/L	1.0E-03	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Beryllium	8.1E+00	ug/L	4.3E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Cadmium	4.6E+00	ug/L	2.5E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Chromium[1]	1.1E+01	ug/L			5.0E-01	1/(mg/kg-day)	1.5E-04	NA	NA	NA	NA	NA
				Cobalt	7.8E+01	ug/L	4.1E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Copper	2.7E+01	ug/L	1.4E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Iron	4.2E+04	ug/L	2.2E-01	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Lead	9.6E+00	ug/L	5.1E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Manganese	3.0E+03	ug/L	1.6E-02	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Nickel	3.0E+02	ug/L	1.6E-03	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Selenium	3.7E+00	ug/L	2.0E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Thallium	4.5E-01	ug/L	2.4E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Vanadium	1.4E+01	ug/L	7.3E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Zinc	1.1E+03	ug/L	6.1E-03	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								2.1E-04					0.0E+00
			Dermal Absorption	Aluminum	2.3E+04	ug/L	3.1E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Antimony	6.0E+00	ug/L	8.0E-08	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Arsenic	7.9E+00	ug/L	1.1E-07	mg/kg/day	1.5E+00	1/(mg/kg-day)	1.6E-07	NA	NA	NA	NA	NA
				Barium	1.9E+02	ug/L	2.5E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Beryllium	8.1E+00	ug/L	1.1E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Cadmium	4.6E+00	ug/L	6.1E-08	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Chromium[1]	1.1E+01	ug/L			2.0E+01	1/(mg/kg-day)	2.7E-05	NA	NA	NA	NA	NA
				Cobalt	7.8E+01	ug/L	4.1E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Copper	2.7E+01	ug/L	3.6E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Iron	4.2E+04	ug/L	5.5E-04	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Lead	9.6E+00	ug/L	1.3E-08	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Manganese	3.0E+03	ug/L	4.0E-05	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Nickel	3.0E+02	ug/L	7.8E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Selenium	3.7E+00	ug/L	5.0E-08	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Thallium	4.5E-01	ug/L	5.9E-09	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Vanadium	1.4E+01	ug/L	1.8E-07	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
				Zinc	1.1E+03	ug/L	9.1E-06	mg/kg/day	NA	NA	NA	NA	NA	NA	NA	NA
			Exp. Route Total								2.7E-05					0.0E+00
		Exposure Point Total									2.4E-04					0.0E+00
	Exposure Medium Total										2.4E-04					0.0E+00
Medium Total											2.4E-04					0.0E+00
										Total of Receptor Risks Across All Media	2.4E-04				Total of Receptor Hazards Across All Media	0.0E+00

Notes-

DAevent for exposure to groundwater calculated on Tables 7.1.CTE Supplement A and Table 7.2.CTE Supplement A.

[1] See Table 7.3.CTE Supplement A for calculation of intake and cancer risk following MMOA method.

N/A = Not applicable.

TABLE 7.3.CTE Supplement A
CALCULATION OF CHEMICAL CANCER RISKS FOR COPC WITH MUTAGENIC MODE OF ACTION
CENTRAL TENDENCY EXPOSURE
SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult/Child

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations										
							Intake					CSF/Unit Risk					Cancer Risk
					Value	Units	Value				Units	Value				Units	
							0-2 yrs	2-6 yrs	6-16 years	16-30 yrs		0-2 yrs (ADAF=10)	2-6 yrs (ADAF=3)	6-16 yrs (ADAF=3)	16-30 yrs (ADAF=1)		
Groundwater	Shallow Groundwater	Tap Water	Ingestion	Chromium	1.1E+01	ug/L	1.4E-05	2.8E-05	2.7E-05		mg/kg/day	5.0E+00	1.5E+00	1.5E+00	5.0E-01	1/(mg/kg-day)	1.5E-04
			Dermal	Chromium	1.1E+01	ug/L	6.0E-08	1.2E-07	1.2E-07		mg/kg/day	2.0E+02	6.0E+01	6.0E+01	2.0E+01	1/(mg/kg-day)	2.7E-05

Cancer risk = $(Intake_{0\text{-}2} \times CSF_{0\text{-}2}) + (Intake_{2\text{-}6} \times CSF_{2\text{-}6}) + (Intake_{6\text{-}16} \times CSF_{6\text{-}16}) + (Intake_{16\text{-}30} \times CSF_{16\text{-}30})$

TABLE 7.4.RME

CALCULATION OF CHEMICAL CANCER RISKS AND NON-CANCER HAZARDS

REASONABLE MAXIMUM EXPOSURE

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Exposure Route	Chemical of Potential Concern	EPC		Cancer Risk Calculations					Non-Cancer Hazard Calculations				
					Value	Units	Intake/Exposure Concentration		CSF/Unit Risk		Cancer Risk	Intake/Exposure Concentration		RfD/RfC		Hazard Quotient
							Value	Units	Value	Units		Value	Units	Value	Units	
Groundwater	Shallow Groundwater	Excavation Pit	Dermal	Aluminum	2.3E+04	ug/L	7.4E-05	NA	NA	NA	NA	5.2E-03	mg/kg/day	1.0E+00	mg/kg/day	5.2E-03
			Absorption	Antimony	6.0E+00	ug/L	1.9E-08	NA	NA	NA	NA	1.3E-06	mg/kg/day	6.0E-05	mg/kg/day	2.2E-02
				Arsenic	7.9E+00	ug/L	2.5E-08	NA	1.5E+00	NA	3.8E-08	1.8E-06	mg/kg/day	3.0E-04	mg/kg/day	5.9E-03
				Barium	1.9E+02	ug/L	6.0E-07	NA	NA	NA	NA	4.2E-05	mg/kg/day	4.9E-03	mg/kg/day	8.6E-03
				Beryllium	8.1E+00	ug/L	2.6E-08	NA	NA	NA	NA	1.8E-06	mg/kg/day	3.5E-05	mg/kg/day	5.2E-02
				Cadmium	4.6E+00	ug/L	1.5E-08	NA	NA	NA	NA	1.0E-06	mg/kg/day	2.5E-05	mg/kg/day	4.1E-02
				Chromium	1.1E+01	ug/L	7.2E-08	NA	2.0E+01	NA	1.4E-06	5.1E-06	mg/kg/day	1.3E-04	mg/kg/day	4.1E-02
				Cobalt	7.8E+01	ug/L	9.9E-08	NA	NA	NA	NA	6.9E-06	mg/kg/day	3.0E-03	mg/kg/day	2.3E-03
				Copper	2.7E+01	ug/L	8.5E-08	NA	NA	NA	NA	6.0E-06	mg/kg/day	1.0E-02	mg/kg/day	6.0E-04
				Iron	4.2E+04	ug/L	1.3E-04	NA	NA	NA	NA	9.3E-03	mg/kg/day	7.0E-01	mg/kg/day	1.3E-02
				Lead	9.6E+00	ug/L	3.1E-09	NA	NA	NA	NA	2.1E-07	mg/kg/day	NA	mg/kg/day	NA
				Manganese	3.0E+03	ug/L	9.6E-06	NA	NA	NA	NA	6.7E-04	mg/kg/day	9.6E-04	mg/kg/day	7.0E-01
				Nickel	3.0E+02	ug/L	1.9E-07	NA	NA	NA	NA	1.3E-05	mg/kg/day	8.0E-04	mg/kg/day	1.6E-02
				Selenium	3.7E+00	ug/L	1.2E-08	NA	NA	NA	NA	8.4E-07	mg/kg/day	5.0E-03	mg/kg/day	1.7E-04
				Thallium	4.5E-01	ug/L	1.4E-09	NA	NA	NA	NA	9.9E-08	mg/kg/day	4.0E-05	mg/kg/day	2.5E-03
				Vanadium	1.4E+01	ug/L	4.4E-08	NA	NA	NA	NA	3.1E-06	mg/kg/day	1.8E-04	mg/kg/day	1.7E-02
				Zinc	1.1E+03	ug/L	2.2E-06	NA	NA	NA	NA	1.5E-04	mg/kg/day	3.0E-01	mg/kg/day	5.1E-04
			Exp. Route Total								1.5E-06					9.3E-01
		Exposure Point Total									1.5E-06					9.3E-01
	Exposure Medium Total										1.5E-06					9.3E-01
Medium Total											1.5E-06					9.3E-01
									Total of Receptor Risks Across All Media		1.5E-06			Total of Receptor Hazards Across All Media		9.3E-01

Notes-

DAevent for exposure to groundwater calculated on Tables 7.4.RME Supplement A.

N/A = Not applicable.

TABLE 9.1.RME

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

REASONABLE MAXIMUM EXPOSURE

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Shallow Aquifer - Tap Water	Aluminum	NA	NA	NA	0.0E+00	Neurotoxicity	6.3E-01	NA	3.3E-03	6.4E-01
			Antimony	NA	NA	NA	0.0E+00	Blood	4.1E-01	NA	1.4E-02	4.3E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	7.2E-01	NA	3.8E-03	7.3E-01
			Barium	NA	NA	NA	0.0E+00	Kidney	2.6E-02	NA	1.9E-03	2.8E-02
			Beryllium	NA	NA	NA	0.0E+00	Gastrointestinal	1.1E-01	NA	8.3E-02	1.9E-01
			Cadmium	NA	NA	NA	0.0E+00	Kidney	2.5E-01	NA	2.6E-02	2.8E-01
			Chromium (total)	NA	NA	NA	0.0E+00	NOE	1.0E-01	NA	4.3E-02	1.5E-01
			Cobalt	NA	NA	NA	0.0E+00	Thyroid	7.1E+00	NA	1.5E-02	7.1E+00
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	1.8E-02	NA	9.6E-05	1.8E-02
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	1.6E+00	NA	8.5E-03	1.6E+00
			Lead	NA	NA	NA	0.0E+00	NA	NA	NA	NA	NA
			Manganese	NA	NA	NA	0.0E+00	CNS	3.4E+00	NA	4.5E-01	3.9E+00
			Nickel	NA	NA	NA	0.0E+00	Decreased Body and Organ Weights	4.0E-01	NA	1.1E-02	4.1E-01
			Selenium	NA	NA	NA	0.0E+00	Whole body	2.1E-02	NA	1.1E-04	2.1E-02
			Thallium	NA	NA	NA	0.0E+00	Hair	1.2E+00	NA	6.4E-03	1.2E+00
			Vanadium	NA	NA	NA	0.0E+00	Hair	7.6E-02	NA	1.5E-02	9.1E-02
			Zinc	NA	NA	NA	0.0E+00	Blood	1.0E-01	NA	3.3E-04	1.0E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		1.6E+01	0.0E+00	6.8E-01	1.7E+01
		Exposure Point Total					0.0E+00					1.7E+01
	Exposure Medium Total						0.0E+00					1.7E+01
Medium Total							0.0E+00					1.7E+01
Receptor Total							0.0E+00				Receptor HI Total	1.7E+01

Total Neurological HI Across All Media =	**4.5E+00**
Total Blood HI Across All Media =	5.3E-01
Total Skin HI Across All Media =	7.3E-01
Total Vascular HI Across All Media =	7.3E-01
Total Kidney HI Across All Media =	3.1E-01
Total Thyroid HI Across All Media =	**7.1E+00**
Total Gastrointestinal HI Across All Media =	**1.9E+00**
Total Body Weight HI Across All Media =	4.1E-01
Total Organ Weight HI Across All Media =	4.1E-01
Total Whole Body HI Across All Media =	2.1E-02
Total Hair HI Across All Media =	**1.3E+00**

CNS - Central Nervous System
HI - Hazard Index
NA - Not Applicable
NOE - No Observed Effects

TABLE 9.1.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Shallow Aquifer - Tap Water	Aluminum	NA	NA	NA	0.0E+00	Neurotoxicity	3.0E-01	NA	9.5E-04	3.0E-01
			Antimony	NA	NA	NA	0.0E+00	Blood	1.9E-01	NA	4.1E-03	2.0E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	3.4E-01	NA	1.1E-03	3.4E-01
			Barium	NA	NA	NA	0.0E+00	Kidney	1.2E-02	NA	5.6E-04	1.3E-02
			Beryllium	NA	NA	NA	0.0E+00	Gastrointestinal	5.2E-02	NA	2.4E-02	7.6E-02
			Cadmium	NA	NA	NA	0.0E+00	Kidney	1.2E-01	NA	7.6E-03	1.3E-01
			Chromium (total)	NA	NA	NA	0.0E+00	NOE	4.9E-02	NA	1.2E-02	6.1E-02
			Cobalt	NA	NA	NA	0.0E+00	Thyroid	3.3E+00	NA	4.3E-03	3.3E+00
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	8.6E-03	NA	2.8E-05	8.6E-03
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	7.6E-01	NA	2.5E-03	7.7E-01
			Lead	NA	NA	NA	0.0E+00	NA	NA	NA	NA	NA
			Manganese	NA	NA	NA	0.0E+00	CNS	1.6E+00	NA	1.3E-01	1.7E+00
			Nickel	NA	NA	NA	0.0E+00	Decreased Body and Organ Weights	1.9E-01	NA	3.0E-03	1.9E-01
			Selenium	NA	NA	NA	0.0E+00	Whole body	9.6E-03	NA	3.1E-05	9.6E-03
			Thallium	NA	NA	NA	0.0E+00	Hair	5.7E-01	NA	1.8E-03	5.7E-01
			Vanadium	NA	NA	NA	0.0E+00	Hair	3.5E-02	NA	4.4E-03	4.0E-02
			Zinc	NA	NA	NA	0.0E+00	Blood	4.9E-02	NA	9.4E-05	4.9E-02
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		7.6E+00	0.0E+00	2.0E-01	7.8E+00
		Exposure Point Total					0.0E+00					7.8E+00
	Exposure Medium Total						0.0E+00					7.8E+00
Medium Total							0.0E+00					7.8E+00
Receptor Total							0.0E+00				Receptor HI Total	7.8E+00

Total Neurological HI Across All Media =	**2.0E+00**
Total Blood HI Across All Media =	2.5E-01
Total Skin HI Across All Media =	3.4E-01
Total Vascular HI Across All Media =	3.4E-01
Total Kidney HI Across All Media =	1.4E-01
Total Thyroid HI Across All Media =	**3.3E+00**
Total Gastrointestinal HI Across All Media =	8.5E-01
Total Body Weight HI Across All Media =	1.9E-01
Total Organ Weight HI Across All Media =	1.9E-01
Total Whole Body HI Across All Media =	9.6E-03
Total Hair HI Across All Media =	6.1E-01

CNS - Central Nervous System
HI - Hazard Index
NA - Not Applicable
NOE - No Observed Effects

TABLE 9.2.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Shallow Aquifer - Tap Water	Aluminum	NA	NA	NA	0.0E+00	Neurotoxicity	1.5E+00	NA	9.9E-03	1.5E+00
			Antimony	NA	NA	NA	0.0E+00	Blood	9.6E-01	NA	4.3E-02	1.0E+00
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	1.7E+00	NA	1.1E-02	1.7E+00
			Barium	NA	NA	NA	0.0E+00	Kidney	6.0E-02	NA	5.8E-03	6.6E-02
			Beryllium	NA	NA	NA	0.0E+00	Gastrointestinal	2.6E-01	NA	2.5E-01	5.1E-01
			Cadmium	NA	NA	NA	0.0E+00	Kidney	5.9E-01	NA	7.9E-02	6.7E-01
			Chromium (total)	NA	NA	NA	0.0E+00	NOE	2.4E-01	NA	1.3E-01	3.7E-01
			Cobalt	NA	NA	NA	0.0E+00	Thyroid	1.7E+01	NA	4.4E-02	1.7E+01
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	4.3E-02	NA	2.9E-04	4.3E-02
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	3.8E+00	NA	2.5E-02	3.8E+00
			Lead	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	8.0E+00	NA	1.3E+00	9.4E+00
			Nickel	NA	NA	NA	0.0E+00	Decreased Body and Organ Weights	9.4E-01	NA	3.2E-02	9.7E-01
			Selenium	NA	NA	NA	0.0E+00	Whole body	4.8E-02	NA	3.2E-04	4.8E-02
			Thallium	NA	NA	NA	0.0E+00	Hair	2.9E+00	NA	1.9E-02	2.9E+00
			Vanadium	NA	NA	NA	0.0E+00	Hair	1.8E-01	NA	4.5E-02	2.2E-01
			Zinc	NA	NA	NA	0.0E+00	Blood	2.4E-01	NA	9.8E-04	2.4E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		3.8E+01	0.0E+00	2.0E+00	4.0E+01
		Exposure Point Total					0.0E+00					4.0E+01
	Exposure Medium Total						0.0E+00					4.0E+01
Medium Total							0.0E+00					4.0E+01
Receptor Total							0.0E+00				Receptor HI Total	4.0E+01

Total Neurological HI Across All Media =	**1.1E+01**
Total Blood HI Across All Media =	**1.2E+00**
Total Skin HI Across All Media =	**1.7E+00**
Total Vascular HI Across All Media =	**1.7E+00**
Total Kidney HI Across All Media =	7.4E-01
Total Thyroid HI Across All Media =	**1.7E+01**
Total Gastrointestinal HI Across All Media =	**4.4E+00**
Total Body Weight HI Across All Media =	9.7E-01
Total Organ Weight HI Across All Media =	9.7E-01
Total Whole Body HI Across All Media =	4.8E-02
Total Hair HI Across All Media =	**3.1E+00**

CNS - Central Nervous System
HI - Hazard Index
NA - Not Applicable
NOE - No Observed Effects

TABLE 9.2.CTE

SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs

CENTRAL TENDENCY EXPOSURE

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Shallow Aquifer - Tap Water	Aluminum	NA	NA	NA	0.0E+00	Neurotoxicity	9.9E-01	NA	2.2E-03	9.9E-01
			Antimony	NA	NA	NA	0.0E+00	Blood	6.4E-01	NA	9.4E-03	6.5E-01
			Arsenic	NA	NA	NA	0.0E+00	Skin, Vascular	1.1E+00	NA	2.5E-03	1.1E+00
			Barium	NA	NA	NA	0.0E+00	Kidney	4.0E-02	NA	1.3E-03	4.2E-02
			Beryllium	NA	NA	NA	0.0E+00	Gastrointestinal	1.7E-01	NA	5.4E-02	2.3E-01
			Cadmium	NA	NA	NA	0.0E+00	Kidney	3.9E-01	NA	1.7E-02	4.1E-01
			Chromium (total)	NA	NA	NA	0.0E+00	NOE	1.6E-01	NA	2.9E-02	1.9E-01
			Cobalt	NA	NA	NA	0.0E+00	Thyroid	1.1E+01	NA	9.8E-03	1.1E+01
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	2.9E-02	NA	6.3E-05	2.9E-02
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	2.5E+00	NA	5.6E-03	2.5E+00
			Lead	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	5.4E+00	NA	3.0E-01	5.7E+00
			Nickel	NA	NA	NA	0.0E+00	Decreased Body and Organ Weights	6.3E-01	NA	7.0E-03	6.4E-01
			Selenium	NA	NA	NA	0.0E+00	Whole body	3.2E-02	NA	7.1E-05	3.2E-02
			Thallium	NA	NA	NA	0.0E+00	Hair	1.9E+00	NA	4.2E-03	1.9E+00
			Vanadium	NA	NA	NA	0.0E+00	Hair	1.2E-01	NA	1.0E-02	1.3E-01
			Zinc	NA	NA	NA	0.0E+00	Blood	1.6E-01	NA	2.2E-04	1.6E-01
			Chemical Total	0.0E+00	0.0E+00	0.0E+00	0.0E+00		2.5E+01	0.0E+00	4.5E-01	2.6E+01
		Exposure Point Total					0.0E+00					2.6E+01
	Exposure Medium Total						0.0E+00					2.6E+01
Medium Total							0.0E+00					2.6E+01
Receptor Total							0.0E+00				Receptor HI Total	2.6E+01

Total Neurological HI Across All Media =	**6.7E+00**
Total Blood HI Across All Media =	8.1E-01
Total Skin HI Across All Media =	**1.1E+00**
Total Vascular HI Across All Media =	**1.1E+00**
Total Kidney HI Across All Media =	4.5E-01
Total Thyroid HI Across All Media =	**1.1E+01**
Total Gastrointestinal HI Across All Media =	**2.8E+00**
Total Body Weight HI Across All Media =	6.4E-01
Total Organ Weight HI Across All Media =	6.4E-01
Total Whole Body HI Across All Media =	3.2E-02
Total Hair HI Across All Media =	**2.0E+00**

CNS - Central Nervous System
HI - Hazard Index
NA - Not Applicable
NOE - No Observed Effects

TABLE 9.3.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Shallow Aquifer - Tap Water	Aluminum	NA	NA	NA	0.0E+00	Neurotoxicity	NA	NA	NA	0.0E+00
			Antimony	NA	NA	NA	0.0E+00	Blood	NA	NA	NA	0.0E+00
			Arsenic	1.8E-04	NA	1.0E-06	1.8E-04	Skin, Vascular	NA	NA	NA	0.0E+00
			Barium	NA	NA	NA	0.0E+00	Kidney	NA	NA	NA	0.0E+00
			Beryllium	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	NA	0.0E+00
			Cadmium	NA	NA	NA	0.0E+00	Kidney	NA	NA	NA	0.0E+00
			Chromium (total)	2.6E-04	NA	1.3E-04	3.9E-04	NOE	NA	NA	NA	0.0E+00
			Cobalt	NA	NA	NA	0.0E+00	Thyroid	NA	NA	NA	0.0E+00
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	NA	0.0E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	NA	0.0E+00
			Lead	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	NA	NA	NA	0.0E+00
			Nickel	NA	NA	NA	0.0E+00	Decreased Body and Organ Weights	NA	NA	NA	0.0E+00
			Selenium	NA	NA	NA	0.0E+00	Whole body	NA	NA	NA	0.0E+00
			Thallium	NA	NA	NA	0.0E+00	Hair	NA	NA	NA	0.0E+00
			Vanadium	NA	NA	NA	0.0E+00	Hair	NA	NA	NA	0.0E+00
			Zinc	NA	NA	NA	0.0E+00	Blood	NA	NA	NA	0.0E+00
			Chemical Total	4.4E-04	0.0E+00	1.3E-04	5.7E-04		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					5.7E-04					0.0E+00
	Exposure Medium Total						5.7E-04					0.0E+00
Medium Total							5.7E-04					0.0E+00
Receptor Total							5.7E-04				Receptor HI Total	0.0E+00

CNS - Central Nervous System
NA - Not Applicable
NOE - No Observed Effects

TABLE 9.3.CTE
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
CENTRAL TENDENCY EXPOSURE
SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Shallow Aquifer - Tap Water	Aluminum	NA	NA	NA	0.0E+00	Neurotoxicity	NA	NA	NA	0.0E+00
			Antimony	NA	NA	NA	0.0E+00	Blood	NA	NA	NA	0.0E+00
			Arsenic	6.3E-05	NA	1.6E-07	6.3E-05	Skin, Vascular	NA	NA	NA	0.0E+00
			Barium	NA	NA	NA	0.0E+00	Kidney	NA	NA	NA	0.0E+00
			Beryllium	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	NA	0.0E+00
			Cadmium	NA	NA	NA	0.0E+00	Kidney	NA	NA	NA	0.0E+00
			Chromium (total)	1.5E-04	NA	2.7E-05	1.8E-04	NOE	NA	NA	NA	0.0E+00
			Cobalt	NA	NA	NA	0.0E+00	Thyroid	NA	NA	NA	0.0E+00
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	NA	0.0E+00
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	NA	0.0E+00
			Lead	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	NA	NA	NA	0.0E+00
			Nickel	NA	NA	NA	0.0E+00	Decreased Body and Organ Weights	NA	NA	NA	0.0E+00
			Selenium	NA	NA	NA	0.0E+00	Whole body	NA	NA	NA	0.0E+00
			Thallium	NA	NA	NA	0.0E+00	Hair	NA	NA	NA	0.0E+00
			Vanadium	NA	NA	NA	0.0E+00	Hair	NA	NA	NA	0.0E+00
			Zinc	NA	NA	NA	0.0E+00	Blood	NA	NA	NA	0.0E+00
			Chemical Total	2.1E-04	0.0E+00	2.7E-05	2.4E-04		0.0E+00	0.0E+00	0.0E+00	0.0E+00
		Exposure Point Total					2.4E-04					0.0E+00
	Exposure Medium Total						2.4E-04					0.0E+00
Medium Total							2.4E-04					0.0E+00
Receptor Total							2.4E-04				Receptor HI Total	0.0E+00

CNS - Central Nervous System
NA - Not Applicable
NOE - No Observed Effects

TABLE 9.4.RME
SUMMARY OF RECEPTOR RISKS AND HAZARDS FOR COPCs
REASONABLE MAXIMUM EXPOSURE
SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Construction Worker
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Shallow Aquifer - Tap Water	Aluminum	NA	NA	NA	0.0E+00	Neurotoxicity	NA	NA	5.2E-03	5.2E-03
			Antimony	NA	NA	NA	0.0E+00	Blood	NA	NA	2.2E-02	2.2E-02
			Arsenic	NA	NA	3.8E-08	3.8E-08	Skin, Vascular	NA	NA	5.9E-03	5.9E-03
			Barium	NA	NA	NA	0.0E+00	Cardiovascular System	NA	NA	8.6E-03	8.6E-03
			Beryllium	NA	NA	NA	0.0E+00	Lifetime	NA	NA	5.2E-02	5.2E-02
			Cadmium	NA	NA	NA	0.0E+00	Kidney	NA	NA	4.1E-02	4.1E-02
			Chromium (total)	NA	NA	1.4E-06	1.4E-06	Blood	NA	NA	4.1E-02	4.1E-02
			Cobalt	NA	NA	NA	0.0E+00	Thyroid	NA	NA	2.3E-03	2.3E-03
			Copper	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	6.0E-04	6.0E-04
			Iron	NA	NA	NA	0.0E+00	Gastrointestinal	NA	NA	1.3E-02	1.3E-02
			Lead	NA	NA	NA	0.0E+00	NA	NA	NA	NA	0.0E+00
			Manganese	NA	NA	NA	0.0E+00	CNS	NA	NA	7.0E-01	7.0E-01
			Nickel	NA	NA	NA	0.0E+00	Whole body	NA	NA	1.6E-02	1.6E-02
			Selenium	NA	NA	NA	0.0E+00	Whole body	NA	NA	1.7E-04	1.7E-04
			Thallium	NA	NA	NA	0.0E+00	Hair	NA	NA	2.5E-03	2.5E-03
			Vanadium	NA	NA	NA	0.0E+00	Whole body	NA	NA	1.7E-02	1.7E-02
			Zinc	NA	NA	NA	0.0E+00	Blood	NA	NA	5.1E-04	5.1E-04
			Chemical Total	0.0E+00	0.0E+00	1.5E-06	1.5E-06		0.0E+00	0.0E+00	9.3E-01	9.3E-01
		Exposure Point Total					1.5E-06					9.3E-01
	Exposure Medium Total						1.5E-06					9.3E-01
Medium Total							1.5E-06					9.3E-01
Receptor Total							1.5E-06				Receptor HI Total	9.3E-01

Total Neurological HI Across All Media =	7.1E-01
Total Blood HI Across All Media =	6.3E-02
Total Skin HI Across All Media =	5.9E-03
Total Vascular HI Across All Media =	5.9E-03
Total Cardiovascular System HI Across All Media =	8.6E-03
Total Lifetime HI Across All Media =	5.2E-02
Total Kidney HI Across All Media =	4.1E-02
Total Thyroid HI Across All Media =	2.3E-03
Total Gastrointestinal HI Across All Media =	1.4E-02
Total Whole Body HI Across All Media =	3.4E-02
Total Hair HI Across All Media =	2.5E-03

CNS - Central Nervous System
HI - Hazard Index
NA - Not Applicable
NOE - No Observed Effects

TABLE 10.1.RME

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Shallow Aquifer - Tap Water	Aluminum					Neurotoxicity	6.3E-01	NA	3.3E-03	6.4E-01
			Beryllium					Gastrointestinal	1.1E-01	NA	8.3E-02	1.9E-01
			Cobalt					Thyroid	7.1E+00	NA	1.5E-02	7.1E+00
			Iron					Gastrointestinal	1.6E+00	NA	8.5E-03	1.6E+00
			Manganese					CNS	3.4E+00	NA	4.5E-01	3.9E+00
			Thallium					Hair	1.2E+00	NA	6.4E-03	1.2E+00
			Vanadium					Hair	1.0E-01	NA	3.3E-04	1.0E-01
			Chemical Total						1.4E+01	0.0E+00	5.7E-01	1.5E+01
		Exposure Point Total										1.5E+01
	Exposure Medium Total											1.5E+01
Medium Total												1.5E+01
Receptor Total								Receptor HI Total				1.5E+01

CNS - Central Nervous System
HI - Hazard Index
NA - Not Applicable

Total Neurological HI Across All Media =	**4.5E+00**
Total Thyroid HI Across All Media =	**7.1E+00**
Total Gastrointestinal HI Across All Media =	**1.8E+00**
Total Hair HI Across All Media =	**1.3E+00**

TABLE 10.1.CTE

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Shallow Aquifer - Tap Water	Aluminum					Neurotoxicity	3.0E-01	NA	9.5E-04	3.0E-01
			Cobalt					Thyroid	3.3E+00	NA	4.3E-03	3.3E+00
			Manganese					CNS	1.6E+00	NA	1.3E-01	1.7E+00
			Chemical Total						5.2E+00	NA	1.3E-01	5.4E+00
		Exposure Point Total										5.4E+00
	Exposure Medium Total											5.4E+00
Medium Total												5.4E+00
Receptor Total								Receptor HI Total				5.4E+00

CNS - Central Nervous System
HI - Hazard Index
NA - Not Applicable

Total Neurological HI Across All Media = **2.0E+00**
Total Thyroid HI Across All Media = **3.3E+00**

TABLE 10.2.RME

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Shallow Aquifer - Tap Water	Aluminum					Neurotoxicity	1.5E+00	NA	9.9E-03	1.5E+00
			Antimony					Blood	9.6E-01	NA	4.3E-02	1.0E+00
			Arsenic					Skin, Vascular	1.7E+00	NA	1.1E-02	1.7E+00
			Beryllium					Gastrointestinal	2.6E-01	NA	2.5E-01	5.1E-01
			Cobalt					Thyroid	1.7E+01	NA	4.4E-02	1.7E+01
			Iron					Gastrointestinal	3.8E+00	NA	2.5E-02	3.8E+00
			Manganese					CNS	8.0E+00	NA	1.3E+00	9.4E+00
			Thallium					Hair	2.9E+00	NA	1.9E-02	2.9E+00
			Vanadium					Hair	1.8E-01	NA	4.5E-02	2.2E-01
			Zinc					Blood	2.4E-01	NA	9.8E-04	2.4E-01
			Chemical Total						3.6E+01	0.0E+00	1.8E+00	3.8E+01
		Exposure Point Total										3.8E+01
	Exposure Medium Total											3.8E+01
Medium Total												3.8E+01
Receptor Total								Receptor HI Total				3.8E+01

Total Neurological HI Across All Media =	**1.1E+01**
Total Blood HI Across All Media =	**1.2E+00**
Total Skin HI Across All Media =	**1.7E+00**
Total Vascular HI Across All Media =	**1.7E+00**
Total Thyroid HI Across All Media =	**1.7E+01**
Total Gastrointestinal HI Across All Media =	**4.3E+00**
Total Hair HI Across All Media =	**3.1E+00**

CNS - Central Nervous System
HI - Hazard Index
NA - Not Applicable
NOE - No Observed Effects

TABLE 10.2.CTE
RISK SUMMARY
CENTRAL TENDENCY EXPOSURE
SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Shallow Aquifer - Tap Water	Aluminum					Neurotoxicity	9.9E-01	NA	2.2E-03	9.9E-01
			Arsenic					Skin, Vascular	1.1E+00	NA	2.5E-03	1.1E+00
			Beryllium					Gastrointestinal	1.7E-01	NA	5.4E-02	2.3E-01
			Cobalt					Thyroid	1.1E+01	NA	9.8E-03	1.1E+01
			Iron					Gastrointestinal	2.5E+00	NA	5.6E-03	2.5E+00
			Manganese					CNS	5.4E+00	NA	3.0E-01	5.7E+00
			Thallium					Hair	1.2E-01	NA	1.0E-02	1.3E-01
			Vanadium					Hair	1E+01	NA	1E-02	1E+01
			Chemical Total						3.2E+01	0.0E+00	3.9E-01	3.3E+01
		Exposure Point Total										3.3E+01
	Exposure Medium Total											3.3E+01
Medium Total												3.3E+01
Receptor Total								Receptor HI Total				3.3E+01

CNS - Central Nervous System
HI - Hazard Index
NA - Not Applicable

Total Neurological HI Across All Media =	**6.7E+00**
Total Skin HI Across All Media =	**1.1E+00**
Total Vascular HI Across All Media =	**1.1E+00**
Total Thyroid HI Across All Media =	**1.1E+01**
Total Gastrointestinal HI Across All Media =	**2.8E+00**
Total Hair HI Across All Media =	**1.1E+01**

TABLE 10.3.RME

RISK SUMMARY

REASONABLE MAXIMUM EXPOSURE

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Shallow Aquifer - Tap Water										
			Arsenic	1.8E-04	NA	1.0E-06	1.8E-04					
			Chromium (total)	2.6E-04	NA	1.3E-04	3.9E-04					
			Chemical Total	4.4E-04	NA	1.3E-04	5.7E-04					
		Exposure Point Total					5.7E-04					
	Exposure Medium Total						5.7E-04					
Medium Total							5.7E-04					
Receptor Total							5.7E-04					

NA - Not Applicable

TABLE 10.3.CTE

RISK SUMMARY

CENTRAL TENDENCY EXPOSURE

SITE 5, ST. JULIENS CREEK ANNEX, CHESAPEAKE, VIRGINIA

Scenario Timeframe: Future
Receptor Population: Resident
Receptor Age: Child/Adult

Medium	Exposure Medium	Exposure Point	Chemical of Potential Concern	Carcinogenic Risk				Non-Carcinogenic Hazard Quotient				
				Ingestion	Inhalation	Dermal	Exposure Routes Total	Primary Target Organ(s)	Ingestion	Inhalation	Dermal	Exposure Routes Total
Groundwater	Groundwater	Shallow Aquifer - Tap Water										
			Arsenic	6.3E-05	NA	1.6E-07	6.3E-05					
			Chromium (total)	1.5E-04	NA	2.7E-05	1.8E-04					
			Chemical Total	2.1E-04	NA	2.7E-05	2.4E-04					
		Exposure Point Total					2.4E-04					
	Exposure Medium Total						2.4E-04					
Medium Total							2.4E-04					
Receptor Total							2.4E-04					

NA - Not Applicable

Attachment C
Field Standard Operating Procedures

STANDARD OPERATING PROCEDURE

Preparing Field Log Books

I. Purpose

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

II. Scope

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

III. Equipment and Materials

- Log book
- Indelible pen

IV. Procedures and Guidelines

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

A. PROCEDURES FOR COMPLETING FIELD LOG BOOKS

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

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

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

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

5. Daily entries will be made chronologically.

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

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

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

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

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

B. INFORMATION TO BE INCLUDED IN FIELD LOG BOOKS

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

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

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

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

5. Tail Gate Safety Meetings: Record time and location of meeting, who was present, topics discussed, issues/problems/concerns identified,

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

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

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

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

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

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

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

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

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

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

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

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

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

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

C. SUGGESTED FORMAT FOR RECORDING FIELD DATA

1. Use the left side border to record times and the remainder of the page to record information (see attached example).

2. Use tables to record sampling information and field data from multiple samples.

3. Sketch sampling locations and other pertinent information.

4. Sketch well construction diagrams.

V. Attachments

Example field notes.

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

JS 5-12-03

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

JS 5-12-03

0843 Collect SAMPLE AT MW-22 for total TAL Metals and VOC'S. No Dissolved Metals Needed PER PM.
0905 JS + BB Mobilize to SITE 17 to show surveyors wells to Survey.
0942 Mobilize to well MW-22 to Collect SAMPLE
0950 CAN not ACCESS WELL MW-22 due to BASE OPERATIONS; CONTACT PAUL PAPERPUSHER AND HE STATED HE will Check on GAINING ACCESS with BASE contact.
0955 Mobilize to well MW-19

JS 5-12-03

Standard Operating Procedure

Locating and Clearing Underground Utilities

I. Purpose

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

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

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

II. Scope

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

Scenario 1

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

Scenario 2

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

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

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

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

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

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

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

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

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

III. Services and Equipment

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

Services

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

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

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

Equipment

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

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

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

IV. Procedures and Guidelines

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

Activity Notification and Dig Permit Procedures

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

Activity Specific: To be provided by Activity or Project Manager

CH2M HILL Utility Clearance Procedures

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

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

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

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

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

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

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

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

IV. Attachments

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

Attachment A – Example SOW for Subcontracting Underground Utilities Locating Services

CTO-XXX

Scope of Work

Subsurface Utility Locating

Site XX

Navy Activity

City, State

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

Proposed Scope of Work

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

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

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

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

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

Field Marking and Documentation

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

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

Bid Sheet/Payment Units

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

Health and Safety Requirements

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

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

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

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

Security

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

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

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

Quality Assurance

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

Subcontractor Standby Time

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

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

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

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

Down Time

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

Schedule

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

Attachment B - Services Available for Identifying and Marking Underground Utilities

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

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

Each are discussed below.

Navy Public Works Department

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

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

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

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

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

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

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

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

Private Subcontractors

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

   The level of service required from the subcontractor will vary depending on the nature of the site. At sites where utility locations are well defined on the maps and recent construction is limited, CH2M HILL may be confident with a limited effort from a traditional utility-locating subcontractor providing a simple EM survey. At

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

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

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

Notes:

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

[1]Equipment types are:

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

[2]Other services include:

A. Data interpretation and/or report preparation to provide a permanent record of the geophysical survey results and a professional interpretation of the findings, including expected accuracy and precision.

B. Non-destructive excavation to field-verify the depths, locations, and types of subsurface utilities.

C. Concrete/asphalt coring and pavement/surface restoration.

Attachment C – Equipment Used for Identifying Underground Utilities

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

CH2M HILL In-house Utility Location Experts

Tamir Klaff/WDC

Home Office Phone – 703-669-9611

Electromagnetic Induction (EMI) Methods

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

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

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

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

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

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

Ground Penetrating Radar (GPR)

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

Magnetic Field Methods

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

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

Optical Methods

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

Attachment D – Utility Clearance Documentation Form

Buried Utility Location Tracking Form

(Submit to CH2M HILL PM within 24 hrs of location activities)

Project Location:
CH2M HILL Project No.:
CH2M HILL Project Manager: Name/Phone:
Fax:
Email:
CH2M HILL Field Team Leader: Name/Phone:

CH2M HILL Purchase Order:

Utility Location Subcontractor:
Subcontractor POC:

Dates of location activities:

Check each box using an "X" if a buried utility is present within 5 feet of a marked Station ID. If color of the flag or paint differs from listed color, note change in color on the form.

Station ID	Gas (Yellow)	Electric (Red)	Fiber optic (Orange)	Cable (Orange)	Water (Blue)	San. Sewer (Green)	Storm Sewer (Green)	Steam (Yellow)	Petroleum (Yellow)	Compressed air (Yellow)	Other ____	Other ____	Other ____	Other ____	Date completed	Technician initials	Notes (methods/tools used)

The findings of the buried utility location activities summarized herein were conducted in strict accordance with the CH2M HILL scope of work.

Subcontractor's Signature

Date

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

PMS 219

PMS 1795*

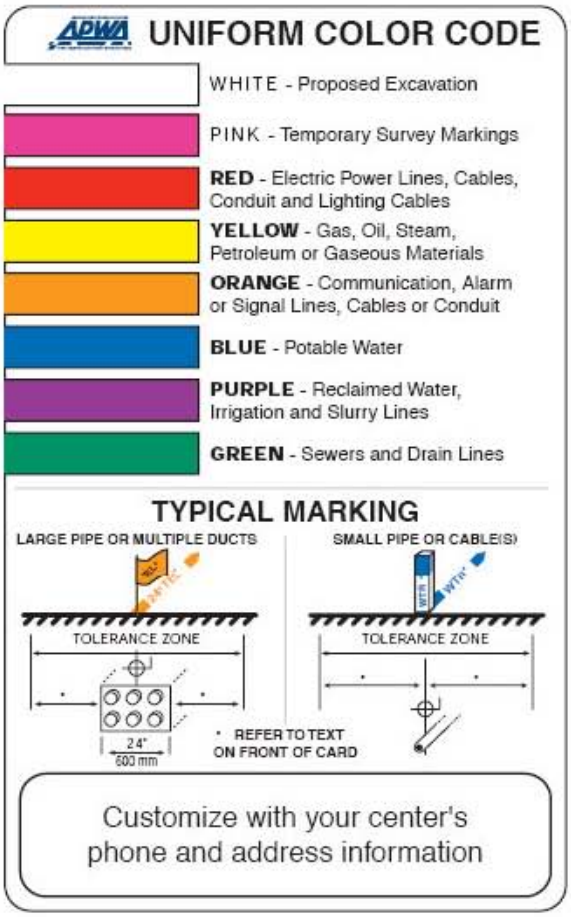
PMS 108

PMS 144*

13.5 parts process
2.5 parts reflex

PMS 253

PMS 3415



GUIDELINES FOR UNIFORM TEMPORARY MARKING OF UNDERGROUND FACILITIES

This marking guide provides for universal use and understanding of the temporary marking of subsurface facilities to prevent accidents and damage or service interruption by contractors, excavators, utility companies, municipalities or any others working on or near underground facilities.

ONE-CALL SYSTEMS
The One-Call damage prevention system shall be contacted prior to excavation.

PROPOSED EXCAVATION
Use white marks to show the location, route or boundary of proposed excavation. Surface marks on roadways do not exceed 1.5" by 18" (40 mm by 450 mm). The facility color and facility owner identity may be added to white flags or stakes.

USE OF TEMPORARY MARKING
Use color-coded surface marks (i.e., paint or chalk) to indicate the location or route of active and out-of-service buried lines. To increase visibility, color coded vertical markers (i.e., stakes or flags) should supplement surface marks. Marks and markers indicate the name, initials or logo of the company that owns or operates the line, and width of the facility if it is greater than 2" (50 mm). Marks placed by other than line owner/operator or its agent indicate the identity of the designating firm. Multiple lines in joint trench are marked in tandem. If the surface over the buried line is to be removed, supplementary offset markings are used. Offset markings are on a uniform alignment and clearly indicate the actual facility is a specific distance away.

TOLERANCE ZONE
Any excavation within the tolerance zone is performed with non-powered hand tools or non-invasive method until the marked facility is exposed. The width of the tolerance zone may be specified in law or code. If not, a tolerance zone including the width of the facility plus 18" (450 mm) measured horizontally from each side of the facility is recommended.

ADOPT UNIFORM COLOR CODE
The American Public Works Association encourages public agencies, utilities, contractors, other associations, manufacturers and all others involved in excavation to adopt the APWA Uniform Color Code, using ANSI standard Z535.1 Safety Colors for temporary marking and facility identification.

Rev. 4/99

STANDARD OPERATING PROCEDURE

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

I. Purpose and Scope

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

II. Equipment and Materials

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

III. Procedures and Guidelines

A. Parameters and Specifications:

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

B. Calibration:

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

Horiba Calibration procedure:

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

YSI Calibration procedure:

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

A. Conductivity Calibration:

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

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

7) Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.

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

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

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

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

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

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

B. Dissolved Oxygen Calibration:

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

1) Go to the calibrate screen as described in Section

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

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

   NOTE: Be sure to completely immerse all the sensors.

8) Use the keypad to enter the known DO concentration of the water.
9) Press **Enter**. The Dissolved Oxygen mg/L Calibration Screen is displayed.
10) Stir the water with a stir bar, or by rapidly moving the probe module, to provide fresh sample to the DO sensor.
11) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
12) Observe the DO mg/L reading, when the reading is stable (shows no significant change for approximately 30 seconds), press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
13) Press **Enter**. This returns you to the DO calibration screen.
14) Press **Escape** to return to the calibrate menu.

15) Rinse the probe module and sensors in tap or purified water and dry.

C. pH Calibration:

1) Go to the calibrate screen.
2) Use the arrow keys to highlight the **pH** selection.
3) Press **Enter**. The pH calibration screen is displayed.
   - Select the **1-point** option only if you are adjusting a previous calibration. If a 2-point or 3-point calibration has been performed previously, you can adjust the calibration by carrying out a one point calibration. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select only one pH buffer.
   - Select the **2-point** option to calibrate the pH sensor using only two calibration standards. Use this option if the media being monitored is known to be either basic or acidic. For example, if the pH of a pond is known to vary between 5.5 and 7, a two-point calibration with pH 7 and pH 4 buffers is sufficient. A three point calibration with an additional pH 10 buffer will not increase the accuracy of this measurement since the pH is not within this higher range.
   - Select the **3-point** option to calibrate the pH sensor using three calibration solutions. In this procedure, the pH sensor is calibrated with a pH 7 buffer and two additional buffers. The 3-point calibration method assures maximum accuracy when the pH of the media to be monitored cannot be anticipated. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select a third pH buffer.
4) Use the arrow keys to highlight the **2-point** selection.
5) Press **Enter**. The pH Entry Screen is displayed.
6) Place the correct amount of pH buffer into a clean, dry or pre-rinsed transport/calibration cup.

   NOTE: For maximum accuracy, the pH buffers you choose should be within the same pH range as the water you are preparing to sample.

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

   NOTE: The sensor must be completely immersed. Using the recommended volumes from Table 6.1 Calibration Volumes, should ensure that the sensor is covered.
9) Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.

   NOTE: Do not over tighten as this could cause damage to the threaded portions.
10) Use the keypad to enter the calibration value of the buffer you are using **at the current temperature**.

    NOTE: pH vs. temperature values are printed on the labels of all YSI pH buffers.
11) Press **Enter**. The pH calibration screen is displayed.

12) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.
13) Observe the reading under pH, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
14) Press **Enter**. This returns you to the Specified pH Calibration Screen.
15) Rinse the probe module, transport/calibration cup and sensors in tap or purified water and dry.
16) Repeat steps 6 through 13 above using a second pH buffer.
17) Press **Enter**. This returns you to the pH Calibration Screen.
18) Press **Escape** to return to the calibrate menu.
19) Rinse the probe module and sensors in tap or purified water and dry.

D. ORP Calibration:

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

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

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

C. Sample Measurement:

Horiba measurement procedure:

As water passes through the flow-through the flow cell, press MEAS to obtain reading;

record data in a field notebook.

YSI measurement procedure:

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

IV. Key Checks and Preventive Maintenance

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

V. References

YSI 556 Multi Probe System Operator Manual

YSI **Environmental**

Pure Data for a Healthy Planet.™

YSI 556 MPS

Multi Probe System

Operations Manual

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1. Safety

1.1 General Safety Information

Read all safety information in this manual carefully before using the YSI 556 Multi-Probe System (MPS). Reagents that are used to calibrate and check this instrument may be hazardous to your health. Take a moment to review *Appendix D Health and Safety*.

⚠ **WARNING**

Warnings are used in this manual when misuse of the instrument could result in death or serious injury to a person.

⚠ **CAUTION**

Cautions are used in this manual when misuse of the instrument could result in mild or serious injury to a person and/or damage to equipment.

⚠ **IMPORTANT SAFETY INSTRUCTIONS!**

⚠ **SAVE THESE INSTRUCTIONS!**

⚠ In essence, the most important safety rule for use of the YSI 556 MPS is to utilize the instrument ONLY for purposes documented in this manual. This is particularly true of the YSI 6117 rechargeable battery pack that contains nickel metal hydride (NiMH) batteries. The user should be certain to read all of the safety precautions outlined below before using the instrument.

⚠ YSI 6117 Rechargeable Battery Pack Safety Information

⚠ **Restrictions on Usage**

1. Never dispose of the battery pack in a fire.
2. Do not attempt to disassemble the YSI 6117 battery pack.
3. Do not tamper with any of the electronic components or the batteries within the battery pack. Tampering with either the electronic circuitry or the batteries will result in the voiding of the warranty and the compromising of the system performance, but, more importantly, can cause safety

hazards which result from overcharging such as overheating, venting of gas, and loss of corrosive electrolyte.

4. Do not charge the battery pack outside the 0–40°C temperature range.
5. Do not use or store the battery at high temperature, such as in strong direct sunlight, in cars during hot weather, or directly in front of heaters.
6. Do not expose the battery pack to water or allow the terminals to become damp.
7. Avoid striking or dropping the battery pack. If the pack appears to have sustained damage from these actions or malfunctions after an impact or drop, the user should not attempt to repair the unit. Instead, contact YSI Customer Service. Refer to *Appendix E Customer Service*.
8. If the battery pack is removed from the YSI 556 MPS, do not store it in pockets or packaging where metallic objects such as keys can short between the positive and negative terminals.

⚠ Precautions for Users with Small Children

Keep the battery pack out of reach of babies and small children.

⚠ Danger Notifications – Misuse creates a STRONG possibility of death or serious injury.

FAILURE TO CAREFULLY OBSERVE THE FOLLOWING PROCEDURES AND PRECAUTIONS CAN RESULT IN LEAKAGE OF BATTERY FLUID, HEAT GENERATION, BURSTING, AND SERIOUS PERSONAL INJURY.

1. Never dispose of the battery pack in a fire or heat it.
2. Never allow the positive and negative terminals of the battery pack to become shorted or connected with electrically conductive materials. When the battery pack has been removed from the YSI 556 MPS, store it in a heavy plastic bag to prevent accidental shorting of the terminals.

3. Never disassemble the battery pack and do not tamper with any of the electronic components or the batteries within the battery pack. The battery pack is equipped with a variety of safety features. Accidental deactivation of any of these safety features can cause a serious hazard to the user.
4. The NiMH batteries in the battery pack contain a strong alkaline solution (electrolyte). The alkaline solution is extremely corrosive and will cause damage to skin or other tissues. If any fluid from the battery pack comes in contact with a user's eyes, immediately flush with clean water and consult a physician immediately. The alkaline solution can damage eyes and lead to permanent loss of eyesight.

⚠ Warning Notifications – Misuse creates a possibility of death or serious injury

1. Do not allow the battery pack to contact freshwater, seawater, or other oxidizing reagents that might cause rust and result in heat generation. If a battery becomes rusted, the gas release vent may no longer operate and this failure can result in bursting.
2. If electrolyte from the battery pack contacts the skin or clothing, thoroughly wash the area immediately with clean water. The battery fluid can irritate the skin.

⚠ Caution Notifications – Misuse creates a possibility of mild or serious injury or damage to the equipment.

1. Do not strike or drop the battery pack. If any impact damage to the battery pack is suspected, contact YSI Customer Service. Refer to *Appendix E Customer Service*.
2. Store the battery pack out of reach of babies and small children.
3. Store the battery pack between the temperatures of -20 and 30°C.
4. Before using the battery pack, be sure to read the operation manual and all precautions carefully. Then store this information carefully to use as a reference when the need arises.

⚠ YSI 616 Cigarette Lighter Charger Safety Information

1. This section contains important safety and operating instructions for the YSI 556 MPS cigarette lighter battery charger (YSI 616; RadioShack Number 270-1533E). BE SURE TO SAVE THESE INSTRUCTIONS.
2. Before using the YSI 616 cigarette lighter charger, read all instructions and cautionary markings on battery charger, battery pack, and YSI 556 MPS.
3. Charge the YSI 6117 battery pack with the YSI 616 cigarette lighter charger ONLY when the YSI 6117 is installed in the YSI 556 MPS.
4. Do not expose charger to rain, moisture, or snow.
5. Use of an attachment not recommended or sold by the battery charger manufacturer may result in a risk of fire, electric shock, or injury to persons.
6. To reduce risk of damage to cigarette lighter and cord, pull by cigarette lighter rather than cord when disconnecting charger.
7. Make sure that the cord is located so that it will not be stepped on, tripped over, or otherwise subjected to damage or stress.
8. Do not operate charger with damaged cord or cigarette lighter connector – replace it immediately.
9. Do not operate charger if it has received a sharp blow, been dropped, or otherwise damaged in any way; contact YSI Customer Service. Refer to *Appendix E Customer Service*.
10. Do not disassemble charger other than to change the fuse as instructed. Replace the part or send it to YSI Product Service if repair is required (refer to *Appendix E Customer Service*). Incorrect reassembly may result in a risk of electric shock or fire.
11. To reduce risk of electric shock, unplug charger before attempting any maintenance or cleaning. Turning off controls will not reduce this risk.

⚠ YSI 556 MPS Water Leakage Safety Information

The YSI 556 MPS has been tested and shown to comply with IP67 criterion, i.e. submersion in 1 meter of water for 30 minutes with no leakage into either the battery compartment or the main case. However, if the instrument is submersed for periods of time in excess of 30 minutes, leakage may occur with subsequent damage to the batteries, the rechargeable battery pack circuitry, and/or the electronics in the main case.

If leakage into the battery compartment is observed when using alkaline C cells, remove batteries, dispose of batteries properly, and dry the battery compartment completely, ideally using compressed air. If corrosion is present on the battery terminals, contact YSI Customer Service for instructions. Refer to *Appendix E Customer Service*.

If leakage into the battery compartment is observed when using the YSI 6117 rechargeable battery pack, remove the battery assembly and set aside to dry. Return the battery pack to YSI Product Service for evaluation of possible damage. Finally dry the battery compartment completely, ideally using compressed air. If corrosion is present on the battery terminals, contact YSI Customer Service for instructions. Refer to *Appendix E Customer Service*.

⚠ **CAUTION:** If water has contacted the rechargeable battery pack, do not attempt to reuse it until it has been evaluated by YSI Product Service (refer to *Appendix E Customer Service*). Failure to follow this precaution can result in serious injury to the user.

If it is suspected that leakage into the main cavity of the case has occurred, remove the batteries immediately and return the instrument to YSI Product Service for damage assessment. Refer to *Appendix E Customer Service*.

⚠ **CAUTION:** Under no circumstances should the user attempt to open the main case.

2. General Information

2.1 Description

The rugged and reliable YSI 556 MPS (Multi-Probe System) combines the versatility of an easy-to-use, easy-to-read handheld unit with all the functionality of a multi-parameter system. Featuring a waterproof, impact-resistant case, the YSI 556 MPS simultaneously measures dissolved oxygen, conductivity, temperature, and optional pH and ORP. A simple cellular phone style keypad and large display make the instrument easy to use. The YSI 556 MPS is compatible with YSI EcoWatch™ for Windows™ software.

The YSI 556 MPS assists the user in conforming to Good Laboratory Practice (GLP) standards which help ensure that quality control/quality assurance methods are followed. Battery life is displayed with a fuel gauge, and the user can choose standard alkaline batteries or an optional rechargeable battery pack.

The 1.5 MB memory can store more than 49,000 data sets. Other options include a flow cell and barometer. The internal barometer can be user-calibrated and displayed along with other data, used in dissolved oxygen calibrations, and logged to memory for tracking changes in barometric pressure.

Features

- Waterproof - meets IP67 specifications
- Field-replaceable DO electrode module; pH and pH/ORP sensors
- Compatible with Ecowatch™ for Windows™ data analysis software
- Assists with Good Laboratory Practice Standards (GLP)
- Choice of DO membrane material for different applications
- Easy-to-use, screw-on cap DO membranes
- User-upgradable software from YSI website
- Three-year warranty on the instrument; one-year on the probe modules
- Available with 4,10, and 20 m cable lengths
- Stores over 49,000 data sets, time and date stamped

- Auto temperature compensating display contrast
- Optional barometer
- Optional rechargeable battery pack or standard alkaline batteries

2.2 Unpacking the Instrument

1. Remove the instrument from the shipping box. Note that the probe module and sensors are shipped in a separate box and will be unpacked later in Section *3.2 Unpacking the Probe Module*.

   NOTE: Do not discard any parts or supplies.

2. Use the packing list to ensure all items are present.

3. Visually inspect all components for damage.

   NOTE: If any parts are missing or damaged, contact your YSI Service Center immediately. Refer to *Appendix E Customer Service* or www.ysi.com.

2.3 Features of the YSI 556 Multi-Probe System

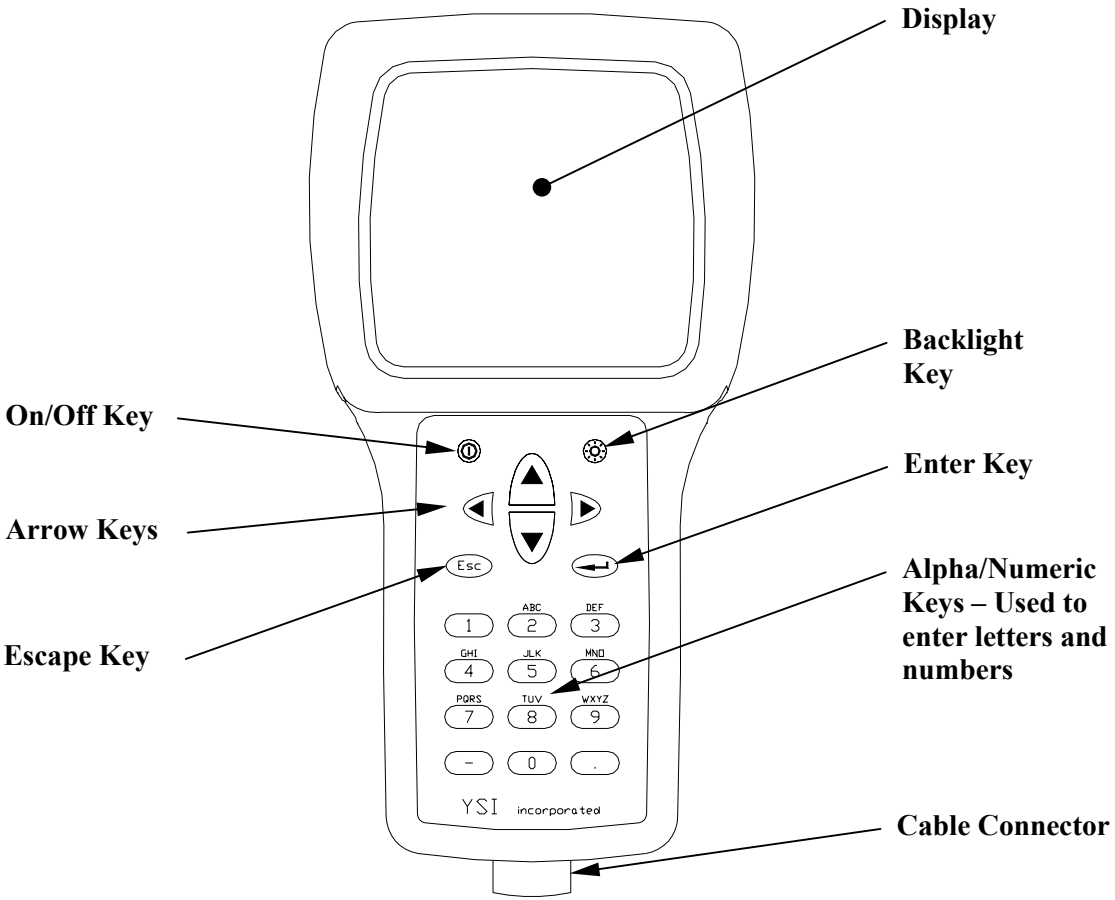


Figure 2.1 Front View of YSI 556 MPS

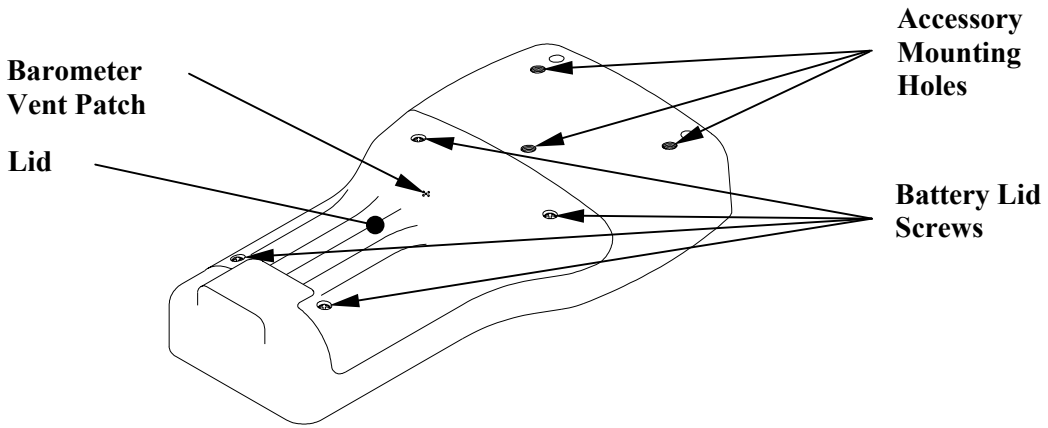


Figure 2.2 Back View of YSI 556 MPS

2.4 Batteries

2.4.1 Battery Life

Standard Alkaline Batteries

With the standard battery configuration of 4 alkaline C cells, the YSI 556 MPS will operate continuously for approximately 180 hours. Assuming a standard usage pattern when sampling of 3 hours of "on time" in a typical day, the alkaline cells will last approximately 60 days.

Optional Rechargeable Battery Pack

When fully charged, the optional rechargeable battery pack will provide approximately 50 hours of battery life.

2.4.2 Inserting 4 C Batteries

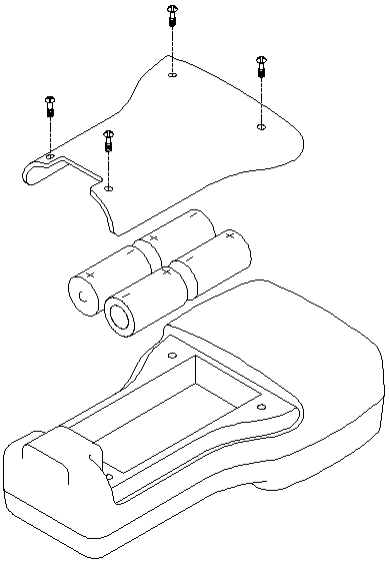


Figure 2.3 Inserting C Cells

⚠ **CAUTION: Install batteries properly to avoid damage to the instrument.**

1. Loosen the four screws in the battery lid on the back of the instrument using any screwdriver.

2. Remove the battery lid.

3. Insert four C batteries between the clips following the polarity (+ and -) labels on the bottom of the battery compartment.

4. Check gasket for proper placement on the battery lid.

5. Replace the battery lid and tighten the 4 screws securely and evenly.

   NOTE: Do not over-tighten the screws.

2.4.3 Inserting Optional Rechargeable Battery Pack

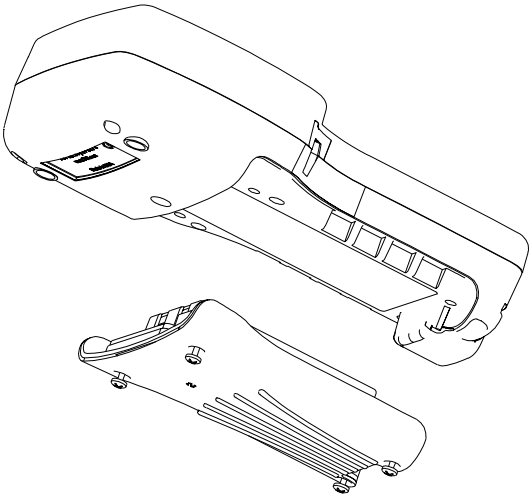


Figure 2.4 Inserting Battery Pack

⚠ **CAUTION: Read all cautions and warnings that come with the battery pack *before* using the battery pack.**

1. Loosen the four screws in the battery lid on the back of the instrument using any screwdriver.

2. Remove the C battery lid and store for future use. Remove C batteries, if installed.

3. Check for proper placement of gasket on the rechargeable battery pack and lid.

4. Install the rechargeable battery pack and lid and tighten the 4 screws securely and evenly.

   NOTE: Do not over tighten the screws.

2.4.4 Charging the Optional Rechargeable Battery Pack

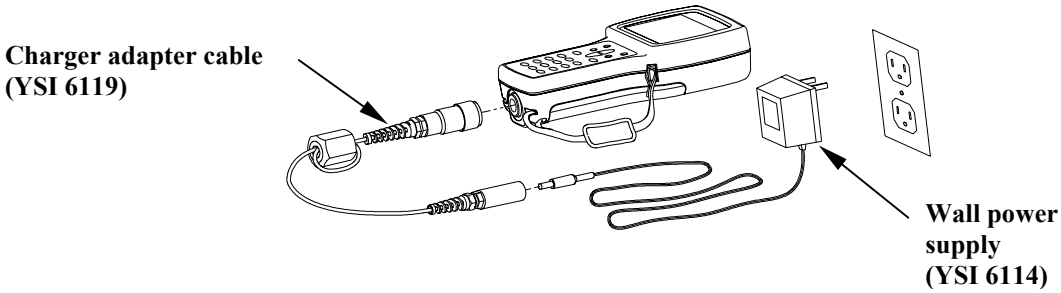


Figure 2.5 Charging the Battery Pack

⚠ **CAUTION: Do not use or store the battery pack at extreme temperatures such as in strong direct sunlight, in cars during hot weather or close to heaters.**

1. Install the rechargeable battery pack into the instrument as described in Section *2.4.3 Inserting Optional Rechargeable Battery Pack*.

2. Attach the charger adapter cable (YSI 6119) to the instrument.

   NOTE: Wall power supplies for use in countries outside the US and Canada can be found in *Appendix B Instrument Accessories*.

3. Insert the barrel connector of the wall power supply into the barrel of the adapter cable.

⚠ **CAUTION: Do not charge the battery pack continuously for more than 48 hours.**

⚠ **CAUTION: Do not drop or expose to water.**

⚠ **CAUTION: Do not charge the battery pack at temperatures below 0°C or above 40°C.**

4. Plug the wall power supply into an AC power outlet for approximately 2 hours to obtain an 80% to 90% charge and for 6 hours to get a full charge.

   NOTE: The battery pack can be recharged whether the instrument is on or off.

2.4.5 Storing the Battery Pack

Remove the battery pack from the instrument when the instrument will not be used for extended periods of time to prevent over discharge of the battery pack.

Store the battery pack in a heavy plastic bag to prevent accidental shorting of the terminals. Store between –20 and 30°C.

2.4.6 Optional Cigarette Lighter Charger

⚠ **CAUTION: Read all warnings and cautions that come with the charger before using the charger.**

⚠ **CAUTION: Only use cigarette lighter charger when *rechargeable* battery pack is inserted into instrument.**

⚠ **CAUTION: Do not mishandle cigarette lighter charger. Do not expose to moisture.**

1. Plug the barrel connector of the cigarette lighter charger into the mating end of the YSI 6119 Charger Adapter Cable.

2. Attach the MS-19 end of the YSI 6119 Charger Adapter Cable to the instrument.

3. Make one of the following modifications to the other end of the charger:

   Slide the adapter ring off the plug to use the device with an American or Japanese vehicle.

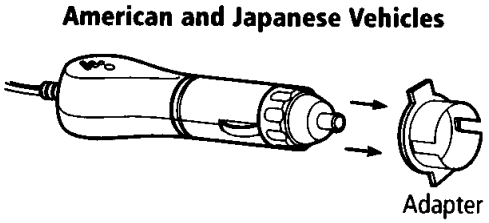


Figure 2.6 Charger Plug Adapter Use

Leave the adapter ring on the plug and position it so that the slots on the adapter ring line up with the plug's spring clips to use the device on a European vehicle.

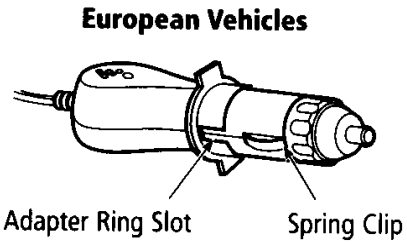


Figure 2.7 European Charger Plug Adapter Use

NOTE: If the charger stops working properly, refer to Section *13 Troubleshooting*.

2.5 Power On

Press and release the on/off button in the upper left corner of the instrument keypad to turn the instrument on or off. See Figure 2.1 Front View of YSI 556 MPS.

2.6 Setting Display Contrast

The display contrast automatically compensates for temperature changes. However, under extreme temperature conditions you may wish to optimize the display by manual adjustment as follows:

1. Press and *hold down* the backlight key in the upper right corner of the keypad and press the “up” arrow to increase (darken) the contrast.

2. Press and *hold down* the backlight key in the upper right corner of the keypad and press the “down” arrow to decrease (lighten) the contrast.

2.7 Backlight

Press and *release* the backlight key in the upper right corner of the keypad to turn the backlight on or off. See Figure 2.1 Front View of YSI 556 MPS.

NOTE: The backlight turns off automatically after two minutes of non-use.

2.8 General Screen Features

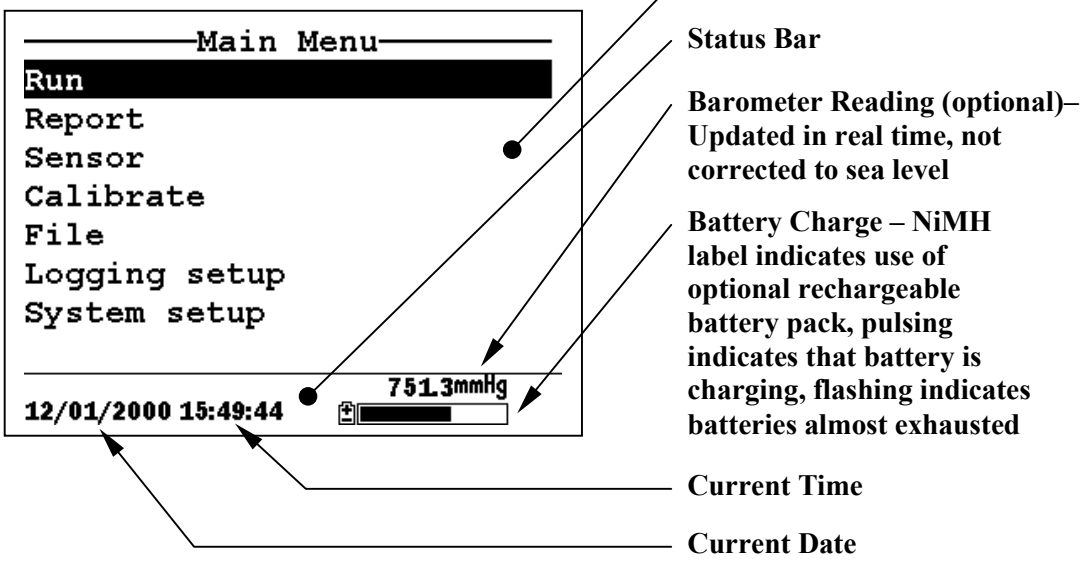


Figure 2.8 Main Menu Screen

2.9 Keypad Use

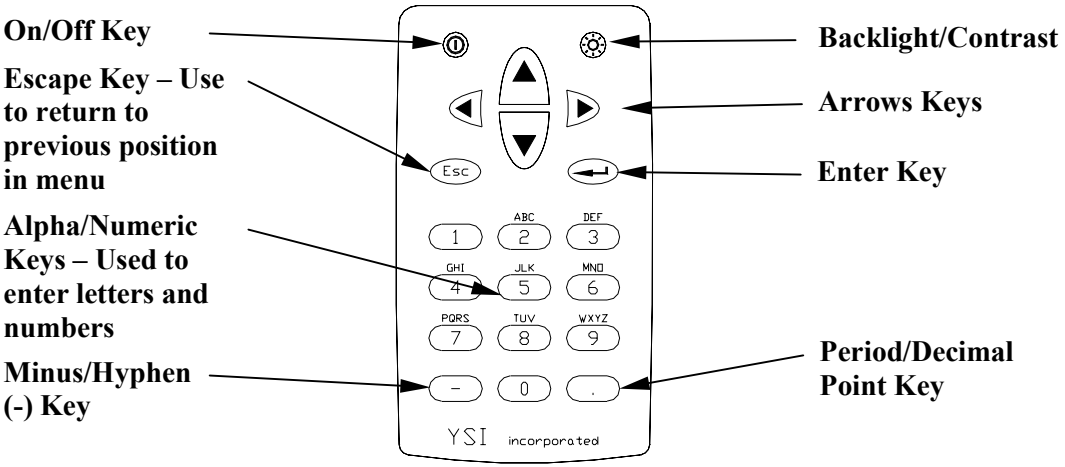


Figure 2.9 Keypad Features

KEY	LETTER/ NUMBER
1	1
2	ABC2abc3
3	DEF3def3
4	GHI4ghi4
5	JKL5jkl5
6	MNO6mno6
7	PQRS7pqrs7
8	TUV8tuv8
9	WXYZ9wxyz9
0	0

Figure 2.10 Keypad Letters & Numbers

1. See Figure 2.10 Keypad Letters & Numbers and press the appropriate key repeatedly until letter or number desired appears in display.

   NOTE: Press the key repeatedly in rapid succession to get to the desired letter or number. If you pause for more than a

second, the cursor automatically scrolls to the right to prepare for the next input.

EXAMPLE 1: Press the **6** key *once* and *release* to display an uppercase “M.”

EXAMPLE 2: Press the **6** key *four times* and *release* to display the number “6.”

EXAMPLE 3: Press the **6** key *five times* and *stop* to display a lowercase “m.”

2. Press the left arrow key to go back and reenter a number or letter that needs to be changed.

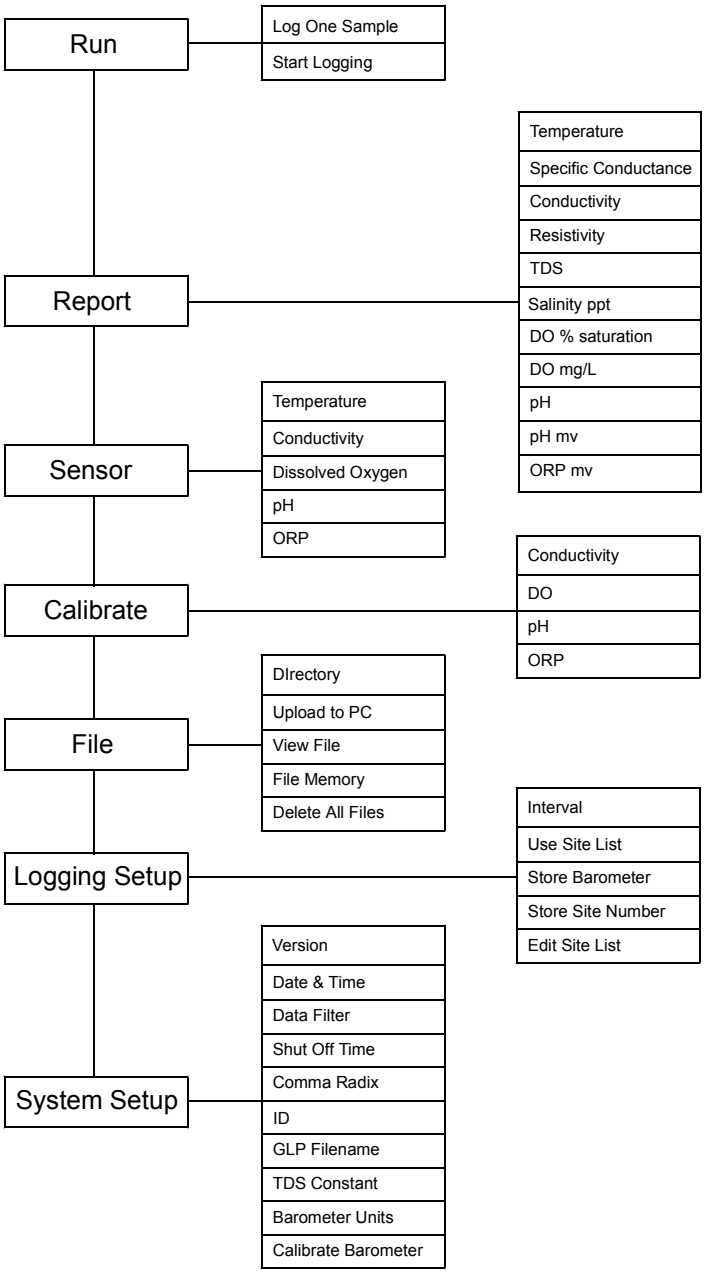
3. Press the **Enter** key when your entry is complete.

   NOTE: The instrument software permits only numeric entries in many instances, such as when setting the clock or entering calibration parameters.

2.10 Instrument Reset

The YSI 556 MPS is characterized by sophisticated software that should provided trouble-free operation. However as with all high-capability software packages, it is always possible that the user will encounter circumstances in which the instrument does not respond to keypad entry. If this occurs, the instrument function can easily be restored by removing and then reapplying battery power. Simply remove either your C-cells or rechargeable battery pack from the battery compartment, wait 30 seconds and then replace the batteries. See Section *2.4 Batteries* for battery removal/reinstallation instructions.

2.11 Menu Flowchart



3. Probe Module

3.1 Introduction

The YSI 5563 Probe module is used for measuring dissolved oxygen, temperature, conductivity, and optional pH and ORP. The probe module is rugged, with the sensors enclosed in a heavy duty probe sensor guard with attached sinking weight. A 4, 10 or 20 meter cable is directly connected to the probe module body making it waterproof. An MS-19 connector at the end of the cable makes the YSI 5563 fully compatible with the YSI 556 Multi-Probe System.

3.2 Unpacking the Probe Module

1. Remove the YSI 5563 Probe module from the shipping boxes.

   NOTE: Do not discard any parts or supplies.

2. Use the packing list to ensure all items are present.

3. Visually inspect all components for damage.

   NOTE: If any parts are missing or damaged, contact your YSI Service Center immediately. Refer to *Appendix E Customer Service* or www.ysi.com.

3.3 Features of the YSI 5563 Probe Module

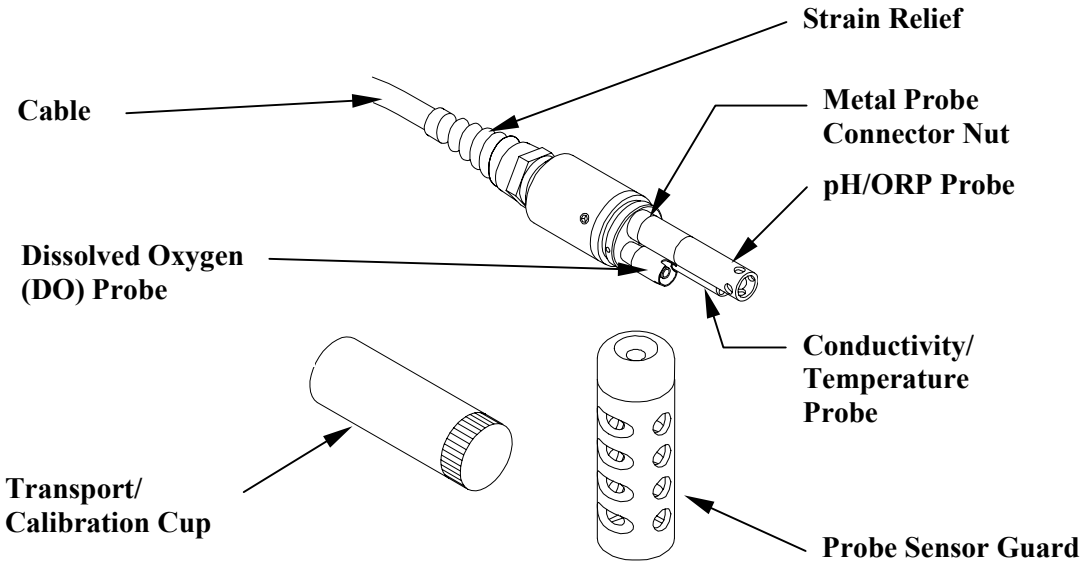


Figure 3.1 Probe Module

3.4 Preparing the Probe Module

To prepare the probe module for calibration and operation, you need to install the sensors into the connectors on the probe module bulkhead. In addition to sensor installation, you need to install a new DO membrane cap.

3.4.1 Sensor Installation

Whenever you install, remove or replace a sensor, it is extremely important that the entire probe module and all sensors be thoroughly dried prior to the removal of a sensor or a sensor port plug. This will prevent water from entering the port. Once you remove a sensor or plug, examine the connector inside the probe module sensor port. If any moisture is present, use compressed air to completely dry the connector. If the connector is corroded, return the probe module to your dealer or directly to YSI Customer Service. Refer to *Appendix E Customer Service*.

Conductivity/Temperature and pH, pH/ORP Sensor Installation

1. Unscrew and remove the probe sensor guard.

2. Using the sensor installation tool supplied in the YSI 5511 maintenance kit, unscrew and remove the sensor port plugs.

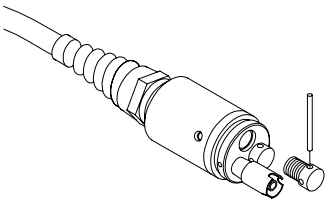


Figure 3.2 Port Plug Removal

3. Locate the port with the connector that corresponds to the sensor that is to be installed.

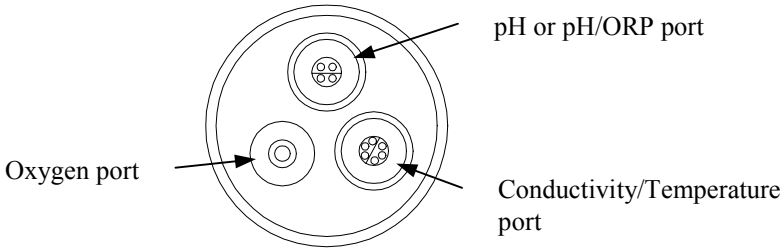


Figure 3.3 Sensor Port Identification

4. Apply a thin coat of o-ring lubricant (supplied in the YSI 5511 maintenance kit) to the o-rings on the connector side of the sensor (see Figure 3.4 O-Ring Lubrication).

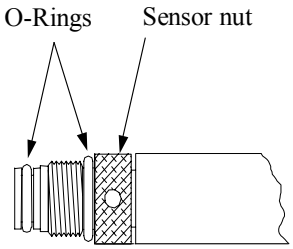


Figure 3.4 O-Ring Lubrication

⚠ **CAUTION:** Make sure that there are NO contaminants between the O-ring and the sensor. Contaminants that are present under the O-ring may cause the O-ring to leak.

5. Be sure the probe module sensor port is free of moisture and then insert the sensor into the correct port. Gently rotate the sensor until the two connectors align.

6. With connectors aligned, screw down the sensor nut using the sensor installation tool.

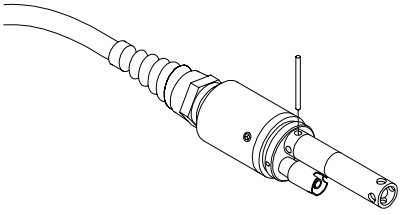


Figure 3.5 Sensor Installation

⚠ **CAUTION:** Do not cross thread the sensor nut. Tighten the nut until it is flush with the face of the probe module bulkhead. Do not over tighten.

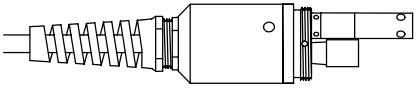


Figure 3.6 Bulkhead Seating

7. Repeat steps 3-6 for any other sensors.

8. Replace the probe sensor guard.

Dissolved Oxygen Sensor Installation

The YSI 5563 comes with the DO sensor already installed. Refer to Section *11.1.2 DO Sensor Replacement* for instructions on installing the YSI 558 Replaceable DO Module Kit.

3.4.2 Membrane Cap Selection

The YSI 5563 is shipped with a YSI 5909 kit that contains membrane caps made with 2 mil polyethylene (PE), a material which should be ideal for most field applications of the 556. However, YSI also offers membrane caps made with two other materials (1 mil polyethylene and 1 mil Teflon) which some users may also prefer. All membranes available for the 556/5563 system provide comparable accuracy if used properly. The difference between the two thicknesses of PE is found in the trade-off of flow dependence and response time as described below. Teflon is offered because some users may prefer to continue using the traditional membrane material used by YSI. To avoid confusion, the membrane caps are color coded as described below and can be ordered in kits as noted:

1 mil Teflon – Black Caps (Kit = YSI 5906)
1 mil Polyethylene (PE) – Yellow Caps (Kit = YSI 5908)
2 mil Polyethylene (PE) – Blue Caps (Kit = YSI 5909)

The 1 mil Teflon caps will offer traditional, reliable performance for most dissolved oxygen applications. The 1 mil PE caps will provide a significantly faster dissolved oxygen response (as long as your 556 Data Filter is set correctly as described below in Sections 10.2 and 10.3.1)) while also giving readings which are significantly less flow dependent than the 1 mil Teflon caps. Finally, 2 mil PE caps will show a large reduction in flow dependence over 1 mil Teflon while not significantly increasing the response time. Generally, one of the PE caps is likely to provide better performance for your application.

IMPORTANT: No matter which type of membrane cap you select, you will also have to confirm your selection in the 556

software from the Sensor menu as described in Section *4 Sensors*.

3.4.3 Membrane Cap Installation

NOTE: The YSI 5563 DO sensor (already installed in the probe module) was shipped dry. A shipping membrane was installed to protect the electrode. **A new membrane cap must be installed before the first use**.

1. Unscrew and remove the probe sensor guard.
2. Unscrew, remove, and discard the old membrane cap.
3. Thoroughly rinse the sensor tip with distilled water.
4. Prepare the electrolyte according to the directions on the electrolyte solution bottle.
5. Hold the new membrane cap and fill it at least 1/2 full with the electrolyte solution.
6. Screw the membrane cap onto the sensor moderately tight. A small amount of electrolyte should overflow.

⚠ **CAUTION:** Do not touch the membrane surface.

7. Screw the probe sensor guard on moderately tight.

3.5 Transport/Calibration Cup

The YSI 5563 Probe module has been supplied with a convenient transport/calibration cup. This cup is an ideal container for calibration of the different sensors, minimizing the amount of solution needed. Refer to Section *6 Calibrate*.

3.5.1 Transport/Calibration Cup Installation

1. Remove probe sensor guard, if already installed.

2. Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body.

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

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

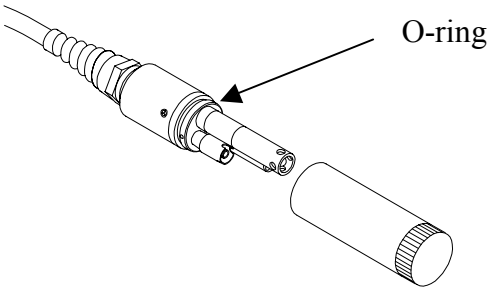


Figure 3.7 Transport/Calibration Cup Installation

3.6 Instrument/Cable Connection

Attach the cable to the instrument as follows:

1. Line up the pins and guides on the cable with the holes and indentations on the cable connector at the bottom of the YSI 556 instrument. See Figure 2.1 Front View of YSI 556 MPS.

2. Holding the cable firmly against the cable connector, turn the locking mechanism clockwise until it snaps into place.

Remove the cable from the instrument by turning the cable connector counterclockwise until the cable disengages from the instrument.

The Sensors Enabled screen allows the user to enable or disable each of the sensors and select which membrane material will be used for the dissolved oxygen sensor. Disabled sensors will not be displayed on the screen in real time or logged to files.

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

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

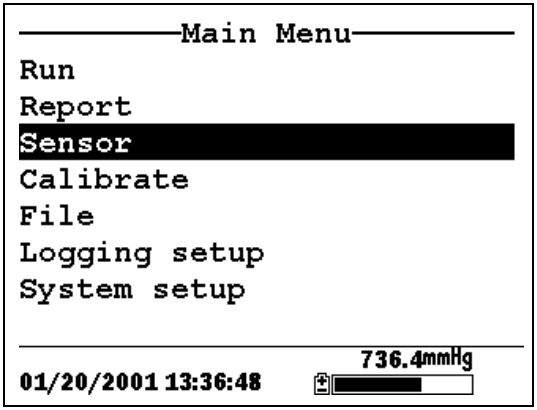


Figure 4.1 Main Menu Screen

3. Use the arrow keys to highlight the **Sensor** selection.

4. Press the **Enter** key to display the sensors enabled screen.

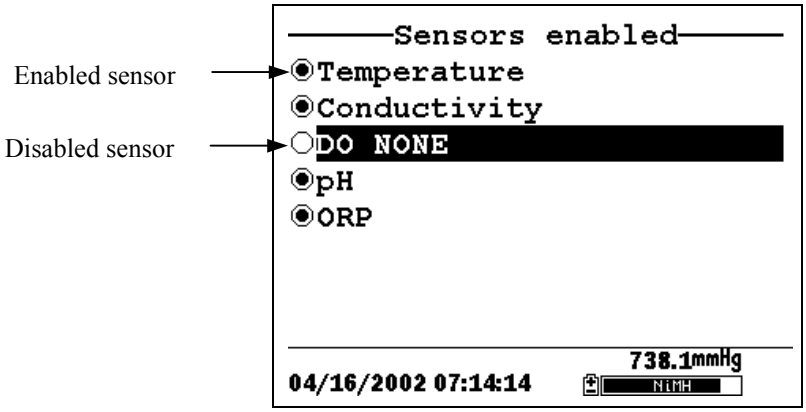


Figure 4.2 Sensors Enabled Screen Before DO Membrane Selection

A black dot to the left of a sensor indicates that sensor is enabled. Sensors with an empty circle are disabled.

Highlight the “DO None” entry as shown above and press **Enter** to display the membrane choice screen. Consult Section *3.4.2 Membrane Cap Selection* for information on the advantages of each type of membrane material. Blue membrane caps using 2 mil polyethylene (PE) were shipped with your YSI 5563 and are likely to be the best choice for most 556 field applications.

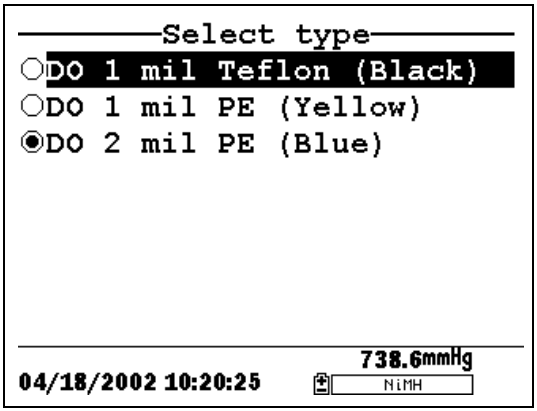


Figure 4.3 Membrane Selection Screen

Highlight the desired membrane choice – in this case, 2 mil PE -- and press Enter to activate your selection with a dot to the left of the screen. Then press **Escape** to return to the Sensor menu that now shows your DO membrane selection.

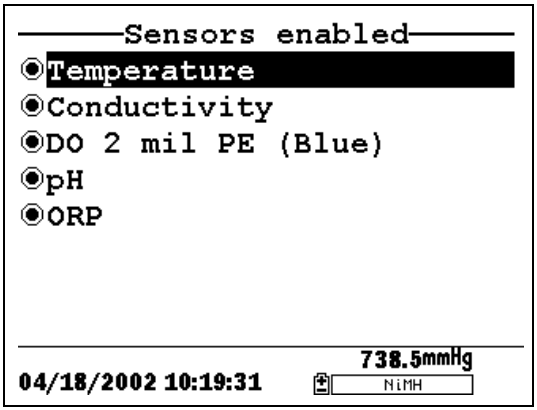


Figure 4.4 Sensors Enabled Screen After DO Membrane Selection

NOTE: The Temperature sensor cannot be disabled. Most other sensors require temperature compensation for accurate readings. In addition, the conductivity sensor must be activated in order to obtain accurate dissolved oxygen mg/L readings.

5. Use the arrow keys to highlight the sensor you want to change, then press the **Enter** key to enable or disable it.

6. Repeat step 5 for each sensor you want to change.

7. Press the **Escape** key to return to the main menu screen.

5. Report

The Report Setup screen allows the user to select which sample parameters and units the YSI 556 MPS will display on the screen. It does NOT determine which parameters are logged to memory. Refer to Section *4 Sensors*.

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

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

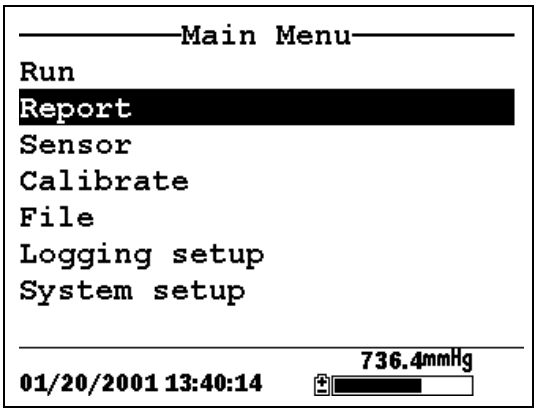


Figure 5.1 Main Menu

3. Use the arrow keys to highlight the **Report** selection.

4. Press the **Enter** key to display the report setup screen.

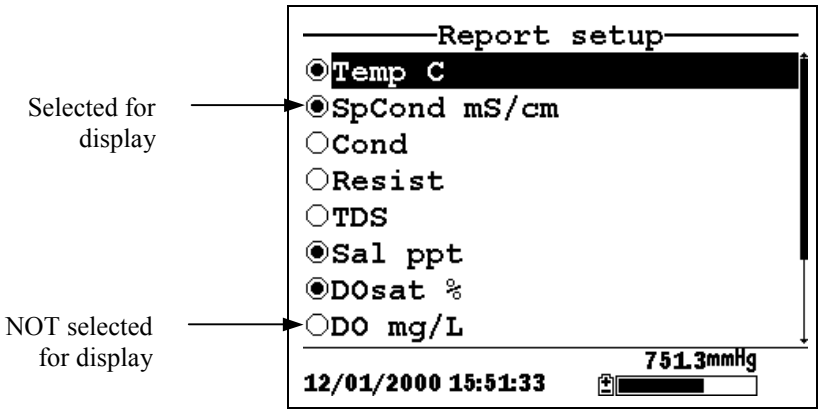


Figure 5.2 Report Setup Screen

NOTE: A black dot to the left of a parameter indicates that parameter is selected for display. Parameters with an empty circle will not be displayed.

NOTE: You may have to scroll down past the bottom of the screen to see all the parameters.

5. Use the arrow keys to highlight the parameter you want to change, then press the **Enter** key. If you can't find the parameter you want, even after scrolling down past the bottom of the screen, the sensor used for that parameter is disabled. Refer to Section *4 Sensors*.

6. If you selected Temperature, Specific Conductivity, Conductivity, Resistance or Total Dissolved Solids, the Units screen will appear.

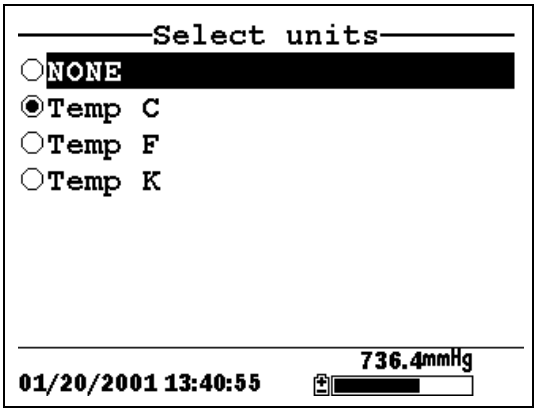


Figure 5.3 Units Screen

7. Use the arrow keys to select the units desired, then press the **Enter** key to return to the report setup screen.

   If you selected Salinity, Dissolved Oxygen %, Dissolved Oxygen mg/L, pH, pH mv or ORP mv, the selection dot will simply toggle on or off.

8. Repeat steps 5 and 6 for each parameter you want to change.

NOTE: All parameters may be enabled at the same time.

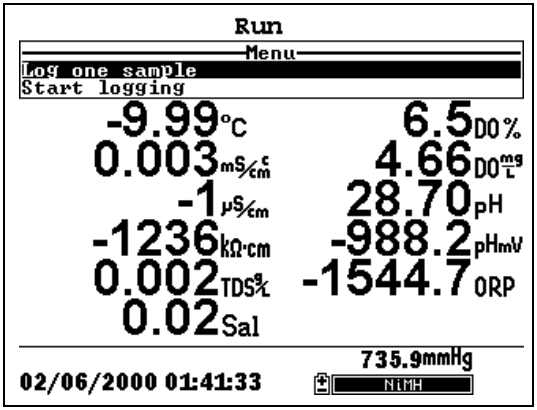


Figure 5.4 All Parameters Displayed

9. Press the **Escape** key to return to the Main menu screen.

6. Calibrate

All of the sensors, except temperature, require periodic calibration to assure high performance. You will find specific calibration procedures for all sensors that require calibration in the following sections. If a sensor listed is not installed in your probe module, skip that section and proceed to the next sensor until the calibration is complete.

⚠ **CAUTION:** Reagents that are used to calibrate and check this instrument may be hazardous to your health. Take a moment to review *Appendix D Health and Safety*. Some calibration standard solutions may require special handling.

6.1 Getting Ready to Calibrate

6.1.1 Containers Needed to Calibrate the Probe Module

The transport/calibration cup that comes with your probe module serves as a calibration chamber for all calibrations and minimizes the volume of calibration reagents required.

Instead of the transport/calibration cup, you may use laboratory glassware to perform calibrations. If you do not use the transport/calibration cup that is designed for the probe module, you are cautioned to do the following:

- ✓ Perform all calibrations with the Probe Sensor Guard installed. This protects the sensors from possible physical damage.
- ✓ Use a ring stand and clamp to secure the probe module body to prevent the module from falling over. Most laboratory glassware has convex bottoms.
- ✓ Ensure that all sensors are immersed in calibration solutions. Many of the calibrations factor in readings from other sensors (e.g., temperature sensor). The top vent hole of the conductivity sensor must also be immersed during some calibrations.

6.1.2 Calibration Tips

1. If you use the Transport/Calibration Cup for dissolved oxygen (DO) calibration, make certain to loosen the seal to allow pressure equilibration before calibration. The DO calibration is a water-saturated air calibration.
2. The key to successful calibration is to ensure that the sensors are completely submersed when calibration values are entered. Use recommended volumes when performing calibrations.
3. For maximum accuracy, use a small amount of previously used calibration solution to pre-rinse the probe module. You may wish to save old calibration standards for this purpose.
4. Fill a bucket with ambient temperature water to rinse the probe module between calibration solutions.
5. Have several clean, absorbent paper towels or cotton cloths available to dry the probe module between rinses and calibration solutions. Shake the excess rinse water off of the probe module, especially when the probe sensor guard is installed. Dry off the outside of the probe module and probe sensor guard. Making sure that the probe module is dry reduces carry-over contamination of calibrator solutions and increases the accuracy of the calibration.
6. If you are using laboratory glassware for calibration, you do not need to remove the probe sensor guard to rinse and dry the sensors between calibration solutions. The inaccuracy resulting from simply rinsing the sensor compartment and drying the outside of the guard is minimal.
7. If you are using laboratory glassware, remove the stainless steel weight from the bottom of the probe sensor guard by turning the weight counterclockwise. When the weight is removed, the calibration solutions have access to the sensors without displacing a lot of fluid. This also reduces the amount of liquid that is carried between calibrations.
8. Make certain that port plugs are installed in all ports where sensors are not installed. It is extremely important to keep these electrical connectors dry.

6.1.3 Recommended Volumes

Follow these instructions to use the transport/calibration cup for calibration procedures.

- ✓ Ensure that an o-ring is installed in the o-ring groove of the transport/calibration cup bottom cap, and that the bottom cap is securely tightened.

  NOTE: Do not over-tighten as this could cause damage to the threaded portions.
- ✓ Remove the probe sensor guard, if it is installed.
- ✓ Remove the o-ring, if installed, from the probe module and inspect the installed o-ring on the probe module for obvious defects and, if necessary, replace it with the extra o-ring supplied.
- ✓ Some calibrations can be accomplished with the probe module upright or upside down. A separate clamp and stand, such as a ring stand, is required to support the probe module in the inverted position.
- ✓ To calibrate, follow the procedures in the next section, Calibration Procedures. The approximate volumes of the reagents are specified below for both the upright and upside down orientations.
- ✓ When using the Transport/Calibration Cup for dissolved oxygen % saturation calibration, make certain that the vessel is vented to the atmosphere by loosening the bottom cap or cup assembly and that approximately 1/8” of water is present in the cup.

Sensor to Calibrate	Upright	Upside Down
Conductivity	55ml	55ml
pH/ORP	30ml	60ml

Table 6.1 Calibration Volumes

6.2 Calibration Procedures

6.2.1 Accessing the Calibrate Screen

1. Press the **On/off** key to display the run screen.
2. Press the **Escape** key to display the main menu screen.
3. Use the arrow keys to highlight the **Calibrate** selection.

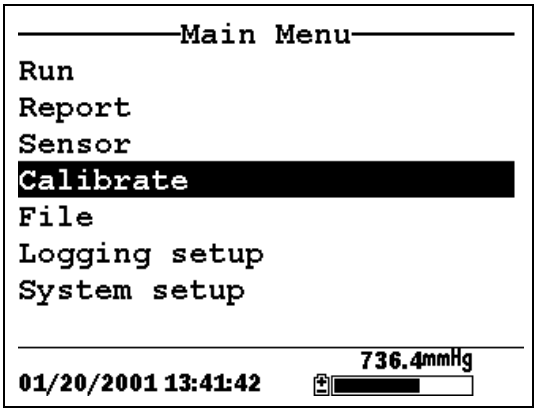


Figure 6.1 Main Menu

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

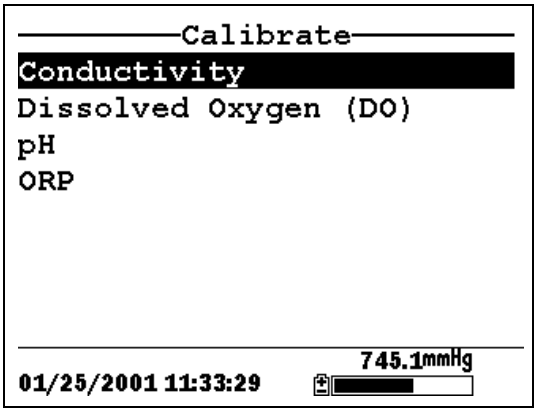


Figure 6.2 Calibrate Screen

6.2.2 Conductivity Calibration

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

1. Go to the calibrate screen as described in Section 6.2.1 Accessing the Calibrate Screen.

2. Use the arrow keys to highlight the **Conductivity** selection. See Figure 6.2 Calibrate Screen.

3. Press **Enter.** The Conductivity Calibration Selection Screen is displayed.

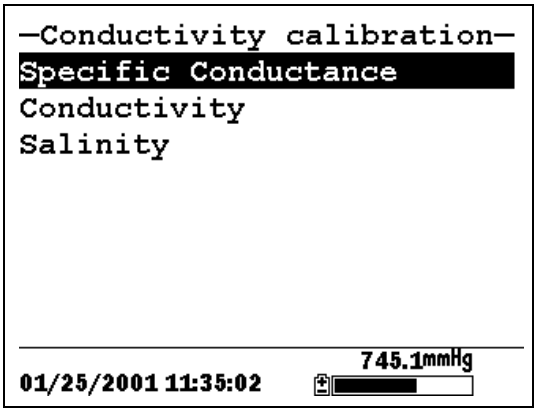


Figure 6.3 Conductivity Calibration Selection Screen

4. Use the arrow keys to highlight the Specific Conductance selection.

5. Press **Enter.** The Conductivity Calibration Entry Screen is displayed.

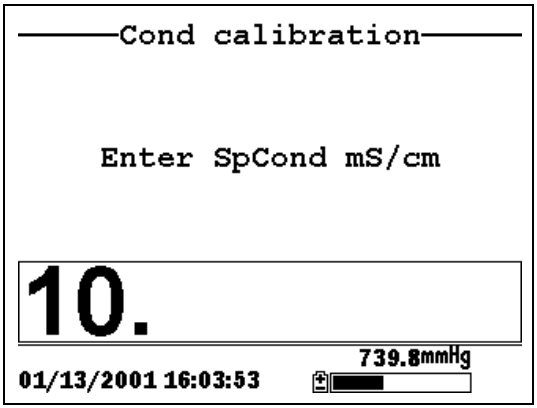


Figure 6.4 Conductivity Calibration Entry Screen

6. Place the correct amount of conductivity standard (see Table 6.1 Calibration Volumes) into a clean, dry or pre-rinsed transport/calibration cup.

⚠ **WARNING**: Calibration reagents may be hazardous to your health. See *Appendix D Health and Safety* for more information.

NOTE: For maximum accuracy, the conductivity standard you choose should be within the same conductivity range as the samples you are preparing to measure. However, we do not recommend using standards less than 1 mS/cm. For example:

- ✓ For fresh water use a 1 mS/cm conductivity standard.
- ✓ For brackish water use a 10 mS/cm conductivity standard.
- ✓ For seawater use a 50 mS/cm conductivity standard.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the conductivity sensor with a small amount of standard that can be discarded. Be certain that you avoid cross-contamination of solutions. Make certain that there are no salt deposits around the oxygen and pH/ORP sensors, particularly if you are employing standards of low conductivity.

7. Carefully immerse the sensor end of the probe module into the solution.

8. Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.

   NOTE: The sensor must be completely immersed past its vent hole. Using the recommended volumes from Table 6.1 Calibration Volumes, should ensure that the vent hole is covered.

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

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

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

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

11. Press **Enter**. The Conductivity Calibration Screen is displayed.

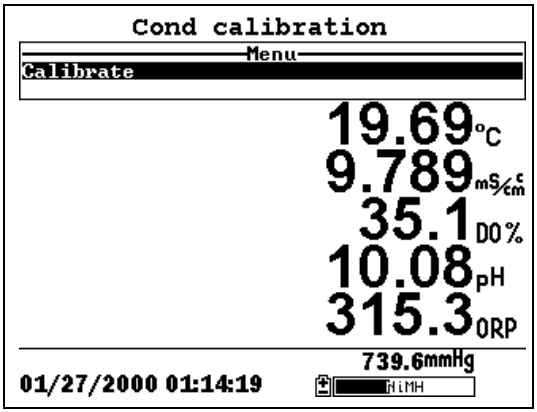


Figure 6.5 Conductivity Calibration Screen

12. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors

will appear on the screen and will change with time as they stabilize.

13. Observe the reading under Specific Conductance. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

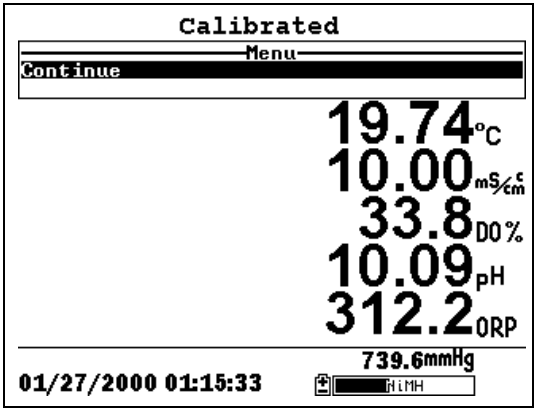


Figure 6.6 Calibrated

14. Press **Enter**. This returns you to the Conductivity Calibrate Selection Screen, See Figure 6.3 Conductivity Calibration Selection Screen.

15. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

16. Rinse the probe module and sensors in tap or purified water and dry.

6.2.3 Dissolved Oxygen Calibration

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

1. Go to the calibrate screen as described in Section *6.2.1 Accessing the Calibrate Screen*.

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

2. Use the arrow keys to highlight the **Dissolved Oxygen** selection. See Figure 6.2 Calibrate Screen.
3. Press **Enter**. The dissolved oxygen calibration screen is displayed.

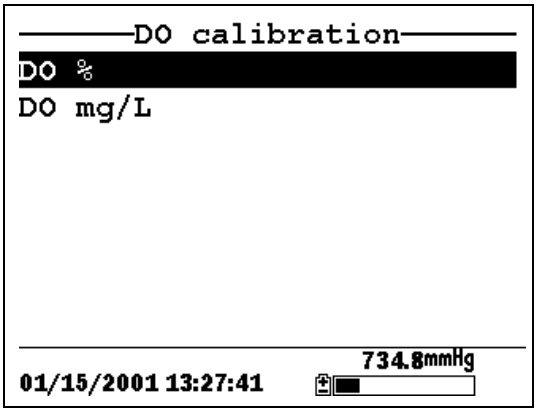


Figure 6.7 DO Calibration Screen

DO Calibration in % Saturation

1. Use the arrow keys to highlight the DO% selection.
2. Press **Enter**. The DO Barometric Pressure Entry Screen is displayed.

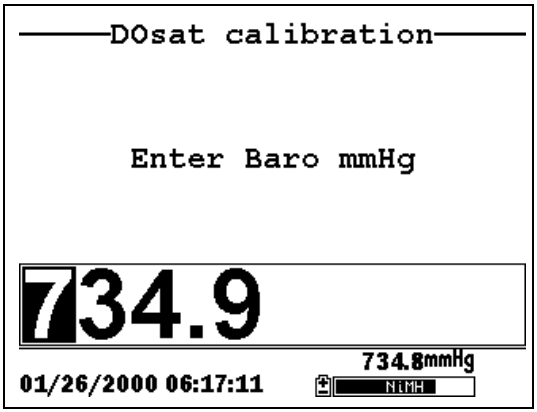


Figure 6.8 DO Barometric Pressure Entry Screen

3. Place approximately 3 mm (1/8 inch) of water in the bottom of the transport/calibration cup.

4. Place the probe module into the transport/calibration cup.

   NOTE: Make sure that the DO and temperature sensors are **not** immersed in the water.

5. Engage only 1 or 2 threads of the transport/calibration cup to ensure the DO sensor is vented to the atmosphere.

6. Use the keypad to enter the current local barometric pressure.

   NOTE: If the unit has the optional barometer, no entry is required.

   NOTE: Barometer readings that appear in meteorological reports are generally corrected to sea level and must be uncorrected before use (refer to Section *10.10 Calibrate Barometer, Step 2*).

7. Press **Enter**. The DO% saturation calibration screen is displayed.

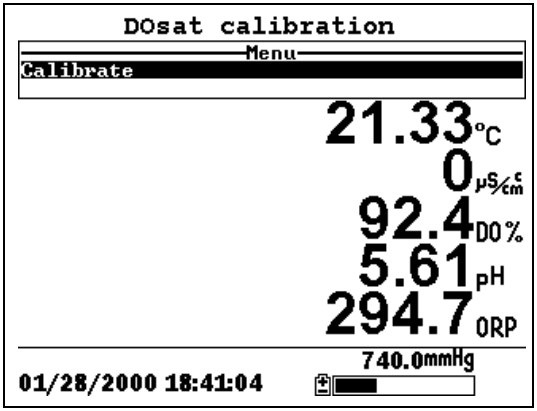


Figure 6.9 DO Sat Calibration Screen

8. Allow approximately ten minutes for the air in the transport/calibration cup to become water saturated and for

the temperature to equilibrate before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

9. Observe the reading under DO %. When the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue. See Figure 6.6 Calibrated.

10. Press **Enter**. This returns you to the DO calibration screen, See Figure 6.7 DO Calibration Screen.

11. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

12. Rinse the probe module and sensors in tap or purified water and dry.

DO Calibration in mg/L

DO calibration in mg/L is carried out in a water sample which has a known concentration of dissolved oxygen (usually determined by a Winkler titration).

1. Go to the DO calibrate screen as described in Section *6.2.3 Dissolved Oxygen Calibration*, steps 1 through 3.

2. Use the arrow keys to highlight the **DO mg/L** selection.

3. Press **Enter**. The DO mg/L Entry Screen is displayed.

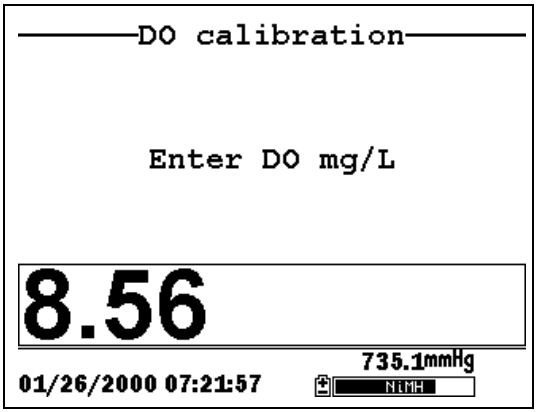


Figure 6.10 DO mg/L Entry Screen

4. Place the probe module in water with a known DO concentration.

   NOTE: Be sure to completely immerse all the sensors.

5. Use the keypad to enter the known DO concentration of the water.

6. Press **Enter**. The Dissolved Oxygen mg/L Calibration Screen is displayed.

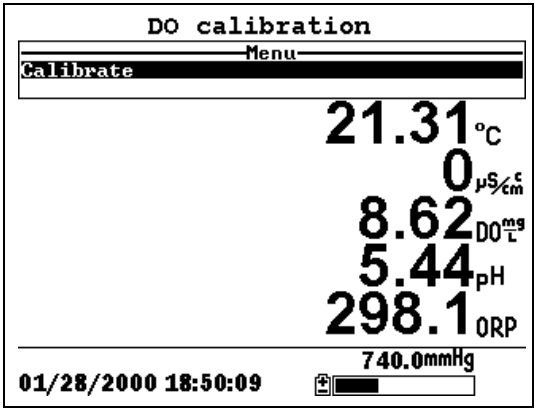


Figure 6.11 DO mg/L Calibration Screen

7. Stir the water with a stir bar, or by rapidly moving the probe module, to provide fresh sample to the DO sensor.

8. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

9. Observe the DO mg/L reading, when the reading is stable (shows no significant change for approximately 30 seconds), press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

10. Press **Enter**. This returns you to the DO calibration screen. See Figure 6.7 DO Calibration Screen.

11. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

12. Rinse the probe module and sensors in tap or purified water and dry.

6.2.4 pH Calibration

1. Go to the calibrate screen as described in *Section 6.2.1 Accessing the Calibrate Screen*.

2. Use the arrow keys to highlight the **pH** selection. See Figure 6.2 Calibrate Screen.

3. Press **Enter**. The pH calibration screen is displayed.

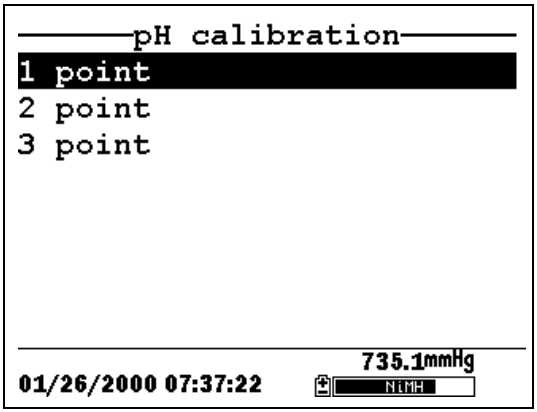


Figure 6.12 pH Calibration Screen

- Select the **1-point** option only if you are adjusting a previous calibration. If a 2-point or 3-point calibration has been performed previously, you can adjust the calibration by carrying out a one point calibration. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select only one pH buffer.
- Select the **2-point** option to calibrate the pH sensor using only two calibration standards. Use this option if the media being monitored is known to be either basic or acidic. For example, if the pH of a pond is known to vary between 5.5 and 7, a two-point calibration with pH 7 and pH 4 buffers is sufficient. A three point calibration with an additional pH 10 buffer will not increase the accuracy of this measurement since the pH is not within this higher range.
- Select the **3-point** option to calibrate the pH sensor using three calibration solutions. In this procedure, the pH sensor is calibrated with a pH 7 buffer and two additional buffers. The 3-point calibration method assures maximum accuracy when the pH of the media to be monitored cannot be anticipated. The procedure for this calibration is the same as for a 2-point calibration, but the software will prompt you to select a third pH buffer.

4. Use the arrow keys to highlight the **2-point** selection.

5. Press **Enter**. The pH Entry Screen is displayed.

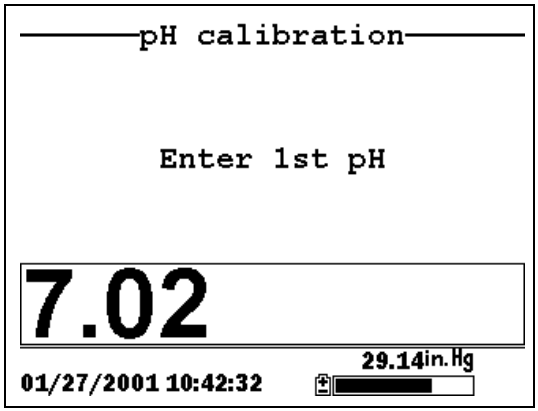


Figure 6.13 pH Entry Screen

6. Place the correct amount (see Table 6.1 Calibration Volumes) of pH buffer into a clean, dry or pre-rinsed transport/calibration cup.

⚠ **WARNING**: Calibration reagents may be hazardous to your health. See *Appendix D Health and Safety* for more information.

NOTE: For maximum accuracy, the pH buffers you choose should be within the same pH range as the water you are preparing to sample.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the pH sensor with a small amount of buffer that can be discarded. Be certain that you avoid cross-contamination of buffers with other solutions.

7. Carefully immerse the sensor end of the probe module into the solution.

8. Gently rotate and/or move the probe module up and down to remove any bubbles from the pH sensor.

NOTE: The sensor must be completely immersed. Using the recommended volumes from Table 6.1 Calibration Volumes, should ensure that the sensor is covered.

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

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

10. Use the keypad to enter the calibration value of the buffer you are using **at the current temperature**.

    NOTE: pH vs. temperature values are printed on the labels of all YSI pH buffers.

11. Press **Enter**. The pH calibration screen is displayed.

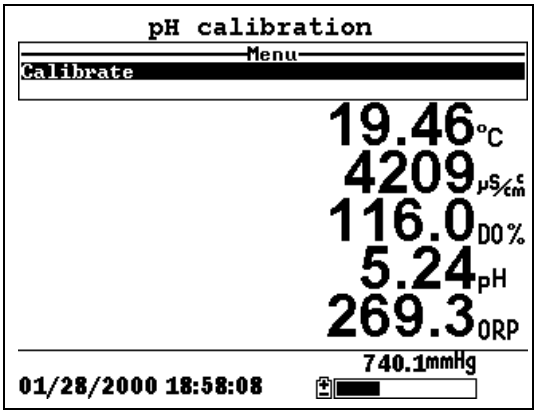


Figure 6.14 pH Calibration Screen

12. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

13. Observe the reading under pH, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

14. Press **Enter**. This returns you to the Specified pH Calibration Screen, See Figure 6.13 pH Entry Screen.

15. Rinse the probe module, transport/calibration cup and sensors in tap or purified water and dry.

16. Repeat steps 6 through 13 above using a second pH buffer.

17. Press **Enter**. This returns you to the pH Calibration Screen, See Figure 6.12 pH Calibration Screen.

18. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

19. Rinse the probe module and sensors in tap or purified water and dry.

6.2.5 ORP Calibration

1. Go to the calibrate screen as described in Section *6.2.1 Accessing the Calibrate Screen*.

2. Use the arrow keys to highlight the **ORP** selection. See Figure 6.2 Calibrate Screen.

3. Press **Enter**. The ORP calibration screen is displayed.

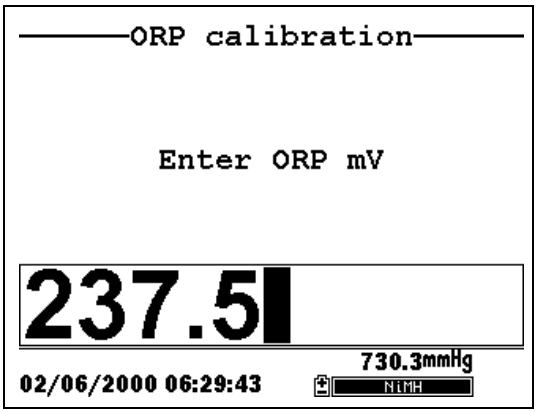


Figure 6.15 Specified ORP Calibration Screen

4. Place the correct amount (see Table 6.1 Calibration Volumes) of a known ORP solution (we recommend Zobell solution) into a clean, dry or pre-rinsed transport/calibration cup.

⚠ **WARNING**: Calibration reagents may be hazardous to your health. See *Appendix D Health and Safety* for more information.

NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the ORP sensor with a small amount of solution that can be discarded. Be certain that you avoid cross-contamination with other solutions.

5. Carefully immerse the sensor end of the probe module into the solution.

6. Gently rotate and/or move the probe module up and down to remove any bubbles from the ORP sensor.

   NOTE: The sensor must be completely immersed. Using the recommended volumes from Table 6.1 Calibration Volumes should ensure that the sensor is covered.

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

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

8. Use the keypad to enter the correct value of the calibration solution you are using at the current temperature. Refer to Table 6.2 Zobel Solution Values.

Temperature °C	Zobell Solution Value, mV
-5	270.0
0	263.5
5	257.0
10	250.5
15	244.0
20	237.5
25	231.0
30	224.5
35	218.0
40	211.5
45	205.0
50	198.5

Table 6.2 Zobel Solution Values

9. Press **Enter**. The ORP calibration screen is displayed.

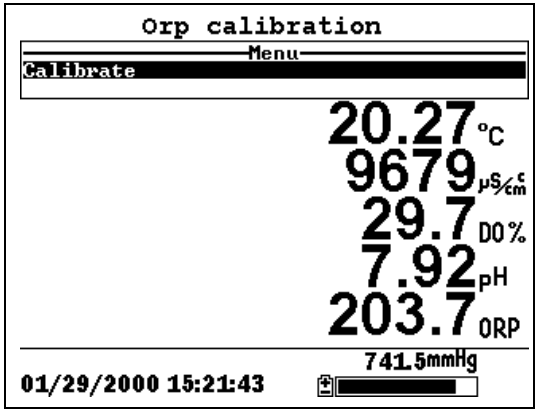


Figure 6.16 ORP Calibration Screen

10. Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

NOTE: Verify that the temperature reading matches the value you used in Table 6.2 Zobel Solution Values.

11. Observe the reading under ORP, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

12. Press **Enter**. This returns you to the Calibrate Screen. See Figure 6.2 Calibrate Screen.

13. Rinse the probe module and sensors in tap or purified water and dry.

6.3 Return to Factory Settings

1. Go to the calibrate screen as described in Section *6.2.1 Accessing the Calibrate Screen*.

2. Use the arrow keys to highlight the **Conductivity** selection. See Figure 6.2 Calibrate Screen.

   NOTE: We will use the Conductivity sensor as an example; however, this process will work for any sensor.

3. Press **Enter.** The Conductivity Calibration Selection Screen is displayed. See Figure 6.3 Conductivity Calibration Selection Screen.

4. Use the arrow keys to highlight the **Specific Conductance** selection.

5. Press **Enter.** The Conductivity Calibration Entry Screen is displayed. See Figure 6.4 Conductivity Calibration Entry Screen.

6. Press and hold the **Enter** key down and press the **Escape** key.

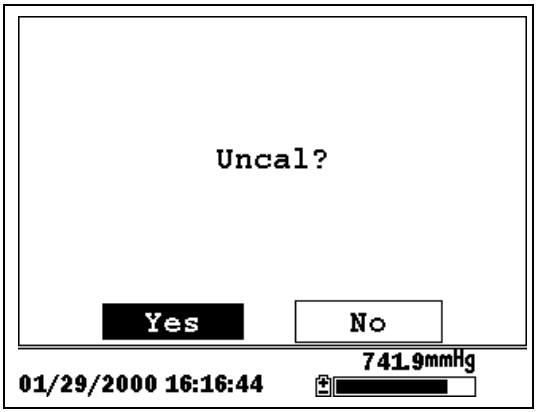


Figure 6.17 ORP Calibration Screen

7. Use the arrow keys to highlight the **YES** selection.

CAUTION: This returns a sensor to the factory settings. For example, in selecting to return specific conductance to the factory setting, salinity and conductivity will automatically return to their factory settings.

8. Press **Enter**. This returns you to the Conductivity Calibrate Selection Screen, See Figure 6.3 Conductivity Calibration Selection Screen.

9. Press **Escape** to return to the calibrate menu. See Figure 6.2 Calibrate Screen.

7. Run

The Run screen displays data from the sensors in real-time and allows the user to log sample data to memory for later analysis. Refer to Section *9 Logging* for details on logging sample data.

7.1 Real-Time Data

NOTE: Before measuring samples you must prepare the probe module (refer to Section *3.4 Preparing the Probe Module*), attach the probe module to the instrument (refer to Section *3.6 Instrument/Cable Connection*) and calibrate the sensors (refer to Section *6 Calibrate*).

1. Press the **On/off** key.

OR select Run from the main menu to display the run screen.

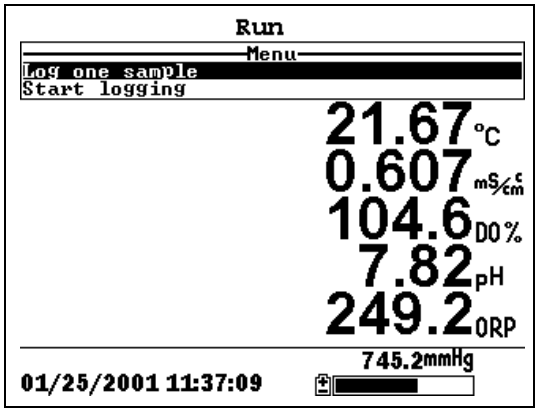


Figure 7.1 Run Screen

2. Make sure the probe sensor guard is installed.

3. Place the probe module in the sample. Be sure to completely immerse all the sensors.

4. Rapidly move the probe module through the sample to provide fresh sample to the DO sensor.

5. Watch the readings on the display until they are stable.

6. Refer to Section *9 Logging* for instructions on logging sample data.

8. File

The File menu allows the user to view, upload or delete sample data and calibration record files stored in the YSI 556 MPS.

8.1 Accessing the File Screen

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

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

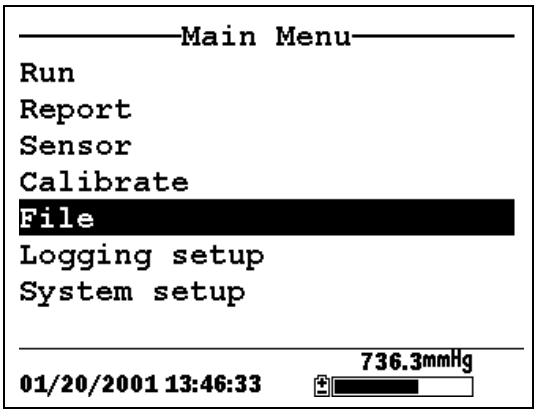


Figure 8.1 Main Menu Screen

3. Use the arrow keys to highlight the **File** selection.

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

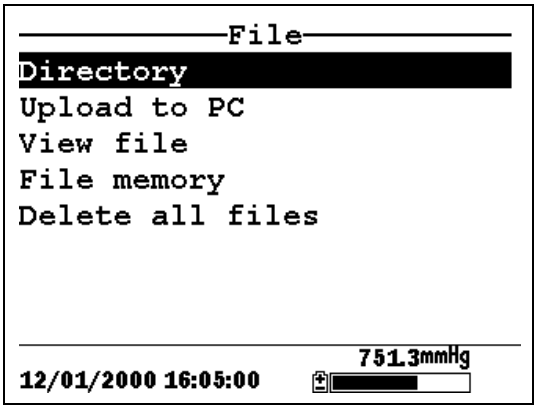


Figure 8.2 File Screen

8.2 Directory

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*.

2. Use the arrow keys to highlight the **Directory** selection. See Figure 8.2 File Screen.

3. Press the **Enter** key. The file list screen is displayed.

   NOTE: Files are listed in the order in which they are logged to memory. Sample Data files have the file extension **.dat**, while Calibration Record files have the file extension **.glp**.

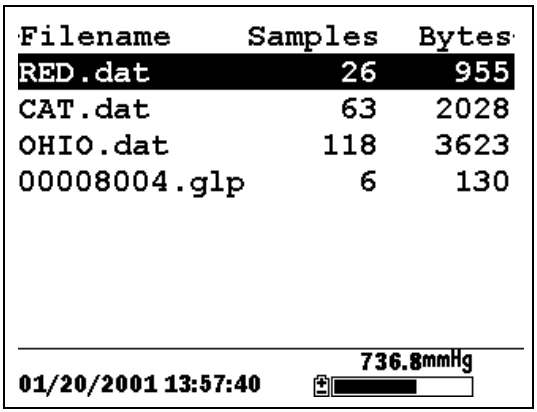


Figure 8.3 File List Screen

4. Use the arrow keys to highlight a file.

5. Press the **Enter** key. The file details screen is displayed.

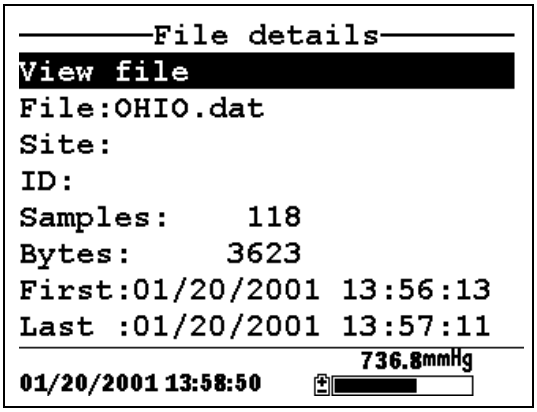


Figure 8.4 File Details Screen

6. Press the **Enter** key to view the file data. Refer to Section *8.3 View File* for details.

7. Press the **Escape** key repeatedly to return to the main menu screen.

8.3 View File

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*. See Figure 8.2 File Screen.

2. Use the arrow keys to highlight the **View file** selection.

3. Press the **Enter** key. A list of files is displayed. See Figure 8.3 File List Screen.

4. Use the arrow keys to highlight an individual file.

   NOTE: You may have to scroll down to see all the files.

5. Press the **Enter** key. The file data is displayed with the file name at the top of the display.

   NOTE: If no file name was specified, the data is stored under the default name NONAME1.dat.

OHIO.dat

Date m/d/y	Time hh:mm:ss	Temp C
01/20/2001	13:56:13	22.54
01/20/2001	13:56:13	22.54
01/20/2001	13:56:14	22.54
01/20/2001	13:56:14	22.54
01/20/2001	13:56:15	22.54
01/20/2001	13:56:15	22.54
01/20/2001	13:56:16	22.54
01/20/2001	13:56:16	22.54
01/20/2001	13:56:17	22.54

736.7mmHg

01/20/2001 13:59:34

Figure 8.5 File Data Screen

6. Use the arrow keys to scroll horizontally and/or vertically to view all the data.

7. Press the **Escape** key repeatedly to return to the main menu screen.

8.4 Upload to PC

EcoWatch™ for Windows™ must be used as the PC software interface to the YSI 556 MPS. Refer to *Appendix G EcoWatch* for more information. EcoWatch for Windows is available at no cost via a download from the YSI Web Site (www.ysi.com) or by contacting YSI Customer Support. Refer to *Appendix E Customer Service.*

8.4.1 Upload Setup

1. Disconnect the YSI 5563 Probe Module from the YSI 556 MPS instrument.

2. Connect the YSI 556 MPS to a serial (Comm) port of your computer via the 655173 PC Interface cable as shown in the following diagram:

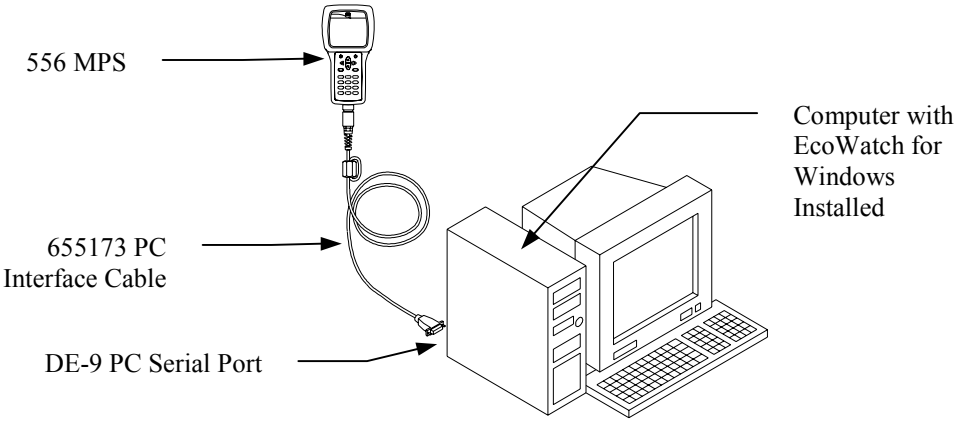


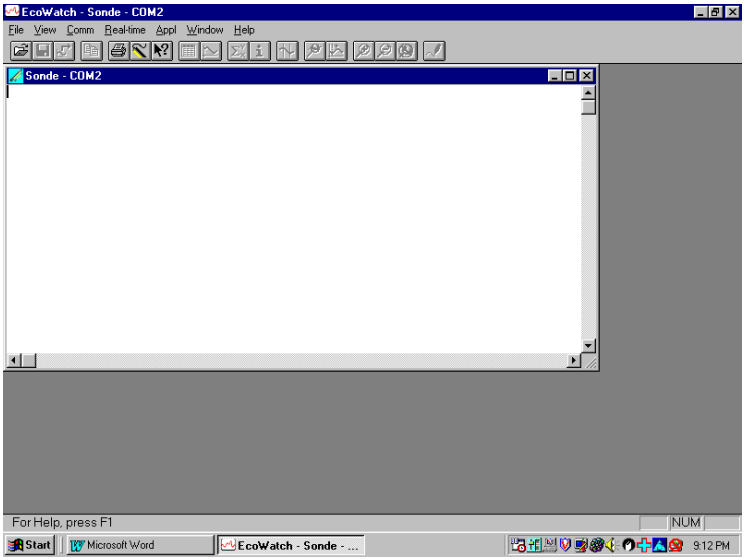
Figure 8.6 Computer/Instrument Interface

3. Open EcoWatch for Windows on your computer.

NOTE: See *Appendix G EcoWatch* for installation instructions.

4. Click on the sonde/probe icon in the upper toolbar.

5. Set the Comm port number to match the port the YSI 556 MPS is connected to. After this setup procedure, the following screen will be present on your PC monitor:



8.4.2 Uploading a .DAT File

1. Setup the instrument as described in Section *8.4.1 Upload Setup*.

2. Go to the YSI 556 MPS file screen as described in Section *8.1 Accessing the File Screen.*

3. Use the arrow keys to highlight the **Upload to PC** selection. See Figure 8.2 File Screen.

4. Press the **Enter** key. The file list screen is displayed. See Figure 8.3 File List Screen.

5. Use the arrow keys to highlight the DAT file that you wish to transfer and press **Enter**, both the YSI 556 MPS and PC displays show the progress of the file transfer.

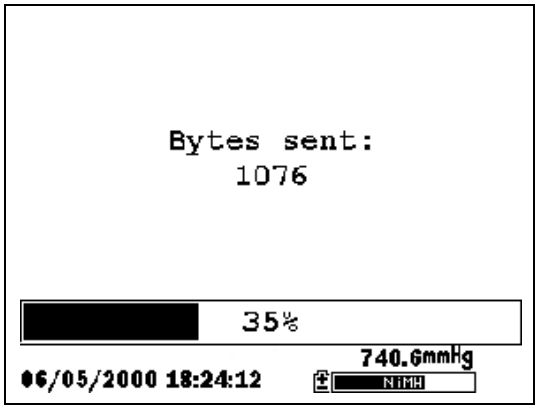
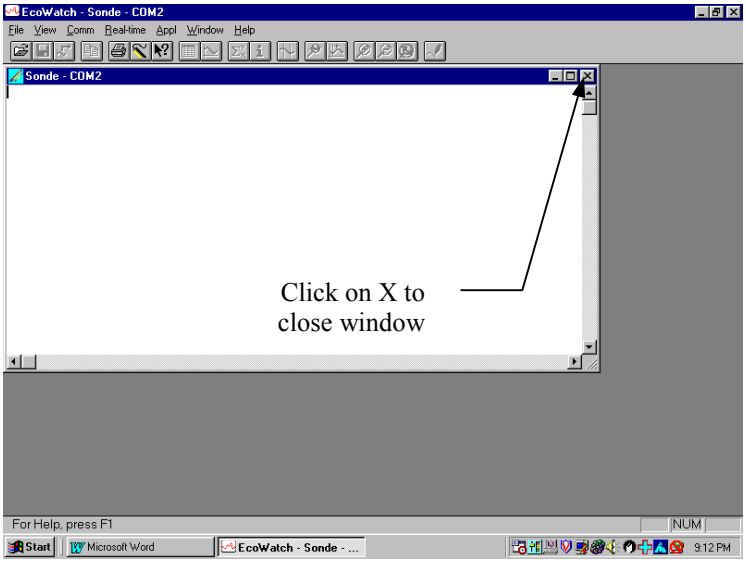


Figure 8.7 File Transfer Progress Screen

NOTE: After transfer, the file will be located in the C:\ECOWWIN\DATA folder of your PC, designated with a .DAT extension.

6. After the file transfer is complete, close the terminal window (small window on the PC) by clicking on the "X" at its upper right corner.



7. Press the **Escape** key on the YSI 556 MPS repeatedly to return to the main menu screen.

8.4.3 Uploading a Calibration Record (.glp) File

For more information on the calibration record, Refer to *Appendix H Calibration Record Information.*

1. Setup up the instrument as described in Section *8.4.1 Upload Setup*.

2. Go to the YSI 556 MPS file screen as described in Section *8.1 Accessing the File Screen.*

3. Use the arrow keys to highlight the **Upload to PC** selection. See Figure 8.2 File Screen.

4. Press the **Enter** key. The file list screen is displayed. See Figure 8.3 File List Screen.

5. Use the arrow keys to highlight the calibration record file that you wish to transfer and press **Enter.**

6. You will then be given a choice of uploading the file in three formats; **Binary, Comma & “” Delimited, and ASCII Text**.

   NOTE: The binary format is reserved for future YSI software packages.

7. Choose an option and press **Enter,** both the YSI 556 and PC displays show the progress of the file transfer.

   NOTE: After transfer, the file will be located in the C:\ECOWWIN\DATA folder of your PC, designated with the appropriate file extension.

   NOTE: To view the Calibration Record data after upload, simply open the .txt file in a general text editor such as Wordpad or Notepad.

8. After the file transfer is complete, close the terminal window (small window on the PC) by clicking on the “X” at its upper right corner.

9. Press the **Escape** key repeatedly to return to the main menu screen.

8.5 File Memory

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*.

2. Use the arrow keys to highlight the **File memory** selection. See Figure 8.2 File Screen.

3. Press the **Enter** key. The file bytes used screen is displayed.

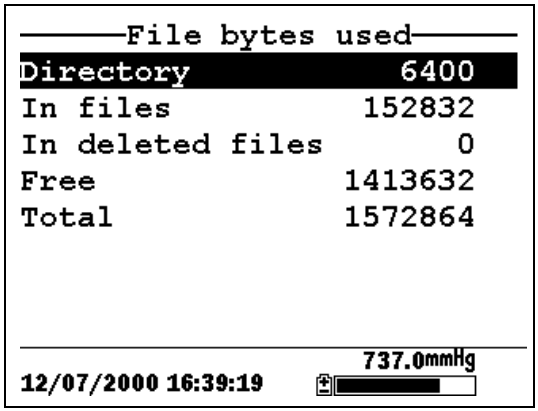


Figure 8.8 File Bytes Used Screen

4. The amount of free memory is listed in line 4 of the file bytes used screen.

   NOTE: If the amount of free memory is low, it may be time to delete all files (after first uploading all data to a PC). Refer to Section *8.6 Delete All Files*.

5. Press the **Escape** key repeatedly to return to the main menu screen.

8.6 Delete All Files

NOTE: It is not possible to delete individual files in order to free up memory. The only way to free up memory is to delete ALL files present. Take care to transfer all files to your computer (refer to Section *8.4 Upload to PC*) *before* deleting them.

1. Go to the file screen as described in Section *8.1 Accessing the File Screen*.

2. Use the arrow keys to highlight the **Delete all files** selection. See Figure 8.2 File Screen.

3. Press the **Enter** key. The Delete all Files screen is displayed.

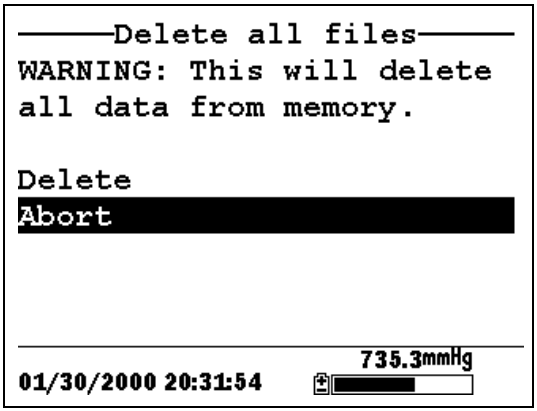


Figure 8.9 Delete All Files Screen

4. Use the arrow keys to highlight the **Delete** selection.

5. Press the **Enter** key.

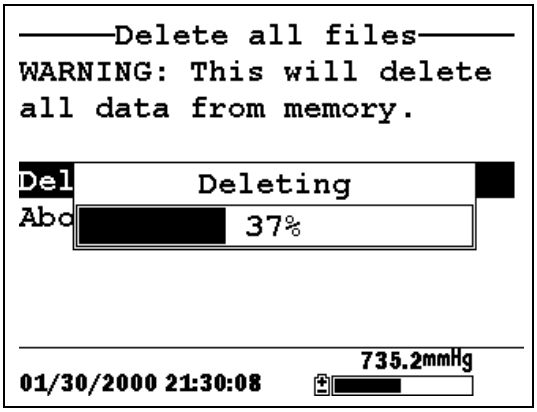


Figure 8.10 Deleting

The progress of file deletion is displayed in bar graph format.

NOTE: Deleting all files in the directory will not change any information in the site list.

6. Press the **Escape** key repeatedly to return to the main menu screen.

9. Logging

9.1 Accessing the Logging Setup Screen

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

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

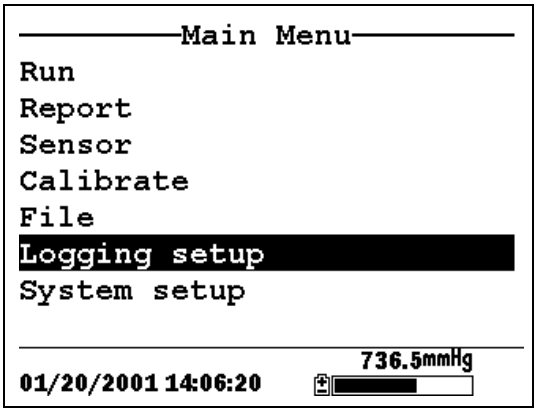


Figure 9.1 Main Menu

3. Use the arrow keys to highlight the **Logging setup** selection.

4. Press the **Enter** key. The logging setup screen is displayed.

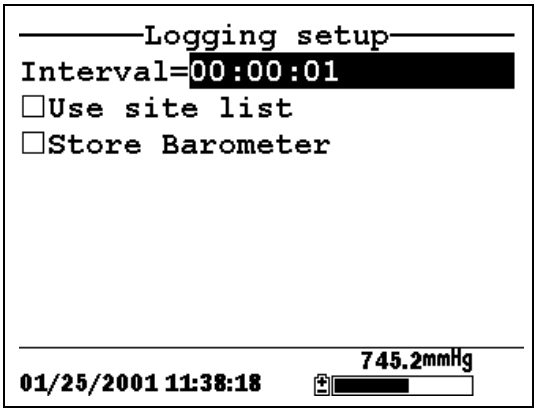


Figure 9.2 Logging Setup Screen

9.2 Setting Logging Interval

Follow steps below to set the interval for logging a data stream.

NOTE: If you do not specify an interval, the instrument will use a default interval setting of 1 second.

NOTE: It is not necessary to set a logging interval when logging a single sample.

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.

2. Use the keypad to enter an interval between 1 second and 15 minutes. Refer to Section *2.9 Keypad Use*.

   NOTE: The interval field has hour, minute and second entry fields. Any entry over 15 minutes will change automatically to a 15-minute setting.

3. Press the **Enter** key. The data stream interval is set.

4. Press the **Escape** key repeatedly to return to the main menu screen.

9.3 Storing Barometer Readings

NOTE: The **Store barometer** option is only available on instruments that are equipped with the optional barometer.

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.

2. Use the arrow keys to highlight the **Store barometer** selection. See Figure 9.2 Logging Setup Screen.

3. Press the **Enter** key until a check mark is entered in the box next to the store barometer selection if you want to log barometric readings.

   OR press the **Enter** key until the box next to the barometer selection is empty if you do not want to log barometric readings.

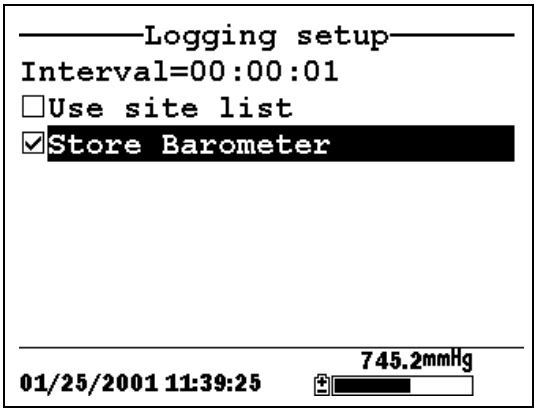


Figure 9.3 Store Barometer

4. Press the **Escape** key repeatedly to return to the main menu screen.

9.4 Creating a Site List

The site list option allows you to define file and site descriptions in the office or laboratory before moving to field logging studies. This is usually more convenient than entering the information at the site and is particularly valuable if you are visiting certain sites on a regular basis. The following section describes how to set up site lists which contain entries designated "Site Descriptions" that will be instantly available to the user in the field to facilitate the logging of data with pre-established naming of files and sites. There are two kinds of **Site Descriptions** available for use in Site lists:

- **Site Descriptions** associated with applications where data from a single site is always logged to a single file. This type is referred to as a "Single-Site Description" and is characterized by two parameters – a file name and a site name. Files logged to YSI 556 MPS memory under a **Single-Site Description** will be characterized primarily by the file name, but will also have the Site name attached, so that it is viewable in either the YSI 556 MPS **File directory** or in EcoWatch for Windows after upload to a PC

- **Site Descriptions** associated with applications where data from multiple sites are logged to a single file. This type is referred to as a "Multi-site Description" and is characterized by three parameters – a file name, a site name, and a site number. Files logged to YSI 556 MPS memory under a **Multi-site Description** are characterized by a file name, but not a site name, since multiple sites are involved. However, each data point has a Site Number attached to it so that the user can easily determine the sampling site when viewing the data from the YSI 556 MPS **File** menu or processing the data in EcoWatch for Windows after upload to a PC.

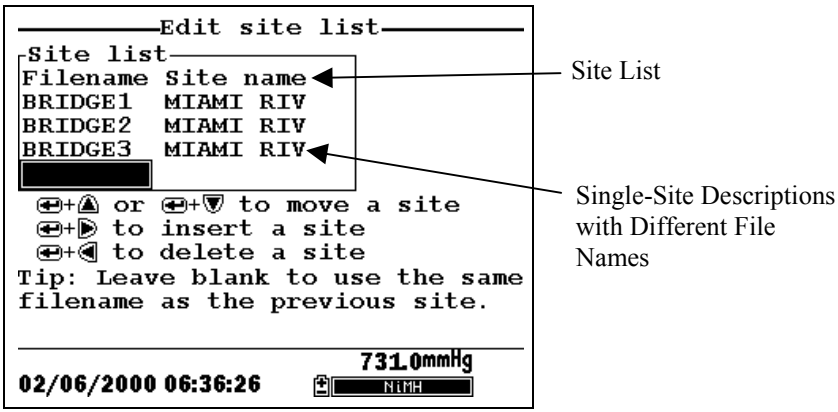


Figure 9.4 Single-Site Descriptions

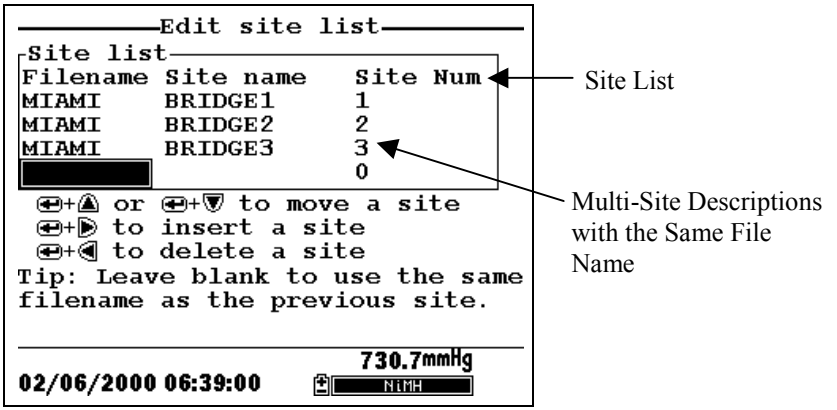


Figure 9.5 Multiple-Site Descriptions

NOTE: Site lists containing Single Site Descriptions are usually input with the designation **Store Site Number** INACTIVE in the YSI 556 MPS **Logging setup** menu. Thus, no site numbers appear in the first **Site list** example. Conversely, **Site lists** containing **Multi-Site Descriptions** MUST be input with the **Store Site Number** selection ACTIVE as shown in the second example.

To create a site list:

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.

2. Use the arrow keys to highlight the **Use site list** selection.

3. Press the **Enter** key. A check mark is entered in the box next to the use site list selection *and* two new entries appear on the logging setup screen. See Figure 9.6 Logging Setup Screen.

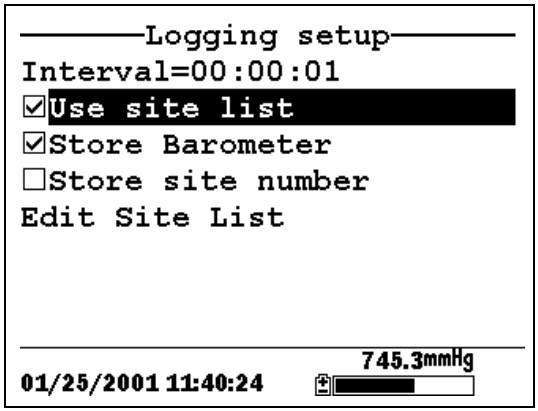


Figure 9.6 Logging Setup Screen

4. Use the arrow keys to highlight the **Store site number** selection.

5. If you are creating Multi-Site Descriptions (which require that the site **number** be stored in your data files), press the **Enter** key until a check mark appears in the box next to the store site number selection.

OR Press the **Enter** key until the box next to the store site number selection is empty, to create Single-Site Descriptions. The site **name** will be stored in the header of your data files.

6. Use the arrow keys to highlight the **Edit site list** selection.

7. Press the **Enter** key. The edit site list screen is displayed. See Figure 9.7 Edit Site List Screen. The **Filename** field is ready for input.

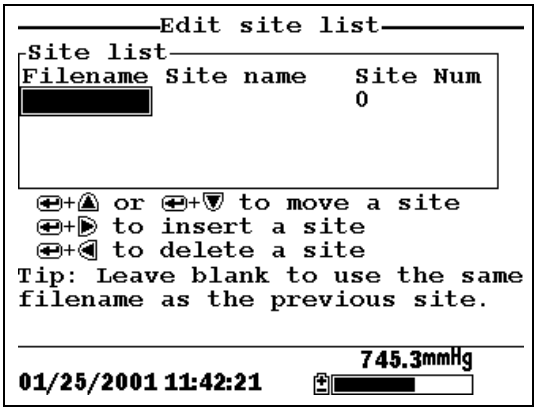


Figure 9.7 Edit Site List Screen

8. Use the keypad to enter a filename up to 8 characters in length. Refer to Section *2.9 Keypad Use*.

9. Press the **Enter** key. The cursor moves to the right for the entry of a **Site name**.

10. Use the keypad to enter a site name up to 11 characters in length. Refer to Section *2.9 Keypad Use*.

    NOTE: If the store site number selection is *not* checked, skip to Step 13.

11. Press the **Enter** key. The cursor moves to the site number entry position.

12. Use the keypad to enter a site number up to 7 characters in length. Refer to Section *2.9 Keypad Use*.

13. Press **Enter**. The cursor moves to the next filename entry position.

14. Repeat Steps 8 to 13 until all filenames and sites have been entered.

15. Press **Escape** repeatedly to return to the main menu screen.

9.5 Editing a Site List

1. Go to the logging setup screen as described in Section *9.1 Accessing the Logging Setup Screen*.

2. Use the arrow keys to highlight the **Edit Site List** selection. See Figure 9.6 Logging Setup Screen.

3. Press the **Enter** key. The edit site list screen is displayed.

4. Edit the site list using the keystrokes described below.

   NOTE: Editing the site list will not have any effect on files stored in the instrument memory.

To MOVE a site: **Use the arrow keys to highlight a site. Press the Up or Down arrow key while holding down the Enter key.**

To INSERT a site above another site: **Use the arrow keys to highlight the site. Press the** Right **arrow key while holding down the** Enter **key. Use keypad to input letters. Refer to Section *2.9 Keypad Use*.**

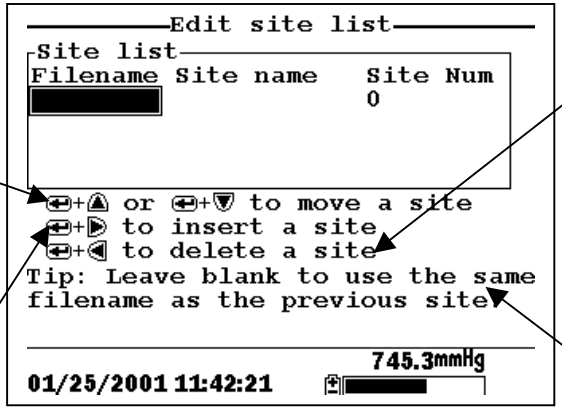


Figure 9.8 Keystrokes for Editing Site List

To DELETE a site: **Use the arrow keys to highlight a site. Press the Left arrow key while holding down the Enter key.**

To use the same file name as the previous site: **Leave the filename blank.**

9.6 Logging Data Without a Site List

1. Follow Steps 1 through 5 in Section 7.1 Real-Time Data.

2. Use the arrow keys to highlight the **Log one sample** selection on the run screen if only a single sample is being logged.

   OR Use the arrow keys to highlight the **Start logging** selection on the run screen if a data stream is being logged.

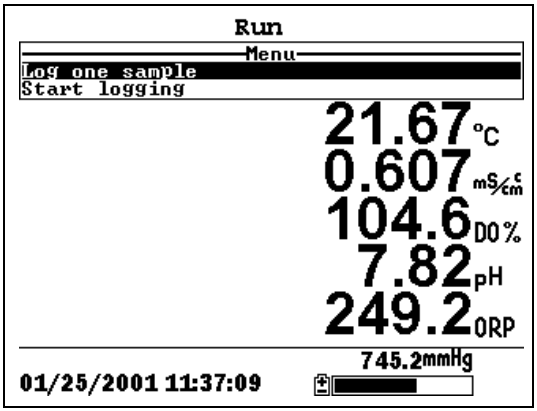


Figure 9.9 Run Screen

3. Press the **Enter** key. The Enter information screen is displayed.

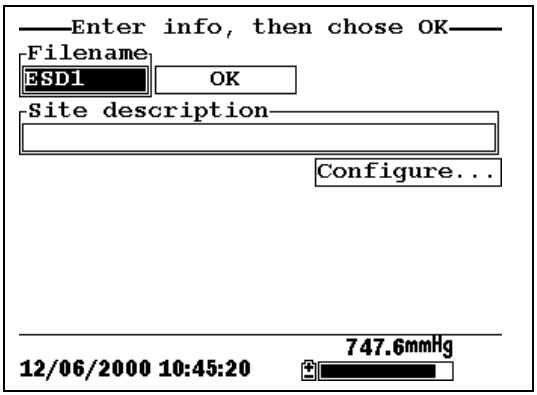


Figure 9.10 Enter Information Screen

NOTE: The last filename used will be displayed.

4. Use the keypad to enter a file name. Refer to Section *2.9 Keypad Use*.

   NOTE: The instrument will assign a default file name of NONAME if no file name is specified.

5. Press the **Enter** key to input the file name.

6. Use the arrow keys to highlight the **Site description** field in the enter information screen.

   NOTE: Entering a Site Description is optional. You may leave the Site Description blank and skip to Step 9.

7. Use the keypad to enter a site description name. Refer to Section *2.9 Keypad Use*.

8. Press the **Enter** key to input the site description.

   NOTE: If you want to change the logging setup, such as sampling interval or storing the barometer reading, use the arrow keys to highlight the **Configure** field, press the **Enter** key, then refer to Section *9.2 Setting Logging Interval* or *9.3 Storing Barometer Readings* for details.

9. Use the arrow keys to highlight the **OK** field in the center of the information screen.

10. Press the **Enter** key to start logging.

    NOTE: If the parameter mismatch screen is displayed, refer to Section *9.8 Adding Data to Existing Files*.

11. If a single point is being logged, the header on the run screen changes momentarily from **Menu** to **Sample logged** to confirm that the point was successfully logged. Skip to Step 13.

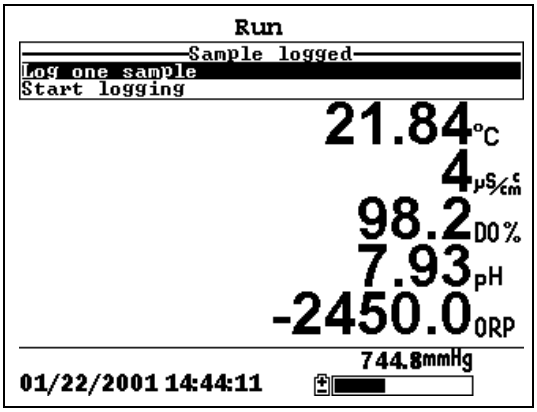


Figure 9.11 Sample Logged Screen

If a continuous stream of points is being logged, the start logging entry in the run screen changes from **Start logging** to **Stop logging**.

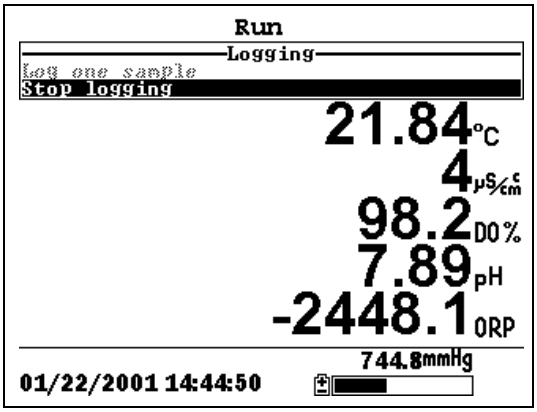


Figure 9.12 Logging Screen

12. At the end of the logging interval, press **Enter** to stop logging.

13. Refer to Section *8.3 View File* to view the data on the instrument display.

9.7 Logging Data With a Site List

1. If you have not already created a site list, refer to Section *9.4 Creating a Site List*.

2. Follow Steps 1 through 5 in Section 7.1 Real-Time Data.

3. Use the arrow keys to highlight the **Log one sample** selection on the run screen if only a single sample is being logged.

   OR Use the arrow keys to highlight the **Start logging** selection on the run screen if a data stream is being logged. See Figure 9.9 Run Screen.

4. Press the **Enter** key. The Pick a site screen is displayed.

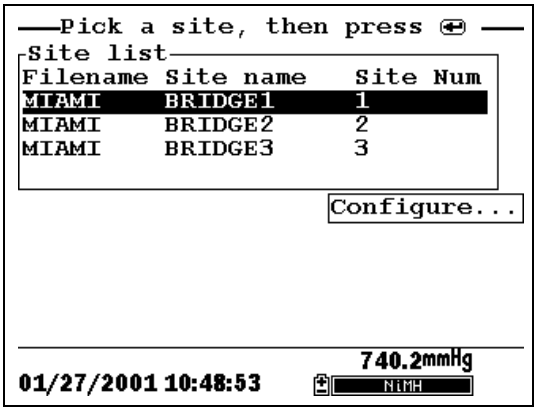


Figure 9.13 Pick a Site Screen

5. Use the arrow keys to highlight the **site** of your choice.

   NOTE: If the site of your choice is grayed out in the site list, refer to Section *9.8 Adding Data to Existing Files*.

   NOTE: Refer to Section *9.5 Editing a Site List* if you want to edit the site list.

6. Press the **Enter** key to start logging.

NOTE: If the parameter mismatch screen is displayed, refer to Section *9.8 Adding Data to Existing Files*.

7. If a single point is being logged, the header on the run screen changes momentarily from **Menu** to **Sample logged** to confirm that the point was successfully logged. See Figure 9.11 Sample Logged Screen. Skip to Step 9.

   If a continuous stream of points is being logged, the start logging entry in the run screen changes from **Start logging** to **Stop logging**. See Figure 9.12 Logging Screen.

8. At the end of the logging interval, press **Enter** to stop logging.

9. Refer to Section *8.3 View File* to view the data on the instrument display.

9.8 Adding Data to Existing Files

In order to add new data to an existing file, the current logging and sensor setup must be *exactly* the same as when the file was created. The following settings must be the same:

- **Sensors enabled** (refer to Section *4 Sensors*)
- **Store Barometer** (refer to Section *9.3 Storing Barometer Readings*)
- **Store Site Number** (refer to Section *9.4 Creating a Site List*)

If the current logging setup is not exactly the same as when the file was created, a parameter mismatch screen is displayed.

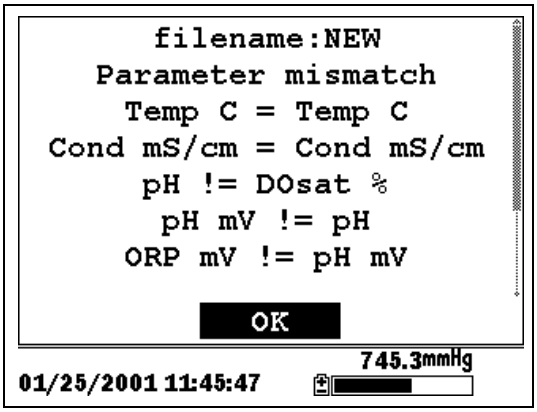


Figure 9.14 Parameter Mismatch Screen

NOTE: The right column shows parameters used when the file was created. The left column shows current parameters.

1. Press the **Down Arrow** key to scroll down and find the mismatch(es).

2. Use the following chart to resolve the mismatch(es).

Mismatch	Action	Reference
Sensor(s) missing from left column	Enable the missing sensor(s)	Section *4 Sensors*
Extra sensor(s) listed in left column	Disable the extra sensor(s)	Section *4 Sensors*
Barometer missing from left column, but present in right column	Enable the Store Barometer setting	Section *9.3 Storing Barometer Readings*
Barometer present in left column, but missing from right column	Disable the Store Barometer setting	Section *9.3 Storing Barometer Readings*
Store Site Number missing from left column, but present in right column	Enable the Store Site Number setting	Section *9.4 Creating a Site List*
Store Site Number present in left column, but missing from right column	Disable the Store Site Number setting	Section *9.4 Creating a Site List*

3. Return to Section *9.6 Logging Data Without a Site List* or *9.7 Logging Data With a Site List*.

10. System Setup

The YSI 556 MPS has a number of features that are user-selectable or can be configured to meet the user's preferences. Most of these choices are found in the **System setup** menu.

10.1 Accessing the System Setup Screen

1. Press the **On/off** key to display the run screen. See Figure 2.1 Front View of YSI 556 MPS.

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

3. Use the arrow keys to highlight the **System setup** selection.

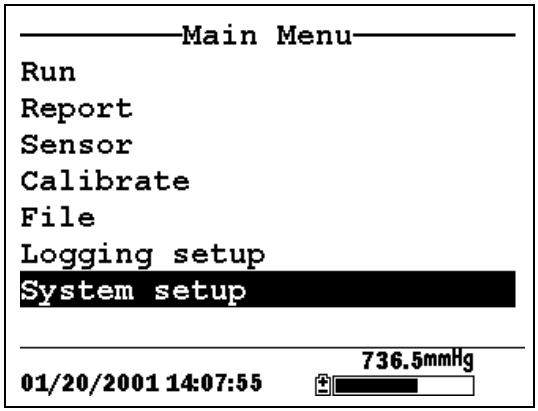


Figure 10.1 Main Menu

4. Press the **Enter** key. The system setup screen is displayed.

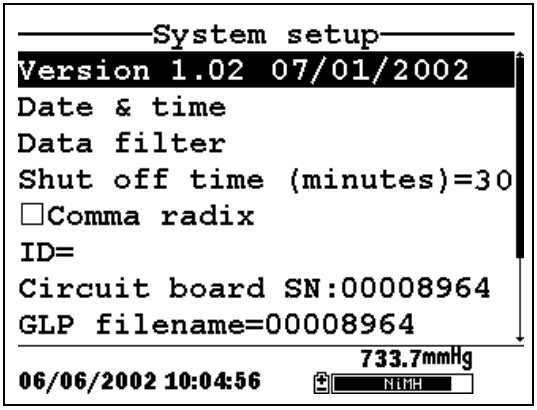


Figure 10.2 System Setup Screen

NOTE: The first line of the **System setup** menu shows the current software version of your YSI 556 MPS. As software enhancements are introduced, you will be able to upgrade your YSI 556 MPS from the YSI Web site. Refer to Section *11.2 Upgrading YSI 556 MPS* Software for details.

10.2 Date and Time Setup

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Date & time** selection on the system setup screen. See Figure 10.2 System Setup Screen.

3. Press **Enter**. The date and time setup screen is displayed.

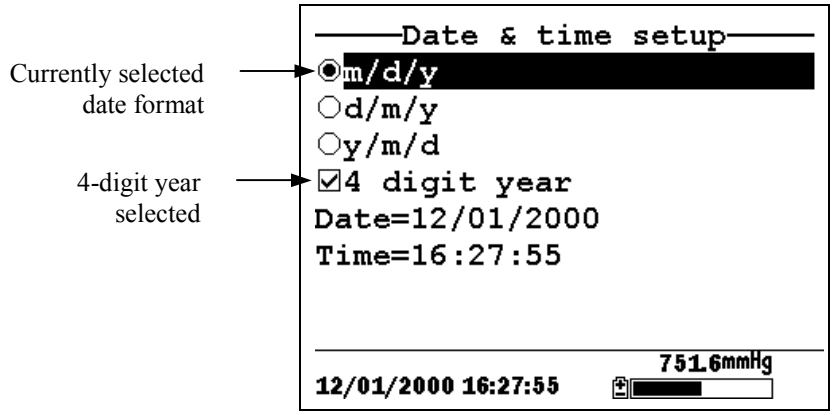


Figure 10.3 Date Setup Screen

NOTE: A black dot to the left of a date format indicates that format is selected.

4. Use the arrow keys to highlight your desired date format.

5. Press **Enter**.

6. Use the arrow keys to highlight the 4-digit year selection.

7. Press **Enter**. A check mark appears in the check box next to the 4-digit year selection.

   NOTE: If unchecked, a 2-digit year is used.

8. Use the arrow keys to highlight the **Date** selection.

9. Press **Enter**. A cursor appears over the first number in the date.

10. Enter the proper number from the keypad for the highlighted date digit. The cursor moves automatically to the next date digit. Refer to Section *2.9 Keypad Use* for more keypad information.

11. Repeat Step 10 until all date digits are correct.

12. Press **Enter** to input the specified date.

13. Use the arrow keys to highlight the **Time** selection.

14. Press **Enter**. A cursor appears over the first number in the time selection.

15. Enter the proper number from the keypad for the highlighted time digit. The cursor moves automatically to the next time digit.

    NOTE: Use military format when entering time. For example, 2:00 PM is entered as 14:00.

16. Repeat Step 15 until all time digits are correct.

17. Press **Enter** to input the correct time.

18. Press the **Escape** key repeatedly to return to the Main menu screen.

10.3 Data Filter

The Data Filter is a software filter that eliminates sensor noise and provides more stable readings.

NOTE: YSI recommends using the default values for the data filter for most field applications.

However, users who are primarily interested in a fast response from their dissolved oxygen sensor should consider a change of the default time constant setting of 8 seconds to one of 2 seconds. This change can be made according to the instructions in Section *10.3.1 Changing the Data Filter Settings* below. The disadvantage of lowering the time constant is that field pH readings may appear somewhat noisy if the cable is in motion.

10.3.1 Changing the Data Filter Settings

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Data filter** selection. See Figure 10.1 Main Menu.

3. Press the **Enter** key. The Data filter setup screen is displayed.

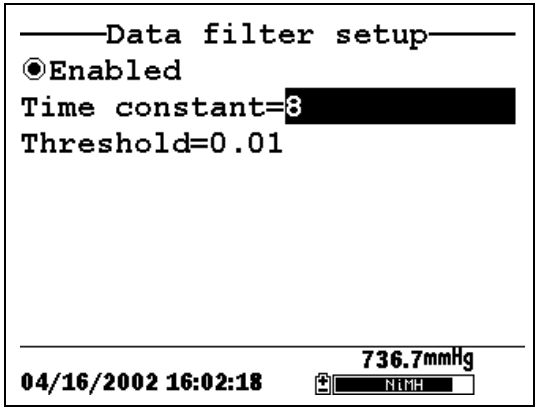


Figure 10.4 Data Filter Screen

4. With Enabled highlighted, press the **Enter** key to Enable or Disable the data filter. A black dot to the left of the selection indicates the data filter is enabled.

5. Use the arrow keys to highlight the **Time constant** field.

   NOTE: This value is the time constant in seconds for the software data filter. Increasing the time constant will result in greater filtering of the data, but will also slow down the apparent response of the sensors.

6. Use the keypad to enter a value. The default value is 8 and this value is ideal for most 556 field applications. As described in Section *10.3 Data Filter* above, users who wish to decrease the response time of the DO readings at the expense of some noise for the pH readings determined concurrently, should change the Time Constant to a value of 2.

7. Press the **Enter** key to enter the time constant.

8. Use the arrow keys to highlight the **Threshold** field.

   NOTE: This value determines when the software data filter will engage/disengage, speeding the response to large changes in a reading. When the difference between two consecutive readings is larger than the threshold, then the reading is displayed unfiltered. When the difference between two consecutive readings drops below the threshold, readings will be filtered again.

9. Use the keypad to enter a value. The default value is 0.01.

10. Press the **Enter** key to enter the threshold.

11. Press the **Escape** key repeatedly to return to the Main menu screen.

10.4 Shutoff Time

The YSI 556 MPS shuts off automatically after 30 minutes of inactivity. The shut off time may be changed as described below.

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Shutoff time** selection on the system setup screen. See Figure 10.2 System Setup Screen.

3. Use the keypad to enter a value from 0 to 60 minutes. The default value is 30.

   NOTE: To disable the automatic shutoff feature, enter a zero (0).

4. Press the **Enter** key to enter the correct shutoff time.

5. Press the **Escape** key repeatedly to return to the main menu screen.

10.5 Comma Radix

The user can toggle between a period (default) and comma for the radix mark by selecting this item and pressing the **Enter** key as follows:

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.
2. Use the arrow keys to highlight the **Comma radix** selection on the system setup screen. See Figure 10.2 System Setup Screen.
3. Press the **Enter** key. A check mark appears in the check box next to the comma radix selection indicating that the radix mark is a comma.

10.6 ID

This selection allows you to enter an identification name/number for your YSI 556 MPS. This ID name/number is logged in the header of each file.

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.
2. Use the arrow keys to highlight the **ID** selection. See Figure 10.1 Main Menu.
3. Use the keypad to enter an alphanumeric ID up to 15 characters in length. Refer to Section *2.9 Keypad Use*.
4. Press the **Enter** key to enter the ID.
5. Press the **Escape** key repeatedly to return to the main menu screen.

10.7 GLP Filename

This selection allows you to enter a different filename for the YSI 556 MPS Calibration Record file.

NOTE: The default filename is the "556 PC board Serial Number.glp."

6. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

7. Use the arrow keys to highlight the **GLP Filename** selection. See Figure 10.1 Main Menu.

8. Use the keypad to enter a filename up to 8 characters in length. Refer to Section *2.9 Keypad Use*.

9. Press the **Enter** key to enter the new filename.

Press the **Escape** key repeatedly to return to the main menu screen.

10.8 TDS Constant

This selection allows you to set the constant used to calculate Total Dissolved Solids (TDS). TDS in g/L is calculated by multiplying this constant times the specific conductance in mS/cm.

10.8.1 Changing the TDS Constant

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **TDS Constant** selection. See Figure 10.1 Main Menu.

3. Use the keypad to enter a value. Refer to Section *2.9 Keypad Use*. The default value is 0.65.

4. Press the **Enter** key to enter the correct TDS constant.

5. Press the **Escape** key repeatedly to return to the main menu screen.

10.9 Barometer Units

The following information is only for instruments with the barometer option.

1. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

2. Use the arrow keys to highlight the **Barometer units** selection on the system setup screen. See Figure 10.2 System Setup Screen.

3. Press the **Enter** key. The Barometer units screen will appear.

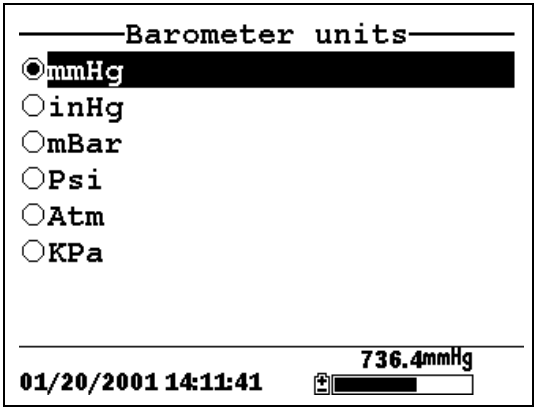


Figure 10.5 Barometer Units Screen

A black dot indicates the currently selected units.

4. Use the arrow keys to highlight your desired barometric unit.

5. Press the **Enter** key to select your choice. A black dot will appear in the circle next to your selected units.

6. Press the **Escape** key repeatedly to return to the main menu screen.

10.10 Calibrate Barometer

The optional barometer has been factory calibrated to provide accurate readings. However, some sensor drift may occur over time, requiring occasional calibration by the user, as follows:

1. Determine your local barometric pressure from an independent laboratory barometer or from your local weather service.

2. If the barometric pressure (BP) reading is from your local weather station, reverse the equation that corrects it to sea level.

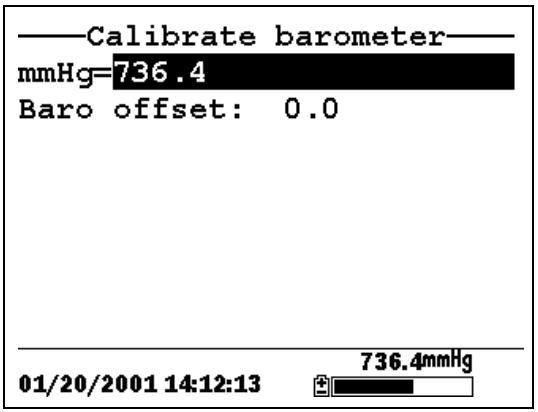
   NOTE: For this equation to be accurate, the barometric pressure units must be in mm Hg.

   True BP = (Corrected BP) – [2.5 * (Local Altitude/100)]

3. Go to the system setup screen as described in Section *10.1 Accessing the System Setup Screen*.

4. Use the arrow keys to highlight the **Calibrate barometer** selection on the system setup screen. See Figure 10.2 System Setup Screen.

5. Press the **Enter** key. The Calibrate Barometer screen is displayed.



6. Use the keypad to input the known barometric pressure value as determined in Step 2.

7. Press the **Enter** key. The new barometer reading is displayed as well as the approximate offset from the factory reading.

   NOTE: To return the sensor to the factory setting, subtract the offset amount from the current setting and repeat Steps 5 to 7.

8. Press the **Escape** key repeatedly to return to the main menu screen.

11. Maintenance

11.1 Sensor Care and Maintenance

Once the sensors have been properly installed, remember that periodic cleaning and DO membrane changes are required.

11.1.1 DO Sensor

For best results, we recommend that the KCl solution and the membrane cap be changed at least once every 30 days.

1. It is important to recognize that oxygen dissolved in the sample is consumed during sensor operation. It is therefore essential that the sample be continuously stirred at the sensor tip. If stagnation occurs, your readings will be artificially low. Stirring may be accomplished by mechanically moving the sample around the sensor tip, or by rapidly moving the sensor through the sample. The rate of stirring should be at least 1 foot per second.

2. Membrane life depends on usage. Membranes will last a long time if installed properly and treated with care. Erratic readings are a result of loose, wrinkled, damaged, or fouled membranes, or from large (more than 1/8" diameter) bubbles in the electrolyte reservoir. If erratic readings or evidence of membrane damage occurs, you should replace the membrane and the electrolyte solution. The average replacement interval is two to four weeks.

3. If the membrane is coated with oxygen consuming (e.g. bacteria) or oxygen producing organisms (e.g. algae), erroneous readings may occur.

4. Chlorine, sulfur dioxide, nitric oxide, and nitrous oxide can affect readings by behaving like oxygen at the sensor. If you suspect erroneous readings, it may be necessary to determine if these gases are the cause.

5. Avoid any environment that contains substances that may attack the probe module and sensor materials. Some of these substances are concentrated acids, caustics, and strong

solvents. The sensor materials that come in contact with the sample include FEP Teflon, acrylic plastic, EPR rubber, stainless steel, epoxy, polyetherimide and the PVC cable covering.

6. It is possible for the silver anode, which is the entire silver body of the sensor, to become contaminated. This will prevent successful calibration. To restore the anode, refer to Section *11.1.1 DO Sensor, Silver Anode Cleaning.*

7. For correct sensor operation, the gold cathode must always be bright. If it is tarnished (which can result from contact with certain gases), or plated with silver (which can result from extended use with a loose or wrinkled membrane), the gold surface must be restored. To restore the cathode, refer to Section *11.1.1 DO Sensor, Gold Cathode Cleaning.*

8. To keep the electrolyte from drying out, store the sensor in the transport/calibration cup with at least 1/8″ of water.

Silver Anode Cleaning

After extended use, a thick layer of AgCl builds up on the silver anode reducing the sensitivity of the sensor. The anode must be cleaned to remove this layer and restore proper performance. The cleaning can be chemical or mechanical:

Chemical Cleaning: Remove the membrane cap and soak the entire anode section in a 14% ammonium hydroxide solution for 2 to 3 minutes, followed by a thorough rinsing with distilled or deionized water. The anode should then be thoroughly wiped with a wet paper towel to remove the residual layer from the anode.

Mechanical Cleaning: Sand off the dark layer from the silver anode with 400 grit wet/dry sandpaper. Wrap the sandpaper around the anode and twist the sensor. Rinse the anode with clean water after sanding, followed by wiping thoroughly with a wet paper towel.

NOTE: After cleaning, a new membrane cap must be installed. Refer to Section *3.4.3 Membrane Cap Installation***.**

Turn the instrument on and allow the system to stabilize for at least 30 minutes. If, after several hours, you are still unable to calibrate, contact your dealer or YSI Customer Service. Refer to *Appendix E Customer Service*.

Gold Cathode Cleaning

For correct sensor operation, the gold cathode must be textured properly. It can become tarnished or plated with silver after extended use. The gold cathode can be cleaned by using the adhesive backed sanding disc and tool provided in the YSI 5238 Probe Reconditioning Kit.

Using the sanding paper provided in the YSI 5238 Probe Reconditioning Kit, wet sand the gold with a twisting motion about 3 times or until all silver deposits are removed and the gold appears to have a matte finish. Rinse the cathode with clean water after sanding, followed by wiping thoroughly with a wet paper towel. If the cathode remains tarnished, contact your dealer or YSI Customer Service. Refer to *Appendix E Customer Service*.

NOTE: After cleaning, a new membrane cap must be installed. Refer to Section *3.4.3 Membrane Cap Installation***.**

11.1.2 DO Sensor Replacement

1. Remove the probe sensor guard.

⚠ **CAUTION:** Thoroughly dry the sensor so that no water enters the probe module sensor port when the sensor is removed.

2. Insert the long end of the hex key wrench into the small hole in the side of the probe module bulkhead. Turn the wrench counterclockwise and remove the screw. (You do not have to remove the screw all the way to release the sensor.)

3. Pull the old DO sensor module straight out of the probe module body.

   NOTE: The DO sensor is not threaded, it is keyed, so it cannot be removed by twisting.

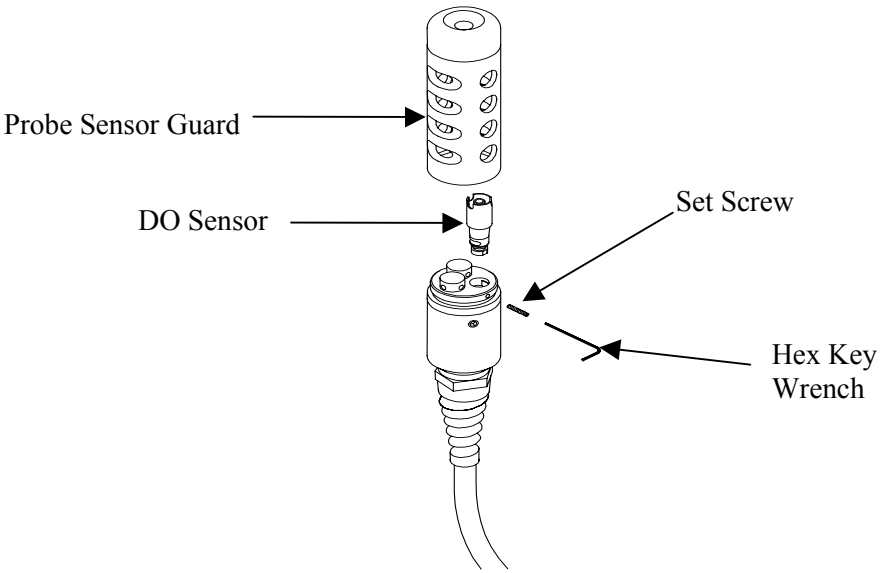


Figure 11.1 DO Sensor Replacement

4. Insert the new DO sensor module. Make sure that the inside of the probe module sensor port and the o-ring on the sensor are clean, with no contaminants, such as grease, dirt, or hair. The DO sensor is keyed, or has a flat side, so that it cannot be aligned improperly.

NOTE: Make sure the DO sensor bottoms out before the set screw is inserted.

5. Insert the set screw into the small hole in the side of the probe module bulkhead, and turn clockwise to rethread.

⚠ **CAUTION:** Make sure that you do not cross-thread the set screw. Use the hex key wrench to tighten the screw in properly, making sure that the screw does not stick out of the side of the probe module bulkhead. The probe sensor guard will not thread

on properly and damage may result if the screw is allowed to stick out.

NOTE: The YSI 5563 DO sensor is shipped dry. A shipping membrane was installed to protect the electrode. A new membrane cap must be installed before the first use. Refer to Section *3.4.1 Sensor Installation.*

11.1.3 YSI 5564 pH and 5565 Combination pH/ORP Sensor Cleaning

Cleaning is required whenever deposits or contaminants appear on the glass and/or platinum surfaces of these sensors or when the response of the sensor becomes slow.

1. Remove the sensor from the probe module.

2. Initially, simply use clean water and a soft clean cloth, lens cleaning tissue, or cotton swab to remove all foreign material from the glass bulb (YSI 5564 and YSI 5565) and platinum button (YSI 5565). Then use a moistened cotton swab to carefully remove any material that may be blocking the reference electrode junction of the sensor.

⚠ **CAUTION:** When using a cotton swab with the YSI 5564 or YSI 5565, be careful NOT to wedge the swab tip between the guard and the glass sensor. If necessary, remove cotton from the swab tip, so that the cotton can reach all parts of the sensor tip without stress.

NOTE: If good pH and/or ORP response is not restored by the above procedure, perform the following additional procedure:

1. Soak the sensor for 10-15 minutes in clean water containing a few drops of commercial dishwashing liquid.

2. GENTLY clean the glass bulb and platinum button by rubbing with a cotton swab soaked in the cleaning solution.

3. Rinse the sensor in clean water, wipe with a cotton swab saturated with clean water, and then re-rinse with clean water.

NOTE: If good pH and/or ORP response is still not restored by the above procedure, perform the following additional procedure:

1. Soak the sensor for 30-60 minutes in one molar (1 M) hydrochloric acid (HCl). This reagent can be purchased from most distributors. Be sure to follow the safety instructions included with the acid.

2. GENTLY clean the glass bulb and platinum button by rubbing with a cotton swab soaked in the acid.

3. Rinse the sensor in clean water, wipe with a cotton swab saturated with clean water, and then re-rinse with clean water. To be certain that all traces of the acid are removed from the sensor crevices, soak the sensor in clean water for about an hour with occasional stirring.

NOTE: If biological contamination of the reference junction is suspected or if good response is not restored by the above procedures, perform the following additional cleaning step:

1. Soak the sensor for approximately 1 hour in a 1 to 1 dilution of commercially available chlorine bleach.

2. Rinse the sensor with clean water and then soak for at least 1 hour in clean water with occasional stirring to remove residual bleach from the junction. (If possible, soak the sensor for period of time longer than 1 hour in order to be certain that all traces of chlorine bleach are removed.) Then re-rinse the sensor with clean water and retest.`

11.1.4 Temperature/Conductivity Sensor Cleaning

The single most important requirement for accurate and reproducible results in conductivity measurement is a clean cell. A dirty cell will change the conductivity of a solution by contaminating it. The small cleaning brush included in the YSI 5511 Maintenance Kit is ideal for this purpose.

To clean the conductivity cell:

1. Dip the brush in clean water and insert it into each hole 15-20 times.

2. Rinse the cell thoroughly in deionized or clean tap water.

NOTE: In the event that deposits have formed on the electrodes, perform the following additional procedure:

1. Use a mild detergent solution in combination with the brush. Dip the brush in the solution and insert it into each hole 15-20 times.

2. Rinse the cell thoroughly in deionized or clean tap water.

   NOTE: After cleaning, check the response and accuracy of the conductivity cell with a calibration standard.

   NOTE: If this procedure is unsuccessful, or if sensor performance is impaired, it may be necessary to return the sensor to a YSI authorized service center for service, Refer to *Appendix E Customer Service*.

   The temperature portion of the sensor requires no maintenance.

11.2 Upgrading YSI 556 MPS Software

1. Access the YSI Environmental Software Downloads page as described in *Appendix G EcoWatch* Step 1 through 3.

2. Click on the **YSI Instruments Software Updates** link (or scroll down until you see YSI 556 MPS).

3. Click on the file icon to the right of the **YSI 556 MPS** listing and save the file to a temporary directory on your computer.

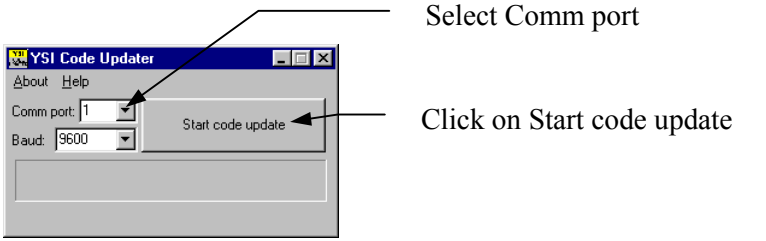
4. After the download is complete, run the file (that you just downloaded) and follow the on screen instructions to install the YSI Code Updater on your computer. If you encounter difficulties, contact YSI customer service for advice. Refer to *Appendix E Customer Service*.

5. If necessary, disconnect the YSI 5563 Probe Module from the YSI 556 MPS instrument.

6. Connect the YSI 556 MPS to a serial port of your computer via the 655173 PC interface cable. See Figure 8.6 Computer/Instrument Interface.

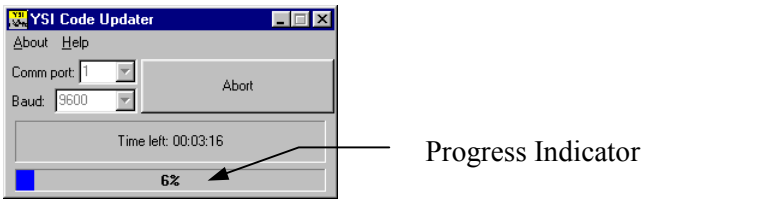
7. Press the **On/off** key on the YSI 556 MPS to display the run screen.

8. Run the YSI Code Updater software that you just installed on your computer. The following window will be displayed:

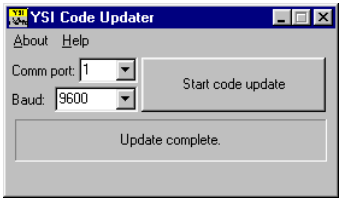


9. Set the Comm port number to match the port that you connected the 655173 PC Interface Cable to, then click on the **Start Code Update button**.

The YSI 556 MPS screen will blank out and a progress indicator will be displayed on the PC.



When the update is finished (indicated on the PC screen), the YSI 556 MPS will return to the Run screen. See Figure 7.1 Run Screen.



10. Close the YSI Code Updater window (on the PC) by clicking on the "X" in the upper right corner of the window.

11. Disconnect the YSI 556 MPS from the 655173 PC interface cable and reconnect it to the YSI 5563 Probe Module. Refer to Section *3.6 Instrument/Cable Connection*.

12. Storage

Proper storage between periods of usage will not only extend the life of the sensors, but will also ensure that the unit will be ready to use as quickly as possible in your next application.

12.1 General Recommendations for Short Term Storage

No matter what sensors are installed in the instrument, it is important to keep them moist without actually immersing them in liquid. Immersing them could cause some of them to drift or result in a shorter lifetime.

YSI recommends that short term storage of all multi-parameter instruments be done by placing approximately 1/2 inch of tap water in the transport/calibration cup that was supplied with the instrument, and by placing the probe module with all of the sensors installed into the cup. The use of a moist sponge instead of a 1/2 inch of tap water is also acceptable, as long as its presence does not compromise the attachment of the cup to the probe module. The transport/calibration cup should be sealed to prevent evaporation.

NOTE: Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body. See Figure 3.7 Transport/Calibration Cup Installation.

⚠ **CAUTION:** The water level has to be low enough so that none of the sensors are actually under water. Check the transport/calibration cup periodically to make certain that the water is still present or the sponge is still moist.

NOTE: If the storage water (tap water) is accidentally lost during field use, environmental water can be used.

12.2 General Recommendations for Long Term Storage

12.2.1 Probe Module Storage

1. Remove the pH or pH/ORP sensor from the probe module and store according to the individual sensor storage instructions found in Section *12.2.2 Sensor Storage*.

2. Seal the empty port with the provided port plug.

NOTE: Leave the conductivity/temperature sensor and dissolved oxygen sensor, with membrane cap still on, in the probe module.

3. Place 1/2″ of water, deionized, distilled or tap, in the transport/calibration cup.

⚠ **CAUTION:** The water level has to be low enough so that none of the sensors are actually under water. Check the transport/calibration cup periodically to make certain that the water is still present or the sponge is still moist.

4. Insert the probe module into the cup.

   NOTE: Ensure that an o-ring is installed in the o-ring groove on the threaded end of the probe module body. See Figure 3.7 Transport/Calibration Cup Installation.

12.2.2 Sensor Storage

Temperature/Conductivity Sensor

No special precautions are required. Sensor can be stored dry or wet, as long as solutions in contact with the thermistor and conductivity electrodes are not corrosive (for example, chlorine bleach). However, it is recommended that the sensor be cleaned with the provided brush prior to long term storage. Refer to Section *11.1.4 Temperature/Conductivity Sensor Cleaning.*

pH and Combination pH/ORP Sensor

The key to sensor storage is to make certain that the reference electrode junction does not dry out. Junctions which have been allowed to dry out due to improper storage procedures can usually be rehydrated by soaking the sensor for several hours (overnight is recommended) in a solution which is 2 molar in potassium chloride. If potassium chloride solution is not available, soaking the sensor in tap water or commercial pH buffers may restore sensor function. However in some cases the sensor may have been irreparably damaged by the dehydration and will require replacement.

⚠ **CAUTION:** Do not store the sensor in distilled or deionized water as the glass sensor may be damaged by exposure to this medium.

1. Remove the pH or pH/ORP sensor from the probe module.

2. Seal the empty port with the provided port plug.

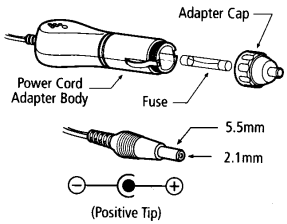
3. Place the sensor in the storage vessel (plastic boot or bottle) which was on the sensor at delivery. The vessel should contain a solution which is 2 molar in potassium chloride.

   NOTE: Make certain that the vessel is sealed to prevent evaporation of the storage solution.

13. Troubleshooting

The following sections describe problems you may encounter when using the YSI 556 MPS and provides suggestions to overcome the symptom.

PROBLEM	POSSIBLE SOLUTION
Display Problems	
No display is visible after pressing the on/off key.	If C cells are used, make certain that they are installed properly with regard to polarity and that good batteries are used. If a rechargeable battery pack is used, place the pack in the instrument and charge for 30 minutes.
Instrument software appears to be locked up as evidenced by no response to keypad entries or display not changing.	First, attempt to reset the instrument by simply turning off and then on again. If this fails, remove battery power from the instrument for 30 seconds and then reapply power. When using C cells, remove the battery lid and one of the batteries; when using the rechargeable battery pack, remove the pack completely from the instrument. After 30 seconds replace the battery or battery pack and check for instrument function.
The 556 display flashes and the instrument speaker makes a continuous clicking sound.	The battery voltage is low. Change to new C cells or recharge the 6117 battery pack.
Water Damage to Instrument	
Leakage detected in battery compartment when using C cells	Dispose of batteries properly. Dry the battery compartment using compressed air if possible. If corrosion is present on battery terminals, contact YSI Customer Service.
Water has contacted rechargeable battery pack	Remove battery pack immediately. Send battery pack to YSI Product Service for evaluation. **CAUTION**: DO NOT REUSE BATTERY PACK UNTIL YSI PRODUCT SERVICE HAS EVALUATED IT.
Leakage suspected into the main cavity of the instrument case	Remove the batteries immediately. Return the instrument to YSI Product Service.

PROBLEM	POSSIBLE SOLUTION
Optional Cigarette Lighter Charger	
Power cord fuse blown 	1. Unscrew adapter's cap, remove tip and pull out fuse. 2. Replace fuse with a new 2-amp fast-blow fuse from an electronics store such as Radio Shack. 3. Reassemble the adapter and securely screw the cap back onto the adapter body.
File Problems	
Upload of files from YSI 556 MPS to PC fails	1. Make sure that cable is connected properly to both 556 and PC. 2. Make certain that the proper Comm port is selected in EcoWatch for Windows.
Barometer data is not stored with sensor data file.	Make sure **Store barometer** is active in the 556 **Logging setup** menu.
Site Descriptions in the **Site List** are "grayed-out" and not available for appending files with additional data.	There is a parameter mismatch between the current 556 setup and that initially used. Change the current logging and sensor setup to match the setup that was initially used to create the file.
Sensor Problems	
Dissolved Oxygen reading unstable or inaccurate. Out of Range message appears during calibration.	Sensor not properly calibrated. Follow DO cal procedures.
	Membrane not properly installed or may be punctured. Replace membrane cap.
	DO sensor electrodes require cleaning. Follow DO cleaning procedure. Use 5511 Maintenance kit.
	Water in sensor connector. Dry connector; reinstall sensor.
	Algae or other contaminant clinging to DO sensor. Rinse DO sensor with clean water.
	Barometric pressure entry is incorrect. Repeat DO cal procedure.
	Calibrated at extreme temperature. Recalibrate at (or near) sample temperature.
	DO sensor has been damaged. Replace sensor.
	Internal failure. Return probe module for service.

PROBLEM	POSSIBLE SOLUTION
Sensor Problems	
pH or ORP readings are unstable or inaccurate. Out of Range message appears during calibration.	Sensor requires cleaning. Follow sensor cleaning procedure.
	Sensor requires calibration. Follow cal procedures.
	pH sensor reference junction has dried out from improper storage. Soak sensor in tap water or buffer until readings become stable.
	Water in sensor connector. Dry connector; reinstall sensor.
	Sensor has been damaged. Replace sensor.
	Calibration solutions out of spec or contaminated with other solution. Use new calibration solutions.
	ORP fails Zobell check. Take into account temperature dependence of Zobell solution readings.
	Internal failure. Return probe module for service.
Conductivity unstable or inaccurate. Out of Range message appears during calibration.	Conductivity improperly calibrated. Follow calibration procedure.
	Conductivity sensor requires cleaning. Follow cleaning procedure.
	Conductivity sensor damaged. Replace sensor.
	Calibration solution out of spec or contaminated. Use new calibration solution.
	Internal failure. Return probe module for service.
	Calibration solution or sample does not cover entire sensor. Immerse sensor fully.
Temperature, unstable or inaccurate	Water in connector. Dry connector; reinstall sensor.
	Sensor has been damaged. Replace the 5560 sensor.
Installed sensor has no reading	The sensor has been disabled. Enable sensor.
	Water in sensor connector. Dry connector; reinstall sensor.
	Sensor has been damaged. Replace the sensor.
	Report output improperly set up. Set up report output.
	Internal failure. Return probe module for service.

If these guidelines and tips fail to correct your problem or if any other symptoms occur, contact YSI Customer Service for Advice. Refer to *Appendix E Customer Service*.

14. Appendix A YSI 556 MPS Specifications

14.1 Sensor Specifications

Dissolved Oxygen	
Sensor Type	Steady state polarographic
Range: *% air sat'n* *mg/L*	▪ 0 to 500% air saturation ▪ 0 to 50 mg/L
Accuracy: *% air sat'n* *mg/L*	▪ 0 to 200% air saturation: ±2% of the reading or 2% air saturation; whichever is greater ▪ 200 to 500% air saturation: ±6% of the reading ▪ 0 to 20 mg/L: ±2% of the reading or 0.2 mg/L; whichever is greater ▪ 20 to 50 mg/L: ±6% of the reading
Resolution: *% air sat'n* *mg/L*	▪ 0.1% air saturation ▪ 0.01 mg/L
Temperature	
Sensor Type:	YSI Precision™ thermistor
Range:	-5 to 45°C
Accuracy:	±0.15°C
Resolution:	0.01°C
Conductivity	
Sensor Type:	4-electrode cell with auto-ranging
Range:	0 to 200 mS/cm
Accuracy:	±0.5% of reading or ±0.001 mS/cm; whichever is greater–4 meter cable ±1.0% of reading or ±0.001 mS/cm; whichever is greater–20 meter cable
Resolution:	0.001 mS/cm to 0.1 mS/cm (range-dependent)
Salinity	
Sensor Type:	Calculated from conductivity and temperature
Range:	0 to 70 ppt
Accuracy:	±1.0% of reading or 0.1 ppt; whichever is greater
Resolution:	0.01 ppt

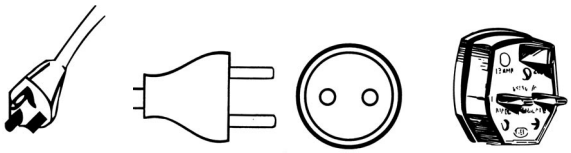
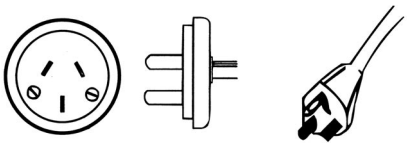
pH (optional)	
Sensor Type:	Glass combination electrode
Range:	0 to 14 units
Accuracy:	±0.2 units
Resolution:	0.01 units
ORP (optional)	
ORP Sensor Type:	Platinum button
Range:	-999 to +999 mV
Accuracy:	±20 mV
Resolution:	0.1 mV

Barometer (optional)	
Range:	500 to 800 mm Hg
Accuracy:	±3 mm Hg within ±15°C temperature range from calibration point
Resolution:	0.1 mm Hg

14.2 Instrument Specifications

Memory Size:	1.5 MB Flash Memory 49,000 data sets (@ 6 parameters per set plus time stamp) 100 Sites
Size:	11.9 cm width x 22.9 cm length (4.7 in. x 9 in.)
Weight with batteries:	0.92 kg (2.1 lbs)
Power:	4 alkaline C-cells; optional rechargeable pack
Cables:	4, 10, and 20 m (13.1, 32.8, 65.6 ft.) lengths
Warranty:	3-Years for the instrument; 1-Year for the probe modules and cable

15. Appendix B Instrument Accessories

ITEM #	ACCESSORY
5563-4	4m Cable with DO/temp/conductivity
5563-10	10m Cable with DO/temp/conductivity
5563-20	20m Cable with DO/temp/conductivity
5564	pH Kit
5565	pH/ORP Kit
6118	Rechargeable Battery Pack Kit for use in US
5094	Rechargeable Battery Pack Kit with universal charger and three adapter cables for use in international applications 
5095	Rechargeable Battery Pack Kit with universal charger and two adapter cables for use in international applications 
5083	Flow Cell – probe module is secured in the flow cell and groundwater is pumped through it
616	Charger, Cigarette Lighter – used to power up the instrument from a car's cigarette lighter
4654	Tripod
614	Ultra Clamp, C Clamp –used to clamp the instrument to a table top or car dashboard
6081	Large Carrying Case, Hard-sided
5085	Hands-free Harness
5065	Carrying Case, Form-fitted, for use in the field – has a clear vinyl window, shoulder strap, belt loop strap and hand strap

16. Appendix C Required Federal Communications Notice

The Federal Communications Commission defines this product as a computing device and requires the following notice.

This equipment generates and uses radio frequency energy and if not installed and used properly, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class A or Class B computing device in accordance with the specification in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient the receiving antenna
- Relocate the computer with respect to the receiver
- Move the computer away from the receiver
- Plug the computer into a different outlet so that the computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet, prepared by the Federal Communications Commission, helpful: "How to Identify and Resolve Radio-TV Interference Problems". This booklet is available from the U.S. Government Printing Office, Washington, D.C. 20402, Stock No.0004-000-00345-4.

17. Appendix D Health and Safety

YSI Conductivity solutions: 3161, 3163, 3165, 3167, 3168, 3169

INGREDIENTS:

- ❑ Iodine
- ❑ Potassium Chloride
- ❑ Water

WARNING: INHALATION MAY BE FATAL.

⚠ ***CAUTION*: AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY EVOLVE TOXIC FUMES IN FIRE.**

Harmful if ingested or inhaled. Skin or eye contact may cause irritation. Has a corrosive effect on the gastro-intestinal tract, causing abdominal pain, vomiting, and diarrhea. Hyper-sensitivity may cause conjunctivitis, bronchitis, skin rashes etc. Evidence of reproductive effects.

FIRST AID:
INHALATION: Remove victim from exposure area. Keep victim warm and at rest. In severe cases seek medical attention.
SKIN CONTACT: Remove contaminated clothing immediately. Wash affected area thoroughly with large amounts of water. In severe cases seek medical attention.
EYE CONTACT: Wash eyes immediately with large amounts of water, (approx. 10 minutes). Seek medical attention immediately.
INGESTION: Wash out mouth thoroughly with large amounts of water and give plenty of water to drink. Seek medical attention immediately.

YSI pH 4.00, 7.00, and 10.00 Buffer Solutions: 3821, 3822, 3823

pH 4 INGREDIENTS:

- ❑ Potassium Hydrogen Phthalate
- ❑ Formaldehyde
- ❑ Water

pH 7 INGREDIENTS:

- ❑ Sodium Phosphate, Dibasic
- ❑ Potassium Phosphate, Monobasic
- ❑ Water

pH 10 INGREDIENTS:

- ❑ Potassium Borate, Tetra
- ❑ Potassium Carbonate
- ❑ Potassium Hydroxide
- ❑ Sodium (di) Ethylenediamine Tetraacetate
- ❑ Water

⚠ ***CAUTION*** **- AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY AFFECT MUCOUS MEMBRANES.**

Inhalation may cause severe irritation and be harmful. Skin contact may cause irritation; prolonged or repeated exposure may cause Dermatitis. Eye contact may cause irritation or conjunctivitis. Ingestion may cause nausea, vomiting and diarrhea.

FIRST AID:

INHALATION - Remove victim from exposure area to fresh air immediately. If breathing has stopped, give artificial respiration. Keep victim warm and at rest. Seek medical attention immediately.

SKIN CONTACT - Remove contaminated clothing immediately. Wash affected area with soap or mild detergent and large amounts of water (approx. 15-20 minutes). Seek medical attention immediately.

EYE CONTACT - Wash eyes immediately with large amounts of water (approx. 15-20 minutes), occasionally lifting upper and lower lids. Seek medical attention immediately.

INGESTION - If victim is conscious, immediately give 2 to 4 glasses of water and induce vomiting by touching finger to back of throat. Seek medical attention immediately.

YSI Zobell Solution: 3682

INGREDIENTS:

- Potassium Chloride
- Potassium Ferrocyanide Trihydrate
- Potassium Ferricyanide

⚠ ***CAUTION*** **- AVOID INHALATION, SKIN CONTACT, EYE CONTACT OR INGESTION. MAY AFFECT MUCOUS MEMBRANES.**

May be harmful by inhalation, ingestion, or skin absorption. Causes eye and skin irritation. Material is irritating to mucous membranes and upper respiratory tract. The chemical, physical, and toxicological properties have not been thoroughly investigated.

Ingestion of large quantities can cause weakness, gastrointestinal irritation and circulatory disturbances.

FIRST AID:

INHALATION - Remove victim from exposure area to fresh air immediately. If breathing has stopped, give artificial respiration. Keep victim warm and at rest. Seek medical attention immediately.

SKIN CONTACT - Remove contaminated clothing immediately. Wash affected area with soap or mild detergent and large amounts of water (approx. 15-20 minutes). Seek medical attention immediately.

EYE CONTACT - Wash eyes immediately with large amounts of water (approx. 15-20 minutes), occasionally lifting upper and lower lids. Seek medical attention immediately.

INGESTION - If victim is conscious, immediately give 2 to 4 glasses of water and induce vomiting by touching finger to back of throat. Seek medical attention immediately.

18. Appendix E Customer Service

For information on Authorized Service Centers, refer to *Authorized Service Centers* in this appendix.

Equipment exposed to biological, radioactive, or toxic materials must be cleaned and disinfected before being returned or presented for service. A cleaning certificate must accompany the equipment. Refer to *18.2 Cleaning Instructions* in this appendix.

18.1 YSI Environmental Authorized Service Centers

For information on the nearest authorized service center, please contact:

YSI Technical Support • 1725 Brannum Lane
Yellow Springs, Ohio • 45387 • Phone: +1 (937) 767-7241
Phone: 800-897-4151 (US) • Email: environmental@ysi.com

or visit our website for the most current information:

www.ysi.com

18.2 Cleaning Instructions

Equipment exposed to biological, radioactive, or toxic materials must be cleaned and disinfected before being serviced. Biological contamination is presumed for any instrument, probe, or other device that has been used with body fluids or tissues, or with wastewater. Radioactive contamination is presumed for any instrument, probe or other device that has been used near any radioactive source.

If an instrument, probe, or other part is returned or presented for service without a Cleaning Certificate, and if in our opinion it represents a potential biological or radioactive hazard, our service personnel reserve the right to withhold service until appropriate cleaning, decontamination, and certification has been completed. We will contact the sender for instructions as to the disposition of the equipment. Disposition costs will be the responsibility of the sender.

When service is required, either at the user's facility or at a YSI Service Center, the following steps must be taken to ensure the safety of service personnel.

- In a manner appropriate to each device, decontaminate all exposed surfaces, including any containers. 70% isopropyl alcohol or a solution of 1/4-cup bleach to 1-gallon tap water is suitable for most disinfecting. Instruments used with wastewater may be disinfected with .5% Lysol if this is more convenient to the user.
- The user shall take normal precautions to prevent radioactive contamination and must use appropriate decontamination procedures should exposure occur.
- If exposure has occurred, the customer must certify that decontamination has been accomplished and that no radioactivity is detectable by survey equipment.
- Any product being returned to the YSI Repair Center should be packed securely to prevent damage.
- Cleaning must be completed and certified on any product before returning it to YSI.

18.3 Packing Procedure

- Clean and decontaminate items to ensure the safety of the handler.
- Complete and include the Cleaning Certificate.
- Place the product in a plastic bag to keep out dirt and packing material.
- Use a large carton, preferably the original, and surround the product completely with packing material.
- Insure for the replacement value of the product.

18.4 Cleaning Certificate

Organization _____

Department _____

Address _____

City _____ State __ Zip _____

Country _____ Phone _____

Model No. of Device __ Lot Number _____

Contaminant (if known) _____

Cleaning Agent(s) used _____

Radioactive Decontamination Certified?

(Answer only if there has been radioactive exposure)

_____ Yes _____ No

Cleaning Certified By _____

Name Date

18.5 Warranty

The instrument is warranted for three years against defects in workmanship and materials when used for its intended purposes and maintained according to instructions. The probe module and cables are warranted for one year. The dissolved oxygen, temperature/conductivity, pH, and pH/ORP combination sensors are warranted for one year. Damage due to accidents, misuse, tampering, or failure to perform prescribed maintenance is not covered. The warranty period for chemicals and reagents is determined by the expiration date printed on their labels. Within the warranty period, YSI will repair or replace, at its sole discretion, free of charge, any product that YSI determines to be covered by this warranty.

To exercise this warranty, write or call your local YSI representative, or contact YSI Customer Service in Yellow Springs, Ohio. Send the product and proof of purchase, transportation prepaid, to the Authorized Service Center selected by YSI. Repair or replacement will be made and the product returned transportation prepaid. Repaired or replaced products are warranted for the balance of the original warranty period, or at least 90 days from date of repair or replacement.

Limitation of Warranty

This Warranty does not apply to any YSI product damage or failure caused by (i) failure to install, operate or use the product in accordance with YSI's written instructions, (ii) abuse or misuse of the product, (iii) failure to maintain the product in accordance with YSI's written instructions or standard industry procedure, (iv) any improper repairs to the product, (v) use by you of defective or improper components or parts in servicing or repairing the product, or (vi) modification of the product in any way not expressly authorized by YSI.

THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED OR IMPLIED, INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. YSI'S LIABILITY UNDER THIS WARRANTY IS LIMITED TO REPAIR OR REPLACEMENT OF THE PRODUCT, AND THIS SHALL BE YOUR SOLE AND EXCLUSIVE REMEDY FOR ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY. IN NO EVENT SHALL YSI BE LIABLE FOR ANY SPECIAL, INDIRECT, INCIDENTAL OR CONSEQUENTIAL DAMAGES RESULTING FROM ANY DEFECTIVE PRODUCT COVERED BY THIS WARRANTY.

19. Appendix F Ferrite Bead Installation

⚠ **WARNING:** If you are using your YSI 556 in a European Community (CE) country or in Australia or New Zealand, you must attach a ferrite bead to the 655173 PC Interface Cable and the YSI 6117 Charger Adapter Cable in order to comply with the Residential, Commercial and Light Industrial Class B Limits for radio-frequency emissions specified in EN55011 (CISPR11) for Industrial, Scientific and Medical laboratory equipment. These ferrite assemblies are supplied as part of cable kits.

1. Make a small loop (approximately 5 cm in diameter) in the cable near the YSI 556 MS-19 connector.

2. Lay the open ferrite bead assembly under the loop with the cable cross-over position within the cylinder of the ferrite bead.

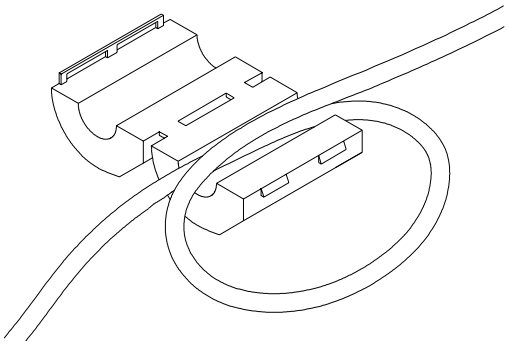


Figure 19.1 Ferrite Bead Installation

3. Snap the two pieces of the bead together making certain that the tabs lock securely.

4. When the installation is complete, the 655173 and YSI 6117 cables should resemble the following drawings.

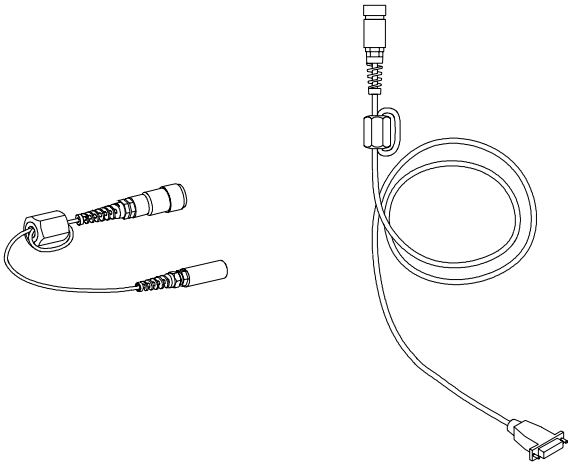


Figure 19.2 Cables with Ferrite Beads

20. Appendix G EcoWatch

EcoWatch™ for Windows™ must be used as the PC software interface to the YSI 556 MPS. EcoWatch is a powerful tool that can also be used with YSI 6-series sondes. Many features of the software will only be utilized by advanced users or are not relevant to the 556 MPS at all. This section is designed in tutorial format to familiarize you with the commonly used features of EcoWatch so that it will be possible to:

- Upload data from a 556 MPS to a PC
- Assemble plots and reports of your data
- Zoom in on certain segments of the plots of your data to facilitate analysis
- Show statistical data for your studies
- Export data in spreadsheet-compatible formats
- Print plots and reports

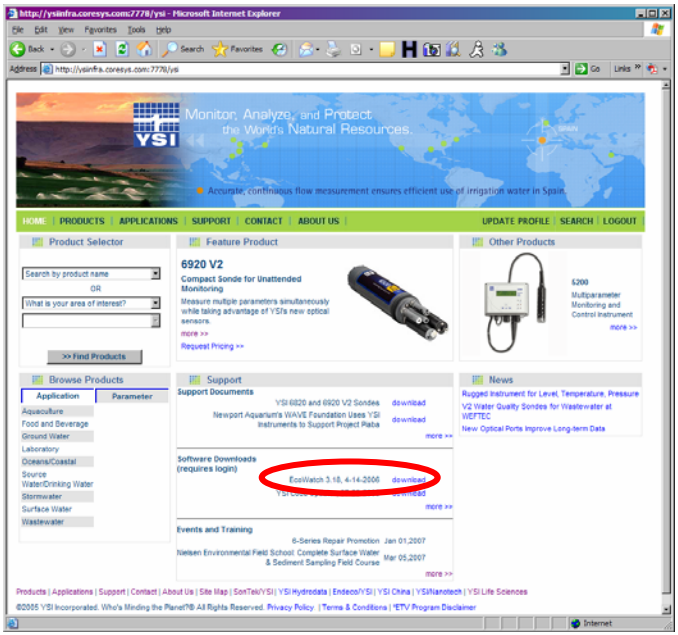
The advanced features of EcoWatch can be explored by downloading a 6-series manual from the YSI Web Site (www.ysi.com), purchasing a hard copy of the manual through YSI Customer Service (Item # 069300), or utilizing the on-line help feature of the software.

20.1 Installing EcoWatch for Windows

EcoWatch for Windows is available at no cost via a download from the YSI Web Site.

1. Access the YSI Web Site at www.ysi.com.

2. Click on the **Login** link and login (or register if you have not previously registered).



3. Click on the EcoWatch link and save the file to a directory on your computer.

4. After the download is complete, run the EcoWatch file (that you just downloaded) and follow the on screen instructions to install the software on your computer.

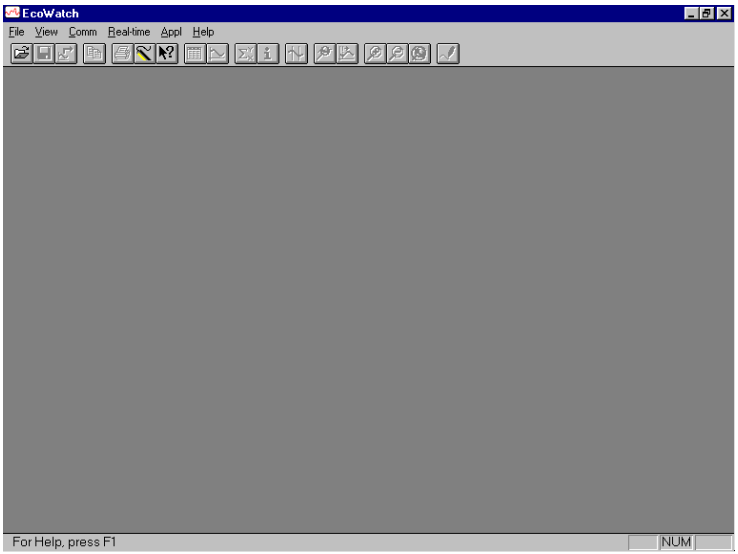
If you encounter difficulties in the download procedure, contact YSI Customer Service. Refer to ***Appendix E Customer Service***. Alternatively, you may purchase the software on CD ROM (Item #006075) by contacting YSI Customer Service.

20.2 EcoWatch Tutorial

This EcoWatch tutorial is designed to teach you the commonly used operations associated with the software when used with your 556 MPS.

After you have uploaded a file, Refer to Section 8.4 Upload to PC, you will see two files in the C:\ECOWWIN\DATA directory; the file you transferred and a file supplied by YSI designated SAMPLE.DAT. This SAMPLE.DAT file is referred to in the remainder of this tutorial section. After following the instructions below for the analysis of SAMPLE.DAT, you apply the same analysis to the data file which was uploaded from your 556 MPS to assure that you are familiar with the basic features and capabilities of EcoWatch for Windows.

To start the analysis of the SAMPLE.DAT file, note that a shortened menu bar is visible and many of the tools in the toolbar appear dimmed or “grayed out” before any file is opened (see below).



Full activation of EcoWatch features will be realized after a file is opened.

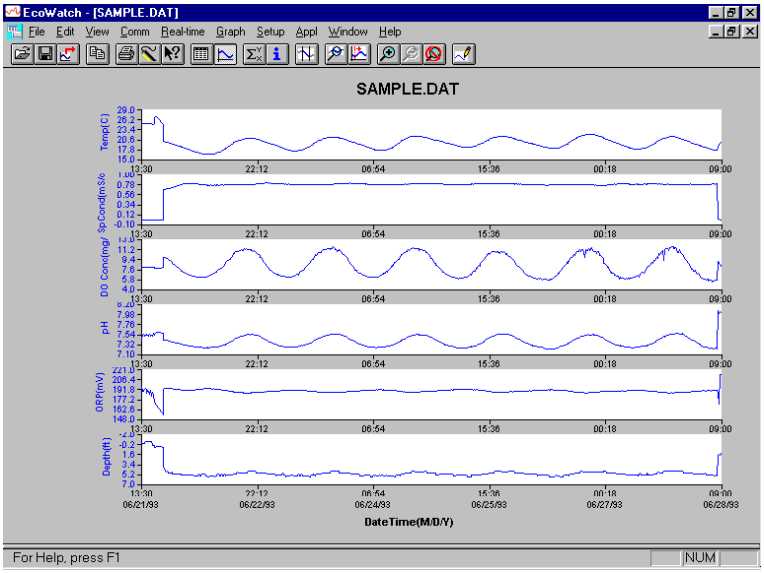
To open the sample data file:

5. 1. Click the **File** menu button in the toolbar.

6. 2. Select the **SAMPLE.DAT** file.

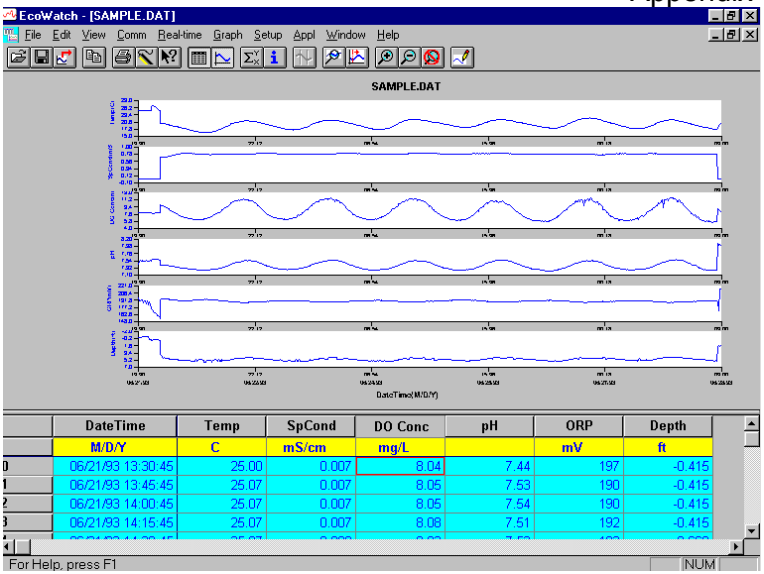
7. 3. Click **OK** to open the file.

The following display will appear:



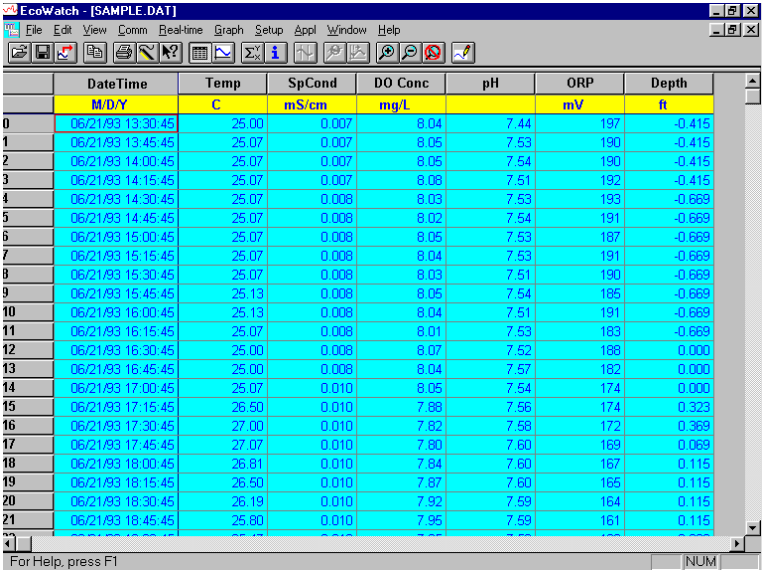
Note that the data in this file appears as a graph of temperature, specific conductance, dissolved oxygen, pH, ORP, and depth, all versus time. The graphs are scaled automatically so that all data fits comfortably on the computer screen. Note also that this data file was obtained with a 6-series sonde for which a depth sensor is available. Depth is NOT a current parameter for the 556 MPS.

The **Table** and **Graph** buttons on the toolbar are on/off switches that are used to display or hide the graph and table pages respectively. When displaying a graph and a table at the same time, you can control the relative size of the two pages by placing the cursor over the small bar that separates them and then dragging it to the desired location. Click the **Table** button to generate the following dual display of data.



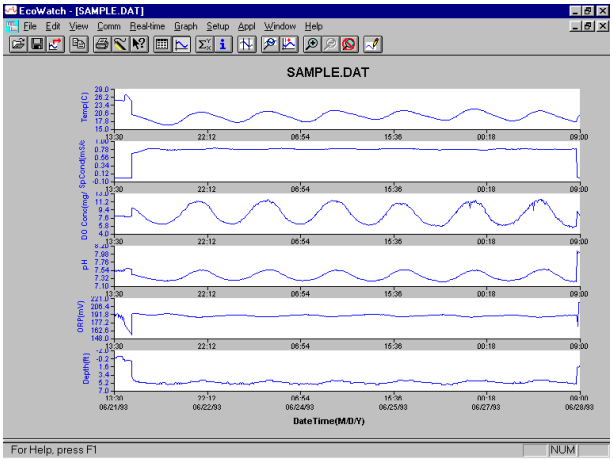
	DateTime	Temp	SpCond	DO Conc	pH	ORP	Depth
	M/D/Y	C	mS/cm	mg/L		mV	ft
0	06/21/93 13:30:45	25.00	0.007	8.04	7.44	197	-0.415
1	06/21/93 13:45:45	25.07	0.007	8.05	7.53	190	-0.415
2	06/21/93 14:00:45	25.07	0.007	8.05	7.54	190	-0.415
3	06/21/93 14:15:45	25.07	0.007	8.08	7.51	192	-0.415

Now click the **Graph** button (turn it off) to display only a report of your data as shown below. Note that the size of the report can be varied by clicking on the and buttons in the Toolbar.

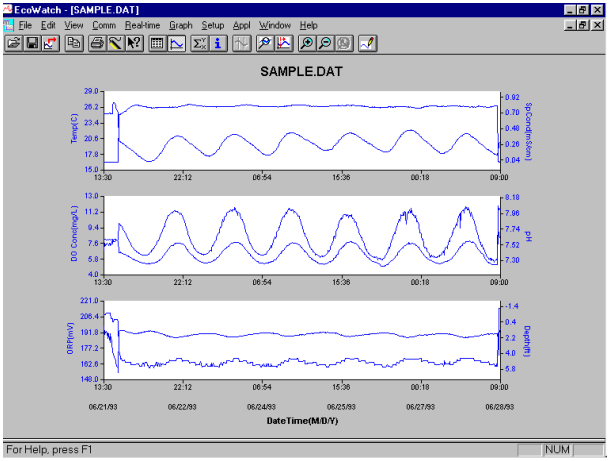


	DateTime	Temp	SpCond	DO Conc	pH	ORP	Depth
	M/D/Y	C	mS/cm	mg/L		mV	ft
0	06/21/93 13:30:45	25.00	0.007	8.04	7.44	197	-0.415
1	06/21/93 13:45:45	25.07	0.007	8.05	7.53	190	-0.415
2	06/21/93 14:00:45	25.07	0.007	8.05	7.54	190	-0.415
3	06/21/93 14:15:45	25.07	0.007	8.08	7.51	192	-0.415
4	06/21/93 14:30:45	25.07	0.008	8.03	7.53	193	-0.669
5	06/21/93 14:45:45	25.07	0.008	8.02	7.54	191	-0.669
6	06/21/93 15:00:45	25.07	0.008	8.05	7.53	187	-0.669
7	06/21/93 15:15:45	25.07	0.008	8.04	7.53	191	-0.669
8	06/21/93 15:30:45	25.07	0.008	8.03	7.51	190	-0.669
9	06/21/93 15:45:45	25.13	0.008	8.05	7.54	185	-0.669
10	06/21/93 16:00:45	25.13	0.008	8.04	7.51	191	-0.669
11	06/21/93 16:15:45	25.07	0.008	8.01	7.53	183	-0.669
12	06/21/93 16:30:45	25.00	0.008	8.07	7.52	188	0.000
13	06/21/93 16:45:45	25.00	0.008	8.04	7.57	182	0.000
14	06/21/93 17:00:45	25.07	0.010	8.05	7.54	174	0.000
15	06/21/93 17:15:45	26.50	0.010	7.88	7.56	174	0.323
16	06/21/93 17:30:45	27.00	0.010	7.82	7.58	172	0.369
17	06/21/93 17:45:45	27.07	0.010	7.80	7.60	169	0.069
18	06/21/93 18:00:45	26.81	0.010	7.84	7.60	167	0.115
19	06/21/93 18:15:45	26.50	0.010	7.87	7.60	165	0.115
20	06/21/93 18:30:45	26.19	0.010	7.92	7.59	164	0.115
21	06/21/93 18:45:45	25.80	0.010	7.95	7.59	161	0.115

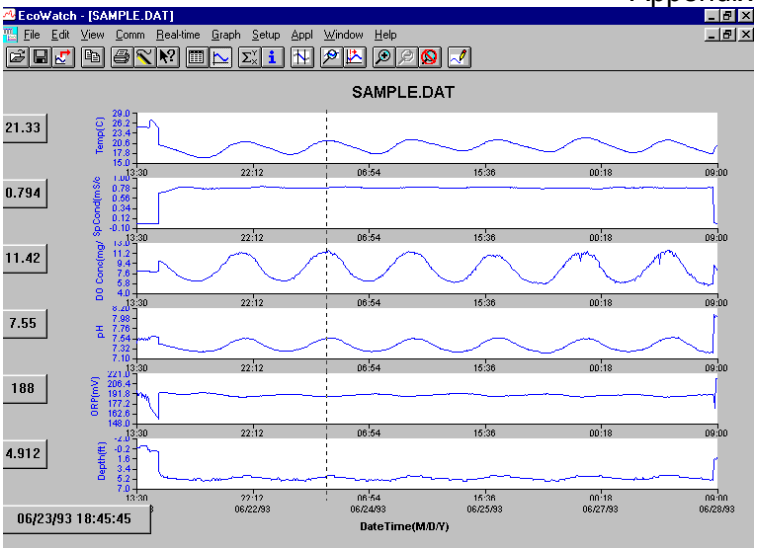
Now return to the original graphic display by toggling the **Table** button “off” and **Graph** button “on”.



From the **Setup** menu, click **Graph**. Click **2 Traces per Graph** and notice that the parameters are now graphed in pairs for easy comparison of parameters.

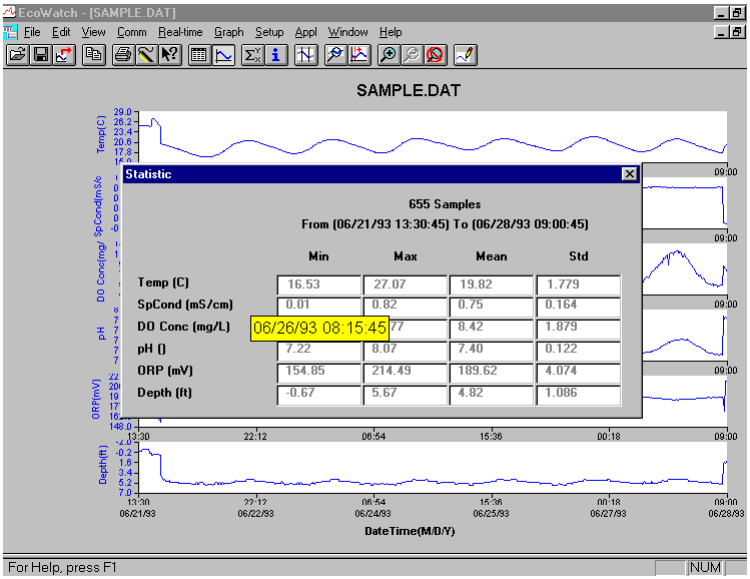


Click **1 Trace per Graph** to return the display to the original setting. Move the cursor to any position in the graph, then click and hold the right mouse button.



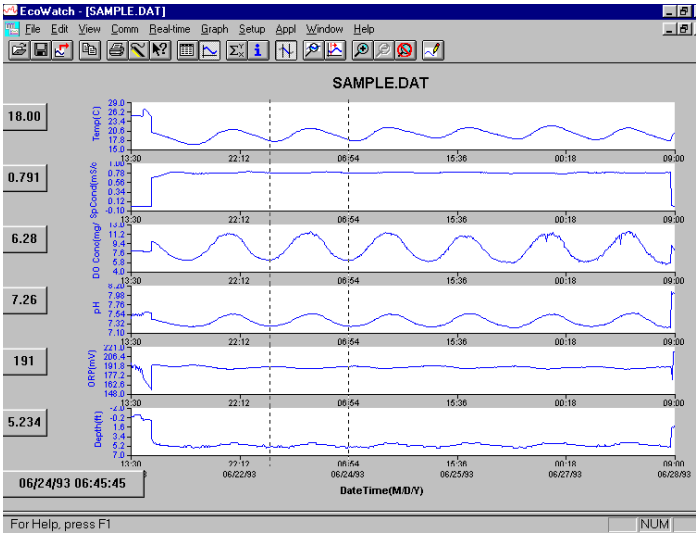
Note that the exact measurements for this point in time are displayed to the left of the graph. While holding down the right mouse button, move to another area on the graph. Notice how the measurements change as you move. When you release the mouse button, the display returns to normal.

To view statistical information for the study, click the **Statistics** button on the toolbar. On the statistics window, click on any min or max value to display the time when it occurred.

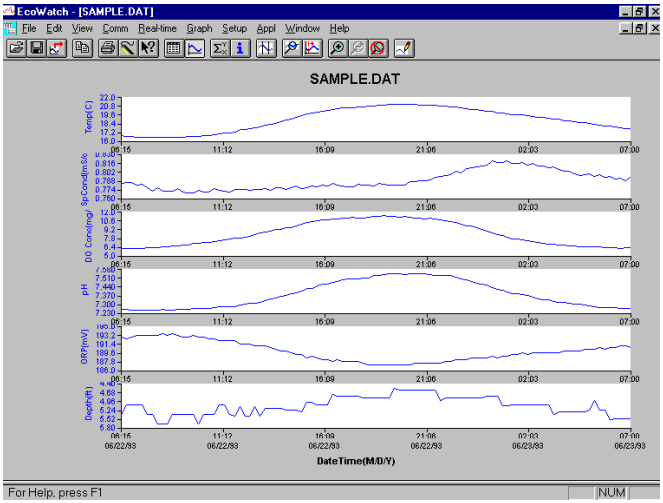


After viewing statistics, click the “x” at the upper right to close the window and return to the normal display.

Now click on the delimiter icon in the toolbar and then move the displayed icon to the graph. Click at the two points shown by dotted lines in the display below, being sure that the first click is to the left of the second.

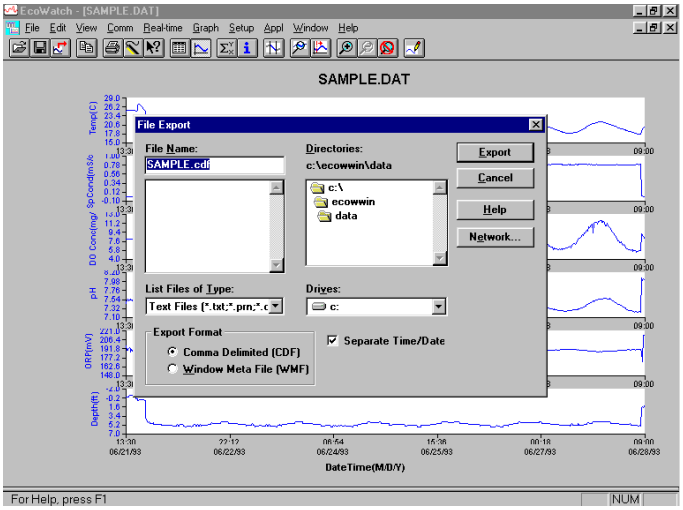


The data between the two selected points will then be graphed in higher resolution as shown below.

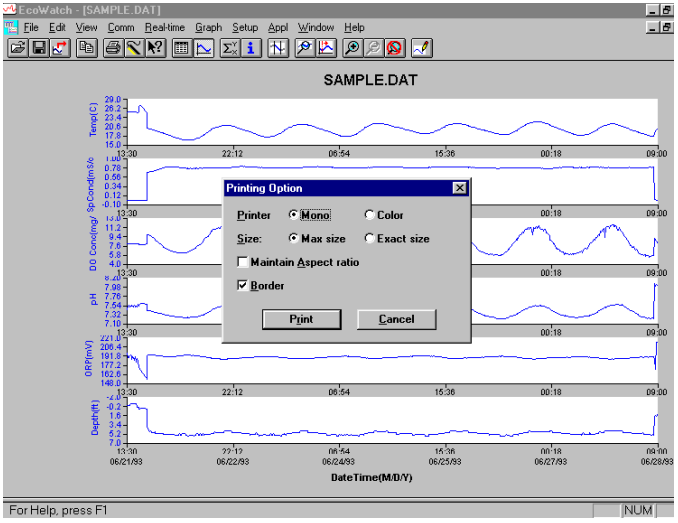


To return to the complete data set, select **Graph** from the toolbar and then click **Cancel Limits**.

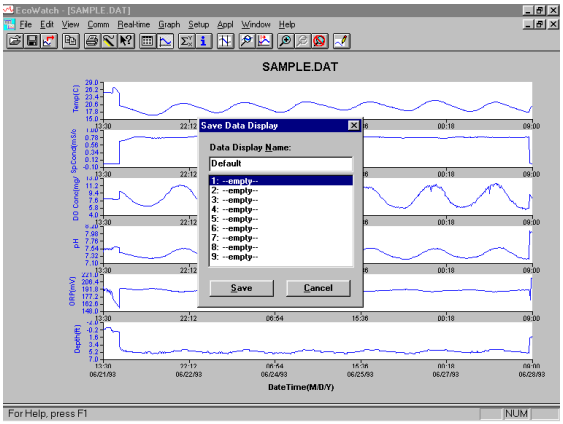
Now select the icon from the Toolbar to create a new data file which will allow your data to be imported into spreadsheets. Select the default export settings for a Comma Delimited File (.CDF) and click OK. A new spreadsheet-importable file (SAMPLE.CDF) is now present in the same folder as the SAMPLE.DAT file.



Now select the icon from the toolbar to print the plot. Accept the default settings and click OK to complete the printing operation.



Finally, end the tutorial by saving the **Data Display** in the format shown. From the **File** menu, click **Save Data Display**.



Then type "Default" for the file name and click **Save**. The parameters, colors, format, and x-axis time interval associated with the current display are now saved and can be accessed any time in the future. Nine different data displays may be saved for any data file. You can easily switch between various displays of the data. The data files can be accessed by clicking **Load Data Display** from the file menu and then selecting the desired presentation.

20.2.1 Summary of Toolbar Capability

The EcoWatch toolbar includes buttons for some of the most common commands in EcoWatch, such as **File Open**. To display or hide the toolbar, open the **View** menu and click on the **Toolbar** command. A check mark appears next to the menu item when the toolbar is displayed.

The toolbar is displayed across the top of the application window, below the menu bar.

Click To:

Open an existing data file (.DAT). EcoWatch displays the **Open** dialog box, in which you can locate and open the desired file.

Save the working Data Display of the active data file. EcoWatch displays the **Save Data Display** dialog box in which you can overwrite existing Data Display or save to a new one.

Export data as a graph in Window Meta File (.WMF) format or as data in Comma Delimited (.CDF) format.

Copy the whole graph page or data from the selection on the table to the clipboard.

Print the active graph page or table page depending on which one is currently active.

Open a new terminal window to communicate with the sonde.

Access context sensitive help (Shift+F1).

Toggle table window during file processing.

Toggle graph window during file processing.

Display study statistics.

Display study info.

Limit the data to be processed in a study.

Enlarge a selective portion of graph.

Center the graph under the cursor.

Enlarge graph or table 20%.

Reduce graph or table 20%.

Return graph or table to its normal state (unzoom)

Redraw the graph.

20.2.2 Other Capabilities

The above tutorial and function list for the toolbar provide basic information to allow you to view and analyze the field data which was stored in your 556 MPS. Some of the other commonly used capabilities of EcoWatch which the user may want to explore are listed below:

- Customize the units for each parameter, e.g., report uS/cm instead of mS/cm for conductivity.
- Customize the order of parameters in each plot or report.
- Customize the colors and fonts of each data display.
- Manually scale the y-axis sensitivity for each parameter.
- Merging of two or more data files with compatible parameter formats
- View information about the study such as number of points, instrument serial number, etc. which was stored in the 556 with the data.
- Print data reports in different statistical formats.
- Create plots of parameter vs. parameter rather than parameter vs. time.

These additional features of EcoWatch for Windows are explained in detail in the YSI 6-series manual (which can be downloaded at no cost from the YSI Web Site as described above) and the Help selection in the EcoWatch menubar. To purchase a hard copy of the 6-series manual, contact YSI Customer Service using the contact information in *Appendix E Customer Service*.

21. Appendix H Calibration Record Information

When your YSI 556 MPS sensors are initially calibrated, relevant information about the sensors will be stored in a separate file in the YSI 556 MPS memory.

NOTE: This file, by default, will have the name "556 Circuit Board Serial Number.glp." The circuit board serial number is assigned at the factory and has a hexadecimal format such as 000080A4. Thus the default calibration record file would be designated 00080A4.glp. Refer to Section *10.7 GLP Filename* to change the filename.

The information in the calibration record will track the sensor performance of your instrument and should be particularly useful for programs operating under Good Laboratory Practices (GLP) protocols.

21.1 Viewing the Calibration Record (.glp) File

NOTE: Make certain that you have performed a calibration on at least one of the sensors associated with your YSI 556 MPS.

1. Follow the procedures outlined in Section *8.3 View File*.

21.2 Uploading the Calibration Record (.glp) File

NOTE: Make certain that you have performed a calibration on at least one of the sensors associated with your YSI 556 MPS.

1. Follow the procedures outlined in Section *8.4 Upload to PC*.

21.3 Understanding the Calibration Record (.glp) File

1. Open a calibration record file. Refer to Section *8.3 View File*.

2. Use the arrow keys to scroll horizontally and/or vertically to view all the data.

00008003.glp

m/d/y	hh:mm:ss	S/N
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:17:51	00008003
01/24/2001	08:25:40	00008003
01/24/2001	08:25:40	00008003

735.9mmHg

01/24/2001 08:39:53

Figure 21.1 Calibration Record Screen 1

00008003.glp

Type	Value
Conductivity gain	1.000000
DO gain	1.000000
pH gain (pH-7)*K/mV	-5.05833
pH offest (pH-7)*K	0.000000
ORP offset mV	0.000000
TDS constant	0.650000
Barometer offset PSI	0.000000
DO gain	1.110250
pH gain (pH-7)*K/mV	-5.05833
pH offest (pH-7)*K	-12.2899

735.9mmHg

01/24/2001 08:39:19

Figure 21.2 Calibration Record Screen 2

NOTE: Each sensor (not parameter) is characterized by either 1 line (Conductivity, Dissolved Oxygen, ORP, TDS, or Barometer (Optional)) or 2 lines (pH) of calibration documentation.

The left hand portion of each calibration entry shows the date and time that a calibration of a particular sensor was performed. In addition, each calibration entry is characterized by the instrument serial number, as defined by YSI. See Figure 21.1 Calibration Record Screen 1. The right hand portion shows the YSI designation of the calibration constants and their values after their calibration has been performed. A more detailed description of the calibration constants is provided below:

- **Conductivity Gain** – A relative number which describes the sensitivity of the sensor. Basically, the value represents the calculated cell constant divided by the typical value of the cell constant (5 cm^{-1}).

- **DO Gain** – A relative number which describes the sensitivity of the sensor. Basically, the value represents the sensor current at the time of calibration divided by the typical value of the sensor current (15 uA).

- **pH Gain** – A number which basically represents the sensitivity of the pH sensor. To remove the effect of temperature on the slope of the relationship of probe output in mv versus pH, the value of pH/mv is multiplied by the temperature in degrees Kelvin (K).

- **pH Offset** – A number which basically represents the offset (or intercept) of the relationship of probe output in mv versus pH, the value of pH is multiplied by the temperature in degrees Kelvin (K).

Anytime you perform a calibration, information concerning the calibration constants will be logged to the Calibration Record file (.glp file). However, if the **Delete All Files** command is used, Refer to Section *8.6 Delete All Files*, the Calibration Record file will also be lost. It is critical that this file should be uploaded to your PC prior to issuing a **Delete All Files** command. Refer to Section *8.4 Upload to PC*.

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STANDARD OPERATING PROCEDURE

Water-Level Measurements

I. Purpose and Scope

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

II. Equipment and Materials

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

III. Procedures and Guidelines

Verify that the unit is turned on and functioning properly. Slowly lower the probe on its cable into the piezometer or well until the probe just contacts the water surface; the unit will respond with a tone or light signal. Note the depth from a reference point indicated on the piezometer or well riser. Typically this is the top of the 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.

STANDARD OPERATING PROCEDURE

Global Positioning System

I. Purpose

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

II. Scope

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

III. Definitions

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

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

IV. Procedures and Guidelines

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

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

A. Calibration

1. Check to ensure that the datalogger and antenna cables are properly connected to the receiver and that the batteries are securely connected.
2. Turn the datalogger unit on by pressing the green **On** key in the bottom left corner. The datalogger will perform a self-calibration. Wait to ensure that the antenna is receiving a sufficient number of satellite signals (usually a minimum of 3).
3. Once the datalogger receives a satellite signal then it is ready for operation.

B. Operations for surveying coordinates of a location

1. The datalogger and GPS receiver are ready for use after the initial self-calibration.
2. Field data may be immediately recorded in the datalogger.
3. The first screen view is the 'Main Menu'. Use the round keypad to select 'Data Collection' and press the **Enter** key.
4. Use the round keypad to select either 'Create new file' or 'Open existing file' and press the **Enter** key. It is not necessary to create a new file at each new location; however, it may be useful to create a new file at the beginning of each day.
5. If a new file is created then the GPS unit will automatically assign it a file name. The file name may be changed if desired. Press the enter key after the file name is assigned. If opening an existing file then use the round keypad to scroll through existing file names.
6. The next screen is 'Antenna options'. Press the **Enter** key to move to the next screen.
7. Select the type of activity to be performed. At the beginning of each day 'Sample Site Detail' should be completed. This allows the operator to enter each field team member, weather, objectives, health and safety meetings, etc. Once the 'Sample Site Detail' is completed then data entry activities may begin including well purging, water level elevations, and sample collection
8. The datalogger prompts the operator when a data field is required and by using the round key pad, numeric, alphanumeric, enter, and escape keys, the operator can perform electronic data capture on the GPS datalogger.
9. Once all information pertaining to an individual site has been recorded, press enter to complete data entry. If GPS signal is obstructed (tree canopy, building height, etc) user may choose to remain in same location until satellite transmission clears the obstruction. This usually takes only a few moments. Data may still be captured and recorded electronically even if GPS signal is insufficient for positioning.
10. To shut down, press the **Escape** key to return to the 'Main Menu'. The unit can be turned off by pressing the green key in the left hand corner. The datalogger should only be turned off when the 'Main Menu' screen is displayed.
11. All data from the datalogger should be downloaded into Trimble Pathfinder Office software on a PC a minimum of once daily. It is recommended that data is downloaded twice daily. Data may be viewed and mapped using Pathfinder Office or exported to

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

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

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

D. Preventive Maintenance

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

STANDARD OPERATING PROCEDURE

Monitoring Well and Borehole Abandonment

I. Purpose and Scope

The purpose of this procedure is to outline equipment and methods that will be used for abandoning monitoring wells. Temporary or permanent monitoring wells or boreholes should be abandoned, or sealed, in order to prevent the borehole or well from as acting as a conduit and/or to prevent cross contamination between hydrogeologic units. Abandoning surface casings installed for double-cased wells also is discussed.

The purpose; location; groundwater quality; age; condition of the well, borehole, or any surface casing; potential for groundwater contamination and cross contamination between water-bearing units; and well, borehole, or surface-casing construction should be considered to determine if a borehole or monitoring well should be abandoned. State-specific requirements for well abandonment should be reviewed and consulted along with this SOP; such requirements may be included in the well permit, if such documents are required. Adequate information to define the former well or borehole location should be collected and maintained in the project files to ensure that the location can be relocated in the future, if necessary.

II. Equipment and Materials

- Drilling rig with appropriate equipment
- Pure, additive-free powdered bentonite for grout
- Cement-Bentonite Grout. Proportion 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.
- Tremie pipe
- Containerization for well riser, casing, and/or cuttings produced if riser and casing are drilled out and for water displaced from the well, borehole, or surface casing during abandonment.

III. Procedures and Guidelines

Boreholes and monitoring wells may be abandoned by sealing in place using grout or by removing or drilling out the well riser and sealing the remaining borehole. Surface casings may be abandoned by similar means.

A. Leaving the Well Screen and Riser and Sealing In-Place

Monitoring wells known to be constructed with an impermeable annular space seal may be abandoned by leaving the well riser in place and sealing the well by filling with grout.

1. The monitoring well screen and casing should be split or "ripped" prior to emplacement of the grout slurry whenever possible. This can be accomplished through the use of a casing splitting tool and drill rig. The splitting tool is attached to the lead drill rod and pushed down through the center of the monitoring well. As the tool is forced down, the splitting tool splits the PVC well casing and screen. This will allow better penetration of the grout slurry into the former annular space of the borehole and provide a more thorough grout seal.

2. Boreholes and monitoring wells should be completely filled with cement grout, bentonite-cement grout, bentonite grout, or concrete. The sealant should be delivered as a slurry which is pumped via a tremie pipe from the bottom of the borehole/monitoring well.

3. Following the completion of the grouting, the monitoring well stick-up or flush mounted protective cover and ground surface seal should be removed and the well riser should be cut off at least 24 inches below the ground surface. The location should then be finished at ground surface with like material (e.g., asphalt or concrete for paved areas and soil or sod in dirt or grass areas).

B. Well Riser Removal or Drilling Out and Sealing the Remaining Borehole

Monitoring wells that are not known to be constructed with an impermeable annular space seal should be abandoned by removing the well riser, if possible, or drilling out the well riser and then sealing the remaining borehole.

1. Prior to abandonment, the monitoring well stick-up or flush-mounted protective cover and ground surface seal should be removed.

2. The well riser may be removed by pulling on the riser or by overdrilling around the riser and then pulling the riser out of the ground. If it is not possible to remove the well riser, the well riser may be drilled over and removed from the borehole in pieces as the augers are removed from the borehole as borehole cuttings. The diameter of the auger used for the overdrilling should be at a minimum, the same size or larger than the diameter of the borehole to ensure that all of the well material is removed.

3. After the well riser is removed or drilled out, the remaining borehole should be sealed according to Section A above.

C. Surface Casing Removal for Double-Cased Wells and Sealing the Remaining Borehole

1. In the event that a surface casing is present around the well riser, information on the construction of the surface casing should be obtained, if possible. A decision must be made as to whether or not to remove the surface casing. If the integrity is uncertain, then the surface casing may be serving as a mode of cross connection. However, the assumption is that the surface casing does not fully penetrate the confining layer into which it is set, so it is often appropriate to leave it in place and abandon the well inside of it. The available information on

the surface casing and its age and appearance should be considered in making this decision.

2. Any work to abandon the surface casing should be done after the well riser and screen have been removed and the borehole grouted up to the bottom of the surface casing. Otherwise, soil, groundwater, and possibly contamination may fall down the surface-casing borehole into the well borehole.

3. If the decision is made to leave the casing, it can be grouted up according to Section A above and the aboveground part of the surface casing and any concrete pad removed.

4. If the decision is made to remove the surface casing, typically the surface casing should be overdrilled with a large auger and then removed. The borehole then is sealed according to Section A above. Alternatively, if the integrity of the annular seal appears to be poor, the surface casing may be removed by inserting an extraction tool in the surface casing, engaging it into the sides of the casing, and removing the casing accordingly. Again, the borehole then is sealed according to Section A above.

IV. Attachments

None.

V. Key Checks and Items

- Know the state or local regulations associated with abandoning the well or borehole
- Know the construction details of the well, surface casing, or borehole so that sound decisions can be made
- If well-construction materials are being removed from the borehole, remove as much as possible so that the borehole can be adequately grouted up
- Use a tremie pipe to ensure proper placement of grout
- Be sure the well or borehole is sealed completely to the surface
- Control IDW
- Maintain well- and borehole-location records in the project files

STANDARD OPERATING PROCEDURE

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

I. Purpose and Scope

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

II. Equipment and Materials

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

III. Procedures and Guidelines

A. Setup and Purging

1. Obtain information on well location, diameter(s), depth, and screen interval(s), and the method for disposal of purged water.

2. Calibrate instruments according to manufacturer's instructions.

3. The well number, site, date, and condition are recorded in the field logbook.

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

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

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

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

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

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

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

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

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

    - pH: within 0.1 pH units
    - Specific conductance: within 3 percent

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

B. Sample Collection

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

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

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

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

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

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

5. The bottle is capped and clearly labeled.

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

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

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

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

C. Additional remarks

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

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

IV. Attachments

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

V. Key Checks and Preventative Maintenance

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

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

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

White Paper on Low-Flow Sampling

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

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

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

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

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

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

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

STANDARD OPERATING PROCEDURE

Chain-of-Custody

I Purpose

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

II Scope

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

III Definitions

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

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

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

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

IV. Procedures

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

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

Sample Identification

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

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

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

Measurements and observations shall be recorded using waterproof ink.

Sample Label

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

- Project - CTO Number.
- Station Location - The unique sample number identifying this sample.
- Date - A six-digit number indicating the day, month, and year of sample collection (e.g., 08/21/12).

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

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

Chain-of-Custody Procedures

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

Field Custody Procedures

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

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

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

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

locations in photographs, an easily read sign with the appropriate sample location number should be included.

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

Transfer of Custody and Shipment

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

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

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

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

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

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

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

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

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

- Complete other carrier-required shipping papers.

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

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

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

V Quality Assurance Records

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

VI Attachments

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

VII References

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

Attachment A

Example Sample Label

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

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

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

SITE NAME	DATE
ANALYSIS	TIME
	PRESERVATIVE

SAMPLE TYPE

☐ Grab ☐ Composite ☐ Other _____

COLLECTED BY:

Attachment B

Example Chain-of-Custody Record

CH2M HILL
APPLIED SCIENCES LABORATORY

CHAIN OF CUSTODY RECORD AND AGREEMENT TO PERFORM SERVICES

CH2M Hill Project #: ☐☐☐☐☐☐☐☐.☐☐.☐☐☐

Purchase Order #:

Project Name:

Company Name CH2M HILL Office:

Project Manager & Phone #:
Mr. [ ]
Ms. [ ]
Dr. [ ]

Report Copy to:

Requested Completion Date:

Sampling Requirements: SDWA ☐ NPDES ☐ RCRA ☐ OTHER ____

Sample Disposal: Dispose ☐ Return ☐

LAB TEST CODES

ANALYSES REQUESTED

SHADED AREA– FOR LAB USE ONLY

Lab 1 #: | Lab 2 #:

Quote #: | Kit Request #:

Project #:

No. of Samples: | Page of

Login: | LIMS Ver:

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

Sampled By & Title (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time	QC Level: 1 2 3 Other: ____
Received By (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time	COC Rec / ICE
Received By (Please sign and print name)	Date/Time	Relinquished By (Please sign and print name)	Date/Time	Ana Req / TEMP
				Cust Seal / Ph
Received By (Please sign and print name)	Date/Time	Shipped Via: UPS BUS Fed-Ex Hand Other ____	Shipping #	
Work Authorized By (Please sign and print name)	Remarks			

Instructions and Agreement Provisions on Reverse Side

DISTRIBUTION: Original - LAB, Yellow - LAB, Pink - Client

REV 3/94 FORM 340

CHAIN OF CUSTODY

EMAX LABORATORIES, INC.
1835 W. 205th Street, Torrance, CA 90501
Tel #: 310-618-8889 Fax #: 310-618-0818
Email: info@emaxlabs.com

PO NUMBER:

SAMPLE STORAGE

EMAX CONTROL NO. *

PROJECT CODE:

CLIENT

PROJECT

COORDINATOR

TEL FAX EMAIL

SEND REPORT TO

COMPANY

ADDRESS

EMAX PM

MATRIX CODE	PRESERVATIVE CODE
DW=Drinking Water	IC = Ice
GW=Ground Water	HC = HCl
WW=Waste Water	HN=HNO3
SD=Solid Waste SL=Sludge	SH=NaOH
SS=Soil/ Sediment	ST=Na2S2O3
WP=Wipes PP=Pure Products	ZA=Zinc Acetate
AR=Air	HS=H_2SO_4
O=	

ANALYSIS REQUIRED

TAT

- ☐ Rush _____hrs.
- ☐ Rush _____days
- ☐ 7 days
- ☐ 14 days
- ☐ 21 days
- ☐ 30 days
- ☐ _____days
- ☐

SAMPLE ID		SAMPLING			CONTAINER			MATRIX CODE	QC	PRESERVATIVE CODE								COMMENTS
LAB	CLIENT	LOCATION	DATE	TIME	NO.	SIZE	TYPE											
* 1																		
* 2																		
* 3																		
* 4																		
* 5																		
* 6																		
* 7																		
* 8																		
* 9																		
* 0																		

Instructions	Cooler #	Temp. (°C)	Sample #s

SAMPLER

COURIER/AIRBILL

RELINQUISHED BY	Date	Time	RECEIVED BY

NOTICE: Turn-around-time (TAT) for samples shall not begin untill all discrepancies have been resolved. For samples received and discrepancies resolved after 1500 hrs, TAT shall start at 0800 hrs the next business day. The client is responsible for all cost associted with sample disposal. Samples shall be disposed of as soon as practical (but not prior to fifteen (15) calendar days) after issuance of analytical report unless a different sample disposal schedule is pre-arranged with EMAX. Disposal fee for samples defined by CA Title 22 as non-hazardous shall be $5.00 per sample. EMAX will return hazardous samples to the client at the client's expense unless directed in writing otherwise.

ENVIRONMENTAL CONSERVATION LABORATORIES CHAIN-OF-CUSTODY RECORD

10775 Central Port Dr.
Orlando, FL 32824
(407) 826-5314 Fax (407) 850-6945

4810 Executive Park Court, Suite 211
Jacksonville, FL 32216-6069
(904) 296-3007 Fax (904) 296-6210

102-A Woodwinds Industrial Court
Cary, NC 27511
(919) 467-3090 Fax (919) 467-3515

Client Name	Project Number
Address	Project Name/Desc
City/ST/Zip	PO # / Billing Info
Tel / Fax	Reporting Contact
Sampler(s) Name, Affiliation (Print)	Billing Contact
Sampler(s) Signature	Facility # (if required)

Requested Analyses

Requested Turnaround Times

Note : Rush requests subject to acceptance by the facility

___ Standard

___ Expedited

Due ___/___ /___

Lab Workorder

Preservation (See Codes) (Combine as necessary)

Item #	Sample ID (Field Identification)	Collection Date	Collection Time	Comp / Grab	Matrix (see codes)	Total # of Containers												Sample Comments

<-- Total # of Containers

Sample Kit Prepared By	Date/Time		Date/Time	Received By	Date/Time
Comments			Date/Time	Received By	Date/Time
			Date/Time	Received By	Date/Time
		Cooler #'s & Temps on Receipt		Condition Upon Receipt ___ Acceptable ___ Unacceptable	

Matrix : **GW**-Groundwater **SO**-Soil **SE**-Sediment **SW**-Surface Water **WW**-Wastewater **A**-Air **O**-Other (detail in comments)

Preservation: **I**-Ice **H**-HCl **N**-HNO3 **S**-H2SO4 **NO**-NaOH **O**-Other (detail in comments)

Note : All samples submitted to ENCO Labs are in accordance with the terms and conditions listed on the reverse of this form, unless prior written agreements exist

Attachment C

Example Custody Seal

CH2M HILL

CUSTODY SEAL

Date

Signature

STANDARD OPERATING PROCEDURE

Packaging and Shipping Procedures for Low-Concentration Samples

I. Purpose and Scope

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

II. Scope

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

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

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

III. Equipment and Materials

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

IV. Procedures and Guidelines

Low-Concentration Samples

A. Prepare coolers for shipment:

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

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

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

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

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

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

G. Fill remaining spaces with vermiculite or absorbent pads.

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

J Close lid and latch.

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

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

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

Medium- and High-Concentration Samples:

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

V. Attachments

None.

VI. Key Checks and Items

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

STANDARD OPERATING PROCEDURE

Equipment Blank and Field Blank Preparation

I. Purpose

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

II. Scope

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

III. Equipment and Materials

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

IV. Procedures and Guidelines

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

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

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

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

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

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

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

F. Collect next field sample.

V. Attachments

None.

VI. Key Checks and Items

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

STANDARD OPERATING PROCEDURE

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 isopropanol (DO NOT USE ACETONE)
- Large plastic pails or tubs for Liquinox® and water, scrub brushes, squirt bottles for Liquinox® solution, methanol and water, plastic bags and sheets
- DOT approved 55-gallon drum for disposal of waste
- Personal Protective Equipment as specified by the Health and Safety Plan
- Decontamination pad and steam cleaner/high pressure cleaner for large equipment

IV. Procedures and Guidelines

A. PERSONNEL DECONTAMINATION

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

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

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

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

4. Remove respirator (if worn).

5. Remove inner gloves and discard.

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

7. Sanitize respirator if worn.

B. SAMPLING EQUIPMENT DECONTAMINATION—GROUNDWATER SAMPLING PUMPS

Sampling pumps are decontaminated after each use as follows.

1. Don phthalate-free gloves.

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

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

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

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

6. Rinse with 1 gallon of tap water.

7. Rinse with 1 gallon of deionized water.

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

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

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

C. SAMPLING EQUIPMENT DECONTAMINATION—OTHER EQUIPMENT

Reusable sampling equipment is decontaminated after each use as follows.

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

D. HEALTH AND SAFETY MONITORING EQUIPMENT DECONTAMINATION

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

E. SAMPLE CONTAINER DECONTAMINATION

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

1. Wipe container with a paper towel dampened with Liquinox® solution or immerse in the solution AFTER THE CONTAINERS HAVE BEEN SEALED. Repeat the above steps using potable water.

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

F. HEAVY EQUIPMENT AND TOOLS

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

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

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

V. Attachments

None.

VI. Key Checks and Items

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

STANDARD OPERATING PROCEDURE

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
- Isopropanol, 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 isopropanol (Optional)
   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 isopropanol.

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.

Attachment D
Laboratory Department of Defense Environmental Laboratory Accreditation Program Letter

LABORATORY ACCREDITATION BUREAU

Certificate # L2278

Scope of Accreditation
For
EMAX Laboratories, Inc.

1835 W 205th Street
Torrance, CA 90501
Kenette Pimentel
310-618-8889

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

Accreditation granted through: **January 10, 2017**

Testing - Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	AK101	GRO
GC	AK102	DRO
GFAA	CA 939M	Organo Lead
Platinum Electrode	EPA 120.1	Specific Conductance
Titrimetric	EPA 130.2	Hardness
Electrode	EPA 150.1	pH
Gravimetric	EPA 160.1	TDS
Gravimetric	EPA 160.2	TSS
Gravimetric	EPA 160.3	Total Residue
Turbidimetric	EPA 180.1	Turbidity
ICP	EPA 200.7	Aluminum
ICP	EPA 200.7	Antimony
ICP	EPA 200.7	Arsenic
ICP	EPA 200.7	Barium
ICP	EPA 200.7	Beryllium
ICP	EPA 200.7	Boron
ICP	EPA 200.7	Cadmium
ICP	EPA 200.7	Calcium
ICP	EPA 200.7	Chromium
ICP	EPA 200.7	Cobalt
ICP	EPA 200.7	Copper
ICP	EPA 200.7	Iron
ICP	EPA 200.7	Lead

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	EPA 200.7	Magnesium
ICP	EPA 200.7	Manganese
ICP	EPA 200.7	Molybdenum
ICP	EPA 200.7	Nickel
ICP	EPA 200.7	Potassium
ICP	EPA 200.7	Selenium
ICP	EPA 200.7	Silver
ICP	EPA 200.7	Sodium
ICP	EPA 200.7	Strontium
ICP	EPA 200.7	Thallium
ICP	EPA 200.7	Tin
ICP	EPA 200.7	Titanium
ICP	EPA 200.7	Vanadium
ICP	EPA 200.7	Zinc
ICP-MS	EPA 200.8	Aluminum
ICP-MS	EPA 200.8	Antimony
ICP-MS	EPA 200.8	Arsenic
ICP-MS	EPA 200.8	Barium
ICP-MS	EPA 200.8	Beryllium
ICP-MS	EPA 200.8	Boron
ICP-MS	EPA 200.8	Cadmium
ICP-MS	EPA 200.8	Calcium
ICP-MS	EPA 200.8	Chromium
ICP-MS	EPA 200.8	Cobalt
ICP-MS	EPA 200.8	Copper
ICP-MS	EPA 200.8	Iron
ICP-MS	EPA 200.8	Lead
ICP-MS	EPA 200.8	Lithium
ICP-MS	EPA 200.8	Magnesium
ICP-MS	EPA 200.8	Manganese
ICP-MS	EPA 200.8	Molybdenum
ICP-MS	EPA 200.8	Nickel
ICP-MS	EPA 200.8	Potassium
ICP-MS	EPA 200.8	Selenium
ICP-MS	EPA 200.8	Silver
ICP-MS	EPA 200.8	Sodium
ICP-MS	EPA 200.8	Strontium
ICP-MS	EPA 200.8	Thallium
ICP-MS	EPA 200.8	Tin
ICP-MS	EPA 200.8	Titanium
ICP-MS	EPA 200.8	Uranium
ICP-MS	EPA 200.8	Vanadium
ICP-MS	EPA 200.8	Zinc

Non-Potable Water		
Technology	**Method**	**Analyte**
IC	EPA 218.6	Hexavalent Chromium
COLD VAPOR	EPA 245.1	Mercury
IC	EPA 300.0	Fluoride
IC	EPA 300.0	Chloride
IC	EPA 300.0	Nitrite
IC	EPA 300.0	Bromide
IC	EPA 300.0	Nitrate
IC	EPA 300.0	Phosphate
IC	EPA 300.0	Sulfate
IC	EPA 300.0	Bromate
IC	EPA 300.0	Chlorate
IC	EPA 300M	Lactate
IC	EPA 300M	Acetate
IC	EPA 300M	Propionate
IC	EPA 300M	Butyrate
IC	EPA 300M	Pyruvate
IC	EPA 310.1	Alkalinity
IC	EPA 314.0	Perchlorate
Titrimetric	EPA 330.3	Total Residual Chlorine
Spectrometric	EPA 352.1	Nitrate-N
Spectrometric	EPA 353.3	Nitrate-N
Spectrometric	EPA 354.1	Nitrite-N
Spectrometric	EPA 365.2	Ortho-phosphate
Spectrometric	EPA 335.2	Cyanide
Spectrometric	EPA 350.2	Ammonia
Spectrometric	EPA 351.3	TKN
Spectrometric	EPA 365.2	Phosphorus
Spectrometric	EPA 370.1	Silica
Titrimetric	EPA 376.1	Sulfide
Spectrometric	EPA 376.2	Sulfide
Electrode	EPA 405.1	BOD
Spectrometric	EPA 410.4	COD
Combustion-IR	EPA 415.1	TOC
Spectrometric	EPA 420.1	Phenols
Spectrometric	EPA 425.1	MBAS
GC	EPA 504.1	DBCP
GC	EPA 504.1	EDB
GC	EPA 608	Aldrin
GC	EPA 608	alpha-BHC
GC	EPA 608	beta-BHC
GC	EPA 608	delta-BHC
GC	EPA 608	gamma-BHC (Lindane)
GC	EPA 608	DDD (4,4)

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 608	DDE (4,4)
GC	EPA 608	DDT (4,4)
GC	EPA 608	Dieldrin
GC	EPA 608	Endosulfan I
GC	EPA 608	Endosulfan II
GC	EPA 608	Endosulfan sulfate
GC	EPA 608	Endrin
GC	EPA 608	Endrin Aldehyde
GC	EPA 608	Heptachlor
GC	EPA 608	Heptachlor epoxide
GC	EPA 608	Methoxychlor
GC	EPA 608	alpha-Chlordane
GC	EPA 608	gamma-Chlordane
GC	EPA 608	Endrin Ketone
GC	EPA 608	Toxaphene
GC	EPA 608	Technical Chlordane
GC	EPA 608	cis-Nonachlor
GC	EPA 608	DDD (2,4)
GC	EPA 608	DDE (2,4)
GC	EPA 608	DDT (2,4)
GC	EPA 608	Mirex
GC	EPA 608	Oxychlordane
GC	EPA 608	trans-Nonachlor
GC	EPA 608	PCB1016
GC	EPA 608	PCB1221
GC	EPA 608	PCB1232
GC	EPA 608	PCB1242
GC	EPA 608	PCB1248
GC	EPA 608	PCB1254
GC	EPA 608	PCB1260
GC	EPA 608	PCB1262
GC	EPA 608	PCB1268
GC-MS	EPA 624	Acrolein
GC-MS	EPA 624	Acrylonitrile
GC-MS	EPA 624	Benzene
GC-MS	EPA 624	Bromodichloromethane
GC-MS	EPA 624	Bromoform
GC-MS	EPA 624	Bromomethane
GC-MS	EPA 624	Carbon tetrachloride
GC-MS	EPA 624	Chlorobenzene
GC-MS	EPA 624	2-Chloroethyl vinyl ether
GC-MS	EPA 624	Chloroethane
GC-MS	EPA 624	Chloroform

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 624	Chloromethane
GC-MS	EPA 624	Dibromochloromethane
GC-MS	EPA 624	1,1-Dichloroethane
GC-MS	EPA 624	1,2-Dichloroethane
GC-MS	EPA 624	1,2-Dichlorobenzene
GC-MS	EPA 624	1,3-Dichlorobenzene
GC-MS	EPA 624	1,4-Dichlorobenzene
GC-MS	EPA 624	Dichlorodifluoromethane
GC-MS	EPA 624	1,1-Dichloroethene
GC-MS	EPA 624	cis-1,2-Dichloroethene
GC-MS	EPA 624	trans-1,2-Dichloroethene
GC-MS	EPA 624	1,2-Dichloropropane
GC-MS	EPA 624	cis-1,3-Dichloropropene
GC-MS	EPA 624	trans-1,3-Dichloropropene
GC-MS	EPA 624	Ethylbenzene
GC-MS	EPA 624	Methylene Chloride
GC-MS	EPA 624	tert-Butyl methyl ether
GC-MS	EPA 624	Styrene
GC-MS	EPA 624	1,1,2,2-Tetrachloroethane
GC-MS	EPA 624	Tetrachloroethene
GC-MS	EPA 624	Toluene
GC-MS	EPA 624	1,1,1-Trichloroethane
GC-MS	EPA 624	1,1,2-Trichloroethane
GC-MS	EPA 624	1,2,4-Trichlorobenzene
GC-MS	EPA 624	Trichloroethene
GC-MS	EPA 624	Trichlorofluoromethane
GC-MS	EPA 624	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	EPA 624	Vinyl Chloride
GC-MS	EPA 624	m-Xylene & p-xylene
GC-MS	EPA 624	o-Xylene
GC-MS	EPA 625	Acenaphthene
GC-MS	EPA 625	Acenaphthylene
GC-MS	EPA 625	Aniline
GC-MS	EPA 625	Anthracene
GC-MS	EPA 625	Azobenzene
GC-MS	EPA 625	Benzidine
GC-MS	EPA 625	Benzo(a)anthracene
GC-MS	EPA 625	benzo(a)pyrene
GC-MS	EPA 625	Benzo(b)fluoranthene
GC-MS	EPA 625	Benzo(e)pyrene
GC-MS	EPA 625	Benzo(g,h,i)perylene
GC-MS	EPA 625	Benzo(k)fluoranthene
GC-MS	EPA 625	Benzoic Acid

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 625	Benzyl Alcohol
GC-MS	EPA 625	Biphenyl
GC-MS	EPA 625	bis(2-chloroethoxy)methane
GC-MS	EPA 625	bis(2-chloroethyl)ether
GC-MS	EPA 625	bis(2-chloroisopropyl)ether
GC-MS	EPA 625	bis(2-Ethylhexyl)adipate
GC-MS	EPA 625	bis(2-Ethylhexyl)phthalate
GC-MS	EPA 625	4-Bromophenyl-phenylether
GC-MS	EPA 625	Butylbenzylphthalate
GC-MS	EPA 625	Carbazole
GC-MS	EPA 625	4-Chloro-3-methylphenol
GC-MS	EPA 625	4-Chloroaniline
GC-MS	EPA 625	2-Chloronaphthalene
GC-MS	EPA 625	2-Chlorophenol
GC-MS	EPA 625	4-Chlorophenyl-phenylether
GC-MS	EPA 625	Chrysene
GC-MS	EPA 625	Dibenzo(a,h)anthracene
GC-MS	EPA 625	Dibenzofuran
GC-MS	EPA 625	1,2-Dichlorobenzene
GC-MS	EPA 625	1,3-Dichlorobenzene
GC-MS	EPA 625	1,4-Dichlorobenzene
GC-MS	EPA 625	3,3'-Dichlorobenzidine
GC-MS	EPA 625	2,4-Dichlorophenol
GC-MS	EPA 625	Diethylphthalate
GC-MS	EPA 625	2,6-Dimethylnaphthalene
GC-MS	EPA 625	2,4-Dimethylphenol
GC-MS	EPA 625	Dimethylphthalate
GC-MS	EPA 625	Di-n-butylphthalate
GC-MS	EPA 625	4,6-Dinitro-2-methylphenol
GC-MS	EPA 625	2,4-Dinitrophenol
GC-MS	EPA 625	2,4-Dinitrotoluene
GC-MS	EPA 625	2,6-Dinitrotoluene
GC-MS	EPA 625	Di-n-octylphthalate
GC-MS	EPA 625	1,2-Diphenylhydrazine
GC-MS	EPA 625	Fluoranthene
GC-MS	EPA 625	Fluorene
GC-MS	EPA 625	Hexachlorobenzene
GC-MS	EPA 625	Hexachlorobutadiene
GC-MS	EPA 625	Hexachlorocyclopentadiene
GC-MS	EPA 625	Hexachloroethane
GC-MS	EPA 625	Indeno(1,2,3-cd)pyrene
GC-MS	EPA 625	Isophorone
GC-MS	EPA 625	1-Methylnaphthalene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 625	2-Methylnaphthalene
GC-MS	EPA 625	1-Methylphenanthrene
GC-MS	EPA 625	2-Methylphenol
GC-MS	EPA 625	4-Methylphenol
GC-MS	EPA 625	Naphthalene
GC-MS	EPA 625	2-Nitroaniline
GC-MS	EPA 625	3-Nitroaniline
GC-MS	EPA 625	4-Nitroaniline
GC-MS	EPA 625	Nitrobenzene
GC-MS	EPA 625	2-Nitrophenol
GC-MS	EPA 625	4-Nitrophenol
GC-MS	EPA 625	n-Nitrosodimethylamine
GC-MS	EPA 625	n-Nitroso-di-n-propylamine
GC-MS	EPA 625	n-Nitrosodiphenylamine
GC-MS	EPA 625	Pentachlorophenol
GC-MS	EPA 625	Perylene
GC-MS	EPA 625	Phenanthrene
GC-MS	EPA 625	Phenol
GC-MS	EPA 625	Pyrene
GC-MS	EPA 625	Pyridine
GC-MS	EPA 625	2,3,4,6-Tetrachlorophenol
GC-MS	EPA 625	1,2,4-Trichlorobenzene
GC-MS	EPA 625	2,3,4-Trichlorophenol
GC-MS	EPA 625	2,3,5-Trichlorophenol
GC-MS	EPA 625	2,4,5-Trichlorophenol
GC-MS	EPA 625	2,4,6-Trichlorophenol
GC-MS	EPA 625	2,3,5-Trimethylnaphthalene
Gravimetric	EPA 1664A / 1664 B	Oil & Grease
Pensky-Martens	EPA 1010 / 1010A	Ignitability
ICP	EPA 6010B / 6010C	Aluminum
ICP	EPA 6010B / 6010C	Antimony
ICP	EPA 6010B / 6010C	Arsenic
ICP	EPA 6010B / 6010C	Barium
ICP	EPA 6010B / 6010C	Beryllium
ICP	EPA 6010B / 6010C	Boron
ICP	EPA 6010B / 6010C	Cadmium
ICP	EPA 6010B / 6010C	Calcium
ICP	EPA 6010B / 6010C	Chromium
ICP	EPA 6010B / 6010C	Cobalt
ICP	EPA 6010B / 6010C	Copper
ICP	EPA 6010B / 6010C	Iron
ICP	EPA 6010B / 6010C	Lead
ICP	EPA 6010B / 6010C	Magnesium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	EPA 6010B / 6010C	Manganese
ICP	EPA 6010B / 6010C	Molybdenum
ICP	EPA 6010B / 6010C	Nickel
ICP	EPA 6010B / 6010C	Potassium
ICP	EPA 6010B / 6010C	Selenium
ICP	EPA 6010B / 6010C	Silver
ICP	EPA 6010B / 6010C	Sodium
ICP	EPA 6010B / 6010C	Strontium
ICP	EPA 6010B / 6010C	Thallium
ICP	EPA 6010B / 6010C	Tin
ICP	EPA 6010B / 6010C	Titanium
ICP	EPA 6010B / 6010C	Vanadium
ICP	EPA 6010B / 6010C	Zinc
ICP-MS	EPA 6020A	Aluminum
ICP-MS	EPA 6020A	Antimony
ICP-MS	EPA 6020A	Arsenic
ICP-MS	EPA 6020A	Barium
ICP-MS	EPA 6020A	Beryllium
ICP-MS	EPA 6020A	Boron
ICP-MS	EPA 6020A	Cadmium
ICP-MS	EPA 6020A	Calcium
ICP-MS	EPA 6020A	Chromium
ICP-MS	EPA 6020A	Cobalt
ICP-MS	EPA 6020A	Copper
ICP-MS	EPA 6020A	Iron
ICP-MS	EPA 6020A	Lead
ICP-MS	EPA 6020A	Magnesium
ICP-MS	EPA 6020A	Manganese
ICP-MS	EPA 6020A	Molybdenum
ICP-MS	EPA 6020A	Nickel
ICP-MS	EPA 6020A	Potassium
ICP-MS	EPA 6020A	Selenium
ICP-MS	EPA 6020A	Silver
ICP-MS	EPA 6020A	Sodium
ICP-MS	EPA 6020A	Strontium
ICP-MS	EPA 6020A	Thallium
ICP-MS	EPA 6020A	Tin
ICP-MS	EPA 6020A	Titanium
ICP-MS	EPA 6020A	Tungsten
ICP-MS	EPA 6020A	Uranium
ICP-MS	EPA 6020A	Vanadium
ICP-MS	EPA 6020A	Zinc
HPLC-MS	EPA 6850	Perchlorate

Non-Potable Water		
Technology	**Method**	**Analyte**
Spectrometric	EPA 7196A	Hex. Chromium
IC	EPA 7199	Hex. Chromium
Cold-Vapor	EPA 7470A	Mercury
GC	EPA 8015B / 8015C / 8015D	Gasoline
GC	EPA 8015B / 8015C / 8015D	Diesel
GC	EPA 8015B / 8015C / 8015D	Motor Oil
GC	EPA 8015B / 8015C	Diethylene Glycol
GC	EPA 8015B / 8015C	Ethanol
GC	EPA 8015B / 8015C	Ethylene Glycol
GC	EPA 8015B / 8015C	Isopropanol
GC	EPA 8015B / 8015C / 8015D	JP4
GC	EPA 8015B / 8015C	Methanol
GC	EPA 8015B / 8015C	Propylene Glycol
GC	EPA 8015B / 8015C / 8015D	JP5
GC	EPA 8015B / 8015C	Triethylene Glycol
GC	EPA 8081A / 8081B	Aldrin
GC	EPA 8081A / 8081B	alpha-BHC
GC	EPA 8081A / 8081B	beta-BHC
GC	EPA 8081A / 8081B	delta-BHC
GC	EPA 8081A / 8081B	gamma-BHC (Lindane)
GC	EPA 8081A / 8081B	DDD (4,4)
GC	EPA 8081A / 8081B	DDE (4,4)
GC	EPA 8081A / 8081B	DDT (4,4)
GC	EPA 8081A / 8081B	Dieldrin
GC	EPA 8081A / 8081B	Endosulfan I
GC	EPA 8081A / 8081B	Endosulfan II
GC	EPA 8081A / 8081B	Endosulfan sulfate
GC	EPA 8081A / 8081B	Endrin
GC	EPA 8081A / 8081B	Endrin Aldehyde
GC	EPA 8081A / 8081B	Heptachlor
GC	EPA 8081A / 8081B	Heptachlor epoxide
GC	EPA 8081A / 8081B	Methoxychlor
GC	EPA 8081A / 8081B	alpha-Chlordane
GC	EPA 8081A / 8081B	gamma-Chlordane
GC	EPA 8081A / 8081B	Endrin Ketone
GC	EPA 8081A / 8081B	Toxaphene
GC	EPA 8081A / 8081B	Technical Chlordane
GC	EPA 8081A / 8081B	cis-Nonachlor
GC	EPA 8081A / 8081B	DDD (2,4)
GC	EPA 8081A / 8081B	DDE (2,4)
GC	EPA 8081A / 8081B	DDT (2,4)
GC	EPA 8081A / 8081B	Mirex
GC	EPA 8081A / 8081B	Oxychlordane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 8081A / 8081B	trans-Nonachlor
GC	EPA 8082 / 8082A	PCB1016
GC	EPA 8082 / 8082A	PCB1221
GC	EPA 8082 / 8082A	PCB1232
GC	EPA 8082 / 8082A	PCB1242
GC	EPA 8082 / 8082A	PCB1248
GC	EPA 8082 / 8082A	PCB1254
GC	EPA 8082 / 8082A	PCB1260
GC	EPA 8082 / 8082A	PCB1262
GC	EPA 8082 / 8082A	PCB1268
GC	EPA 8082 / 8082A	PCB 8
GC	EPA 8082 / 8082A	PCB 18
GC	EPA 8082 / 8082A	PCB 28
GC	EPA 8082 / 8082A	PCB 44
GC	EPA 8082 / 8082A	PCB 52
GC	EPA 8082 / 8082A	PCB 66
GC	EPA 8082 / 8082A	PCB 77
GC	EPA 8082 / 8082A	PCB 81
GC	EPA 8082 / 8082A	PCB 101
GC	EPA 8082 / 8082A	PCB 105
GC	EPA 8082 / 8082A	PCB 114
GC	EPA 8082 / 8082A	PCB 118
GC	EPA 8082 / 8082A	PCB 123
GC	EPA 8082 / 8082A	PCB 126
GC	EPA 8082 / 8082A	PCB 128
GC	EPA 8082 / 8082A	PCB 138
GC	EPA 8082 / 8082A	PCB 153
GC	EPA 8082 / 8082A	PCB 156
GC	EPA 8082 / 8082A	PCB 157
GC	EPA 8082 / 8082A	PCB 167
GC	EPA 8082 / 8082A	PCB 169
GC	EPA 8082 / 8082A	PCB 170
GC	EPA 8082 / 8082A	PCB 180
GC	EPA 8082 / 8082A	PCB 187
GC	EPA 8082 / 8082A	PCB 189
GC	EPA 8082 / 8082A	PCB 195
GC	EPA 8082 / 8082A	PCB 206
GC	EPA 8082 / 8082A	PCB 209
GC	EPA 8082 / 8082A	PCB 110
GC	EPA 8141A / 8141B	Azinphos-methyl
GC	EPA 8141A / 8141B	Bolstar
GC	EPA 8141A / 8141B	Chlorpyrifos
GC	EPA 8141A / 8141B	Coumaphos

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	EPA 8141A / 8141B	Demeton
GC	EPA 8141A / 8141B	Diazinon
GC	EPA 8141A / 8141B	Dichlorvos
GC	EPA 8141A / 8141B	Disulfoton
GC	EPA 8141A / 8141B	Ethoprop
GC	EPA 8141A / 8141B	Fensulfothion
GC	EPA 8141A / 8141B	Fenthion
GC	EPA 8141A / 8141B	Merphos
GC	EPA 8141A / 8141B	Mevinphos
GC	EPA 8141A / 8141B	Naled
GC	EPA 8141A / 8141B	Methyl Parathion
GC	EPA 8141A / 8141B	Phorate
GC	EPA 8141A / 8141B	Ronnel
GC	EPA 8141A / 8141B	Stirophos
GC	EPA 8141A / 8141B	Tokuthion
GC	EPA 8141A / 8141B	Trichloronate
GC	EPA 8141A / 8141B	Dimethoate
GC	EPA 8141A / 8141B	EPN
GC	EPA 8141A / 8141B	Famphur
GC	EPA 8141A / 8141B	Malathion
GC	EPA 8141A / 8141B	Ethyl Parathion
GC	EPA 8141A / 8141B	O,O,O-Triethylphosphorothioate
GC	EPA 8141A / 8141B	Sulfotepp
GC	EPA 8141A / 8141B	Thionazin
GC	EPA 8141A / 8141B	Tributyl Phosphate
GC	EPA 8151A	Acifluorfen
GC	EPA 8151A	Bentazon
GC	EPA 8151A	Chloramben
GC	EPA 8151A	2,4-D
GC	EPA 8151A	2,4-DB
GC	EPA 8151A	Dacthal
GC	EPA 8151A	Dalapon
GC	EPA 8151A	Dicamba
GC	EPA 8151A	3,5-Dichlorobenzoic acid
GC	EPA 8151A	Dichlorprop
GC	EPA 8151A	Dinoseb
GC	EPA 8151A	MCPA
GC	EPA 8151A	MCPP
GC	EPA 8151A	4-Nitrophenol
GC	EPA 8151A	Pentachlorophenol
GC	EPA 8151A	Picloram
GC	EPA 8151A	Silvex
GC	EPA 8151A	2,4,5-T

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8260B / 8260C	Acetone
GC-MS	EPA 8260B / 8260C	Acrolein
GC-MS	EPA 8260B / 8260C	Acrylonitrile
GC-MS	EPA 8260B / 8260C	Benzene
GC-MS	EPA 8260B / 8260C	Bromobenzene
GC-MS	EPA 8260B / 8260C	Bromochloromethane
GC-MS	EPA 8260B / 8260C	Bromodichloromethane
GC-MS	EPA 8260B / 8260C	Bromoform
GC-MS	EPA 8260B / 8260C	Bromomethane
GC-MS	EPA 8260B / 8260C	tert-Butyl alcohol
GC-MS	EPA 8260B / 8260C	2-Butanone (MEK)
GC-MS	EPA 8260B / 8260C	n-Butylbenzene
GC-MS	EPA 8260B / 8260C	sec-Butylbenzene
GC-MS	EPA 8260B / 8260C	tert-Butylbenzene
GC-MS	EPA 8260B / 8260C	Carbon disulfide
GC-MS	EPA 8260B / 8260C	Carbon tetrachloride
GC-MS	EPA 8260B / 8260C	Chlorobenzene
GC-MS	EPA 8260B / 8260C	2-Chloroethyl vinyl ether
GC-MS	EPA 8260B / 8260C	Chloroethane
GC-MS	EPA 8260B / 8260C	Chloroform
GC-MS	EPA 8260B / 8260C	1-Chlorohexane
GC-MS	EPA 8260B / 8260C	Chloromethane
GC-MS	EPA 8260B / 8260C	2-Chlorotoluene
GC-MS	EPA 8260B / 8260C	4-Chlorotoluene
GC-MS	EPA 8260B / 8260C	Isopropyl ether (DIPE)
GC-MS	EPA 8260B / 8260C	Dibromochloromethane
GC-MS	EPA 8260B / 8260C	1,2-Dibromo-3-chloropropane
GC-MS	EPA 8260B / 8260C	1,2-Dibromoethane
GC-MS	EPA 8260B / 8260C	Dibromomethane
GC-MS	EPA 8260B / 8260C	1,1-Dichloroethane
GC-MS	EPA 8260B / 8260C	1,2-Dichloroethane
GC-MS	EPA 8260B / 8260C	1,2-Dichlorobenzene
GC-MS	EPA 8260B / 8260C	1,3-Dichlorobenzene
GC-MS	EPA 8260B / 8260C	trans-1,4-Dichloro-2-Butene
GC-MS	EPA 8260B / 8260C	1,4-Dichlorobenzene
GC-MS	EPA 8260B / 8260C	Dichlorodifluoromethane
GC-MS	EPA 8260B / 8260C	1,1-Dichloroethene
GC-MS	EPA 8260B / 8260C	cis-1,2-Dichloroethene
GC-MS	EPA 8260B / 8260C	trans-1,2-Dichloroethene
GC-MS	EPA 8260B / 8260C	Dichlorofluoromethane
GC-MS	EPA 8260B / 8260C	1,1-Dichloropropene
GC-MS	EPA 8260B / 8260C	1,2-Dichloropropane
GC-MS	EPA 8260B / 8260C	1,3-Dichloropropane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8260B / 8260C	2,2-Dichloropropane
GC-MS	EPA 8260B / 8260C	cis-1,3-Dichloropropene
GC-MS	EPA 8260B / 8260C	trans-1,3-Dichloropropene
GC-MS	EPA 8260B / 8260C	tert-Butyl ethyl ether (ETBE)
GC-MS	EPA 8260B / 8260C	Ethyl Methacrylate
GC-MS	EPA 8260B / 8260C	Ethylbenzene
GC-MS	EPA 8260B / 8260C	2-Hexanone (MBK)
GC-MS	EPA 8260B / 8260C	Hexachlorobutadiene
GC-MS	EPA 8260B / 8260C	Iodomethane
GC-MS	EPA 8260B / 8260C	Isopropylbenzene
GC-MS	EPA 8260B / 8260C	p-Isopropyltoluene
GC-MS	EPA 8260B / 8260C	Methylene Chloride
GC-MS	EPA 8260B / 8260C	4-Methyl-2-pentanone (MIBK)
GC-MS	EPA 8260B / 8260C	tert-Butyl methyl ether
GC-MS	EPA 8260B / 8260C	Naphthalene
GC-MS	EPA 8260B / 8260C	n-Propylbenzene
GC-MS	EPA 8260B / 8260C	Styrene
GC-MS	EPA 8260B / 8260C	tert-Amyl methyl ether (TAME)
GC-MS	EPA 8260B / 8260C	1,1,1,2-Tetrachloroethane
GC-MS	EPA 8260B / 8260C	1,1,2,2-Tetrachloroethane
GC-MS	EPA 8260B / 8260C	Tetrachloroethene
GC-MS	EPA 8260B / 8260C	Toluene
GC-MS	EPA 8260B / 8260C	1,1,1-Trichloroethane
GC-MS	EPA 8260B / 8260C	1,1,2-Trichloroethane
GC-MS	EPA 8260B / 8260C	1,2,3-Trichlorobenzene
GC-MS	EPA 8260B / 8260C	1,2,4-Trichlorobenzene
GC-MS	EPA 8260B / 8260C	Trichloroethene
GC-MS	EPA 8260B / 8260C	Trichlorofluoromethane
GC-MS	EPA 8260B / 8260C	1,2,3-Trichloropropane
GC-MS	EPA 8260B / 8260C	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	EPA 8260B / 8260C	1,2,4-Trimethylbenzene
GC-MS	EPA 8260B / 8260C	1,3,5-Trimethylbenzene
GC-MS	EPA 8260B / 8260C	Vinyl Acetate
GC-MS	EPA 8260B / 8260C	Vinyl Chloride
GC-MS	EPA 8260B / 8260C	m-Xylene & p-xylene
GC-MS	EPA 8260B / 8260C	o-Xylene
GC-MS	EPA 8260B / 8260C	2-Butanol
GC-MS	EPA 8260B / 8260C	Cyclohexane
GC-MS	EPA 8260B / 8260C	1,4-Dioxane
GC-MS	EPA 8260B / 8260C	2-Chloro-1,1,1-trifluoroethane
GC-MS	EPA 8260B / 8260C	Chlorotrifluoroethylene
GC-MS	EPA 8260B / 8260C	cis-1,4-Dichloro-2-butene
GC-MS	EPA 8260B / 8260C	Ethanol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8260B / 8260C	Ethyl Methacrylate
GC-MS	EPA 8260B / 8260C	Isobutyl Alcohol
GC-MS	EPA 8260B / 8260C	Methacrylonitrile
GC-MS	EPA 8260B / 8260C	Methyl Methacrylate
GC-MS	EPA 8260B / 8260C	Pentachloroethane
GC-MS	EPA 8260B / 8260C	Propionitrile
GC-MS	EPA 8260B / 8260C	Sec-Propyl alcohol
GC-MS	EPA 8260B / 8260C	Tetrahydrofuran
GC-MS	EPA 8260B / 8260C	trans-1,4-Dichloro-2-butene
GC-MS	EPA 8260B / 8260C SIM	Benzene
GC-MS	EPA 8260B / 8260C SIM	Carbon tetrachloride
GC-MS	EPA 8260B / 8260C SIM	Chloroform
GC-MS	EPA 8260B / 8260C SIM	Chloromethane
GC-MS	EPA 8260B / 8260C SIM	1,2-Dibromo-3-chloropropane
GC-MS	EPA 8260B / 8260C SIM	1,2-Dibromoethane
GC-MS	EPA 8260B / 8260C SIM	1,2-Dichloroethane
GC-MS	EPA 8260B / 8260C SIM	1,1-Dichloroethene
GC-MS	EPA 8260B / 8260C SIM	cis-1,2-Dichloroethene
GC-MS	EPA 8260B / 8260C SIM	trans-1,2-Dichloroethene
GC-MS	EPA 8260B / 8260C SIM	1,1,2,2-Tetrachloroethane
GC-MS	EPA 8260B / 8260C SIM	Tetrachloroethene
GC-MS	EPA 8260B / 8260C SIM	1,1,1-Trichloroethane
GC-MS	EPA 8260B / 8260C SIM	1,1,2-Trichloroethane
GC-MS	EPA 8260B / 8260C SIM	Trichloroethene
GC-MS	EPA 8260B / 8260C SIM	1,2,3-Trichloropropane
GC-MS	EPA 8260B / 8260C SIM	Vinyl Chloride
GC-MS	EPA 8260B / 8260C SIM	1,4-Dioxane
GC-MS	EPA 8270C / 8270D	Acenaphthene
GC-MS	EPA 8270C / 8270D	Acenaphthylene
GC-MS	EPA 8270C / 8270D	Aniline
GC-MS	EPA 8270C / 8270D	Anthracene
GC-MS	EPA 8270C / 8270D	Azobenzene
GC-MS	EPA 8270C / 8270D	Benzidine
GC-MS	EPA 8270C / 8270D	Benzo(a)anthracene
GC-MS	EPA 8270C / 8270D	benzo(a)pyrene
GC-MS	EPA 8270C / 8270D	Benzo(b)fluoranthene
GC-MS	EPA 8270C / 8270D	Benzo(e)pyrene
GC-MS	EPA 8270C / 8270D	Benzo(g,h,i)perylene
GC-MS	EPA 8270C / 8270D	Benzo(k)fluoranthene
GC-MS	EPA 8270C / 8270D	Benzoic Acid
GC-MS	EPA 8270C / 8270D	Benzyl Alcohol
GC-MS	EPA 8270C / 8270D	Biphenyl
GC-MS	EPA 8270C / 8270D	bis(2-chloroethoxy)methane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	bis(2-chloroethyl)ether
GC-MS	EPA 8270C / 8270D	bis(2-chloroisopropyl)ether
GC-MS	EPA 8270C / 8270D	bis(2-Ethylhexyl)adipate
GC-MS	EPA 8270C / 8270D	bis(2-Ethylhexyl)phthalate
GC-MS	EPA 8270C / 8270D	4-Bromophenyl-phenylether
GC-MS	EPA 8270C / 8270D	Butylbenzylphthalate
GC-MS	EPA 8270C / 8270D	Carbazole
GC-MS	EPA 8270C / 8270D	4-Chloro-3-methylphenol
GC-MS	EPA 8270C / 8270D	4-Chloroaniline
GC-MS	EPA 8270C / 8270D	2-Chloronaphthalene
GC-MS	EPA 8270C / 8270D	2-Chlorophenol
GC-MS	EPA 8270C / 8270D	4-Chlorophenyl-phenylether
GC-MS	EPA 8270C / 8270D	Chrysene
GC-MS	EPA 8270C / 8270D	Dibenzo(a,h)anthracene
GC-MS	EPA 8270C / 8270D	Dibenzofuran
GC-MS	EPA 8270C / 8270D	1,2-Dichlorobenzene
GC-MS	EPA 8270C / 8270D	1,3-Dichlorobenzene
GC-MS	EPA 8270C / 8270D	1,4-Dichlorobenzene
GC-MS	EPA 8270C / 8270D	3,3'-Dichlorobenzidine
GC-MS	EPA 8270C / 8270D	2,4-Dichlorophenol
GC-MS	EPA 8270C / 8270D	Diethylphthalate
GC-MS	EPA 8270C / 8270D	2,6-Dimethylnaphthalene
GC-MS	EPA 8270C / 8270D	2,4-Dimethylphenol
GC-MS	EPA 8270C / 8270D	Dimethylphthalate
GC-MS	EPA 8270C / 8270D	Di-n-butylphthalate
GC-MS	EPA 8270C / 8270D	4,6-Dinitro-2-methylphenol
GC-MS	EPA 8270C / 8270D	2,4-Dinitrophenol
GC-MS	EPA 8270C / 8270D	2,4-Dinitrotoluene
GC-MS	EPA 8270C / 8270D	2,6-Dinitrotoluene
GC-MS	EPA 8270C / 8270D	Di-n-octylphthalate
GC-MS	EPA 8270C / 8270D	Fluoranthene
GC-MS	EPA 8270C / 8270D	Fluorene
GC-MS	EPA 8270C / 8270D	Hexachlorobenzene
GC-MS	EPA 8270C / 8270D	Hexachlorobutadiene
GC-MS	EPA 8270C / 8270D	Hexachlorocyclopentadiene
GC-MS	EPA 8270C / 8270D	Hexachloroethane
GC-MS	EPA 8270C / 8270D	Indeno(1,2,3-cd)pyrene
GC-MS	EPA 8270C / 8270D	Isophorone
GC-MS	EPA 8270C / 8270D	1-Methylnaphthalene
GC-MS	EPA 8270C / 8270D	2-Methylnaphthalene
GC-MS	EPA 8270C / 8270D	1-Methylphenanthrene
GC-MS	EPA 8270C / 8270D	2-Methylphenol
GC-MS	EPA 8270C / 8270D	4-Methylphenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	Naphthalene
GC-MS	EPA 8270C / 8270D	2-Nitroaniline
GC-MS	EPA 8270C / 8270D	3-Nitroaniline
GC-MS	EPA 8270C / 8270D	4-Nitroaniline
GC-MS	EPA 8270C / 8270D	Nitrobenzene
GC-MS	EPA 8270C / 8270D	2-Nitrophenol
GC-MS	EPA 8270C / 8270D	4-Nitrophenol
GC-MS	EPA 8270C / 8270D	n-Nitrosodimethylamine
GC-MS	EPA 8270C / 8270D	n-Nitroso-di-n-propylamine
GC-MS	EPA 8270C / 8270D	n-Nitrosodiphenylamine
GC-MS	EPA 8270C / 8270D	Pentachlorophenol
GC-MS	EPA 8270C / 8270D	Perylene
GC-MS	EPA 8270C / 8270D	Phenanthrene
GC-MS	EPA 8270C / 8270D	Phenol
GC-MS	EPA 8270C / 8270D	Pyrene
GC-MS	EPA 8270C / 8270D	Pyridine
GC-MS	EPA 8270C / 8270D	2,3,4,6-Tetrachlorophenol
GC-MS	EPA 8270C / 8270D	1,2,4-Trichlorobenzene
GC-MS	EPA 8270C / 8270D	2,3,4-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,3,5-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,4,5-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,4,6-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,3,5-Trimethylnaphthalene
GC-MS	EPA 8270C / 8270D	1,2,4,5-Tetrachlorobenzene
GC-MS	EPA 8270C / 8270D	1,3,5-Trinitrobenzene
GC-MS	EPA 8270C / 8270D	1,3-Dinitrobenzene
GC-MS	EPA 8270C / 8270D	1,4-Dioxane
GC-MS	EPA 8270C / 8270D	1,4-Naphthoquinone
GC-MS	EPA 8270C / 8270D	1-Chloronaphthalene
GC-MS	EPA 8270C / 8270D	1-Naphthylamine
GC-MS	EPA 8270C / 8270D	2,6-Dichlorophenol
GC-MS	EPA 8270C / 8270D	2-acetylaminofluorene
GC-MS	EPA 8270C / 8270D	2-Naphthylamine
GC-MS	EPA 8270C / 8270D	2-Picoline
GC-MS	EPA 8270C / 8270D	3,3-Dimethylbenzidine
GC-MS	EPA 8270C / 8270D	3,4-Dimethylphenol
GC-MS	EPA 8270C / 8270D	3,5-Dimethylphenol
GC-MS	EPA 8270C / 8270D	3-Methylchlolanthrene
GC-MS	EPA 8270C / 8270D	4-Aminobiphenyl
GC-MS	EPA 8270C / 8270D	4-Nitroquinoline-N-oxide
GC-MS	EPA 8270C / 8270D	5-Nitro-o-toluidine
GC-MS	EPA 8270C / 8270D	7,12-Dimethylbenz(a)anthracene
GC-MS	EPA 8270C / 8270D	a,a-dimethylphenethylamine

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	Acetophenone
GC-MS	EPA 8270C / 8270D	Aramite
GC-MS	EPA 8270C / 8270D	Atrazine
GC-MS	EPA 8270C / 8270D	Biphenyl
GC-MS	EPA 8270C / 8270D	Chlorobenzilate
GC-MS	EPA 8270C / 8270D	Diallate
GC-MS	EPA 8270C / 8270D	Dibenzo(a,j)acridine
GC-MS	EPA 8270C / 8270D	Dimethoate
GC-MS	EPA 8270C / 8270D	Dinoseb
GC-MS	EPA 8270C / 8270D	Diphenyl ether
GC-MS	EPA 8270C / 8270D	Disulfoton
GC-MS	EPA 8270C / 8270D	Ethyl methacrylate
GC-MS	EPA 8270C / 8270D	Ethyl methanesulfonate
GC-MS	EPA 8270C / 8270D	Ethyl parathion
GC-MS	EPA 8270C / 8270D	Famphur
GC-MS	EPA 8270C / 8270D	Hexachlorophene
GC-MS	EPA 8270C / 8270D	Hexachloropropene
GC-MS	EPA 8270C / 8270D	Isodrin
GC-MS	EPA 8270C / 8270D	Isosafrole
GC-MS	EPA 8270C / 8270D	kepone
GC-MS	EPA 8270C / 8270D	Methapyrilene
GC-MS	EPA 8270C / 8270D	Methyl methanesulfonate
GC-MS	EPA 8270C / 8270D	Methyl parathion
GC-MS	EPA 8270C / 8270D	N-nitrosodiethylamine
GC-MS	EPA 8270C / 8270D	N-Nitrosodi-n-butylamine
GC-MS	EPA 8270C / 8270D	N-Nitrosomethylethylamine
GC-MS	EPA 8270C / 8270D	N-Nitrosomorpholine
GC-MS	EPA 8270C / 8270D	N-Nitrosopiperdine
GC-MS	EPA 8270C / 8270D	N-Nitrosopyrrolidine
GC-MS	EPA 8270C / 8270D	O,O,O-triethyl phosphorothi
GC-MS	EPA 8270C / 8270D	o-toluidine
GC-MS	EPA 8270C / 8270D	p-Dimethylaminoazobenze
GC-MS	EPA 8270C / 8270D	Pentachlorobenzene
GC-MS	EPA 8270C / 8270D	Pentachloroethane
GC-MS	EPA 8270C / 8270D	Pentachloronitrobenzene
GC-MS	EPA 8270C / 8270D	Phenacetin
GC-MS	EPA 8270C / 8270D	Phorate
GC-MS	EPA 8270C / 8270D	p-phenylenediamine
GC-MS	EPA 8270C / 8270D	Pronamide
GC-MS	EPA 8270C / 8270D	Safrole
GC-MS	EPA 8270C / 8270D	Sulfotepp
GC-MS	EPA 8270C / 8270D	Thionazin
GC-MS	EPA 8270C / 8270D SIM	Acenaphthene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D SIM	Acenaphthylene
GC-MS	EPA 8270C / 8270D SIM	Anthracene
GC-MS	EPA 8270C / 8270D SIM	Azobenzene
GC-MS	EPA 8270C / 8270D SIM	Benzo(a)anthracene
GC-MS	EPA 8270C / 8270D SIM	benzo(a)pyrene
GC-MS	EPA 8270C / 8270D SIM	Benzo(b)fluoranthene
GC-MS	EPA 8270C / 8270D SIM	Benzo(e)pyrene
GC-MS	EPA 8270C / 8270D SIM	Benzo(g,h,i)perylene
GC-MS	EPA 8270C / 8270D SIM	Benzo(k)fluoranthene
GC-MS	EPA 8270C / 8270D SIM	Biphenyl
GC-MS	EPA 8270C / 8270D SIM	bis(2-chloroethyl)ether
GC-MS	EPA 8270C / 8270D SIM	bis(2-Ethylhexyl)phthalate
GC-MS	EPA 8270C / 8270D SIM	Carbazole
GC-MS	EPA 8270C / 8270D SIM	4-Chloro-3-methylphenol
GC-MS	EPA 8270C / 8270D SIM	2-Chlorophenol
GC-MS	EPA 8270C / 8270D SIM	Chrysene
GC-MS	EPA 8270C / 8270D SIM	Dibenzo(a,h)anthracene
GC-MS	EPA 8270C / 8270D SIM	2,4-Dichlorophenol
GC-MS	EPA 8270C / 8270D SIM	2,6-Dimethylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	2,4-Dimethylphenol
GC-MS	EPA 8270C / 8270D SIM	Fluoranthene
GC-MS	EPA 8270C / 8270D SIM	Fluorene
GC-MS	EPA 8270C / 8270D SIM	Hexachlorobenzene
GC-MS	EPA 8270C / 8270D SIM	Indeno(1,2,3-cd)pyrene
GC-MS	EPA 8270C / 8270D SIM	1-Methylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	2-Methylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	1-Methylphenanthrene
GC-MS	EPA 8270C / 8270D SIM	Naphthalene
GC-MS	EPA 8270C / 8270D SIM	n-Nitrosodimethylamine
GC-MS	EPA 8270C / 8270D SIM	n-Nitroso-di-n-propylamine
GC-MS	EPA 8270C / 8270D SIM	Pentachlorophenol
GC-MS	EPA 8270C / 8270D SIM	Perylene
GC-MS	EPA 8270C / 8270D SIM	Phenanthrene
GC-MS	EPA 8270C / 8270D SIM	Phenol
GC-MS	EPA 8270C / 8270D SIM	Pyrene
GC-MS	EPA 8270C / 8270D SIM	2,4,5-Trichlorophenol
GC-MS	EPA 8270C / 8270D SIM	2,4,6-Trichlorophenol
GC-MS	EPA 8270C / 8270D SIM	2,3,5-Trimethylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	1,4-Dioxane
GC-MS	EPA 8270C / 8270D SIM	Butylbenzylphthalate
GC-MS	EPA 8270C / 8270D SIM	Diethylphthalate
GC-MS	EPA 8270C / 8270D SIM	Dimethylphthalate
GC-MS	EPA 8270C / 8270D SIM	Di-n-butylphthalate

Non-Potable Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D SIM	Di-n-octylphthalate
HPLC	EPA 8310	Acenaphthene
HPLC	EPA 8310	Acenaphthylene
HPLC	EPA 8310	Anthracene
HPLC	EPA 8310	Benzo(a)anthracene
HPLC	EPA 8310	Benzo(a)pyrene
HPLC	EPA 8310	Benzo(b)fluoranthene
HPLC	EPA 8310	Benzo(g,h,i)perylene
HPLC	EPA 8310	Benzo(k)fluoranthene
HPLC	EPA 8310	Chrysene
HPLC	EPA 8310	Dibenzo(a,h)anthracene
HPLC	EPA 8310	Fluoranthene
HPLC	EPA 8310	Fluorene
HPLC	EPA 8310	Indeno(1,2,3-cd)pyrene
HPLC	EPA 8310	1-Methylnaphthalene
HPLC	EPA 8310	2-Methylnaphthalene
HPLC	EPA 8310	Naphthalene
HPLC	EPA 8310	Phenanthrene
HPLC	EPA 8310	Pyrene
HPLC	EPA 8330A / 8330 B	HMX
HPLC	EPA 8330A / 8330 B	RDX
HPLC	EPA 8330A/ 8330 B	1,3,5-TNB
HPLC	EPA 8330A/ 8330 B	1,3-DNB
HPLC	EPA 8330A/ 8330 B	Tetryl
HPLC	EPA 8330A/ 8330 B	Nitrobenzene
HPLC	EPA 8330A/ 8330 B	2,4,6-TNT
HPLC	EPA 8330A/ 8330 B	4-AM-2,6-DNT
HPLC	EPA 8330A/ 8330 B	2-AM-4,6-DNT
HPLC	EPA 8330A/ 8330 B	2,6-DNT
HPLC	EPA 8330A/ 8330 B	2,4-DNT
HPLC	EPA 8330A/ 8330 B	2-Nitrotoluene
HPLC	EPA 8330A/ 8330 B	4-Nitrotoluene
HPLC	EPA 8330A/ 8330 B	3-Nitrotoluene
HPLC	EPA 8330A	3,5-Dinitroaniline
HPLC	EPA 8330A	2,4-Diamino-6-nitrotoluene
HPLC	EPA 8330A	2,6-Diamino-4-nitrotoluene
HPLC	EPA 8330A	Picric Acid
HPLC	EPA 8332	Nitroglycerine
HPLC	EPA 8332	PETN
Spectrometric	EPA 9014	Cyanide
Electrode	EPA 9040 B / 9040C	pH
IC	EPA 9056 / 9056A	Bromate
IC	EPA 9056 / 9056A	Bromide

Non-Potable Water		
Technology	**Method**	**Analyte**
IC	EPA 9056 / 9056A	Chloride
IC	EPA 9056 / 9056A	Fluoride
IC	EPA 9056 / 9056A	Nitrate
IC	EPA 9056 / 9056A	Nitrite
IC	EPA 9056 / 9056A	Phosphate
IC	EPA 9056 / 9056A	Sulfate
IC	EPA 9056 / 9056A	Chlorate
Combustion-IR	EPA 9060A	TOC
Spectrometric	EPA 9065	Phenols
Gravimetric	EPA 9070A	Oil & Grease
Gravimetric	EPA 9071B	Oil & Grease
GC	RSK175	Methane
GC	RSK175	Acetylene
GC	RSK175	Ethylene
GC	RSK175	Ethane
GC	RSK175	Propane
GC	RSK175	Carbon dioxide
Spectrometric	SM4500-NH3C	Ammonia
Spectrometric	SM4500-NH3F	Ammonia
Spectrometric	SM4500-NOrgC	TKN
Spectrometric	SM4500-PE	Phosphorus
Turbidimetric	SM 2130B	Turbidity
Titrimetric	SM 2310B	Acidity
Titrimetric	SM 2320B	Alkalinity
Titrimetric	SM 2340C	Hardness
Platinum Electrode	SM 2510B	Specific Conductance
Gravimetric	SM 2540C	TDS
Gravimetric	SM 2540D	TSS
Gravimetric	SM 2540B	Total Residue
Spectrometric	SM3500-FeB	Ferrous iron
IC	SM 4110B	Bromate
IC	SM 4110B	Bromide
IC	SM 4110B	Chloride
IC	SM 4110B	Fluoride
IC	SM 4110B	Nitrate
IC	SM 4110B	Nitrite
IC	SM 4110B	Phosphate
IC	SM 4110B	Sulfate
IC	SM 4110B	Chlorate
Titrimetric	SM4500-Cl-B	Chloride
Titrimetric	SM4500-Cl B	Total Residual Chlorine
Spectrometric	SM4500CNE	Cyanide
Electrode	SM 4500-FC	Fluoride

Non-Potable Water		
Technology	**Method**	**Analyte**
Electrode	SM 4500 HB	pH
Spectrometric	SM4500-NO2B	Nitrite-N
Spectrometric	SM4500-NO3E	Nitrate-N
Spectrometric	SM4500PE	Ortho-phosphate
Spectrometric	SM4500-PE(PB5)	Phosphorus
Spectrometric	SM4500-S2D	Sulfide
Titrimetric	SM4500-S2F	Sulfide
Spectrometric	SM4500-SiO2C	Silica
Electrode	SM5210B	BOD
Spectrometric	SM 5220D	COD
Combustion-IR	SM 5310B	TOC
Spectrometric	SM5540C	Surfactants (MBAS)
Distillation	EPA 9010C	Cyanide
MicroDistillation	QuickChem 10-204-00-1-X	Cyanide
ICP/ICP-MS	SM2340B	Hardness
Preparation	**Method**	**Type**
Purge & Trap	EPA 5030B / 5030C	Volatiles Prep
Acid Digestion	EPA 3005A / EPA 3010A / EPA 200.8 / EPA 200.7	Metals Prep
Continuous Liquid-Liquid	EPA 3520C	Organic Extraction
Waste Dilution	EPA 3580A	Organic Extraction
TCLP	EPA 1311	Leaching
SPLP	EPA 1312	Leaching

Drinking Water		
Technology	**Method**	**Analyte**
Platinum Electrode	EPA 120.1	Specific Conductance
Electrode	EPA 150.1	pH
Gravimetric	EPA 160.1	TDS
Gravimetric	EPA 160.2	TSS
Gravimetric	EPA 160.3	Total Residue
ICP-MS	EPA 200.8	Aluminum
ICP-MS	EPA 200.8	Antimony
ICP-MS	EPA 200.8	Arsenic
ICP-MS	EPA 200.8	Barium
ICP-MS	EPA 200.8	Beryllium
ICP-MS	EPA 200.8	Boron
ICP-MS	EPA 200.8	Cadmium
ICP-MS	EPA 200.8	Calcium
ICP-MS	EPA 200.8	Chromium
ICP-MS	EPA 200.8	Cobalt

Drinking Water		
Technology	**Method**	**Analyte**
ICP-MS	EPA 200.8	Copper
ICP-MS	EPA 200.8	Iron
ICP-MS	EPA 200.8	Lithium
ICP-MS	EPA 200.8	Lead
ICP-MS	EPA 200.8	Magnesium
ICP-MS	EPA 200.8	Manganese
ICP-MS	EPA 200.8	Molybdenum
ICP-MS	EPA 200.8	Nickel
ICP-MS	EPA 200.8	Potassium
ICP-MS	EPA 200.8	Selenium
ICP-MS	EPA 200.8	Silver
ICP-MS	EPA 200.8	Sodium
ICP-MS	EPA 200.8	Strontium
ICP-MS	EPA 200.8	Thallium
ICP-MS	EPA 200.8	Tin
ICP-MS	EPA 200.8	Titanium
ICP-MS	EPA 200.8	Uranium
ICP-MS	EPA 200.8	Vanadium
ICP-MS	EPA 200.8	Zinc
IC	EPA 218.6	Hexavalent Chromium
Cold Vapor	EPA 245.1	Mercury
IC	EPA 300.0	Bromate
IC	EPA 300.0	Bromide
IC	EPA 300.0	Chloride
IC	EPA 300.0	Fluoride
IC	EPA 300.0	Nitrate
IC	EPA 300.0	Nitrite
IC	EPA 300.0	Phosphate
IC	EPA 300.0	Sulfate
IC	EPA 300.0	Chlorate
IC	EPA 300M	Acetate
IC	EPA 300M	Butyrate
IC	EPA 300M	Lactate
IC	EPA 300M	Propionate
IC	EPA 300M	Pyruvate
IC	EPA314.0	Perchlorate
Spectrometric	EPA 335.2	Cyanide
Spectrometric	EPA 350.2	Ammonia
Spectrometric	EPA 351.3	TKN
Spectrometric	EPA 352.1	Nitrate-N
Spectrometric	EPA 353.3	Nitrate-N

Drinking Water		
Technology	**Method**	**Analyte**
Spectrometric	EPA 354.1	Nitrite-N
Spectrometric	EPA 365.2	Ortho-phosphate
Spectrometric	EPA 365.2	Phosphorus
Spectrometric	EPA 370.1	Silica
Titrimetric	EPA 376.1	Sulfide
Spectrometric	EPA 410.4	COD
Combustion-IR	EPA 415.1	TOC
Spectrometric	EPA 420.1	Phenols
GC	EPA 504.1	DBCP
GC	EPA 504.1	EDB
GC-MS	EPA 524.2	Acetone
GC-MS	EPA 524.2	Benzene
GC-MS	EPA 524.2	Bromobenzene
GC-MS	EPA 524.2	Bromochloromethane
GC-MS	EPA 524.2	Bromodichloromethane
GC-MS	EPA 524.2	Bromoform
GC-MS	EPA 524.2	Bromomethane
GC-MS	EPA 524.2	tert-Butyl alcohol
GC-MS	EPA 524.2	2-Butanone (MEK)
GC-MS	EPA 524.2	n-Butylbenzene
GC-MS	EPA 524.2	sec-Butylbenzene
GC-MS	EPA 524.2	tert-Butylbenzene
GC-MS	EPA 524.2	Carbon disulfide
GC-MS	EPA 524.2	Carbon tetrachloride
GC-MS	EPA 524.2	Chlorobenzene
GC-MS	EPA 524.2	Chloroethane
GC-MS	EPA 524.2	Chloroform
GC-MS	EPA 524.2	Chloromethane
GC-MS	EPA 524.2	2-Chlorotoluene
GC-MS	EPA 524.2	4-Chlorotoluene
GC-MS	EPA 524.2	Dibromochloromethane
GC-MS	EPA 524.2	1,2-Dibromo-3-chloropropane
GC-MS	EPA 524.2	1,2-Dibromoethane
GC-MS	EPA 524.2	Dibromomethane
GC-MS	EPA 524.2	1,1-Dichloroethane
GC-MS	EPA 524.2	1,2-Dichloroethane
GC-MS	EPA 524.2	1,2-Dichlorobenzene
GC-MS	EPA 524.2	1,3-Dichlorobenzene
GC-MS	EPA 524.2	1,4-Dichlorobenzene
GC-MS	EPA 524.2	Dichlorodifluoromethane
GC-MS	EPA 524.2	1,1-Dichloroethene

Drinking Water		
Technology	**Method**	**Analyte**
GC-MS	EPA 524.2	cis-1,2-Dichloroethene
GC-MS	EPA 524.2	trans-1,2-Dichloroethene
GC-MS	EPA 524.2	1,1-Dichloropropene
GC-MS	EPA 524.2	1,2-Dichloropropane
GC-MS	EPA 524.2	1,3-Dichloropropane
GC-MS	EPA 524.2	2,2-Dichloropropane
GC-MS	EPA 524.2	cis-1,3-Dichloropropene
GC-MS	EPA 524.2	trans-1,3-Dichloropropene
GC-MS	EPA 524.2	tert-Butyl ethyl ether (ETBE)
GC-MS	EPA 524.2	Ethylbenzene
GC-MS	EPA 524.2	2-Hexanone (MBK)
GC-MS	EPA 524.2	Hexachlorobutadiene
GC-MS	EPA 524.2	Isopropyl ether (DIPE)
GC-MS	EPA 524.2	Isopropylbenzene
GC-MS	EPA 524.2	p-Isopropyltoluene
GC-MS	EPA 524.2	Methylene Chloride
GC-MS	EPA 524.2	4-Methyl-2-pentanone (MIBK)
GC-MS	EPA 524.2	tert-Butyl methyl ether
GC-MS	EPA 524.2	Naphthalene
GC-MS	EPA 524.2	n-Propylbenzene
GC-MS	EPA 524.2	Styrene
GC-MS	EPA 524.2	tert-Amyl methyl ether (TAME)
GC-MS	EPA 524.2	1,1,1,2-Tetrachloroethane
GC-MS	EPA 524.2	1,1,2,2-Tetrachloroethane
GC-MS	EPA 524.2	Tetrachloroethene
GC-MS	EPA 524.2	Toluene
GC-MS	EPA 524.2	1,1,1-Trichloroethane
GC-MS	EPA 524.2	1,1,2-Trichloroethane
GC-MS	EPA 524.2	1,2,3-Trichlorobenzene
GC-MS	EPA 524.2	1,2,4-Trichlorobenzene
GC-MS	EPA 524.2	Trichloroethene
GC-MS	EPA 524.2	Trichlorofluoromethane
GC-MS	EPA 524.2	1,2,3-Trichloropropane
GC-MS	EPA 524.2	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	EPA 524.2	1,2,4-Trimethylbenzene
GC-MS	EPA 524.2	1,3,5-Trimethylbenzene
GC-MS	EPA 524.2	Vinyl Chloride
GC-MS	EPA 524.2	m-Xylene & p-xylene
GC-MS	EPA 524.2	o-Xylene
Titrimetric	SM 2320B	Alkalinity
HPLC-MS	EPA 6850	Perchlorate

Drinking Water		
Technology	**Method**	**Analyte**
ICP/ICP-MS by Calculation	SM 2340B	Hardness
Titrimetric	SM 2340C	Hardness
Platinum Electrode	SM 2510B	Specific Conductance
Gravimetric	SM 2540B	Total Residue
Gravimetric	SM 2540C	TDS
Gravimetric	SM 2540D	TSS
Spectrometric	SM 3500- FeB	Ferrous Iron
Spectrometric	SM 4500-CNE	Cyanide
Electrode	SM 4500 HB	pH
Spectrometric	SM 4500-NH3C	Ammonia
Spectrometric	SM 4500-NH3F	Ammonia
Spectrometric	SM 4500-NO2B	Nitrite-N
Spectrometric	SM 4500-NO3E	Nitrate-N
Spectrometric	SM 4500-NOrgC	TKN
Spectrometric	SM 4500-PE	Ortho-phosphate
Spectrometric	SM 4500-PE(PB5)	Phosphorus
Titrimetric	SM 4500-S2F	Sulfide
Spectrometric	SM 4500-SiO2C	Silica
Spectrometric	SM 5220D	COD
Combustion-IR	SM 5310B	TOC
Spectrometric	SM 5540C	Surfactants
MicroDistillation	QuickChem 10-204-00-1-X	Cyanide

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	AK101	GRO
GC	AK102	DRO
GC	AK103	RRO
GC	AZ8015	DRO (C10-C22)
GC	AZ8015	ORO (C22-C32)
GC	RSK175	Methane
GC	RSK175	Acetylene
GC	RSK175	Ethylene
GC	RSK175	Ethane
GC	RSK175	Propane
GC	RSK175	Carbon dioxide
Spectrometric	SM4500-NH3C	Ammonia
Spectrometric	SM4500-NH3F	Ammonia
Spectrometric	SM4500-NOrgC	TKN
Spectrometric	SM4500-PE(PB5)	Phosphorus

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Titrimetric	Walkley Black	TOC
Electrode	EPA 9045C / 9045D	pH
Spectrometric	EPA 9065	Phenols
Penskey-Martens	EPA 1010/ 1010A	Ignitability
ICP	EPA 6010B / 6010C	Aluminum
ICP	EPA 6010B / 6010C	Antimony
ICP	EPA 6010B / 6010C	Arsenic
ICP	EPA 6010B / 6010C	Barium
ICP	EPA 6010B / 6010C	Beryllium
ICP	EPA 6010B / 6010C	Boron
ICP	EPA 6010B / 6010C	Cadmium
ICP	EPA 6010B / 6010C	Calcium
ICP	EPA 6010B / 6010C	Chromium
ICP	EPA 6010B / 6010C	Cobalt
ICP	EPA 6010B / 6010C	Copper
ICP	EPA 6010B / 6010C	Iron
ICP	EPA 6010B / 6010C	Lead
ICP	EPA 6010B / 6010C	Lithium
ICP	EPA 6010B / 6010C	Magnesium
ICP	EPA 6010B / 6010C	Manganese
ICP	EPA 6010B / 6010C	Molybdenum
ICP	EPA 6010B / 6010C	Nickel
ICP	EPA 6010B / 6010C	Potassium
ICP	EPA 6010B / 6010C	Selenium
ICP	EPA 6010B / 6010C	Silver
ICP	EPA 6010B / 6010C	Sodium
ICP	EPA 6010B / 6010C	Strontium
ICP	EPA 6010B / 6010C	Thallium
ICP	EPA 6010B / 6010C	Tin
ICP	EPA 6010B / 6010C	Titanium
ICP	EPA 6010B / 6010C	Vanadium
ICP	EPA 6010B / 6010C	Zinc
IPC-MS	EPA 6020A	Aluminum
IPC-MS	EPA 6020A	Antimony
IPC-MS	EPA 6020A	Arsenic
IPC-MS	EPA 6020A	Barium
IPC-MS	EPA 6020A	Beryllium
IPC-MS	EPA 6020A	Boron
IPC-MS	EPA 6020A	Cadmium
IPC-MS	EPA 6020A	Calcium
IPC-MS	EPA 6020A	Chromium
IPC-MS	EPA 6020A	Cobalt
IPC-MS	EPA 6020A	Copper

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP-MS	EPA 6020A	Iron
ICP-MS	EPA 6020A	Lead
ICP-MS	EPA 6020A	Lithium
ICP-MS	EPA 6020A	Magnesium
ICP-MS	EPA 6020A	Manganese
ICP-MS	EPA 6020A	Molybdenum
ICP-MS	EPA 6020A	Nickel
ICP-MS	EPA 6020A	Potassium
ICP-MS	EPA 6020A	Selenium
ICP-MS	EPA 6020A	Silver
ICP-MS	EPA 6020A	Sodium
ICP-MS	EPA 6020A	Strontium
ICP-MS	EPA 6020A	Thallium
ICP-MS	EPA 6020A	Tin
ICP-MS	EPA 6020A	Titanium
ICP-MS	EPA 6020A	Tungsten
ICP-MS	EPA 6020A	Uranium
ICP-MS	EPA 6020A	Vanadium
ICP-MS	EPA 6020A	Zinc
HPLC-MS	EPA 6850	Perchlorate
Spectrometric	EPA 7196A	Hex. Chromium
IC	EPA 7199	Hex. Chromium
Cold-Vapor	EPA 7471A / 7471B	Mercury
GC	EPA 8011	DBCP
GC	EPA 8011	EDB
GC	EPA 8015B / 8015C / 8015D	Gasoline
GC	EPA 8015B / 8015C / 8015D	Diesel
GC	EPA 8015B / 8015C / 8015D	Motor Oil
GC	EPA 8015B / 8015C / 8015D	JP5
GC	EPA 801 5B / 8015C	Ethanol
GC	EPA 8015B / 8015C	Isopropanol
GC	EPA 8015B / 8015C	Diethylene Glycol
GC	EPA 8015B / 8015C	Ethylene Glycol
GC	EPA 8015B / 8015C	Triethylene Glycol
GC	EPA 8015B / 8015C / 8015D	JP4
GC	EPA 8015B / 8015C	Methanol
GC	EPA 8015B / 8015C	Propylene Glycol
GC	EPA 8081A / 8081B	Aldrin
GC	EPA 8081A / 8081B	alpha-BHC
GC	EPA 8081A / 8081B	beta-BHC
GC	EPA 8081A / 8081B	delta-BHC
GC	EPA 8081A / 8081B	gamma-BHC (Lindane)
GC	EPA 8081A / 8081B	DDD (4,4)

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8081A / 8081B	DDE (4,4)
GC	EPA 8081A / 8081B	DDT (4,4)
GC	EPA 8081A / 8081B	Dieldrin
GC	EPA 8081A / 8081B	Endosulfan I
GC	EPA 8081A / 8081B	Endosulfan II
GC	EPA 8081A / 8081B	Endosulfan sulfate
GC	EPA 8081A / 8081B	Endrin
GC	EPA 8081A / 8081B	Endrin Aldehyde
GC	EPA 8081A / 8081B	Heptachlor
GC	EPA 8081A / 8081B	Heptachlor epoxide
GC	EPA 8081A / 8081B	Methoxychlor
GC	EPA 8081A / 8081B	alpha-Chlordane
GC	EPA 8081A / 8081B	gamma-Chlordane
GC	EPA 8081A / 8081B	Endrin Ketone
GC	EPA 8081A / 8081B	Toxaphene
GC	EPA 8081A / 8081B	Technical Chlordane
GC	EPA 8081A / 8081B	cis-Nonachlor
GC	EPA 8081A / 8081B	DDD (2,4)
GC	EPA 8081A / 8081B	DDE (2,4)
GC	EPA 8081A / 8081B	DDT (2,4)
GC	EPA 8081A / 8081B	Mirex
GC	EPA 8081A / 8081B	Oxychlordane
GC	EPA 8081A / 8081B	trans-Nonachlor
GC	EPA 8082 / 8082A	PCB1016
GC	EPA 8082 / 8082A	PCB1221
GC	EPA 8082 / 8082A	PCB1232
GC	EPA 8082 / 8082A	PCB1242
GC	EPA 8082 / 8082A	PCB1248
GC	EPA 8082 / 8082A	PCB1254
GC	EPA 8082 / 8082A	PCB1260
GC	EPA 8082 / 8082A	PCB1262
GC	EPA 8082 / 8082A	PCB1268
GC	EPA 8082 / 8082A	PCB 8
GC	EPA 8082 / 8082A	PCB 18
GC	EPA 8082 / 8082A	PCB 28
GC	EPA 8082 / 8082A	PCB 44
GC	EPA 8082 / 8082A	PCB 52
GC	EPA 8082 / 8082A	PCB 66
GC	EPA 8082 / 8082A	PCB 77
GC	EPA 8082 / 8082A	PCB 81
GC	EPA 8082 / 8082A	PCB 101
GC	EPA 8082 / 8082A	PCB 105
GC	EPA 8082 / 8082A	PCB 110

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8082 / 8082A	PCB 114
GC	EPA 8082 / 8082A	PCB 118
GC	EPA 8082 / 8082A	PCB 123
GC	EPA 8082 / 8082A	PCB 126
GC	EPA 8082 / 8082A	PCB 128
GC	EPA 8082 / 8082A	PCB 138
GC	EPA 8082 / 8082A	PCB 153
GC	EPA 8082 / 8082A	PCB 156
GC	EPA 8082 / 8082A	PCB 157
GC	EPA 8082 / 8082A	PCB 167
GC	EPA 8082 / 8082A	PCB 169
GC	EPA 8082 / 8082A	PCB 170
GC	EPA 8082 / 8082A	PCB 180
GC	EPA 8082 / 8082A	PCB 187
GC	EPA 8082 / 8082A	PCB 189
GC	EPA 8082 / 8082A	PCB 195
GC	EPA 8082 / 8082A	PCB 206
GC	EPA 8082 / 8082A	PCB 209
GC	EPA 8141A / 8141B	Azinphos-methyl
GC	EPA 8141A / 8141B	Bolstar
GC	EPA 8141A / 8141B	Chlorpyrifos
GC	EPA 8141A / 8141B	Coumaphos
GC	EPA 8141A / 8141B	Demeton
GC	EPA 8141A / 8141B	Diazinon
GC	EPA 8141A / 8141B	Dichlorvos
GC	EPA 8141A / 8141B	Disulfoton
GC	EPA 8141A / 8141B	Ethoprop
GC	EPA 8141A / 8141B	Fensulfothion
GC	EPA 8141A / 8141B	Fenthion
GC	EPA 8141A / 8141B	Merphos
GC	EPA 8141A / 8141B	Mevinphos
GC	EPA 8141A / 8141B	Naled
GC	EPA 8141A / 8141B	Methyl Parathion
GC	EPA 8141A / 8141B	Phorate
GC	EPA 8141A / 8141B	Ronnel
GC	EPA 8141A / 8141B	Stirophos
GC	EPA 8141A / 8141B	Tokuthion
GC	EPA 8141A / 8141B	Trichloronate
GC	EPA 8141A / 8141B	Dimethoate
GC	EPA 8141A / 8141B	EPN
GC	EPA 8141A / 8141B	Famphur
GC	EPA 8141A / 8141B	Malathion
GC	EPA 8141A / 8141B	Ethyl Parathion

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC	EPA 8141A / 8141B	O,O,O-Triethylphosphorothioate
GC	EPA 8141A / 8141B	Sulfotepp
GC	EPA 8141A / 8141B	Thionazin
GC	EPA 8141A / 8141B	Tributyl Phosphate
GC-MS	EPA 8260B / 8260C	Acetone
GC-MS	EPA 8260B / 8260C	Acrolein
GC-MS	EPA 8260B / 8260C	Acrylonitrile
GC-MS	EPA 8260B / 8260C	Benzene
GC-MS	EPA 8260B / 8260C	Bromobenzene
GC-MS	EPA 8260B / 8260C	Bromochloromethane
GC-MS	EPA 8260B / 8260C	Bromodichloromethane
GC-MS	EPA 8260B / 8260C	Bromoform
GC-MS	EPA 8260B / 8260C	Bromomethane
GC-MS	EPA 8260B / 8260C	tert-Butyl alcohol
GC-MS	EPA 8260B / 8260C	2-Butanone (MEK)
GC-MS	EPA 8260B / 8260C	n-Butylbenzene
GC-MS	EPA 8260B / 8260C	sec-Butylbenzene
GC-MS	EPA 8260B / 8260C	tert-Butylbenzene
GC-MS	EPA 8260B / 8260C	Carbon disulfide
GC-MS	EPA 8260B / 8260C	Carbon tetrachloride
GC-MS	EPA 8260B / 8260C	Chlorobenzene
GC-MS	EPA 8260B / 8260C	2-Chloroethyl vinyl ether
GC-MS	EPA 8260B / 8260C	Chloroethane
GC-MS	EPA 8260B / 8260C	Chloroform
GC-MS	EPA 8260B / 8260C	1-Chlorohexane
GC-MS	EPA 8260B / 8260C	Chloromethane
GC-MS	EPA 8260B / 8260C	2-Chlorotoluene
GC-MS	EPA 8260B / 8260C	4-Chlorotoluene
GC-MS	EPA 8260B / 8260C	Isopropyl ether (DIPE)
GC-MS	EPA 8260B / 8260C	Dibromochloromethane
GC-MS	EPA 8260B / 8260C	1,2-Dibromo-3-chloropropane
GC-MS	EPA 8260B / 8260C	1,2-Dibromoethane
GC-MS	EPA 8260B / 8260C	Dibromomethane
GC-MS	EPA 8260B / 8260C	1,1-Dichloroethane
GC-MS	EPA 8260B / 8260C	1,2-Dichloroethane
GC-MS	EPA 8260B / 8260C	1,2-Dichlorobenzene
GC-MS	EPA 8260B / 8260C	1,3-Dichlorobenzene
GC-MS	EPA 8260B / 8260C	trans-1,4-Dichloro-2-Butene
GC-MS	EPA 8260B / 8260C	1,4-Dichlorobenzene
GC-MS	EPA 8260B / 8260C	Dichlorodifluoromethane
GC-MS	EPA 8260B / 8260C	1,1-Dichloroethene
GC-MS	EPA 8260B / 8260C	cis-1,2-Dichloroethene
GC-MS	EPA 8260B / 8260C	trans-1,2-Dichloroethene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8260B / 8260C	Dichlorofluoromethane
GC-MS	EPA 8260B / 8260C	1,1-Dichloropropene
GC-MS	EPA 8260B / 8260C	1,2-Dichloropropane
GC-MS	EPA 8260B / 8260C	1,3-Dichloropropane
GC-MS	EPA 8260B / 8260C	2,2-Dichloropropane
GC-MS	EPA 8260B / 8260C	cis-1,3-Dichloropropene
GC-MS	EPA 8260B / 8260C	trans-1,3-Dichloropropene
GC-MS	EPA 8260B / 8260C	tert-Butyl ethyl ether (ETBE)
GC-MS	EPA 8260B / 8260C	Ethyl Methacrylate
GC-MS	EPA 8260B / 8260C	Ethylbenzene
GC-MS	EPA 8260B / 8260C	2-Hexanone (MBK)
GC-MS	EPA 8260B / 8260C	Hexachlorobutadiene
GC-MS	EPA 8260B / 8260C	Iodomethane
GC-MS	EPA 8260B / 8260C	Isopropylbenzene
GC-MS	EPA 8260B / 8260C	p-Isopropyltoluene
GC-MS	EPA 8260B / 8260C	Methylene Chloride
GC-MS	EPA 8260B / 8260C	4-Methyl-2-pentanone (MIBK)
GC-MS	EPA 8260B / 8260C	tert-Butyl methyl ether
GC-MS	EPA 8260B / 8260C	Naphthalene
GC-MS	EPA 8260B / 8260C	n-Propylbenzene
GC-MS	EPA 8260B / 8260C	Styrene
GC-MS	EPA 8260B / 8260C	tert-Amyl methyl ether (TAME)
GC-MS	EPA 8260B / 8260C	1,1,1,2-Tetrachloroethane
GC-MS	EPA 8260B / 8260C	1,1,2,2-Tetrachloroethane
GC-MS	EPA 8260B / 8260C	Tetrachloroethene
GC-MS	EPA 8260B / 8260C	Toluene
GC-MS	EPA 8260B / 8260C	1,1,1-Trichloroethane
GC-MS	EPA 8260B / 8260C	1,1,2-Trichloroethane
GC-MS	EPA 8260B / 8260C	1,2,3-Trichlorobenzene
GC-MS	EPA 8260B / 8260C	1,2,4-Trichlorobenzene
GC-MS	EPA 8260B / 8260C	Trichloroethene
GC-MS	EPA 8260B / 8260C	Trichlorofluoromethane
GC-MS	EPA 8260B / 8260C	1,2,3-Trichloropropane
GC-MS	EPA 8260B / 8260C	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	EPA 8260B / 8260C	1,2,4-Trimethylbenzene
GC-MS	EPA 8260B / 8260C	1,3,5-Trimethylbenzene
GC-MS	EPA 8260B / 8260C	Vinyl Acetate
GC-MS	EPA 8260B / 8260C	Vinyl Chloride
GC-MS	EPA 8260B / 8260C	m-Xylene & p-xylene
GC-MS	EPA 8260B / 8260C	o-Xylene
GC-MS	EPA 8260B / 8260C	2-Butanol
GC-MS	EPA 8260B / 8260C	Cyclohexane
GC-MS	EPA 8260B / 8260C	1,4-Dioxane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8260B / 8260C	2-Chloro-1,1,1-trifluoroethane
GC-MS	EPA 8260B / 8260C	Chlorotrifluoroethylene
GC-MS	EPA 8260B / 8260C	cis-1,4-Dichloro-2-butene
GC-MS	EPA 8260B / 8260C	Ethanol
GC-MS	EPA 8260B / 8260C	Ethyl Methacrylate
GC-MS	EPA 8260B / 8260C	Isobutyl Alcohol
GC-MS	EPA 8260B / 8260C	Methacrylonitrile
GC-MS	EPA 8260B / 8260C	Methyl Methacrylate
GC-MS	EPA 8260B / 8260C	Pentachloroethane
GC-MS	EPA 8260B / 8260C	Propionitrile
GC-MS	EPA 8260B / 8260C	Sec-Propyl alcohol
GC-MS	EPA 8260B / 8260C	Tetrahydrofuran
GC-MS	EPA 8260B / 8260C	trans-1,4-Dichloro-2-butene
GC-MS	EPA 8260B / 8260C SIM	Benzene
GC-MS	EPA 8260B / 8260C SIM	Carbon tetrachloride
GC-MS	EPA 8260B / 8260C SIM	Chloroform
GC-MS	EPA 8260B / 8260C SIM	Chloromethane
GC-MS	EPA 8260B / 8260C SIM	1,2-Dibromo-3-chloropropane
GC-MS	EPA 8260B / 8260C SIM	1,2-Dibromoethane
GC-MS	EPA 8260B / 8260C SIM	1,2-Dichloroethane
GC-MS	EPA 8260B / 8260C SIM	1,1-Dichloroethene
GC-MS	EPA 8260B / 8260C SIM	cis-1,2-Dichloroethene
GC-MS	EPA 8260B / 8260C SIM	trans-1,2-Dichloroethene
GC-MS	EPA 8260B / 8260C SIM	1,1,2,2-Tetrachloroethane
GC-MS	EPA 8260B / 8260C SIM	Tetrachloroethene
GC-MS	EPA 8260B / 8260C SIM	1,1,1-Trichloroethane
GC-MS	EPA 8260B / 8260C SIM	1,1,2-Trichloroethane
GC-MS	EPA 8260B / 8260C SIM	Trichloroethene
GC-MS	EPA 8260B / 8260C SIM	1,2,3-Trichloropropane
GC-MS	EPA 8260B / 8260C SIM	Vinyl Chloride
GC-MS	EPA 8260B / 8260C SIM	1,4-Dioxane
GC-MS	EPA 8270C / 8270D	Acenaphthene
GC-MS	EPA 8270C / 8270D	Acenaphthylene
GC-MS	EPA 8270C / 8270D	Aniline
GC-MS	EPA 8270C / 8270D	Anthracene
GC-MS	EPA 8270C / 8270D	Azobenzene
GC-MS	EPA 8270C / 8270D	Benzidine
GC-MS	EPA 8270C / 8270D	Benzo(a)anthracene
GC-MS	EPA 8270C / 8270D	benzo(a)pyrene
GC-MS	EPA 8270C / 8270D	Benzo(b)fluoranthene
GC-MS	EPA 8270C / 8270D	Benzo(e)pyrene
GC-MS	EPA 8270C / 8270D	Benzo(g,h,i)perylene
GC-MS	EPA 8270C / 8270D	Benzo(k)fluoranthene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	Benzoic Acid
GC-MS	EPA 8270C / 8270D	Benzyl Alcohol
GC-MS	EPA 8270C / 8270D	Biphenyl
GC-MS	EPA 8270C / 8270D	bis(2-chloroethoxy)methane
GC-MS	EPA 8270C / 8270D	bis(2-chloroethyl)ether
GC-MS	EPA 8270C / 8270D	bis(2-chloroisopropyl)ether
GC-MS	EPA 8270C / 8270D	bis(2-Ethylhexyl)adipate
GC-MS	EPA 8270C / 8270D	bis(2-Ethylhexyl)phthalate
GC-MS	EPA 8270C / 8270D	4-Bromophenyl-phenylether
GC-MS	EPA 8270C / 8270D	Butylbenzylphthalate
GC-MS	EPA 8270C / 8270D	Carbazole
GC-MS	EPA 8270C / 8270D	4-Chloro-3-methylphenol
GC-MS	EPA 8270C / 8270D	4-Chloroaniline
GC-MS	EPA 8270C / 8270D	2-Chloronaphthalene
GC-MS	EPA 8270C / 8270D	2-Chlorophenol
GC-MS	EPA 8270C / 8270D	4-Chlorophenyl-phenylether
GC-MS	EPA 8270C / 8270D	Chrysene
GC-MS	EPA 8270C / 8270D	Dibenzo(a,h)anthracene
GC-MS	EPA 8270C / 8270D	Dibenzofuran
GC-MS	EPA 8270C / 8270D	1,2-Dichlorobenzene
GC-MS	EPA 8270C / 8270D	1,3-Dichlorobenzene
GC-MS	EPA 8270C / 8270D	1,4-Dichlorobenzene
GC-MS	EPA 8270C / 8270D	3,3'-Dichlorobenzidine
GC-MS	EPA 8270C / 8270D	2,4-Dichlorophenol
GC-MS	EPA 8270C / 8270D	Diethylphthalate
GC-MS	EPA 8270C / 8270D	2,6-Dimethylnaphthalene
GC-MS	EPA 8270C / 8270D	2,4-Dimethylphenol
GC-MS	EPA 8270C / 8270D	Dimethylphthalate
GC-MS	EPA 8270C / 8270D	Di-n-butylphthalate
GC-MS	EPA 8270C / 8270D	4,6-Dinitro-2-methylphenol
GC-MS	EPA 8270C / 8270D	2,4-Dinitrophenol
GC-MS	EPA 8270C / 8270D	2,4-Dinitrotoluene
GC-MS	EPA 8270C / 8270D	2,6-Dinitrotoluene
GC-MS	EPA 8270C / 8270D	Di-n-octylphthalate
GC-MS	EPA 8270C / 8270D	Fluoranthene
GC-MS	EPA 8270C / 8270D	Fluorene
GC-MS	EPA 8270C / 8270D	Hexachlorobenzene
GC-MS	EPA 8270C / 8270D	Hexachlorobutadiene
GC-MS	EPA 8270C / 8270D	Hexachlorocyclopentadiene
GC-MS	EPA 8270C / 8270D	Hexachloroethane
GC-MS	EPA 8270C / 8270D	Indeno(1,2,3-cd)pyrene
GC-MS	EPA 8270C / 8270D	Isophorone
GC-MS	EPA 8270C / 8270D	1-Methylnaphthalene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	2-Methylnaphthalene
GC-MS	EPA 8270C / 8270D	1-Methylphenanthrene
GC-MS	EPA 8270C / 8270D	2-Methylphenol
GC-MS	EPA 8270C / 8270D	4-Methylphenol
GC-MS	EPA 8270C / 8270D	Naphthalene
GC-MS	EPA 8270C / 8270D	2-Nitroaniline
GC-MS	EPA 8270C / 8270D	3-Nitroaniline
GC-MS	EPA 8270C / 8270D	4-Nitroaniline
GC-MS	EPA 8270C / 8270D	Nitrobenzene
GC-MS	EPA 8270C / 8270D	2-Nitrophenol
GC-MS	EPA 8270C / 8270D	4-Nitrophenol
GC-MS	EPA 8270C / 8270D	n-Nitrosodimethylamine
GC-MS	EPA 8270C / 8270D	n-Nitroso-di-n-propylamine
GC-MS	EPA 8270C / 8270D	n-Nitrosodiphenylamine
GC-MS	EPA 8270C / 8270D	Pentachlorophenol
GC-MS	EPA 8270C / 8270D	Perylene
GC-MS	EPA 8270C / 8270D	Phenanthrene
GC-MS	EPA 8270C / 8270D	Phenol
GC-MS	EPA 8270C / 8270D	Pyrene
GC-MS	EPA 8270C / 8270D	Pyridine
GC-MS	EPA 8270C / 8270D	2,3,4,6-Tetrachlorophenol
GC-MS	EPA 8270C / 8270D	1,2,4-Trichlorobenzene
GC-MS	EPA 8270C / 8270D	2,3,4-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,3,5-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,4,5-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,4,6-Trichlorophenol
GC-MS	EPA 8270C / 8270D	2,3,5-Trimethylnaphthalene
GC-MS	EPA 8270C / 8270D	1,2,4,5-Tetrachlorobenzene
GC-MS	EPA 8270C / 8270D	1,3,5-Trinitrobenzene
GC-MS	EPA 8270C / 8270D	1,3-Dinitrobenzene
GC-MS	EPA 8270C / 8270D	1,4-Dioxane
GC-MS	EPA 8270C / 8270D	1,4-Naphthoquinone
GC-MS	EPA 8270C / 8270D	1-Chloronaphthalene
GC-MS	EPA 8270C / 8270D	1-Naphthylamine
GC-MS	EPA 8270C / 8270D	2,6-Dichlorophenol
GC-MS	EPA 8270C / 8270D	2-acetylaminofluorene
GC-MS	EPA 8270C / 8270D	2-Naphthylamine
GC-MS	EPA 8270C / 8270D	2-Picoline
GC-MS	EPA 8270C / 8270D	3,3-Dimethylbenzidine
GC-MS	EPA 8270C / 8270D	3,4-Dimethylphenol
GC-MS	EPA 8270C / 8270D	3,5-Dimethylphenol
GC-MS	EPA 8270C / 8270D	3-Methylchlolanthrene
GC-MS	EPA 8270C / 8270D	4-Aminobiphenyl

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	4-Nitroquinoline-N-oxide
GC-MS	EPA 8270C / 8270D	5-Nitro-o-toluidine
GC-MS	EPA 8270C / 8270D	7,12-Dimethylbenz(a)anthracene
GC-MS	EPA 8270C / 8270D	Acetophenone
GC-MS	EPA 8270C / 8270D	Aramite
GC-MS	EPA 8270C / 8270D	Atrazine
GC-MS	EPA 8270C / 8270D	Biphenyl
GC-MS	EPA 8270C / 8270D	Chlorobenzilate
GC-MS	EPA 8270C / 8270D	Diallate
GC-MS	EPA 8270C / 8270D	Dibenzo(a,j)acridine
GC-MS	EPA 8270C / 8270D	Dimethoate
GC-MS	EPA 8270C / 8270D	Dinoseb
GC-MS	EPA 8270C / 8270D	Diphenyl ether
GC-MS	EPA 8270C / 8270D	Disulfoton
GC-MS	EPA 8270C / 8270D	Ethyl methacrylate
GC-MS	EPA 8270C / 8270D	Ethyl methanesulfonate
GC-MS	EPA 8270C / 8270D	Ethyl parathion
GC-MS	EPA 8270C / 8270D	Famphur
GC-MS	EPA 8270C / 8270D	Hexachlorophene
GC-MS	EPA 8270C / 8270D	Hexachloropropene
GC-MS	EPA 8270C / 8270D	Isodrin
GC-MS	EPA 8270C / 8270D	Isosafrole
GC-MS	EPA 8270C / 8270D	kepone
GC-MS	EPA 8270C / 8270D	Methapyrilene
GC-MS	EPA 8270C / 8270D	Methyl methanesulfonate
GC-MS	EPA 8270C / 8270D	Methyl parathion
GC-MS	EPA 8270C / 8270D	N-nitrosodiethylamine
GC-MS	EPA 8270C / 8270D	N-Nitrosodi-n-butylamine
GC-MS	EPA 8270C / 8270D	N-Nitrosomethylethylamine
GC-MS	EPA 8270C / 8270D	N-Nitrosomorpholine
GC-MS	EPA 8270C / 8270D	N-Nitrosopiperdine
GC-MS	EPA 8270C / 8270D	N-Nitrosopyrrolidine
GC-MS	EPA 8270C / 8270D	O,O,O-triethyl phosphorothi
GC-MS	EPA 8270C / 8270D	o-toluidine
GC-MS	EPA 8270C / 8270D	p-Dimethylaminoazobenze
GC-MS	EPA 8270C / 8270D	Pentachlorobenzene
GC-MS	EPA 8270C / 8270D	Pentachloroethane
GC-MS	EPA 8270C / 8270D	Pentachloronitrobenzene
GC-MS	EPA 8270C / 8270D	Phenacetin
GC-MS	EPA 8270C / 8270D	Phorate
GC-MS	EPA 8270C / 8270D	p-phenylenediamine
GC-MS	EPA 8270C / 8270D	Pronamide
GC-MS	EPA 8270C / 8270D	Safrole

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D	Sulfotepp
GC-MS	EPA 8270C / 8270D	Thionazin
GC-MS	EPA 8270C / 8270D SIM	Acenaphthene
GC-MS	EPA 8270C / 8270D SIM	Acenaphthylene
GC-MS	EPA 8270C / 8270D SIM	Anthracene
GC-MS	EPA 8270C / 8270D SIM	Azobenzene
GC-MS	EPA 8270C / 8270D SIM	Benzo(a)anthracene
GC-MS	EPA 8270C / 8270D SIM	benzo(a)pyrene
GC-MS	EPA 8270C / 8270D SIM	Benzo(b)fluoranthene
GC-MS	EPA 8270C / 8270D SIM	Benzo(e)pyrene
GC-MS	EPA 8270C / 8270D SIM	Benzo(g,h,i)perylene
GC-MS	EPA 8270C / 8270D SIM	Benzo(k)fluoranthene
GC-MS	EPA 8270C / 8270D SIM	Biphenyl
GC-MS	EPA 8270C / 8270D SIM	bis(2-chloroethyl)ether
GC-MS	EPA 8270C / 8270D SIM	bis(2-Ethylhexyl)phthalate
GC-MS	EPA 8270C / 8270D SIM	Carbazole
GC-MS	EPA 8270C / 8270D SIM	4-Chloro-3-methylphenol
GC-MS	EPA 8270C / 8270D SIM	2-Chlorophenol
GC-MS	EPA 8270C / 8270D SIM	Chrysene
GC-MS	EPA 8270C / 8270D SIM	Dibenzo(a,h)anthracene
GC-MS	EPA 8270C / 8270D SIM	2,4-Dichlorophenol
GC-MS	EPA 8270C / 8270D SIM	2,6-Dimethylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	2,4-Dimethylphenol
GC-MS	EPA 8270C / 8270D SIM	Fluoranthene
GC-MS	EPA 8270C / 8270D SIM	Fluorene
GC-MS	EPA 8270C / 8270D SIM	Hexachlorobenzene
GC-MS	EPA 8270C / 8270D SIM	Indeno(1,2,3-cd)pyrene
GC-MS	EPA 8270C / 8270D SIM	1-Methylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	2-Methylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	1-Methylphenanthrene
GC-MS	EPA 8270C / 8270D SIM	Naphthalene
GC-MS	EPA 8270C / 8270D SIM	n-Nitrosodimethylamine
GC-MS	EPA 8270C / 8270D SIM	n-Nitroso-di-n-propylamine
GC-MS	EPA 8270C / 8270D SIM	Pentachlorophenol
GC-MS	EPA 8270C / 8270D SIM	Perylene
GC-MS	EPA 8270C / 8270D SIM	Phenanthrene
GC-MS	EPA 8270C / 8270D SIM	Phenol
GC-MS	EPA 8270C / 8270D SIM	Pyrene
GC-MS	EPA 8270C / 8270D SIM	2,4,5-Trichlorophenol
GC-MS	EPA 8270C / 8270D SIM	2,4,6-Trichlorophenol
GC-MS	EPA 8270C / 8270D SIM	2,3,5-Trimethylnaphthalene
GC-MS	EPA 8270C / 8270D SIM	1,4-Dioxane
GC-MS	EPA 8270C / 8270D SIM	Butylbenzylphthalate

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC-MS	EPA 8270C / 8270D SIM	Diethylphthalate
GC-MS	EPA 8270C / 8270D SIM	Dimethylphthalate
GC-MS	EPA 8270C / 8270D SIM	Di-n-butylphthalate
GC-MS	EPA 8270C / 8270D SIM	Di-n-octylphthalate
HPLC	EPA 8310	Acenaphthene
HPLC	EPA 8310	Acenaphthylene
HPLC	EPA 8310	Anthracene
HPLC	EPA 8310	Benzo(a)anthracene
HPLC	EPA 8310	Benzo(a)pyrene
HPLC	EPA 8310	Benzo(b)fluoranthene
HPLC	EPA 8310	Benzo(g,h,i)perylene
HPLC	EPA 8310	Benzo(k)fluoranthene
HPLC	EPA 8310	Chrysene
HPLC	EPA 8310	Dibenzo(a,h)anthracene
HPLC	EPA 8310	Fluoranthene
HPLC	EPA 8310	Fluorene
HPLC	EPA 8310	Indeno(1,2,3-cd)pyrene
HPLC	EPA 8310	1-Methylnaphthalene
HPLC	EPA 8310	2-Methylnaphthalene
HPLC	EPA 8310	Naphthalene
HPLC	EPA 8310	Phenanthrene
HPLC	EPA 8310	Pyrene
HPLC	EPA 8330A	HMX
HPLC	EPA 8330A	RDX
HPLC	EPA 8330A	1,3,5-TNB
HPLC	EPA 8330A	1,3-DNB
HPLC	EPA 8330A	Tetryl
HPLC	EPA 8330A	Nitrobenzene
HPLC	EPA 8330A	2,4,6-TNT
HPLC	EPA 8330A	4-AM-2,6-DNT
HPLC	EPA 8330A	2-AM-4,6-DNT
HPLC	EPA 8330A	2,6-DNT
HPLC	EPA 8330A	2,4-DNT
HPLC	EPA 8330A	2-Nitrotoluene
HPLC	EPA 8330A	4-Nitrotoluene
HPLC	EPA 8330A	3-Nitrotoluene
HPLC	EPA 8330A	3,5-Dinitroaniline
HPLC	EPA 8330A	2,4-Diamino-6-nitrotoluene
HPLC	EPA 8330A	2,6-Diamino-4-nitrotoluene
HPLC	EPA 8330A	Picric Acid
HPLC	EPA 8332	Nitroglycerine

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
HPLC	EPA 8332	PETN
Combustion-IR	EPA 9060A	TOC
IC	EPA9056/9056A	Bromate
IC	EPA9056/9056A	Bromide
IC	EPA9056/9056A	Chloride
IC	EPA9056/9056A	Fluoride
IC	EPA9056/9056A	Nitrate
IC	EPA9056/9056A	Nitrite
IC	EPA9056/9056A	Phosphate
IC	EPA9056/9056A	Sulfate
IC	EPA 9056 / 9056A	Chlorate
GC	EPA 8151A	Acifluorfen
GC	EPA 8151A	Bentazon
GC	EPA 8151A	Chloramben
GC	EPA 8151A	2,4-D
GC	EPA 8151A	2,4-DB
GC	EPA 8151A	Dacthal
GC	EPA 8151A	Dalapon
GC	EPA 8151A	Dicamba
GC	EPA 8151A	3,5-Dichlorobenzoic acid
GC	EPA 8151A	Dichlorprop
GC	EPA 8151A	Dinoseb
GC	EPA 8151A	MCPA
GC	EPA 8151A	MCPP
GC	EPA 8151A	Pentachlorophenol
GC	EPA 8151A	Picloram
GC	EPA 8151A	Silvex
GC	EPA 8151A	2,4,5-T
Spectrometric	EPA 9014	Cyanide
Gravimetric	EPA 9071B	Oil & Grease
GFAA	CA 939M	Organo Lead
Preparation	**Method**	**Type**
Purge &Trap	EPA 5030B / EPA 5035	Volatiles Prep
Acid Digestion	EPA 3050B	Metals Prep
Alkaline Digestion	EPA 3060A	Hexavalent Chrom
Soxhlet	EPA 3540C	Organic Extraction
Sonication	EPA 3550C	Organic Extraction
Waste Dilution	EPA 3580A	Organic Extraction
Microwave	EPA 3546	Organic Extraction
TCLP	EPA 1311	Leaching
SPLP	EPA 1312	Leaching

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
Floricil Clean-up	EPA 3620C	Extract Clean-Up
GPC Clean-up	EPA 3640A	Extract Clean-Up
Sulfur Clean-up	EPA 3660B	Extract Clean-Up
Acid/Permanganate Clean-up	EPA 3665A	Extract Clean-Up

Air and Emissions		
Technology	**Method**	**Analyte**
GC-MS	TO-15	1,1,1-trichloroethane
GC-MS	TO-15	1,1,2,2-tetrachloroethane
GC-MS	TO-15	1,1,2-Trichloro1,2,2-trifluoroethane
GC-MS	TO-15	1,1,2-trichloroethane
GC-MS	TO-15	1,1-dichloroethane
GC-MS	TO-15	1,1-Dichloroethene
GC-MS	TO-15	1,2,4-trichlorobenzene
GC-MS	TO-15	1,2,4-trimethylbenzene
GC-MS	TO-15	1,2-dibromoethane
GC-MS	TO-15	1,2-dichlorobenzene
GC-MS	TO-15	1,2-dichloroethane
GC-MS	TO-15	1,2-dichloroethene
GC-MS	TO-15	1,2-dichloropropane
GC-MS	TO-15	1,3,5-trimethylbenzene
GC-MS	TO-15	1,3-Butadiene
GC-MS	TO-15	1,3-Butadiene, 1,1,2,3,4,Hexachloro
GC-MS	TO-15	1,3-dichlorobenzene
GC-MS	TO-15	1,4-dichlorobenzene
GC-MS	TO-15	1,4-Dioxane
GC-MS	TO-15	2,2,4-Trimethylpentane
GC-MS	TO-15	4-Ethyltoluene
GC-MS	TO-15	Acetone
GC-MS	TO-15	Acrylonitrile
GC-MS	TO-15	Allyl Chloride
GC-MS	TO-15	Benzene
GC-MS	TO-15	Benzyl Chloride
GC-MS	TO-15	Bromodichloromethane
GC-MS	TO-15	Bromoform
GC-MS	TO-15	Bromomethane
GC-MS	TO-15	Carbon Disulfide
GC-MS	TO-15	Carbon Tetrachloride
GC-MS	TO-15	Chlorobenzene

LABORATORY ACCREDITATION BUREAU

Certificate # L2278

Air and Emissions		
Technology	**Method**	**Analyte**
GC-MS	TO-15	Chloroethane
GC-MS	TO-15	Chloroethene
GC-MS	TO-15	Chloroform
GC-MS	TO-15	Chloromethane
GC-MS	TO-15	cis-1,3-Dichloropropene
GC-MS	TO-15	Cyclohexane
GC-MS	TO-15	Dibromochloromethane
GC-MS	TO-15	Dichlorodifluoromethane
GC-MS	TO-15	Dichlorotetrafluoroethane
GC-MS	TO-15	Ethyl Acetate
GC-MS	TO-15	Ethylbenzene
GC-MS	TO-15	Isopropyl Alcohol
GC-MS	TO-15	m+p-Xylene
GC-MS	TO-15	Methyl butyl Ketone
GC-MS	TO-15	Methyl Ethyl Ketone
GC-MS	TO-15	Methyl Isobutyl Ketone
GC-MS	TO-15	Methyl Tert-Butyl Ether
GC-MS	TO-15	Methylene Chloride
GC-MS	TO-15	n-Heptane
GC-MS	TO-15	n-Hexane
GC-MS	TO-15	o-Xylene
GC-MS	TO-15	Styrene
GC-MS	TO-15	Tetrachloroethylene
GC-MS	TO-15	Tetrahydrofuran
GC-MS	TO-15	Toluene
GC-MS	TO-15	Trans-1,2-Dichloroethene
GC-MS	TO-15	trans-1,3-Dichloropropene
GC-MS	TO-15	Trichloroethylene
GC-MS	TO-15	Trichloromonofluoromethan
GC-MS	TO-15	Vinyl Acetate
GC-MS	TO-15	Vinyl Bromide

Notes:

1) This laboratory offers commercial testing service.

Approved by: _____ Date: January 9, 2014

R. Douglas Leonard
Chief Technical Officer

Reissued: 1/9/14

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

ENVIRONMENTAL CONSERVATION LABORATORIES – ORLANDO
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ENVIRONMENTAL

Valid To: March 31, 2014 Certificate Number: 3000.01

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

Testing Technologies

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

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

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

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

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

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

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

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

Preparation Methods

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

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

ENVIRONMENTAL CONSERVATION LABORATORIES - ORLANDO

Orlando, FL

for technical competence in the field of

Environmental Testing

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

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

Presented this 29th day of May 2012.

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

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