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FINAL SAMPLING AND ANALYSIS PLAN REVISION 3 WETLAND SEDIMENT AND SURFACE WATER SAMPLING OPERABLE UNITS 1,2, AND 16 SITE 41 NAS PENSACOLA FL

10/1/2014

RESOLUTION CONSULTANTS

FINAL
SAMPLING AND ANALYSIS PLAN

WETLAND SEDIMENT AND SURFACE WATER SAMPLING
OPERABLE UNITS 1, 2, and 16 — SITE 41
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Revision Number: 3

Prepared For:

Department of the Navy
Naval Facility Engineering Command Southeast
Building 135 North, P.O. Box 30
Jacksonville, Florida 32212-0030

and

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Prepared By:

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Contract Number: N62470-11-D-8013
CTO JM07

October 2014

SAP WORKSHEET #1: TITLE AND APPROVAL PAGE

(UFP-QAPP Manual Section 2.1)

FINAL SAMPLING AND ANALYSIS PLAN

WETLAND SEDIMENT AND SURFACE WATER SAMPLING
OPERABLE UNITS 1, 2, and 16 — SITE 41
NAVAL AIR STATION PENSACOLA, PENSACOLA, FLORIDA

Revision Number: 3

Prepared For:

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EXECUTIVE SUMMARY

Resolution Consultants has prepared this Uniform Federal Policy Sampling and Analysis Plan (SAP) for the wetlands investigation at Naval Air Station (NAS) Pensacola Site 41, under Contract No. N62470-11-D-8013, Comprehensive Long-term Environmental Action Navy (CLEAN), Contract Task Order (CTO) JM07.

Environmental investigations have been completed at NAS Pensacola since the mid-1980s. As directed by the United States (U.S.) Environmental Protection Agency (EPA) in the late 1980s, the Navy combined the wetlands at the NAS Pensacola facility into a single Operable Unit (OU 16), Site 41. Site 41 encompasses the approximately 81 wetlands or wetland complexes, both tidal and nontidal, that are within the base boundary. These wetlands are either palustrine or estuarine and drain directly into either Pensacola Bay or Bayou Grande.

A Remedial Investigation (RI) was conducted for NAS Pensacola Site 41, assessing the nature and extent of contaminants resulting from Navy activities and Installation Restoration program sites discharging to wetlands within the NAS Pensacola boundary and assessing human health and ecological risk.

The wetlands were investigated in a multiphase RI. The RI report was finalized in August 2005, with a subsequent RI addendum completed in 2007. The RI identified several wetlands that were not impacted by nearby installation restoration sites and were eliminated from needing further investigation. The 2007 RI Addendum identified wetlands that could be eliminated from further evaluation based on the nature and extent of contamination in surface water and sediment, an analysis of contaminant fate and transport, and human health and ecological risk assessments. Chemicals of concern (COCs) identified during the RI include metals, pesticides, and polynuclear aromatic hydrocarbons (PAHs). Other analytes, including semivolatile organic compounds (SVOCs) and polychlorinated biphenyls (PCBs), were added to this investigation based on regulatory comments in partnering team meetings.

In December 2010, a draft Feasibility Study (FS) report was submitted for regulatory review by Tetra Tech NUS, Inc. (Tetra Tech). The FS refined the COCs, calculated preliminary remediation goals, and provided remedial alternatives. Regulatory comments on the FS requested additional sampling to support the remedial alternatives.

Subsequent analysis by a Partnering Team consisting of the United States Department of the Navy (Navy), EPA, Florida Department of Environmental Protection (FDEP), Tetra Tech, and EnSafe identified the need to better characterize the vertical and horizontal spatial extent of contaminants

and refine risks in sediment at thirteen wetlands: Wetlands 1B, 3, 4D, 5A, 6, 7, 12, 15, 18A, 18B, 48, 64 Complex, and W2. Wetlands 1B, 3, 4D, 15, 18A, and 18B are all located within the vicinity of NAS Pensacola's OU 1 (Site 1) landfill. Wetlands 5A, 6 (northern portion), 7 (southern portion), and the Wetland 64 complex (northern portion of Wetland 7, 8, and 64) are associated with NAS Pensacola's OU 2, which includes the following Sites: 11, 12, 25, 26, 27, and 30. Wetland 5A is located to the east of the A.C. Read Golf Course, Wetlands 6 (northern portion) and 7 (southern portion) are adjacent to each other and south of the Wetland 64 complex, which is an approximately 41-acre area upstream of the NAS Pensacola Yacht Basin in the northeastern quadrant of the base. OU 16 includes the remaining wetlands: Wetland 12, 48, and W2. Wetland 12, located south of OU 10, is in the northeastern portion of NAS Pensacola, at the southern end of Magazine Point, directly north of Chevalier Field and the Naval Air Technical Training Center. Wetland 48 is in a mostly undeveloped portion of NAS Pensacola, north of Radford Boulevard, and south of the NAS Pensacola Fuel Farm. Wetland W2, connected to Bayou Grande, is on the northern side of NAS Pensacola near Forrest Sherman Field.

This SAP was generated for, and complies with, applicable Navy, U.S. EPA Region 4, and FDEP requirements, regulations, guidance, and technical standards, as appropriate. This includes the Department of Defense (DoD), Department of Energy (DOE), and U.S. EPA Interagency Data Quality Task Force (IDQTF) environmental requirements regarding federal facilities, as specified in the Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP) guidance (U.S. EPA 2005).

This SAP outlines the organization, project management, objectives, planned activities, measurement, data acquisition, assessment, oversight, and data review procedures associated with the planned wetland investigation at NAS Pensacola. Protocols for sample collection, handling and storage, chain of custody, laboratory and field analyses, data validation, and reporting are also addressed. Field activities will be conducted in accordance with Resolution Consultants and FDEP Standard Operating Procedures (SOPs) and will meet the requirements of the Site-Specific Health and Safety Plan, prepared under separate cover.

Although all the selected wetlands are presented in this SAP, the Navy, U.S. EPA, and FDEP have agreed that the subsequent data analyses and presentations will be evaluated separately by OU (1, 2, and 16) and not presented as one document.

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List of Abbreviations and Acronyms

AA	Atomic absorption
AET	Apparent Effect Threshold
amu	Atomic mass unit
AVS	Acid volatile sulfide
AVS/SEM	Acid volatile sulfide and simultaneously extracted metals
BEHP	bis(2-ethylhexyl)phthalate
BG	Background
bgs	below ground surface
BOD	biological oxygen demand
CAS No.	Chemical Abstract Services number
CCCs	Calibration check compounds
CCV	Continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLEAN	Comprehensive Long-term Environmental Action Navy
COC	Chemical of concern
COD	Coefficient of the determination
CSM	Conceptual site model
CTO	Contract Task Order
CVAA	Cold-vapor atomic absorption
°C	Degrees Celsius
D	Duplicate result
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenyldichloroethylene
DDT	Dichlorodiphenyltrichloroethane
DDx	DDT and daughter products (DDD and DDE)
DFTPP	Decafluorotriphenylphosphine
DL	Detection limit
DoD	Department of Defense
DoD QSM	Department of Defense Quality Systems Manual
DOE	Department of Energy
DO	Dissolved oxygen
DQO	Data Quality Objective
DVA	Data Validation Assistant
EB	Equipment rinsate blank
ECOTOX	U.S. EPA Ecotoxicology Threshold
EDD	Electronic Data Deliverable
EICP	Extracted ion current profile
ELAP	Environmental Laboratory Accreditation Program
EPA	Environmental Protection Agency
eQAPP	Electronic Quality Assurance Project Plan
ERA	Ecological Risk Assessment
ESB	Equilibrium Partitioning Sediment Benchmark

List of Abbreviations and Acronyms (continued)

FDEP	Florida Department of Environmental Protection
FTL	Field team leader
FRC	Federal Records Center
FS	Feasibility Study
GC	Gas chromatography
GC/ECD	Gas chromatography/electron capture detector
GC/MS	Gas chromatograph/mass spectrometer
GPS	Global positioning system
HDPE	High density polyethylene
HH	Human Health
HHRA	Human Health Risk Assessment
HSO	Health and safety officer
HSO	Horizontal step-out
ICAL	Initial calibration
ICP-AES	Inductively coupled plasma-atomic emission spectrometry
ICP-MS	Inductively coupled plasma-mass spectrometry
ICS	Interference check solution
ICS-A	Interference check solution A
ICS-AB	Interference check solution AB
ICV	Initial calibration verification
ID	Identification
IDQTF	Interagency Data Quality Task Force
IDW	Investigation-derived waste
IR	Installation Restoration
J	Estimated
LEL	Lowest Effect Level
LCS	Laboratory control sample
LCS/LCSD	Laboratory control sample/laboratory control sample duplicate
LOD	Limit of detection
LOEC	Lowest observed effect concentration
LOQ	Limit of quantitation
µmol/g	Micromole per gram
mg/kg	Milligram per kilogram
mg/l	Milligram per liter
mV	Millivolts
MPC	Measurement performance criteria
MS	Mass spectrometry
MSD	Matrix spike duplicate
MS/MSD	Matrix spike/matrix spike duplicate

List of Abbreviations and Acronyms (continued)

NA	Not applicable
NAS	Naval Air Station
NATTC	Naval Air Technical Training Center
NAVFAC	Naval Facilities Engineering Command
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NELAP	National Environmental Laboratory Accreditation Program
NFA	No further action
NIRIS	Naval Installation Restoration Information Solution
NIST	National Institute of Standards and Technology
nm	Nanometer
No.	Number
NOAA	National Oceanic and Atmospheric Administration
NOEC	No Observed Effect Concentration
OU	Operable unit
%D	Percent difference/percent drift
%R	Percent recovery
%RSD	Percent relative standard deviation
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl compound
PEC	Probable Effect Concentration
PEL	Probable Effects Level
PM	Project manager
PQL	Project Quantitation Limit
PRG	Preliminary Remediation Goal
QA	Quality assurance
QAO	Quality assurance officer
QC	Quality control
QSM	Quality Systems Manual
r	Correlation coefficient
r^2	Coefficient of determination
R	Rejected
RC	Reference Concentration
RCRA	Resource Conservation and Recovery Act
RF	Response factor
RG	Remediation Goal
RI	Remedial Investigation
ROD	Record of Decision
RPD	Relative percent difference
RPM	Remedial project manager
RRT	Relative retention time

List of Abbreviations and Acronyms (continued)

S	Sample result
SA	Concentration of spike added
SAP	Sampling and analysis plan
SE	Southeast
SEL	Severe Effect Level
SEM	Simultaneously extracted metals
SIM	Selective ion monitoring
SIM-PAH	Selective ion monitoring polynuclear aromatic hydrocarbon
SOP	Standard operating procedure
SPCC	System performance check compound
SQAG	Sediment Quality Assessment Guideline
SR	Sample recovery
SSO	Site safety officer
SSR	Spike sample recovery
SVOC	Semivolatile organic compound
TAL	Target analyte list
TBD	To be determined
TCL	Target compound list
TDS	Total Dissolved Solids
TKN	Total Kjeldahl Nitrogen
TOC	Total organic carbon
TOM	Task order manager
TSS	Total Suspended Solids
U	Undetected
UET	Upper Effects Threshold
UFP-QAPP	Uniform Federal Policy for Quality Assurance Plans
UJ	Undetected and estimated
UR	Undetected and rejected
U.S. EPA	United States Environmental Protection Agency
VOC	Volatile organic compound

SAP WORKSHEET #2: SAMPLING AND ANALYSIS PLAN IDENTIFYING INFORMATION

(UFP-QAPP Manual Section 2.2.4)

Site Name/Number: Site 41 Wetlands

Operable Unit: Operable Units (OU) 1, 2, and 16

Contractor Name: Resolution Consultants

Contract Number: N69450-12-R-0479

Contract Title: Comprehensive Long-Term Environmental Action Navy (CLEAN)

Work Assignment No: Contract Task Order (CTO) JM07

1. This sampling and analysis plan (SAP) was prepared in accordance with the requirements of the *Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP)* (U.S. EPA 2005) and United States (U.S.) Environmental Protection Agency (EPA) *Guidance for Quality Assurance Project Plans, EPA QA/G-5* (U.S. EPA 2002).

2. Identify regulatory program: Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA)

3. This SAP is a project-specific SAP.

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

Organization Partners/Stakeholders	Connection
U.S. EPA Region 4	Lead Regulatory Oversight
Florida Department of Environmental Protection (FDEP)	Regulatory Oversight
Naval Facilities Engineering Command (NAVFAC) Southeast	Lead Agency
Naval Air Station (NAS) Pensacola	Property Owner, Navy Contractor
CH2M Hill	Tier I Team Partner
Resolution Consultants	Tier I Team Partner
Tetra Tech	Tier I Team Partner

5. Lead organization: Naval Facilities Engineering Command Southeast (NAVFAC SE)

6. If any required SAP elements and required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below: Not Applicable (NA), as there are no exclusions.

SAP WORKSHEET #3: DISTRIBUTION LIST

(UFP-QAPP Manual Section 2.3.1)

SAP Recipients	Title	Organization	Telephone Number	E-mail Address or Mailing Address
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Notes:
NAVFAC = Naval Facilities Engineering Command
NAS = Naval Air Station

SAP WORKSHEET #4: PROJECT PERSONNEL SIGN-OFF SHEET

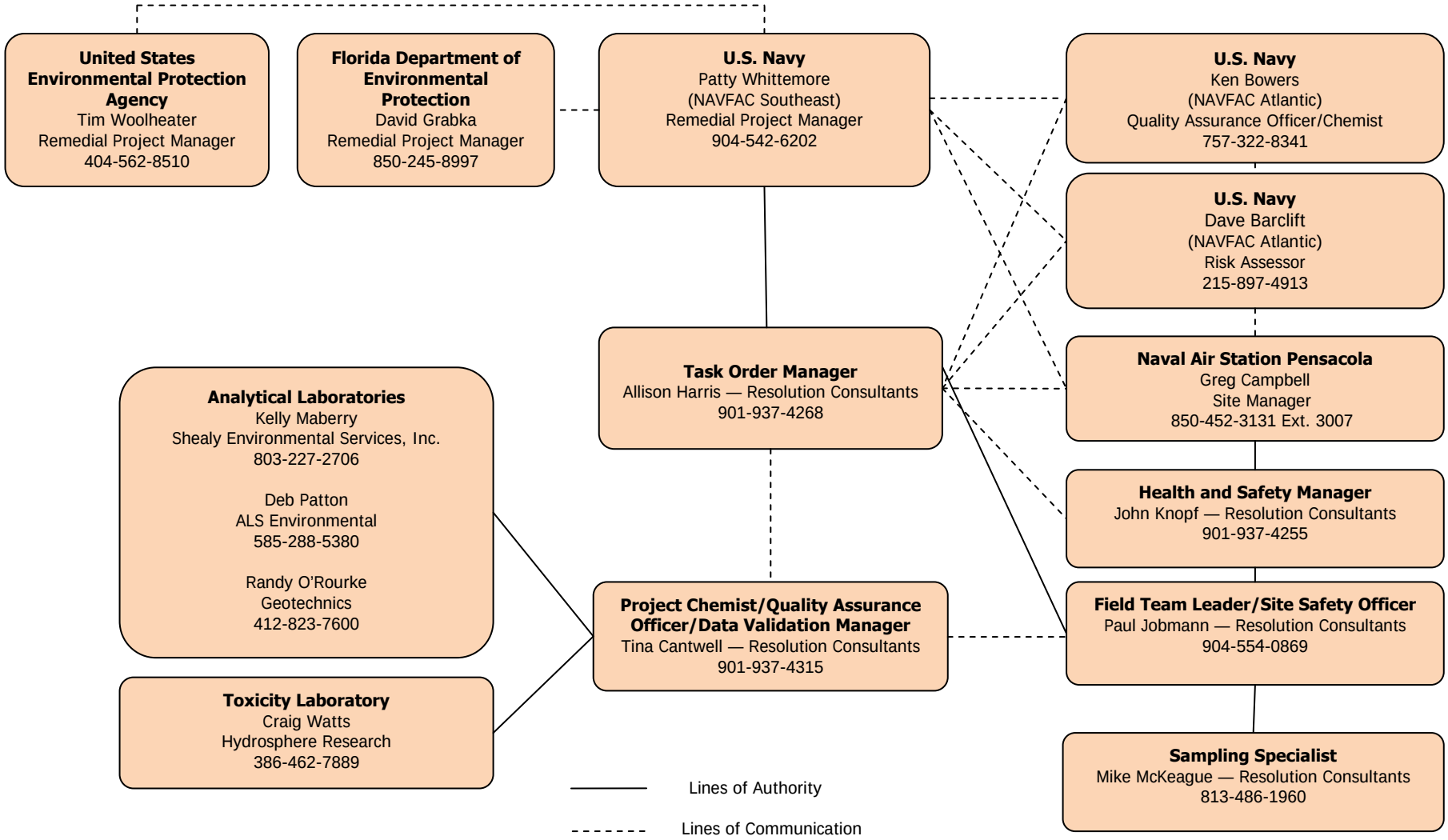
(UFP-QAPP Manual Section 2.3.2)

Certification that project personnel have read the text will be obtained by the following methods:

- E-mails will be sent to Navy, Resolution Consultants, regulatory agencies, and subcontractor project personnel, who will be requested to verify by e-mail that they have read the applicable SAP sections and provide the date on which they were reviewed. Copies of the verification e-mail will be included in the project files and identified in Worksheet #29. Copies of regulatory agency comments, if received, will be retained in the project files and are listed in Worksheet #29 as project records.

SAP WORKSHEET #5: PROJECT ORGANIZATIONAL CHART

(UFP-QAPP Manual Section 2.4.1)



SAP WORKSHEET #6: COMMUNICATION PATHWAYS

(UFP-QAPP Manual Section 2.4.2)

The communication pathways for the SAP are shown below. Communications described in this worksheet will be documented in the appropriate format for the specific interaction. Appropriate forms of documentation include, but are not limited to: email, telephone logs, field logbook notations, field forms, audit reports, and formal memoranda, or as described below. Communications will be part of the project records and will be maintained in the locations described in Worksheet #29.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Regulatory Agency Interface	Navy RPM	Patty Whittemore	904-542-6202	The Navy RPM informs regulatory agency of work progress on a periodic basis.
Progress Reports	Resolution Consultants FTL/SSO Resolution Consultants TOM Navy RPM	Paul Jobmann Allison Harris Patty Whittemore	904-554-0869 901-937-4268 904-542-6202	FTL verbally informs the TOM on a daily basis field updates. TOM provides a weekly update to the RPM either by phone message and/or e-mail each Friday afternoon field activities are taking place.
Gaining Site Access	Resolution Consultants FTL NAS Pensacola Site Manager	Paul Jobmann Greg Campbell	904-554-0869 850-452-3131	The Resolution Consultants FTL will contact the NAS Pensacola point of contact verbally or via e-mail at least 3 days before commencement of field work to arrange for access to the site for all field personnel.
Obtaining Utility Clearances for Intrusive Activities	Resolution Consultants FTL NAS Pensacola Site Manager	Paul Jobmann Greg Campbell	904-554-0869 850-452-3131	The Resolution Consultants FTL will coordinate verbally or via e-mail with NAS Pensacola point of contact at least 14 days in advance of site access to initiate the utility clearance process for all intrusive sampling locations.
Stop Work due to Safety Issues	Resolution Consultants FTL/SSO Resolution Consultants TOM Resolution Consultants HSO Navy RPM NAS Pensacola Site Manager U.S. EPA RPM FDEP RPM	Paul Jobmann Allison Harris John Knopf Patty Whittemore Greg Campbell Tim Woolheater David Grabka	904-554-0869 901-937-4268 901-937-4255 904-542-6202 850-452-3131 404-562-8510 850-245-8997	Any field team member who observes an unsafe situation has the authority to stop work. If Resolution Consultants is the responsible party for a stop work command, the Resolution Consultants SSO will inform onsite personnel, subcontractor(s), the NAS Pensacola site manager, and the identified Partnering Team members within 1 hour (verbally or by e-mail). If a subcontractor is the responsible party, the subcontractor PM must verbally inform the Resolution Consultants SSO within 15 minutes, and the Resolution Consultants SSO will then follow the procedure listed above.
SAP Changes before Field/Laboratory work	Resolution Consultants TOM Navy RPM U.S. EPA RPM FDEP RPM	Allison Harris Patty Whittemore Tim Woolheater David Grabka	901-937-4268 904-542-6202 404-562-8510 850-245-8997	Any change of the approved SAP will be made only upon authorization of the Navy RPM and regulatory agencies. The Resolution Consultants TOM is responsible for initiating any SAP change requests via the communication channels described for the Navy and regulatory agencies.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
SAP Changes in the Field	Resolution Consultants FTL/SSO Resolution Consultants TOM Navy RPM U.S. EPA RPM FDEP RPM	Paul Jobmann Allison Harris Patty Whittemore Tim Woolheater David Grabka	904-554-0869 901-937-4268 904-542-6202 404-562-8510 850-245-8997	FTL informs TOM verbally within same day; TOM informs Navy RPM via e-mail within 24 hours; TOM sends a concurrence letter to RPM, if warranted, within 7 calendar days and RPM signs the letter within 5 business days of receipt. Scope change is to be implemented before work is executed. Document the change on a field task modification request form (within 2 business days) or SAP amendment (within timeframe agreed to by Project Team). The Navy will notify U.S. EPA//FDEP of any significant SAP field changes within 5 business days. Any change of the approved SAP, affecting the scope or implementation of the sampling program, will be made only upon authorization of the Navy RPM and regulatory agencies.
Field Corrective Actions	Resolution Consultants FTL/SSO Resolution Consultants TOM Navy RPM U.S. EPA RPM FDEP RPM	Paul Jobmann Allison Harris Patty Whittemore Tim Woolheater David Grabka	904-554-0869 901-937-4268 904-542-6202 404-562-8510 850-245-8997	FTL informs TOM verbally within same day; TOM informs Navy RPM via e-mail within 24 hours that corrective actions have been implemented. Corrective actions will be documented in weekly progress reports. Navy RPM will notify U.S. EPA/FDEP of any significant corrective actions taken within 5 business days.
Recommendations to stop work and initiate work upon corrective action	Resolution Consultants FTL/SSO Resolution Consultants TOM Resolution Consultants QAO Navy RPM	Paul Jobmann Allison Harris Tina Cantwell Patty Whittemore	904-554-0869 901-937-4268 901-937-4315 904-542-6202	Responsible party verbally informs the TOM, FTL, and subcontractors within 1 hour of recommendation to stop work and within 24 hours of recommendation to restart work. Responsible party follows verbal notification with an e-mail to the Project Team within 24 hours.
Sample Receipt and Laboratory Quality Variances	Shealy Environmental Services PM Hydrosphere Research PM ALS Environmental PM Geotechnics PM Resolution Consultants FTL Resolution Consultants TOM	Kelly Maberry Craig Watts Deb Patton Randy O'Rourke Paul Jobmann Allison Harris	803-227-2706 386-462-7889 585-288-5380 412-823-7600 904-554-0869 901-937-4268	The analytical/toxicity Laboratory PM will notify (verbally or via e-mail) the Resolution Consultants FTL immediately upon receipt of any chain of custody/sample receipt variances for clarification or direction from the Resolution Consultants FTL. The Resolution Consultants FTL will notify (verbally or via e-mail) the Resolution Consultants TOM within 1 business day, if corrective action is required. The Resolution Consultants TOM will notify (verbally or via e-mail) the analytical/toxicity Laboratory PM and the Resolution Consultants FTL within 1 business day of any required corrective action.
Analytical Corrective Actions	Shealy Environmental Services PM Hydrosphere Research PM ALS Environmental PM Geotechnics PM Resolution Consultants Project Chemist	Kelly Mayberry Craig Watts Deb Patton Randy O'Rourke Tina Cantwell	803-227-2706 386-462-7889 585-288-5380 412-823-7600 901-937-4315	The analytical/toxicity laboratory shall notify the Resolution Consultants' chemist of any analytical data anomaly within 1 business day of discovery. After the analytical/toxicity laboratory receives guidance from Resolution Consultants' chemist, the laboratory shall initiate any corrective action to prevent further anomalies.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Analytical Data Quality Issues	Shealy Environmental Services PM Hydrosphere Research PM ALS Environmental PM Geotechnics PM Resolution Consultants Project Chemist Resolution Consultants TOM Navy RPM	Kelly Maberry Craig Watts Deb Patton Randy O'Rourke Tina Cantwell Allison Harris Patty Whittemore	803-227-2706 386-462-7889 585-288-5380 412-823-7600 901-937-4315 901-937-4268 904-542-6202	The analytical/toxicity laboratory PM notifies (verbally or via e-mail) the Resolution Consultants' chemist within 1 business day of when an issue related to analytical/toxicity laboratory data is discovered. Resolution Consultants' chemist notifies Resolution Consultants' TOM within 1 business day. Resolution Consultants' chemist notifies the Resolution Consultants' TOM verbally or via e-mail within 48 hours of validation completion that a non-routine and significant analytical/toxicity laboratory quality deficiency has been detected that could affect this project and/or other projects. Resolution Consultants' TOM verbally advises the Navy RPM within 24 hours of notification from the chemist. The Navy RPM takes corrective action that is appropriate for the identified deficiency. If there are significant data quality or nonuseable data issues the Navy QAO/Chemist will be contacted to ensure the issues do not have the potential to impact other Navy projects.
Reporting Data Validation Issues/ Data Validation Corrective Actions	Resolution Consultants Project Chemist Resolution Consultants TOM	Tina Cantwell Allison Harris	901-937-4315 901-937-4268	The Resolution Consultants project chemist or data validator will perform validation as specified in Worksheets #34, #35, and #36, and will contact the analytical/toxicity laboratory as soon as possible if issues are found that require corrective action. If the Resolution Consultants project chemist or data validator identifies non-usable data during the data validation process that requires corrective action, the Resolution Consultants TOM will coordinate with the project chemist to take corrective action appropriate for the identified deficiency to ensure the project objectives are met. Corrective action may include resampling and/or reanalyzing the affected samples, as determined by the Resolution Consultants TOM.

Communication Drivers	Responsible Entity	Name	Phone Number	Procedure (Timing, Pathway To/From, etc.)
Notification of Non-Usable Data	Shealy Environmental Services PM Hydrosphere Research PM ALS Environmental PM Geotechnics PM Resolution Consultants Project Chemist Resolution Consultants TOM NAVFAC SE RPM U.S. EPA RPM FDEP RPM	Kelly Maberry Craig Watts Deb Patton Randy O'Rourke Tina Cantwell Allison Harris Patty Whittemore Tim Woolheater David Grabka	803-227-2706 386-462-7889 585-288-5380 412-823-7600 901-937-4315 901-937-4268 904-542-6202 404-562-8510 850-245-8997	If the analytical/toxicity laboratory determines that any data they have generated is non-usable, the analytical/toxicity Laboratory PM will notify (verbally or via e-mail) the Resolution Consultants project chemist within 1 business day of when the issue is discovered. The Resolution Consultants project chemist will notify (verbally or via e-mail) Resolution Consultants TOM within 1 business day of the need for corrective action, if the non-usable data is a significant issue (i.e., critical sample data). Corrective action may include resampling and/or reanalyzing the effected samples. If a Resolution Consultants project chemist or data validator identifies non-usable data during the data validation process, the TOM will be notified verbally or via e-mail within 48 hours of validation completion that a non-routine and significant analytical/toxicity laboratory quality deficiency has resulted in non-usable data. The Resolution Consultants TOM will take corrective action appropriate for the identified deficiency to ensure the project objectives are met. The Resolution Consultants TOM will notify (verbally or via email) the NAVFAC RPM on any problems with the analytical/toxicity laboratory or analysis that could significantly affect the usability of the data or project failures that impact the ability to complete the scope of work. The NAVFAC RPM, may at their discretion, contact the Navy QAO/Chemist for assistance in problem resolution. Such notification will be made within 1 business day of when the issue is discovered. The NAVFAC RPM will notify the U.S. EPA and FDEP when any significant corrective action is taken.

Notes:

RPM	=	Remedial project manager	SSO	=	Site safety officer
FTL	=	Field team leader	HSO	=	Health and safety officer
TOM	=	Task order manager	SAP	=	Sampling and analysis plan
QAO	=	Quality assurance officer	PM	=	Project manager
U.S. EPA	=	United States Environmental Protection Agency	FDEP	=	Florida Department of Environmental Protection
NAVFAC	=	Naval Facilities Engineering Command	NAS	=	Naval Air Station

SAP WORKSHEET #7: PERSONNEL RESPONSIBILITIES TABLE

(UFP-QAPP Manual Section 2.4.3)

Name	Title/Role	Organizational Affiliation	Responsibilities
Patty Whittemore	Remedial Project Manager	NAVFAC Southeast	Oversees project implementation, including scoping, data review, and evaluation.
Ken Bowers	Quality Assurance Officer/Chemist	NAVFAC Atlantic	Provides quality control and chemistry oversight.
Dave Barclift	Risk Assessor	NAVFAC Atlantic	Provides ecological risk assessment oversight.
Greg Campbell	NAS Pensacola Site Manager	NAS Pensacola Public Works Center	Oversees Base activities, including field work coordination, scoping, data review, and evaluation.
Tim Woolheater	Remedial Project Manager	U.S. EPA	Participates in scoping, data review, evaluation, and review of the SAP. Oversees project execution for U.S. EPA.
David Grabka	Remedial Project Manager	FDEP	Participates in scoping, data review, evaluation, and review of the SAP. Oversees project execution for FDEP.
Allison Harris	Task Order Manager	Resolution Consultants	Oversees project, financial, schedule, and technical day to day management of the project.
Paul Jobmann	Field Team Leader/ Site Safety Officer	Resolution Consultants	As the FTL, supervises, coordinates, and performs and documents field sampling activities. As the SSO, is responsible for onsite project-specific health and safety training and monitoring site conditions.
Mike McKeague	Sampling Specialist	Resolution Consultants	Performs and documents sampling activities, packs samples, prepared chain-of-custody records.
John Knopf	Health and Safety Officer	Resolution Consultants	Responsible for providing health and safety training for all personnel and approving the site-specific Health and Safety Plan. Prepares health and safety reports for management
Tina Cantwell	Project Chemist/QAO/Data Validation Manager	Resolution Consultants	As project chemist, prepares laboratory scopes of work, and coordinates laboratory related functions with laboratory. Performs or oversees data quality reviews and quality assurance of data validation deliverables. As QAO, ensures quality aspects of the project are implemented, documented, and maintained. As data validation manager, performs or oversees data validation and data input in both the project database and the Navy's Naval Installation Restoration Information Solution database.
Kelly Maberry	Project Manager/ Analytical Laboratory	Shealy Environmental Services, Inc.	Coordinates analyses with analytical laboratory staff, ensures that scope of work is followed, provides quality review of data packages, and communicates with Resolution Consultant project staff.

Name	Title/Role	Organizational Affiliation	Responsibilities
Craig Watts	Laboratory Director/ Toxicity Laboratory	Hydrosphere Research	Coordinates analyses with toxicity laboratory staff, ensures that scope of work is followed, provides quality review of data packages, and communicates with Resolution Consultant project staff.
Deb Patton	Project Manager/ AVS-SEM Laboratory	ALS Environmental	Coordinates analyses with analytical laboratory staff, ensures that scope of work is followed, provides quality review of data packages, and communicates with Resolution Consultant project staff.
Randy O'Rourke	Project Manager/ Grain Size Laboratory	Geotechnics	Coordinates analyses with analytical laboratory staff, ensures that scope of work is followed, provides quality review of data packages, and communicates with Resolution Consultant project staff.

Notes:

NAVFAC = Naval Facilities Engineering Command
U.S. EPA = United States Environmental Protection Agency
SAP = Sampling and analysis plan
SSO = Site safety officer
NAS = Naval Air Station
FDEP = Florida Department of Environmental Protection
FTL = Field team leader
QAO = Quality assurance officer
AVS-SEM = Acid volatile sulfide and simultaneously extracted metals

SAP WORKSHEET #8: SPECIAL PERSONNEL TRAINING REQUIREMENTS TABLE

(UFP-QAPP Manual Section 2.4.4)

All field personnel will have appropriate training to conduct the field activities to which they are assigned. Additionally, each site worker will be required to have completed appropriate Hazardous Waste Operations and Emergency Response training specified in Occupational Safety and Health Administration 29 Code of Federal Regulations 1910.120(e). In addition, the subcontracted boat operator will possess the necessary training and licensing required by Florida boating laws.

SAP WORKSHEET #9: PROJECT SCOPING SESSION PARTICIPANTS SHEET

(UFP-QAPP Manual Section 2.5.1)

Project/Site Name: NAS Pensacola Wetlands			
Site Location: Jacksonville, Florida			
Date of Session: 27 March 2012 and 28 March 2012 (Partnering Meeting)			
Scoping Session Purpose: Discuss OU 16, Site 41 Wetlands			
Name	**Title**	**Affiliation**	**E-mail Address**
Patty Marajh-Whittemore	Navy Remedial Project Manager	NAVFAC Southeast	patty.whittemore@navy.mil
Greg Campbell	NAS Pensacola Site Manager/Point of Contact	NAS Pensacola Public Works Center	gregory.campbell@navy.mil
Dave Barclift	Risk Assessor	NAVFAC Atlantic	david.barclift@navy.mil
Ken Bowers	Navy Chemist	NAVFAC Atlantic	kenneth.a.bowers@navy.mil
David Grabka	Remedial Project Manager	FDEP	david.grabka@dep.state.fl.us
Ligia Mora-Applegate	Risk Assessor	FDEP	ligiamora.applegate@dep.state.fl.us
Steve Roberts	Professor/Director of the Center for Environmental and Human Toxicology	University of Florida/FDEP	smroberts@ufl.edu
Leah Stuchal	Research Assistant Professor/Toxicologist	University of Florida	lstuchal@ufl.edu
Roxana Weil	Toxicologist	University of Florida, Day 1	rweil@ufl.edu
Tim Woolheater	Remedial Project Manager	U.S. EPA	woolheater.tim@epa.gov
Linda George	Ecological Risk Assessor	U.S. EPA	george.linda@epa.gov
Joe Owusu	Ecological Risk Assessor	Integrated Laboratory Systems/U.S. EPA	owusu.joe@epa.gov
Gerry Walker	Tetra Tech Project Manager	Tetra Tech	gerry.walker@tetratech.com
Brian Caldwell	Technical Expert	Resolution Consultants	bcaldwell@ensafe.com
Ron Kotun	Risk Assessor	Tetra Tech	ronald.kotun@tetratech.com
Aaron Bernhardt	Ecological Risk Assessor	Tetra Tech	aaron.berhardt@tetratech.com
Leigh Ciofani	Risk Assessor/Scribe	Tetra Tech	leigh.ciofani@tetratech.com
Allison Harris	Task Order Manager	Resolution Consultants	aharris@ensafe.com
Claire Marcussen	Senior Risk Assessor	Skeo Solutions	cmarcussen@skeo.com

Notes:

NAVFAC	=	Naval Facilities Engineering Command
NAS	=	Naval Air Station
OU	=	Operable Unit
FDEP	=	Florida Department of Environmental Protection
U.S. EPA	=	U.S. Environmental Protection Agency

Comments/Decisions: Meeting minutes are located in Appendix A.

Action Items: Meeting minutes are located in Appendix A.

Consensus Decisions: Meeting minutes are located in Appendix A and consensuses decisions are summarized on page WS 9-3.

SAP WORKSHEET #9: PROJECT SCOPING SESSION PARTICIPANTS SHEET (Continued)

(UFP-QAPP Manual Section 2.5.1)

Project/Site Name: NAS Pensacola Wetlands			
Site Location: Teleconference			
Date of Session: 9 May 2012			
Scoping Session Purpose: Follow-up Teleconference from March 2012 Partnering Team meeting			
Name	**Title**	**Affiliation**	**E-mail Address**
Patty Marajh-Whittemore	Navy Remedial Project Manager	NAVFAC Southeast	patty.whittemore@navy.mil
Greg Campbell	NAS Pensacola Site Manager/Point of Contact	NAS Pensacola Public Works Center	gregory.campbell@navy.mil
Dave Barclift	Risk Assessor	NAVFAC Atlantic	david.barclift@navy.mil
Ken Bowers	Navy Chemist	NAVFAC Atlantic	kenneth.a.bowers@navy.mil
David Grabka	Remedial Project Manager	FDEP	david.grabka@dep.state.fl.us
Ligia Mora-Applegate	Risk Assessor	FDEP	ligiamora.applegate@dep.state.fl.us
Tim Woolheater	Remedial Project Manager	U.S. EPA	woolheater.tim@epa.gov
Linda George	Ecological Risk Assessor	U.S. EPA	george.linda@epa.gov
Joe Owusu	Ecological Risk Assessor	U.S. EPA Integrated Laboratory Systems	owusu.joe@epa.gov
Gerry Walker	Tetra Tech Project Manager	Tetra Tech	gerry.walker@tetratech.com
Brian Caldwell	Technical Expert	Resolution Consultants	bcaldwell@ensafe.com
Ron Kotun	Risk Assessor	Tetra Tech	ronald.kotun@tetratech.com
Aaron Bernhardt	Ecological Risk Assessor	Tetra Tech	aaron.berhardt@tetratech.com
Leigh Ciofani	Risk Assessor/Scribe	Tetra Tech	leigh.ciofani@tetratech.com
Allison Harris	Task Order Manager	Resolution Consultants	aharris@ensafe.com
Claire Marcussen	Senior Risk Assessor	Skeo Solutions	cmarcussen@skeo.com

Notes:

NAVFAC	=	Naval Facilities Engineering Command
NAS	=	Naval Air Station
OU	=	Operable Unit
FDEP	=	Florida Department of Environmental Protection
U.S. EPA	=	U.S. Environmental Protection Agency

Comments/Decisions: Meeting minutes are located in Appendix B.

Action Items: Meeting minutes are located in Appendix B.

Consensus Decisions: Meeting minutes are located in Appendix B and consensuses decisions are summarized on page WS 9-3.

Consensus Items from the 27 and 28 March 2012, Operable Unit 16 (Site 41) Meeting and the Conference Call on 9 May 2012

Overall, there was agreement among the participants on the identified receptors benthic invertebrates (ecological) and maintenance workers (human health). For the sampling approach, the Navy will collect sediment samples from 0-4 inches, 4-12inches, and 12-24 inches. At some wetlands, the Navy will collect both primary samples and step-out samples. The primary samples will be collected and analyzed first, and if there are exceedances of PRGs in those samples, the adjacent step-out (or deeper) samples will be collected and analyzed. If there are no Preliminary Remediation Goal (PRG) exceedances, 10-20 percent (probably 1 or 2) of the deeper samples will be analyzed to determine whether sediment is contaminated at depth.

Sediment samples also will be collected from wetlands not impacted by known sites to 1) obtain reference samples for toxicity testing, and 2) obtain updated background data for metals and background data for polynuclear aromatic hydrocarbons (PAHs). Team agreed that if the bioaccumulative chemicals were at concentrations higher than the Remedial Investigation (RI) samples, food web modeling would be conducted.

The Team agreed that only new toxicity data will be used to develop PRGs. Based on the prior assessment indicating that volatile organic compounds (VOCs) were not a concern at Site 41, sediment samples will not be analyzed for VOCs.

The Team agreed to compare the total PAH results to Probable Effects Levels (PELs) or Probable Effects Concentrations (PECs) for the evaluation. The total PAH concentrations for the PEC and PEL are calculated by summing 13 of the individual PAH concentrations.

The Team agreed that the PAH concentrations across Wetland 1B will be averaged and compared to the PRG.

The Team agreed that all step out samples will be analyzed before deciding which samples should undergo toxicity testing.

U.S. EPA agreed to review the PRGs again. The PRG table presented the sources of the values used for the PRGs, many of which were refinement values.

SAP WORKSHEET #9: PROJECT SCOPING SESSION PARTICIPANTS SHEET (Continued)

(UFP-QAPP Manual Section 2.5.1)

Project/Site Name: NAS Pensacola Wetlands			
Site Location: Conference Call			
Date of Session: 7 June 2013			
Scoping Session Purpose: Discuss OU 16, Site 41 Wetlands, Response to Comments on the OU 16 UFP-SAP			
Name	**Title**	**Affiliation**	**E-mail Address**
Patty Marajh-Whittemore	Navy Remedial Project Manager	NAVFAC Southeast	patty.whittemore@navy.mil
Dave Barclift	Risk Assessor	NAVFAC Atlantic	david.barclift@navy.mil
Mike Singletary	Navy Technical Expert	NAVFAC Southeast	michael.a.singletary@navy.mil
Ken Bowers	Navy Chemist	NAVFAC Atlantic	kenneth.a.bowers@navy.mil
David Grabka	Remedial Project Manager	FDEP	david.grabka@dep.state.fl.us
Steve Roberts	Professor/Director of the Center for Environmental and Human Toxicology	University of Florida/FDEP	smroberts@ufl.edu
Leah Stuchal	Research Assistant Professor/Toxicologist	University of Florida	lstuchal@ufl.edu
Tim Woolheater	Remedial Project Manager	U.S. EPA	woolheater.tim@epa.gov
Linda George	Ecological Risk Assessor	U.S. EPA	george.linda@epa.gov
Steve Dillard	Ecological Risk Assessor	Resolution Consultants	sdillard@aecom.com
Allison Harris	Task Order Manager	Resolution Consultants	aharris@ensafe.com
Claire Marcussen	Senior Risk Assessor	Skeo Solutions	cmarcussen@skeo.com

Notes:

NAVFAC	=	Naval Facilities Engineering Command
NAS	=	Naval Air Station
OU	=	Operable Unit
FDEP	=	Florida Department of Environmental Protection
UFP-SAP	=	Uniform Federal Policy for Sampling Analysis Plan
U.S. EPA	=	U.S. Environmental Protection Agency

Comments/Decisions: Meeting minutes are located in Appendix C.

Action Items: Meeting minutes are located in Appendix C.

Consensus Decisions: Meeting minutes are located in Appendix C and consensus decisions are summarized below.

The parties agreed that OU 1, OU 2, and OU 16 wetlands could be handled separately but should be consistent.

The Navy agreed to sample surface water at OU 1.

The Navy agreed to sample the Wetlands 6/7 area near the weir for 4,4'-dichlorodiphenyltrichloroethane (DDT), 4,4'-dichlorodiphenyldichloroethane (DDD), and 4,4'-dichlorodiphenyldichloroethylene (DDE) (collectively called DDx).

SAP WORKSHEET #10: CONCEPTUAL SITE MODEL

(UFP-QAPP Manual Section 2.5.2)

10.1 Site Setting and Environmental History

The United States Navy has maintained a presence in the Pensacola, Florida, area since 1825 when a Navy yard was established on Pensacola Bay. Between 1828 and 1835, the Navy acquired approximately 2,300 acres as operations expanded. Several natural disasters in the early 1900's destroyed the yard and forced it into maintenance status in 1911. Three years later, the Navy's first permanent air station was established on the site of the old Navy yard. The air station has been the primary training base for naval aviators since that time, and the base continues to expand.

The current 5,800-acre Naval Air Station Pensacola facility is surrounded to the south by Pensacola Bay and north by Bayou Grande. The terrain is generally flat with rolling undulations. Undeveloped areas, particularly on the west side of the facility, are mostly wooded with pines and hardwoods, with intertidal marshes and salt-tolerant vegetation near the shores; the more developed south-central and eastern portions of the facility contain less native vegetation, especially in training and industrial complexes and on the sprawling A.C. Read Golf Course. The subtropical climate averages 60 inches of rainfall per year, some coming in heavy downpours and occasional hurricanes. The shallow geology consists of sand and silty sand, supporting a shallow, unconfined, highly transmissive surficial aquifer, in which shallow groundwater flow mimics topography.

OU 1, OU 2, and OU 16, encompasses approximately 81 wetlands (Figure 10-1) and wetland complexes throughout the base, ranging from fresh-water dominated to salt water, and including open marshes, forested ponds, and man-made ditches, both tidal and nontidal, within the NAS Pensacola boundary. Some of these wetlands receive inputs from anthropogenic activities such as urban storm water runoff, use of pesticides from landscaping, and industrial and maintenance operations.

10.2 Previous Investigation Findings

The combined wetlands have been investigated since the early 1990s. The RI (EnSafe 2005) and RI Addendum (EnSafe 2007) reported a list of chemicals of concern (COCs) in wetlands sediment and surface water. The list was dominated by metals and pesticides, but also included PAHs and DDT in some areas. The RI identified wetlands that could be eliminated from

Bayou Grande

Pensacola Bay

Yacht Basin

OU 1
Site 1

OU 2
Site 30

OU 4
Site 15

OU 13
Site 24

OU 6
Site 29

OU 11
Site 38

OU 10
Site 32

OU 2
Site 26

OU 3
Site 2

Site 3

Site 4

Site 5

Site 6

Site 7

Site 8

Site 9

Site 10

Site 11

Site 12

Site 13

Site 14

Site 16a

Site 16b

Site 17

Site 22

Site 25

Site 27

Site 33

Site 34

Site 39

Site 43

Site 44

Site 45

Monitored Outfall 002

Monitored Outfall 003

Monitored Outfall 007

Monitored Outfall 030

UST A

UST B

UST C

UST D

UST E

UST F

UST G

UST H

UST I

UST J

UST K

UST L

UST M

UST N

UST O

UST P

UST Q

UST R

UST S

UST T

Wetland 1
Wetland 1A
Wetland 2
Wetland 3
Wetland 4A
Wetland 4B
Wetland 4C
Wetland 4D
Wetland 5A
Wetland 5B
Wetland 6
Wetland 6A
Wetland 6B
Wetland 7
Wetland 8
Wetland 9
Wetland 10
Wetland 11
Wetland 12
Wetland 13
Wetland 14
Wetland 15
Wetland 16
Wetland 17
Wetland 18A
Wetland 18B
Wetland 19A
Wetland 19B
Wetland 20
Wetland 21
Wetland 22A
Wetland 22B
Wetland 23
Wetland 24A
Wetland 24B
Wetland 25A
Wetland 25B
Wetland 26
Wetland 26A
Wetland 26B
Wetland 27
Wetland 27A
Wetland 27B
Wetland 28A
Wetland 28B
Wetland 28C
Wetland 28D
Wetland 28E
Wetland 28F
Wetland 28G
Wetland 28H
Wetland 28I
Wetland 28J
Wetland 28K
Wetland 28L
Wetland 28M
Wetland 28N
Wetland 28O
Wetland 28P
Wetland 28Q
Wetland 28R
Wetland 28S
Wetland 28T
Wetland 28U
Wetland 28V
Wetland 28W
Wetland 28X
Wetland 28Y
Wetland 28Z
Wetland 29
Wetland 30
Wetland 31
Wetland 32
Wetland 33
Wetland 34
Wetland 35
Wetland 36
Wetland 37
Wetland 38
Wetland 39A
Wetland 39B
Wetland 40
Wetland 41A
Wetland 41B
Wetland 42
Wetland 43
Wetland 44
Wetland 45
Wetland 46
Wetland 47
Wetland 48
Wetland 49
Wetland 50
Wetland 51
Wetland 52
Wetland 52A
Wetland 52B
Wetland 52C
Wetland 52D
Wetland 53
Wetland 54
Wetland 55
Wetland 55A
Wetland 55B
Wetland 56
Wetland 57
Wetland 58
Wetland 59 (ball field)
Wetland 60
Wetland 61
Wetland 62
Wetland 63A
Wetland 63B
Wetland 64
Wetland 65
Wetland 66
Wetland 67
Wetland 68
Wetland 69
Wetland 70A
Wetland 70B
Wetland 71
Wetland 72
Wetland 73A
Wetland 73B
Wetland 74
Wetland 75
Wetland 76
Wetland 77
Wetland 78
Wetland 79
Wetland 80
Wetland W1
Wetland W2

Legend

- Storm Water Outfall
- Storm Water Inlet
- Storm Water Pipe
- Shoreline
- Road
- Site
- Operable Unit (OU)
- UST Sites
- NASP Boundary
- Building

Wetlands

- OU16 Wetlands
- OU2 Wetlands
- OU1 Wetlands
- Reference Wetlands
- Not Wetlands/Could not be located
- Closed Wastewater Treatment Ponds
- Other Wetlands

N
W E
S

0 360 720 1,440 2,160 2,880 3,600 4,320 5,040 5,760 6,480 7,200 Feet

FIGURE 10-1
OU1, OU2, OU16, Reference Wetlands, and Associated Sites

UFP-SAP
OU1, OU2, and OU16 Wetlands
NAS Pensacola, FL

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further evaluation, and additional wetlands not impacted by nearby installation restoration sites also were eliminated. The following wetlands were not sampled or evaluated further because no link to Navy CERCLA/Resource Conservation and Recovery Act (RCRA) sites was identified, see Table 10-1:

Table 10-1
Wetlands Eliminated from Further Consideration

2	28	41	54	70
9	30	42	55	71
11	31	43	59	73
14	34	44	60	74
20	35	45	61	75
21	36	46	62	76
22	37	47	66	77
23	38	50	67	78
24	39	51	68	79
26	40	53	69	

The RI was followed by an FS by Tetra Tech (2010), which refined the COC list and evaluated remedial alternatives. Table 10-2 identifies the wetlands that were evaluated in the RI/FS but were recommended for no further action (NFA) based on RI findings, handled under the auspices of the Florida Petroleum Program (12, W1), or in accordance with Navy policy, which prohibits investigation of a wetland not attributable with an Installation Restoration (IR) site (48).

Table 10-2
Wetlands Eliminated in the RI/FS

1A	13	19B	58
1B	15	48	63A
4D	16	49	63B
5B	17	52	72
6	18A	56	W1
10	18B	57	W2
12	19A		

Subsequent analysis by a Partnering Team consisting of the Navy, U.S. EPA, FDEP, Tetra Tech, and EnSafe identified the need to better characterize the vertical and horizontal spatial extent of contaminants and refine risks in sediment at 13 wetlands. An investigative approach was developed and discussed in the 27 and 28 March 2012, technical meeting. Surface water samples are also included for characterization and for possible food web models to upper trophic level organisms (see Appendix D). Table 10-3 summarizes the 13 wetlands retained for further characterization and risk assessment. Wetlands 1B, 4D, northern portion of 6, 15, 18A, 18B, and 48 have been included for additional analysis based on regulator concerns.

The western portion of Wetland W2 is also included. The previous assessment of Wetland W2 included only the northeastern portion of the wetland.

Table 10-3
Wetlands Retained for Further Characterization and Risk Assessment

Operable Unit (OU)	Wetland	Sediment	Surface Water
OU 1	1B	Yes	Yes
	3	Yes	Yes
	4D	Yes	Yes
	15	Yes	Yes
	18A	Yes	Yes
	18B	Yes	Yes
OU 2	5A	Yes	Yes
	6 (northern portion)	Yes	Yes
	7 (southern portion near connection with 6)	Yes	Yes
	64 Complex (northern portion of Wetland 7, Wetland 8 and 64)	Yes	Yes
OU 16	12	Yes	Yes
	48	Yes	Yes
	Western Portion of W2	Yes	Yes

The wetlands have been generally grouped by OU and will be assessed based on geographic location. Wetlands 1B, 3, 4D, 15, 18A, and 18B are all near NAS Pensacola's OU 1 (Site 1) landfill. Wetland 5A, 6 (northern end), 7, and the Wetland 64 complex are associated with NAS Pensacola's OU 2. Wetland 5A is to the east of the A.C. Read Golf Course, and Wetland 64 complex is an approximately 41-acre area on the eastern shore of the upstream side of the NAS Pensacola Yacht Basin, which is in the northeastern quadrant of the base. The remaining three wetlands (12, 48, and W2) are considered OU 16. Wetland 12, south of former Industrial Wastewater Treatment Plant (OU 10), is in the northeastern portion of NAS Pensacola, at the southern end of Magazine Point, directly north of Chevalier Field and the Naval Air Technical Training Center. Wetland 48 is in a mostly undeveloped portion of NAS Pensacola, north of Radford Boulevard, and south of the NAS Pensacola Fuel Farm. Wetland W2 connected to Bayou Grande is on the northern side of NAS Pensacola near Forrest Sherman Field. These wetland locations are provided in Figure 10-1. Although the OU 1, OU 2 and 16 wetlands are presented together in this SAP, the resulting data will assessed by respective OU in separate reports.

The RI included a detailed risk assessment which concluded that benthic invertebrates and human maintenance workers are the primary receptors of concern at the wetlands. Higher trophic level organisms may also be of concern, and will be considered for evaluation based

on decision criteria specified in Section 11.5.3. Therefore, based on the results of the RI, the Technical Memorandum within the FS, the 27 and 28 March 2012, technical meeting, partnering team meeting 9 May 2012, and teleconference minutes, these are the only receptors included in this SAP. Because maintenance workers will not be exposed to sediment at all of the wetlands, this receptor will only be evaluated at certain wetlands, as presented in the wetland-specific conceptual site model (CSM) sections of this SAP.

10.3 Reference Wetlands

Reference wetlands have been updated from the RI. Freshwater Wetlands 32 and 70A and saltwater reference wetlands 27B and 33 are designated as background wetlands for non-Hurricane series soil wetlands and additional data are needed to re-evaluate and calculate background concentrations to assess other wetland conditions. Sections 10.3.1 and 10.3.2 provide a brief description of each reference wetland.

Wetlands 25A and 27A were identified to assess background chemistry of iron-rich Hurricane series soil and associated sediments for iron in Wetland 3 (described fully in Section 10.3.3). Data are needed to calculate background concentrations to assess other Hurricane series soil wetland conditions. Section 10.3.3 provides a brief description of each Hurricane series soil reference wetland.

Background calculations will be performed using the methods provided in Section 11.3.

10.3.1 Freshwater Wetlands

Reference Wetland 32 — Wetland 32 is upstream from Wetland 33 on Navy property adjacent to NAS Pensacola to the southwest. The area is also known as Trout Point. Parsons and Pruitt described this system as a palustrine emergent wetland (U.S. EPA 1991). A freshwater stream runs through Wetland 32, eventually draining into Wetland 33, which discharges to Big Lagoon. The stream originates to the northeast of Trout Point, near Wetland 53. Saw grass *(Cladium jamaicense)* is the predominant vegetation in Wetland 32.

In 1996, the Navy took steps to preserve the Trout Point area, which has been subject to minimal impact from surrounding development. The area around Wetland 32 was developed into a low impact recreational area, with a board walk and nature trail. No IR sites exist in the immediate vicinity of Wetland 32.

Reference Wetland 70A — Wetland 70 is along the NAS Pensacola shoreline of Bayou Grande across Redoubt Bayou from Site 1. Parsons and Pruitt (U.S. EPA 1991) divided this wetland into two distinctive parts, Wetlands 70A and 70B. Wetland 70A is described as an inland forested, scrub-shrub system. Wetland 70A contains sweetbay magnolia *(Magnolia virginiana)* and black titi *(Cliftonia monophylla)*. There is no prominent surface water drainage into this area. No IR sites exist in the vicinity of Wetland 70A.

10.3.2 Saltwater Wetlands

Reference Wetland 27B — Wetland 27 is along the NAS Pensacola shoreline of Bayou Grande, east of Wetlands 25, 66, and 67. Parsons and Pruitt (U.S. EPA 1991) divided this site into two distinctive parts, Wetlands 27A and 27B. Wetland 27A is described as an inland palustrine system, whereas Wetland 27B is an estuarine emergent wetland, seaward of Wetland 27A. Wetland 27A contains sweetbay magnolia *(Magnolia virginiana)* and black titi *(Cliftonia monophylla)*. There is no prominent surface water drainage into this area. Wetland 27B is tidally influenced from Bayou Grande and maintains a thick growth of black needlerush *(Juncus roemerianus)*. No IR sites exist in the vicinity of Wetland 27.

Reference Wetland 33 — Wetland 33 is an estuarine lagoon on Navy property adjacent to NAS Pensacola to the southwest. The area is also known as Trout Point. Parsons and Pruitt (U.S. EPA 1991) described this system as an estuarine emergent wetland. Wetland 33 has an open water portion approximately 20 acres in size, with an outlet to Big Lagoon on its western end. Saw grass *(Cladium jamaicense)* and black needlerush *(Juncus roemerianus)* line the shoreline of this wetland.

In 1996, the Navy took steps to preserve the Trout Point area, which has been subject to minimal impact from surrounding development. The area around Wetland 33 was developed into a low impact recreational area, with a board walk and nature trail. The marsh within Wetland 33 was named Davis Marsh. No IR sites exist in the immediate vicinity of Wetland 33.

Non-Hurricane Series Soil Reference Wetlands
Freshwater Wetlands: 32 and 70A
Saltwater Wetlands 27B and 33

Media:	**Sediment**
Background Tests:	TCL SVOCs/PAHs + TICs TCL pesticides, TAL Metals + Tin
Ancillary Tests:	TOC, Grain Size, pH
Contingent Tests:	Toxicity
Media:	**Surface Water**
Background Tests:	TCL SVOCs/PAHs + TICs TCL pesticides, TAL Metals + Tin, Hardness (32 and 70A only)
Contingent Tests:	Toxicity
Field Tests:	Temperature, pH, Salinity, ORP, DO, and Depth

Box 10-1

Box 10-1 summarizes the background testing needed for the freshwater and saltwater wetlands, and Worksheet #17 provides the sampling design and rationale.

10.3.3 Hurricane Series Soil Wetlands

Hurricane Series Soil is described in the Escambia County Soil Survey as poorly drained soil that are strongly to very strongly acidic (pH 3.5 to 6) and containing masses of iron accumulation at depths of 24 to 45 inches below surface (USDA 1997). Hurricane Series Soil is identified at many wetlands, particularly Wetland 3. Figure 10-2 presents the wetlands and soil types across NAS Pensacola. Iron is a risk driver at Wetland 3 in OU 1, and the soil may be a naturally occurring source of the iron concentrations in sediment and surface water. To assess the sediment and surface water associated with the soil type, two reference wetlands (Wetlands 25A and 27A) have been selected for sampling.

Hurricane Series Soil Reference Wetland 25A — Wetland 25 is off Bayou Grande to the west of Redoubt Bayou. Parsons and Pruitt (U.S. EPA 1991) divided this area into two distinctive sites, Wetlands 25A and 25B. Wetland 25A is small inland palustrine wetland, whereas Wetland 25B is an estuarine wetland lying seaward of Wetland 25A. Wetland 25B is tidally influenced from Bayou Grande. A minor natural surface water drainage pathway runs through Wetland 25A, discharging to the open water part of Wetland 25B. Wetland 25B supports a large stand of black needlerush *(Juncus roemerianus)*. No IR sites exist in the vicinity of Wetland 25.

Hurricane Series Soil Reference Wetland 27A — Wetland 27 is along NAS Pensacola shoreline of Bayou Grande, east of Wetlands 25, 66, and 67. Parsons and Pruitt (U.S. EPA 1991) divided this site into two distinctive parts, Wetlands 27A and 27B. Wetland 27A is described as an inland palustrine system, whereas Wetland 27B is an estuarine emergent wetland, seaward of Wetland 27A. Wetland 27A contains sweetbay magnolia *(Magnolia virginiana)* and black titi *(Cliftonia monophylla)*. There is no prominent surface water drainage into this area. Wetland 27B is tidally influenced from Bayou Grande and maintains a thick growth of black needlerush *(Juncus roemerianus)*. No IR sites exist in the vicinity of Wetland 27.

Hurricane Series Soil Reference Wetlands 25A and 27A

Media:	**Sediment**
Background Tests:	TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin
Ancillary Tests:	TOC, Grain Size, pH
Contingent Tests:	Toxicity
Media:	**Surface Water**
Background Tests:	TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin, Hardness
Contingent Tests:	Toxicity
Field Tests:	Temperature, pH, Salinity, ORP, DO, and Depth

Box 10-2

Box 10-2 summarizes the Hurricane series soil background testing needed and Worksheet #17 provides the sampling design and rationale.

Bayou Grande

Pensacola Bay

Yacht Basin

OU 1
Site 1

OU 2
Site 30

OU 3
Site 2

OU 4
Site 15

OU 6
Site 29

OU 10
Site 32

OU 11
Site 38

OU 12
Site 11

OU 13
Site 8

Site 24

Site 16a

Site 16b

Site 3

Site 4

Site 5

Site 6

Site 7

Site 9

Site 14

Site 17

Site 22

Site 25

Site 27

Site 33

Site 34

Site 35

Site 36

Site 37

Site 39

Site 43

Site 44

Monitored Outfall 002

Monitored Outfall 003

Monitored Outfall 007

Monitored Outfall 023

Wetland 1

Wetland 1A

Wetland 2

Wetland 3

Wetland 4A

Wetland 4C

Wetland 5A

Wetland 6

Wetland 7

Wetland 8

Wetland 9

Wetland 10

Wetland 11

Wetland 12

Wetland 13

Wetland 14

Wetland 15

Wetland 16

Wetland 17

Wetland 18A

Wetland 19A

Wetland 19B

Wetland 20

Wetland 21

Wetland 22A

Wetland 22B

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Legend

Wetlands

- Phase I
- Phase II
- Phase III
- Resampled
- Not Wetlands/Could not be located
- Closed Wastewater Treatment Ponds

Soil Description: MUKEY

- Allanton-Pottsburg complex: 1425322
- Arents-Urban land complex: 1425324
- Beaches: 1425318
- Bigbee-Garcon-Fluvaquents complex, flooded: 1425356
- Corolla-Duckston sands, gently undulating, flooded: 1425311
- Croatan and Pickney soils, depressional: 1425313
- Croatan muck, depressional: 1425320
- Direго muck, tidal: 1425314
- Dorovan muck and Fluvaquents, frequently flooded: 1425355
- Duckston sand, frequently flooded: 1425310
- Foxworth sand, 0 to 5 percent slopes: 1425327
- Hurricane sand, 0 to 5 percent slopes: 1425319
- Kureb sand, 0 to 8 percent slopes: 1425315
- Kureb sand, 8 to 12 percent slopes: 1425325
- Lakeland sand, 0 to 5 percent slopes: 1425321
- Lakeland sand, 5 to 8 percent slopes: 1425328
- Leon sand: 1425317
- Newhan-Corolla complex, rolling, rarely flooded: 1425316
- Pickney sand: 1425312
- Pits: 1425326
- Resota sand, 0 to 5 percent slopes: 1425323
- Urban land: 1425330
- Water: 1425384

- Storm Water Outfall
- Storm Water Inlet
- Storm Water Pipe
- Shoreline
- Road
- Site
- Operable Unit (OU)
- UST Sites
- NASP Boundary
- Building

N W E S

0 360 720 1,440 2,160 2,880 3,600 4,320 5,040 5,760 6,480 7,200 Feet

FIGURE 10-2
NAS Pensacola Wetlands, Soil Types, and Associated Sites

UFP-SAP
OU, OU2, and OU16 Wetlands
NAS Pensacola, FL

Date: 9/23/2013 | Drwn by: NR | File: X:\Navy\Pensacola-Old\CTO-036\Projects\RI_report\Fig10-2_SoilTypes.mxd

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10.4 Operable Unit 1 Conceptual Site Models

OU 1 is the former sanitary landfill where a variety of domestic and industrial wastes were disposed during the early 1950s and continuing until 1976. The wetlands of interest associated with OU 1 include the following: 1B, 3, 4D, 15, 18A, and 18B. CSMs for each wetland to be sampled are presented below.

10.4.1 Wetland 1B

Wetland 1B is 3-foot wide, maintained open storm water ditch southwest of the OU 1 landfill. It is a freshwater wetland, a palustrine forested system dominated by slash pines (*Pinus elliotti*) and is approximately one acre in size. This maintained drainage ditch is formed by twin 54-inch concrete pipes and merges downstream with the Southeast Drainage Ditch (Wetland W2) and discharges at Monitored Outfall 30. Wetland 1B is a part of the NAS Pensacola storm water drainage system and conveys runoff to Bayou Grande. The ditch is under the auspices of the NAS Pensacola Storm Water Pollution Prevention Program and Wetland 1B is one of the tributaries discharging storm water, from Forrest Sherman field, monitored under this program.

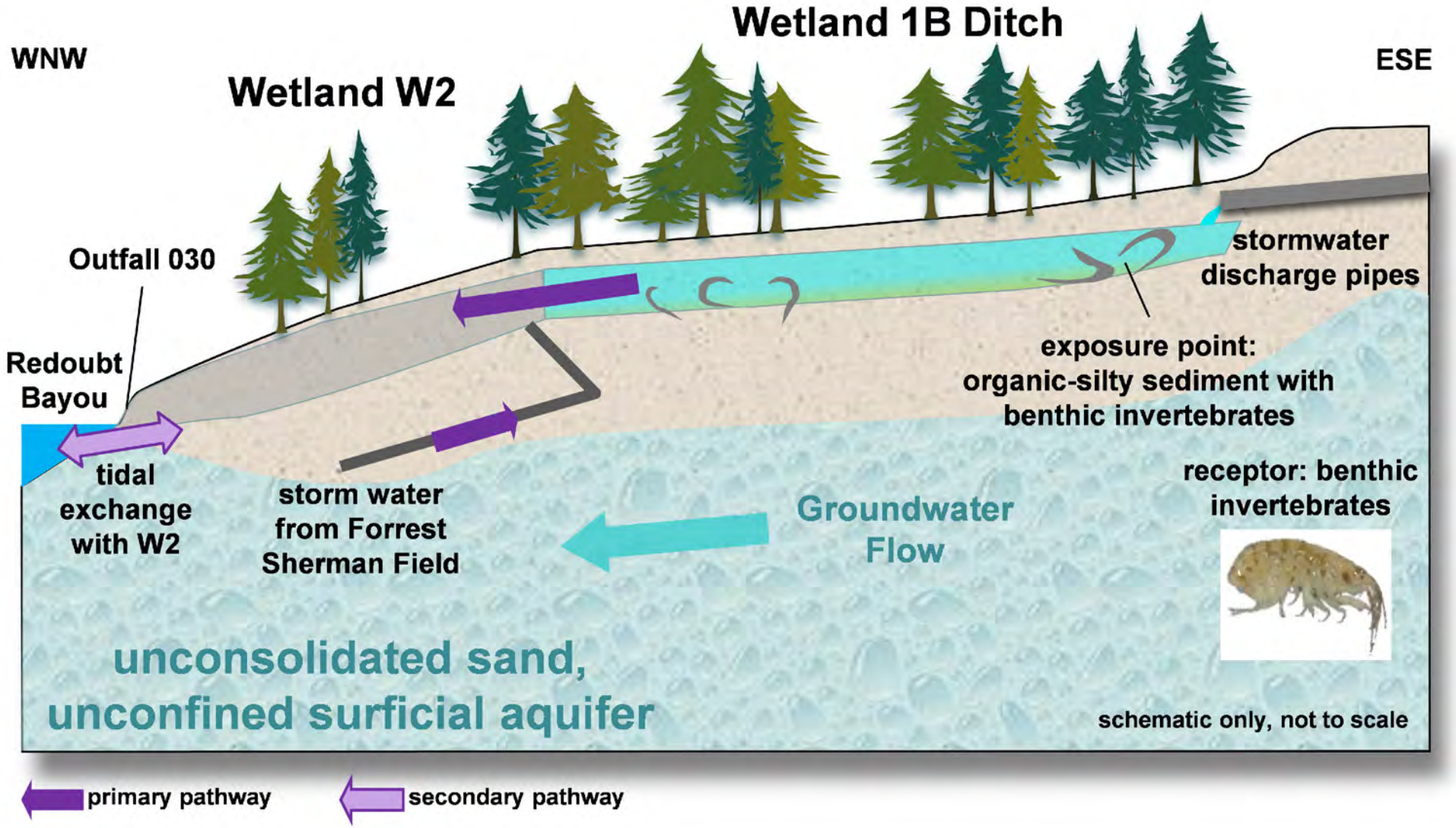
The current CSM uncertainty is vertical and horizontal extent of contamination where chemical concentrations were previously elevated and down gradient of storm water outfall. There is uncertainty of the source of PAHs in sediment. Data needed to further characterize the wetland are provided in Box 10-3, and Worksheet #17 provides the sampling design and rationale. If bioaccumulative chemicals are detected at concentrations greater than those detected in the RI, food web modeling may be conducted for upper trophic level organisms. Evaluation of upper trophic level receptors will be contingent on the following: 1) identification of sediment concentrations that are greater than historical concentrations and 2) determination that extent of contamination is not an isolated area. Figure 10-3 shows the CSM for Wetland 1B.

Wetland 1B (OU 1)	
Special Feature:	**Storm Water Conveyance**
Receptors:	**Benthic invertebrates**
Media:	**Sediment**
Risk Drivers:	PAHs, Iron
Ancillary Tests:	TOC, Grain Size, pH
Contingent Tests:	Toxicity, Food web model
Media:	**Surface Water**
Risk Drivers:	PAHs, Iron
Field Tests:	Temperature, pH, Salinity, ORP, DO, and Depth
Contingent Test:	Food web model

Box 10-3

Figure 10-3
Wetland 1B, Conceptual Site Model
UFP-SAP, OU1, OU2, and OU16 Wetlands
NAS Pensacola, Pensacola, Florida

REQUESTED BY: A. Harris	DATE: 11/11/2013
DRAWN BY: L. Hughes	TASK ORDER NUMBER: JM07



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10.4.2 Wetland 3

Wetland 3 is in the north-central portion of NAS Pensacola, west of the A.C. Read Golf Course, and east of the Site 1 landfill. Wetland 3 is a palustrine system with the predominant vegetation being scrub-shrub emergent (sweet bay magnolias, cattails and saw grass). The area surrounding the wetland consists of pine trees, and some oaks and other species. Wetland 3 receives shallow groundwater and surface water runoff from the site and is primarily fed by a visible seep at the north end of the wetland. The Wetland 3 area ranges from 0 to about 3 feet in depth and from 3 to 500 feet wide, is relatively flat topographically, and consists of saturated sediment drained by a narrow and shallow stream channel approximately 4 inches deep and 1 to 2 feet wide. Shallow sheet flow drains from the southwest to the northeast into a drainage culvert that discharges into Wetland 4D. This culvert runs east under John Tower Road and a golf course fairway prior to discharging into Wetland 4D. Sediment in most of the wetland is highly organic, with total organic carbon (TOC) detected at up to 24 percent.

The soils underlying Wetland 3 are classified as being in the Hurricane series (USDA 1997). Hurricane series soil is characterized as poorly drained soils that are strongly to very strongly acidic (pH 3.5 to 6) and contain masses of iron accumulation. Sediments in Wetland 3 are composed of black sandy organic silt to brown poorly graded medium to fine sands and silts. The type of iron (ferric or ferrous) in the soil depends on the pH, moisture content and oxygen content of the soil. The dissolution of iron minerals from the iron-rich Hurricane series soil underlying the wetland may result in a different native surface water and sediment chemistry than other wetlands on the site and may contribute to the iron detected in surface water and sediment and the formation of iron-rich floc in the wetland. Hurricane series soil is also present in several other wetlands on NAS Pensacola.

Due to the adjacent Site 1 landfill, the groundwater flowing to the seep at the north end of Wetland 3 is low in oxygen and exhibits reducing conditions. The low oxygen and reducing conditions may promote the growth of iron-reducing bacteria, which could reduce the ferric iron present in the soil to the more soluble and mobile ferrous iron, which flows with groundwater. At the groundwater-to-surface water interface, the geochemistry of the groundwater changes as it flows from the low oxygen environment into the oxygen-rich environment of the surface water body. Aeration of the groundwater at the groundwater-to-surface water interface and in the surface water body oxidizes the iron from ferrous iron to ferric iron, which results in iron precipitation.

Iron contamination has been detected in seeps emanating from the east side of the landfill, in surface water, and in sediments around the landfill. OU 1 including Wetland 3 was assessed in an RI/FS. The OU 1 Record of Decision (ROD) identified a component to address iron contaminated groundwater discharging to Wetland 3: The component included a groundwater interception system to capture the contaminated groundwater upgradient of Wetland 3. The intercepted groundwater was to reduce iron concentrations before being reintroduced into Wetland 3. The treatment system was designed and constructed, and the Navy operated the groundwater interception system from June 1999 until May 2010.

Operation of the treatment system was discontinued based on the following findings:

An Optimization Study completed in 2007 found that although the groundwater interception system could contribute to reducing some iron concentrations within shallow groundwater, surface water data indicated that the groundwater interception system was not having an appreciable effect on the overall iron concentrations in surface water within Wetland 3 because of the prevalence of iron within the shallow groundwater upgradient, sidegradient, and downgradient to the groundwater interception system. Furthermore, the Optimization Study found that attenuation of iron is naturally occurring in Wetland 3. Based upon field observations, physical processes including natural sedimentation appear to be occurring where the iron flocculent is dropping out of suspension. An additional field observation in January 2003 (Singletary 2004) indicated iron flocculent was being transported from the upgradient seep to Wetland 3 and then to Wetland 4D.

The 2008 Five Year Review concurred with the 2006 Optimization Study and concluded that: performance of the groundwater interception system does not appear to be sufficient to capture and extract the iron contamination migrating to the wetland. Furthermore, even if the groundwater interception system was effectively capturing and treating the local groundwater (which it does not appear to do based upon the elevated iron concentrations in groundwater immediately downgradient of the groundwater interception system) the prevalence of iron within the shallow groundwater upgradient, side-gradient, and downgradient to the groundwater interception system would make achievement of the remedial action objectives for surface water in Wetland 3 impractical with the existing system. Therefore, the use of the interceptor trench was discontinued. Remedial alternatives for treating the iron at Wetland 3 will be evaluated in a feasibility study (FS) and a final remedy selected in a ROD Amendment. This investigation will provide additional information that will allow for the selection of additional remedial alternatives.

Data needed to further characterize the wetland are provided in Box 10-4, and Worksheet #17 provides the sampling design and rationale. If bioaccumulative chemicals are detected at concentrations greater than those detected in the RI, food web models may be conducted for upper trophic level organisms. Evaluation of upper trophic level receptors will be contingent on the following: 1) identification of sediment concentrations that are greater than historical concentrations and 2) determination that extent of contamination is not an isolated area.

Figure 10-4 shows the current CSM for Wetland 3. The sampling presented in this SAP will assess:

Wetland 3 (OU 1)	
Special Feature:	**Groundwater Seep connected to Wetland 4 via culvert**
Receptors:	**Benthic invertebrates**
Ecological Risk	
Media:	**Sediment**
Risk Drivers:	Iron
Ancillary Tests:	Grain Size, pH, TOC
Contingent Tests:	Toxicity, Food Web Model
CSM Refinement	
Media:	**Surface Water**
Risk Drivers:	Iron
Ancillary Tests:	Aluminum, Manganese, Magnesium, Alkalinity, Acidity, Hardness, Sulfate, Nitrate, Nitrite, Total Phosphorus, TKN, Ammonia, Nitrogen, TDS, TSS, TOC
Field Tests:	Temperature, pH, Salinity, ORP, DO, Depth, Ferrous Iron, Sulfide
Contingent Tests:	Toxicity, Food Web Model

Box 10-4

Does iron infiltrate into Wetland 3 only at the seep, or at other points along the axis of the wetland?

1. How do the flow, water level, and chemistry of the discharge at the seep vary seasonally?

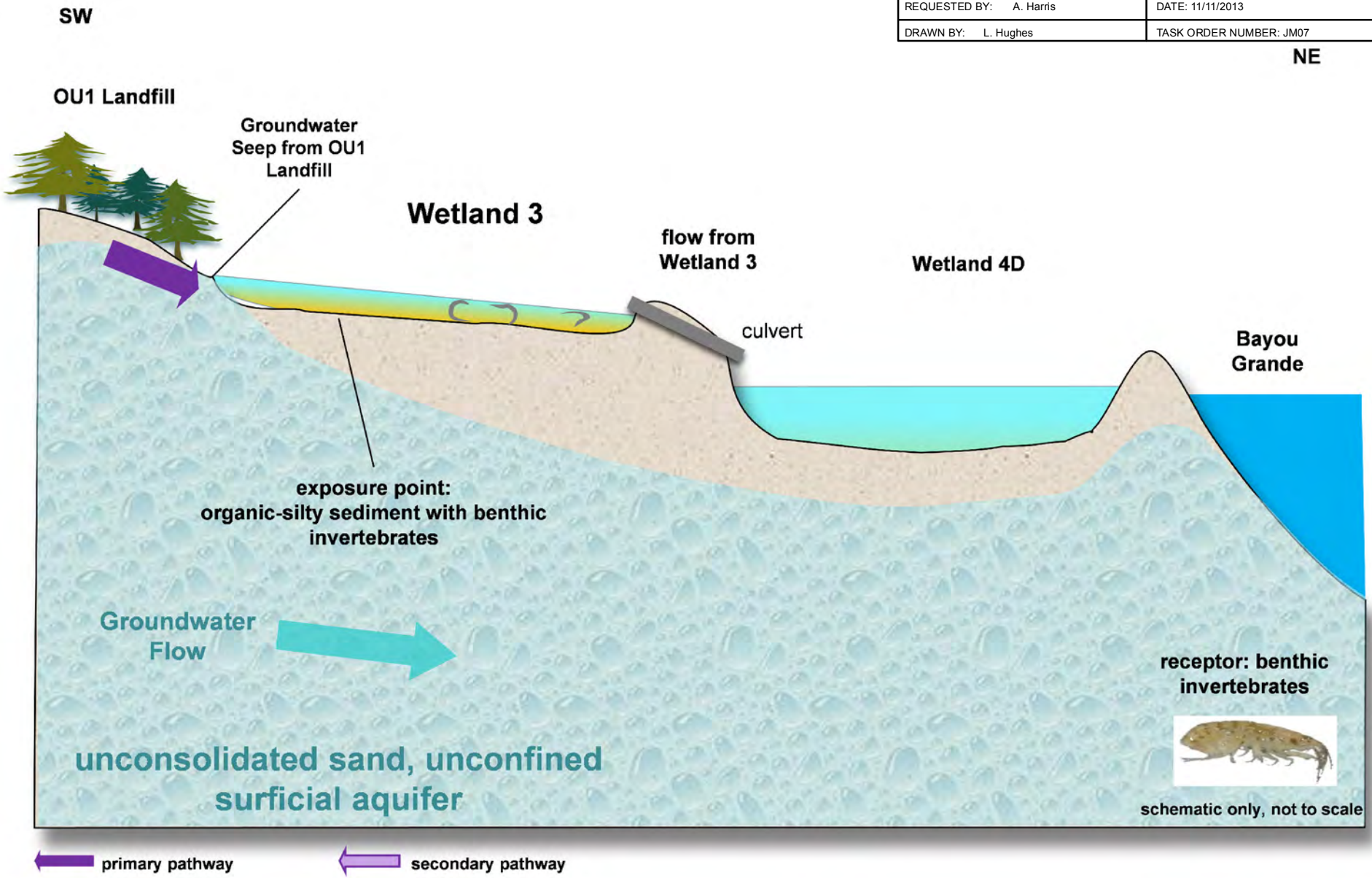
2. What is the geochemistry of surface water in the seep area compared to locations along the axis of the wetland?

3. What is the current topography within the wetland (near the seep, along the axis, and near the discharge structure)?

4. Do the characteristics of the Hurricane series soil underlying the wetland affect the iron concentrations in surface water and sediment?

Figure 10-4
Wetland 3, Conceptual Site Model
UFP-SAP, OU1, OU2, and OU16 Wetlands
NAS Pensacola, Pensacola, Florida

REQUESTED BY: A. Harris	DATE: 11/11/2013
DRAWN BY: L. Hughes	TASK ORDER NUMBER: JM07



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10.4.3 Wetland 4D

Wetland 4D is in the northern portion of the eastern half of NAS Pensacola. Positioned on the north part of A.C. Read Golf Course and comprising of 1.4 acres, Wetland 4D is a saltwater-dominated estuarine system with emergent vegetation (saw grass and black needlerush). Wetland 4D receives freshwater from surface water discharges from Wetland 3 from the west, Wetland 4C from the south (via Wetlands 4A[1] and 4B), and is tidally influenced by Bayou Grande from the north. Groundwater from western adjacent Site 1 also flows toward this wetland. The primary release mechanisms are likely from OU 1 landfill constituents via surface flow from Wetland 3, groundwater to surface water pathway, and potential golf course runoff via influx/mixing from Wetlands 4A, 4B, and 4C.

The current CSM uncertainty is the vertical and horizontal extent of contamination where chemical concentrations were previously elevated. Data needed to further characterize the wetland are provided in Box 10-5, and Worksheet #17 provides the sampling design and rationale. If bioaccumulative chemicals are detected at concentrations greater than those detected in the RI, food web models may be conducted for upper trophic level organisms. Evaluation of upper trophic level receptors will be contingent on the following: 1) identification of sediment concentrations that are greater than historical concentrations and 2) determination that extent of contamination is not an isolated area. Figure 10-5 shows the CSM for Wetland 4D.

Wetland 4D (OU 1)	
Special Feature:	**Saltwater Wetland, Connected via culvert to Wetland 3, Golf Course Pond**
Receptors:	**Benthic invertebrates**
Media:	**Sediment**
Risk Drivers:	Iron, Lead, DDx
Ancillary Tests:	Aluminum, TOC, AVS/SEM, Grain Size, pH
Contingent Tests:	Toxicity, Food web model
Media:	**Surface Water**
Risk Drivers:	Iron, Lead, DDx
Field Tests:	Temperature, pH, Salinity, ORP, DO, and Depth
Contingent Test:	Food web model

Box 10-5

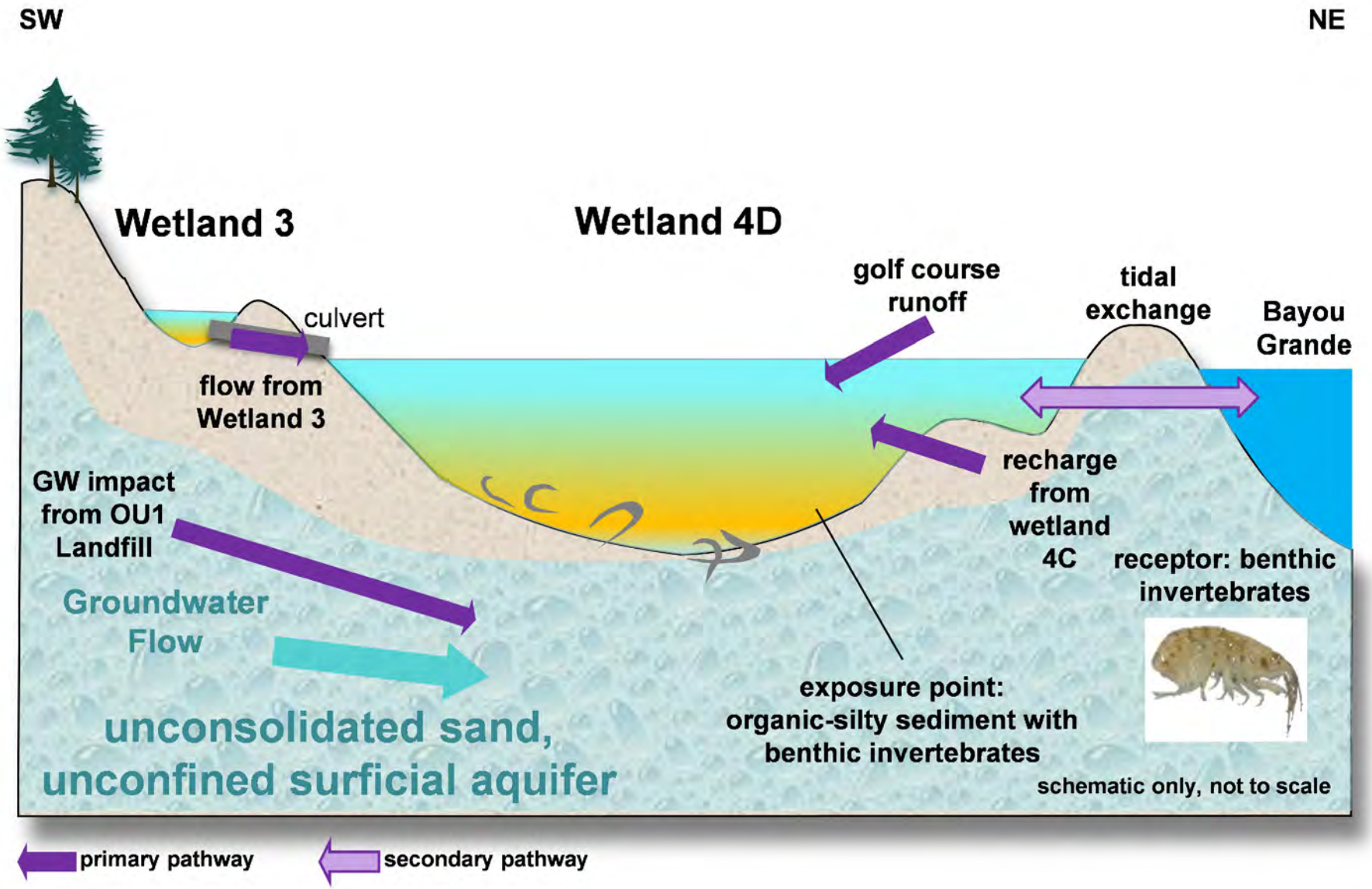
10.4.4 Wetland 15

Comprising of 1.2 acres, Wetland 15 is a saltwater wetland on the shore of Bayou Grande, just northeast of Site 1, between Wetland 4D and the NAS Pensacola Picnic Ground. This wetland is bordered by the A.C. Read Golf Course to the south, east, and west, and Bayou Grande to the north. Wetland 15 is fed from the south by surface water runoff from the area of the golf course and from the north by tidal influences from Bayou Grande. This wetland has recreational or functional uses, because it could be accessed by Navy personnel or trespassers walking and/or

[1] Wetland 4A encompasses an irrigation reservoir for the golf course.

Figure 10-5
Wetland 4D, Conceptual Site Model
UFP-SAP, OU1, OU2, and OU16 Wetlands
NAS Pensacola, Pensacola, Florida

REQUESTED BY: A. Harris	DATE: 11/4/2013
DRAWN BY: L. Hughes	TASK ORDER NUMBER: JM07



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wading through the wetland. Site 1 groundwater also flows toward this wetland. The potential primary release mechanisms may include runoff and shallow-groundwater outflow from OU 1 landfill.

The current CSM uncertainties are the vertical and horizontal extent of contamination where chemical concentrations were previously elevated. Data needed to further characterize the wetland are provided in Box 10-6, and Worksheet #17 provides the sampling design and rationale. If bioaccumulative chemicals are detected at concentrations greater than those detected in the RI, food web models may be conducted for upper trophic level organisms. Evaluation of upper trophic level receptors will be contingent on the following: 1) identification of sediment concentrations that are greater than historical concentrations and 2) determination that extent of contamination is not an isolated area. Figure 10-6 illustrates the CSM for Wetland 15.

Wetland 15 (OU 1)	
Special Feature:	**Saltwater Wetland**
Receptors:	**Benthic invertebrates** **Maintenance workers**
Media:	**Sediment**
Risk Drivers:	Arsenic, Iron, Lead, Manganese, Selenium, DDx
Ancillary Tests:	Aluminum, TOC, AVS/SEM, Grain Size, pH
Contingent Tests:	Toxicity, Food web model
Media:	**Surface Water**
Risk Drivers:	Arsenic, Iron, Lead, Manganese, Selenium, DDx
Field Tests:	Temperature, pH, Salinity, ORP, DO, and Depth
Contingent Test:	Food web model

Box 10-6

10.4.5 Wetland 18A

Wetland 18 is adjacent to the eastern shore of Redoubt Bayou, which is along the northern shoreline of Bayou Grande, situated at the midpoint of NAS Pensacola. Wetland 18 is subdivided into fresh water (18A) and salt water (18B) portions. Comprised of 1.3 acres and classified as a palustrine emergent system, Wetland 18A is a long, narrow ditch fed by groundwater seeps from Site 1 to the east and leads toward Wetland 18B, which connects with Redoubt Bayou. Wetland 18A, which is no deeper than a foot and has a maximum width of 2 feet, transitions to Wetland 18B via a stream, approximately 2-feet wide, and located to the west. Minor tidal mixing with salt-water occurs between Wetlands 18A and 18B. The likely primary release mechanisms may include runoff and shallow-groundwater from the OU 1 landfill seeping into the wetland.

Figure 10-6
Wetland 15, Conceptual Site Model
UFP-SAP, OU1, OU2, and OU16 Wetlands
NAS Pensacola, Pensacola, Florida

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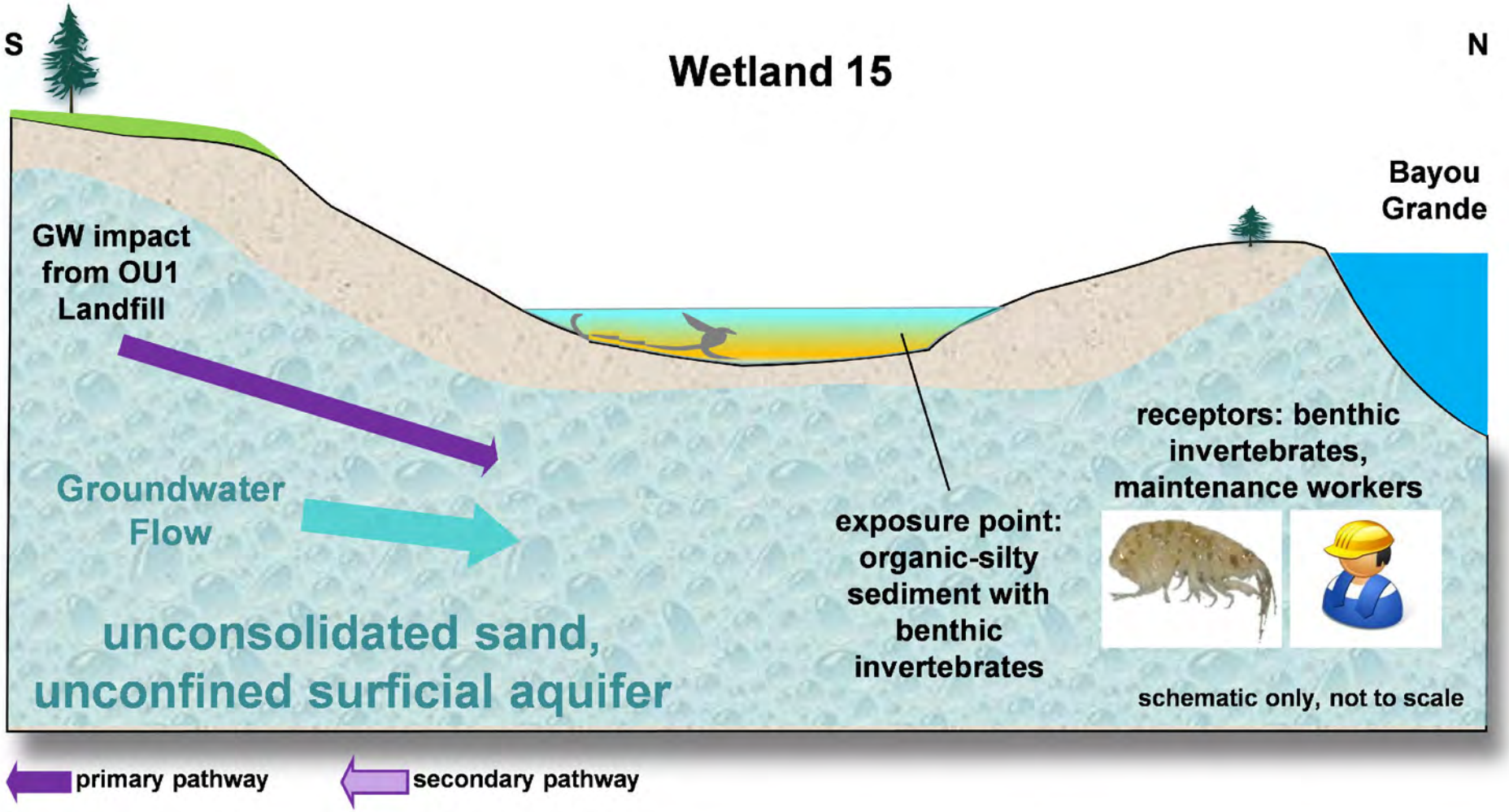
REQUESTED BY: A. Harris	DATE: 11/11/2013
DRAWN BY: L. Hughes	TASK ORDER NUMBER: JM07



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The current CSM uncertainty is the vertical and horizontal extent of contamination where chemical concentrations were previously elevated. Data needed to further characterize the wetland are provided in Box 10-7, and Worksheet #17 provides the sampling design and rationale. If bioaccumulative chemicals are detected at concentrations greater than those detected in the RI, food web models may be conducted for upper trophic level organisms. Evaluation of upper trophic level receptors will be contingent on the following: 1) identification of sediment concentrations that are greater than historical concentrations and 2) determination that extent of contamination is not an isolated area. Figure 10-7 illustrates the CSM for Wetland 18A.

Wetland 18A (OU 1)	
Special Feature:	**Freshwater Wetland**
Receptors:	**Benthic invertebrates** **Maintenance workers**
Media:	**Sediment**
Risk Drivers:	Arsenic, Iron, Lead, DDx
Ancillary Tests:	Aluminum, TOC, AVS/SEM, Grain Size, pH
Contingent Tests:	Toxicity, Food web model
Media:	**Surface Water**
Risk Drivers:	Arsenic, Iron, Lead, DDx
Ancillary Tests:	Hardness
Field Tests:	Temperature, pH, Salinity, ORP, DO, and Depth
Contingent Test:	Food web model

Box 10-7

10.4.6 Wetland 18B

Wetland 18B is the saltwater portion of Wetland 18 and consists of 0.6 acres. Wetland 18B, classified as an estuarine emergent system, connects to and is tidally interactive with Redoubt Bayou, and additionally is fed by freshwater influx from Wetland 18A and from freshwater drainages. It is up to 8 feet deep and 50 feet wide, depending on bayou influx.

Wetland 18B (OU 1)	
Special Feature:	**Saltwater Wetland**
Receptors:	**Benthic invertebrates** **Maintenance workers**
Media:	**Sediment**
Risk Drivers:	Arsenic, Iron, DDx
Ancillary Tests:	Aluminum, TOC, Grain Size, pH
Contingent Tests:	Toxicity, Food web model
Media:	**Surface Water**
Risk Drivers:	Arsenic, Iron, DDx
Field Tests:	Temperature, pH, Salinity, ORP, DO, and Depth
Contingent Test:	Food web model

Box 10-8

Redoubt Bayou borders Wetlands 18A and 18B to the west, and Site 1 borders the wetlands to the east. Wetland 18B has occasional surface flow due to the tides. The wetland also receives freshwater flow from a small surface water drainage pattern. The likely primary release mechanisms may be OU 1 landfill constituents via inflow from Wetland 18A.

The current CSM uncertainty is the vertical and horizontal extent of contamination where chemical concentrations were previously elevated. Data needed to further characterize the wetland are provided in Box 10-8, and Worksheet #17 provides the sampling design and rationale. If bioaccumulative chemicals are detected at concentrations greater than those detected in the RI, food web models may be conducted for upper trophic level organisms.

Figure 10-7
Wetland 18A/18B, Conceptual Site Model
UFP-SAP, OU1, OU2, and OU16 Wetlands
NAS Pensacola, Pensacola, Florida

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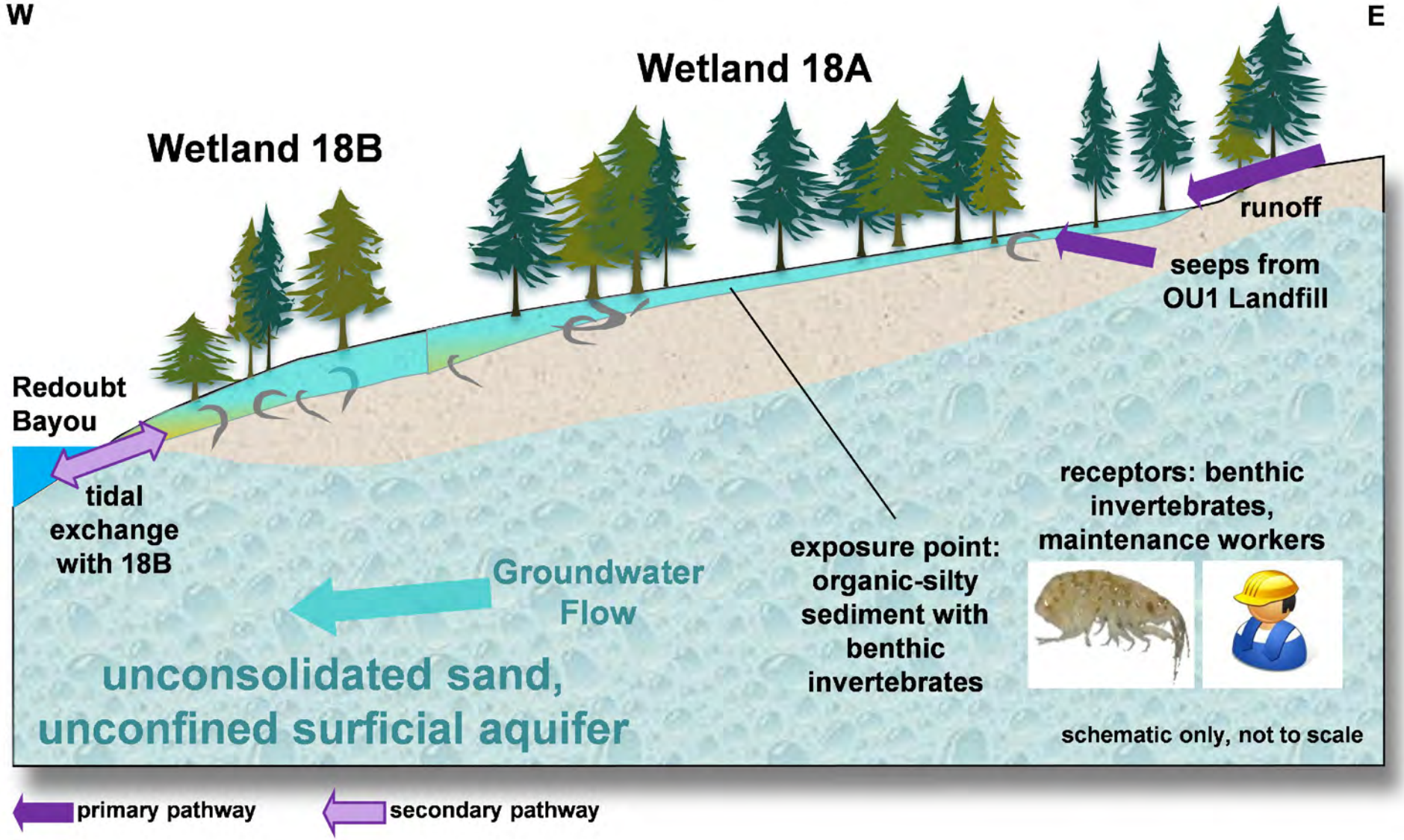

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Evaluation of upper trophic level receptors will be contingent on the following: 1) identification of sediment concentrations that are greater than historical concentrations and 2) determination that extent of contamination is not an isolated area. Figure 10-7 illustrates the CSM for Wetland 18B.

10.5 Operable Unit 2 Conceptual Site Models

OU 2 includes several sites that were investigated during the RI, is located in the northeastern portion of the base, and is roughly 300 acres in size. The wetlands of interest associated with OU 2 are Wetland 5A, 6, 7, and the Wetland 64 complex (northern portion of Wetland 7, Wetland 8 and 64). CSMs for each wetland are presented below.

10.5.1 Wetland 5A

Wetland 5A, a freshwater palustrine system in a wooded area within the developed portion of NAS Pensacola, is roughly 1.3 acres in size and is bordered by Murray Road to the east, the golf course to the west, and buildings to the north and south. Wetland 5A is connected to Wetland 5B (1.2 acres) by a culvert, which runs under Murray Road. Typical vegetation found in Wetland 5A consists of hardwoods, such as oaks and sweet bay magnolias. A 200-300 foot vegetative buffer surrounding this area likely offers habitat to various species. The open water portion of the wetland ranges from zero to three feet in depth and varies from 80-150 feet in width and serves as a storm water conduit.

Wetland 5A is traced back to the 1930s and has reportedly housed a saw mill, served as a drainage pathway, and contained a waste receiving structure where drums of contaminated solid waste, sludge, and sediment waste were removed in 1994. Beaver dams at the downstream end of Wetland 5A raised the water level in the basin containing this wetland, facilitating sedimentation and the emergence of a marsh. The dams, along with a potable water tank with a faulty value that accidentally added thousands of gallons of water a day to the wetland, contributed to the wetland's water source. Since the dams were removed and the valve was repaired, the water has receded.

Wetland 5A continues to serve as a storm water conduit. NAS Pensacola Storm Drainage Map 1276912 shows three outfalls in Wetland 5A. Outfall T discharges storm water from the Bachelor Officers' Quarters area to the south. Outfall V and an unnamed outfall discharge storm water from the former Building 649 Complex. Wetland 5A drains via Wetland 5B into Wetland 6, which empties into the NAS Pensacola Yacht Basin (Wetland 64 complex).

The likely primary release mechanisms from OU 2 include the former industrial waste sewer line (clean closed under RCRA), storm water from three outfalls, surface runoff, and former waste receiving structure.

Wetland 5A (OU 2)	
Special Feature:	**Freshwater Wetland**
Receptors:	**Benthic invertebrates**
Media:	**Sediment**
Risk Drivers:	TAL Metals, Tin, PCBs, PAHs, DDx, bis(2-ethylhexyl) phthalate
Ancillary Tests:	TOC, AVS/SEM, Grain Size
Contingent Tests:	Toxicity, Food web model
Media:	**Surface Water**
Risk Drivers:	TAL Metals, Tin, PCBs, PAHs, DDx, bis(2-ethylhexyl) phthalate
Ancillary Tests:	Hardness
Field Tests:	Temperature, pH, Salinity, ORP, DO, and Depth
Contingent Test:	Food web model

Box 10-9

Wetland 5A is located in an active portion of the base, under homeland security restrictions, where both trespassers and Navy personnel could obtain access. The current CSM uncertainties are the vertical and horizontal extent of contamination where chemical concentrations were previously elevated. Data needed to further characterize the wetland are provided in Box 10-9 and Worksheet #17 provides the sampling design and rationale. If bioaccumulative chemicals are detected at concentrations greater than those detected in the RI, food web models may be conducted for upper trophic level organisms. Evaluation of upper trophic level receptors will be contingent on the following: 1) identification of sediment concentrations that are greater than historical concentrations and 2) determination that extent of contamination is not an isolated area. Figure 10-8 illustrates the CSM for Wetland 5A.

10.5.2 Northern Portion of Wetland 6

Wetland 6 is a tile-lined drainage ditch originating at the parade grounds north of the NAS Chapel and draining to the north into the Wetland 64 complex, the Navy Yacht Basin. The wetland is palustrine with open water that is bound by mowed grass, buildings, or isolated areas of highly disturbed vegetation. The wetland is channelized from its headwaters through its discharge to the Wetland 64 complex and flows from south to north. It is intersected on the west by Wetland 5B, approximately halfway down its defined span. Wetland 6 receives surface water from Wetland 5B and storm water drainage from the east through a series of drainage ditches, from what is now the Naval Air Technical Training Center (NATTC) training complex (and originally was Chevalier Field, which contained IR sites 9, 27, and 34). The wetland is tidally influenced along its entire length. The ditch portion of Wetland 6 is no deeper than about 3 feet and has a maximum width of about 3 to 5 feet. Wetland 6 is near or adjacent to OU 2 Sites 12 and 30, OU 6 (Sites 9, 29, and 34), and Sites 10 and 36.

Figure 10-8
Wetland 5A, Conceptual Site Model
UFP-SAP, OU1, OU2, and OU16 Wetlands
NAS Pensacola, Pensacola, Florida

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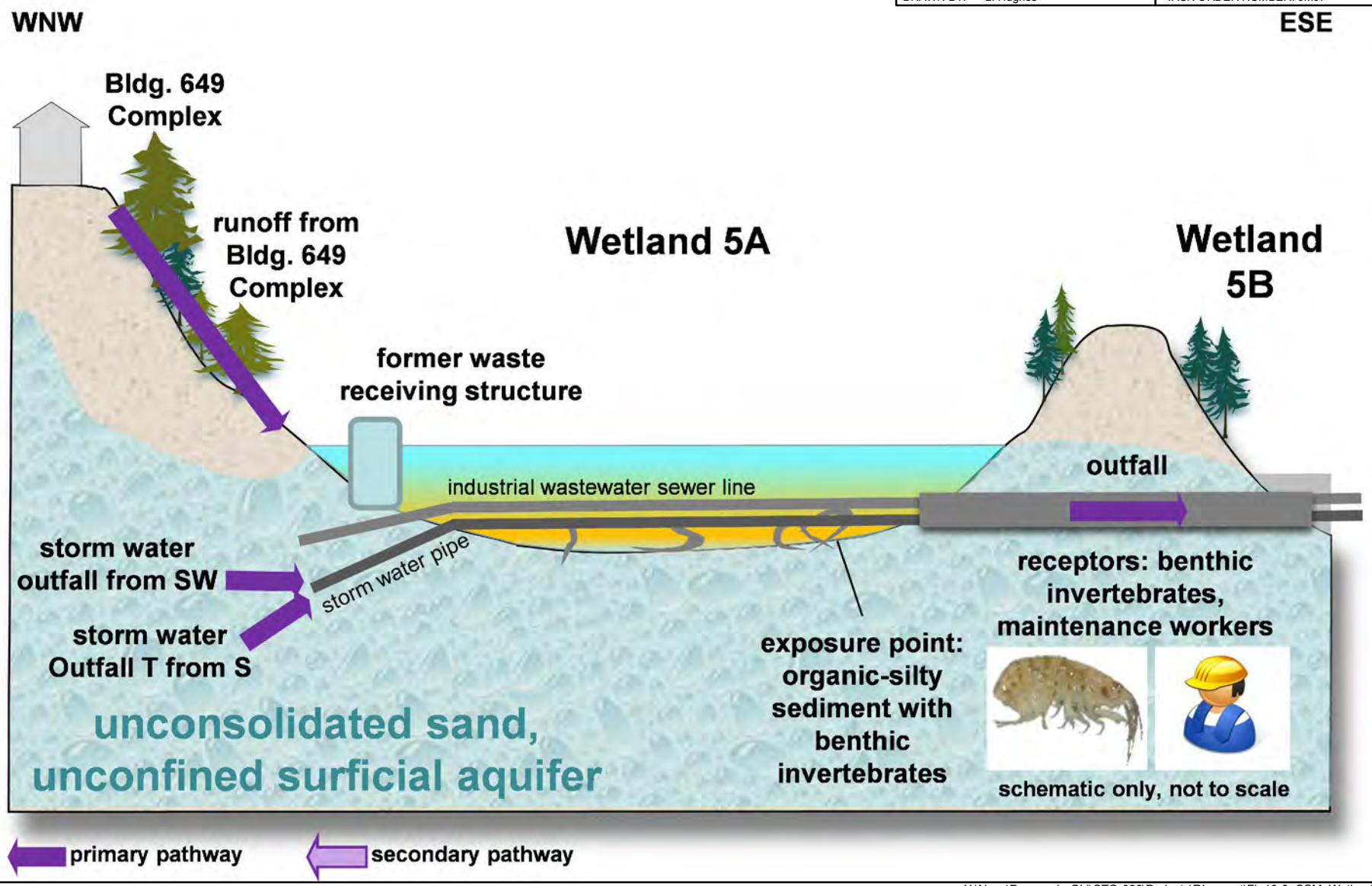

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On an as needed basis, maintenance of the ditch includes vegetation and sediment removal to maintain the grade of the ditch. The last maintenance event on Wetland 6 was performed in 2008.

Sediment in Wetland 6 ranges from a brown poorly graded fine sand with a TOC of 0.121% to a dark yellow brown poorly graded sand with silt and organics and a TOC of 4.03%.

Wetland 6 is inundated with surface water year round. Potential receptors of the COCs in sediments are benthic invertebrates.

The likely primary release mechanisms are from Wetland 5B and from surface runoff from adjacent OUs and sites.

Sampling at the northern end of Wetland 6 (north of connection of Wetland 5B) was included based on U.S. EPA concerns with historical elevated DDT concentrations in sediment and the potential for migration of sediments to the downgradient Wetland 64 complex (Wetlands 7 [northern end], 8, and 64) raised during the March 2012 scoping meeting. Data needed to further characterize the wetland are provided in Box 10-10, and Worksheet #17 provides the sampling design and rationale. If bioaccumulative chemicals are detected at concentrations greater than those detected in the RI, food web models may be conducted for upper trophic level organisms. Evaluation of upper trophic level receptors will be contingent on the following: 1) identification of sediment concentrations that are greater than historical concentrations and 2) determination that extent of contamination is not an isolated area. Figure 10-9 illustrates the CSM for Wetland 6.

Northern Portion of Wetland 6 (OU 2)	
Special Feature:	**Tile-lined Storm Water Conveyance**
Receptors:	**Benthic invertebrates** **Maintenance workers**
Media:	**Sediment**
Risk Drivers:	DDx
Ancillary Tests:	TOC, Grain Size
Contingency Tests:	Food web model
Media:	**Surface Water**
Risk Drivers:	DDx
Field Tests:	Temperature, pH, Salinity, ORP, DO, and Depth
Contingent Test:	Food web model

Box 10-10

Figure 10-9
Wetland 6 and 7, Conceptual Site Model
UFP-SAP, OU1, OU2, and OU16 Wetlands
NAS Pensacola, Pensacola, Florida

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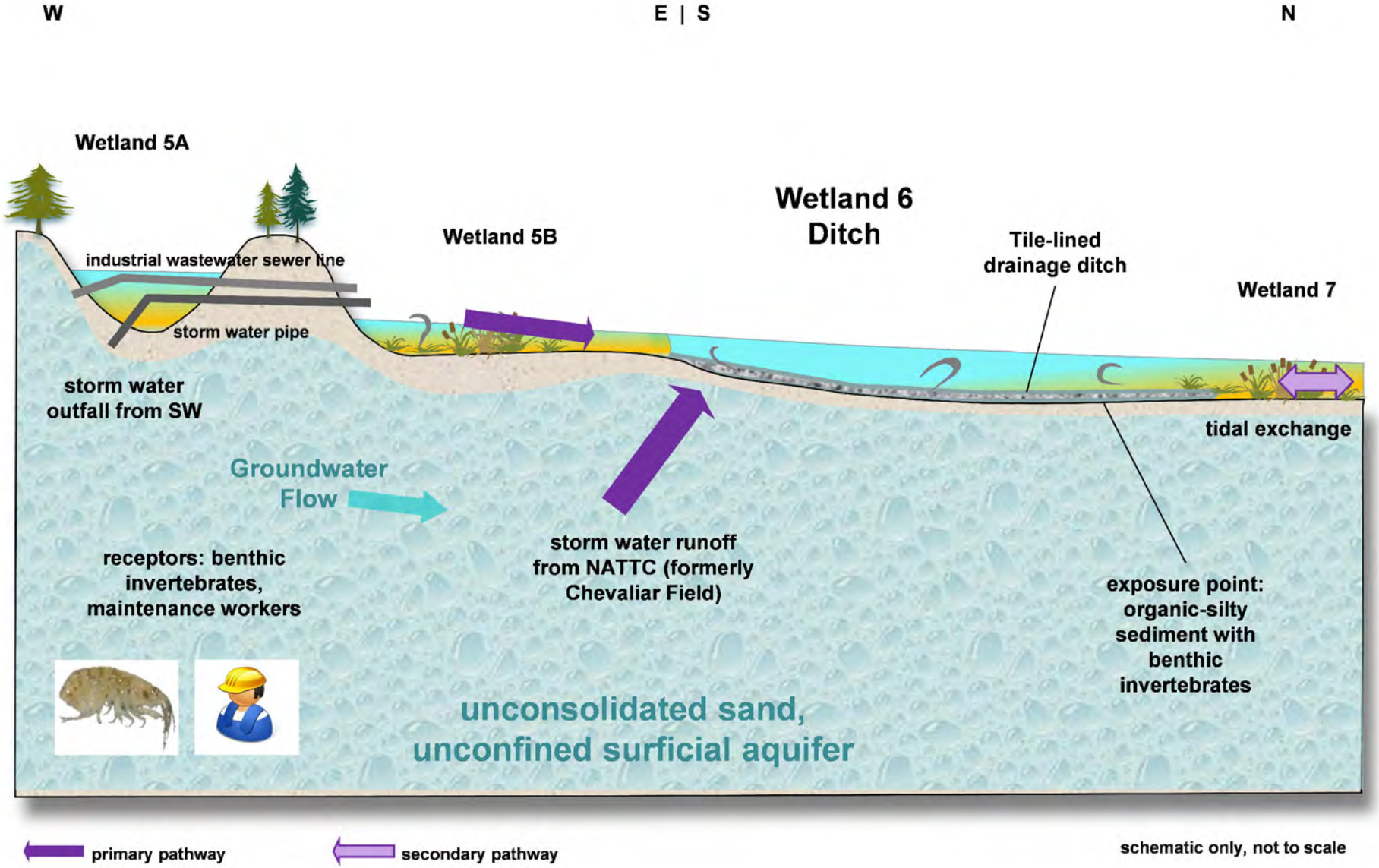

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10.5.3 Southern Portion of Wetland 7

The southern portion of Wetland 7 encompasses the downstream end of the tile-lined storm water drainage ditch (Wetland 6) that drains into the Yacht Basin. Wetland 7 is fed by Wetlands 5A, 5B, and 6, flows from south to north and ultimately discharges to Wetland 64 and the Yacht Basin. The wetland is a palustrine emergent marsh with open water that is bound by heavy vegetation. IR sites that are potentially affecting Wetland 7 include Site 10, OU 2 (Sites 11, 12, and 30) and OU 6 (Sites 9, 29, and 34). The northern portion of Wetland 7 is included in the Wetland 64 complex.

Sediments at Wetland 7 are composed of dark gray organic silt. Wetland 7 is inundated with surface water year round. Therefore, direct contact with sediment is excluded from the human health pathways assessed for Wetland 7. Potential receptors of the COCs in sediments are benthic invertebrates. Based on the depth of surface water, contact with surface water while wading would be the only likely exposure scenario.

The likely primary release mechanisms are from Wetland 6 and from surface runoff from adjacent OUs and sites.

Sampling at the southern end of Wetland 7 near Wetland 6 was added to the revised SAP based on U.S. EPA concerns with historical elevated DDT concentrations in sediment and the potential for migration of sediments to the downgradient Wetland 64 complex (Wetlands 7 [northern end], 8, and 64) raised during the March 2012 scoping meeting. Data needed to further characterize the wetland are provided in Box 10-11, and Worksheet #17 provides the sampling design and rationale. If bioaccumulative chemicals are detected at concentrations greater than those detected in the RI, food web models may be conducted for upper trophic level organisms. Evaluation of upper trophic level receptors will be contingent on the following: 1) identification of sediment concentrations that are greater than historical concentrations and 2) determination that extent of contamination is not an isolated area. Figure 10-9 illustrates the CSM for Wetland 7.

Southern Portion of Wetland 7 (OU 2)	
Special Feature:	**Freshwater Wetland**
Receptors:	**Benthic invertebrates** **Maintenance workers**
Media:	**Sediment**
Risk Drivers:	DDx
Ancillary Tests:	TOC, Grain Size
Contingency Tests:	Food web model
Media:	**Surface Water**
Risk Drivers:	DDx
Field Tests:	Temperature, pH, Salinity, ORP, DO, and Depth
Contingent Test:	Food web model

Box 10-11

10.5.4 Wetland 64 Complex (Wetlands 7 [Northern End], 8, and 64)

Wetland 64 is an approximately 41-acre saltwater wetland in the northeastern quadrant of the base. For the Site 41 RI, the Wetland 64 complex investigation incorporated adjacent freshwater Wetlands 7 (northern end) and 8; thus for this investigation, Wetland 64 complex will comprise Wetlands 7, 8, and 64.

Wetlands 5A and 5B contribute additional discharge to Wetland 6, which ultimately discharges into the Wetland 64 complex including Wetlands 7 and 8. Wetland 6 drains storm water runoff from the area directly around NATTC and the NAS Chapel. The NATTC was previously the Naval Aviation Depot or NADEP. Adjacent Wetland 7 encompasses the downstream end of the tile-lined storm water conduit (Wetland 6) that drains into the Yacht Basin. Adjacent Wetland 8 includes the western shore of Magazine Point.

The likely primary release mechanisms include storm water drainage, runoff, and surface soil transport from sites potentially affecting the Wetland 64 complex including: Site 10, OU 2 (Sites 11, 12, and 30), and OU 6 (Sites 9, 29, 34, and Wetland 6).

Wetland 64 Complex (OU 2)	
Special Feature:	**Saltwater Wetland**
Receptors:	**Benthic invertebrates**
Media:	**Sediment**
Risk Drivers:	TAL Metals, TCL SVOCs/PAHs, PCBs
Ancillary Tests:	TOC, AVS/SEM, Grain Size
Contingent Tests:	Toxicity, Food web model (OU-wide)
Media:	**Surface Water**
Risk Drivers:	TAL Metals, TCL SVOCs/PAHs, PCBs
Field Tests:	Temperature, pH, Salinity, ORP, DO, and Depth
Contingent Test:	Food web model

Box 10-12

The current CSM uncertainty is the vertical and horizontal extent of contamination where chemical concentrations were previously elevated. Data needed to further characterize the wetland are provided in Box 10-12, and Worksheet #17 provides the sampling design and rationale. Chemicals identified as risk drivers in Box 10-12 were not identified in the RI as COCs; however, they are being further characterized based on partnering team comments and regulatory concerns. If bioaccumulative chemicals are detected at concentrations greater than those detected in the RI, food web models may be conducted for upper trophic level organisms. Evaluation of upper trophic level receptors will be contingent on the following: 1) identification of sediment concentrations that are greater than historical concentrations and 2) determination that extent of contamination is not an isolated area. Figure 10-10 illustrates the CSM for the Wetland 64 complex.

Figure 10-10
Wetland 64 Complex, Conceptual Site Model
UFP-SAP, OU1, OU2, and OU16 Wetlands
NAS Pensacola, Pensacola, Florida

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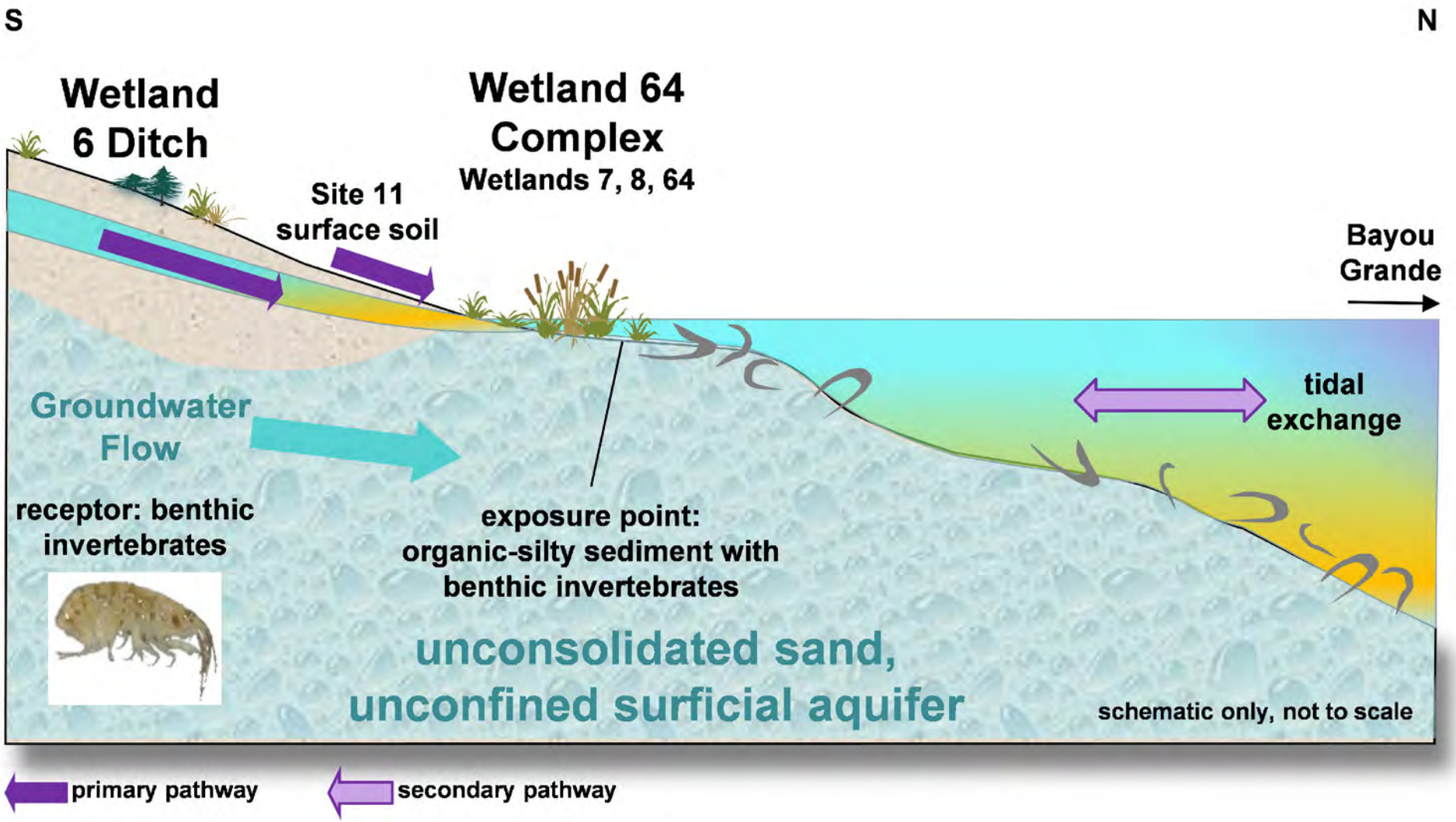

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10.6 Operable Unit 16 Conceptual Site Models

OU 16 includes three wetlands that were investigated during the RI and are not within the OU 1 and OU 2 boundaries. The wetlands of interest associated with OU 16 are Wetland 12, 48, and W2. CSMs for each wetland are presented below.

10.6.1 Wetland 12

Wetland 12, which is 0.4 acres, is south of the former industrial wastewater treatment plant (OU 10). Located at the industrialized southern end of Magazine Point, the shallow freshwater-forested Wetland 12 is fed by surface runoff and rainfall. The open water portion ranges from one to three feet deep and is inundated with cattails *(Typha* sp.*)*. The transition from open water to upland is very gradual and depends heavily on recent precipitation.

Soil was removed but confirmation sample results are not available, and although sediment samples were obtained immediately after the spill, a confirmation report is not available. The RI identified pesticides greater than reference values and metals exceedances occurred in surface water, but effects were not indicated by food web models. Nevertheless, because the Partnering Team found insufficient documentation of confirmation sampling, the site was included in this investigation to document and assess conditions in sediment.

The current CSM uncertainty is the vertical and horizontal extent of contamination where chemical concentrations were previously elevated. Data needed to further characterize the wetland are provided in Box 10-13, and Worksheet #17 provides the sampling design and rationale. If bioaccumulative chemicals are detected at concentrations greater than those detected in the RI, food web models may be conducted for upper trophic level organisms Evaluation of upper trophic level receptors will be contingent on the following: 1) identification of sediment concentrations that are greater than historical concentrations and 2) determination that extent of contamination is not an isolated area. Figure 10-11 illustrates the CSM for Wetland 12.

Wetland 12 (OU 16)	
Special Feature:	**Freshwater Forested Wetland**
Receptors:	**Benthic invertebrates**
Media:	**Sediment**
Risk Drivers:	pesticides
Ancillary Tests:	TOC, Grain Size
Contingency Test:	Food web model
Media:	**Surface Water**
Risk Drivers:	pesticides
Field Tests:	Temperature, pH, Salinity, ORP, DO, and Depth
Contingent Test:	Food web model

Box 10-13

Figure 10-11
Wetland 12, Conceptual Site Model
UFP-SAP, OU1, OU2, and OU16 Wetlands
NAS Pensacola, Pensacola, Florida

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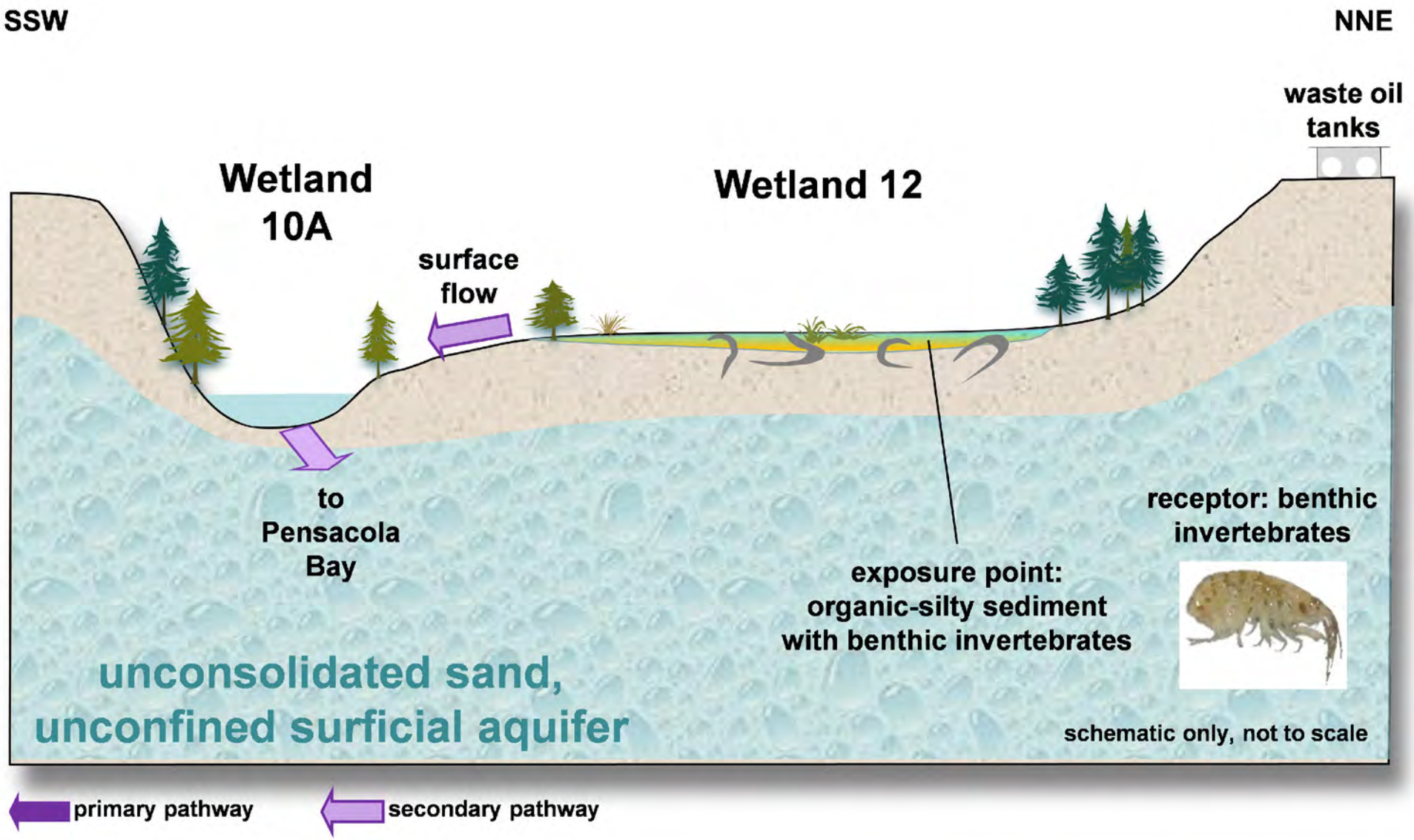

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10.6.2 Wetland 48

Wetland 48 lies south of the Fuel Farm in a largely undeveloped southwest portion of NAS Pensacola. It is a thickly vegetated palustrine forested freshwater wetland that appears to be fed by surface water and groundwater sources. Surface water drains to the east into Wetland 52, passing through a culvert under the access road to the fuel farm. Although a 1983 jet fuel spill may have impacted the site, previous sampling has shown elevated pesticide concentrations (DDD, DDE, and DDT), the source of which is unknown.

The current CSM uncertainty is the vertical and horizontal extent of contamination where chemical concentrations were previously elevated. Data needed to further characterize the wetland are provided in Box 10-14, and Worksheet #17 provides the sampling design and rationale. Food web modeling will be conducted for upper trophic level organisms. Figure 10-12 illustrates the CSM for Wetland 48.

Wetland 48 (OU 16)	
Special Feature:	**Freshwater Wetland**
Receptors:	**Benthic invertebrates, Upper trophic level receptors**
Media:	**Sediment**
Risk Drivers:	DDx
Ancillary Tests:	TOC, Grain Size
Contingent Test:	Food web model
Media:	**Surface Water**
Risk Drivers:	DDx
Field Tests:	Temperature, pH, Salinity, ORP, DO, and Depth
Contingent Test:	Food web model

Box 10-14

10.6.3 Wetland W2

Wetland W2, also known as the Southeast Drainage Ditch, drains surface and storm water from the northeastern end of Forrest Sherman Field and the Barrancas Cemetery area into the southern portion of Redoubt Bayou. The southwest portion of Wetland W2 also receives storm water drainage. The Wetland W2 drainage system receives surface water from the cemetery area via buried twin eight-foot diameter culverts, which pass under Taylor Road, emerging on the northwest side of Site 1 adjacent to Wetland 1. This feature continues to the southwest as an open drainage ditch for approximately 1,000 feet until it intersects Wetland W2 about 900 feet upstream from Redoubt Bayou. Wetland W2 is tidally influenced from Redoubt Bayou to this intersection. An active National Pollutant Discharge Elimination System permit location exists where the two ditches intersect. The IR sites potentially affecting Wetland W2 are Sites 5, 6, and 16. Wetland W2 contains emergent vegetation such as cattails (*Typha latifolia*) and duck potato (*Sagittaria* sp). Vegetation is periodically cleared from this system to facilitate free flow of water.

Figure 10-12
Wetland 48, Conceptual Site Model
UFP-SAP, OU1, OU2, and OU16 Wetlands
NAS Pensacola, Pensacola, Florida

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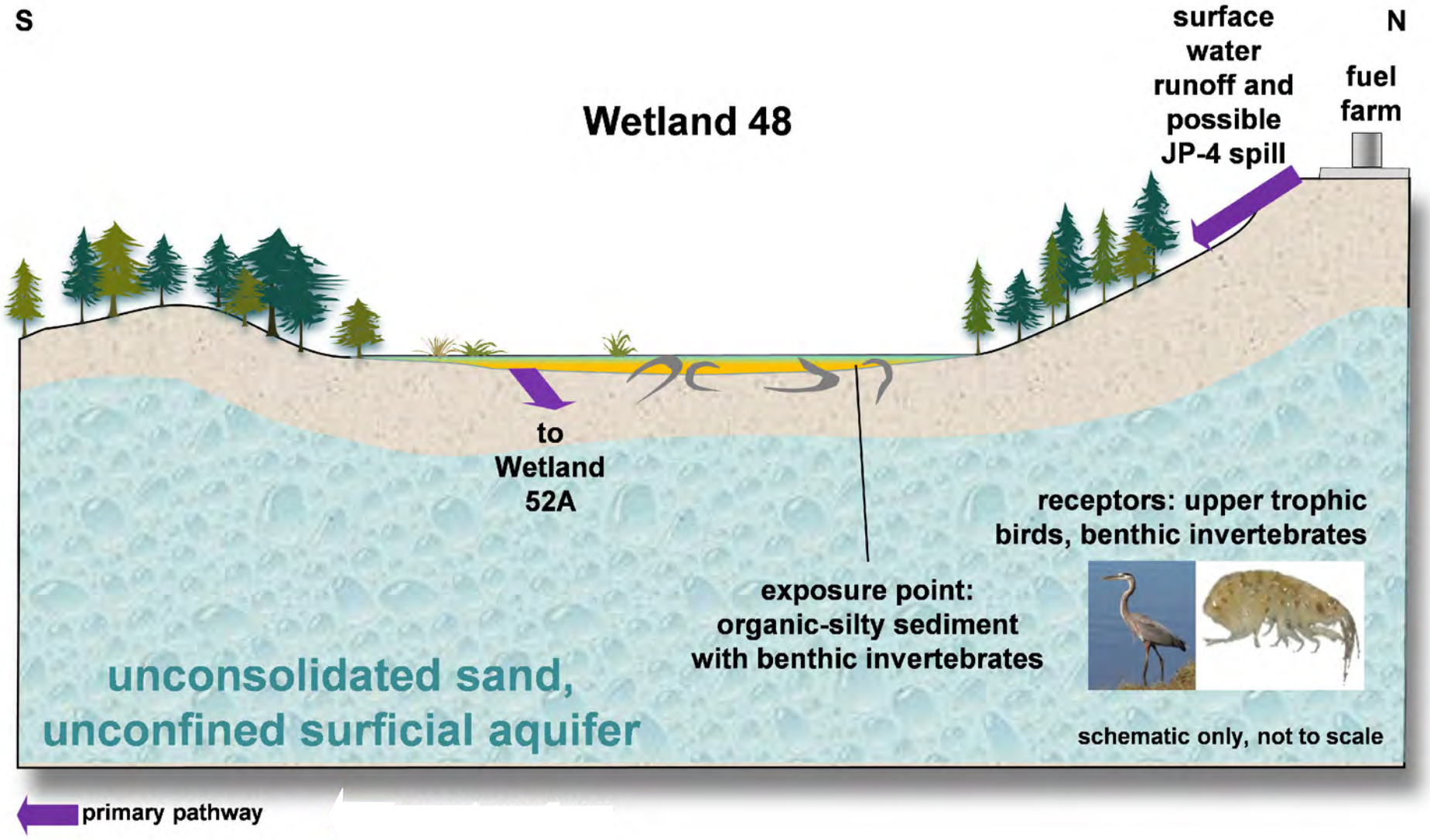

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Sediments at Wetland W2 are mostly composed of fine-grained sand to medium fine-grained sand. The sediment near Redoubt Bayou is mostly composed of dark brown silty sand with organics to brown poorly graded sand, medium, trace of silt.

Potential receptors of the COCs in sediments are benthic invertebrates. Based on the depth of surface water, contact with surface water while wading would be the only likely exposure scenario. Wetland W2 is in a restricted area of the base, the wetland is only accessible to Navy personnel.

The northern end of Wetland W2 was assessed during the OU 16 RI and was approved for NFA. Sampling at the western end of Wetland W2 was added to the revised SAP based on concerns with potential impacts along the western reach of the wetlands from the adjacent airfield and Sites 5, 6, and 16. Sites 5 and 16 were approved for NFA. The current CSM uncertainty is the horizontal and vertical extent of contamination. Data needed to characterize the wetland are provided in Box 10-15, and Worksheet #17 provides the sampling design and rationale. If bioaccumulative chemicals are detected at concentrations greater than those detected in the RI, food web models may be conducted for upper trophic level organisms. Evaluation of upper trophic level receptors will be contingent on the following: 1) identification of sediment concentrations that are greater than historical concentrations and 2) determination that extent of contamination is not an isolated area. Figure 10-13 illustrates the CSM for Wetland W2.

Southwest Portion of Wetland W2 (OU 16)	
Special Feature:	**Drainage Ditch/Storm Water Conveyance**
Receptors:	**Benthic invertebrates, Maintenance Worker**
Media:	**Sediment**
Risk Drivers:	TAL Metals, SVOCs, Pesticides/PCBs
Ancillary Tests:	TOC, Grain Size
Contingent Tests:	Toxicity, Food web model
Media:	**Surface Water**
Risk Drivers:	TAL Metals, SVOCs, Pesticides/PCBs
Ancillary Tests:	Hardness
Field Tests:	Temperature, pH, Salinity, ORP, DO, and Depth
Contingent Test:	Food web model

Box 10-15

Figure 10-13
Wetland W2, Conceptual Site Model
UFP-SAP, OU1, OU2, and OU16 Wetlands
NAS Pensacola Sites 5, 6, 16
NAS Pensacola, Pensacola, Florida

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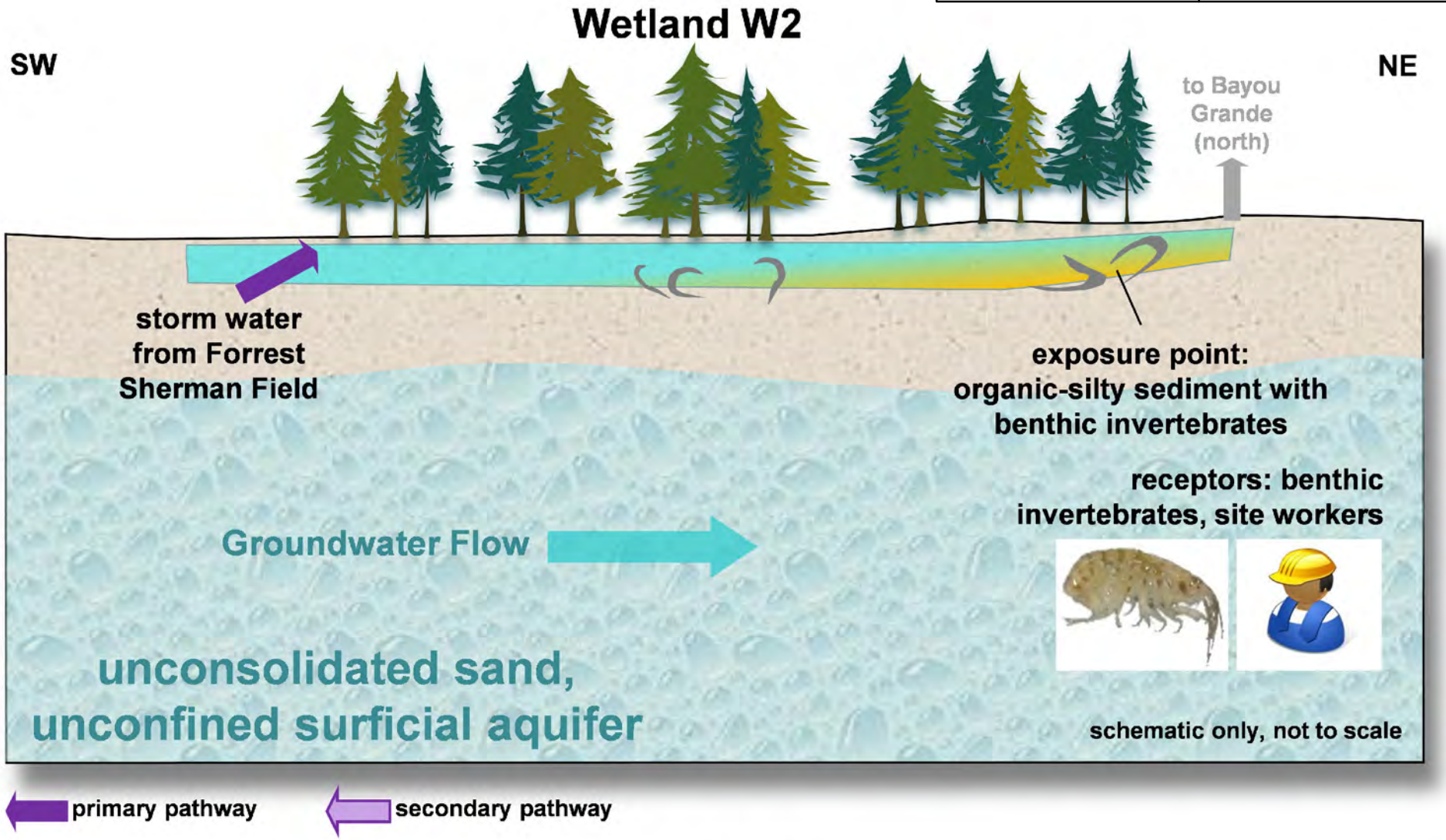

Note: northern end of W2 assessed during OU16 RI and approved for NFA

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SAP WORKSHEET #11: PROJECT QUALITY OBJECTIVES/SYSTEMATIC PLANNING PROCESS STATEMENTS

(UFP-QAPP Manual Section 2.6.1)

11.1 Problem Statement

Selected Wetlands
OU 1 — 1B, 3, 4D, 15, 18A, 18B
OU 2 — 5A, northern portion of 6, southern portion of 7, 64 Complex (northern portion of 7, 8, and 64)
OU 16 — 12, 48, W2

The 2007 RI report identified metals, PAHs, bis(2-ethylhexyl)phthalate, and pesticides in selected wetlands sediment at concentrations indicating potential excess risk primarily to benthic invertebrates and, in some wetlands, human health (site maintenance worker). Data are needed to further characterize naturally occurring conditions, characterize the horizontal and/or vertical extent of contamination in sediments of these wetlands, and update and refine assessments of ecological and human health risk. Sediment samples will be collected and analyzed to more precisely delineate areas where concentrations are elevated, to support further refinement of risk estimates, and to support design of a remedy that will cost-effectively reduce risks to acceptable levels. Surface water samples also will be collected for laboratory analysis to better characterize this medium, assess the groundwater to surface water interface at OU 1, and for use in food web models if needed. The results of these analyses will be summarized in separate OU-specific FS reports, and will be used to identify wetland areas to be addressed, potential cleanup levels, and remedial alternatives.

11.2 Identify the Goals of the Study

The overall focus of this investigation at selected wetlands is to provide sufficient current data to characterize the vertical and horizontal extent of contamination and to assess risk to ecological receptors (particularly benthic invertebrates) and, at some wetlands, human receptors (maintenance workers). The sampling design and rationale are site-specific and are based on the 2007 RI report, 2007 RI Addendum, and subsequent partnering team meetings. In general, the sampling design has eight general goals:

1. Collect additional background samples and calculate new background values.

2. Assess current conditions at locations identified in the RI as having PRG exceedances (EnSafe 2007; TetraTech 2012).

3. Assess the horizontal extent of sediment contamination near previous PRG exceedances and along expected migration paths within each wetland.

4. Assess the vertical extent of sediment contamination.

5. Characterize iron surface water contamination at OU 1 and, in those wetlands where concentrations are above background and project screening levels, perform laboratory toxicity testing if it is needed to refine ecological risk estimates.

6. Assess the toxicity of sediment and/or surface water to ecological receptors. In those wetlands where concentrations are above background and project screening levels, perform laboratory toxicity testing if it is needed to refine ecological risk estimates.

7. Assess the potential for bioaccumulation and food web effects on higher-trophic-level receptors based on comparisons with historical maximum sediment concentrations in the previous RI, as well as consideration of chemical-specific characteristics and food web transfer factors. If appropriate, use food web modeling to evaluate risk to receptors representing higher-trophic-level assessment endpoints.

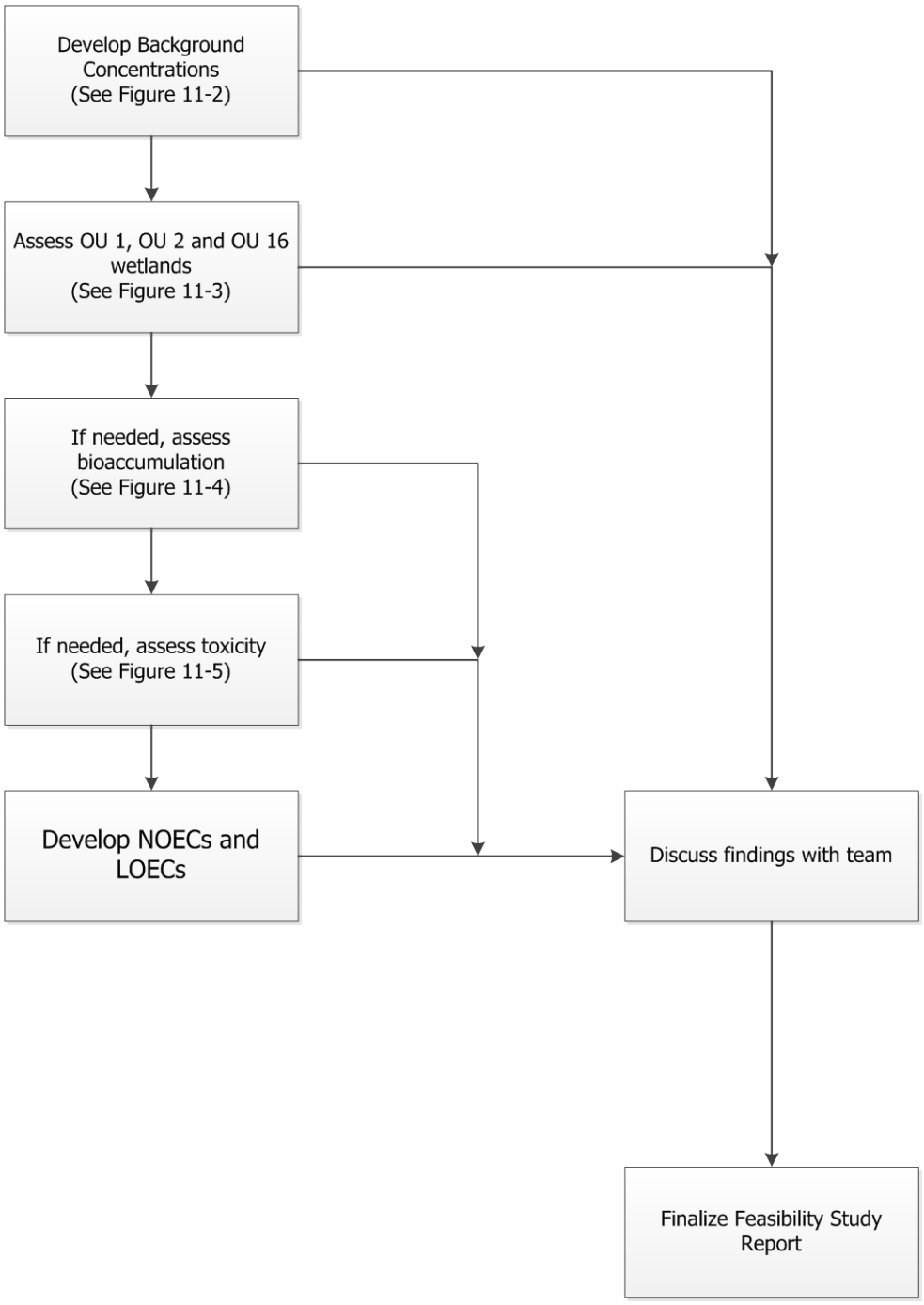
8. Develop PRGs for human health and ecological COCs, using current data and refined background concentrations, identified in this risk assessment. For human receptors and higher-trophic-level ecological receptors, back calculate site-specific PRGs based on acceptable risk levels. For benthic invertebrates, identify protective sediment concentrations from regulatory agencies or the scientific literature and, at wetlands where laboratory toxicity tests are performed, incorporate toxicity test results in the development of site-specific PRGs.

The investigation has been developed to address the principal study questions below. The process is shown in Figure 11-1.

1. Do concentrations in wetland sediment and surface water exceed revised background concentrations?

2. Is the CSM complete, including lateral and vertical extent of contamination transport mechanisms, etc. for surface water and sediment at OU 1, OU 2 and OU 16?

Figure 11-1
General DQO Approach Flowchart
OU 1, OU 2, and OU 16 Wetlands, NAS Pensacola



3. Do concentrations in wetland sediment and surface water exceed revised background?

4. Do concentrations in wetland sediment pose significant risk to ecological assessment endpoints?

5. Do concentrations in wetland sediment pose significant risk to human receptors?

6. Do concentrations in surface water pose significant risk to ecological assessment endpoints?

Data from the investigation will be used to refine the ecological risk assessment (ERA) and human health risk assessment (HHRA) for individual wetlands, or multiple wetlands within an OU, as warranted. If unacceptable risk is identified, remedial goals (RGs) will be developed for the COCs that are determined to pose risk and designated as ecological or human health COCs. The OU can then proceed to the FS phase. If excess risk is not identified for a given wetland or OU, the wetland or OU will be recommended for NFA.

11.3 Inputs to Problem Resolution

To resolve the problem statement above, the following information is needed:

- Chemical Data: Sediment and surface water samples will be analyzed for the site-specific select list of target analytes that are presented in Worksheet #18. The sampling methods that will be used are presented in Worksheet #21, and the analytical methods are presented in Worksheet #19. These data will be used for ecological and/or human health risk screening at specific wetlands as indicated in Worksheet #10. The data will be presented to the Partnering Team to allow for consensus on whether additional toxicity testing, food web modeling, and/or human health evaluations are required. Decision rules specified in this worksheet will guide determination of these additional evaluations. Sediment samples also will be analyzed for aluminum, TOC, grain size, AVS/SEM, and pH at select wetlands identified in Worksheet #10. As discussed below, these data will assist in characterizing sediment properties, evaluating geochemical relationships of inorganics, and assessing the bioavailability of chemicals in sediment.

— Aluminum — Simple linear regressions are run for the abundant reference metal aluminum against those metals that are of concern (e.g., arsenic, cadmium, chromium, and lead). In this case, the process is concerned with the relationship between real values of constituents; therefore, only actual detects are used. This type of statistical analysis derives a linear equation that describes the relationship between concentrations of a particular metal and concentrations of aluminum. The equation is graphically displayed as a trend line between the two metals. The degree of correlation (the coefficient of determination) is a measure of how much of the concentration variance in one metal can be explained by its co-occurrence with the other. Aluminum regression trend graphs will be used to assess outliers that may indicate potential wetland contamination. The trend analysis will be presented to the Team for identification of naturally occurring elevated concentrations or contamination.

— Total organic carbon (TOC) — TOC data provide an indication of the adsorption capacity of sediment. Sediments with greater TOC levels have a greater potential for certain chemicals, particularly organic compounds, to adsorb to organic carbon in sediment particles and become less bioavailable. TOC will be used to normalize bulk sediment chemical concentrations to the organic carbon content of the sediment. This will provide an estimate of the bioavailable component of the total concentration to be used in assessing the potential for adverse effects on benthic organisms.

— Acid-volatile sulfide/simultaneously extracted metals (AVS/SEM) — Comparison of the molar concentrations of AVS and SEM provides an indication of the potential bioavailability and toxicity of certain metals in sediment. AVS is a reactive pool of solid-phase sulfide that represents an important partitioning phase controlling the bioavailability and toxicity of cadmium, copper, lead, nickel, silver, and zinc to sediment-associated biota. These six metals, collectively referred to as SEM, represent those metals that form a more stable complex with sulfide than does iron. According to the model, if the SEM concentration is less than the AVS concentration, these six metals are bound to sulfide in the solid phase rather than being dissolved in sediment pore water. As a result, they are not bioavailable. Thus, if the SEM/AVS ratio is less than 1.0 or the SEM — AVS difference is less than zero (i.e., a negative value), sufficient AVS is available to bind all the SEM, and sediment-associated biota will not be exposed to toxic concentrations of these metals in the sediment pore water (Hansen et al. 2005).

Equilibrium-partitioning sediment benchmark (ESB) comparisons based on SEM — AVS data will be used as one line of evidence in a weight-of-evidence approach by which the Partnering Team will determine if toxicity testing of sediment at a given wetland location is warranted.

— pH — pH data provide an indication of the acidity or basicity of sediment. Hurricane Series soil have an acid pH between 3.5 and 6 (USDA 1997) and pH data will be used to assess whether OU 1 sediment is influenced by Hurricane Series soil.

- Toxicity Testing: Toxicity testing will be conducted where needed to address uncertainty associated with the results of the assessment of the chemistry data. If the decision is made that toxicity testing is to be conducted at a given wetland location, then full scan[2] analyses (except for VOCs) will be performed on sediment samples collected in conjunction with toxicity testing.

- Field Parameters: To better characterize subject wetlands, the following field parameters will be collected for surface water (if present): temperature, pH, salinity, dissolved oxygen (DO), oxidation-reduction potential (ORP), and surface water depth.

- Sample Location Data: Sample location horizontal coordinates and vertical depths must be measured so that data can be analyzed and presented in a spatial context. Horizontal coordinates will be measured using a hand-held global positioning system (GPS). Depth intervals will be measured using a tape measure or other device with similar accuracy and precision.

Background Data: Background concentrations are considered to be levels of naturally occurring chemicals in the environment that have not been influenced by human activities, as well as levels of anthropogenic (non-naturally occurring) chemicals that are present in the environment due to human activities not related to the site. Comparison to background concentrations will be used to distinguish COCs from background chemicals and to determine background levels of COCs with both site-related and background sources.

[2] Full scan analysis includes the following: target analyte list metals, target compound list semivolatile organic compounds, target compound list pesticides, and polychlorinated biphenyl compounds.

Coupled surface water/sediment samples will be collected from six reference wetlands (two from each general type — freshwater, saltwater, and Hurricane Series soil). The resulting data will be compiled and compared to the historical data from the reference wetlands as an initial qualitative measure. The historical data and the recent data will then be compared quantitatively to determine if there are significant differences between them, using statistical tests such as Kolmogorov-Smirnov or Wilcoxon Mann-Whitney at a 95% confidence level. If there are significant differences, then only the recent data will be utilized for further evaluations. If there are not, then the two datasets will be combined and used in total for subsequent evaluations. It is anticipated that subsequent evaluations will consist of population analyses (where the individual parameter is the only variable), and/or multivariate analyses such as normalization regressions or principal component analysis. Background data qualified as non-detect will be evaluated at one-half of the limit of quantitation.

The revised background data set will be used to determine whether chemicals detected at the wetlands are site-related following the methods contained in Navy's Background Guidance (*Guidance for Environmental Background Analysis, Volume II: Sediment*, April 2003). Background concentrations will be calculated for metals, SVOCs, and pesticides. As was established during the RI, the base-wide total DDT background concentration of 110 µg/kg, will be used for DDD, DDE, and DDT. The base-wide level will be re-evaluated with background data collected during this investigation.

COCs present on site at concentrations less than background concentrations will not be recommended for further action or evaluation.

Project Screening Levels: Project screening levels are chemical concentrations to which the site analytical data will be compared to determine the need for additional sampling and to evaluate potential risk. Data will be compared to multiple screening values including background concentrations, media-specific screening values, and PRGs provided in the 2012 Technical Memorandum (TetraTech, 2012).

PRGs developed as part of the Technical Memorandum were the greatest value among background/reference concentrations, sediment screening levels, sediment refinement levels, and site-specific no-observed-effects concentrations (NOECs) or lowest-observed-effects concentrations (LOECs). These historical PRGs were developed for either single wetlands or groups of wetlands, depending on the similarity of the wetlands. Updated site-specific PRGs for the wetlands addressed in this investigation will be determined based on an evaluation of the most recent chemistry and toxicity data, which will be collected during this investigation.

To help the team determine which vertical and/or horizontal step-out sample locations will be analyzed for sediment, concentrations will be compared to the following: 1) Historical PRGs, 2) FDEP Threshold Effect Concentration (freshwater sediment) or Threshold Effect Level (salt water sediment); 3) FDEP PEC (freshwater sediment) or PEL (salt water sediment). If PRGs or FDEP values are not available, comparisons will be made to values from the following sources: 4) U.S. EPA's ECOTOX database; 5) National Oceanic and Atmospheric Administration (NOAA) Screening Quick Reference Tables; and 6) U.S. EPA Region 4 Sediment Screening Values from the 2001 Ecological Risk Assessment Bulletins. Comparisons will also be made to available sediment reference concentrations. Each of the screening or reference value comparisons contributes to a line of evidence determination regarding potential risk at the site. The individual target analytes and screening levels are presented in Worksheet #15. Decisions regarding the need for additional data to determine the extent of contamination will be made by the partnering team.

For surface water, the detected concentrations will be compared to the following: 1) FDEP Class III chronic Surface Water Quality Criteria (freshwater or saltwater-specific). If FDEP values are not available, comparisons will be made to values from the following sources: 2) U.S. EPA Region 4 Surface Water Screening Values from the 2001 Ecological Risk Assessment Bulletins; 3) U.S. EPA's Biological Technical Assistance Group Surface Water Screening Values; and 4) NOAA Screening Quick Reference Tables. Each of the screening or reference value comparisons contributes to a line of evidence determination regarding potential risk at the site. The individual target analytes and screening levels are presented in Worksheet #15.

Analytical methods were chosen that would achieve the best detection limits to answer the study questions. Good faith efforts were undertaken to ensure that contaminants can be measured at the lowest achievable levels for the applied method. However, in some cases, current technology used by the analytical methods cannot achieve all of the screening levels. Therefore, in general, non-detected values that are greater than screening levels will not be considered for additional step-out and toxicity sampling. If all detected analytes are less than screening levels for a sample, the detection limits for the non-detects will be evaluated to ensure they are less than screening levels. If detection limits exceed screening levels but the elevation is due to instrument limitations, no further evaluation will be considered (e.g., no additional sampling; no step-out samples). If detection limits are elevated due to sample dilutions and not the result of instrument limitations, the data will be further evaluated to determine the suitable path forward.

Discussion will be provided in the text regarding associated uncertainties of elevated detection limits as appropriate.

11.4 Definition of the Boundaries of the Study

NAS Pensacola, which occupies approximately 5,800 acres, is bound by Bayou Grande to the north and Pensacola Bay to the east and south. To the west, the land changes to residential and less developed swampy lowlands, forests, and beaches. NAS Pensacola's eastern portion is largely developed with military and industrial facilities and historical/cultural sites. Most of the installation's activities are on the eastern side of the base. OU 16 originally encompassed all of the wetlands potentially impacted by site activities within the NAS Pensacola boundary, while the focus of this study is within the specific boundaries of the wetlands being investigated. The selected wetlands are now grouped by their associated terrestrial sites. Wetlands associated with OU 1 include 1B, 3, 4D, 15, 18A, and 18B. Wetlands associated with OU 2 include 5A, 6, 7, and 64. OU 16 wetlands include 12, W2, and 48. Reference wetlands (25A, 27A, 27B, 32, 33, and 70A) will also be assessed for during this study.

The target sediment interval is from 0 to 24 inches below the sediment surface at locations that exhibited elevated concentrations during the RI. The sediment depth of greatest interest from an ecological perspective is sediment at 0-4 inches below the ground/sediment surface (bgs) because this is the most biologically active zone for benthic invertebrates. Samples collected at intervals between 4 and 24 inches bgs will be used to delineate the vertical extent of contamination and assess whether the area is naturally capped or whether remedial action is necessary. Temporal changes will not significantly affect the outcome of the investigation. Sediment sampling will be dependent on weather conditions such as significant rainfall events.

11.5 Analytic Approach

The following decision rules have been developed for the multiple phases of investigation/data evaluation that will occur during the wetlands field activities. As stated in Section 11.2, OU 1, OU 2, and OU 16 will be evaluated separately using the decision rules outlined in this analytic approach. Different outcomes may be recommended for each OU.

11.5.1 Determination of Background

Reference Wetlands
Freshwater — 32, 70A
Saltwater — 27B, 33
Hurricane Series soil — 25A, 27A

Initial field activities will include sampling of reference wetlands to compile new background datasets for metals, SVOCs, and pesticides. As discussed previously in Section 10, some impacted wetlands are underlain by an iron-rich, low-pH (3.5 — 6 standard unit) soil type (the Hurricane Series soil) which may present different native sediment/surface water chemistry. Background samples will be collected from two freshwater wetlands, two estuarine wetlands, and two wetlands with Hurricane Series soil that have not been impacted by site activities. Every effort was made to differentiate freshwater and saltwater wetlands for background; however, field measurements using a refractometer will be collected before sample collection to ensure the samples are representative of freshwater or saltwater. Background samples will be collected for both sediment and surface water. Sediment samples will be collected from up to five locations within each wetland and will be collected from depths of 0-4 inches bgs, 4-12 inches bgs, and 12-24 inches bgs at each location. The decision rule process, also shown in Figure 11-2, is as follows:

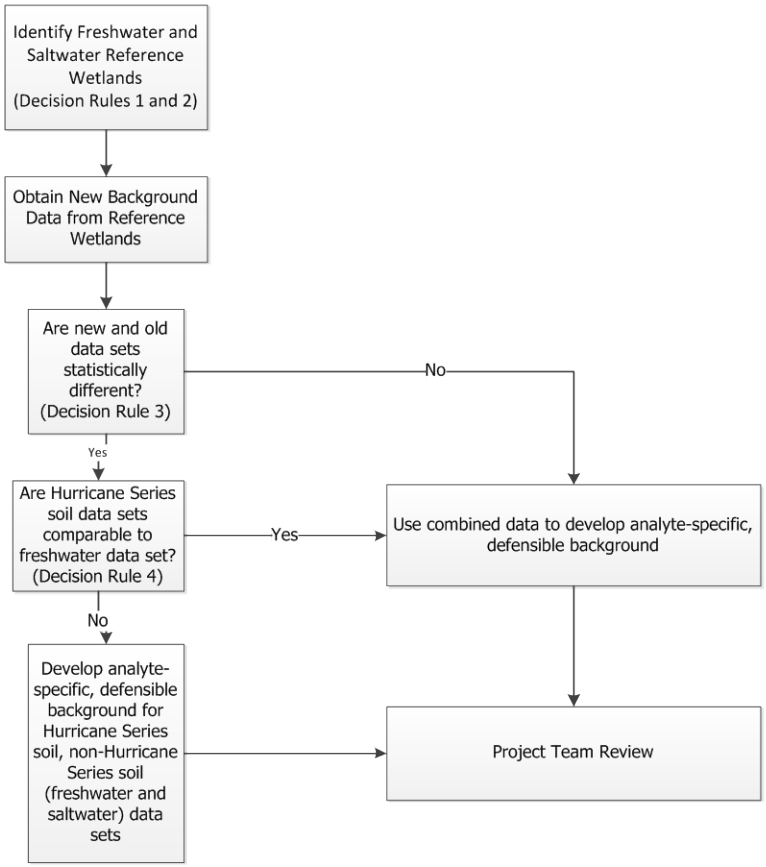
Decision Rule #1 — If a wetland is partially saltwater as shown by the A/B designation, then determine the freshwater/saltwater interface; determine appropriate background locations.

Decision Rule #2 — If a reference wetland is in the Hurricane Series soil type, then determine appropriate background sample locations and mark sample locations appropriately for future use in background calculations.

Decision Rule #3 — If freshwater and saltwater background data are statistically comparable to the historical freshwater/saltwater background data, then the historical and current datasets will be merged into a comprehensive dataset. If the data are not comparable, then only the current dataset (collected under the protocols outlined in this SAP) will be used for calculating background concentrations.

Decision Rule #4 — If Hurricane Series soil wetlands freshwater background data are statistically comparable to non-Hurricane Series soil freshwater background datasets, then the wetlands datasets will be merged. If the Hurricane Series soil wetlands data are statistically different than freshwater background values, then Hurricane Series soil background values will be calculated.

Figure 11-2
Background Evaluation Flowchart
OU 1, 2, and 16 Wetlands, NAS Pensacola



The revised background data set will be used to determine whether chemicals are site-related following the methods contained in the Navy's Background Guidance (Guidance for Environmental Background Analysis, Volume II: Sediment, April 2003).

11.5.2 Refinement Wetland 3CSM

To supplement the CSM refinement at Wetland 3, the following decision rule has been developed.

Decision Rule #5 — If supplemental physical, hydrogeological, and geochemical data are sufficient to characterize seepage and transport into Wetland 3, then conclude investigations and revise the CSM. If not, then identify data gaps and present sampling approach to the Partnering Team for approval.

11.5.3 Refinement of Extent

As supported in Worksheet #10 and in Sections 11.1 and 11.2, the goals of the focused investigation activity include assessing extent of contamination, for use in determining extent and in supplementing remedial alternative development. To this end, targeted investigations have been developed to refine the extent of contamination within each wetland. The process to evaluate analytical results is outlined in Figure 11-3.

Decision Rule #6 (Sampling Phase I) — Primary sediment sample locations and horizontal step-out locations at 0-4 inches bgs will be collected. Primary samples will be analyzed first.

If primary sediment sample locations at 0-4 inches bgs have chemical concentrations that exceed background and screening levels, then horizontal step-out sample locations that are directly adjacent to primary location exceedances will be analyzed at 0-4 inches bgs.

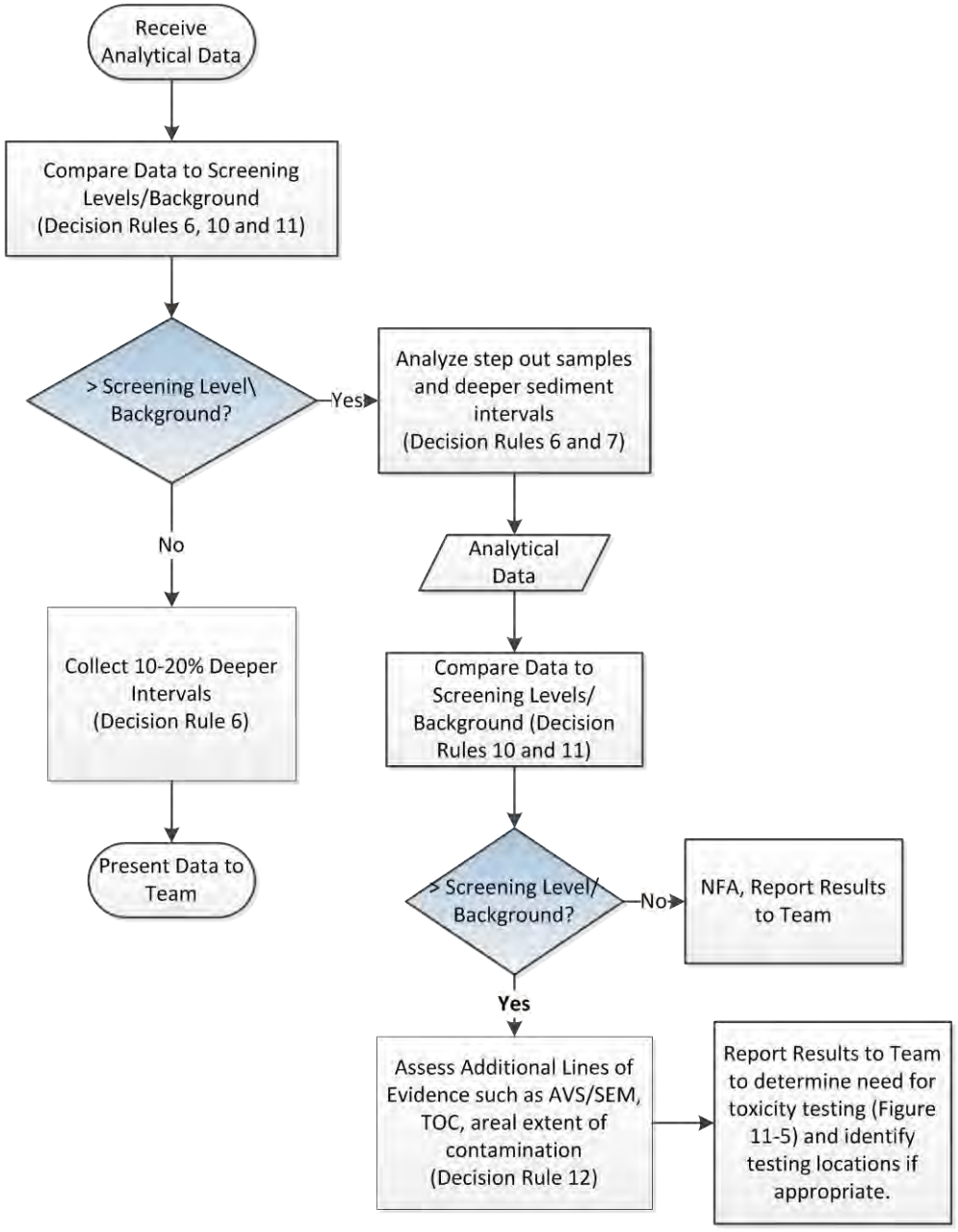
Decision Rule #7 (Sampling Phase II) — If chemical concentrations of primary sediment sample locations at 0-4 inches bgs do not exceed background and screening levels, then between 10 and 20 percent (a minimum of one) will be sampled at vertical step-outs at 4-12 inches bgs and 12-24 inches bgs. These deeper samples will be collected and analyzed to document subsurface sediment conditions and determine if natural capping is occurring.

If background and screening levels are exceeded in the analytical results of primary and horizontal step-out samples, then the associated vertical step-out sediment samples will be collected at these locations at 4-12 inches bgs and 12-24 inches bgs. Sediment samples at 4-12 inches bgs will be analyzed first.

If chemical concentrations from horizontal step-out locations at 4-12 inches bgs are greater than background and screening levels, then the deeper depth of 12-24 inches bgs will be analyzed to determine the vertical extent of contamination.

Decision Rule #8 (Surface Water Sampling) — If surface water is present, then surface water samples will be collected at the sampling locations and frequencies identified in Worksheet #18.

Figure 11-3
Evaluation of Analytical Results
OU 1, 2, and 16 Wetlands, NAS Pensacola



Decision Rule #9 (Human Health CSM) — If current site information regarding land use and other information in the CSM indicates 1) sediment is not constantly under water, 2) maintenance workers could be exposed to site media, and 3) sediment concentrations are greater than historic maximum sediment concentrations reported in the 2007 RI, then the maintenance worker receptor will be evaluated as part of the HHRA. Otherwise, human health risk to maintenance workers will not be evaluated.

Project screening levels and toxicity data collected during the multi-phase extent/CSM field activities will be screened against refined background values. The following decision rules will be used to determine the need for comparing against screening levels, bioaccumulation assessment, and subsequent toxicity testing.

Decision Rule #10 — If surface water or sediment concentrations in a wetland exceed background/reference concentrations, then comparing against screening levels is required. Otherwise, concentrations that do not exceed background levels will not be considered further. (Note — only constituents that exceed background levels will be carried forward. If no constituents exceed background, the wetland will be recommended for NFA.)

Decision Rule #11 — If a wetland is in a Hurricane Series soil type, the same process outlined in Decision Rule #9 will be followed, but background levels specific to Hurricane Series soil will be used.

Decision Rule #12 — If surface water or sediment concentrations exceed ecological screening levels identified in Worksheet #15, then additional lines of evidence will be considered in assessing the detected concentrations. These lines of evidence include AVS/SEM, TOC, and areal extent and magnitude of exceedances. Risk to the assessment endpoints will be evaluated using such lines of evidence to characterize risks and determine their ecological significance. Based on this risk characterization, the wetland may be recommended for further evaluation, possibly including toxicity testing. If COCs are not identified for the wetland, the wetland will be recommended for NFA.

Sources for Screening Levels
- FDEP
- NOAA
- U. S. EPA
- Historical, site-specific effects levels
- Reference Concentrations

Decision Rule #13 — Food web modeling will be performed at Wetland 48. In addition, if concentrations of bioaccumulative contaminants are greater than historical maximum sediment concentrations previously evaluated in the 2007 RI, then food web modeling may be employed at other wetlands. Food web models would be evaluated on a wetland-specific basis. Evaluation of upper-trophic-level receptors will be contingent upon the following: 1) identifying concentrations in new data that are greater than historical concentrations, and 2) determining that the extent of contamination is greater than an isolated area or potential hot spot. The process for assessing bioaccumulation is illustrated in Figure 11-4.

If these conditions are met and bioaccumulative contaminants are present at concentrations greater than the historical maximum sediment concentrations evaluated in the previous ERA, then food web models will be conducted.[3]

If concentrations reported for the proposed sediment samples are less than historical maximum sediment concentrations in the RI or data are indicative of an isolated hot spot, then no food- web or bioaccumulation effects will be evaluated.

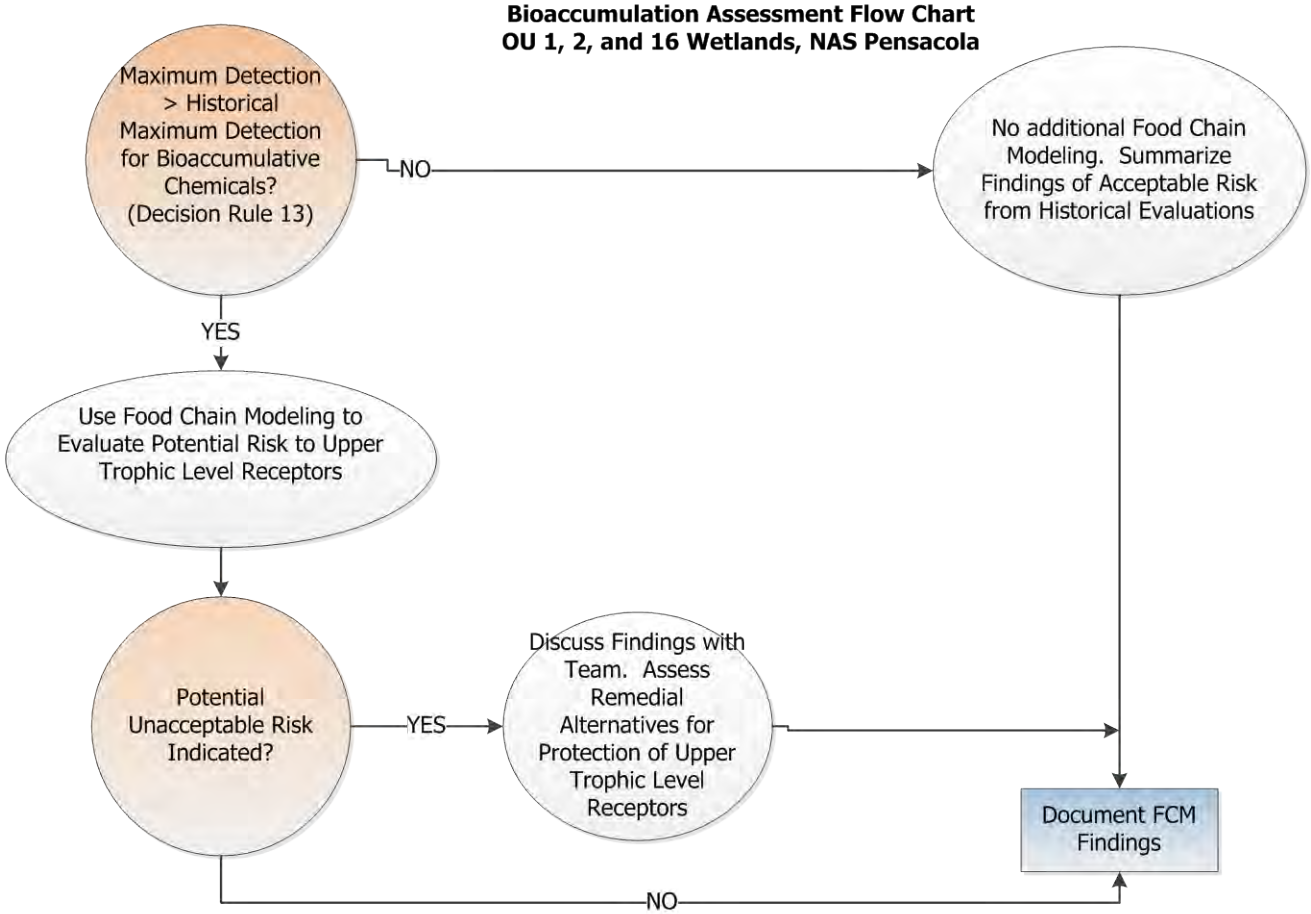
11.5.5 Determination of Need for Toxicity Testing

Data will be evaluated using a line-of-evidence approach to determine the need for toxicity testing. Recommendations to the Partnering Team will identify the wetlands and media that require toxicity testing and will identify specific locations for sampling. The process for assessing toxicity is outlined in Figure 11-5.

Lines-of-Evidence
- Screening results
- Historical data
- Risk estimates
- Number and extent of exceedances
- AVS/SEM
- TOC

[3] If food chain and bioaccumulation effects are evaluated, the models and methods described in Appendix D will be used. Otherwise, these methods will not be applicable and will not be used.

Figure 11-4
Bioaccumulation Assessment Flow Chart
OU 1, 2, and 16 Wetlands, NAS Pensacola

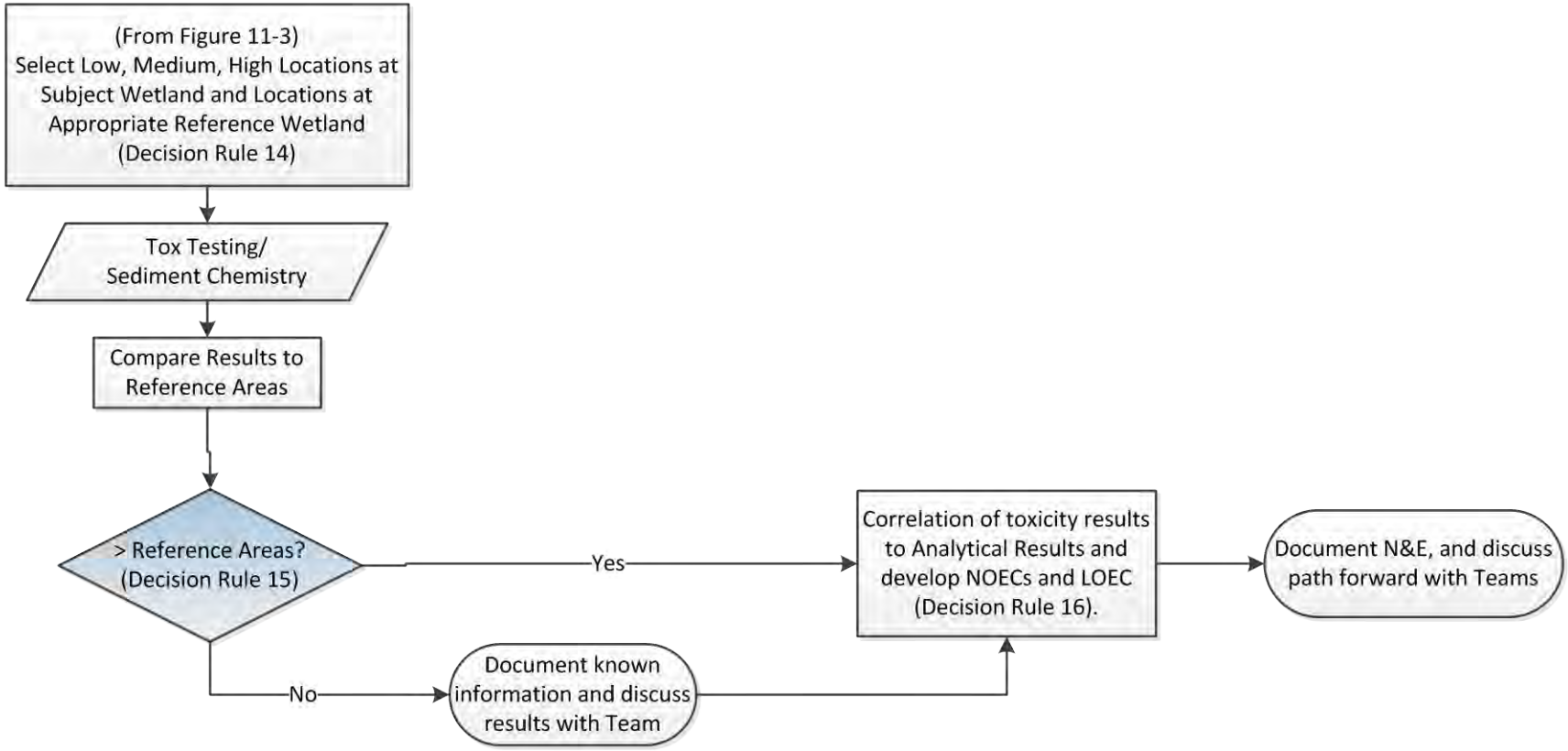


The need for toxicity testing to further evaluate detections at a particular wetland will be based on factors that include the following:

Exceedances of screening levels, including:

- Number of samples with exceedances
- Number of chemicals that exceed
- Spatial distribution of samples with exceedances
- Magnitude of exceedances
- Similarity of site concentrations to reference concentrations
- Bioavailability of chemicals as indicated by AVS/SEM and normalization to TOC

Figure 11-5
Evaluation of Toxicity Results
OU 1, 2 and 16 Wetlands, NAS Pensacola



Decision Rule #14 — If toxicity testing is required, then also identify appropriate reference locations for toxicity testing based on background data and other field findings.

Upon concurrence of the Partnering Team, the anticipated sediment sample analyses will include toxicity testing and full scan chemical analysis (except VOCs) of sediment from a maximum of three locations per wetland at a depth of 0 to 4 inches bgs.[1] The sample locations for toxicity testing will represent the maximum, minimum, and intermediate sediment concentrations from the area of concern in a given wetland. In addition, toxicity tests will be conducted on sediment from the reference wetlands.

If sediment toxicity testing is needed, the test organisms and toxicity testing endpoints identified in the technical memorandum will be used (TetraTech 2012). Analysis of freshwater sediments will be performed in accordance with U.S. EPA Test Method 100.4, a 42-day test using the freshwater amphipod *Hyallella azteca* to measure effects on survival, growth, and reproduction. For estuarine wetlands, the U.S. EPA method for assessing the chronic toxicity of marine and estuarine sediments with the amphipod *Leptocheirus plumulosus* in a 28-day chronic test (described in document EPA 600/R-01/020) will be used to evaluate effects on survival, growth, and reproduction.

If warranted, surface water samples from Wetland 3 as well as Hurricane Series soil reference wetlands will be submitted for toxicity testing. Locations tested will be selected based on prior investigation findings to represent low, medium, and high contaminant concentrations if possible. Filtered and unfiltered surface water samples will be submitted for full suite (except VOCs) analysis. Toxicity testing of freshwater will be performed in accordance with U.S. EPA Test Method 1002.0, a 7-day test using a freshwater crustacean, the daphnid *Ceriodaphnia dubia*, to measure effects on survival and reproduction.

Surface water samples from other wetlands of concern as well as appropriate reference wetlands will be submitted for toxicity testing. Locations tested will represent maximum, minimum, and intermediate concentrations of COCs based on prior investigation findings. Toxicity testing of freshwater will be performed as described above. Toxicity testing of estuarine water will be performed in accordance with U.S. EPA Test Method 1007.0, a 7-day test using a

[1] Full scan analysis includes the following: target analyte list metals, target compound list semivolatile organic compounds, target compound list pesticides, and polychlorinated biphenyl compounds.

saltwater crustacean, the mysid shrimp *Mysidopsis bahia*, to measure effects on survival, growth, and fecundity (egg development).

Lab control data will be used to determine if the test methods are acceptable, and comparisons to reference area toxicity will be used to determine if site-specific toxicity differs from toxicity observed in reference areas. The testing laboratory will compare results for site wetlands to reference areas in accordance with standard statistical methods to determine if differences are significant. Site toxicity data will be compared to the reference area most representative of the particular site (i.e., saltwater, freshwater, Hurricane Series soil). Wetlands 32 and 70A are freshwater reference wetlands, Wetlands 27B and 33 are estuarine reference wetlands, and Wetlands 25A and 27A are Hurricane Series soil reference wetlands, as indicated in Worksheet #17.

If site lethal or sublethal effects are significantly greater than reference area effects, additional lines of evidence will be considered to identify potential causal factors. Data will be evaluated for potential correlations with analytical chemistry results. The spatial distribution of chemicals exceeding screening values and professional judgment regarding the ecological significance of potential adverse effects on benthic invertebrates that could affect the food web or community will also be considered when characterizing ecological risk.

11.5.6 Evaluation of Toxicity Testing Results

Decision rules for evaluating toxicity test results and ecological risk assessment data evaluation are shown below. Data will be evaluated using a line-of-evidence approach, incorporating toxicity testing results with prior analytical data, food web models, etc.

Decision Rule #15 — If laboratory toxicity test results indicate adverse effects in site samples relative to reference area samples, then proceed to Decision Rule #16. If site toxicity results are not significantly greater than reference toxicity results, then use the lack of significant toxicity as a line of evidence to reduce risk estimates when characterizing ecological risk.

Decision Rule #16 — If site wetland toxicity exceeds reference wetland toxicity, then evaluate correlations between toxicity and analytical data to identify NOECs and LOECs for consideration when developing PRGs based on the risk assessment. If no correlation is present, then re-evaluate toxicity evaluation approach — additional sampling and assessment may be needed.

The line of evidence approach outlined above may result in multiple outcomes, as summarized in Table 11-1:

Table 11-1
Line of Evidence Toxicity Approach

Line of Evidence:	Result	Potential Unacceptable Risk?	Comments
Media Screening Sediment	Detection > Project Screening Levels	Yes	Consider bioaccumulation potential (AVS/SEM, TOC), nature and extent of contamination. Decision point regarding need for sediment toxicity testing.
	Detection < Project Screening Levels	No	NFA for benthic receptors is supported; no sediment toxicity testing recommended.
Media Screening Surface Water	Detection > Project Screening Levels	Yes	Consider nature and extent of contamination. Decision point regarding need for surface water toxicity testing.
	Detection < Project Screening Levels	No	NFA for benthic receptors is supported; no surface water toxicity testing recommended.
Food Web Modeling	New data maximum < Historical maximum	No	No food web modeling required. NFA for upper trophic level receptors is supported based on Remedial Investigation.
	Hazard quotients > 1.0	Yes	Decision point regarding need for FS protective of upper trophic level receptors (consider magnitude of hazard quotients, spatial distribution of COCs, uncertainties).
	Hazard quotients < 1.0	No	NFA for upper trophic level receptors is supported
Toxicity Testing	Site toxicity ≤ Reference area toxicity	No	Acceptable risk to community represented by toxicity test species is supported (NFA supported).
	Site toxicity > Reference area toxicity	Yes	Evaluate correlations with COCs.
	Site toxicity correlated with chemical concentrations	Yes	FS recommended; NOEC and LOEC identified from toxicity data.
	Site toxicity not correlated with chemical concentrations	Yes, additional evaluation may be warranted	FS recommended; NOEC and LOEC potentially identified from toxicity data.

Notes:

AVS/SEM	=	Acid volatile sulfide and simultaneously extracted metals			
TOC	=	Total organic carbon	COC	=	Chemical of concern
NFA	=	No further action	NOEC	=	No Observed Effects Concentration
FS	=	Feasibility study	LOEC	=	Lowest Observed Effects Concentration

11.7 Performance Criteria

The objective of this section is to complete the following:

- Identify potential sources of study error (i.e., field error, analytical error)
- Establish and identify the methods used to reduce potential sources of error
- Determine how decision errors will be managed during the project

Sampling Strategy

The sediment sampling design was developed to characterize the extent of contamination and refine ecological and human health risk evaluations.

Sources of Error

Sources of error may be divided into two main categories: sampling errors and measurement errors. A sampling error occurs when the sampling design, planning, and implementation do not provide for a representative range of heterogeneity at the site. A measurement error occurs because of performance variance from analytical/toxicity laboratory instrumentation, analytical methods, and operator error. The U.S. EPA identifies the combination of all these errors as a "total study error" (U.S. EPA 2006). One objective of the investigation is to reduce the total study error so that decision-makers can be confident that the data collected accurately represent the chemical characteristics of the site.

Managing Decision Error

The investigation will use decision-error minimization techniques in sampling design, sampling methodologies, and laboratory measurement of COCs. Possible decision errors will be minimized during the field investigation by using the following methods:

- Use standard field sampling methodologies (as discussed in Worksheets #18 and #21).
- Use applicable analytical methods and standard operating procedures (SOPs) for sample analysis by a competent analytical laboratory having National Environmental Laboratory Accreditation Program (NELAP) accreditation in Florida and accredited through the Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP), as appropriate.
- Laboratory error will be assessed using spikes and blanks, and sampling error will be assessed using duplicates.

Decision errors associated with judgmental sampling are based on sample design and measurement errors. Assuming that the best possible professional judgment was used to develop the judgmental sampling plan (i.e., position sampling locations), the most important decision errors will be associated with field and analytical/toxicity laboratory techniques involved in the collection and analysis of the data.

Sampling Methodologies and Procedures

Possible decision errors generated by sampling errors will be minimized during the field investigation by applying standardized field sampling methodologies (discussed in

Worksheets #18, #20, #21, and #22). Sampling activities will be performed in accordance with the SOPs specified in this SAP.

Managing Laboratory Sampling Error

Control of potential analytical/toxicity laboratory error and sampling error will be minimized by using blanks and duplicates, respectively. The sample matrix, number of samples, and number and type of laboratory quality assurance (QA)/quality control (QC) samples are summarized in Worksheets #18 and #20. Worksheet #19 details sample volumes, sample container specifications, preservation requirements, and maximum holding times.

The analytical/toxicity laboratory will provide electronic data deliverable files, portable document format files of the data deliverables for all project data, and a hard copy of data deliverables for all results. Designated analytical samples will be used to obtain necessary subsamples for laboratory QC measurements (i.e., analytical sample duplicate and sample matrix spike/matrix spike duplicate [MS/MSD]), as specified in Worksheet #12. Tasks will be completed using the laboratory SOPs.

Individual chemical concentrations at each sample depth will be compared directly to the screening levels. Data quality will be evaluated as part of the verification/validation and the data usability processes described in Worksheets #34 through #36. Failure to meet validation targets or limitations on data use identified during a data usability assessment shall be described in the project report.

Portable document format copies of all analytical data packages will be stored on CD-ROM, archived in the NAVFAC Atlantic Administrative Record file, and uploaded onto the Naval Installation Restoration Information Solution (NIRIS) system at the close of the project. All other data generated in the field and reports generated for the project will be stored as computer readable data files by Resolution Consultants.

11.8 Sampling Design

The sampling design for the site was developed to optimize resources and generate data to satisfy the Data Quality Objectives. The sediment and surface water sampling design, rationale, and locations are summarized in Worksheets #17 and #18. These Worksheets identify where sediment and surface water samples will be collected and the analyses to be conducted for each sample.

SAP WORKSHEET #12: FIELD QUALITY CONTROL SAMPLES

(UFP-QAPP Manual Section 2.6.2)

Measurement Performance Criteria Table — Field QC Samples				
QC Sample	**Analytical Group**	**Frequency**	**Data quality Indicators**	**Measurement Performance Criteria**
Equipment Rinsate Blank	Metals, SVOCs/PAHs via SIM, Pesticides, PCBs	One per week per matrix per sampling equipment	Bias/Contamination	No analytes ≥ ½ LOQ, except common laboratory contaminants, which must be < LOQ.
Field Duplicate	Metals, SVOCs/PAHs via SIM, Pesticides, PCBs	One per 20 field samples	Precision	Values > 5X LOQ: RPD ≤50 (solids), RPD ≤30 (liquids)
Matrix Spike/Matrix Spike Duplicate	Metals, SVOCs/PAHs via SIM, Pesticides, PCBs	One pair per 20 field samples	Accuracy/Bias/ Precision	Percent recoveries — DoD QSM Limits RPD must be ≤ 30 (SVOCs, PAHs, Pesticides, PCBs) RPD must be ≤ 20 (Metals)
Cooler Temperature Indicator	Metals, SVOCs/PAHs via SIM, Pesticides, PCBs	One per cooler	Representativeness	Temperature must be above freezing and less than or equal to 6 °C.

Notes:

QC	=	Quality Control
SVOCs	=	Semivolatile organic compounds
PAHs	=	Polynuclear aromatic hydrocarbons
PCBs	=	Polychlorinated biphenyl compounds
LOQ	=	Limit of quantitation
RPD	=	Relative percent difference
SIM	=	Selective Ion Monitoring
DoD QSM	=	*Department of Defense Quality Systems Manual for Environmental Laboratories*, Version 4.2, October 2010

SAP WORKSHEET #13: SECONDARY DATA CRITERIA AND LIMITATIONS TABLE

(UFP-QAPP Manual Section 2.7)

Secondary Data Criteria and Limitations Table				
Secondary Data	**Data Source (originating organization, report title and date)**	**Data Generator(s) (originating organization, data types, data generation/collection dates)**	**How Data Will Be Used**	**Limitations on Data Use**
Historical Analytical Data	*Remedial Investigation Report OU 16, Naval Air Station, Pensacola, Site 41, Pensacola Florida*, November 2007	*Originating Organization*: EnSafe Inc. *Data Types*: contaminants of potential concern, nature and extent of contamination, analytical and toxicity data, fate and transport methods, risk assessment evaluation *Data Collection Dates*: 1995 — 2004	The historical data will be compared to new data to assess current site conditions.	Potential limitation when evaluating results reported as not detected; historical detection limits may not be as sensitive as those for more recent data.
Historical Analytical Data	*Site 41 (Operable Unit 16) Remedial Investigation Report Addendum, Wetlands 10 and 48, Pensacola Florida*, 15 October 2007	*Originating Organization*: EnSafe Inc. *Data Types*: contaminants of potential concern, nature and extent of contamination, analytical and toxicity data, fate and transport methods, risk assessment evaluation for Wetlands 10 and 48 *Data Collection Dates*: 2007	The historical data will be compared to new data to assess current site conditions.	Potential limitation when evaluating results reported as not detected; historical detection limits may not be as sensitive as those for more recent data.
Historical Analytical Data	*Feasibility Study Report, Operable Unit (OU) 16, Site 41 Wetlands, Naval Air Station Pensacola, Pensacola, Florida*, December 2010	*Originating Organization*: Tetra Tech *Data Types*: contaminants of potential concern, nature and extent of contamination, analytical and toxicity data, preliminary remediation goals *Data Collection Dates*: 1995 — 2004	The historical data will be compared to new data to assess current site conditions.	Potential limitation when evaluating results reported as not detected; historical detection limits may not be as sensitive as those for more recent data.
COC, Preliminary PRGs	*Technical Memorandum — Refined List of Chemicals of Concern for the Feasibility Study and Development of Preliminary Remediation Goals for Sediment, Site 41, Combined wetlands, Naval Air Station Pensacola*, 2010	*Originating Organization*: Tetra Tech *Data Types*: contaminants of potential concern refinement, preliminary remediation goals *Data Collection Dates*: 2010	New data will be compared to PRGs to assess current site conditions.	Preliminary PRGs will be further refined using new data obtained during this investigation.
Sampling Approach	*NAS Pensacola OU 16, Site 41 Wetlands Briefing Meeting Minutes*, 27 and 28 March 2012	*Originating Organization*: NAS Pensacola Partnering Team *Data Types*: contaminants of potential concern refinement, preliminary remediation goals *Data Collection Dates*: 2012	Partnering Meeting is used as the basis for the sampling approach presented in this Sampling and Analysis Plan.	None

Secondary Data Criteria and Limitations Table				
Secondary Data	**Data Source (originating organization, report title and date)**	**Data Generator(s) (originating organization, data types, data generation/collection dates)**	**How Data Will Be Used**	**Limitations on Data Use**
Sampling Approach	*Technical Memorandum Sampling Approach for Collection of Additional Sediment Samples Operable Unit 16, Site 41 Combined Wetlands, Naval Air Station Pensacola, Pensacola, Florida*, April 2012	*Originating Organization*: Tetra Tech *Data Types*: contaminants of potential concern refinement, preliminary remediation goals *Data Collection Dates*: 2012	Technical Memorandum is used as the basis for the sampling approach presented in this Sampling and Analysis Plan.	None
Sampling Approach	*NAS Pensacola Wetlands Follow-Up Teleconference Minutes,* 9 May 2012	*Originating Organization*: NAS Pensacola Partnering Team *Data Types*: contaminants of potential concern refinement, preliminary remediation goals *Data Collection Dates*: 2012	Partnering Meeting is used as the basis for the sampling approach presented in this Sampling and Analysis Plan.	None
Sampling Approach	*NAS Pensacola Wetlands Teleconference Minutes,* 7 June 2013	*Originating Organization*: NAS Pensacola Partnering Team *Data Types*: addition of three wetlands, addition of surface water sampling, separation of OU 1, OU 2, and OU 16 wetlands *Data Collection Dates*: 2013	Partnering Meeting is used as the basis for the sampling approach presented in this Sampling and Analysis Plan.	None

Notes:

NAS = Naval Air Station
COC = Chemicals of Concern
PRGs = Preliminary Remediation Goals
OU = Operable Unit

SAP WORKSHEET #14: SUMMARY OF PROJECT TASKS

(UFP-QAPP Manual Section 2.8.1)

The following project tasks are summarized below:

- Field Tasks
- Analytical/Toxicity Laboratory Tasks
- Data Management and Review
- Project Report

Field Tasks

The following describes field tasks and procedures that are applicable to this investigation.

Mobilization/Demobilization — Mobilization will consist of the delivery, assembly (in satisfactory working order), and secure storage of necessary equipment, materials, and supplies, along with the acquisition of personnel and vehicle base access badges. The Resolution Consultants FTL, or designee, will coordinate with the NAS Pensacola point of contact to identify appropriate locations for the temporary storage of equipment and supplies.

Site-specific health and safety briefings for all Resolution Consultants field personnel and subcontractors will be conducted as part of mobilization. There are no specialized/non-routine project-specific training requirements or certifications needed by personnel to successfully complete sampling tasks. However, the subcontracted boat operator will possess the necessary training and licensing required by Florida boating laws. All field personnel will have appropriate training to conduct the field activities to which they are assigned. Each sampler will be required to have completed the Occupational Safety and Health Administration 40-hour Hazardous Waste Operations and Emergency Response course and 8-hour refresher, if applicable.

Demobilization will consist of the prompt and timely removal of equipment, materials, and supplies from the site at the completion of fieldwork. Demobilization also includes the cleanup and removal of waste generated during the investigation.

Equipment Calibration — Field equipment calibration procedures are described in Worksheet #22. At a minimum, field equipment will be calibrated at the beginning and end of each day, unless stated otherwise by the equipment manufacturer. Documentation of the field equipment calibration is required.

Sediment Sampling — The sampling and analysis program is outlined in Worksheets #17 and #18. Sediment samples will be collected using a shovel or ponar, in accordance with SOP FS 4000. Sample documentation, collection, and handling will be in accordance with SOPs 3-02, 3-03A, and 3-04A as cited in in Worksheet #21. A sample log will be prepared for each location with descriptions and all relevant information, observations, and field screening results. Sample depths will be included on each log. After sampling, each hole will be backfilled as needed using sediment removed from the hole.

Field Quality Control Tasks — As specified on Worksheet #12, analytical laboratory field QC samples collected will include field duplicates and equipment rinsate blanks. In addition, extra sample volume will be collected for the laboratory QC analysis of matrix spike and matrix spike duplicates. Worksheet #20 presents the field QC sample summary.

Surface Water Sampling and Measurements — The sampling and analysis program is outlined in Worksheets #17 and #18. Surface water samples will be collected in accordance with SOP FS 2100. Sample documentation, collection, and handling will be in accordance with SOPs 3-02, 3-03A, and 3-04A as cited in in Worksheet #21. A sample log will be prepared for each location with descriptions and all relevant information, observations, and field screening results. Field measurements of pH, specific conductance, salinity, temperature, and DO will be performed at each sediment location where surface water is present. Field measurements will be conducted using SOPs FT 1000, FT 1200, FT 1300, FT 1400, and FT 1500.

Field Documentation — Field documentation will be performed in accordance with SOP-3-02 and SOP-3-03A. Field activities will be summarized in indelible ink in a bound logbook with consecutively numbered pages that cannot be removed. If an incorrect entry is made, striking a single line through the incorrect information will make the correction; and the person making the correction will initial and date the change. Logbooks will be assigned to field personnel and stored in a secured area when not in use. Boring logs, sampling forms, and other field forms may also be used to document field activities.

Global Positioning System Locating — A hand-held GPS unit capable of sub-meter accuracy (e.g., Trimble GeoXM or Trimble GeoHX) will be used to locate sampling points, in accordance with SOP 3-07, found in Appendix E. The GPS survey will use third order monument data, if available. Select monuments or markers (such as surveyed permanent monitoring wells) will be visited at the start and end of each day. Before the start of fieldwork, Resolution Consultants will load

site boundaries, known cultural, or terrain features that may affect surveys, and background maps into the GPS unit. In addition, coordinates of the planned sampling locations will be loaded into the unit so that the field team can reacquire and mark each location in the field. Field personnel will have the flexibility to adjust sampling locations up to 10 feet in any direction, as necessary, to avoid physical obstructions or safety hazards (e.g., pavement, utility lines, sprinkler heads, etc.), or otherwise ensure proper placement of samples. If the Resolution Consultants FTL determines that moving a sampling location more than 10 feet is appropriate, he will contact the Resolution Consultants task order manager (TOM), who will engage the NAVFAC remedial project manager (RPM). Following sample collection, each location will be resurveyed using GPS to obtain the respective coordinates. GPS data collected during the survey will be stored in the GPS unit and downloaded to a computer daily or as soon as possible after acquisition. Data will also be manually entered into a field log as it is collected. Once downloaded from the GPS unit, the data will then be uploaded for processing by Resolution Consultants' Geographic Information System personnel. To ensure sub-meter accuracy, a minimum of six satellites is desired for each position. If GPS accuracy is not sub-meter, data will not be collected until more satellites become available and the accuracy criteria are met. In locations where the overhead canopy interferes with satellite lines-of-sight and GPS accuracy cannot be reasonably established, an alternative positioning technique will be employed (e.g., compass and tape measure, fiducials, or total station) to ensure that anomaly locations can be reacquired at a later date, if necessary.

Decontamination — Decontamination of reusable sampling equipment will be conducted before sampling and between samples at each location, in accordance with SOP FC 1000.

Waste Handing — Aqueous investigation-derived waste (IDW) will include decontamination fluids. IDW will be containerized in adequately labeled 55-gallon Department of Transportation-approved drums. Characterization samples will be collected and submitted for chemical analysis, as required by the disposal facility. Pending characterization data, the drums will be temporarily staged as instructed by the NAS Pensacola point of contact. Based on characterization results, IDW will be transported and appropriately disposed at a Navy-approved off-site disposal facility.

Personal protective equipment, including gloves, wipes, discarded paper towels, and disposable equipment (e.g., tubing), will be bagged and properly discarded in an appropriate on-base solid waste dumpster.

Site Restoration — If investigation activities disturb or alter the landscape or vegetation, site surfaces will be restored to pre-existing conditions (to the extent possible). Equipment and supplies used during the investigation will be removed from the site at the conclusion of field activities.

Analytical/ Toxicity Laboratory Tasks

Shealy Environmental Services, a FDEP-accredited and DoD ELAP-accredited laboratory will perform chemical analysis of COCs. Three additional laboratories will be used to perform specialized testing to supplement chemical analysis. ALS Environmental (formerly Columbia Analytical Services, Inc.) will perform AVS/SEM testing, Geotechnics will perform grain size analysis, and Hydrosphere Research will conduct toxicity testing. Copies of pertinent laboratory accreditations are included in Appendix F. Analyses will be performed in accordance with the analytical methods identified in Worksheets #23 and #30. The subcontract laboratories will perform the analyses per laborator-specific SOPs identified in Worksheet #23. Toxicity laboratory SOPs are included in Appendix G. Based on previous regulator comments to minimize the size of SAPs, analytical laboratory SOPs are not included in an appendix but may be provided upon request.

The subcontracted laboratories will provide fully validatable data packages, which will include summary forms containing all method-specific quality control information and raw data. Sediment results will be reported by each laboratory on an adjusted dry-weight basis, as applicable to the testing method. Results of percent moisture will be reported in each analytical data package and associated electronic data deliverable files. This information will also be captured in the project database, which will eventually be uploaded to the NIRIS database.

Data Management and Review

The following describes data management and review tasks and procedures that are applicable to this investigation. Data management will take place coinciding with the sampling events and after receipt of the laboratory and toxicity data packages, which are anticipated 21 and 60 days, respectively, from sample receipt.

Data Handling and Management — After each sampling event is completed, the field sampling log sheets will be organized by date and media and filed in the project files. The field logbooks for this project will be used only for this site, and will also be categorized and maintained in the project files after the completion of the field program.

Data Handling and Management — The principal data generated for this project will be from field data and analytical/toxicity laboratory data. The field forms, chain of custody, air bills, and logbooks will be placed in the project files after the completion of the field program. All project records will be maintained in a secure location. Analytical laboratory data, provided in electronic format, will verified for accuracy prior to use and during the data validation process. After data are validated, the electronic data results will be uploaded into the Resolution Consultants database for use in data evaluation and subsequent report preparation. The project database will be located on a secure network, which is password protected. Toxicity laboratory reports will be filed with the project records in a secure location. The Resolution Consultants TOM (or designee) is responsible for the overall tracking and control of data generated for the project.

Analytical Data Review and Validation — After receipt of analytical/toxicity laboratory results, Resolution Consultants will verify data completeness as specified on Worksheet #34. To ensure that the analytical results meet the project quality objectives, the analytical laboratory data will undergo verification and validation, with raw data review, as cited in Worksheets #34 through #36 and described below. Data reviewers will be independent of the data generation activities. External verification and validation is not planned for toxicity data due to the nature of testing and presentation, which are mostly statistical comparisons in accordance with the toxicity testing methods and SOP. The usability assessment processes are described in Worksheet #37.

Prior to data validation, electronic analytical laboratory data will be verified for accuracy against the hardcopy laboratory report and the electronic quality assurance project plan (eQAPP) will be established using the project-specific criteria defined in Worksheets #12, #19, and #28. The laboratory will be requested to resubmit electronic data found to be inaccurate.

During the data validation process, the Resolution Consultants Data Validation Assistant (DVA) tool will be used to review method accuracy and precision data from field and analytical laboratory QC samples contained in the laboratory electronic data deliverable (EDD) and to qualify that data according to the project-specific eQAPP. The DVA tool uses EarthSoft's EQuIS relational database to assemble a series of Excel worksheets into a DVA workbook for the validator that present:

- Data validation QC elements that need review, compared to control limits stored in the project-specific eQAPP.

- Associated sample results for duplicate samples and blanks.

- A place to make the necessary qualifications and result updates directly into an electronic format documenting qualifiers using coded reasons.

- A list of all samples affected by the qualification.

The hardcopy analytical data report will be manually reviewed for data not provided in the electronic data files (e.g., sample handling, tuning, calibration, and raw data outputs). Hardcopy data will be assessed against the measurement performance criteria presented in this SAP and in the DoD *Quality Systems Manual* (2010); the results of these findings will be added to the Excel DVA workbook. The DVA workbook is used to update the project database with the validator's changes, eliminating the manual data entry process and allowing for 100 percent of data to be reviewed prior to uploading to the project database.

Data Tracking and Control — The TOM (or designee) is responsible for the overall tracking and control of data generated for the project. Data are tracked from generation to archiving in the project-specific files. The project chemist (or designee) is responsible for tracking the samples collected and shipped to the contracted analytical/toxicity laboratory. Upon receipt of the data packages from the analytical laboratory, the project chemist will oversee the analytical data validation effort, which includes verifying that the data packages are complete and that results for all samples have been delivered by the analytical laboratory.

Resolution Consultants shall submit all Administrative Record Files, Site Files, and Post Decision Files in accordance with the specifications defined in the NAVFAC *Environmental Restoration Recordkeeping Manual* (NAVFAC 2009). Additionally, Resolution Consultants will update and manage the project related documents, data, and maps in NIRIS. Project related spatial data including maps, models, and associated collected or created data will also be uploaded into NIRIS. All documentation submittals for NIRIS will be coordinated with the RPM.

Data Storage, Archiving, and Retrieval — After completion of planned reviews, the laboratory/toxicity data packages will be entered into the Resolution Consultants' Navy CLEAN file system and archived in secure files. The field records including field logbooks, sample logs, chain-of-custody records, and field calibration logs will be submitted by the Resolution Consultants

FTL to be entered into the Navy CLEAN file system before archiving in secure project files. Project files are audited for accuracy and completeness. Project files will be kept in a secured, limited access area and at the completion of the Navy contract. Files will be shipped to the Federal Records Center (FRC) for storage where the files will remain until 50 years after the last decision document for NAS Pensacola. Final validated analytical data will be uploaded into the NIRIS database.

Project Reports — The anticipated deliverables included under this task are FS Addendums for OU 1 and OU 2 and a FS for OU 16. The reports will document the findings of the investigation. The report will include appropriate sections concerning site background, investigation activities, physical characteristics, nature and extent of contamination, trend analysis, and conclusions and recommendations as well as evaluation of remedial alternatives.

The report will be issued in draft to NAVFAC SE for initial review. NAVFAC SE comments will be addressed and the draft final report will be issued for regulatory review. Resolution Consultants will prepare responses to comments from U.S. EPA and FDEP reviewers.

Project documents and records obtained during the course of project activities (e.g., calibration logs, health and safety certificates, etc.) are identified on Worksheet #29.

SAP WORKSHEET #15: REFERENCE LIMITS AND EVALUATION TABLES

(UFP-QAPP Manual Section 2.8.1)

Matrix:	**Freshwater Sediment**												
Analytical Group:	**Semivolatile Organic Compounds**												
Analyte	**CAS No.**	**Site-Specific Preliminary Remediation Goal[1] (mg/kg)**	**Basis of Preliminary Remediation Goal**	**Florida SQAG TEC (mg/kg)**	**Florida SQAG PEC (mg/kg)**	**Reference Concen-tration (mg/kg)**	**Other Screening Level[2] (mg/kg)**	**Other Screening Level Source**	**Lowest Screening Level (mg/kg)**	**PQL Goals (mg/kg)**	**LOQ[3] (mg/kg)**	**LOD[3] (mg/kg)**	**DL[3] (mg/kg)**
1,1'-Biphenyl	92-52-4	—	—	—	—	—	1.1	ECOTOX	1.1	0.37	0.033	0.0165	0.01
1,2,4,5-Tetrachlorobenzene	95-94-3	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.01
2,2'-Oxybis(1-chloropropane)	108-60-1	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.011
2,3,4,6-Tetrachlorophenol	58-90-2	—	—	—	—	—	—	—	—	—	0.067	0.0335	0.01
2,4,5-Trichlorophenol	95-95-4	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.0093
2,4,6-Trichlorophenol	88-06-2	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.0098
2,4-Dichlorophenol	120-83-2	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.01
2,4-Dimethylphenol	105-67-9	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.012
2,4-Dinitrophenol	51-28-5	—	—	—	—	—	—	—	—	—	0.17	0.14	0.11
2,4-Dinitrotoluene	121-14-2	—	—	—	—	—	—	—	—	—	0.067	0.0335	0.018
2,6-Dinitrotoluene	606-20-2	—	—	—	—	—	—	—	—	—	0.067	0.0335	0.017
2-Chloronaphthalene	91-58-7	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.011
2-Chlorophenol	95-57-8	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.0092
2-Methylnaphthalene	91-57-6	—	—	—	—	—	0.33	Region 4 SQAG	0.33	0.11	0.0033	0.00165	0.00099
2-Methylphenol	95-48-7	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.006
2-Nitroaniline	88-74-4	—	—	—	—	—	—	—	—	—	0.067	0.0335	0.023
2-Nitrophenol	88-75-5	—	—	—	—	—	—	—	—	—	0.067	0.0335	0.018
3,3'-Dichlorobenzidine	91-94-1	—	—	—	—	—	—	—	—	—	0.17	0.085	0.036
3-Nitroaniline	99-09-2	—	—	—	—	—	—	—	—	—	0.067	0.044	0.039
4,6-Dinitro-2-methylphenol	534-52-1	—	—	—	—	—	—	—	—	—	0.17	0.15	0.13
4-Bromophenyl-phenylether	101-55-3	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.0098
4-Chloro-3-methylphenol	59-50-7	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.0084
4-Chloroaniline	106-47-8	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.0068
4-Chlorophenyl-phenyl ether	7005-72-3	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.011
4-Methylphenol	106-44-5	—	—	—	—	—	0.1	NOAA-AET	0.1	0.03	0.067	0.0335	0.012
4-Nitroaniline	100-01-6	—	—	—	—	—	—	—	—	—	0.067	0.0335	0.019
4-Nitrophenol	100-02-7	—	—	—	—	—	—	—	—	—	0.17	0.12	0.096

Matrix:	**Freshwater Sediment**												
Analytical Group:	**Semivolatile Organic Compounds**												
Analyte	**CAS No.**	**Site-Specific Preliminary Remediation Goal[1] (mg/kg)**	**Basis of Preliminary Remediation Goal**	**Florida SQAG TEC (mg/kg)**	**Florida SQAG PEC (mg/kg)**	**Reference Concen-tration (mg/kg)**	**Other Screening Level[2] (mg/kg)**	**Other Screening Level Source**	**Lowest Screening Level (mg/kg)**	**PQL Goals (mg/kg)**	**LOQ[3] (mg/kg)**	**LOD[3] (mg/kg)**	**DL[3] (mg/kg)**
Acenaphthene	83-32-9	—	—	0.0067	0.089	—	—	—	0.0067	0.002	0.0033	0.00165	0.00099
Acenaphthylene	208-96-8	—	—	0.0059	0.13	—	—	—	0.0059	0.002	0.0033	0.00165	0.00095
Acetophenone	98-86-2	—	—	—	—	—	—	—	—	—	0.033	0.02	0.018
Anthracene	120-12-7	—	—	0.057	0.85	—	—	—	0.057	0.019	0.0033	0.00165	0.00051
Atrazine	1912-24-9	—	—	—	—	—	—	—	—	—	0.033	0.02	0.017
Benzaldehyde	100-52-7	—	—	—	—	—	—	—	—	—	0.033	0.02	0.017
Benzo(a)anthracene	56-55-3	—	—	0.11	1.1	—	—	—	0.11	0.037	0.0033	0.00165	0.00056
Benzo(a)pyrene	50-32-8	—	—	0.15	1.5	—	—	—	0.15	0.05	0.0033	0.00165	0.00066
Benzo(b)fluoranthene	205-99-2	—	—	—	—	—	—	—	—	—	0.0033	0.00165	0.0005
Benzo(g,h,i)perylene	191-24-2	—	—	—	—	—	3.2	NOAA SEL	3.2	1.1	0.0033	0.00165	0.00065
Benzo(k)fluoranthene	207-08-9	—	—	—	—	—	13.4	NOAA SEL	13.4	4.5	0.0033	0.00165	0.00048
Bis(2-chloroethoxy)methane	111-91-1	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.01
Bis(2-chloroethyl)ether	111-44-4	—	—	—	—	—	0.75	NOAA UET	0.75	0.25	0.033	0.0165	0.0092
Bis(2-ethylhexyl)phthalate	117-81-7	—	—	0.18	2.6	—	—	—	0.18	0.06	0.033	0.0165	0.012
Butylbenzylphthalate	85-68-7	—	—	—	—	—	1.1	ECOTOX	1.1	0.37	0.067	0.0335	0.022
Caprolactam	105-60-2	—	—	—	—	—	—	—	—	—	0.033	0.02	0.017
Carbazole	86-74-8	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.014
Chrysene	218-01-9	—	—	0.17	1.3	—	—	—	0.17	0.057	0.0033	0.00165	0.00045
Dibenzo(a,h)anthracene	53-70-3	—	—	0.033	0.14	—	—	—	0.033	0.011	0.0033	0.00165	0.00051
Dibenzofuran	132-64-9	—	—	—	—	—	2	ECOTOX	2	0.7	0.033	0.0165	0.01
Diethylphthalate	84-66-2	—	—	—	—	—	53	NOAA Dutch	53	18	0.033	0.0165	0.011
Dimethylphthalate	131-11-3	—	—	—	—	—	84	NOAA Dutch	84	28	0.033	0.0165	0.011
Di-n-butylphthalate	84-74-2	—	—	—	0.043	—	—	—	0.043	0.014	0.033	0.02	0.018
Di-n-octylphthalate	117-84-0	—	—	—	—	—	60	NOAA Dutch	60	20	0.067	0.0335	0.032
Fluoranthene	206-44-0	—	—	0.42	2.2	—	—	—	0.42	0.14	0.0033	0.00165	0.00042
Fluorene	86-73-7	—	—	0.077	0.54	—	—	—	0.077	0.026	0.0033	0.00165	0.00057
Hexachlorobenzene	118-74-1	—	—	0.02	0.24	—	—	—	0.02	0.0067	**0.033**	0.0165	0.015
Hexachlorobutadiene	87-68-3	—	—	0.055	0.55	—	—	—	0.055	0.018	0.033	0.0165	0.011
Hexachlorocyclo-pentadiene	77-47-4	—	—	—	—	—	—	—	—	—	0.17	0.085	0.024
Hexachloroethane	67-72-1	—	—	—	—	—	1	ECOTOX	1	0.3	0.033	0.0165	0.0089
Indeno(1,2,3-cd)pyrene	193-39-5	—	—	—	—	—	3.2	NOAA SEL	3.2	1.1	0.0033	0.00165	0.0001
Isophorone	78-59-1	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.0074

Matrix:	**Freshwater Sediment**												
Analytical Group:	**Semivolatile Organic Compounds**												
Analyte	**CAS No.**	**Site-Specific Preliminary Remediation Goal[1] (mg/kg)**	**Basis of Preliminary Remediation Goal**	**Florida SQAG TEC (mg/kg)**	**Florida SQAG PEC (mg/kg)**	**Reference Concen-tration (mg/kg)**	**Other Screening Level[2] (mg/kg)**	**Other Screening Level Source**	**Lowest Screening Level (mg/kg)**	**PQL Goals (mg/kg)**	**LOQ[3] (mg/kg)**	**LOD[3] (mg/kg)**	**DL[3] (mg/kg)**
Naphthalene	91-20-3	—	—	0.18	0.56	—	—	—	0.18	0.06	0.0033	0.00165	0.00097
Nitrobenzene	98-95-3	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.0054
N-Nitroso-di-npropylamine	621-64-7	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.013
N-Nitrosodiphenylamine	86-30-6	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.0086
Pentachlorophenol	87-86-5	—	—	—	—	—	8	NOAA Dutch	8	2.7	0.17	0.15	0.14
Phenanthrene	85-01-8	—	—	0.2	1.2	—	—	—	0.2	0.0.067	0.0033	0.00165	0.00072
Phenol	108-95-2	—	—	—	—	—	0.048	NOAA UET	0.048	0.016	0.033	0.0165	0.009
Pyrene	129-00-0	—	—	0.2	1.5	—	—	—	0.2	0.067	0.0033	0.00165	0.0005
Total PAHs	—	—	—	—	23	—	—	—	23	7.76	—	—	—

Matrix:	**Freshwater Sediment**												
Analytical Group:	**Pesticides/Polychlorinated Biphenyls**												
Analyte	**CAS No.**	**Site-Specific Preliminary Remediation Goal[1] (mg/kg)**	**Basis of Preliminary Remediation Goal**	**Florida SQAG TEC (mg/kg)**	**Florida SQAG PEC (mg/kg)**	**Reference Concen-tration (mg/kg)**	**Other Screening Level[2] (mg/kg)**	**Other Screening Level Source**	**Lowest Screening Level (mg/kg)**	**PQL Goals (mg/kg)**	**LOQ[3] (mg/kg)**	**LOD[3] (mg/kg)**	**DL[3] (mg/kg)**
4,4'-DDD*	72-54-8	0.1 (3, 5A, 18A), 0.05 (48)	PRG-NOEC/RC	0.0049	0.028	0.05	—	—	0.0049	0.0016	0.0017	0.00085	0.000036
4,4'-DDE*	72-55-9	0.057 (3, 5A, 18A)/0.04 (48)	PRG-NOEC/RC	0.0032	0.031	0.04	—	—	0.0032	0.0011	0.0017	0.00085	0.000022
4,4'-DDT*	50-29-3	0.063	NOAA-PEC	0.0042	0.063	0.02	—	—	0.0042	0.0014	0.0017	0.00085	0.00007
Total DDx*	—	—	—	—	0.57	0.11	—	—	0.11	0.0367	—	—	—
Aldrin	309-00-2	—	—	—	—	—	0.04	NOAA UET	0.04	0.013	0.0017	0.00085	0.000042
alpha-BHC	319-84-6	—	—	0.0024 [4]	0.005 [4]	—	—	—	0.0024	0.0008	0.0017	0.00085	0.000045
alpha-Chlordane	5103-71-9	—	—	0.0032 [5]	0.018 [5]	—	—	—	0.0032	0.0011	0.0017	0.00085	0.000028
beta-BHC	319-85-7	—	—	0.0024 [4]	0.005 [4]	—	—	—	0.0024	0.0008	0.0017	0.00085	0.000036
delta-BHC	319-86-8	—	—	0.0024 [4]	0.005 [4]	—	—	—	0.0024	0.0008	0.0017	0.00085	0.000021
Dieldrin	60-57-1	—	—	0.0019	0.062	—	—	—	0.0019	0.00063	0.0017	0.00085	0.000028
Endosulfan I	959-98-8	0.0052	PRG-NOEC	—	—	—	—	—	0.0052	0.0017	0.0017	0.00085	0.000041
Endosulfan II	33213-65-9	—	—	—	—	—	—	—	—	—	0.0017	0.00085	0.000032
Endosulfan sulfate	1031-07-8	0.0072	PRG-LOEC	—	—	—	—	—	0.0072	0.0024	0.0017	0.00085	0.000037

Matrix:	**Freshwater Sediment**												
Analytical Group:	**Pesticides/Polychlorinated Biphenyls**												
Analyte	**CAS No.**	**Site-Specific Preliminary Remediation Goal[1] (mg/kg)**	**Basis of Preliminary Remediation Goal**	**Florida SQAG TEC (mg/kg)**	**Florida SQAG PEC (mg/kg)**	**Reference Concen-tration (mg/kg)**	**Other Screening Level[2] (mg/kg)**	**Other Screening Level Source**	**Lowest Screening Level (mg/kg)**	**PQL Goals (mg/kg)**	**LOQ[3] (mg/kg)**	**LOD[3] (mg/kg)**	**DL[3] (mg/kg)**
Endrin	72-20-8	—	—	0.0022	0.21	—	—	—	0.0022	0.00073	0.0017	0.00085	0.000022
Endrin aldehyde	7421-93-4	—	—	0.0022[6]	0.21[6]	—	—	—	0.00226	0.00075	0.0017	0.00085	0.000036
Endrin ketone	53494-70-5	—	—	0.0022[6]	0.21[6]	—	—	—	0.00226	0.00075	0.0017	0.00085	0.000036
gamma-BHC (Lindane)	58-89-9	—	—	0.0024	0.005	—	—	—	0.0024	0.0008	0.0017	0.00085	0.000075
gamma-Chlordane	5103-74-2	—	—	0.0032 [5]	0.018 [5]	—	—	—	0.0032	0.0011	0.0017	0.00085	0.000025
Heptachlor	76-44-8	—	—	—	—	—	0.01	NOAA UET	0.01	0.0033	0.0017	0.00085	0.000057
Heptachlor epoxide	1024-57-3	—	—	0.0025	0.016	—	—	—	0.0025	0.00083	0.0017	0.00085	0.000036
Methoxychlor	72-43-5	—	—	—	—	—	0.019	ECOTOX	0.019	0.0063	0.0067	0.00335	0.000067
Toxaphene	8001-35-2	—	—	0.0001	0.032	—	—	—	0.0001	0.000033	**0.083**	**0.0415**	**0.0091**
Aroclor-1016	12674-11-2	—	—	0.060 [7]	0.68 [7]	—	—	—	0.06	0.02	0.017	0.0085	0.0011
Aroclor-1221	11104-28-2	—	—	0.060 [7]	0.68 [7]	—	—	—	0.06	0.02	0.017	0.013	0.0097
Aroclor-1232	11141-16-5	—	—	0.060 [7]	0.68 [7]	—	—	—	0.06	0.02	0.017	0.0085	0.0033
Aroclor-1242	53469-21-9	—	—	0.060 [7]	0.68 [7]	—	—	—	0.06	0.02	0.017	0.0085	0.0023
Aroclor-1248	12672-29-6	—	—	0.060 [7]	0.68 [7]	—	—	—	0.06	0.02	0.017	0.0085	0.0038
Aroclor-1254	11097-69-1	—	—	0.060 [7]	0.68 [7]	—	—	—	0.06	0.02	0.017	0.0085	0.0018
Aroclor-1260	11096-82-5	—	—	0.060 [7]	0.68 [7]	—	—	—	0.06	0.02	0.017	0.0085	0.008
Aroclor-1262	37324-23-5	—	—	0.060 [7]	0.68 [7]	—	—	—	0.06	0.02	0.017	0.0085	0.008
Aroclor-1268	11100-14-4	—	—	0.060 [7]	0.68 [7]	—	—	—	0.06	0.02	0.017	0.0085	0.008

Matrix:	**Freshwater Sediment**												
Analytical Group:	**Metals**												
Analyte	**CAS No.**	**Site-Specific Preliminary Remediation Goal[1] (mg/kg)**	**Basis of Preliminary Remediation Goal**	**Florida SQAG TEC (mg/kg)**	**Florida SQAG PEC (mg/kg)**	**Reference Concen-tration (mg/kg)**	**Other Screening Level[2] (mg/kg)**	**Other Screening Level Source**	**Lowest Screening Level (mg/kg)**	**PQL Goals (mg/kg)**	**LOQ[3] (mg/kg)**	**LOD[3] (mg/kg)**	**DL[3] (mg/kg)**
Aluminum	7429-90-5	—	—	—	—	13,610	—	—	13610	4540	2	1.5	1
Antimony	7440-36-0	27.7	PRG-LOEC	—	—	4.43	—	—	4.43	1.48	0.05	0.04	0.03
Arsenic[8*]	7440-38-2	—	—	9.8	33	6.62	14	PRG-HH	6.62	2.2	0.05	0.04	0.03
Barium	7440-39-3	87	PRG-NOEC	20	60	14	—	—	14	4.7	0.25	0.19	0.13
Beryllium	7440-41-7	—	—	—	—	0.84	—	—	0.84	0.28	0.02	0.0155	0.011

Matrix:	Freshwater Sediment													
Analytical Group:	**Metals**													
Analyte	**CAS No.**	**Site-Specific Preliminary Remediation Goal[1] (mg/kg)**	**Basis of Preliminary Remediation Goal**	**Florida SQAG TEC (mg/kg)**	**Florida SQAG PEC (mg/kg)**	**Reference Concen-tration (mg/kg)**	**Other Screening Level[2] (mg/kg)**	**Other Screening Level Source**	**Lowest Screening Level (mg/kg)**	**PQL Goals (mg/kg)**	**LOQ[3] (mg/kg)**	**LOD[3] (mg/kg)**	**DL[3] (mg/kg)**
Cadmium*	7440-43-9	—	—	1	5	1.8	—	—	1	0.33	0.005	0.004	0.003
Calcium	7440-70-2	—	—	—	—	10,756.67	—	—	10756.67	3590	10	5	2.5
Chromium	7440-47-3	—	—	43	110	39.37	—	—	39.37	13.1	0.25	0.19	0.13
Cobalt	7440-48-4	—	—	—	—	2.8	50	NOAA LEL	2.8	0.93	0.25	0.125	0.05
Copper*	7440-50-8	—	—	32	150	19.5	—	—	19.5	6.5	0.05	0.04	0.03
Iron	7439-89-6	246,000	PRG-NOEC	—	—	11,911.67	40,000	NOAA-SEL	11911.67	3970	1	0.8	0.6
Lead*	7439-92-1	258	PRG-LOEC	36	130	82.47	—	—	36	12	0.05	0.04	0.03
Magnesium	7439-95-4	—	—	—	—	7,513.33	—	—	7513.33	2504	2.5	1.9	1.3
Manganese	7439-96-5	—	—	—	—	37.97	1100	NOAA-UET	37.97	12.7	0.25	0.125	0.1
Mercury	7439-97-6	—	—	0.18	1.1	0.55	—	—	0.18	0.06	0.0083	0.007	0.0059
Nickel	7440-02-0	—	—	23	49	9.28	—	—	9.28	3.1	0.25	0.125	0.05
Potassium	7440-09-7	—	—	—	—	1,628.67	—	—	1628.67	543	10	5	2.5
Selenium	7782-49-2	5.4	PRG-NOEC	—	—	3.45	—	—	3.45	1.15	0.05	0.04	0.03
Silver	7440-22-4	—	—	1	2.2	2.1	—	—	1	0.33	0.05	0.04	0.03
Sodium	7440-23-5	—	—	—	—	18,993.33	—	—	18993.33	6331	10	5	2.5
Thallium	7440-28-0	—	—	—	—	1.57	—	—	1.57	0.5	0.025	0.019	0.013
Tin	7440-31-5	—	—	—	—	—	5	NOAA BG	5	1.7	0.5	0.25	0.05
Vanadium	7440-62-2	—	—	—	—	28.67	50	NOAA BG	28.67	9.6	0.25	0.19	0.13
Zinc*	7440-66-6	—	—	120	460	36.73	—	—	36.73	12.2	0.5	0.25	0.1

Freshwater Sediment Notes:

[1] Site-Specific Preliminary Remediation Goals (PRGs) were calculated for specific wetlands, which are indicated in parentheses after the value (Sampling and Analysis Plan Memorandum [TetraTech 2012] or Feasibility Study Addendum [TetraTech 2010]).

[2] Available screening values are provided from alternate sources for cases in which Florida SQAGs were not available. Values were identified from the following hierarchy of sources: ECOTOX > NOAA > U.S. EPA Region 4.

[3] LOQ, LOD, and DLs provided by Shealy Environmental Services, Inc., are targets that are achievable under optimal conditions and may vary during the course of the project. Sediment Results will be reported on a dry-weight basis.

[4] Gamma-BHC used as a surrogate compound

[5] Chlordane used as a surrogate compound

[6] Endrin used as a surrogate compound

[7] Total PCB value is provided

[8] The value for arsenic is a Human Health-based PRG; this chemical was not an ecological chemical of concern.

CAS No. = Chemical Abstract Services number

mg/kg = Milligram per kilogram

Freshwater Sediment Notes (Continued):

Florida SQAG	=	Sediment Quality Assessment Guidelines for the protection of sediment-dwelling organisms in Florida (Table 5.1 in MacDonald 2003)
TEC	=	Threshold Effect Concentration for Inland Waters
PEC	=	Probable Effect Concentration for Inland Waters
PQL	=	Project Quantitation Limit
LOQ	=	Laboratory Limit of Quantitation
LOD	=	Laboratory Limit of Detection
DL	=	Laboratory Detection Limit
PAHs	=	Polynuclear aromatic hydrocarbons
DDx	=	Total 4,4'-dichlorodiphenyltrichloroethane, 4,4'-dichlorodiphenyldichloroethane, and 4,4'-dichlorodiphenyldichloroethylene
ECOTOX	=	U.S. EPA Ecotox Threshold from the January 1996 Ecological Update
Region 4 SQAG	=	U.S. EPA Region 4 Sediment Screening Values from the 2001 Ecological Risk Assessment Bulletins
NOAA	=	National Oceanic and Atmospheric Administration Screening Quick Reference Tables (Buchman 2008)
AET	=	NOAA compiled sediment Apparent Effect Threshold from Washington Dept. of Ecology
SEL	=	NOAA compiled sediment Severe Effect Level from Ontario guidelines for the protection and management of aquatic sediment quality
UET	=	NOAA compiled sediment Upper Effects Threshold
Dutch	=	NOAA compiled sediment Dutch intervention standard
PRG	=	Previously Determined Sampling and Analysis Plan Memorandum (TetraTech 2012) or Feasibility Study Addendum Preliminary Remediation Goal (TetraTech 2010)
NOEC	=	No Observed Effect Concentration documented in the Sampling and Analysis Plan Memorandum (based on toxicity testing)
RC	=	Reference Concentration determined as part of the 2007 Remedial Investigation and subsequent Feasibility Study
LOEC	=	Lowest Observed Effect Concentration documented in the Sampling and Analysis Plan Memorandum (based on toxicity testing)
HH	=	Human Health arsenic Preliminary Remediation Goal from the Sampling and Analysis Plan Memorandum, Table 5
LEL	=	NOAA compiled sediment Lowest Effect Level from Ontario guidelines for the protection and management of aquatic sediment quality
BG	=	NOAA compiled sediment background screening value from U.S. EPA
—	=	Screening levels have been established for all chemicals of concern. If full scan analysis is performed with toxicity tests, screening levels can be developed for the remaining compounds if necessary.
Gray shade	=	Laboratory LOQ, LOD, and/or DL exceeds the lowest screening level.
*	=	Identified as a COC in Tetra Tech (2010)

DLs for all chemicals of concern are below their respective project action levels. The remaining compounds are being analyzed only when toxicity testing is being performed and will be reported as estimated concentrations at the DL per Florida Department of Environmental Protection guidelines.

SAP WORKSHEET #15: REFERENCE LIMITS AND EVALUATION TABLES (continued)

Matrix:	**Saltwater Sediment**												
Analytical Group:	**Semivolatile Organic Compounds**												
Analyte	**CAS No.**	**Site-Specific Preliminary Remediation Goal[1] (mg/kg)**	**Basis of Preliminary Remediation Goal**	**Florida TEL (mg/kg)**	**Florida PEL (mg/kg)**	**Reference Concen-tration (mg/kg)**	**Other Screening Level[2] (mg/kg)**	**Other Screening Level Source**	**Lowest Screening Level (mg/kg)**	**PQL Goals (mg/kg)**	**LOQ[3] (mg/kg)**	**LOD[3] (mg/kg)**	**DL[3] (mg/kg)**
1,1'-Biphenyl	92-52-4	—	—	—	—	—	1.1	ECOTOX	1.1	0.37	0.033	0.0165	0.01
1,2,4,5-Tetrachlorobenzene	95-94-3	—	—	—	—	—	1	NOAA Dutch	1	0.3	0.033	0.0165	0.01
2,2'-Oxybis(1-chloropropane)	108-60-1	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.011
2,3,4,6-Tetrachlorophenol	58-90-2	—	—	—	—	—	10	NOAA Dutch	10	3.3	0.067	0.0335	0.01
2,4,5-Trichlorophenol	95-95-4	—	—	—	—	—	0.003	NOAA AET	0.003	0.001	**0.033**	**0.017**	**0.009**
2,4,6-Trichlorophenol	88-06-2	—	—	—	—	—	0.006	NOAA AET	0.006	0.002	**0.033**	**0.017**	**0.01**
2,4-Dichlorophenol	120-83-2	—	—	—	—	—	0.000208	NOAA AET	0.000208	6.9E-05	**0.033**	**0.017**	**0.01**
2,4-Dimethylphenol	105-67-9	—	—	—	—	—	0.018	NOAA-AET	0.018	0.006	**0.033**	0.0165	0.012
2,4-Dinitrophenol	51-28-5	—	—	—	—	—	—	—	—	—	0.17	0.14	0.11
2,4-Dinitrotoluene	121-14-2	—	—	—	—	—	—	—	—	—	0.067	0.0335	0.018
2,6-Dinitrotoluene	606-20-2	—	—	—	—	—	—	—	—	—	0.067	0.0335	0.017
2-Chloronaphthalene	91-58-7	—	—	—	—	—	10	NOAA Dutch	10	3.3	0.033	0.0165	0.011
2-Chlorophenol	95-57-8	—	—	—	—	—	0.00333	NOAA AET	0.00333	0.00111	**0.033**	**0.017**	**0.009**
2-Methylnaphthalene	91-57-6	—	—	0.0202	0.201	—	—	—	0.0202	0.067	0.0033	0.0017	0.001
2-Methylphenol	95-48-7	—	—	—	—	—	0.008	NOAA-AET	0.008	0.00267	**0.033**	**0.017**	0.006
2-Nitroaniline	88-74-4	—	—	—	—	—	—	—	—	—	0.067	0.0335	0.023
2-Nitrophenol	88-75-5	—	—	—	—	—	—	—	—	—	0.067	0.0335	0.018
3,3'-Dichlorobenzidine	91-94-1	—	—	—	—	—	—	—	—	—	0.17	0.085	0.036
3-Nitroaniline	99-09-2	—	—	—	—	—	—	—	—	—	0.067	0.044	0.039
4,6-Dinitro-2-methylphenol	534-52-1	—	—	—	—	—	—	—	—	—	0.17	0.15	0.13
4-Bromophenyl-phenylether	101-55-3	—	—	—	—	—	1.3	ECOTOX	1.3	0.43	0.033	0.0165	0.0098
4-Chloro-3-methylphenol	59-50-7	—	—	—	—	—	15	NOAA Dutch	15	5	0.033	0.0165	0.0084
4-Chloroaniline	106-47-8	—	—	—	—	—	50	NOAA Dutch	50	17	0.033	0.0165	0.0068
4-Chlorophenyl-phenyl ether	7005-72-3	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.011
4-Methylphenol	106-44-5	—	—	—	—	—	0.1	NOAA-AET	0.1	0.03	0.067	0.0335	0.012
4-Nitroaniline	100-01-6	—	—	—	—	—	—	—	—	—	0.067	0.0335	0.019
4-Nitrophenol	100-02-7	—	—	—	—	—	—	—	—	—	0.17	0.12	0.096
Acenaphthene	83-32-9	—	—	0.00671	0.0889	—	—	—	0.00671	0.002	0.0033	0.0017	0.001
Acenaphthylene	208-96-8	—	—	0.00587	0.128	—	—	—	0.00587	0.002	0.0033	0.0017	0.001
Acetophenone	98-86-2	—	—	—	—	—	—	—	—	—	0.033	0.02	0.018

Matrix:	**Saltwater Sediment**												
Analytical Group:	**Semivolatile Organic Compounds**												
Analyte	**CAS No.**	**Site-Specific Preliminary Remediation Goal[1] (mg/kg)**	**Basis of Preliminary Remediation Goal**	**Florida TEL (mg/kg)**	**Florida PEL (mg/kg)**	**Reference Concen-tration (mg/kg)**	**Other Screening Level[2] (mg/kg)**	**Other Screening Level Source**	**Lowest Screening Level (mg/kg)**	**PQL Goals (mg/kg)**	**LOQ[3] (mg/kg)**	**LOD[3] (mg/kg)**	**DL[3] (mg/kg)**
Anthracene	120-12-7	—	—	0.0469	0.245	—	0.245	PEL	0.0469	0.016	0.0033	0.0017	0.0005
Atrazine	1912-24-9	—	—	—	—	—	0.71	NOAA Dutch	0.71	0.24	0.033	0.02	0.017
Benzaldehyde	100-52-7	—	—	—	—	—	—	—	—	—	0.033	0.02	0.017
Benzo(a)anthracene	56-55-3	—	—	0.0748	0.693	—	—	—	0.0748	0.025	0.0033	0.0017	0.0006
Benzo(a)pyrene	50-32-8	—	—	0.0888	0.763	—	—	—	0.0888	0.03	0.0033	0.0017	0.0007
Benzo(b)fluoranthene	205-99-2	—	—	—	—	—	1.8	NOAA AET	1.8	0.6	0.0033	0.0017	0.0005
Benzo(g,h,i)perylene	191-24-2	—	—	—	—	—	0.67	NOAA AET	0.67	0.22	0.0033	0.0017	0.0007
Benzo(k)fluoranthene	207-08-9	—	—	—	—	—	1.8	NOAA AET	1.8	0.6	0.0033	0.0017	0.0005
Bis(2-chloroethoxy)methane	111-91-1	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.01
Bis(2-chloroethyl)ether	111-44-4	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.0092
Bis(2-ethylhexyl)phthalate	117-81-7	—	—	0.182	2.647	—	—	—	0.182	0.061	0.033	0.0165	0.012
Butylbenzylphthalate	85-68-7	—	—	—	—	—	11	ECOTOX	11	3.7	0.067	0.0335	0.022
Caprolactam	105-60-2	—	—	—	—	—	—	—	—	—	0.033	0.02	0.017
Carbazole	86-74-8	0.32	PRG-LOEC	—	—	—	—	—	0.32	0.107	0.033	0.0165	0.014
Chrysene	218-01-9	—	—	0.108	0.846	—	—	—	0.108	0.036	0.0033	0.0017	0.0005
Dibenzo(a,h)anthracene	53-70-3	—	—	0.00622	0.135	—	—	—	0.00622	0.0021	0.0033	0.0017	0.0005
Dibenzofuran	132-64-9	0.13	PRG-LOEC	—	—	—	—	—	0.13	0.043	0.033	0.0165	0.01
Diethylphthalate	84-66-2	—	—	—	—	—	0.63	ECOTOX	0.63	0.21	0.033	0.0165	0.011
Dimethylphthalate	131-11-3	—	—	—	—	—	0.006	NOAA AET	0.006	0.002	**0.033**	**0.017**	**0.011**
Di-n-butylphthalate	84-74-2	—	—	—	—	—	11	ECOTOX	11	3.7	0.033	0.02	0.018
Di-n-octylphthalate	117-84-0	—	—	—	—	—	0.061	NOAA AET	0.061	0.02	**0.067**	0.0335	0.032
Fluoranthene	206-44-0	—	—	0.113	1.494	—	—	—	0.113	0.038	0.0033	0.0017	0.0004
Fluorene	86-73-7	—	—	0.0212	0.144	—	—	—	0.0212	0.0071	0.0033	0.0017	0.0006
Hexachlorobenzene	118-74-1	—	—	—	—	—	0.006	NOAA AET	0.006	0.002	**0.033**	**0.017**	**0.015**
Hexachlorobutadiene	87-68-3	—	—	—	—	—	0.0013	NOAA AET	0.0013	0.00043	**0.033**	**0.017**	**0.011**
Hexachlorocyclo-pentadiene	77-47-4	—	—	—	—	—	—	—	—	—	0.17	0.085	0.024
Hexachloroethane	67-72-1	—	—	—	—	—	1	ECOTOX	1	0.3	0.033	0.0165	0.0089
Indeno(1,2,3-cd)pyrene	193-39-5	—	—	—	—	—	0.6	NOAA AET	0.6	0.2	0.0033	0.0017	0.0001
Isophorone	78-59-1	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.0074
Naphthalene	91-20-3	—	—	0.0346	0.391	—	—	—	0.0346	0.012	0.0033	0.0017	0.001
Nitrobenzene	98-95-3	—	—	—	—	—	0.021	NOAA AET	0.021	0.007	**0.033**	0.0165	0.0054
N-Nitroso-di-npropylamine	621-64-7	—	—	—	—	—	—	—	—	—	0.033	0.0165	0.013
N-Nitrosodiphenylamine	86-30-6	—	—	—	—	—	0.028	NOAA AET	0.028	0.0093	**0.033**	0.0165	0.0086
Pentachlorophenol	87-86-5	—	—	—	—	—	0.017	NOAA AET	0.017	0.0057	**0.17**	**0.15**	**0.14**

Matrix:	**Saltwater Sediment**												
Analytical Group:	**Semivolatile Organic Compounds**												
Analyte	**CAS No.**	**Site-Specific Preliminary Remediation Goal[1] (mg/kg)**	**Basis of Preliminary Remediation Goal**	**Florida TEL (mg/kg)**	**Florida PEL (mg/kg)**	**Reference Concen-tration (mg/kg)**	**Other Screening Level[2] (mg/kg)**	**Other Screening Level Source**	**Lowest Screening Level (mg/kg)**	**PQL Goals (mg/kg)**	**LOQ[3] (mg/kg)**	**LOD[3] (mg/kg)**	**DL[3] (mg/kg)**
Phenanthrene	85-01-8	—	—	0.0867	0.544	—	—	—	0.0867	0.029	0.0033	0.0017	0.0007
Phenol	108-95-2	—	—	—	—	—	0.13	NOAA AET	0.13	0.043	0.033	0.0165	0.009
Pyrene	129-00-0	—	—	0.153	1.398	—	—	—	0.153	0.051	0.0033	0.0017	0.0005
Sum LMW-PAHs	—	—	—	—	1.442	—	—	—	1.442	0.49	—	—	—
Sum HMW-PAHs	—	—	—	—	6.676	—	—	—	6.676	2.22	—	—	—

Matrix:	**Saltwater Sediment**												
Analytical Group:	**Pesticides/Polychlorinated Biphenyls**												
Analyte	**CAS No.**	**Site-Specific Preliminary Remediation Goal[1] (mg/kg)**	**Basis of Preliminary Remediation Goal**	**Florida TEL (mg/kg)**	**Florida PEL (mg/kg)**	**Reference Concen-tration (mg/kg)**	**Other Screening Level[2] (mg/kg)**	**Other Screening Level Source**	**Lowest Screening Level (mg/kg)**	**PQL Goals (mg/kg)**	**LOQ[3] (mg/kg)**	**LOD[3] (mg/kg)**	**DL[3] (mg/kg)**
4,4'-DDD	72-54-8	0.05	RC	0.00122	0.00781	0.05	—	—	0.00122	0.000417	**0.002**	0.00085	0.000036
4,4'-DDE	72-55-9	—	—	0.00207	0.374	0.04	—	—	0.00207	0.0007	0.0017	0.00085	0.000022
4,4'-DDT	50-29-3	0.11 (15, 16, 18B)	PRG-NOEC	0.00119	0.00477	0.02	—	—	0.00119	0.0004	**0.002**	0.00085	0.00007
Total DDx	—	—	—	—	0.0517	0.11	—	—	0.0517	0.017	—	—	—
Aldrin	309-00-2	—	—	—	—	—	0.0095	NOAA-AET	0.0095	0.00317	0.0017	0.00085	0.000042
alpha-BHC	319-84-6	—	—	0.00032 [4]	0.00099 [4]	—	—	—	0.00032	0.00011	**0.002**	**0.00085**	0.000045
alpha-Chlordane	5103-71-9	—	—	0.00226	0.00479	—	—	—	0.00226	0.00075	0.0017	0.00085	0.000028
beta-BHC	319-85-7	—	—	0.00032 [4]	0.00099 [4]	—	—	—	0.00032	0.00011	**0.002**	**0.00085**	0.000036
delta-BHC	319-86-8	—	—	0.00032 [4]	0.00099 [4]	—	—	—	0.00032	0.00011	**0.002**	**0.00085**	0.000021
Dieldrin	60-57-1	0.0077	PRG-LOEC	0.00072	0.0043	—	—	—	0.00072	0.00024	**0.002**	**0.00085**	0.000028
Endosulfan I	959-98-8	—	—	—	—	—	0.0029	NOAA-ECOTOX	0.0029	0.00097	0.0017	0.00085	0.000041
Endosulfan II	33213-65-9	—	—	—	—	—	0.0029	Endosulfan I	0.0029	0.00097	0.0017	0.00085	0.000032
Endosulfan sulfate	1031-07-8	—	—	—	—	—	0.0029	Endosulfan I	0.0029	0.00097	0.0017	0.00085	0.000037
Endrin	72-20-8	—	—	—	—	—	0.207	PEC (Freshwater)	0.207	0.069	0.0017	0.00085	0.000022
Endrin aldehyde	7421-93-4	—	—	—	—	—	0.207	PEC (Freshwater)	0.207	0.069	0.0017	0.00085	0.000036
Endrin ketone	53494-70-5	—	—	—	—	—	0.207	PEC (Freshwater)	0.207	0.069	0.0017	0.00085	0.000036

Matrix:	**Saltwater Sediment**												
Analytical Group:	**Pesticides/Polychlorinated Biphenyls**												
Analyte	**CAS No.**	**Site-Specific Preliminary Remediation Goal[1] (mg/kg)**	**Basis of Preliminary Remediation Goal**	**Florida TEL (mg/kg)**	**Florida PEL (mg/kg)**	**Reference Concen-tration (mg/kg)**	**Other Screening Level[2] (mg/kg)**	**Other Screening Level Source**	**Lowest Screening Level (mg/kg)**	**PQL Goals (mg/kg)**	**LOQ[3] (mg/kg)**	**LOD[3] (mg/kg)**	**DL[3] (mg/kg)**
gamma-BHC (Lindane)	58-89-9	—	—	0.00032	0.00099	—	—	—	0.00032	0.00011	**0.002**	**0.00085**	0.000075
gamma-Chlordane	5103-74-2	—	—	0.00226	0.00479	—	—	—	0.00226	0.00075	0.0017	0.00085	0.000025
Heptachlor	76-44-8	—	—	—	—	—	0.0003	NOAA-AET	0.0003	0.0001	**0.002**	**0.00085**	0.000057
Heptachlor epoxide	1024-57-3	—	—	—	—	—	0.0003	Heptachlor	0.0003	0.0001	**0.002**	**0.00085**	0.000036
Methoxychlor	72-43-5	—	—	—	—	—	0.019	ECOTOX	0.019	0.0063	0.0067	0.00335	0.000067
Toxaphene	8001-35-2	—	—	—	—	—	0.028	ECOTOX	0.028	0.0093	**0.083**	**0.0415**	0.0091
Aroclor-1016	12674-11-2	—	—	0.0216 [5]	0.189 [5]	—	—	—	0.0216	0.0072	0.017	0.0085	0.0011
Aroclor-1221	11104-28-2	—	—	0.0216 [5]	0.189 [5]	—	—	—	0.0216	0.0072	0.017	0.013	0.0097
Aroclor-1232	11141-16-5	—	—	0.0216 [5]	0.189 [5]	—	—	—	0.0216	0.0072	0.017	0.0085	0.0033
Aroclor-1242	53469-21-9	—	—	0.0216 [5]	0.189 [5]	—	—	—	0.0216	0.0072	0.017	0.0085	0.0023
Aroclor-1248	12672-29-6	—	—	0.0216 [5]	0.189 [5]	—	—	—	0.0216	0.0072	0.017	0.0085	0.0038
Aroclor-1254	11097-69-1	—	—	0.0216 [5]	0.189 [5]	—	—	—	0.0216	0.0072	0.017	0.0085	0.0018
Aroclor-1260	11096-82-5	—	—	0.0216 [5]	0.189 [5]	—	—	—	0.0216	0.0072	0.017	0.0085	0.008
Aroclor-1262	37324-23-5	—	—	0.0216 [5]	0.189 [5]	—	—	—	0.0216	0.0072	0.017	0.0085	0.008
Aroclor-1268	11100-14-4	—	—	0.0216 [5]	0.189 [5]	—	—	—	0.0216	0.0072	0.017	0.0085	0.008

Matrix:	**Saltwater Sediment**												
Analytical Group:	**Metals**												
Analyte	**CAS No.**	**Site-Specific Preliminary Remediation Goal[1] (mg/kg)**	**Basis of Preliminary Remediation Goal**	**Florida TEL (mg/kg)**	**Florida PEL (mg/kg)**	**Reference Concen-tration (mg/kg)**	**Other Screening Level[2] (mg/kg)**	**Other Screening Level Source**	**Lowest Screening Level (mg/kg)**	**PQL Goals (mg/kg)**	**LOQ[3] (mg/kg)**	**LOD[3] (mg/kg)**	**DL[3] (mg/kg)**
Aluminum	7429-90-5	—	—	—	—	4,274	18000	NOAA-AET	4274	1425	2	1.5	1
Antimony	7440-36-0	—	—	—	—	0.26	9.3	NOAA-AET	0.26	0.087	0.05	0.04	0.03
Arsenic*	7440-38-2	—	—	7.24	41.6	2.14	—	—	2.14	0.71	0.05	0.04	0.03
Barium	7440-39-3	—	—	—	—	3.84	48	NOAA-AET	3.84	1.28	0.25	0.19	0.13
Beryllium	7440-41-7	0.26 (15, 16, 18), 0.3 (64)	PRG-LOEC	—	—	0.13	—	—	0.13	0.043	0.02	0.0155	0.011
Cadmium*	7440-43-9	17.7	PRG-LOEC	0.676	4.21	0.39	—	—	0.39	0.13	0.005	0.004	0.003
Calcium	7440-70-2	—	—	—	—	1,978.80	—	—	1978.8	660	10	5	2.5
Chromium*	7440-47-3	592	PRG-LOEC	52.3	160	13.1	—	—	13.1	4.37	0.25	0.19	0.13
Cobalt	7440-48-4	10	NOAA-AET	—	—	0.91	—	—	0.91	0.3	0.25	0.125	0.05

Matrix:	**Saltwater Sediment**													
Analytical Group:	**Metals**													
Analyte	**CAS No.**	**Site-Specific Preliminary Remediation Goal[1] (mg/kg)**	**Basis of Preliminary Remediation Goal**	**Florida TEL (mg/kg)**	**Florida PEL (mg/kg)**	**Reference Concen-tration (mg/kg)**	**Other Screening Level[2] (mg/kg)**	**Other Screening Level Source**	**Lowest Screening Level (mg/kg)**	**PQL Goals (mg/kg)**	**LOQ[3] (mg/kg)**	**LOD[3] (mg/kg)**	**DL[3] (mg/kg)**
Copper*	7440-50-8	108	PRG-PEL	18.7	108	8.44	—	—	8.44	2.8	0.05	0.04	0.03
Iron	7439-89-6	—	—	—	—	2,684.40	220000	NOAA-AET	2684.4	895	1	0.8	0.6
Lead*	7439-92-1	330	PRG-LOEC	30.2	112	21.04	—	—	21.04	7.0	0.05	0.04	0.03
Magnesium	7439-95-4	—	—	—	—	2943.6	—	—	2943.6	981	2.5	1.9	1.3
Manganese*	7439-96-5	—	—	—	—	9.81	260	NOAA-AET	9.81	3.27	0.25	0.125	0.1
Mercury	7439-97-6	0.11 [6]	RC	0.13	0.696	0.11	—	—	0.11	0.04	0.0083	0.007	0.0059
Nickel	7440-02-0	—	—	15.9	42.8	3.69	—	—	3.69	1.23	0.25	0.125	0.05
Potassium	7440-09-7	—	—	—	—	899.72	—	—	899.72	300	10	5	2.5
Selenium*	7782-49-2	1.3	PRG-LOEC	—	—	0.66	—	—	0.66	0.22	0.05	0.04	0.03
Silver*	7440-22-4	1.9	PRG-LOEC	0.733	1.77	0.52	—	—	0.52	0.17	0.05	0.04	0.03
Sodium	7440-23-5	—	—	—	—	11,439.60	—	—	11439.6	3813	10	5	2.5
Thallium	7440-28-0	—	—	—	—	0.39	—	—	0.39	0.13	0.025	0.019	0.013
Tin	7440-31-5	—	—	—	—	—	3.4	NOAA AET	3.4	1.1	0.5	0.25	0.05
Vanadium	7440-62-2	—	—	—	—	8.59	57	NOAA-AET	8.59	2.87	0.25	0.19	0.13
Zinc*	7440-66-6	306	PRG-LOEC	124	271	14.36	—	—	14.36	4.79	0.5	0.25	0.1

Saltwater Sediment Notes:

[1] Site-Specific Preliminary Remediation Goals (PRGs) were calculated for specific wetlands, which are indicated in parentheses after the value. (Sampling and Analysis Plan Memorandum [TetraTech 2012] or Feasibility Study Addendum [TetraTech 2010]).

[2] Available screening values are provided from alternate sources for cases in which Florida SQAGs were not available. Values were identified from the following hierarchy of sources: > ECOTOX > NOAA > U.S. EPA Region 4.

[3] LOQ, LOD, and DLs provided by Shealy Environmental Services, Inc., are targets that are achievable under optimal conditions and may vary during the course of the project. Results will be reported on a dry-weight basis.

[4] Gamma-BHC used as a surrogate compound

[5] Total PCB value is provided.

[6] The PRG for mercury at Wetland 64 is a reference concentration. Ecological screening levels for benthic invertebrates are not applicable because mercury was not selected as a chemical of concern for risks to sediment invertebrates. It was selected due to risk to the red drum via the food web pathway.

CAS No. = Chemical Abstract Services number
mg/kg = Milligram per kilogram
TEL = Threshold Effect Level for Coastal Waters (MacDonald 1994)
PEL = Probable Effect Level for Coastal Waters (MacDonald 1994)
PEC = Probable Effect Concentration for Inland Waters
PQL = Project Quantitation Limit
LOQ = Laboratory Limit of Quantitation
LOD = Laboratory Limit of Detection

Saltwater Sediment Notes (Continued):

DL	=	Laboratory Detection Limit
LMW-PAHs	=	Low molecular weight polynuclear aromatic hydrocarbons
HMW-PAHs	=	High molecular weight polynuclear aromatic hydrocarbons
DDx	=	Total 4,4'-dichlorodiphenyltrichloroethane, 4,4'-dichlorodiphenyldichloroethane, and 4,4'-dichlorodiphenyldichloroethylene
ECOTOX	=	U.S. EPA Ecotox Threshold from the January 1996 Ecological Update
NOAA	=	National Oceanic and Atmospheric Administration Screening Quick Reference Tables (Buchman 2008)
Dutch	=	NOAA compiled sediment Dutch intervention standard
AET	=	NOAA compiled sediment Apparent Effect Threshold from Washington Dept. of Ecology
PRG	=	Previously Determined Sampling and Analysis Plan Memorandum (TetraTech 2012) or Feasibility Study Addendum Preliminary Remediation Goal (TetraTech 2010)
LOEC	=	Lowest Observed Effect Concentration documented in the Sampling and Analysis Plan Memorandum
RC	=	Reference Concentration determined as part of the 2007 Remedial Investigation and subsequent Feasibility Study
NOEC	=	No Observed Effect Concentration documented in the Sampling and Analysis Plan Memorandum
—	=	Screening levels have been established for all chemicals of concern. If full scan analysis is performed with toxicity tests, screening levels can be developed for the remaining compounds if necessary.
Gray shade	=	Laboratory LOQ, LOD, and/or DL exceeds the lowest screening level.
*	=	Identified as a COC in TetraTech (2010)

DLs for all chemicals of concern are below their respective project action levels. The remaining compounds are being analyzed only when toxicity testing is being performed and will be reported as estimated concentrations at the DL per Florida Department of Environmental Protection guidelines.

SAP WORKSHEET #15: REFERENCE LIMITS AND EVALUATION TABLES (continued)

Matrix:	**Freshwater Surface Water**									
Analytical Group:	**Semivolatile Organic Compounds**									
Analyte	**CAS No.**	**FDEP Class III Surface Water Quality Criteria (µg/L)**	**Reference Concentration[1] (µg/L)**	**Other Screening Level[2] (µg/L)**	**Other Screening Level Source**	**Lowest Screening Level (µg/L)**	**PQL Goals (µg/L)**	**LOQ[3] (µg/L)**	**LOD[3] (µg/L)**	**DL[3] (µg/L)**
1,1'-Biphenyl	92-52-4	—	—	14	R3 BTAG	14	4.6	5	0.2	0.2
1,2,4,5-Tetrachlorobenzene	95-94-3	—	—	3	R3 BTAG	3	1	1	0.5	0.25
2,2'-Oxybis(1-chloropropane)	108-60-1	—	—	—	—	—	—	1	0.2	0.19
2,3,4,6-Tetrachlorophenol	58-90-2	—	—	1.2	R3 BTAG	1.2	0.4	**2**	1	0.51
2,4,5-Trichlorophenol	95-95-4	—	—	63	NOAA Chronic	63	21	1	0.41	0.21
2,4,6-Trichlorophenol	88-06-2	6.5	—	—	—	6.5	2.2	5	0.2	0.14
2,4-Dichlorophenol	120-83-2	790	—	—	—	790	260	1	0.41	0.21
2,4-Dimethylphenol	105-67-9	—	—	21.2	R4 ERB	21.2	7	1	0.41	0.39
2,4-Dinitrophenol	51-28-5	14260	—	—	—	14260	4700	10	1	0.43
2,4-Dinitrotoluene	121-14-2	9.1	—	—	—	9.1	3	2	0.4	0.25
2,6-Dinitrotoluene	606-20-2	—	—	81	R3 BTAG	81	27	10	0.4	0.38
2-Chloronaphthalene	91-58-7	—	—	0.396	NOAA Chronic	0.396	0.132	**1**	0.2	0.17
2-Chlorophenol	95-57-8	400	—	—	—	400	130	5	0.2	0.2
2-Methylnaphthalene	91-57-6	—	—	4.7	R3 BTAG	4.7	1.6	1	0.2	0.18
2-Methylphenol	95-48-7	—	—	13	R3 BTAG	13	4.3	1	0.41	0.3
2-Nitroaniline	88-74-4	—	—	—	—	—	—	2	0.4	0.33
2-Nitrophenol	88-75-5	—	—	3500	R4 ERB	3500	1200	10	0.4	0.39
3,3'-Dichlorobenzidine	91-94-1	—	—	4.5	R3 BTAG	4.5	1.5	**5**	0.82	0.58
3-Nitroaniline	99-09-2	—	—	—	—	—	—	10	0.4	0.23
4,6-Dinitro-2-methylphenol	534-52-1	—	—	—	—	—	—	25	1	0.58
4-Bromophenyl-phenylether	101-55-3	—	—	—	—	—	—	1	0.2	0.14
4-Chloro-3-methylphenol	59-50-7	—	—	—	—	—	—	1	0.2	0.19
4-Chloroaniline	106-47-8	—	—	232	R3 BTAG	232	77	5	0.41	0.22
4-Chlorophenyl-phenyl ether	7005-72-3	—	—	—	—	—	—	5	0.2	0.2
4-Methylphenol	106-44-5	—	—	543	R3 BTAG	543	180	2	0.82	0.64
4-Nitroaniline	100-01-6	—	—	—	—	—	28	2	0.4	0.19
4-Nitrophenol	100-02-7	—	—	82.8	R4 ERB	82.8	900	5	1	0.42
Acenaphthene	83-32-9	2700[4]	—	—	—	2700	900	0.2	0.04	0.021
Acenaphthylene	208-96-8	—	—	—	—	—	—	0.2	0.04	0.024
Acetophenone	98-86-2	—	—	—	—	—	—	10	0.41	0.32

Matrix:	**Freshwater Surface Water**										
Analytical Group:	**Semivolatile Organic Compounds**										
Analyte	**CAS No.**	**FDEP Class III Surface Water Quality Criteria (µg/L)**	**Reference Concentration[1] (µg/L)**	**Other Screening Level[2] (µg/L)**	**Other Screening Level Source**	**Lowest Screening Level (µg/L)**	**PQL Goals (µg/L)**	**LOQ[3] (µg/L)**	**LOD[3] (µg/L)**	**DL[3] (µg/L)**
Anthracene	120-12-7	110000[4]	—	—	—	110000	37000	0.2	0.04	0.016
Atrazine	1912-24-9	—	—	1.8	R3 BTAG	1.8	0.6	**10**	0.2	0.2
Benzaldehyde	100-52-7	—	—	—	—	—	—	10	0.41	0.22
Benzo(a)anthracene	56-55-3	—	—	0.018	R3 BTAG	0.018	0.006	**0.2**	**0.04**	**0.019**
Benzo(a)pyrene	50-32-8	—	—	0.015	R3 BTAG	0.015	0.005	**0.2**	**0.04**	**0.02**
Benzo(b)fluoranthene	205-99-2	—	—	—	—	—	—	0.2	0.04	0.019
Benzo(g,h,i)perylene	191-24-2	—	—	7.64	NOAA Chronic	7.64	2.5	0.2	0.08	0.062
Benzo(k)fluoranthene	207-08-9	—	—	—	—	—	—	0.2	0.04	0.024
Bis(2-chloroethoxy)methane	111-91-1	—	—	—	—	—	—	5	0.2	0.18
Bis(2-chloroethyl)ether	111-44-4	—	—	—	—	—	—	1	0.41	0.23
Bis(2-ethylhexyl)phthalate	117-81-7	—	—	0.3	R4 ERB	0.3	1	**5**	0.2	0.11
Butylbenzylphthalate	85-68-7	3	—			3	1	2	0.2	0.09
Caprolactam	105-60-2	—	—	—	—	—	—	10	0.41	0.29
Carbazole	86-74-8	—	—	—	—	—	—	1	0.2	0.06
Chrysene	218-01-9	—	—	—	—	—	—	0.2	0.04	0.021
Dibenzo(a,h)anthracene	53-70-3	—	—	—	—	—	—	0.2	0.08	0.04
Dibenzofuran	132-64-9	—	—	3.7	R3 BTAG	3.7	1.2	1	0.2	0.19
Diethylphthalate	84-66-2	3	—	—	—	3	1	1	0.2	0.14
Dimethylphthalate	131-11-3	3	—	—	—	3	1	**5**	0.2	0.11
Di-n-butylphthalate	84-74-2	3	—	—	—	3	1	**5**	0.2	0.06
Di-n-octylphthalate	117-84-0	3	—	—	—	3	1	1	0.2	0.089
Fluoranthene	206-44-0	370[4]	—	—	—	370	120	0.2	0.04	0.018
Fluorene	86-73-7	14000[4]	—	—	—	14000	4700	0.2	0.04	0.022
Hexachlorobenzene	118-74-1	—	—	0.0003	R3 BTAG	0.0003	0.0001	**1**	**0.2**	**0.17**
Hexachlorobutadiene	87-68-3	49.7	—	—	—	49.7	17	1	0.2	0.12
Hexachlorocyclopentadiene	77-47-4	—	—	0.07	R4 ERB	0.07	0.02	**10**	**1**	**0.71**
Hexachloroethane	67-72-1	—	—	12	R3 BTAG	12	4	5	0.41	0.22
Indeno(1,2,3-cd)pyrene	193-39-5	—	—	4.31	NOAA Chronic	4.31	1.4	0.2	0.08	0.05
Isophorone	78-59-1	—	—	1170	R4 ERB	1170	390	5	0.41	0.21
Naphthalene	91-20-3	—	—	62	R4 ERB	62	21	0.2	0.04	0.03
Nitrobenzene	98-95-3	—	—	270	R4 ERB	270	90	1	0.41	0.25
N-Nitroso-di-npropylamine	621-64-7	—	—	—	—	—	—	5	0.2	0.2

Matrix:	**Freshwater Surface Water**										
Analytical Group:	**Semivolatile Organic Compounds**										
Analyte	**CAS No.**	**FDEP Class III Surface Water Quality Criteria (µg/L)**	**Reference Concentration[1] (µg/L)**	**Other Screening Level[2] (µg/L)**	**Other Screening Level Source**	**Lowest Screening Level (µg/L)**	**PQL Goals (µg/L)**	**LOQ[3] (µg/L)**	**LOD[3] (µg/L)**	**DL[3] (µg/L)**
N-Nitrosodiphenylamine	86-30-6	—	—	58.5	R4 ERB	58.5	20	5	0.41	0.24
Pentachlorophenol	87-86-5	8.2	—	—	—	8.2	2.7	0.2	0.04	0.028
Phenanthrene	85-01-8	—	—	0.4	R3 BTAG	0.4	0.13	0.2	0.04	0.023
Phenol	108-95-2	300	—	—	—	300	100	1	0.41	0.22
Pyrene	129-00-0	11000[4]	—	—	—	11000	3700	0.2	0.04	0.017
Sum PAHs	—	0.031[5]	—	—	—	0.031	0.010	—	—	—

Matrix:	**Freshwater Surface Water**									
Analytical Group:	**Pesticides/Polychlorinated Biphenyls**									
Analyte	**CAS No.**	**FDEP Class III Surface Water Quality Criteria (µg/L)**	**Reference Concentration [1] (µg/L)**	**Other Screening Level[2] (µg/L)**	**Other Screening Level Source**	**Lowest Screening Level (µg/L)**	**PQL Goals (µg/L)**	**LOQ[3] (µg/L)**	**LOD[3] (µg/L)**	**DL[3] (µg/L)**
4,4'-DDD	72-54-8	—	—	0.0064	R4 ERB	0.0064	0.0021	**0.025**	0.004	0.001
4,4'-DDE	72-55-9	—	—	10.5	R4 ERB	10.5	3.5	0.025	0.004	0.0011
4,4'-DDT	50-29-3	0.00059	—	—	—	0.00059	0.0002	**0.025**	**0.004**	**0.002**
Aldrin	309-00-2	0.00014	—	—	—	0.00014	0.000047	**0.025**	**0.004**	**0.0017**
alpha-BHC	319-84-6	—	—	500	R4 ERB	500	170	0.025	0.004	0.001
alpha-Chlordane	5103-71-9	0.00059	—	—	—	0.00059	0.0002	**0.025**	**0.004**	**0.0013**
beta-BHC	319-85-7	0.046	—	—	—	0.046	0.015	0.025	0.004	0.0039
delta-BHC	319-86-8	—	—	141	R3 BTAG	141	47	0.025	0.004	0.0011
Dieldrin	60-57-1	0.00014	—	—	—	0.00014	0.000047	**0.025**	**0.004**	**0.001**
Endosulfan I	959-98-8	0.056[6]	—	—	—	0.056	0.019	0.025	0.004	0.0022
Endosulfan II	33213-65-9	0.056[6]	—			0.056	0.019	0.025	0.004	0.0015
Endosulfan sulfate	1031-07-8	0.056[6]	—	—	—	0.056	0.019	0.025	0.004	0.0011
Endrin	72-20-8	0.0023	—	—	—	0.0023	0.00077	**0.025**	**0.004**	0.001
Endrin aldehyde	7421-93-4	0.0023[7]	—	—	—	0.0023	0.00077	**0.025**	**0.004**	0.0019
Endrin ketone	53494-70-5	0.0023[7]	—	—	—	0.0023	0.00077	**0.025**	**0.004**	0.0012
gamma-BHC (Lindane)	58-89-9	0.063	—	—	—	0.063	0.021	0.025	0.004	0.0011
gamma-Chlordane	5103-74-2	0.00059	—	—	—	0.00059	0.0002	**0.025**	**0.004**	**0.0015**

Matrix:	**Freshwater Surface Water**										
Analytical Group:	**Pesticides/Polychlorinated Biphenyls**										
Analyte	**CAS No.**	**FDEP Class III Surface Water Quality Criteria (µg/L)**	**Reference Concentration [1] (µg/L)**	**Other Screening Level[2] (µg/L)**	**Other Screening Level Source**	**Lowest Screening Level (µg/L)**	**PQL Goals (µg/L)**	**LOQ[3] (µg/L)**	**LOD[3] (µg/L)**	**DL[3] (µg/L)**
Heptachlor	76-44-8	0.00021	—	—	—	0.00021	0.00007	**0.025**	**0.02**	**0.013**
Heptachlor epoxide	1024-57-3	—	—	0.0038	R4 ERB	0.0038	0.0013	**0.025**	**0.004**	0.002
Methoxychlor	72-43-5	0.03	—	—	—	0.03	0.01	**0.1**	0.004	0.002
Toxaphene	8001-35-2	0.0002	—	—	—	0.0002	0.00007	**0.31**	**0.093**	**0.03**
Aroclor-1016	12674-11-2	0.000045	—	—	—	0.000045	0.000015	**0.25**	**0.125**	**0.05**
Aroclor-1221	11104-28-2	0.000045	—	—	—	0.000045	0.000015	**0.25**	**0.125**	**0.14**
Aroclor-1232	11141-16-5	0.000045	—	—	—	0.000045	0.000015	**0.25**	**0.125**	**0.2**
Aroclor-1242	53469-21-9	0.000045	—	—	—	0.000045	0.000015	**0.25**	**0.125**	**0.14**
Aroclor-1248	12672-29-6	0.000045	—	—	—	0.000045	0.000015	**0.25**	**0.125**	**0.15**
Aroclor-1254	11097-69-1	0.000045	—	—	—	0.000045	0.000015	**0.25**	**0.125**	**0.11**
Aroclor-1260	11096-82-5	0.000045	—	—	—	0.000045	0.000015	**0.25**	**0.125**	**0.06**
Aroclor-1262	37324-23-5	0.000045	—	—	—	0.000045	0.000015	**0.25**	**0.125**	**0.1**
Aroclor-1268	11100-14-4	0.000045	—	—	—	0.000045	0.000015	**0.25**	**0.125**	**0.1**

Matrix:	**Freshwater Surface Water**									
Analytical Group:	**Metals**									
Analyte	**CAS No.**	**FDEP Class III Surface Water Quality Criteria (µg/L)**	**Reference Concentration[1] (µg/L)**	**Other Screening Level[2] (µg/L)**	**Other Screening Level Source**	**Lowest Screening Level (µg/L)**	**PQL Goals (µg/L)**	**LOQ[3] (µg/L)**	**LOD[3] (µg/L)**	**DL[3] (µg/L)**
Aluminum	7429-90-5	—	1090.25	—	—	1090.25	360	40	4	1.812
Antimony	7440-36-0	4300	4	—	—	4	1.3	1	0.2	0.097
Arsenic	7440-38-2	50	2.7	—	—	2.7	0.9	1	0.5	0.261
Barium	7440-39-3	—	3.68	4	R3 BTAG	3.68	1.3	**5**	0.1	0.045
Beryllium	7440-41-7	0.13	1	—	—	0.13	0.043	**0.4**	0.08	0.028
Cadmium	7440-43-9	0.16[8]	3	—	—	0.16	0.053	0.1	0.06	0.059
Calcium	7440-70-2	—	7675	116000	R3 BTAG	7675	2600	200	40	13
Chromium	7440-47-3	48.85[8,9]	8	—	—	8.00	2.7	5	0.5	0.346
Cobalt	7440-48-4	—	3	23	R3 BTAG	3	1	**5**	0.1	0.029
Copper	7440-50-8	5.16[8]	4	—	—	4.00	1.3	1	0.5	0.148
Iron	7439-89-6	1000	2360	—	—	1000	330	20	10	5.71

Matrix:	**Freshwater Surface Water**										
Analytical Group:	**Metals**										
Analyte	**CAS No.**	**FDEP Class III Surface Water Quality Criteria (µg/L)**	**Reference Concentration[1] (µg/L)**	**Other Screening Level[2] (µg/L)**	**Other Screening Level Source**	**Lowest Screening Level (µg/L)**	**PQL Goals (µg/L)**	**LOQ[3] (µg/L)**	**LOD[3] (µg/L)**	**DL[3] (µg/L)**
Lead	7439-92-1	1.32[8]	3.2	—	—	1.32	0.44	1	0.1	0.047
Magnesium	7439-95-4	—	20260	82000	R3 BTAG	20260	6800	50	2.5	0.941
Manganese	7439-96-5	—	13.2	120	R3 BTAG	13.2	4.4	5	0.5	0.198
Mercury	7439-97-6	0.012	0.13	—	—	0.012	0.004	**0.1**	**0.04**	**0.015**
Nickel	7440-02-0	29.02[8]	12	—	—	12.00	4	5	1	0.277
Potassium	7440-09-7	—	6995	53000	R3 BTAG	6995	2330	200	20	6
Selenium	7782-49-2	5	3	—	—	3	4	1	0.5	0.253
Silver	7440-22-4	0.07	4	—	—	0.07	0.02	**1**	0.02	0.011
Sodium	7440-23-5	—	182200	680000	R3 BTAG	182200	61000	200	10	4
Thallium	7440-28-0	6.3	2	—	—	2	0.67	0.5	0.25	0.076
Tin	7440-31-5	—	4.2	—	—	4.2	1.4	**5**	**4.8**	**4.6**
Vanadium	7440-62-2	—	4.7	20	R3 BTAG	4.7	1.6	**5**	2.5	1.46
Zinc	7440-66-6	66.6[8]	5.53	—	—	5.53	1.8	**10**	5	1.453

Freshwater Surface Water Notes:

[1] Reference Concentration determined as part of the 2007 Remedial Investigation and subsequent Feasibility Study. Values will be updated.

[2] Available screening values are provided from alternate sources for cases in which Florida Class III surface water criteria were not available. Values were identified from the following hierarchy of sources: U.S. EPA Region 4 ERB > U.S. R3 BTAG > NOAA Chronic Screening Values

[3] LOQ, LOD, and DLs provided by Shealy Environmental Services, Inc., are targets that are achievable under optimal conditions and may vary during the course of the project.

[4] This criterion is protective of human health not of aquatic life.

[5] Value for sum of the following PAHs: acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(g,h,i)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and phenanthrene

[6] Value for endosulfan.

[7] Value for endrin.

[8] Hardness-dependent freshwater screening values based on default hardness of 50 mg $CaCO_3$/L were calculated as follows:

Metal	**Equation**	**Screening Value (µg/L)**
Cadmium	$e^{(0.7401[lnH]-4.719)}$	0.16
Chromium (III)	$e^{(0.819[lnH]+0.6848)}$	48.85
Copper	$e^{(0.8545[lnH]-1.702)}$	5.16
Lead	$e^{(1.273[lnH]-4.705)}$	1.32
Nickel	$e^{(0.846[lnH]+0.0584)}$	29.02
Zinc	$e^{(0.8473[lnH]+0.884)}$	66.60

lnH = natural log of water hardness
e = exponential function

Freshwater Surface Water Notes (Continued):

[9] Value for trivalent chromium.

CAS No.	=	Chemical Abstract Services number
µg/L	=	Micrograms per liter
FDEP	=	Florida Department of Environmental Protection
PQL	=	Project Quantitation Limit
LOQ	=	Laboratory Limit of Quantitation
LOD	=	Laboratory Limit of Detection
DL	=	Laboratory Detection Limit
R3 BTAG	=	U.S. EPA Region 3 Biological Technical Assistance Group Surface Water Screening Values available at: http://www.epa.gov/reg3hwmd/risk/eco/index.htm
NOAA Chronic	=	Chronic National Oceanic and Atmospheric Administration Screening Quick Reference Tables, 2008.
R4 ERB	=	U.S. EPA Region 4 Surface Water Screening Values from the 2001 Ecological Risk Assessment Bulletins available at: http://www.epa.gov/region4/superfund/programs/riskassess/ecolbul.html
Gray shade	=	Laboratory LOQ, LOD, and/or DL exceeds the lowest screening level.

Matrix:	**Saltwater Surface Water**										
Analytical Group:	**Semivolatile Organic Compounds**										
Analyte	**CAS No.**	**FDEP Class III Surface Water Quality Criteria (µg/L)**	**Reference Concentration[1] (µg/L)**	**Other Screening Level[2] (µg/L)**	**Other Screening Level Source**	**Lowest Screening Level (µg/L)**	**PQL Goals (µg/L)**	**LOQ[3] (µg/L)**	**LOD[3] (µg/L)**	**DL[3] (µg/L)**
1,1'-Biphenyl	92-52-4	—	—	14[4]	R3 BTAG	14	4.7	5	2.5	0.2
1,2,4,5-Tetrachlorobenzene	95-94-3	—	—	129	R3 BTAG	129	43	1	0.5	0.25
2,2'-Oxybis(1-chloropropane)	108-60-1	—	—	—	—	—	—	1	0.5	0.19
2,3,4,6-Tetrachlorophenol	58-90-2	—	—	1.2[4]	R3 BTAG	1.2	0.4	**2**	1	0.51
2,4,5-Trichlorophenol	95-95-4	—	—	12	NOAA Chronic	12	4	1	0.5	0.21
2,4,6-Trichlorophenol	88-06-2	6.5	—	—	—	6.5	2.2	5	2.5	0.14
2,4-Dichlorophenol	120-83-2	790	—	—	—	790	260	1	0.5	0.21
2,4-Dimethylphenol	105-67-9	—	—	—	—	—	—	1	0.5	0.39
2,4-Dinitrophenol	51-28-5	14260	—	—	—	14260	4800	5	2.5	0.43
2,4-Dinitrotoluene	121-14-2	9.1	—	—	—	9.1	3	2	1	0.25
2,6-Dinitrotoluene	606-20-2	—	—	—	—	—	—	10	5	0.38
2-Chloronaphthalene	91-58-7	—	—	—	—	—	—	1	0.5	0.17
2-Chlorophenol	95-57-8	400	—	—	—	400	130	5	2.5	0.2
2-Methylnaphthalene	91-57-6	—	—	4.2	R3 BTAG	4.2	1.4	0.2	0.1	0.027
2-Methylphenol	95-48-7	—	—	1020	R3 BTAG	1020	340	1	0.5	0.3
2-Nitroaniline	88-74-4	—	—	—	—	—	—	2	1	0.33
2-Nitrophenol	88-75-5	—	—	2940	R3 BTAG	2940	980	10	5	0.39
3,3'-Dichlorobenzidine	91-94-1	—	—	73	R3 BTAG	73	24	5	2.5	0.58
3-Nitroaniline	99-09-2	—	—	—	—	—	—	10	5	0.23
4,6-Dinitro-2-methylphenol	534-52-1	—	—	—	—	—	—	25	12.5	0.58
4-Bromophenyl-phenylether	101-55-3	—	—	—	—	—	—	1	0.5	0.14
4-Chloro-3-methylphenol	59-50-7	—	—	—	—	—	—	1	0.5	0.19
4-Chloroaniline	106-47-8	—	—	—	—	—	—	5	2.5	0.22
4-Chlorophenyl-phenyl ether	7005-72-3	—	—	—	—	—	—	5	2.5	0.2
4-Methylphenol	106-44-5	—	—	—	—	—	—	2	1	0.64
4-Nitroaniline	100-01-6	—	—	—	—	—	—	2	1	0.19
4-Nitrophenol	100-02-7	—	—	71.7	R4 ERB	71.7	24	5	2.5	0.42
Acenaphthene	83-32-9	2700[5]	—	—	—	2700	900	0.2	0.1	0.021
Acenaphthylene	208-96-8	—	—	—	—	—	—	0.2	0.1	0.024
Acetophenone	98-86-2	—	—	—	—	—	—	10	5	0.32
Anthracene	120-12-7	110000[5]	—	—	—	110000	37000	0.2	0.1	0.016

Matrix:	**Saltwater Surface Water**										
Analytical Group:	**Semivolatile Organic Compounds**										
Analyte	**CAS No.**	**FDEP Class III Surface Water Quality Criteria (µg/L)**	**Reference Concentration[1] (µg/L)**	**Other Screening Level[2] (µg/L)**	**Other Screening Level Source**	**Lowest Screening Level (µg/L)**	**PQL Goals (µg/L)**	**LOQ[3] (µg/L)**	**LOD[3] (µg/L)**	**DL[3] (µg/L)**
Atrazine	1912-24-9	—	—	—	—	—	—	10	5	0.2
Benzaldehyde	100-52-7	—	—	—	—	—	—	10	5	1
Benzo(a)anthracene	56-55-3	—	—	—	—	—	—	0.2	0.1	0.019
Benzo(a)pyrene	50-32-8	—	—	—	—	—	—	0.2	0.1	0.02
Benzo(b)fluoranthene	205-99-2	—	—	—	—	—	—	0.2	0.1	0.019
Benzo(g,h,i)perylene	191-24-2	—	—	—	—	—	—	0.2	0.1	0.062
Benzo(k)fluoranthene	207-08-9	—	—	—	—	—	—	0.2	0.1	0.024
Bis(2-chloroethoxy)methane	111-91-1	—	—	—	—	—	—	5	2.5	0.18
Bis(2-chloroethyl)ether	111-44-4	—	—	—	—	—	—	1	0.5	0.23
Bis(2-ethylhexyl)phthalate	117-81-7	—	—	0.3[4]	R3 BTAG	0.3	0.1	**5**	**2.5**	0.11
Butylbenzylphthalate	85-68-7	3	—	—	—	3	1	2	1	0.09
Caprolactam	105-60-2	—	—	—	—	—	—	10	5	1.2
Carbazole	86-74-8	—	—	—	—	—	—	1	0.5	0.06
Chrysene	218-01-9	—	—	—	—	—	—	0.2	0.1	0.021
Dibenzo(a,h)anthracene	53-70-3	—	—	—	—	—	—	0.2	0.1	0.04
Dibenzofuran	132-64-9	—	—	65	R3 BTAG	65	22	1	0.5	0.19
Diethylphthalate	84-66-2	3	—	—	—	3	1	1	0.5	0.14
Dimethylphthalate	131-11-3	3	—	—	—	3	1	**5**	2.5	0.11
Di-n-butylphthalate	84-74-2	3	—	—	—	3	1	**5**	2.5	0.06
Di-n-octylphthalate	117-84-0	3	—	—	—	3	1	1	0.5	0.089
Fluoranthene	206-44-0	370[5]	—	—	—	370	120	0.2	0.1	0.018
Fluorene	86-73-7	14000[5]	—	—	—	14000	4700	0.2	0.1	0.022
Hexachlorobenzene	118-74-1	—	—	—	—	—	—	1	0.5	0.17
Hexachlorobutadiene	87-68-3	49.7	—	—	—	49.7	17	1	0.5	0.12
Hexachlorocyclopentadiene	77-47-4	—	—	0.07	R4 ERB	0.07	0.02	**10**	**5**	**0.23**
Hexachloroethane	67-72-1	—	—	9.4	R3 BTAG	9.4	3.1	5	2.5	0.22
Indeno(1,2,3-cd)pyrene	193-39-5	—	—	—	—	—	—	0.2	0.1	0.05
Isophorone	78-59-1	—	—	129	R4 ERB	129	43	5	2.5	0.21
Naphthalene	91-20-3	—	—	23.5	R4 ERB	23.5	7.8	0.2	0.1	0.03
Nitrobenzene	98-95-3	—	—	66.8	R4 ERB	66.8	22	1	0.5	0.25
N-Nitroso-di-n-propylamine	621-64-7	—	—	120	R3 BTAG	120	40	5	2.5	0.2
N-Nitrosodiphenylamine	86-30-6	—	—	33000	R4 ERB	33000	11000	5	2.5	0.24

Matrix:	**Saltwater Surface Water**									
Analytical Group:	**Semivolatile Organic Compounds**									
Analyte	**CAS No.**	**FDEP Class III Surface Water Quality Criteria (µg/L)**	**Reference Concentration[1] (µg/L)**	**Other Screening Level[2] (µg/L)**	**Other Screening Level Source**	**Lowest Screening Level (µg/L)**	**PQL Goals (µg/L)**	**LOQ[3] (µg/L)**	**LOD[3] (µg/L)**	**DL[3] (µg/L)**
Pentachlorophenol	87-86-5	7.9	—	—	—	7.9	2.6	**25**	**12.5**	0.57
Phenanthrene	85-01-8	—	—	1.5	R3 BTAG	1.5	0.5	0.2	0.1	0.023
Phenol	108-95-2	300	—	—	—	300	100	1	0.5	0.22
Pyrene	129-00-0	11000[5]	—	—	—	11000	3700	0.2	0.1	0.017
Sum PAHs	—	0.031[6]	—	—	—	0.031	0.010	—	—	—

Matrix:	**Saltwater Surface Water**									
Analytical Group:	**Pesticides/Polychlorinated Biphenyls**									
Analyte	**CAS No.**	**FDEP Class III Surface Water Quality Criteria (µg/L)**	**Reference Concentration[1] (µg/L)**	**Other Screening Level[2] (µg/L)**	**Other Screening Level Source**	**Lowest Screening Level (µg/L)**	**PQL Goals (µg/L)**	**LOQ[3] (µg/L)**	**LOD[3] (µg/L)**	**DL[3] (µg/L)**
4,4'-DDD	72-54-8	—	—	0.025	R4 ERB	0.025	0.0083	**0.025**	0.0125	0.001
4,4'-DDE	72-55-9	—	—	0.14	R4 ERB	0.14	0.05	0.025	0.0125	0.0011
4,4'-DDT	50-29-3	0.00059	—	—	—	0.00059	0.0002	**0.025**	**0.0125**	**0.002**
Aldrin	309-00-2	0.00014	—	—	—	0.00014	0.000047	**0.025**	**0.0125**	**0.0017**
alpha-BHC	319-84-6	—	—	1400	R4 ERB	1400	470	0.025	0.0125	0.001
alpha-Chlordane	5103-71-9	0.00059	—	—	—	0.00059	0.0002	**0.025**	**0.0125**	**0.0013**
beta-BHC	319-85-7	0.046	—	—	—	0.046	0.015	0.025	0.0125	0.0039
delta-BHC	319-86-8	—	—	—	—	—	—	0.025	0.0125	0.0011
Dieldrin	60-57-1	0.00014	—	—	—	0.00014	0.000047	**0.025**	**0.0125**	**0.001**
Endosulfan I	959-98-8	0.0087[7]	—	—	—	0.0087	0.0029	**0.025**	**0.0125**	0.0022
Endosulfan II	33213-65-9	0.0087[7]	—	—	—	0.0087	0.0029	**0.025**	**0.0125**	0.0015
Endosulfan sulfate	1031-07-8	0.0087[7]	—	—	—	0.0087	0.0029	**0.025**	**0.0125**	0.0011
Endrin	72-20-8	0.0023	—	—	—	0.0023	0.00077	**0.025**	**0.0125**	0.001
Endrin aldehyde	7421-93-4	0.0023[8]	—	—	—	0.0023	0.00077	**0.025**	**0.0125**	0.0019
Endrin ketone	53494-70-5	0.0023[8]	—	—	—	0.0023	0.00077	**0.025**	**0.0125**	0.0012
gamma-BHC (Lindane)	58-89-9	0.063	—	—	—	0.063	0.021	0.025	0.0125	0.0011
gamma-Chlordane	5103-74-2	0.00059	—	—	—	0.00059	0.0002	**0.025**	**0.0125**	**0.0015**
Heptachlor	76-44-8	0.00021	—	—	—	0.00021	0.00007	**0.025**	**0.18**	**0.013**

Matrix:	**Saltwater Surface Water**										
Analytical Group:	**Pesticides/Polychlorinated Biphenyls**										
Analyte	**CAS No.**	**FDEP Class III Surface Water Quality Criteria (µg/L)**	**Reference Concentration[1] (µg/L)**	**Other Screening Level[2] (µg/L)**	**Other Screening Level Source**	**Lowest Screening Level (µg/L)**	**PQL Goals (µg/L)**	**LOQ[3] (µg/L)**	**LOD[3] (µg/L)**	**DL[3] (µg/L)**
Heptachlor epoxide	1024-57-3	—	—	0.0036	R4 ERB	0.0036	0.0012	**0.025**	**0.0125**	0.002
Methoxychlor	72-43-5	0.03	—	—	—	0.03	0.01	**0.1**	**0.05**	0.002
Toxaphene	8001-35-2	0.0002	—	—	—	0.0002	0.00007	**0.25**	**0.125**	**0.03**
Aroclor-1016	12674-11-2	0.000045	—	—	—	0.000045	0.000015	**0.25**	**0.125**	**0.05**
Aroclor-1221	11104-28-2	0.000045	—	—	—	0.000045	0.000015	**0.25**	**0.2**	**0.14**
Aroclor-1232	11141-16-5	0.000045	—	—	—	0.000045	0.000015	**0.25**	**0.22**	**0.2**
Aroclor-1242	53469-21-9	0.000045	—	—	—	0.000045	0.000015	**0.25**	**0.2**	**0.14**
Aroclor-1248	12672-29-6	0.000045	—	—	—	0.000045	0.000015	**0.25**	**0.2**	**0.15**
Aroclor-1254	11097-69-1	0.000045	—	—	—	0.000045	0.000015	**0.25**	**0.125**	**0.11**
Aroclor-1260	11096-82-5	0.000045	—	—	—	0.000045	0.000015	**0.25**	**0.125**	**0.06**
Aroclor-1262	37324-23-5	0.000045	—	—	—	0.000045	0.000015	**0.25**	**0.125**	**0.1**
Aroclor-1268	11100-14-4	0.000045	—	—	—	0.000045	0.000015	**0.25**	**0.125**	**0.1**

Matrix:	**Saltwater Surface Water**									
Analytical Group:	**Metals**									
Analyte	**CAS No.**	**FDEP Class III Surface Water Quality Criteria (µg/L)**	**Reference Concentration[1] (µg/L)**	**Other Screening Level[2] (µg/L)**	**Other Screening Level Source**	**Lowest Screening Level (µg/L)**	**PQL Goals (µg/L)**	**LOQ[3] (µg/L)**	**LOD[3] (µg/L)**	**DL[3] (µg/L)**
Aluminum	7429-90-5	1500	2927.5	—	—	1500	500	40	20	1.8
Antimony	7440-36-0	4300	4.15	—	—	4.15	1.4	1	0.5	0.097
Arsenic	7440-38-2	50	3.6	—	—	3.6	1.2	1	0.5	0.26
Barium	7440-39-3	—	9.43	4[4]	R3 BTAG	4	1.3	**5**	2.5	0.045
Beryllium	7440-41-7	0.13	0.82	—	—	0.13	0.043	**0.4**	**0.2**	0.028
Cadmium	7440-43-9	8.8	2.4	—	—	2.4	0.8	0.1	0.08	0.059
Calcium	7440-70-2	—	76800	116000[4]	R3 BTAG	76800	26000	200	100	13
Chromium	7440-47-3	—	10.87	103[9]	R4 ERB	10.87	3.6	5	2.5	0.35
Cobalt	7440-48-4	—	2.38	23[4]	R3 BTAG	2.38	0.79	**5**	**2.5**	0.029
Copper	7440-50-8	3.7	7.03	—	—	3.7	1.2	1	0.5	0.15
Iron	7439-89-6	300	1352	—	—	300	100	20	10	5.7
Lead	7439-92-1	8.5	13.75	—	—	8.5	2.8	1	0.5	0.047

Matrix:	**Saltwater Surface Water**										
Analytical Group:	**Metals**										
Analyte	**CAS No.**	**FDEP Class III Surface Water Quality Criteria (µg/L)**	**Reference Concentration[1] (µg/L)**	**Other Screening Level[2] (µg/L)**	**Other Screening Level Source**	**Lowest Screening Level (µg/L)**	**PQL Goals (µg/L)**	**LOQ[3] (µg/L)**	**LOD[3] (µg/L)**	**DL[3] (µg/L)**
Magnesium	7439-95-4	—	243650	—	—	243650	81000	50	25	0.94
Manganese	7439-96-5	—	12.15	—	—	12.15	4.1	5	2.5	0.2
Mercury	7439-97-6	0.025	0.21	—	—	0.025	0.008	**0.1**	**0.075**	**0.053**
Nickel	7440-02-0	8.3	9.3	—	—	8.3	2.7	5	2.5	0.28
Potassium	7440-09-7	—	81250	—	—	81250	27000	200	100	6
Selenium	7782-49-2	71	2.9	—	—	2.9	0.97	1	0.5	0.25
Silver	7440-22-4	2.3	3.01	—	—	2.3	0.77	1	0.5	0.011
Sodium	7440-23-5	—	1952000	—	—	1952000	651000	200	100	4
Thallium	7440-28-0	6.3	2.55	—	—	2.55	0.85	0.5	0.25	0.076
Tin	7440-31-5	—	—	—	—	—	—	5	4.8	4.6
Vanadium	7440-62-2	—	6.69	—	—	6.69	2.2	5	2.5	1.5
Zinc	7440-66-6	86	12.88	—	—	12.88	4.3	10	5	1.5

Saltwater Surface Water Notes:

[1] Reference Concentration determined as part of the 2007 Remedial Investigation and subsequent Feasibility Study. Values will be updated.

[2] Available screening values are provided from alternate sources for cases in which Florida Class III surface water criteria were not available. Values were identified from the following hierarchy of sources: U.S. EPA Region 4 ERB > U.S. R3 BTAG > NOAA Chronic Screening Values

[3] LOQ, LOD, and DLs provided by Shealy Environmental Services, Inc., are targets that are achievable under optimal conditions and may vary during the course of the project.

[4] No saltwater screening value available; value is derived for freshwater and is suggested for use by source document.

[5] This criterion is protective of human health not of aquatic life.

[6] Value for sum of the following PAHs: acenaphthylene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and phenanthrene

[7] Value for endosulfan.

[8] Value for endrin.

[9] Value for trivalent chromium.

CAS No. = Chemical Abstract Services number
µg/L = Micrograms per liter
FDEP = Florida Department of Environmental Protection
PQL = Project Quantitation Limit
LOQ = Laboratory Limit of Quantitation
LOD = Laboratory Limit of Detection
DL = Laboratory Detection Limit
R3 BTAG = U.S. EPA Region 3 Biological Technical Assistance Group Surface Water Screening Values available at: http://www.epa.gov/reg3hwmd/risk/eco/index.htm
NOAA Chronic = Chronic National Oceanic and Atmospheric Administration Screening Quick Reference Tables, 2008.
R4 ERB = U.S. EPA Region 4 Surface Water Screening Values from the 2001 Ecological Risk Assessment Bulletins available at: http://www.epa.gov/region4/superfund/programs/riskassess/ecolbul.html
Gray shade = Laboratory LOQ, LOD, and/or DL exceeds the lowest screening level.

SAP WORKSHEET #16: PROJECT SCHEDULE/TIMELINE TABLE

(UFP-QAPP Manual Section 2.8.2)

Table 16-1
Project Schedule

Task Name	Start	Finish
NAS Pensacola Wetlands	**6/1/2012**	**10/13/2019**
OU 1, 2 and 16 Wetlands UFP-SAP	**6/1/2012**	**10/17/2014**
Prepare Draft Internal UFP-SAP	6/1/2012	8/29/2012
Submit Draft Internal UFP-SAP	8/30/2012	8/30/2012
Navy Comments	8/31/2012	9/13/2012
Prepare Draft UFP-SAP	9/14/2012	9/27/2012
Submit Draft UFP-SAP	9/27/2012	9/27/2012
U.S. EPA/FDEP Comments	9/28/2012	12/18/2012
Response to Regulatory Comments	12/19/2012	2/16/2013
Comments on the Response to Comments	2/17/2013	4/26/2013
Response to Regulatory Comments 2	4/27/2013	5/16/2013
Comments on the Responses to Comments 2	5/17/2013	6/6/2013
Conference Call	6/7/2013	6/7/2013
Revise Response to Comments	6/8/2013	8/11/2013
U.S. EPA/FDEP Comments	8/12/2013	9/10/2013
Response to Regulatory Comments	2/12/2014	4/11/2014
Prepare Draft/Final UFP-SAP	4/12/14	9/11/2014
Submit Draft/Final UFP-SAP	9/12/2014	9/12/2014
Approval Draft-Final UFP-SAP	9/13/2014	9/30/2014
Prepare Final UFP-SAP	10/1/2014	10/10/2014
Submit Final UFP-SAP	10/10/2014	10/10/2014
EPA/FDEP Review and Approval OU 16 UFP-SAP	10/11/2014	10/17/2014
OU 1,2, and 16 Wetlands Field Investigation/Laboratory Analysis/Data Validation	**10/20/2014**	**6/18/2015**
Reference Wetlands/Phase I Sampling	**10/20/2014**	**12/22/2014**
Mobilization	10/20/2014	10/27/2014
Field Investigation	10/28/2014	11/5/2014
Laboratory Analysis	10/29/2014	11/13/2014
Data Validation	11/5/2014	11/20/2014
Data Evaluation	11/6/2014	11/26/2014
Submit Data to Team	11/26/2014	11/26/2014
Team Review of Data	11/27/2014	12/12/2014
Discuss Data with Team	12/15/2014	12/22/2014
Phase II Sampling	**1/15/2015**	**3/12/2015**

Table 16-1
Project Schedule

Task Name	Start	Finish
Mobilization	1/15/2015	1/19/2015
Field Investigation	1/20/2015	1/28/2015
Laboratory Analysis	1/21/2015	2/5/2015
Data Validation	1/27/2015	2/11/2015
Data Evaluation	1/28/2015	2/17/2015
Submit Data to Team	2/17/2015	2/17/2015
Team Review of Data	2/17/15	3/4/2015
Discuss Data with Team	3/5/2015	3/12/2015
Phase III/Toxicity Sampling	**3/12/2015**	**6/18/2015**
Mobilization	3/12/2015	3/16/2015
Field Investigation	3/16/2015	3/24/2015
Laboratory Analysis/Toxicity Testing	3/17/2015	5/16/2015
Data Validation	4/14/2015	6/3/2015
Data Evaluation	6/3/2015	6/18/2015
Submit Data to Team	6/18/2015	6/18/2015
OU 16 Wetlands Feasibility Study Report	**6/18/2015**	**6/24/2016**
Prepare Draft Internal FS	6/18/2015	9/16/2015
Submit Draft Internal FS	9/16/2015	9/16/2015
Navy Comments	9/16/2015	10/1/2015
Prepare Draft FS	10/1/2015	10/16/2015
Submit Draft FS	10/16/2015	10/16/2015
EPA/FDEP Comments	10/16/2015	1/14/2016
Response to Regulatory Comments	1/14/2016	3/13/2016
Prepare Draft/Final FS	3/13/2016	5/12/2016
Submit Draft/Final FS	5/12/2016	5/12/2016
Approval Draft-Final FS	5/12/2016	6/10/2016
Prepare Final FS	6/10/2016	6/24/2016
Submit Final FS	6/24/2016	6/24/2016
OU 16 Wetlands Proposed Plan	**2/12/2016**	**2/14/2017**
Prepare Draft Internal PP	2/12/2016	4/11/2016
Submit Draft Internal PP	4/11/2016	4/11/2016
Navy Comments	4/11/2016	4/25/2016
Prepare Draft PP	4/25/2016	5/8/2016
Submit Draft PP	5/8/2016	5/8/2016
EPA/FDEP Comments	5/8/2016	8/5/2016
Response to Regulatory Comments	8/5/2016	10/4/2016

Table 16-1
Project Schedule

Task Name	Start	Finish
Prepare Draft-Final PP	10/4/2016	12/2/2016
Submit Draft-Final PP	12/2/2016	12/2/2016
Approval Draft-Final PP	12/2/2016	1/1/2017
Prepare Final PP	1/1/2017	1/15/2017
Submit Final PP	1/15/2017	1/15/2017
Comment Period	1/15/2017	2/14/2017
OU 16 Wetlands Record of Decision	**5/8/2016**	**4/11/2017**
Prepare Draft Internal ROD	5/8/2016	7/6/2016
Submit Draft Internal ROD	7/6/2016	7/6/2016
Navy Comments	7/6/2016	7/20/2016
Prepare Draft ROD	7/20/2016	8/2/2016
Submit Draft ROD	8/2/2016	8/2/2016
EPA/FDEP Comments	8/2/2016	10/31/2016
Response to Regulatory Comments	10/31/2016	12/29/2016
Prepare Draft-Final ROD	12/29/2016	2/26/2017
Submit Draft-Final ROD	2/26/2017	2/26/2017
Approval of Draft Final ROD	2/26/2017	3/28/2017
Prepare Final ROD	3/28/2017	4/11/2017
Submit Final ROD	4/11/2017	4/11/2017
OU 16 Wetlands Remedial Design	**11/29/2016**	**11/2/2017**
Prepare Draft Internal RD	11/29/2016	1/28/2017
Submit Draft Internal RD	1/28/2017	1/28/2017
Navy Comments	1/28/2017	2/10/2017
Prepare Draft RD	2/10/2017	2/23/2017
Submit Draft RD	2/23/2017	2/23/17
EPA/FDEP Comments	2/23/17	5/24/2017
Response to Regulatory Comments	5/24/2017	7/22/2017
Prepare Draft-Final RD	7/22/2017	9/20/2017
Submit Draft-Final RD	9/20/2017	9/20/2017
Approval Draft-Final RD	9/20/2017	10/19/2017
Prepare Final RD	10/19/2017	11/2/2017
Submit Final RD	11/2/2017	11/2/2017
OU 16 Wetlands Remedial Action Work Plan	**6/23/2017**	**6/21/2018**
Prepare Draft Internal RA WP	6/23/2017	8/21/2017
Submit Draft Internal RA WP	8/21/2017	8/21/2017
Navy Comments	8/21/2017	9/14/2017

Table 16-1
Project Schedule

Task Name	Start	Finish
Prepare Draft RA WP	9/14/2017	9/28/2017
Submit Draft Remedial Action Work Plan	9/28/2017	9/28/2017
Regulatory Review of Draft Remedial Action Work Plan	9/28/2017	12/26/2017
Response to Regulatory Comments	12/26/2017	2/22/2018
Prepare Draft-Final RA WP	2/22/2018	4/23/2018
Submit Draft Final Remedial Action Work Plan	4/23/2018	4/23/2018
Approval of Draft Final Remedial Action Work Plan	4/23/2018	5/22/2018
Prepare Final Remedial Action Work Plan	5/22/2018	6/21/2018
Submit Final Remedial Action Work Plan	6/21/2018	6/21/2018
OU 16 Wetlands Remedial Action Completion	**6/21/2018**	**12/17/2018**
OU 16 Wetlands Remedial Action Completion Report	**12/17/2018**	**10/13/2019**
Prepare Draft Internal Remedial Action Completion Report	12/17/2018	2/14/2019
Submit Draft Internal Remedial Action Completion Report	2/14/2019	2/14/2019
Navy Comments	2/14/2019	2/28/2019
Prepare Draft RACR Report	2/28/2019	3/6/2019
Submit Draft RACR Report	3/6/2019	3/6/2019
EPA/FDEP Comments	3/6/2019	5/4/2019
Response to Regulatory Comments	5/4/2019	7/3/2019
Prepare Draft Final Remedial Action Completion Report	7/3/2019	8/31/2019
Submit Draft Final Remedial Action Completion Report	8/31/2019	8/31/2019
Approval Draft Final Remedial Action Completion Report	8/31/2019	9/30/2019
Prepare Final Remedial Action Completion Report	9/30/2019	10/13/2019
Submit Final Remedial Action Completion Report	10/13/2019	10/13/2019

Notes:
FS = Feasibility Study
PP = Proposed Plan
ROD = Record of Decision
RA = Remedial Action
WP = Work Plan
RACR = Remedial Action Completion Report

SAP WORKSHEET #17: SAMPLING DESIGN AND RATIONALE

(UFP-QAPP Manual Section 3.1.1)

17.1 Site-Specific Sampling Design

This worksheet presents the design and rationale of the sampling and analysis program to be conducted during this investigation. The sampling approach, based on professional judgment that was agreed upon by the Partnering Team, is biased to investigate areas most likely to contain "worst-case" concentrations of COCs as identified in the RI and FS. Data from these "worse-case" areas will facilitate screening efforts necessary to determine whether an impact to human or ecological receptors has occurred. Sampling locations and analytical lists are unique to each wetland, based on RI results, Partnering Team agreements, and refinements of the site-specific conceptual models (Worksheet #10).

The sampling design addresses four distinct sampling objectives:

1. Determining background reference concentrations

2. Assess horizontal and/or vertical extent of sediment contamination near previous PRG exceedances and along expected migration paths within each wetland

3. Characterize surface water contamination

4. Assess the toxicity of sediment and/or surface water to ecological receptors

5. Assess the potential for bioaccumulation and food web effects on higher-trophic-level receptors

6. Develop PRGs for human health and ecological COCs, using current data and refined background concentrations, identified in this risk assessment.

Work will be performed in four phases in the order provided below:

1. Background/Wetland 3 CSM — Reference wetlands and Wetland 3 refinement sampling

2. Sediment/Surface Water Phase I — Surface water and primary and horizontal sediment sample locations

3. Sediment Phase II (Contingent on Phase I Results) — Vertical and horizontal step out sediment sampling locations

4. Toxicity Sediment/Surface Water Phase III (Contingent on Phase I/II Results) — Toxicity sediment and/or surface water sampling

The anticipated sample locations and coordinates for each phase are presented in Worksheet #18. Some locations may need to be adjusted slightly in the field based on site conditions (i.e., too much water, not within wetlands, etc.). If movement of a sample location is required, the rationale will be documented in the field logbook and the coordinates for the new location will be recorded. The SOPs for sample collection, preservation, and handling are identified in Worksheet #21. Additional detail for each objective is provided in the following sections.

17.2 Background/Reference Concentration Sampling

Background samples will be collected from reference Wetlands 32 and 70A (freshwater), Wetlands 27B and 33 (saltwater), and 25A and 27A (Hurricane series soil). Background samples will be collected for both sediment and surface water.

Samples collected from the six reference wetlands will serve two purposes:

1. To provide background data on SVOCs/PAHs, pesticides, and metals plus tin in sediment

2. To provide background data on SVOCs/PAHs, pesticides, and metals plus tin in surface water

Reference wetlands are not impacted by site activities and will be sampled before the wetlands being investigated at Site 41.

There will be five locations sampled per wetland at 0-4 inches, 4-12 inches, and 12-24 inches (Figures 17-1 through 17-5). Sample analyses are summarized in Table 17-1.

N

Wetland
25B

041M25A01

041M25A05

041M25A02

Wetland
25A

041M25A04

041M25A03

Proposed Sediment and Surface Water Locations

Wetland Boundary

Extent of Water *

0 50 100 200 300 Feet

Figure 17-1: Reference Wetland 25A
Sample Locations
UFP-SAP, OU1, OU2, OU16 Wetlands
NAS Pensacola, Pensacola, Florida

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: A. Harris	DATE: 11/4/2013
DRAWN BY: N. Rinehart	TASK ORDER NUMBER: JM07

Basemap Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

* Source: NAVFAC SE/NIRIS

NOTE: Wetland boundaries may not reflect current conditions.

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N

041M27B06

041M27B05

Wetland
27B

041M27B04

041M27B03

041M27B07

041M27A01

Wetland
27A

041M27A02

041M27A03

041M27A05

041M27A04

RI Sample Locations

Proposed Sediment and Surface Water Locations

Surface Water Locations

Wetland Boundary

Extent of Water *

0 50 100 200 300 Feet

Figure 17-2: Reference Wetland 27A/27B
Sample Locations
UFP-SAP, OU1, OU2, OU16 Wetlands
NAS Pensacola, Pensacola, Florida

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* Source: NAVFAC SE/NIRIS

NOTE: Wetland boundaries may not reflect current conditions.

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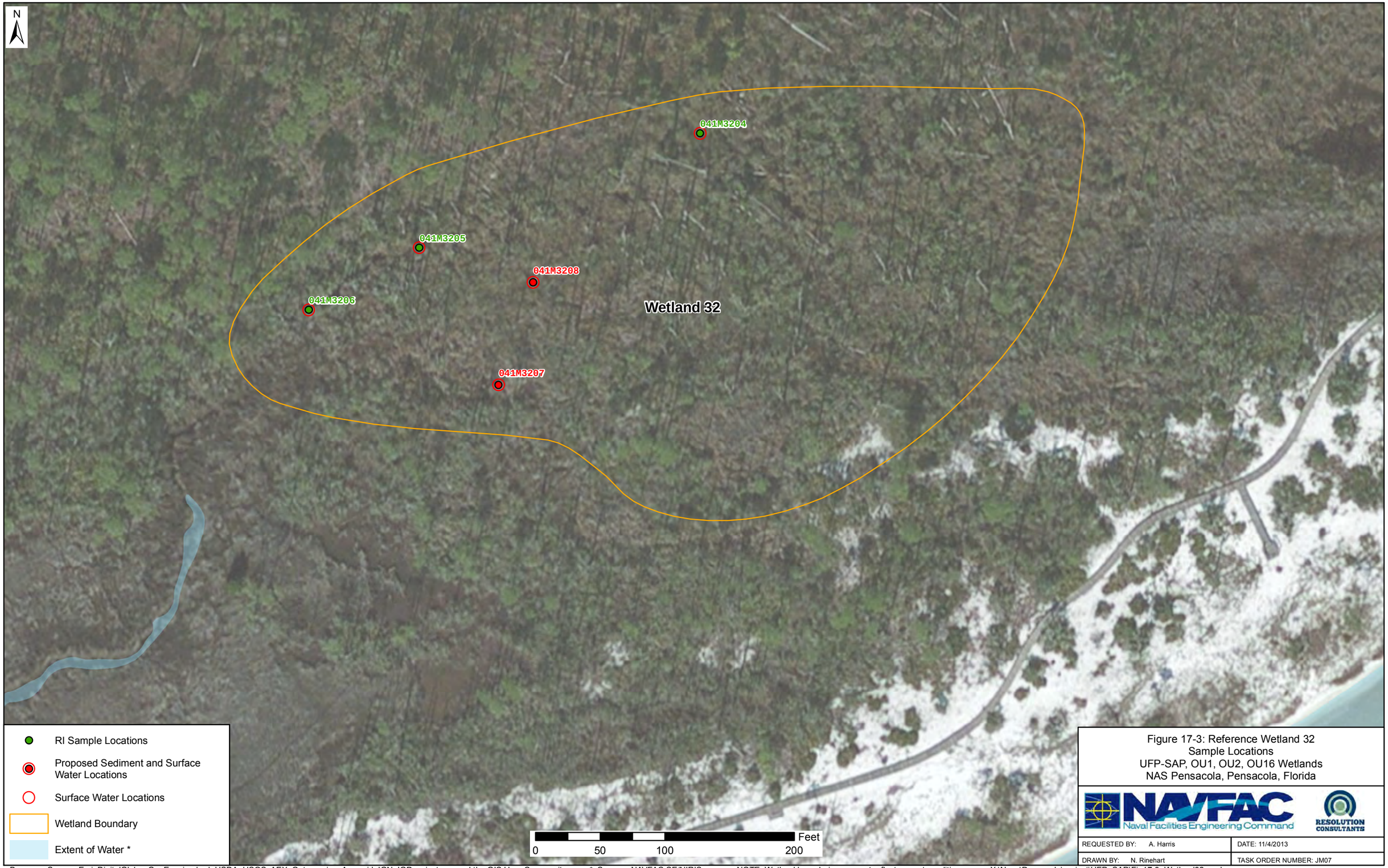

Figure 17-3: Reference Wetland 32
Sample Locations
UFP-SAP, OU1, OU2, OU16 Wetlands
NAS Pensacola, Pensacola, Florida

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Figure 17-4: Reference Wetland 33
Sample Locations
UFP-SAP, OU1, OU2, OU16 Wetlands
NAS Pensacola, Pensacola, Florida

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N

Wetland 70B

041M70A02

Wetland 70A

041M70A01

041M70A04

041M70A03

041M70A05

Proposed Primary Sediment and Surface Water Locations

Wetland Boundary

Extent of Water *

Feet
0 50 100

Figure 17-5: Wetland 70A
Sample Locations
UFP-SAP, OU1, OU2, and OU16 Wetlands
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Table 17-1
Background Analytical Summary

Wetland	Media	Depth (Inches)	Number of Samples	Analysis
Freshwater Wetlands 32 and 70A	Sediment	0-4 4-12 12-24	Wetland 32 — 5 per interval Wetland 70A — 5 per interval	Background: TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin Ancillary Tests: TOC, Grain Size, pH Contingent Tests: Toxicity
Freshwater Wetlands 32 and 70A	Surface Water	0	Wetland 32 — 5 Wetland 70A — 5	Background: TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin Ancillary Tests: Hardness Contingent Tests: Toxicity Field Tests: Temperature, pH, Salinity, ORP, DO, and Depth
Saltwater Wetlands 27B and 33	Sediment	0-4 4-12 12-24	Wetland 27B — 5 per interval Wetland 33 — 5 per interval	Background: TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin Ancillary Tests: TOC, Grain Size, pH Contingent Tests: Toxicity
Saltwater Wetlands 27B and 33	Surface Water	0	Wetland 27B — 5 Wetland 33 — 5	Background: TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin Contingent Tests: Toxicity Field Tests: Temperature, pH, Salinity, ORP, DO, and Depth
Hurricane Series Soil Wetlands 25A and 27A	Sediment	0-4 4-12 12-24	Wetland 25A — 5 per interval Wetland 27A — 5 per interval	Background: TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin Ancillary Tests: TOC, Grain Size, pH Contingent Tests: Toxicity
Hurricane Series Soil Wetlands 25A and 27A	Surface Water	0	Wetland 25A — 5 Wetland 27A — 5	Background: TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin Ancillary Tests: Hardness Contingent Tests: Toxicity Field Tests: Temperature, pH, Salinity, ORP, DO, and Depth

Notes:

TCL = Target compound list
SVOC = Semivolatile organic compound
PAH = Polynuclear aromatic hydrocarbon
TIC = Tentatively identified compound
TAL = Target analyte list
TOC = Total organic carbon
ORP = Oxidation-reduction potential
DO = Dissolved oxygen

17.3 Wetland 3 Conceptual Site Model Refinement

Data will be collected at the seep and at other points along the axis of the wetland to assess topography, flow, water levels, and geochemistry in Wetland 3. Sampling is intended to assess the uncertainties in the CSM and to evaluate the feasibility of remedial alternatives. Sixteen surface water samples (four at the seep, eight along the axis, and four at the sampler's discretion) are planned (Figure 17-6). Sampling will be completed semi-annually (wet/dry seasons) for one year to assess seasonal changes in water chemistry.

The sample locations include: four samples at the seep area to characterize the source; eight samples along the wetland axis to characterize changes in water quality along the axis; and four samples at the discretion of the sampler to characterize other discharges to the wetland (Table 17-2). Filtered and unfiltered surface water samples will be collected for iron laboratory analysis to assess the impacts of the observed iron floc.

Table 17-2
Conceptual Site Model Refinement Analytical Summary — Wetland 3

Wetland	Media	Depth (Inches)	Number of Samples	Analysis
3	Surface Water	0	Seep Area — 4 Wetland Axis — 8 Observational — 4	Risk Drivers: Iron (Total and Dissolved) Ancillary Tests: Total and dissolved: Aluminum, Manganese, and Magnesium, Alkalinity, Acidity, Hardness, Sulfate, Nitrate, Nitrite, Total Phosphorus, TKN, Ammonia-Nitrogen, TDS, TSS, TOC Field Tests: Temperature, pH, Salinity, ORP, DO, Depth, Ferrous Iron, Sulfide Contingent Tests: Toxicity

Notes:

TKN = Total kjeldahl nitrogen
TDS = Total dissolved solids
TSS = Total suspended solids
TOC = Total organic carbon
ORP = Oxidation-reduction potential
DO = Dissolved oxygen

In addition to surface water chemistry data, information to be gathered on a wet/dry season basis for one year includes: surface water level at six shallow piezometers to be installed along the axis of the wetland; water flow from the seep; and topography within the wetland (near the seep, along the axis and near the discharge culvert).

N

041M0325
041GP206
041M0301
041W0318
041W0319
041M0324
041GP205
041GP204
041W0317
041W0316
041M0302
041M0326
041M0305
041W0315
041GP203
041M0303
041M0307
041M0323
041M0306
041W0314
041M0304
Wetland 3
041GP202
041W0313
041M0321
041W0312
041M0322
041W0308
041W0309
041W0310
041GP201
041W0311

Previous Sample Locations
Proposed Primary Sediment Sample Locations
Proposed CSM Piezometer
Proposed CSM Surface Water Sample Locations
Storm Sewer Culvert / Line *
Wetland Boundary
Extent of Water *

0 50 100 200 300 400 Feet

Figure 17-6: Wetland 3
Sample Locations
UFP-SAP, OU1, OU2, OU16 Wetlands
NAS Pensacola, Pensacola, Florida

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17.4 OU 1 Wetlands

The wetlands of interest associated with OU 1 include the following: 1B, 3, 4D, 15, 18A, and 18B. The following paragraphs present the sampling approach for each OU 1 wetland.

As decided upon by the Partnering Team during meetings summarized in Worksheet #9, sampling locations were selected to assess the horizontal extent of contamination; the 0 to 4 inch depth sample will assess current site conditions and the potential for excess risk. The 4 to 12 inch and 12 to 24 inch samples, contingent upon the results of the 0 to 4 inch depth, will assess the vertical extent of contamination and will be used for remedial volume development for consideration in the FS. A summary table, including sample identification numbers, depth, relevant SOP, and applicable laboratory and field analyses, is included as Worksheet #18. SOPs for field activities are summarized in Worksheet #21. The following paragraphs present the sampling approach for each wetland.

Wetland 1B (OU 1) — Previous sampling at the head of the ditch will be confirmed by one sample location and will be extended downstream to more fully characterize PAH contaminants along the ditch's full length. As decided upon by the Partnering Team during meetings summarized in Worksheet #9, the five primary sediment samples and three surface water sample locations are shown in Figure 17-7. Sediment and surface water samples will be analyzed for tests as shown in Table 17-3 and Worksheet #18. The need for toxicity testing will follow criteria in Section 11.5.4.

Wetland 4D (OU 1) — Sampling is intended to assess the vertical and horizontal extent of contamination found in three RI locations (041M04D1, 041M04D2, and 041M04D4; Figure 17-8). Surface water sample locations are also shown on Figure 17-8. As decided upon by the Partnering Team during meetings summarized in Worksheet #9, sampling will involve 11 primary sediment sample locations and 11 horizontal sediment step-outs (as needed). Pesticides (DDD, DDE, and DDT) will only be collected in the area of 041M04D4 where the highest RI pesticide concentrations were observed. Sediment and surface water samples will be analyzed for tests as shown in Table 17-3 and Worksheet #18. The need for toxicity testing will follow criteria in Section 11.5.4.

Wetland 3 (OU 1) — As decided upon by the Partnering Team during meetings summarized in Worksheet #9, the six primary sample locations are shown in Figure 17-6. Sediment samples will be analyzed for tests as shown in Table 17-3 and Worksheet #18. Surface water samples were

N

041M1B09

041M1B08

Wetland 1B

041M1B07

041M1B06

041M0104

041M1B05

041M0103

Previous Sample Locations

Proposed Primary Sample Locations

Surface Water Locations

Surface Water Flow

Wetland Boundary

Extent of Water *

0 50 100 200 300 400 Feet

Figure 17-7: Wetland 1B
Sample Locations
UFP-SAP, OU1, OU2, OU16 Wetlands
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N

Bayou Grande

Tidal Exchange

OU1 Landfill

Wetland 4D

041M04D19
041M04D18
041M04D14
041M04D15
041M04D2
041M04D16
041M04D13
041M04D21
041M04D17
041M04D20
041M04D27
041M04D12
041M04D26
041M04D24
041M04D08
041M04D4
041M04D11
041M04D22
041M04D23
041M04D1
041M04D07
041M04D10
041M04D25
041M04D06
041M04D09

Culvert from Wetland 3

Direct Flow

- Previous Sample Locations
- Proposed Primary Sample Locations
- Horizontal Step-out Locations
- Surface Water Locations
- Surface Water Flow
- Tidal Exchange
- Storm Sewer Culvert / Line *
- Wetland Boundary *
- Extent of Water *

0 50 100 200 300 400 Feet

Figure 17-8: Wetland 4D
Sample Locations
UFP-SAP, OU1, OU2, OU16 Wetlands
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NOTE: Wetland boundaries may not reflect current conditions.

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discussed previously Section 17.2 and outlined on Table 17-2. If warranted based on the initial round of CSM refinement surface water samples, surface water toxicity testing will be conducted, and sample locations will be selected by the Partnering Team.

Wetland 15 (OU 1) — Sampling will focus on the presumed surface-water runoff point on the south end of the wetland, and will broaden coverage within the wetland to better characterize nature and extent. As decided upon by the Partnering Team during meetings summarized in Worksheet #9, fourteen primary and three horizontal step-out samples are planned (Figure 17-9). The three surface water sample locations are also shown on Figure 17-9. Sediment and surface water samples will be analyzed for tests as shown in Table 17-3 and Worksheet #18. The need for toxicity testing will follow criteria in Section 11.5.4.

Wetland 18A (OU 1) — Sampling will confirm previous detections at RI locations 041M18A1 and 041M18A2 and determine the vertical and horizontal extent of contaminants near those locations. As decided upon by the Partnering Team during meetings summarized in Worksheet #9, there will be 14 primary and nine horizontal step-out sediment sample locations (Figure 17-10). The three surface water sample locations are also shown on Figure 17-10. Sediment and surface water samples will be analyzed for tests as shown in Table 17-3 and Worksheet #18. The need for toxicity testing will follow criteria in Section 11.5.4.

Wetland 18B (OU 1) — Sampling will confirm previous detections at RI location 41M18B1 and determine the vertical and horizontal extent of contaminants across the wetland; sample locations are integrated with those for upstream Wetland 18A to avoid duplication and to address 18A and B as a whole. As decided upon by the Partnering Team during meetings summarized in Worksheet #9, there will be nine primary and three horizontal step-out sediment sample locations (Figure 17-10). The three surface water sample locations are also shown on Figure 17-10. Sediment and surface water samples will be analyzed for tests as shown in Table 17-3 and Worksheet #18. The need for toxicity testing will follow criteria in Section 11.5.4.

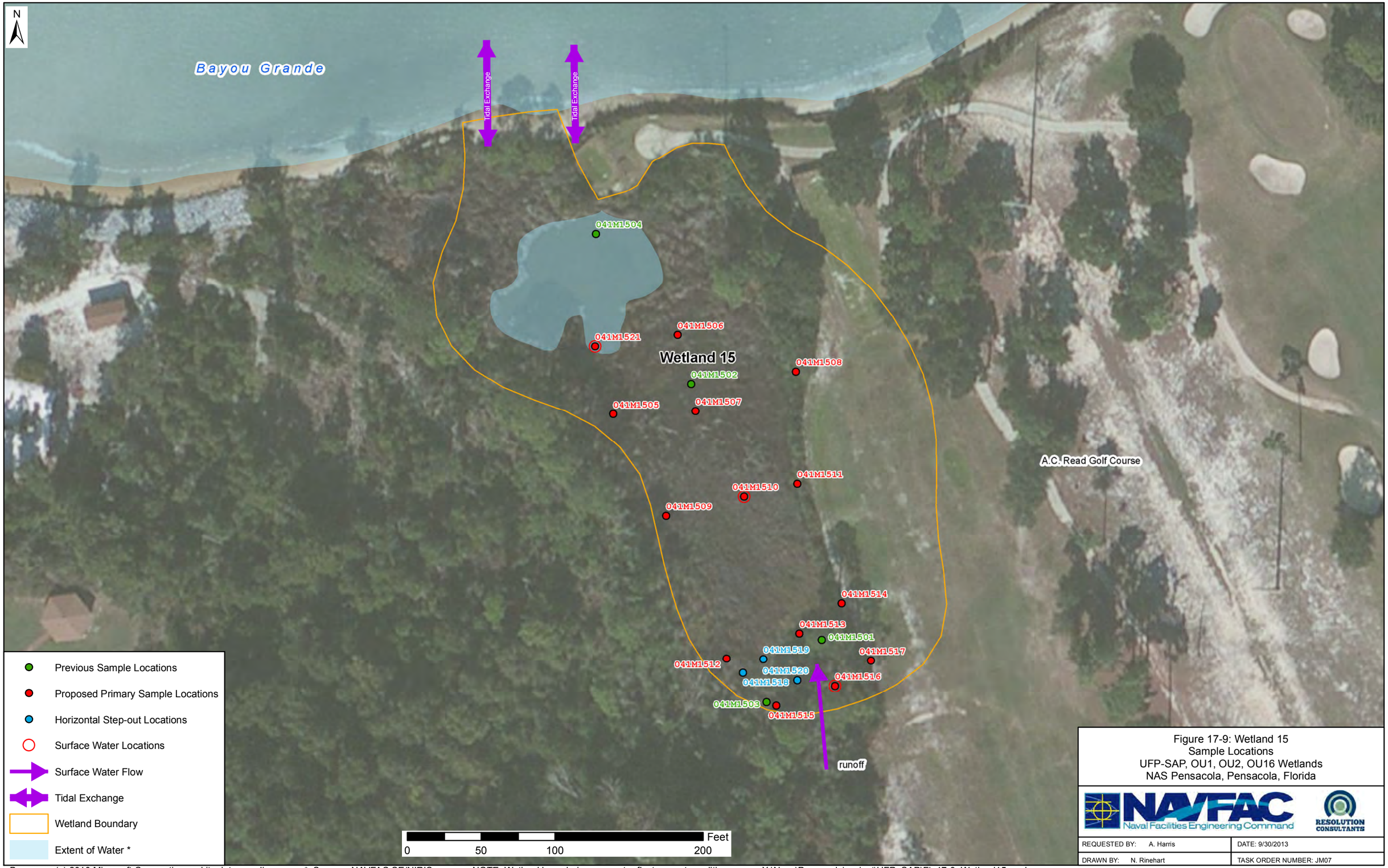

Figure 17-9: Wetland 15
Sample Locations
UFP-SAP, OU1, OU2, OU16 Wetlands
NAS Pensacola, Pensacola, Florida

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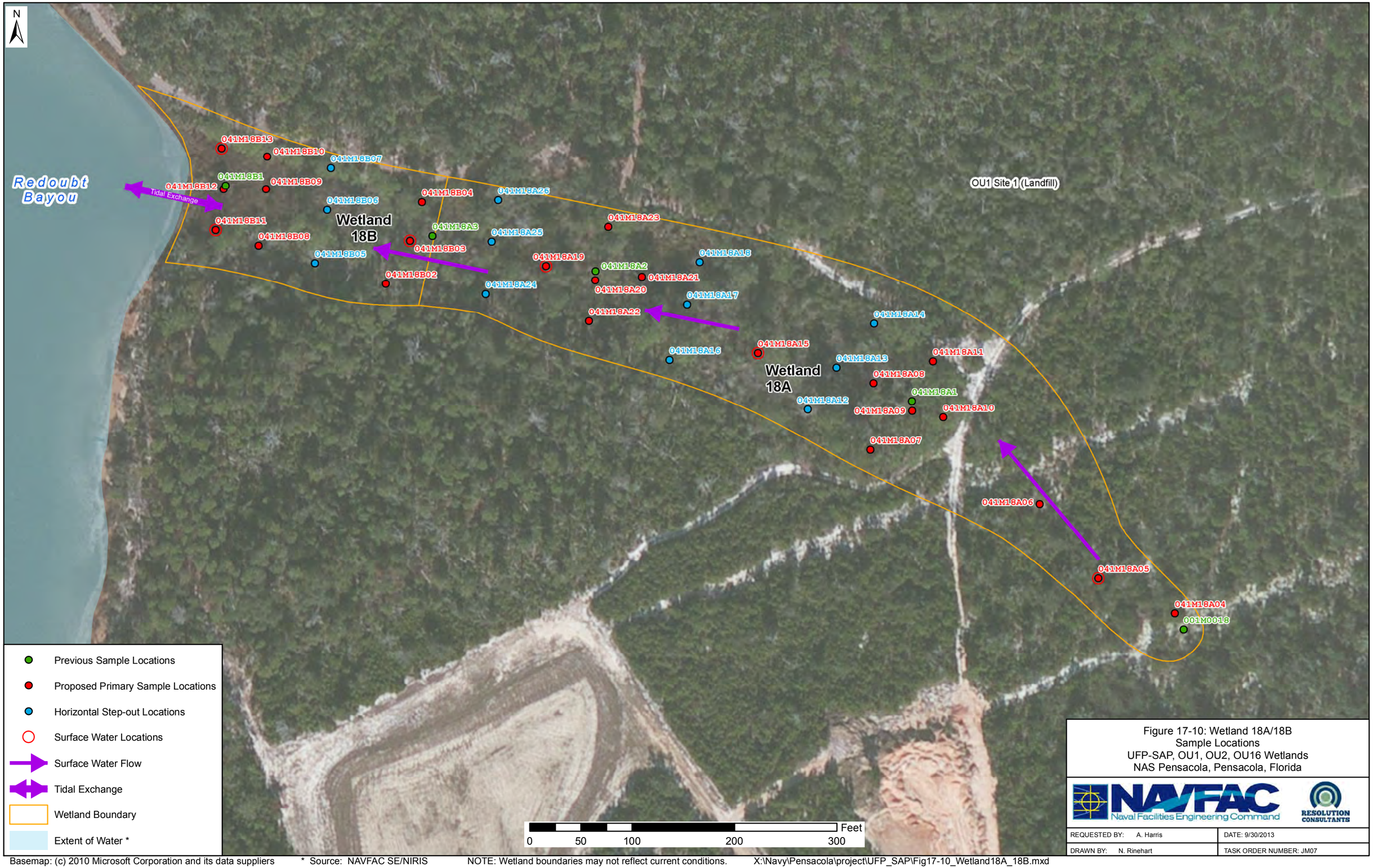

Figure 17-10: Wetland 18A/18B
Sample Locations
UFP-SAP, OU1, OU2, OU16 Wetlands
NAS Pensacola, Pensacola, Florida

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Table 17-3
Operable Unit 1 Sample Collection and Analysis Summary

Wetland	Media	Depth (inches)	Number of Samples	Analysis
1B	Sediment	0-4 Primary 4-12 Vertical 12-24 Vertical	5 Primary 5 Contingent 5 Contingent	Risk Drivers: PAHs, Iron Ancillary Tests: TOC, Grain Size, pH Contingent Tests: Toxicity
1B	Surface Water	0	3	Risk Drivers: PAHs, Iron Field Tests: Temperature, pH, Salinity, ORP, DO, Depth Contingent Tests: Toxicity
3	Sediment	0-4 4-12 12-24	6 Primary 6 Contingent 6 Contingent	Risk Drivers: Iron Ancillary Tests: Grain Size, pH, TOC Contingent Tests: Toxicity
4D	Sediment	0-4 Primary 0-4 Primary HSO 4-12 Vertical 4-12 Horizontal 12-24 Vertical 12-24 Horizontal	11 Primary (3 DDx) 11 Primary HSO (3 DDx) 11 Contingent (3 DDx) 11 Contingent (3 DDx) 11 Contingent (3 DDx) 11 Contingent (3 DDx)	Risk Drivers: Iron, Lead, DDx Ancillary Tests: Aluminum, TOC, AVS/SEM, Grain Size, pH Contingent Tests: Toxicity
4D	Surface Water	0	3	Risk Drivers: Iron, Lead, DDx Field Tests: Temperature, pH, Salinity, ORP, DO, Depth Contingent Tests: Toxicity
15	Sediment	0-4 Primary 0-4 Primary HSO 4-12 Vertical 4-12 Horizontal 12-24 Vertical 12-24 Horizontal	14 Primary 3 Primary HSO 14 Contingent 3 Contingent 14 Contingent 3 Contingent	Risk Drivers: Arsenic, Iron, Lead, Manganese, Selenium, DDx Ancillary Tests: Aluminum, TOC, AVS/SEM, Grain Size, pH Contingent Tests: Toxicity
15	Surface Water	0	3	Risk Drivers: Arsenic, Iron, Lead, Manganese, Selenium, DDx Field Tests: Temperature, pH, Salinity, ORP, DO, Depth Contingent Tests: Toxicity
18A	Sediment	0-4 Primary 0-4 Primary HSO 4-12 Vertical 4-12 Horizontal 12-24 Vertical 12-24 Horizontal	14 Primary 9 Primary HSO 14 Contingent 9 Contingent 14 Contingent 9 Contingent	Risk Drivers: Arsenic, Iron, Lead, DDx Ancillary Tests: Aluminum, TOC, AVS/SEM, Grain Size, pH Contingent Tests: Toxicity
18A	Surface Water	0	3	Risk Drivers: Arsenic, Iron, Lead, DDx Ancillary Tests: Hardness Field Tests: Temperature, pH, Salinity, ORP, DO, Depth Contingent Tests: Toxicity
18B	Sediment	0-4 Primary 0-4 Primary HSO 4-12 Vertical 4-12 Horizontal 12-24 Vertical 12-24 Horizontal	9 Primary 3 Primary HSO 9 Contingent 3 Contingent 9 Contingent 3 Contingent	Risk Drivers: Arsenic, Iron, DDx Ancillary Tests: Aluminum, TOC, Grain Size, pH Contingent Tests: Toxicity
18B	Surface Water	0	3	Risk Drivers: Arsenic, Iron, DDx Field Tests: Temperature, pH, Salinity, ORP, DO, Depth Contingent Tests: Toxicity

Notes:
All sample quantities were derived by the Partnering Team during meetings summarized in Worksheet #9.
TOC = Total organic carbon
ORP = Oxidation-reduction potential

Notes (Continued):

DO	=	Dissolved oxygen
HSO	=	Horizontal step-out
DDx	=	4,4'-Dichlorodiphenyldichloroethane, 4,4'-dichlorodiphenyldichloroethylene, and 4,4'-dichlorodiphenyltrichloroethane
AVS/SEM	=	Acid volatile sulfide and simultaneously extracted metals (cadmium, copper, lead, nickel, silver, and zinc)

Surface water sampling and analysis for Wetland 3 are summarized in Table 17-2.

17.5 OU 2 Wetlands

The wetlands of interest associated with OU 2 are Wetland 5A, northern portion of 6, southern portion of 7, and the Wetland 64 complex (northern portion of 7, 8, and 64). The following paragraphs present the sampling approach for each OU 2 wetland.

Wetland 5A (OU 2) — Sampling is intended to extend the RI findings across the wetland, focusing on the northern portion most likely impacted by the former waste receiving structure (thought to be a primitive oil-water separator) and by runoff from the Building 649 complex. Two sampling points will serve as confirmation points for previous RI locations (41M5A01 and 41M5A05) where elevated metal concentrations were observed. As decided upon by the Partnering Team during meetings summarized in Worksheet #9, the 18 primary sediment sample locations and three surface water sample locations are shown in Figure 17-11. Sediment and surface water samples will be analyzed for tests as shown in Table 17-4 and Worksheet #18. The need for toxicity testing will follow criteria in Section 11.5.4.

Northern Portion of Wetland 6 (OU 2) — Sampling at the northern end of Wetland 6 (north of connection of Wetland 5B) is intended to assess historical elevated DDT concentrations in sediment and the potential for migration of sediments to the downgradient Wetland 64 complex (Wetlands 7, 8, and 64). One sediment sample and one surface water sample will be collected near the weir feature in the northern portion of Wetland 6. As decided upon by the Partnering Team during meetings summarized in Worksheet #9, the one sediment and one surface water sample location is shown in Figure 17-12. Sediment and surface water samples will be analyzed for tests as shown in Table 17-4 and Worksheet #18. Toxicity sampling is not planned for this wetland.

Southern Portion of Wetland 7 (OU 2) — Sampling at the southern end of Wetland 7 near Wetland 6 is intended to assess elevated DDT concentrations in sediment and the potential for migration of sediments to the downgradient Wetland 64 complex (Wetlands 7, 8, and 64). One sediment and one surface water sample will be collected north of the weir feature near Wetland 6. As decided upon by the Partnering Team during meetings summarized in

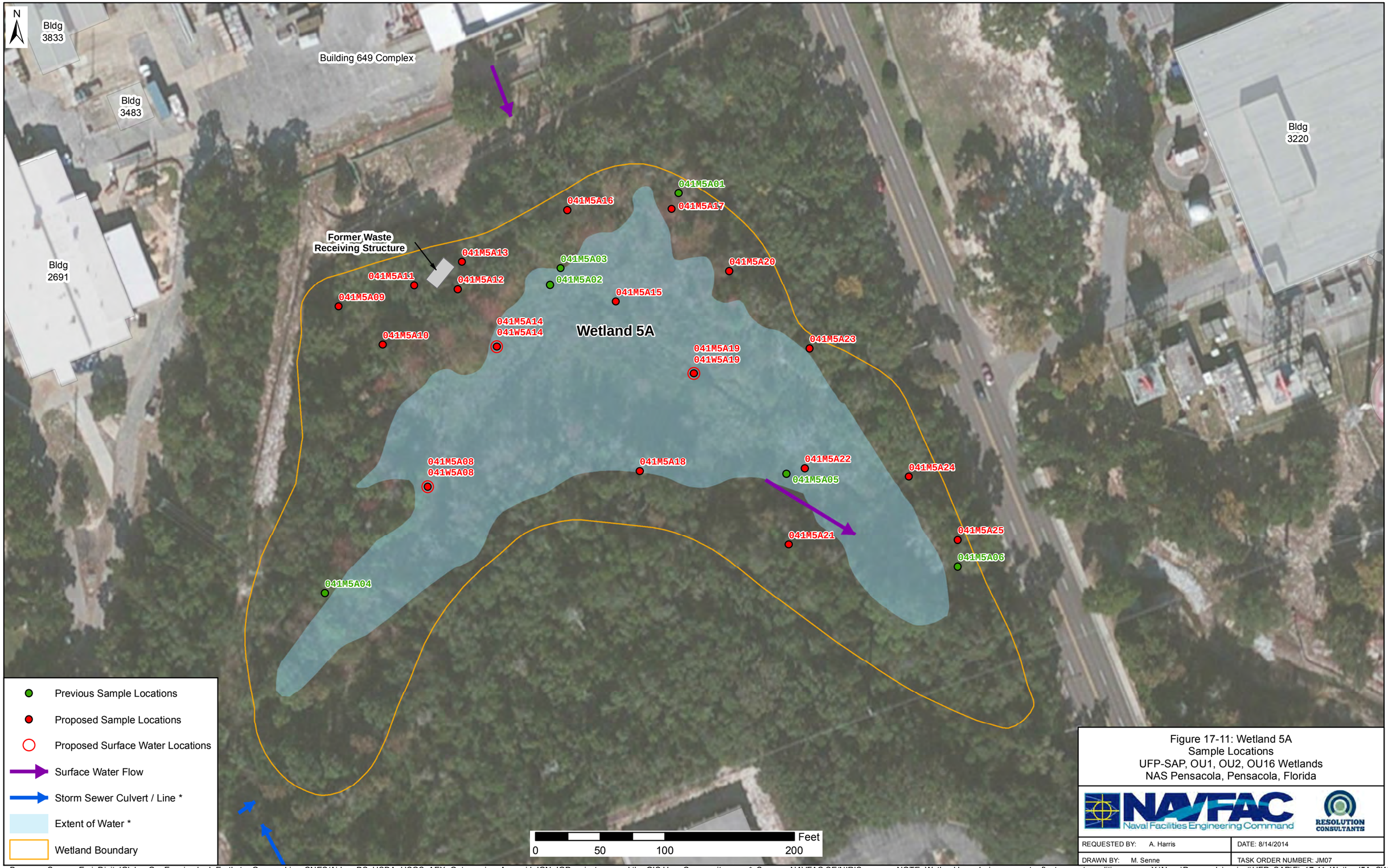

Figure 17-11: Wetland 5A
Sample Locations
UFP-SAP, OU1, OU2, OU16 Wetlands
NAS Pensacola, Pensacola, Florida

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Basemap Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

* Source: NAVFAC SE/NIRIS

NOTE: Wetland boundaries may not reflect current conditions.

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N

Wetland 7

041M0701
041W0701

041M0612
041W0612

Wetland 6

041M0611

041M0610

Previous Sample Locations
Proposed Sample Locations
Proposed Surface Water Locations
Surface or Ground Water Flow
Storm Sewer Culvert / Line *
Wetland Boundary
Extent of Water *

0 40 80 120 160
Feet

Figure 17-12: Wetland 6 and 7
Sample Locations
UFP-SAP, OU1, OU2, OU16 Wetlands
NAS Pensacola, Pensacola, Florida

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Basemap Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community * Source: NAVFAC SE/NIRIS Note: Wetland boundaries may

Worksheet #9, the one sediment and one surface water sample location is shown in Figure 17-12. Sediment and surface water samples will be analyzed for tests as shown in Table 17-4 and Worksheet #18. Toxicity sampling is not planned for this wetland.

Wetland 64 Complex (Northern Portion of Wetland 7, 8, and 64 [OU 2]) — Sampling will supplement previous results with additional spatial sampling at 12 primary and three horizontal step-out locations, as shown on Figure 17-13. As decided upon by the Partnering Team during meetings summarized in Worksheet #9, these 15 sediment and three surface water sample locations were chosen to assess RI results, assess the vertical extent of contamination and increase spatial coverage. Sediment and surface water samples will be analyzed for tests as shown in Table 17-4 and Worksheet #18. The need for toxicity testing will follow criteria in Section 11.5.4.

Table 17-4
Operable Unit 2 Sample Collection and Analysis Summary

Wetland	Media	Depth (inches)	Number of Samples	Analysis	
5A	Sediment	0-4 Primary 4-12 Vertical 12-24 Vertical	18 Primary 18 Contingent 18 Contingent	Risk Drivers: Ancillary Tests: Contingent Tests:	TAL Metals, Tin, PCBs, PAHs, DDx, bis(2-ethylhexyl) phthalate TOC, AVS/SEM, Grain Size Toxicity
5A	Surface Water	0	3	Risk Drivers: Ancillary Tests: Field Tests: Contingent Tests:	TAL Metals, Tin, PCBs, PAHs, DDx, bis(2-ethylhexyl) phthalate Hardness Temperature, pH, Salinity, ORP, DO, Depth Toxicity
Northern Portion of 6	Sediment	0-4 Primary 4-12 Vertical 12-24 Vertical	1 Primary 1 Contingent 1 Contingent	Risk Drivers: Ancillary Tests:	DDx TOC, Grain Size
Northern Portion of 6	Surface Water	0	1	Risk Drivers: Field Tests:	DDx Temperature, pH, Salinity, ORP, DO, Depth
Southern Portion of 7	Sediment	0-4 Primary	1 Primary	Risk Drivers: Ancillary Tests:	DDx TOC, Grain Size
Southern Portion of 7	Surface Water	0	1	Risk Drivers: Field Tests:	DDx Temperature, pH, Salinity, ORP, DO, Depth
64 Complex (Northern Portion of 7, 8 and 64)	Sediment	0-4 Primary 0-4 Primary HSO 4-12 Vertical 4-12 Horizontal 12-24 Vertical 12-24 Horizontal	12 Primary 3 Primary HSO 12 Contingent 3 Contingent 12 Contingent 3 Contingent	Risk Drivers: Ancillary Tests: Contingent Tests:	TAL Metals, TCL SVOCs/PAHs, PCBs TOC, AVS/SEM, Grain Size Toxicity
64 Complex (Northern Portion of 7, 8 and 64)	Surface Water	0	3	Risk Drivers: Field Tests: Contingent Tests:	TAL Metals, TCL SVOCs/PAHs, PCBs Temperature, pH, Salinity, ORP, DO, Depth Toxicity

Notes:
All sample quantities were derived by the Partnering Team during meetings summarized in Worksheet #9.
TAL = Target analyte list
PCBs = Polychlorinated biphenyl compounds
PAH = Polynuclear aromatic hydrocarbons

Notes Continued:

DDx	=	4,4'-Dichlorodiphenyldichloroethane, 4,4'-dichlorodiphenyldichloroethylene, and 4,4'-dichlorodiphenyltrichloroethane
TOC	=	Total organic carbon
AVS/SEM	=	Acid volatile sulfide and simultaneously extracted metals (cadmium, copper, lead, nickel, silver, and zinc)
TCL	=	Target compound list
ORP	=	Oxidation-reduction potential
DO	=	Dissolved oxygen
SVOC	=	Semivolatile organic compounds
HSO	=	Horizontal step-out

17.6 OU 16 Wetlands

The wetlands of interest associated with OU 16 are Wetland 12, 48, and W2. The following paragraphs present the sampling approach for each OU 16 wetland.

Wetland 12 — The sampling goal is to assess the wetland sediment for impacts from adjacent sites and operations. As decided upon by the Partnering Team during meetings summarized in Worksheet #9, five primary and four horizontal step-out sediment sampling locations are planned in a down-flow direction from RI sample point 041M1201 (Figure 17-14). Sediment samples and three surface water samples will be analyzed for tests as shown in Table 17 5 and Worksheet #18. The need for toxicity testing will follow criteria in Section 11.5.4.

Wetland 48 — Nine samples were collected during the RI. As decided upon by the Partnering Team during meetings summarized in Worksheet #9, the 19 primary and eight horizontal step-out sediment sample locations planned for the current effort will expand the RI coverage vertically and horizontally to better characterize the spatial extent of contaminants (Figure 17-15). Sediment samples and three surface water samples will be analyzed for tests as shown in Table 17-5 and Worksheet #18. Toxicity sampling is not planned for this wetland. However, if detected concentrations are higher than those detected in the RI, food web models may be conducted for upper trophic level organisms.

Wetland W2 — Northern end of Wetland W2 was assessed during the RI and was approved for No Further Action. Sampling at the western end of Wetland W2 was added to the revised SAP based on concerns with potential impacts along the western reach of the wetlands from the adjacent airfield and Sites 5, 6, and 16. Four sediment and three surface water sample locations are planned for this event to assess nature and extent of contamination. As decided upon by the Partnering Team during meetings summarized in Worksheet #9, the sample locations are shown in Figure 17-16. Sediment and surface water samples will be analyzed for tests as shown in Table 17-5 and Worksheet #18. The need for toxicity testing will follow criteria in Section 11.5.4.

N

Yacht Basin

041M6409

041M6416

041M6415
041W6415

041M6424
041W6424

041M6405

041M6414

041M6423

041M6406

041M6413

Tidal Exchange

Wetland 8

OU2 Site 11

041M6421

041M6403

041M6422

041M6420

041M6412

041M6404

Wetland 64

041M6419

041M6402

041M6411

041M6418

041M6417
041W6417

041M6410

Wetland 7

Flow Along
Wetland 6 Ditch

Feet
0 50 100 200 300

Previous Sample Locations
Proposed Primary Sample Locations
Horizontal Step-out Locations
Proposed Surface Water Locations
Surface Water Flow
Tidal Exchange
Wetland Boundary
Extent of Water *

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Figure 17-13: Wetland 64 Complex
Sample Locations
UFP-SAP, OU1, OU2, OU16 Wetlands
NAS Pensacola, Pensacola, Florida

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: A. Harris	DATE: 8/14/2014
DRAWN BY: M. Senne	TASK ORDER NUMBER: JM07

Basemap: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community * Source: NAVFAC SE/NIRIS NOTE: Wetland boundaries may not reflect current conditions.

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Figure 17-14: Wetland 12
Sample Locations
UFP-SAP, OU1, OU2, OU16 Wetlands
NAS Pensacola, Pensacola, Florida

NAVFAC Naval Facilities Engineering Command
RESOLUTION CONSULTANTS

REQUESTED BY: A. Harris	DATE: 8/14/2014
DRAWN BY: M. Senne	TASK ORDER NUMBER: JM07

Basemap: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community * Source: NAVFAC SE/NIRIS NOTE: Wetland boundaries may not reflect current conditions.

Figure 17-15: Wetland 48
Sample Locations
UFP-SAP, OU1, OU2, OU16 Wetlands
NAS Pensacola, Pensacola, Florida

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: A. Harris	DATE: 8/14/2014
DRAWN BY: M. Senne	TASK ORDER NUMBER: JM07

Basemap: Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community * Source: NAVFAC SE/NIRIS NOTE: Wetland boundaries may not reflect current conditions. X:\Navy\Pensacola\project\UFP_SAP\Fig17-15_Wetland48_SWadded.mxd

N

25R

041MW203

to outfall 030

041MW202

041MW201

Wetland W2

041MW207
041WW207

041MW205
041WW205

041MW206

041MW204
041WW204

0 50 100 200 300 400 Feet

- Previous Sample Locations
- Proposed Sample Locations
- Proposed Surface Water Locations
- Surface or Ground Water Flow
- Storm Sewer Culvert / Line *
- Wetland Boundary
- Extent of Water *

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Figure 17-16: Wetland W2
Sample Locations
UFP-SAP, OU1, OU2, OU16 Wetlands
NAS Pensacola, Pensacola, Florida

NAVFAC Naval Facilities Engineering Command

RESOLUTION CONSULTANTS

REQUESTED BY: A. Harris	DATE: 8/14/2014
DRAWN BY: N. Rinehart	TASK ORDER NUMBER: XXXXX

Basemap Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

* Source: NAVFAC SE/NIRIS

NOTE: Wetland boundaries may not reflect current conditions.

Table 17-5
Operable Unit 16 Sample Collection and Analysis Summary

Wetland	Media	Depth (inches)	Number of Samples	Analysis
12	Sediment	0-4 Primary 0-4 Primary HSO 4-12 Vertical 4-12 Horizontal 12-24 Vertical 12-24 Horizontal	5 Primary 4 Primary HSO 5 Contingent 4 Contingent 5 Contingent 4 Contingent	Risk Drivers: Pesticides Ancillary Tests: TOC, Grain Size Contingent Tests: Toxicity
12	Surface Water	0	3	Risk Drivers: Pesticides Field Tests: Temperature, pH, Salinity, ORP, DO, Depth Contingent Tests: Toxicity
48	Sediment	0-4 Primary 0-4 Primary HSO 4-12 Vertical 4-12 Horizontal 12-24 Vertical 12-24 Horizontal	19 Primary 8 Primary HSO 19 Contingent 8 Contingent 19 Contingent 8 Contingent	Risk Drivers: DDx Ancillary Tests: TOC, Grain Size Contingent Analysis: Food Web Model for higher trophic organisms
48	Surface Water	0	3	Risk Drivers: DDx Field Tests: Temperature, pH, Salinity, ORP, DO, Depth
W2	Sediment	0-4 Primary 4-12 Vertical 12-24 Vertical	4 Primary 4 Contingent 4 Contingent	Potential Risk Drivers: TAL metals, SVOCs, pesticides and PCBs Ancillary Tests: TOC, Grain Size Contingent Tests: Toxicity
W2	Surface Water	0	3	Risk Drivers: TAL metals, SVOCs, pesticides and PCBs Ancillary Tests: Hardness Field Tests: Temperature, pH, Salinity, ORP, DO, Depth Contingent Tests: Toxicity

Notes:
All sample quantities were derived by the Partnering Team during meetings summarized in Worksheet #9.

DDx = 4,4'-dichlorodiphenyldichloroethane, 4,4'-dichlorodiphenyldichloroethylene, and 4,4'-dichlorodiphenyltrichloroethane
TOC = Total organic carbon
PAH = Polynuclear aromatic hydrocarbons
ORP = Oxidation-reduction potential
DO = Dissolved oxygen
HSO = Horizontal step-out
TAL = Target analyte list
SVOC = Semivolatile organic compound
PCBs = Polychlorinated biphenyls

17.7 Toxicity Testing

Upon concurrence of the Partnering Team, the anticipated sample analyses will include toxicity testing and full scan chemical analysis of sediment from a maximum of three locations per wetland at a depth of 0 to 4 inches bgs.[1] The sample locations for toxicity testing will represent the maximum, minimum, and intermediate sediment concentrations from the area of concern in a given wetland. In addition, toxicity tests will be conducted on reference sediment from the reference wetlands. The need for toxicity testing will follow criteria in Section 11.5.4 and the Partnering Team will decide locations for toxicity tests.

Toxicity testing will also be considered for selected surface water locations and on surface water from a corresponding reference wetland; sample locations will represent maximum, minimum, and intermediate concentrations based on prior investigation findings. Sample locations will be agreed upon by the Partnering Team before collection.

[1] Full scan analysis includes the following: target analyte list metals, target compound list semivolatile organic compounds, target compound list pesticides, and polychlorinated biphenyl compounds.

SAP WORKSHEET #18: LOCATION-SPECIFIC SAMPLING METHODS/SOP REQUIREMENTS TABLE

(UFP-QAPP Manual Section 3.1.1)

PHASE I SEDIMENT SAMPLES

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
1B (OU 1)	041M1B05	041M1B0504	0-4	Primary	1086943.7	504661.84	*Risk Drivers:* PAHs, Iron *Ancillary Tests:* TOC, Grain Size, pH *Contingent Tests:* Toxicity	1
	041M1B06	041M1B0604	0-4	Primary	1086663.3	504803.33		1
	041M1B07	041M1B0704	0-4	Primary	1086522.7	504852.81		1
	041M1B08	041M1B0804	0-4	Primary	1086289.2	504935.28		1
	041M1B09	041M1B0904	0-4	Primary	1086047	505049.86		1
3 (OU 1)	041M0321	041M032104	0-4	Primary	1088655.01	506427.41	*Risk Drivers:* Iron *Ancillary Tests:* Grain Size, pH, TOC *Contingent Tests:* Toxicity	1
	041M0322	041M032204	0-4	Primary	1088995.39	506377.86		1
	041M0323	041M032304	0-4	Primary	1088784.27	506621.30		1
	041M0324	041M032404	0-4	Primary	1088713.18	506866.89		1
	041M0325	041M032504	0-4	Primary	1089092.33	506905.67		1
	041M0326	041M032604	0-4	Primary	1088887.67	506741.94		1
4D (OU 1)	041M04D06	041M04D0604	0-4	Primary	1089466.9	507005.78	*Risk Drivers:* Iron, Lead *Ancillary Tests:* Aluminum, TOC, AVS/SEM, Grain Size, pH Contingent Tests: Toxicity	1
	041M04D07	041M04D0704	0-4	Primary	1089497.3	507056.13		1
	041M04D08	041M04D0804	0-4	Primary	1089491.2	507118.63		1
	041M04D09	041M04D0904	0-4	Horizontal	1089514.6	506989.29		1
	041M04D10	041M04D1004	0-4	Horizontal	1089557.2	507037.9		1
	041M04D11	041M04D1104	0-4	Horizontal	1089548.5	507089.12		1
	041M04D12	041M04D1204	0-4	Horizontal	1089530.3	507167.24		1
	041M04D13	041M04D1304	0-4	Primary	1089769.8	507316.55		1
	041M04D14	041M04D1404	0-4	Primary	1089814.1	507382.52		1
	041M04D15	041M04D1504	0-4	Primary	1089894.8	507359.08		1
	041M04D16	041M04D1604	0-4	Primary	1089845.4	507322.62		1
	041M04D17	041M04D1704	0-4	Primary	1089849.7	507267.94		1
	041M04D18	041M04D1804	0-4	Horizontal	1089741.2	507379.91		1
	041M04D19	041M04D1904	0-4	Horizontal	1089881.8	507429.39		1
	041M04D20	041M04D2004	0-4	Horizontal	1089784.6	507246.23		1
	041M04D21	041M04D2104	0-4	Horizontal	1089920.9	507290.5		1
4D (OU 1)	041M04D22	041M04D2204	0-4	Primary	1090135.3	507077.83	*Risk Drivers:* Iron, Lead, DDx *Ancillary Tests:* Aluminum, TOC, AVS/SEM, Grain Size, pH *Contingent Tests:* Toxicity	1
	041M04D23	041M04D2304	0-4	Primary	1090177	507076.96		1
	041M04D24	041M04D2404	0-4	Primary	1090175.2	507131.65		1

PHASE I SEDIMENT SAMPLES

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
4D (OU 1)	041M04D25	041M04D2504	0-4	Horizontal	1090103.2	507018.8	*Risk Drivers:* Iron, Lead, DDx *Ancillary Tests:* Aluminum, TOC, AVS/SEM, Grain Size, pH *Contingent Tests:* Toxicity	1
	041M04D26	041M04D2604	0-4	Horizontal	1090129.2	507152.48		1
	041M04D27	041M04D2704	0-4	Horizontal	1090192.6	507198.49		1
15 (OU 1)	041M1505	041M150504	0-4	Primary	1088675.6	508409.28	*Risk Drivers:* Arsenic, Iron, Lead, Manganese, Selenium, DDx *Ancillary Tests:* Aluminum, TOC, AVS/SEM, Grain Size, pH *Contingent Tests:* Toxicity	1
	041M1506	041M150604	0-4	Primary	1088720.2	508461.81		1
	041M1507	041M150704	0-4	Primary	1088731.1	508410.12		1
	041M1508	041M150804	0-4	Primary	1088799.7	508435.33		1
	041M1509	041M150904	0-4	Primary	1088709.9	508339.84		1
	041M1510	041M151004	0-4	Primary	1088762.8	508351.56		1
	041M1511	041M151104	0-4	Primary	1088798.8	508359.37		1
	041M1512	041M151204	0-4	Primary	1088748.5	508242.18		1
	041M1513	041M151304	0-4	Primary	1088798.2	508258.04		1
	041M1514	041M151404	0-4	Primary	1088827.1	508277.77		1
	041M1515	041M151504	0-4	Primary	1088781.4	508209.68		1
	041M1516	041M151604	0-4	Primary	1088821.4	508222.22		1
	041M1517	041M151704	0-4	Primary	1088846.2	508238.71		1
	041M1518	041M151804	0-4	Horizontal	1088759.4	508232.38		1
	041M1519	041M151904	0-4	Horizontal	1088773.5	508241.26		1
	041M1520	041M152004	0-4	Horizontal	1088795.9	508226.63		1
	041M1521	041M152104	0-4	Primary	1088664.29	508455.42		1
18A (OU 1)	041M18A04	041M18A0404	0-4	Primary	1087319.5	506513	*Risk Drivers:* Arsenic, Iron, Lead, DDx *Ancillary Tests:* Aluminum, TOC, AVS/SEM, Grain Size, pH *Contingent Tests:* Toxicity	1
	041M18A05	041M18A0504	0-4	Primary	1087245.7	506549.03		1
	041M18A06	041M18A0604	0-4	Primary	1087190.1	506622.58		1
	041M18A07	041M18A0704	0-4	Primary	1087025.9	506679.28		1
	041M18A08	041M18A0804	0-4	Primary	1087030.3	506744.38		1
	041M18A09	041M18A0904	0-4	Primary	1087067.6	506716.61		1
	041M18A10	041M18A1004	0-4	Primary	1087097.6	506709.66		1
	041M18A11	041M18A1104	0-4	Primary	1087088.9	506764.35		1
	041M18A12	041M18A1204	0-4	Horizontal	1086965.7	506720.12		1
	041M18A13	041M18A1304	0-4	Horizontal	1086994.5	506760.4		1
	041M18A14	041M18A1404	0-4	Horizontal	1087032	506802.76		1
	041M18A15	041M18A1504	0-4	Primary	1086918.2	506776.38		1
	041M18A16	041M18A1604	0-4	Horizontal	1086831.7	506771.51		1

PHASE I SEDIMENT SAMPLES

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
18A (OU 1)	041M18A17	041M18A1704	0-4	Horizontal	1086850.1	506825.33	*Risk Drivers:* Arsenic, Iron, Lead, DDx *Ancillary Tests:* Aluminum, TOC, AVS/SEM, Grain Size, pH *Contingent Tests:* Toxicity	1
	041M18A18	041M18A1804	0-4	Horizontal	1086863.3	506866.3		1
	041M18A19	041M18A1904	0-4	Primary	1086713	506865.78		1
	041M18A20	041M18A2004	0-4	Primary	1086760.8	506850.83		1
	041M18A21	041M18A2104	0-4	Primary	1086806.5	506853.28		1
	041M18A22	041M18A2204	0-4	Primary	1086753.8	506811.22		1
	041M18A23	041M18A2304	0-4	Primary	1086774.6	506902.8		1
	041M18A24	041M18A2404	0-4	Horizontal	1086653.6	506839.91		1
	041M18A25	041M18A2504	0-4	Horizontal	1086660.5	506890.95		1
	041M18A26	041M18A2604	0-4	Horizontal	1086667.8	506931.23		1
18B (OU 1)	041M18B02	041M18B0204	0-4	Primary	1086556.3	506852.12	*Risk Drivers:* Arsenic, Iron, DDx *Ancillary Tests*: Aluminum, TOC, Grain Size, pH *Contingent Tests:* Toxicity	1
	041M18B03	041M18B0304	0-4	Primary	1086580.8	506893.53		1
	041M18B04	041M18B0404	0-4	Primary	1086593.3	506931.03		1
	041M18B05	041M18B0504	0-4	Horizontal	1086487.6	506873.47		1
	041M18B06	041M18B0604	0-4	Horizontal	1086500.6	506925.56		1
	041M18B07	041M18B0704	0-4	Horizontal	1086505.3	506966.18		1
	041M18B08	041M18B0804	0-4	Primary	1086432.9	506891.96		1
	041M18B09	041M18B0904	0-4	Primary	1086441.5	506947.17		1
	041M18B10	041M18B1004	0-4	Primary	1086443.3	506978.68		1
	041M18B11	041M18B1104	0-4	Primary	1086391.4	506908.1		1
	041M18B12	041M18B1204	0-4	Primary	1086400	506947.94		1
	041M18B13	041M18B1304	0-4	Primary	1086398.8	506987.7		1
5A (OU 2)	041M5A08	041M5A0804	0-4	Primary	1093003.9	504410.69	*Risk Drivers:* TAL Metals, Tin, PCBs, PAHs, DDx, bis(2-ethylhexyl) phthalate *Ancillary Tests:* TOC, AVS/SEM, Grain Size *Contingent Tests:* Toxicity	1
	041M5A09	041M5A0904	0-4	Primary	1092937.9	504551.39		1
	041M5A10	041M5A1004	0-4	Primary	1092971.3	504521.19		1
	041M5A11	041M5A1104	0-4	Primary	1092996.8	504566.5		1
	041M5A12	041M5A1204	0-4	Primary	1093030.3	504562.75		1
	041M5A13	041M5A1304	0-4	Primary	1093034	504583.84		1
	041M5A14	041M5A1404	0-4	Primary	1093059.5	504517.71		1
	041M5A15	041M5A1504	0-4	Primary	1093152.3	504550.45		1
	041M5A16	041M5A1604	0-4	Primary	1093116.3	504622.06		1
	041M5A17	041M5A1704	0-4	Primary	1093197	504621.2		1

PHASE I SEDIMENT SAMPLES

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
5A (OU 2)	041M5A18	041M5A1804	0-4	Primary	1093168	504418.94	*Risk Drivers:* TAL Metals, Tin, PCBs, PAHs, DDx, bis(2-ethylhexyl) phthalate *Ancillary Tests:* TOC, AVS/SEM, Grain Size *Contingent Tests:* Toxicity	
	041M5A19	041M5A1904	0-4	Primary	1093211.4	504493.59		1
	041M5A20	041M5A2004	0-4	Primary	1093240.4	504572.15		1
	041M5A21	041M5A2104	0-4	Primary	1093281.7	504359.91		1
	041M5A22	041M5A2204	0-4	Primary	1093295.6	504418.5		1
	041M5A23	041M5A2304	0-4	Primary	1093301.2	504510.95		1
	041M5A24	041M5A2404	0-4	Primary	1093375.9	504410.26		1
	041M5A25	041M5A2504	0-4	Primary	1093412.6	504360.44		1
Northern Portion of 6 (OU 2)	041M0612	041M061204	0-4	Primary	1095093.62	505400.46	*Risk Drivers:* DDx; *Ancillary Tests:* TOC, Grain Size	1
Southern Portion of 7 (OU 2)	041M0701	041M070104	0-4	Primary	1095127.61	505567.45	*Risk Drivers:* DDx; *Ancillary Tests:* TOC, Grain Size	1
64 Complex including northern portion of Wetland 7, Wetland 8 and Wetland 64 (OU 2)	041M6410	041M641004	0-4	Primary	1095344.3	505896.27	*Risk Drivers:* TAL Metals, TCL SVOCs/PAHs, PCBs *Ancillary Tests:* TOC, AVS/SEM, Grain Size *Contingent Tests:* Toxicity	1
	041M6411	041M641104	0-4	Primary	1095271.6	506073.13		1
	041M6412	041M641204	0-4	Primary	1095400.8	506283.64		1
	041M6413	041M641304	0-4	Primary	1095487.6	506444.23		1
	041M6414	041M641404	0-4	Primary	1095472.4	506520.18		1
	041M6415	041M641504	0-4	Primary	1095460.5	506577.69		1
	041M6416	041M641604	0-4	Horizontal	1095419.2	506638.45		1
	041M6417	041M641704	0-4	Primary	1095362.8	506027.56		1
	041M6418	041M641804	0-4	Primary	1095488.7	506041.67		1
	041M6419	041M641904	0-4	Primary	1095576.6	506159.94		1
	041M6420	041M642004	0-4	Primary	1095605.8	506282.55		1
	041M6421	041M642104	0-4	Primary	1095672	506367.19		1
	041M6422	041M642204	0-4	Horizontal	1095565.7	506290.15		1
	041M6423	041M642304	0-4	Horizontal	1095717.6	506485.46		1
	041M6424	041M642404	0-4	Primary	1095542.9	506532.12		1
12 (OU 16)	041M1203	041M120304	0-4	Primary	1096400.3	505503.73	*Risk Drivers:* Pesticides *Ancillary Tests:* TOC, Grain Size *Contingent Tests:* Toxicity	1
	041M1204	041M120404	0-4	Primary	1096406.1	505480.29		1
	041M1205	041M120504	0-4	Primary	1096363	505495.05		1
	041M1206	041M120604	0-4	Primary	1096373.4	505472.83		1
	041M1207	041M120704	0-4	Primary	1096379.2	505438.28		1
	041M1208	041M120804	0-4	Horizontal	1096330.4	505495.4		1
	041M1209	041M120904	0-4	Horizontal	1096334.5	505461.89		1
	041M1210	041M121004	0-4	Horizontal	1096351.4	505430.12		1

PHASE I SEDIMENT SAMPLES

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
	041M1211	041M121104	0-4	Horizontal	1096360.4	505405.99		
48 (OU 16)	041M4810	041M481004	0-4	Primary	1075006.4	497357.88	*Risk Drivers:* DDx *Ancillary Tests:* TOC, Grain Size *Contingent Analysis:* Food Web Model for higher trophic organisms	1
	041M4811	041M481104	0-4	Primary	1075109.7	497359.62		1
	041M4812	041M481204	0-4	Primary	1075229.5	497354.41		1
	041M4813	041M481304	0-4	Primary	1075437	497366.57		1
	041M4814	041M481404	0-4	Primary	1075546.4	497364.83		1
	041M4815	041M481504	0-4	Primary	1075664.4	497396.95		1
	041M4816	041M481604	0-4	Primary	1075014.2	497268.48		1
	041M4817	041M481704	0-4	Primary	1075243.4	497266.67		1
	041M4818	041M481804	0-4	Primary	1075330.2	497252.57		1
	041M4819	041M481904	0-4	Primary	1075456.1	497263.42		1
	041M4820	041M482004	0-4	Primary	1075548.3	497255.82		1
	041M4821	041M482104	0-4	Primary	1075656.6	497278.02		1
	041M4822	041M482204	0-4	Primary	1075112.3	497172.99		1
	041M4823	041M482304	0-4	Primary	1075251.2	497151.29		1
	041M4824	041M482404	0-4	Primary	1075442.2	497195.56		1
	041M4825	041M482504	0-4	Primary	1075556.8	497192.09		1
	041M4826	041M482604	0-4	Primary	1075649.6	497192.09		1
	041M4827	041M482704	0-4	Primary	1075252.1	497042.78		1
	041M4828	041M482804	0-4	Primary	1075446.5	497107.02		1
	041M4829	041M482904	0-4	Horizontal	1075014.2	497469.86		1
	041M4830	041M483004	0-4	Horizontal	1075121	497469		1
	041M4831	041M483104	0-4	Horizontal	1075234.7	497462.92		1
	041M4832	041M483204	0-4	Horizontal	1075433.3	497467.41		1
	041M4833	041M483304	0-4	Horizontal	1075547.2	497464.15		1
	041M4834	041M483404	0-4	Horizontal	1075663.3	497460.9		1
	041M4835	041M483504	0-4	Horizontal	1075013.3	497169.02		1
	041M4836	041M483604	0-4	Horizontal	1075094.7	497049.66		1
W2 (OU 16)	041MW204	041MW20404	0-4	Primary	1084368.79	503709.00	*Risk Drivers:* TAL Metals, SVOCs, Pesticides/PCBs *Ancillary Tests:* TOC, Grain Size *Contingent Tests:* Toxicity	1
	041MW205	041MW20504	0-4	Primary	1085059.77	503968.12		1
	041MW206	041MW20604	0-4	Primary	1084757.47	503857.76		1
	041MW207	041MW20704	0-4	Primary	1085640.38	504184.05		1

PHASE I SEDIMENT SAMPLES								
Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000								
Wetland	**Sample Location**	**Sampling Identification**	**Depth (inches)**	**Primary/ Vertical/ Horizontal**	**X Coordinate**	**Y Coordinate**	**Analytical Group**	**Number of Samples**
Phase I Sediment Field QC Samples								
Field Duplicate	041M1B07	041N1B0704	0-4	Primary	1086522.7	504852.81	*Risk Drivers:* PAHs, Iron	1
Field Duplicate	041M0323	041N032304	0-4	Primary	1088784.27	506621.30	*Risk Drivers:* Iron	1
Field Duplicate	041M1505	041N150504	0-4	Primary	1088675.6	508409.28	*Risk Drivers:* Arsenic, Iron, Lead, Manganese, Selenium, DDx	1
Field Duplicate	041M18A4	041N18A404	0-4	Primary	1087319.5	506513	*Risk Drivers:* Arsenic, Iron, Lead, DDx	1
Field Duplicate	041M18B2	041N18B204	0-4	Primary	1086556.3	506852.12	*Risk Drivers:* Arsenic, Iron, DDx	1
Field Duplicate	041M04D22	041N04D2204	0-4	Primary	1090135.3	507077.83	*Risk Drivers:* Iron, Lead, DDx	1
Field Duplicate	041M5A10	041N5A1004	0-4	Primary	1092971.3	504521.19	*Risk Drivers:* TAL Metals, Tin, PCBs, PAHs, DDx, bis(2-ethylhexyl) phthalate	1
Field Duplicate	041M6410	041N641004	0-4	Primary	1095344.3	505896.27	*Risk Drivers:* TAL Metals, TCL SVOCs/PAHs, PCBs	1
Field Duplicate	041M4810	041N481004	0-4	Primary	1075006.4	497357.88	*Risk Drivers:* pesticides	1
MS/MSD	041M1B07	041M1B0704	0-4	Primary	1086522.7	504852.81	*Risk Drivers:* PAHs, Iron	1
MS/MSD	041M0323	041M032304	0-4	Primary	1088784.27	506621.30	*Risk Drivers:* Iron	1
MS/MSD	041M1505	041M150504	0-4	Primary	1088675.6	508409.28	*Risk Drivers:* Arsenic, Iron, Lead, Manganese, Selenium, DDx	1
MS/MSD	041M18A4	041M18A404	0-4	Primary	1087319.5	506513	*Risk Drivers:* Arsenic, Iron, Lead, DDx	1
MS/MSD	041M18B2	041M18B204	0-4	Primary	1086556.3	506852.12	*Risk Drivers:* Arsenic, Iron, DDx	1
MS/MSD	041M04D22	041M04D2204	0-4	Primary	1090135.3	507077.83	*Risk Drivers:* Iron, Lead, DDx	1
MS/MSD	041M5A10	041M5A1004	0-4	Primary	1092971.3	504521.19	*Risk Drivers:* TAL Metals, Tin, PCBs, PAHs, DDx, bis(2-ethylhexyl) phthalate	1
MS/MSD	041M6410	041M641004	0-4	Primary	1095344.3	505896.27	*Risk Drivers:* TAL Metals, TCL SVOCs/PAHs, PCBs	1
MS/MSD	041M4810	041M481004	0-4	Primary	1075006.4	497357.88	*Risk Drivers:* pesticides	1
Equipment Blank	EBMMDDYY	EBMMDDYY	NA	Primary	NA	NA	Risk Drivers: TAL Metals + Tin, TCL SVOCs/PAHs, PCBs, DDx	1
Equipment Blank	EBMMDDYY	EBMMDDYY	NA	Primary	NA	NA	Risk Drivers: TAL Metals + Tin, TCL SVOCs/PAHs, PCBs, DDx	1

PHASE II SEDIMENT SAMPLES (Contingent Upon Phase I Results and Partnering Team Consensus)

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
1B (OU 1)	041M1B05	041M1B0512	4-12	Vertical	1086943.7	504661.84	*Risk Drivers:* PAHs, Iron *Ancillary Tests:* TOC, Grain Size, pH *Contingent Tests:* Toxicity	2
		041M1B0524	12-24					
	041M1B06	041M1B0612	4-12	Vertical	1086663.3	504803.33		2
		041M1B0624	12-24					
	041M1B07	041M1B0712	4-12	Vertical	1086522.7	504852.81		2
		041M1B0724	12-24					
	041M1B08	041M1B0812	4-12	Vertical	1086289.2	504935.28		2
		041M1B0824	12-24					
	041M1B09	041M1B0912	4-12	Vertical	1086047	505049.86		2
		041M1B0924	12-24					
4D (OU 1)	041M04D06	041M04D0612	4-12	Vertical	1089466.9	507005.78	*Risk Drivers:* Iron, Lead, DDx *Ancillary Tests:* Aluminum, TOC, AVS/SEM, Grain Size, pH *Contingent Tests:* Toxicity	2
		041M04D0624	12-24					
	041M04D07	041M04D0712	4-12	Vertical	1089497.3	507056.13		2
		041M04D0724	12-24					
	041M04D08	041M04D0812	4-12	Vertical	1089491.2	507118.63		2
		041M04D0824	12-24					
	041M04D09	041M04D0912	4-12	Horizontal	1089514.6	506989.29		2
		041M04D0924	12-24					
	041M04D10	041M04D1012	4-12	Horizontal	1089557.2	507037.9		2
		041M04D1024	12-24					
	041M04D11	041M04D1112	4-12	Horizontal	1089548.5	507089.12		2
		041M04D1124	12-24					
	041M04D12	041M04D1212	4-12	Horizontal	1089530.3	507167.24		2
		041M04D1224	12-24					
	041M04D13	041M04D1312	4-12	Vertical	1089769.8	507316.55		2
		041M04D1324	12-24					
	041M04D14	041M04D1412	4-12	Vertical	1089814.1	507382.52		2
		041M04D1424	12-24					
	041M04D15	041M04D1512	4-12	Vertical	1089894.8	507359.08		2
		041M04D1524	12-24					
	041M04D16	041M04D1612	4-12	Vertical	1089845.4	507322.62		2
		041M04D1624	12-24					
	041M04D17	041M04D1712	4-12	Vertical	1089849.7	507267.94		2
		041M04D1724	12-24					

PHASE II SEDIMENT SAMPLES (Contingent Upon Phase I Results and Partnering Team Consensus)

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
4D (OU 1)	041M04D18	041M04D1812	4-12	Horizontal	1089741.2	507379.91	*Risk Drivers:* Iron, Lead, DDx *Ancillary Tests*: Aluminum, TOC, AVS/SEM, Grain Size, pH *Contingent Tests:* Toxicity	2
		041M04D1824	12-24					
	041M04D19	041M04D1912	4-12	Horizontal	1089881.8	507429.39		2
		041M04D1924	12-24					
	041M04D20	041M04D2012	4-12	Horizontal	1089784.6	507246.23		2
		041M04D2024	12-24					
	041M04D21	041M04D2112	4-12	Horizontal	1089920.9	507290.5		2
		041M04D2124	12-24					
	041M04D22	041M04D2212	4-12	Vertical	1090135.3	507077.83		2
		041M04D2224	12-24					
	041M04D23	041M04D2312	4-12	Vertical	1090177	507076.96		2
		041M04D2324	12-24					
	041M04D24	041M04D2412	4-12	Vertical	1090175.2	507131.65		2
		041M04D2424	12-24					
	041M04D25	041M04D2512	4-12	Horizontal	1090103.2	507018.8		2
		041M04D2524	12-24					
	041M04D26	041M04D2612	4-12	Horizontal	1090129.2	507152.48		2
		041M04D2624	12-24					
	041M04D27	041M04D2712	4-12	Horizontal	1090192.6	507198.49		2
		041M04D2724	12-24					
15 (OU 1)	041M1505	041M150512	4-12	Vertical	1088675.6	508409.28	*Risk Drivers:* Arsenic, Iron, Lead, Manganese, Selenium, DDx *Ancillary Tests:* Aluminum, TOC, AVS/SEM, Grain Size, pH *Contingent Tests:* Toxicity	2
		041M150524	12-24					
	041M1506	041M150612	4-12	Vertical	1088720.2	508461.81		2
		041M150624	12-24					
	041M1507	041M150712	4-12	Vertical	1088731.1	508410.12		2
		041M150724	12-24					
	041M1508	041M150812	4-12	Vertical	1088799.7	508435.33		2
		041M150824	12-24					
	041M1509	041M150912	4-12	Vertical	1088709.9	508339.84		2
		041M150924	12-24					
	041M1510	041M151012	4-12	Vertical	1088762.8	508351.56		2
		041M151024	12-24					
	041M1511	041M151112	4-12	Vertical	1088798.8	508359.37		2
		041M151124	12-24					

PHASE II SEDIMENT SAMPLES (Contingent Upon Phase I Results and Partnering Team Consensus)

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
15 (OU 1)	041M1512	041M151212	4-12	Vertical	1088748.5	508242.18	*Risk Drivers:* Arsenic, Iron, Lead, Manganese, Selenium, DDx *Ancillary Tests:* Aluminum, TOC, AVS/SEM, Grain Size, pH *Contingent Tests:* Toxicity	2
		041M151224	12-24					
	041M1513	041M151312	4-12	Vertical	1088798.2	508258.04		2
		041M151324	12-24					
	041M1514	041M151412	4-12	Vertical	1088827.1	508277.77		2
		041M151424	12-24					
	041M1515	041M151512	4-12	Vertical	1088781.4	508209.68		2
		041M151524	12-24					
	041M1516	041M151612	4-12	Vertical	1088821.4	508222.22		2
		041M151624	12-24					
	041M1517	041M151712	4-12	Vertical	1088846.2	508238.71		2
		041M151724	12-24					
	041M1518	041M151812	4-12	Horizontal	1088759.4	508232.38		2
		041M151824	12-24					
	041M1519	041M151912	4-12	Horizontal	1088773.5	508241.26		2
		041M151924	12-24					
	041M1520	041M152012	4-12	Horizontal	1088795.9	508226.63		2
		041M152024	12-24					
	041M1521	041M152112	4-12	Primary	1088664.29	508455.42		2
		041M152124	12-24					
18A (OU 1)	041M18A04	041M18A0412	4-12	Vertical	1087319.5	506513	*Risk Drivers:* Arsenic, Iron, Lead, DDx *Ancillary Tests:* Aluminum, TOC, AVS/SEM, Grain Size, pH *Contingent Tests:* Toxicity	2
		041M18A0424	12-24					
	041M18A05	041M18A0512	4-12	Vertical	1087245.7	506549.03		2
		041M18A0524	12-24					
	041M18A06	041M18A0612	4-12	Vertical	1087190.1	506622.58		2
		041M18A0624	12-24					
	041M18A07	041M18A0712	4-12	Vertical	1087025.9	506679.28		2
		041M18A0724	12-24					
	041M18A08	041M18A0812	4-12	Vertical	1087030.3	506744.38		2
		041M18A0824	12-24					
	041M18A09	041M18A0912	4-12	Vertical	1087067.6	506716.61		2
		041M18A0924	12-24					

PHASE II SEDIMENT SAMPLES (Contingent Upon Phase I Results and Partnering Team Consensus)

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
18A (OU 1)	041M18A10	041M18A1012	4-12	Vertical	1087097.6	506709.66	*Risk Drivers:* Arsenic, Iron, Lead, DDx *Ancillary Tests:* Aluminum, TOC, AVS/SEM, Grain Size, pH *Contingent Tests:* Toxicity	2
		041M18A1024	12-24					
	041M18A11	041M18A1112	4-12	Vertical	1087088.9	506764.35		2
		041M18A1124	12-24					
	041M18A12	041M18A1212	4-12	Horizontal	1086965.7	506720.12		2
		041M18A1224	12-24					
	041M18A13	041M18A1312	4-12	Horizontal	1086994.5	506760.4		2
		041M18A1324	12-24					
	041M18A14	041M18A1412	4-12	Horizontal	1087032	506802.76		2
		041M18A1424	12-24					
	041M18A15	041M18A1512	4-12	Vertical	1086918.2	506776.38		2
		041M18A1524	12-24					
	041M18A16	041M18A1612	4-12	Horizontal	1086831.7	506771.51		2
		041M18A1624	12-24					
	041M18A17	041M18A1712	4-12	Horizontal	1086850.1	506825.33		2
		041M18A1724	12-24					
	041M18A18	041M18A1812	4-12	Horizontal	1086863.3	506866.3		2
		041M18A1824	12-24					
	041M18A19	041M18A1912	4-12	Vertical	1086713	506865.78		2
		041M18A1924	12-24					
	041M18A20	041M18A2012	4-12	Vertical	1086760.8	506850.83		2
		041M18A2024	12-24					
	041M18A21	041M18A2112	4-12	Vertical	1086806.5	506853.28		2
		041M18A2124	12-24					
	041M18A22	041M18A2212	4-12	Vertical	1086753.8	506811.22		2
		041M18A2224	12-24					
	041M18A23	041M18A2312	4-12	Vertical	1086774.6	506902.8		2
		041M18A2324	12-24					
	041M18A24	041M18A2412	4-12	Horizontal	1086653.6	506839.91		2
		041M18A2424	12-24					
	041M18A25	041M18A2512	4-12	Horizontal	1086660.5	506890.95		2
		041M18A2524	12-24					
	041M18A26	041M18A2612	4-12	Horizontal	1086667.8	506931.23		2
		041M18A2624	12-24					

PHASE II SEDIMENT SAMPLES (Contingent Upon Phase I Results and Partnering Team Consensus)

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
18B (OU 1)	041M18B02	041M18B0212	4-12	Vertical	1086556.3	506852.12	*Risk Drivers:* Arsenic, Iron, DDx *Ancillary Tests:* Aluminum, TOC, Grain Size, pH *Contingent Tests:* Toxicity	2
		041M18B0224	12-24					
	041M18B03	041M18B0312	4-12	Vertical	1086580.8	506893.53		2
		041M18B0324	12-24					
	041M18B04	041M18B0412	4-12	Vertical	1086593.3	506931.03		2
		041M18B0424	12-24					
	041M18B05	041M18B0512	4-12	Horizontal	1086487.6	506873.47		2
		041M18B0524	12-24					
	041M18B06	041M18B0612	4-12	Horizontal	1086500.6	506925.56		2
		041M18B0624	12-24					
	041M18B07	041M18B0712	4-12	Horizontal	1086505.3	506966.18		2
		041M18B0724	12-24					
	041M18B08	041M18B0812	4-12	Vertical	1086432.9	506891.96		2
		041M18B0824	12-24					
	041M18B09	041M18B0912	4-12	Vertical	1086441.5	506947.17		2
		041M18B0924	12-24					
	041M18B10	041M18B1012	4-12	Vertical	1086443.3	506978.68		2
		041M18B1024	12-24					
	041M18B11	041M18B1112	4-12	Vertical	1086391.4	506908.1		2
		041M18B1124	12-24					
	041M18B12	041M18B1212	4-12	Vertical	1086400	506947.94		2
		041M18B1224	12-24					
	041M18B13	041M18B1312	4-12	Vertical	1086398.8	506987.7		2
		041M18B1324	12-24					
5A (OU 2)	041M5A08	041M5A0812	4-12	Vertical	1093003.9	504410.69	*Risk Drivers:* TAL Metals, Tin, PCBs, PAHs, DDx, bis(2-ethylhexyl) phthalate *Ancillary Tests:* TOC, AVS/SEM, Grain Size *Contingent Tests:* Toxicity	2
		041M5A0824	12-24					
	041M5A09	041M5A0912	4-12	Vertical	1092937.9	504551.39		2
		041M5A0924	12-24					
	041M5A10	041M5A1012	4-12	Vertical	1092971.3	504521.19		2
		041M5A1024	12-24					
	041M5A11	041M5A1112	4-12	Vertical	1092996.8	504566.5		2
		041M5A1124	12-24					
	041M5A12	041M5A1212	4-12	Vertical	1093030.3	504562.75		2
		041M5A1224	12-24					
	041M5A13	041M5A1312	4-12	Vertical	1093034	504583.84		2
		041M5A1324	12-24					

PHASE II SEDIMENT SAMPLES (Contingent Upon Phase I Results and Partnering Team Consensus)

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
5A (OU 2)	041M5A14	041M5A1412	4-12	Vertical	1093059.5	504517.71	*Risk Drivers:* TAL Metals, Tin, PCBs, PAHs, DDx, bis(2-ethylhexyl) phthalate *Ancillary Tests:* TOC, AVS/SEM, Grain Size *Contingent Tests:* Toxicity	2
		041M5A1424	12-24					
	041M5A15	041M5A1512	4-12	Vertical	1093152.3	504550.45		2
		041M5A1524	12-24					
	041M5A16	041M5A1612	4-12	Vertical	1093116.3	504622.06		2
		041M5A1624	12-24					
	041M5A17	041M5A1712	4-12	Vertical	1093197	504621.2		2
		041M5A1724	12-24					
	041M5A18	041M5A1812	4-12	Vertical	1093168	504418.94		2
		041M5A1824	12-24					
	041M5A19	041M5A1912	4-12	Vertical	1093211.4	504493.59		2
		041M5A1924	12-24					
	041M5A20	041M5A2012	4-12	Vertical	1093240.4	504572.15		2
		041M5A2024	12-24					
	041M5A21	041M5A2112	4-12	Vertical	1093281.7	504359.91		2
		041M5A2124	12-24					
	041M5A22	041M5A2212	4-12	Vertical	1093295.6	504418.5		2
		041M5A2224	12-24					
	041M5A23	041M5A2312	4-12	Vertical	1093301.2	504510.95		2
		041M5A2324	12-24					
	041M5A24	041M5A2412	4-12	Vertical	1093375.9	504410.26		2
		041M5A2424	12-24					
	041M5A25	041M5A2512	4-12	Vertical	1093412.6	504360.44		2
		041M5A2524	12-24					
6 (OU 2)	041M0612	041M061212	4-12	Vertical	1095093.62	505400.462	*Risk Drivers:* DDx; *Ancillary Tests:* TOC, Grain Size	2
	041M0612	041M061224	12-24					
64 Complex (OU 2)	041M6410	041M641012	4-12	Vertical	1095344.3	505896.27	*Risk Drivers:* TAL Metals, TCL SVOCs/PAHs, PCBs *Ancillary Tests:* TOC, AVS/SEM, Grain Size *Contingent Tests:* Toxicity	2
		041M641024	12-24					
	041M6411	041M641112	4-12	Vertical	1095271.6	506073.13		2
		041M641124	12-24					
	041M6412	041M641212	4-12	Vertical	1095400.8	506283.64		2
		041M641224	12-24					
	041M6413	041M641312	4-12	Vertical	1095487.6	506444.23		2
		041M641324	12-24					
	041M6414	041M641412	4-12	Vertical	1095472.4	506520.18		2
		041M641424	12-24					

PHASE II SEDIMENT SAMPLES (Contingent Upon Phase I Results and Partnering Team Consensus)

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
64 Complex (northern portion of Wetland 7, Wetland 8, and Wetland 64) (OU 2)	041M6415	041M641512	4-12	Vertical	1095460.5	506577.69	*Risk Drivers:* TAL Metals, TCL SVOCs/PAHs, PCBs *Ancillary Tests:* TOC, AVS/SEM, Grain Size *Contingent Tests:* Toxicity	2
		041M641524	12-24					
	041M6416	041M641612	4-12	Horizontal	1095419.2	506638.45		2
		041M641624	12-24					
	041M6417	041M641712	4-12	Vertical	1095362.8	506027.56		2
		041M641724	12-24					
	041M6418	041M641812	4-12	Vertical	1095488.7	506041.67		2
		041M641824	12-24					
	041M6419	041M641912	4-12	Vertical	1095576.6	506159.94		2
		041M641924	12-24					
	041M6420	041M642012	4-12	Vertical	1095605.8	506282.55		2
		041M642024	12-24					
	041M6421	041M642112	4-12	Vertical	1095672	506367.19		2
		041M642124	12-24					
	041M6422	041M642212	4-12	Horizontal	1095565.7	506290.15		2
		041M642224	12-24					
	041M6423	041M642312	4-12	Horizontal	1095717.6	506485.46		2
		041M642324	12-24					
	041M6424	041M642412	4-12	Vertical	1095542.9	506532.12		2
		041M642424	12-24					
12 (OU 16)	041M1203	041M120312	4-12	Vertical	1096400.3	505503.73	*Risk Drivers:* pesticides *Ancillary Tests:* TOC, Grain Size *Contingent Tests:* Toxicity	2
		041M120324	12-24					
	041M1204	041M120412	4-12	Vertical	1096406.1	505480.29		2
		041M120424	12-24					
	041M1205	041M120512	4-12	Vertical	1096363	505495.05		2
		041M120524	12-24					
	041M1206	041M120612	4-12	Vertical	1096373.4	505472.83		2
		041M120624	12-24					
	041M1207	041M120712	4-12	Vertical	1096379.2	505438.28		2
		041M120724	12-24					
	041M1208	041M120812	4-12	Horizontal	1096330.4	505495.4		2
		041M120824	12-24					
	041M1209	041M120912	4-12	Horizontal	1096334.5	505461.89		2
		041M120924	12-24					
	041M1210	041M121012	4-12	Horizontal	1096351.4	505430.12		2
		041M121024	12-24					

PHASE II SEDIMENT SAMPLES (Contingent Upon Phase I Results and Partnering Team Consensus)

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
12 (OU 16)	041M1211	041M121112	4-12	Horizontal	1096360.4	505405.99	*Risk Drivers:* pesticides *Ancillary Tests:* TOC, Grain Size *Contingent Tests:* Toxicity	2
		041M121124	12-24					
48 (OU 16)	041M4810	041M481012	4-12	Vertical	1075006.4	497357.88	*Risk Drivers:* DDx *Ancillary Tests:* TOC, Grain Size *Contingent Analysis:* Food Web Model for higher trophic organisms	2
		041M481024	12-24					
	041M4811	041M481112	4-12	Vertical	1075109.7	497359.62		2
		041M481124	12-24					
	041M4812	041M481212	4-12	Vertical	1075229.5	497354.41		2
		041M481224	12-24					
	041M4813	041M481312	4-12	Vertical	1075437	497366.57		2
		041M481324	12-24					
	041M4814	041M481412	4-12	Vertical	1075546.4	497364.83		2
		041M481424	12-24					
	041M4815	041M481512	4-12	Vertical	1075664.4	497396.95		2
		041M481524	12-24					
	041M4816	041M481612	4-12	Vertical	1075014.2	497268.48		2
		041M481624	12-24					
	041M4817	041M481712	4-12	Vertical	1075243.4	497266.67		2
		041M481724	12-24					
	041M4818	041M481812	4-12	Vertical	1075330.2	497252.57		2
		041M481824	12-24					
	041M4819	041M481912	4-12	Vertical	1075456.1	497263.42		2
		041M481924	12-24					
	041M4820	041M482012	4-12	Vertical	1075548.3	497255.82		2
		041M482024	12-24					
	041M4821	041M482112	4-12	Vertical	1075656.6	497278.02		2
		041M482124	12-24					
	041M4822	041M482212	4-12	Vertical	1075112.3	497172.99		2
		041M482224	12-24					
	041M4823	041M482312	4-12	Vertical	1075251.2	497151.29		2
		041M482324	12-24					
	041M4824	041M482412	4-12	Vertical	1075442.2	497195.56		2
		041M482424	12-24					
	041M4825	041M482512	4-12	Vertical	1075556.8	497192.09		2
		041M482524	12-24					

PHASE II SEDIMENT SAMPLES (Contingent Upon Phase I Results and Partnering Team Consensus)

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
48 (OU 16)	041M4826	041M482612	4-12	Vertical	1075649.6	497192.09	*Risk Drivers:* DDx *Ancillary Tests:* TOC, Grain Size *Contingent Analysis :* Food Web Model for higher trophic organisms	2
		041M482624	12-24					
	041M4827	041M482712	4-12	Vertical	1075252.1	497042.78		2
		041M482724	12-24					
	041M4828	041M482812	4-12	Vertical	1075446.5	497107.02		2
		041M482824	12-24					
	041M4829	041M482912	4-12	Horizontal	1075014.2	497469.86		2
		041M482924	12-24					
	041M4830	041M483012	4-12	Horizontal	1075121	497469		2
		041M483024	12-24					
	041M4831	041M483112	4-12	Horizontal	1075234.7	497462.92		2
		041M483124	12-24					
	041M4832	041M483212	4-12	Horizontal	1075433.3	497467.41		2
		041M483224	12-24					
	041M4833	041M483312	4-12	Horizontal	1075547.2	497464.15		2
		041M483324	12-24					
	041M4834	041M483412	4-12	Horizontal	1075663.3	497460.9		2
		041M483424	12-24					
	041M4835	041M483512	4-12	Horizontal	1075013.3	497169.02		2
		041M483524	12-24					
	041M4836	041M483612	4-12	Horizontal	1075094.7	497049.66		2
		041M483624	12-24					
W2 (OU 2)	041MW204	041MW20412	4-12	Vertical	1084368.79	503709.00	*Risk Drivers:* TAL Metals, SVOCs, Pesticides/PCBs *Ancillary Tests:* TOC, Grain Size *Contingent Tests:* Toxicity	2
		041MW20424	12-24					
	041MW205	041MW20512	4-12	Vertical	1085059.77	503968.12		2
		041MW20524	12-24					
	041MW206	041MW20612	4-12	Vertical	1084757.47	503857.76		2
		041MW20624	12-24					
	041MW207	041MW20712	4-12	Vertical	1085640.38	504184.05		2
		041MW20724	12-24					

Field QC Samples — Sampling locations, quantities, and tests for Phase II sediment samples are based on Phase I results and Partnering team consensus. If additional Phase II sediment samples are collected, field quality control samples will be collected based on the Worksheet #12 frequency.

REFERENCE WETLANDS SEDIMENT SAMPLES

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
25A (Hurricane Series Soil)	041M25A01	041M25A0104	0-4	NA	1084399.48	509149.23	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin *Ancillary Tests:* TOC, Grain Size, pH *Contingent Tests:* Toxicity	3
		041M25A0112	4-12					
		041M25A0124	12-24					
	041M25A02	041M25A0204	0-4	NA	1084187.04	509056.77		3
		041M25A0212	4-12					
		041M25A0224	12-24					
	041M25A03	041M25A0304	0-4	NA	1084365.88	508928.76		3
		041M25A0312	4-12					
		041M25A0324	12-24					
	041M25A04	041M25A0404	0-4	NA	1084543.77	509003.99		3
		041M25A0412	4-12					
		041M25A0424	12-24					
	041M25A05	041M25A0504	0-4	NA	1084665.05	509121.83		3
		041M25A0512	4-12					
		041M25A0524	12-24					
27A (Hurricane Series Soil)	041M27A01	041M27A0104	0-4	NA	1081164.79	508323.02	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin *Ancillary Tests:* TOC, Grain Size, pH *Contingent Tests:* Toxicity	3
		041M27A0112	4-12					
		041M27A0124	12-24					
	041M27A02	041M27A0204	0-4	NA	1081096.78	508214.08		3
		041M27A0212	4-12					
		041M27A0224	12-24					
	041M27A03	041M27A0304	0-4	NA	1081282.03	508195.62		3
		041M27A0312	4-12					
		041M27A0324	12-24					
	041M27A04	041M27A0404	0-4	NA	1081392.35	508117.98		3
		041M27A0412	4-12					
		041M27A0424	12-24					
	041M27A05	041M27A0504	0-4	NA	1081458.69	508223.75		3
		041M27A0512	4-12					
		041M27A0524	12-24					
32 (Freshwater)	041M3204	041M320404	0-4	NA	1070607.09	494985.17	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin *Ancillary Tests:* TOC, Grain Size, pH *Contingent Tests:* Toxicity	3
		041M320412	4-12					
		041M320424	12-24					
	041M3205	041M320504	0-4	NA	1070388.07	494901.43		3
		041M320512	4-12					
		041M320524	12-24					

REFERENCE WETLANDS SEDIMENT SAMPLES

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
32 (Freshwater)	041M3206	041M320604	0-4	NA	1070301.64	494855.41	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin *Ancillary Tests:* TOC, Grain Size, pH *Contingent Tests:* Toxicity	3
		041M320612	4-12					
		041M320624	12-24					
	041M3207	041M320704	0-4	NA	1070447.04	494794.12		3
		041M320712	4-12					
		041M320724	12-24					
	041M3208	041M320804	0-4	NA	1070475.65	494872.88		3
		041M320812	4-12					
		041M320824	12-24					
70A (Freshwater)	041M70A01	041M70A0104	0-4	NA	1077436.05	507394.85	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin *Ancillary Tests:* TOC, Grain Size, pH *Contingent Tests:* Toxicity	3
		041M70A0112	4-12					
		041M70A0124	12-24					
	041M70A02	041M70A0204	0-4	NA	1077466.44	507465.23		3
		041M70A0212	4-12					
		041M70A0224	12-24					
	041M70A03	041M70A0304	0-4	NA	1077528.82	507340.47		3
		041M70A0312	4-12					
		041M70A0324	12-24					
	041M70A04	041M70A0404	0-4	NA	1077613.59	507385.26		3
		041M70A0412	4-12					
		041M70A0424	12-24					
	041M70A05	041M70A0504	0-4	NA	1077738.35	507354.87		3
		041M70A0512	4-12					
		041M70A0524	12-24					
27B (Saltwater)	041M27B03	041M27B0304	0-4	NA	1080869.25	508306.26	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin *Ancillary Tests:* TOC, Grain Size, pH *Contingent Tests:* Toxicity	3
		041M27B0312	4-12					
		041M27B0324	12-24					
	041M27B04	041M27B0404	0-4	NA	1080831.00	508335.85		3
		041M27B0412	4-12					
		041M27B0424	12-24					
	041M27B05	041M27B0504	0-4	NA	1080971.07	508383.95		3
		041M27B0512	4-12					
		041M27B0524	12-24					
	041M27B06	041M27B0604	0-4	NA	1080901.00	508408.82		3
		041M27B0612	4-12					
		041M27B0624	12-24					

REFERENCE WETLANDS SEDIMENT SAMPLES								
Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000								
Wetland	**Sample Location**	**Sampling Identification**	**Depth (inches)**	**Primary/ Vertical/ Horizontal**	**X Coordinate**	**Y Coordinate**	**Analytical Group**	**Number of Samples**
27B (Saltwater)	041M27B07	041M27B0704	0-4	NA	1080933.28	508275.28	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin *Ancillary Tests:* TOC, Grain Size, pH *Contingent Tests:* Toxicity	3
		041M27B0712	4-12					
		041M27B0724	12-24					
33 (Saltwater)	041M3304	041M330404	0-4	NA	1069925.61	494388.71	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin *Ancillary Tests:* TOC, Grain Size, pH *Contingent Tests:* Toxicity	3
		041M330412	4-12					
		041M330424	12-24					
	041M3305	041M330504	0-4	NA	1069234.72	494508.99		3
		041M330512	4-12					
		041M330524	12-24					
	041M3306	041M330604	0-4	NA	1069141.02	494434.36		3
		041M330612	4-12					
		041M330624	12-24					
	041M3307	041M330704	0-4	NA	1069433.89	494445.69		3
		041M330712	4-12					
		041M330724	12-24					
	041M3308	041M330804	0-4	NA	1069788.31	494274.45		3
		041M330812	4-12					
		041M330824	12-24					
Reference Wetlands Field QC Samples								
Field Duplicate	041M25A03	041N25A0304	0-4	NA	1084365.88	508928.76	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin	1
Field Duplicate	041M27A03	041N27A0304	0-4	NA	1081282.03	508195.62	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin	1
Field Duplicate	041M3206	041N320604	0-4	NA	1070301.64	494855.41	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin	1
Field Duplicate	041M70A03	041N70A0304	0-4	NA	1077528.82	507340.47	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin	1
Field Duplicate	041M3306	041N330604	0-4	NA	1069141.02	494434.36	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin	1

REFERENCE WETLANDS SEDIMENT SAMPLES								
Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 4000								
Wetland	**Sample Location**	**Sampling Identification**	**Depth (inches)**	**Primary/ Vertical/ Horizontal**	**X Coordinate**	**Y Coordinate**	**Analytical Group**	**Number of Samples**
Reference Wetlands Field QC Samples (Continued)								
MS/MSD	041M25A03	041M25A0304	0-4	NA	1084365.88	508928.76	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin	1
MS/MSD	041M27A03	041M27A0304	0-4	NA	1081282.03	508195.62	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin	1
MS/MSD	041M3206	041M320604	0-4	NA	1070301.64	494855.41	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin	1
MS/MSD	041M70A03	041M70A0304	0-4	NA	1077528.82	507340.47	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin	1
MS/MSD	041M3306	041M330604	0-4	NA	1069141.02	494434.36	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin	1
Equipment Blank	EBMMDDYY	EBMMDDYY	NA	Primary	NA	NA	*Laboratory Tests:* TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin	1

SURFACE WATER SAMPLES

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 2000, FS 2100

Field Test SOP References: FT 1000, FT 1100, FT 1200, FT 1300, FT 1400, FT 1500, FT 1600, FT 1800, HACH 8131, HACH 8146

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
Reference Wetlands								
25A (Hurricane Series Soil)	041W25A01	041W25A0100	00	NA	1084399.48	509149.23	*Laboratory Test:* TCL SVOCs/PAHs + TICs TCL pesticides, TAL Metals + Tin, Hardness *Contingent Tests:* Toxicity *Field Tests:* Temperature, pH, Salinity, ORP, DO, and Depth	1
	041W25A02	041W25A0200	00	NA	1084187.04	509056.77		1
	041W25A03	041W25A0300	00	NA	1084365.88	508928.76		1
	041W25A04	041W25A0400	00	NA	1084543.77	509003.99		1
	041W25A05	041W25A0500	00	NA	1084665.05	509121.83		1
27A (Hurricane Series Soil)	041W27A01	041W27A0100	00	NA	1081164.79	508323.02	*Laboratory Test:* TCL SVOCs/PAHs + TICs TCL pesticides, TAL Metals + Tin, Hardness *Contingent Tests:* Toxicity *Field Tests:* Temperature, pH, Salinity, ORP, DO, and Depth	1
	041W27A02	041W27A0200	00	NA	1081096.78	508214.08		1
	041W27A03	041W27A0300	00	NA	1081282.03	508195.62		1
	041W27A04	041W27A0400	00	NA	1081392.35	508117.98		1
	041W27A05	041W27A0500	00	NA	1081458.69	508223.75		1
32 (Freshwater)	041W3204	041W320400	00	NA	1070607.09	494985.17	*Laboratory Test:* TCL SVOCs/PAHs + TICs TCL pesticides, TAL Metals + Tin, Hardness *Contingent Tests:* Toxicity *Field Tests:* Temperature, pH, Salinity, ORP, DO, and Depth	1
	041W3205	041W320500	00	NA	1070388.07	494901.43		1
	041W3206	041W320600	00	NA	1070301.64	494855.41		1
	041W3207	041W320700	00	NA	1070447.04	494794.12		1
	041W3208	041W320800	00	NA	1070475.65	494872.88		1
70A (Freshwater)	041W70A01	041W70A0100	00	NA	1080869.25	508306.26	*Laboratory Test:* TCL SVOCs/PAHs + TICs TCL pesticides, TAL Metals + Tin, Hardness *Contingent Tests:* Toxicity *Field Tests:* Temperature, pH, Salinity, ORP, DO, and Depth	1
	041W70A02	041W70A0200	00	NA	1080831.00	508335.85		1
	041W70A03	041W70A0300	00	NA	1080971.07	508383.95		1
	041W70A04	041W70A0400	00	NA	1080901.00	508408.82		1
	041W70A05	041W70A0500	00	NA	1080933.28	508275.28		1
27B (Saltwater)	041W27B03	041W27B0300	00	NA	1080869.25	508306.26	*Laboratory Test:* TCL SVOCs/PAHs + TICs TCL pesticides, TAL Metals + Tin *Contingent Tests:* Toxicity *Field Tests:* Temperature, pH, Salinity, ORP, DO, and Depth	1
	041W27B04	041W27B0400	00	NA	1080831.00	508335.85		1
	041W27B05	041W27B0500	00	NA	1080971.07	508383.95		1
	041W27B06	041W27B0600	00	NA	1080901.00	508408.82		1
	041W27B07	041W27B0700	00	NA	1080933.28	508275.28		1
33 (Saltwater)	041W3304	041W330400	00	NA	1069925.61	494388.71	*Laboratory Test:* TCL SVOCs/PAHs + TICs TCL pesticides, TAL Metals + Tin *Contingent Tests:* Toxicity *Field Tests:* Temperature, pH, Salinity, ORP, DO, and Depth	1
	041W3305	041W330600	00	NA	1069234.72	494508.99		1
	041W3306	041W330600	00	NA	1069141.02	494434.36		1
	041W3307	041W330700	00	NA	1069433.89	494445.69		1
	041W3308	041W330800	00	NA	1069788.31	494274.45		1

SURFACE WATER SAMPLES

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 2000, FS 2100

Field Test SOP References: FT 1000, FT 1100, FT 1200, FT 1300, FT 1400, FT 1500, FT 1600, FT 1800, HACH 8131, HACH 8146

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
Wetland 3 Conceptual Site Model Refinement								
3 (OU 1)	041W0308	041W030800	00	NA	1088657.16	506341.24	*Risk Drivers:* Iron (Dissolved and Total) *Laboratory Tests:* Total and Dissolved: Aluminum, Manganese, and Magnesium, Alkalinity, Acidity, Hardness, Sulfate, Nitrate, Nitrite, Total Phosphorus, TKN, Ammonia-Nitrogen, TDS, TSS, TOC *Field Tests:* Temperature, pH, Salinity, ORP, DO, Depth, Ferrous Iron, Sulfide *Contingent Tests:* Toxicity	1
	041W0309	041W030900	00	NA	1088650.70	506326.16		1
	041W0310	041W031000	00	NA	1088676.55	506330.47		1
	041W0311	041W031100	00	NA	1088667.93	506315.39		1
	041W0312	041W031200	00	NA	1088704.56	506420.95		1
	041W0313	041W031300	00	NA	1088732.56	506487.73		1
	041W0314	041W031400	00	NA	1088754.11	506584.68		1
	041W0315	041W031500	00	NA	1088790.73	506657.92		1
	041W0316	041W031600	00	NA	1088835.97	506750.56		1
	041W0317	041W031700	00	NA	1088911.37	506800.11		1
	041W0318	041W031800	00	NA	1089051.40	506877.66		1
	041W0319	041W031900	00	NA	1089163.43	506897.05		1
	041W0320	041W031600	00	NA	TBD in field	TBD in field		1
	041W0321	041W031700	00	NA	TBD in field	TBD in field		1
	041W0322	041W031800	00	NA	TBD in field	TBD in field		1
	041W0323	041W031900	00	NA	TBD in field	TBD in field		1
1B (OU 1)	041W1B05	041W1B0500	00	NA	1086943.7	504661.84	*Risk Drivers:* PAHs, Iron *Field Tests:* Temperature, pH, Salinity, ORP, DO, Depth *Contingent Tests:* Toxicity	1
	041W1B07	041W1B0700	00	NA	1086522.7	504852.81		1
	041W1B09	041W1B0900	00	NA	1086047	505049.86		1
4D (OU 1)	041W04D6	041W04D600	00	NA	1089466.9	507005.78	*Risk Drivers:* Iron, Lead, DDx *Field Tests:* Temperature, pH, Salinity, ORP, DO, Depth *Contingent Tests:* Toxicity	1
	041W04D13	041W04D1300	00	NA	1089769.8	507316.55		1
	041W04D22	041W04D2200	00	NA	1090135.3	507077.83		1
15 (OU 1)	041W1510	041W151000	00	NA	1088762.8	508351.56	*Risk Drivers:* Arsenic, Iron, Lead, Manganese, Selenium, DDx *Field Tests:* Temperature, pH, Salinity, ORP, DO, Depth *Contingent Tests:* Toxicity	1
	041W1516	041W151600	00	NA	1088821.4	508222.22		1
	041W1521	041W152100	00	NA	1088664.29	508455.42		1
18A (OU 1)	041W18A05	041W18A0500	00	NA	1087245.7	506549.03	*Risk Drivers:* Arsenic, Iron, Lead, DDx *Laboratory Tests:* Hardness *Field Tests:* Temperature, pH, Salinity, ORP, DO, Depth *Contingent Tests:* Toxicity	1
	041W18A15	041W18A1500	00	NA	1086918.2	506776.38		1
	041W18A19	041W18A1900	00	NA	1086713	506865.78		1

SURFACE WATER SAMPLES

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 2000, FS 2100

Field Test SOP References: FT 1000, FT 1100, FT 1200, FT 1300, FT 1400, FT 1500, FT 1600, FT 1800, HACH 8131, HACH 8146

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
18B (OU 1)	041W18B03	041W18B0300	00	NA	1086580.8	506893.53	*Risk Drivers:* Arsenic, Iron, DDx *Field Tests:* Temperature, pH, Salinity, ORP, DO, Depth	1
	041W18B11	041W18B1100	00	NA	1086391.4	506908.1		1
	041W18B13	041W18B1300	00	NA	1086398.8	506987.7		1
5A (OU 2)	041W5A14	041W5A1400	00	NA	1093059.5	504517.71	*Risk Drivers:* TAL Metals, Tin, PCBs, PAHs, DDx, bis(2-ethylhexyl)phthalate *Laboratory Tests:* Hardness *Contingent Tests:* Toxicity *Field Tests:* Temperature, pH, Salinity, ORP, DO, Depth	1
	041W5A08	041W5A0800	00	NA	1093003.9	504410.69		1
	041W5A19	041W5A1900	00	NA	1093211.4	504493.59		1
Northern Portion of 6 (OU 2)	041W0612	041W061200	00	NA	1095093.62	505400.46	*Risk Drivers:* DDx *Field Tests:* Temperature, pH, Salinity, ORP, DO, Depth	1
Southern Portion of 7 (OU 2)	041W0701	041W070100	00	NA	1095127.61	505567.45	*Risk Drivers:* DDx *Field Tests:* Temperature, pH, Salinity, ORP, DO, Depth	1
64 Complex (OU 2)	041W6417	041W641700	00	NA	1095362.8	506027.56	*Risk Drivers:* TAL Metals, TCL SVOCs/PAHs, PCBs *Contingent Tests:* Toxicity *Field Tests:* Temperature, pH, Salinity, ORP, DO, Depth	1
	041W6424	041W642400	00	NA	1095542.9	506532.12		1
	041W6415	041W6415	00	NA	1095460.5	506577.69		1
12 (OU 16) if present	041W1204	041W120400	00	NA	1096406.1	505480.29	*Risk Drivers:* Pesticides *Contingent Tests:* Toxicity *Field Tests:* Temperature, pH, Salinity, ORP, DO, Depth	1
	041W1206	041W120600	00	NA	1096373.4	505472.83		1
	041W1207	041W120700	00	NA	1096379.2	505438.28		1
48 (OU 16) if present	041W4817	041W481700	00	NA	1075243.4	497266.67	*Risk Drivers:* DDx *Field Tests:* Temperature, pH, Salinity, ORP, DO, Depth	1
	041W4819	041W481900	00	NA	1075456.1	497263.42		1
	041W4827	041W482700	00	NA	1075252.1	497042.78		1
W2 (OU 16) if present	041WW204	041WW20400	00	NA	1084368.79	503709.00	*Risk Drivers:* TAL Metals, SVOCs, Pesticides/PCBs *Laboratory Tests:* Hardness *Contingent Tests:* Toxicity *Field Tests:* Temperature, pH, Salinity, ORP, DO, Depth	1
	041WW205	041WW20500	00	NA	1085059.77	503968.12		1
	041WW207	041WW20700	00	NA	1085640.38	504184.05		1
Surface Water Field QC Samples								
Duplicate	041W70A03	041R70A0300	00	NA	1080971.07	508383.95	*Laboratory Test:* TCL SVOCs/PAHs + TICs TCL pesticides, TAL Metals + Tin	1
Duplicate	041W27A03	041R27A0300	00	NA	1081282.03	508195.62	*Laboratory Test:* TCL SVOCs/PAHs + TICs TCL pesticides, TAL Metals + Tin	1

SURFACE WATER SAMPLES

Sampling SOP References: 3-02, 3-03A, 3-04A, 3-24, FC 1000, FS 1000, FS 2000, FS 2100

Field Test SOP References: FT 1000, FT 1100, FT 1200, FT 1300, FT 1400, FT 1500, FT 1600, FT 1800, HACH 8131, HACH 8146

Wetland	Sample Location	Sampling Identification	Depth (inches)	Primary/ Vertical/ Horizontal	X Coordinate	Y Coordinate	Analytical Group	Number of Samples
Duplicate	041W27B05	041R27B0500	00	NA	1080971.07	508383.95	*Laboratory Test:* TCL SVOCs/PAHs + TICs TCL pesticides, TAL Metals + Tin	1
Duplicate	041W0315	041R031500	00	NA	1088790.73	506657.92	*Risk Drivers:* Iron (Dissolved and Total)	1
MS/MSD	041W70A03	041R70A0300	00	NA	1080971.07	508383.95	*Laboratory Test:* TCL SVOCs/PAHs + TICs TCL pesticides, TAL Metals + Tin	1
MS/MSD	041W27A03	041R27A0300	00	NA	1081282.03	508195.62	*Laboratory Test:* TCL SVOCs/PAHs + TICs TCL pesticides, TAL Metals + Tin	1
MS/MSD	041W27B05	041R27B0500	00	NA	1080971.07	508383.95	*Laboratory Test:* TCL SVOCs/PAHs + TICs TCL pesticides, TAL Metals + Tin	1
MS/MSD	041W0315	041R031500	00	NA	1088790.73	506657.92	*Risk Drivers:* Iron (Dissolved and Total)	1

Notes:

Sampling locations, quantities, and tests for Phase II sediment samples are based on Phase I results and Partnering team consensus. If additional Phase II sediment samples are collected, field quality control samples will be collected based on the Worksheet #12 frequency.

SOP = Standard operating procedure (see Worksheet #21 for full SOP citations)
PAH = Polynuclear aromatic hydrocarbons
TOC = Total organic carbon
AVS/SEM = Acid volatile sulfides/simultaneously extracted metals
DDx = 4,4'-Dichlorodiphenyldichloroethane, 4,4'-Dichlorodiphenyldichloroethylene, and 4,4'-Dichlorodiphenyltrichloroethane
TAL = Target analyte list
TCL = Target compound list
SVOCs = Semivolatile organic compounds
PCBs = Polychlorinated biphenyl compounds
TICs = Tentatively identified compounds
ORP = Oxidization reduction potential
DO = Dissolved oxygen
TKN = Total Kjeldahl nitrogen
TDS = Total dissolved solids
TSS = Total suspended solids
TBD = To be determined
MS = Matrix spike
MSD = Matrix spike duplicate

QA/QC sample collection analytical frequency (limited to risk driver constituents and reference wetland laboratory tests):

Field Duplicate = One per 20 field samples MS/MSD = One pair per 20 field samples Equipment Blank = One per week per matrix per sampling equipment

SAP WORKSHEET #19: FIELD SAMPLING REQUIREMENTS TABLE

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Containers	Sample Volume	Preservation Requirements	Maximum Holding Time[1] (preparation/ analysis)
Sediment	SVOCs/PAHs via SIM	SW-846 3550C/8270D/SOP S-SV-021	(1) 4 ounce glass jar	30 grams	Cool 0-6° Celsius	14 days to preparation 40 days to analysis
Sediment	Pesticides	SW-846 3550C/8081B/SOP S-SV-003	(1) 4 ounce glass jar	30 grams	Cool 0-6° Celsius	14 days to preparation 40 days to analysis
Sediment	PCBs	SW-846 3550C/8082A/SOP S-SV-003	(1) 4 ounce glass jar	30 grams	Cool 0-6° Celsius	14 days to preparation 40 days to analysis
Sediment	Metals	SW-846 3050B/6020A/SOP S-IM-021	(1) 4 ounce glass jar	1 gram	None	180 days
Sediment	Mercury	SW-846 7471B/SOP S-IM-006	(1) 4 ounce glass jar	0.5 gram	Cool 0-6° Celsius	28 days
Sediment	Total Organic Carbon	Walkley-Black/SOP S-IN-030	(1) 4 ounce glass jar	1 gram	Cool 0-6° Celsius	28 days
Sediment	AVS/SEM	EPA 821/R-91-100/SOP GEN-AVS/SEM	(1) 4 ounce glass jar	10 grams	Cool 0-6° Celsius	14 days to SEM extraction and analysis of sulfide 14 days from extraction to filtration of SEM extract 28 days from extraction to mercury Analysis 180 days from extraction to metals Analysis
Sediment	Grain Size	ASTM D 422/SOP S3	(1) 8 ounce plastic or glass jar	30 grams	Not Applicable	Not Applicable
Sediment	pH	SW-846 9045D/SOP S-IN-016	(1) 2 ounce glass jar	50 grams	Cool 0-6° Celsius	48 Hours
Sediment	Toxicity - Saltwater	EPA 600/R-01/020, *28-day Chronic Toxicity Tests on Marine and Estuarine Sediments with the amphipod Leptocheirus plumulosus*/SOP TST-017	(1) 1 gallon HDPE	175 mL	Cool 0-6° Celsius	8 weeks
Sediment	Toxicity - Freshwater	EPA 600/R-99/064 Method 100.4, *42-day Survival, Growth & Reproduction Test for Sediments with the amphipod Hyalella azteca/* SOP TST-013	(1) 1 gallon HDPE	100 mL	Cool 0-6° Celsius	8 weeks
Surface Water	Metals, Hardness	SW-846 3010A/6020A/SOP S-IM-021 SM2340C (Hardness)/SOP S-IN-044	(1) 250-mL plastic bottle	50 mL	Nitric acid to a pH less than 2	180 days

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Containers	Sample Volume	Preservation Requirements	Maximum Holding Time[1] (preparation/ analysis)
Surface Water	SVOCs/PAHs via SIM	SW-846 3510C/8270D/SOP S-SV-021	(2) 1 liter amber glass bottles	1000 mL	Cool to 0-6°C	7 days to extraction 40 days from extraction to analysis
Surface Water	Pesticides	SW-846 3510C/8081B/SOP S-SV-003	(2) 1 liter amber glass bottles	1000 mL	Cool to 0-6°C	7 days to extraction 40 days from extraction to analysis
Surface Water	PCBs	SW-846 3510C/8082A/SOP S-SV-003	(2) 1 liter amber glass bottles	1000 mL	Cool to 0-6°C	7 days to extraction 40 days from extraction to analysis
Surface Water	Metals	SW-846 3510C/6020A/SOP S-IM-021	(1) 500 mL plastic	100 mL	Nitric acid to a pH less than 2	180 days
Surface Water	Mercury	SW-846 7470A/SOP S-IM-006	(1) 500 mL plastic	100 mL	Nitric acid to a pH less than 2	28 days
Surface Water	Alkalinity	SM2320B/SOP S-IN-014	(1) 250-mL plastic bottle	100 mL	Cool to 0-6°C	14 days
Surface Water	Acidity	SM2310B/SOP S-IN-068	(1) 250-mL plastic bottle	100 mL	Cool to 0-6°C	14 days
Surface Water	Anions: Sulfate, Nitrate, Nitrite	SW-846 9056A/SOP S-IN-010	(1) 250-mL plastic bottle	50 mL	Cool to 0-6°C	48 hours for Nitrate and Nitrite 28 days for Sulfate
Surface Water	Total Phosphorus	U.S. EPA 365.1/SOP S-IN-063	(1) 250-mL plastic bottle	50 mL	Sulfuric acid to pH less than 2; Cool to 0-6°C	28 days
Surface Water	Total Kjeldahl Nitrogen	U.S. EPA 351.2/SOP S-IN-006	(1) 500-mL plastic	200 mL	Sulfuric acid to pH less than 2; Cool to 0-6°C	28 days
Surface Water	Ammonia	SM4500NH3 B/E/U.S. EPA 350.1/ SOP S-IN-002	(1) 500-mL plastic	200 mL	Sulfuric acid to pH less than 2; Cool to 0-6°C	28 days
Surface Water	Total Dissolved Solids	SM2540C/SOP S-IN-024	(1) 250-mL plastic bottle	100 mL	Cool to 0-6°C	7 Days
Surface Water	Total Suspended Solids	SM2540C/SOP S-IN-025	(1) 1-Liter plastic bottle	500 mL	Cool to 0-6°C	7 Days
Surface Water	Total Organic Carbon	SW-846 9060A/SOP S-IN-008	(2) 40mL amber glass vials	40 mL	Hydrochloric acid to a pH less than 2; Cool to 0-6°C; no headspace	28 days

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Containers	Sample Volume	Preservation Requirements	Maximum Holding Time[1] (preparation/ analysis)
Surface Water	Toxicity — Saltwater	EPA-821-R-02-014, Method 1007.0, *Chronic Toxicity of Saltwater to the Mysid Shrimp*, *Mysidopsis bahial* SOP TST-007	(1) 0.5 gallon HDPE	200 mL	Cool 0-6° Celsius	14 days
Surface Water	Toxicity — Freshwater	EPA-821-R-02-013, Method 1002.0, *Chronic Toxicity of Freshwater to the Water Flea, Ceriodaphnia dubial* SOP TST-005	(1) 0.5 gallon HDPE	1,600 mL	Cool 0-6° Celsius	14 days
Surface Water	Field Measurement: pH, ORP, DO, Temperature, Salinity, Flow Depth	Field testing SOPs: FT 1000, FT 1100, FT 1200, FT 1300, FT 1400, FT 1500, FT 1800	None — Direct Measurement	None	None	None — Direct Measurement
Surface Water	Field Measurement: Turbidity	Field testing SOP: FT 1600	(1) 15 mL vial	10 mL	None	As soon as possible after collection
Surface Water	Field Measurement: Ferrous Iron	HACH 8146	(1) 250-mL glass BOD bottle	25 mL	None	As soon as possible after collection
Surface Water	Field Measurement: Sulfide	HACH 8131	(1) 250-mL glass BOD bottle	25 mL	None	As soon as possible after collection

Notes:

[1] Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted.

SOP = Standard operating procedure
SVOCs = Semivolatile organic compounds
PAHs = Polynuclear aromatic hydrocarbons
SIM = Selective ion monitoring
PCBs = Polychlorinated biphenyls
AVS = Acid volatile sulfide
SEM = Simultaneously extracted metals
HDPE = High density polyethylene
mL = Milliliters
ORP = Oxidization reduction potential
DO = Dissolved oxygen
BOD = Biochemical oxygen demand

SAP WORKSHEET #20: FIELD QUALITY CONTROL SAMPLE SUMMARY TABLE

(UFP-QAPP Manual Section 3.1.1)

Matrix	Date Type	Parameter	No. of Sampling Locations	No. of Field Duplicates	No. of Equipment Blanks	No. of Matrix Spikes/Matrix Spike Duplicates	Total No. of Samples to Laboratory
Sediment Phase I							
Sediment	Risk Driver	PAHs (only)	23	2	2 (a)	2 / 2	31
Sediment	Risk Driver	Pesticides	12	1	1 (a)	1 / 1	16
Sediment	Risk Driver	Iron (Only)	11	1	2 (a)	1 / 1	16
Sediment	Risk Driver	Iron, Lead	22	2	2 (a)	2 / 2	30
Sediment	Risk Driver	Arsenic, Iron, Lead, Manganese, Selenium	17	1	2 (a)	1 / 1	22
Sediment	Risk Driver	Arsenic, Iron, Lead	23	2	2 (a)	2 / 2	31
Sediment	Risk Driver	Arsenic, Iron	12	1	2 (a)	1 / 1	17
Sediment	Risk Driver	DDx (only)	88	5	2 (a)	5 / 5	105
Sediment	Risk Driver	TAL Metals, Tin, PCBs, PAHs, DDx, bis(2-ethylhexyl) phthalate	18	1	2 (a)	1 / 1	23
Sediment	Risk Driver	TAL Metals, TCL SVOCs/PAHs, PCBs	19	1	2 (a)	1 / 1	24
Sediment	Ancillary	TOC	160	0	0	0	160
Sediment	Ancillary	Grain size	160	0	0	0	160
Sediment	Ancillary	pH	85	0	0	0	85
Sediment	Ancillary	AVS/SEM	95	0	0	0	95
Sediment	Ancillary	Aluminum	74	0	0	0	74
Sediment Phase II (b)							
Reference Wetlands							
Sediment	Risk Driver/Background	TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals + Tin	90	5	1	5 / 5	106
Sediment	Ancillary/Background	TOC, Grain Size, pH	90	0	0	0	90
Surface Water Phase I							
Surface Water	Risk Driver	Iron (Total and Dissolved)	16	1	1	1 / 1	20
Surface Water	Risk Driver	PAHs (only)	3	1	1	1 / 1	7
Surface Water	Risk Driver	Pesticides	6	1	1	1 / 1	10
Surface Water	Risk Driver	Iron (Only)	3	1	1	1 / 1	7
Surface Water	Risk Driver	Iron, Lead	6	1	1	1 / 1	10
Surface Water	Risk Driver	Arsenic, Iron, Lead, Manganese, Selenium	3	1	1	1 / 1	7

Matrix	Date Type	Parameter	No. of Sampling Locations	No. of Field Duplicates	No. of Equipment Blanks	No. of Matrix Spikes/Matrix Spike Duplicates	Total No. of Samples to Laboratory
Surface Water	Risk Driver	Arsenic, Iron, Lead	3	1	1	1 / 1	7
Surface Water	Risk Driver	Arsenic, Iron	3	1	1	1 / 1	7
Surface Water	Risk Driver	DDx (only)	20	1	1	1 / 1	24
Surface Water	Risk Driver	TAL Metals, Tin, PCBs, PAHs, DDx, bis(2-ethylhexyl) phthalate	3	1	1	1 / 1	7
Surface Water	Risk Driver	TAL Metals, TCL SVOCs/PAHs, PCBs	6	1	1	1 / 1	10
Surface Water	Ancillary	Hardness	29	0	0	0 / 0	23
Reference Wetlands							
Surface Water	Risk Driver/Background	TCL SVOCs/PAHs + TICs, TCL pesticides, TAL Metals (total) + Tin	30	2	1	1 / 1	35
Wetland 3 Surface Water	Ancillary	Aluminum, Manganese, and Magnesium (total and dissolved), Alkalinity, Acidity, Hardness, Sulfate, Nitrate, Nitrite, Total Phosphorus, TKN, Ammonia-Nitrogen, TDS, TSS, TOC	16	0	0	0	16

Notes:

(a) = Equipment blanks will be collected for the full suite of risk driver parameters: TAL Metals + Tin, TCL SVOCs/PAHs, PCBs, DDx

(b) = Sampling locations, quantities, and tests for Phase II sediment samples are based on Phase I results and Partnering team consensus; therefore, exact quantities cannot be provided. Worksheet #18 provides the sampling scope contingent upon Phase I results. If additional Phase II sediment samples are collected, field quality control samples will be collected based on the Worksheet #12 frequency.

Toxicity sample collection is contingent on Phase I results and Partnering team consensus; therefore, sample quantities cannot be provided.

No. = Number
PAH = Polynuclear aromatic hydrocarbons
DDx = 4,4'-Dichlorodiphenyldichloroethane, 4,4'-Dichlorodiphenyldichloroethylene, and 4,4'-Dichlorodiphenyltrichloroethane
PCBs = Polychlorinated biphenyl compounds
TAL = Target analyte list
TCL = Target compound list
SVOCs = Semivolatile organic compounds
TOC = Total organic carbon
AVS/SEM = Acid volatile sulfides/simultaneously extracted metals
TICs = Tentatively identified compounds
TKN = Total Kjeldahl nitrogen
TDS = Total dissolved solids
TSS = Total suspended solids

Notes (Continued):

QA/QC sample collection analytical frequency (limited to risk driver constituents and reference wetland laboratory tests):

Field Duplicate	=	One per 20 field samples
Equipment Blank	=	One per week per matrix per sampling equipment. Surface water samples will be collected directly from laboratory bottles and will not require an equipment blank.
MS/MSD	=	One pair per 20 field samples

SAP WORKSHEET #21: PROJECT SAMPLING SOP REFERENCES TABLE

(UFP-QAPP Manual Section 3.1.2)

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Yes/No)	Comments
3-02	*Log Books* Revision 0; May 2012	Resolution Consultants	None	No	SOP in Appendix E
3-03A	*Sampling Labeling, and Chain-of-Custody* Revision 0; August 2012	Resolution Consultants	None	No	SOP in Appendix E
3-04A	*Sample Handling, Storage, and Shipping* Revision 0; May 2012	Resolution Consultants	None	No	SOP in Appendix E
3-05	*Investigation Derived Waste Management* Revision 11; July 2012	Resolution Consultants	None	No	SOP in Appendix E
3-07	*Land Surveying* Revision 0; August 2012	Resolution Consultants	None	No	SOP in Appendix E
3-24	*Water Quality Parameter Testing for Groundwater Sampling* Revision 0; May 2012	Resolution Consultants	Multi-parameter water quality meter with flow through cell	No	SOP in Appendix E
FC 1000	*Cleaning/Decontamination Procedures* 1 March 2014, (Effective 30 July 2014)	FDEP	None	No	SOP in Appendix E
FS 1000	*General Sampling Procedures* 1 March 2014, (Effective 30 July 2014)	FDEP	None	No	SOP in Appendix E
FS 2000	*General Aqueous Sampling Procedures* 1 March 2014, (Effective 30 July 2014)	FDEP	None	No	SOP in Appendix E
FS 2100	*Surface Water Sampling Procedures* 1 March 2014, (Effective 30 July 2014)	FDEP	None	No	SOP in Appendix E
FS 2200	*Groundwater Sampling Procedures* 1 March 2014, (Effective 30 July 2014)	FDEP	Peristaltic pump	No	SOP in Appendix E
FS 4000	*Sediment Sampling* 1 March 2014, (Effective 30 July 2014)	FDEP	Shovel, ponar, Wildco Core Sampler	No	SOP in Appendix E
FT 1000	*General Field Testing and Measurement* 1 March 2014, (Effective 30 July 2014)	FDEP	None	No	SOP in Appendix E
FT 1100	*Field Measurement of Hydrogen Ion Activity (pH)* 1 March 2014, (Effective 30 July 2014)	FDEP	pH Meter	No	SOP in Appendix E
FT 1200	*Field Measurement of Specific Conductance (Conductivity)* 1 March 2014, (Effective 30 July 2014)	FDEP	Self-contained instrument with temperature-compensation adjustment	No	SOP in Appendix E

Reference Number	Title, Revision Date and/or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Yes/No)	Comments
FT 1300	*Field Measurement of Salinity* 1 March 2014, (Effective 30 July 2014)	FDEP	Self-contained instrument with temperature-compensation adjustment	No	SOP in Appendix E
FT 1400	*Field Measurement of Temperature* 1 March 2014, (Effective 30 July 2014)	FDEP	Digital thermistor	No	SOP in Appendix E
FT 1500	*Field Measurement of Dissolved Oxygen (DO)* 1 March 2014, (Effective 30 July 2014)	FDEP	Membrane-type polarographic or galvanic electrode dissolved oxygen sensor	No	SOP in Appendix E
FT 1600	*Field Measurement of Turbidity* 1 March 2014, (Effective 30 July 2014)	FDEP	Turbidimeter (nephelometer) or a spectrophotometer	No	SOP in Appendix E
FT 1800	*Field Measurement of Water Flow and Velocity* 1 March 2014, (Effective 30 July 2014)	FDEP	Marsh-McBirney Model 201D or Flo-Mate Model 2000 Flow Meter	No	SOP in Appendix E
Hach 8131	*Sulfide, Methylene Blue Method/* Hach June 2003	HACH	HACH 8131 Sulfide test kit	No	SOP in Appendix E
Hach 8146	*Ferrous Iron 1,10 Phenanthroline Method/* Hach June 2003	HACH	HACH 8146 Ferrous Iron test kit	No	SOP in Appendix E

Notes:
SOP = Standard operating procedure
FDEP = Florida Department of Environmental Protection
U.S. EPA = United States Environmental Protection Agency

SAP WORKSHEET #22: FIELD EQUIPMENT CALIBRATION, MAINTENANCE, TESTING, AND INSPECTION TABLE

(UFP-QAPP Manual Section 3.1.2.4)

Field Equipment	Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference	Spare Parts (Kept in Carrying Case)
YSI 600 Series Water Quality Meter (Piezometer/Groundwater Sampling)	Visual Inspection Calibration/ Verification	Daily Beginning and end of day	Dissolved Oxygen — ±0.3 mg/L Oxidation-Reduction Potential — ±10 mv pH — ±0.2 Standard pH Units Salinity — ±5% Temperature — ±0.5 °C Specific Conductance — ±5%	Operator correction or replacement	Resolution Consultants FTL or designee	Manufacturer's Guidance Manual, SOP-3-24, FT 1100, FT 1200, FT 1300, FT 1400, FT 1500	Batteries Calibration solutions
YSI Professional Plus Handheld Multi-parameter Instrument (Surface Water Sampling)	Visual Inspection Calibration/ Verification	Daily Beginning and end of each day	Dissolved Oxygen — ±0.3% Oxidation Reduction Potential — ±10 mV pH — ±0.2 units Salinity — ±5% Temperature — ±0.5 °C Specific Conductance — ±5%	Operator correction or replacement	Resolution Consultants FTL or designee	Manufacturer's Guidance Manual, SOP-3-24, FT 1100, FT 1200, FT 1300, FT 1400, FT 1500	Batteries Calibration solutions
LaMotte Model 2020e (or similar) Turbidity Meter	Visual Inspection Calibration/ Verification	Daily Beginning of each day	Nephelometric Turbidity Unit <10	Operator correction or replacement	Resolution Consultants FTL	Manufacturer's Manual, FT 1600	Batteries
Water Level Indicator Solinist Model 101 (or similar)	Visual Inspection; field checks as per manufacturer	Once upon receiving from vendor, then daily	0.01-foot accuracy	Operator correction or replacement	Resolution Consultants FTL or designee	Manufacturer's Manual, FS 2200	Batteries
Marsh-McBirney Flomate Model 2000 Portable Flowmeter	Zero Adjust	Daily Beginning of each day used	Zero Stability — ±0.05 ft/sec	Operator correction	Resolution Consultant FTL or designee	Manufacturer's Guidance Manual, FT 1800	Batteries
Peristaltic Pump GeoTech Series II (or similar)	Visual Inspection Field checks as per manufacturer	Daily Beginning of each day	Pump is variable speed and therefore, acceptance is based on pumps ability to pump at rate necessary to achieve stable flow from various wells.	Operator correction or replacement	Resolution Consultants FTL or designee	Manufacturer's Manual FS 2200	Battery Pack Power Cords Screws Nuts Washers
Spectrophotometer Hach DR/4000 (or similar)	Visual Inspection Calibration/Verification	Daily Beginning of each day and as required for each test	Measurement within the calibration range for each stored procedure	Operator correction, replacement, or sample dilution	Resolution Consultants FTL or designee	Manufacturer's Guidance Manual, SOP-3-18	Test kit reagents Batteries Sample cells

Field Equipment	Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference	Spare Parts (Kept in Carrying Case)
Global Positioning System	Positioning	Beginning and end of each day used	Accuracy: sub-meter horizontal dilution Of precision < 3, number of satellites must be at least six	Wait for better signal, replace unit, or choose alternate location technique	Resolution Consultants FTL or designee	Manufacturer's Guidance Manual, SOP 3-07	Battery Pack Spare stylus and tether

Notes:

FTL = Field team leader
mg/L = milligram per liter
mV = millivolts
SOP = Standard operating procedure
DO = Dissolved Oxygen
ORP = Oxidation Reduction Potential

Field measurement equipment will be checked for operation in accordance with the manufacturer's specifications. This includes battery checks, routine replacement of membranes, and cleaning of conductivity electrodes. All equipment will be inspected for damage when first handed out and when returned from use. Equipment used to gather, generate, or measure environmental data will be calibrated within the frequency stipulated by the SOP and manufacturer's instructions in such a manner that accuracy and reproducibility of results are consistent.

Prior to use, field-measuring equipment will be examined to verify that it is in operating condition and field personnel will follow the manufacturer's instructions for assembly, operation, and maintenance of field instruments and equipment. Inspections of instruments prior to their use shall consist of a general examination of the probes, wires, and electrical systems (battery check), and calibration check. If a field instrument proves faulty, the equipment will be taken out-of-service until corrective action can be performed to return the unit to working order. If appropriate, a substitute unit will be delivered to the site to ensure that the integrity of the work is not compromised.

Field personnel will verify that the SOP calibration requirements have been met for instruments used and that all equipment is in proper working condition prior to use. They will document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements. The preventive maintenance of field equipment is described in detail in the associated manufacturer's equipment manuals. Records of equipment maintenance will be maintained in the field logbook.

Instruments may also be re-calibrated during the day if field personnel consider it necessary. Instrument calibration will be recorded in the field logbook or on project-specific calibration forms. Field instruments will be calibrated according to SOPs in Appendix E.

Whenever field measurements do not fall within acceptance limits, corrective action should be taken to bring the analysis back into control. The corrective action should include: (1) finding the cause of the problem, (2) correcting the problem, including replacing equipment, (3) demonstrating the problem has been corrected by reanalyzing appropriate laboratory reference samples, if necessary, and (4) repeating the analyses of any investigative samples that may have been affected by the control problem, if necessary. Any preventative or corrective maintenance completed will be documented in the field notes.

SAP WORKSHEET #23: ANALYTICAL SOP REFERENCES TABLE

(UFP-QAPP Manual Section 3.2.1)

Laboratory Name and Address: Shealy Environmental Services, Inc., 106 Vantage Point Drive, West Columbia, South Carolina 29172

Laboratory Point of Contact/Project Manager: Kelly Maberry, kmaberry@shealylab.com, (803) 227-2706

Laboratory SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to Quality Systems Manual	Modified for Project Work?
S-EX-017	*Ultrasonic Extraction Method 3550 B/C*, Revision 5, 11 April 2013	Definitive	Sediment, Preparation SVOCs/PAHs via SIM, Pesticides and PCBs	Sonicator	No	No
S-SV-021	*GC/MS Analysis Based on EPA Method 8270D, Prepared by EPA Methods 3520C 3550C, 3580A,* Revision 12, 6 December 2012	Definitive	Sediment, SVOCs/PAHs via SIM	GC/MS	No	No
S-SV-003	*Gas Chromatographic Analysis Based on EPA 608 and SW-846, Methods 8000B, 8081A/B, 8082/A*, Revision 15, 12 June 2013	Definitive	Sediment, Pesticides and PCBs	GC	No	No
S-IM-021; S-IN-044	*Inductively Coupled Plasma-Mass Spectrometry Analysis by 6020A*, Revision 4, 10 April 2013 *Total Hardness (as mg CaCO3/L), EDTA Titrimetric Method SM 2340C-2011 and Calculation Method SM 2340 B-2011*, Revision 9, 13 March 2013	Definitive	Sediment, Metals Surface Water Metals: Aluminum, Iron, Manganese, Magnesium; Hardness only: Calcium	ICP-MS	No	No
S-IM-006	*Mercury by Cold-Vapor Atomic Absorption Method 245.1/7470A and Method 245.2/7471A/B*, Revision 11, 10 April 2013	Definitive	Sediment, Mercury	Hydra AA Analyzer	No	No
S-IM-013	*Acid Digestion of Sediments, Sludges and Soils, Method 3050B*, Revision 8, 10 April 2013	Definitive	Sediment, Metals Preparation	Not Applicable	No	No
S-IM-008	*Acid Digestion of Aqueous Samples for Total Recoverable Metal Analysis by ICP and ICP-MS Spectroscopy Method 200.7/3005A*, Revision 9, 9 May 2013	Definitive	Surface Water, Metals Preparation	Not Applicable	No	No
S-IN-030	*Total Organic Carbon, Walkley-Black Procedure*, Revision 6, 14 September 2012	Definitive[1]	Sediment, Total Organic Carbon	Balance, pipet	No	No
S-IN-016	*pH by Electrometric Measurement Standard Method 4500-H+B-2011 and SW-846 9040B/C and pH Paper Method SW-846-9041A and EPA9045C/D*, Revision 10, 29 November 2012	Definitive[1]	Sediment, pH	pH meter	No	No

Laboratory Name and Address: Shealy Environmental Services, Inc., 106 Vantage Point Drive, West Columbia, South Carolina 29172

Laboratory Point of Contact/Project Manager: Kelly Maberry, kmaberry@shealylab.com, (803) 227-2706

Laboratory SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to Quality Systems Manual	Modified for Project Work?
S-IN-014	*Alkalinity by Titration, Standard Method 2320 B-2011, Carbon Dioxide and Forms of Alkalinity by Calculation SM4500-CO2-D*, Revision 7, 12 August 2013	Definitive[1]	Surface Water, Alkalinity	Digital Titrator	No	No
S-IN-068	*Acidity by Titration, Standard Method 2310B-2011*, Revision 1, 4 January 2013	Definitive[1]	Surface Water, Acidity	Manual Titration	No	No
S-IN-010	*Inorganic Anions by Ion Chromatography, EPA Method 300.0 and SW-846 9056A*, Revision 13, 7 September 2012	Definitive[1]	Surface Water, Anions: Sulfate, Nitrate, Nitrite	Ion Chromatograph	No	No
S-IN-063	*Total and Ortho Phosphorus by Colorimetric Automated, EPA Method 365.1 with Discrete Analyzer*, Revision 7, 23 January 2013	Definitive[1]	Surface Water, Total Phosphorus	Konelab Analyzer	No	No
S-IN-006	*Total Kjeldahl Nitrogen (TKN) by Flow Injection Analysis Colorimetery (Phenate) Method 351.2*, Revision 8, 5 August 2013	Definitive[1]	Surface Water, Total Kjeldahl Nitrogen	Lachat flow injection analyzer	No	No
S-IN-002	*EPA Method 350.1, Determination of Ammonia Nitrogen with Modified Analysis using Konelab Discrete Analyzer*, Revision 13, 30 May 2013	Definitive[1]	Surface Water, Ammonia	Konelab Analyzer	No	No
S-IN-024	*Total Dissolved Solids (TDS) by SM 2540 C-2011 and Total Dissolved Volatile Solid (TDVS) by EPA Method 160.4*, Revision 6, 14 September 2012	Definitive[1]	Surface Water, Total Dissolved Solids	Oven, Balance	No	No
S-IN-025	*Total Suspended Solids (TSS) SM 2540 D-2011 and Total Volatile Suspended Solid (TVSS) EPA Method 160.4*, Revision 8, 23 January 2013	Definitive[1]	Surface Water, Total Suspended Solids	Oven, Balance	No	No
S-IN-008	*Total Organic Carbon (TOC) Standard Method 5310C-2011 and SW-846 9060A*, Revision 9, 9 May 2013	Definitive[1]	Surface Water, Total Organic Carbon	Total Organic Carbon analyzer	No	No

Notes:

[1]Analytical procedure produces definitive results; however, the end use of the data will be as a screening level tool to assess sediment and/or surface water chemistry. Laboratory SOPs may be provided upon request.

SOP = Standard operating procedure
PAHs = Polynuclear aromatic hydrocarbons
GC/MS = Gas chromatography/mass spectroscopy
GC = Gas chromatography
AA = Atomic absorption
SVOCs = Semivolatile organic compounds
SIM = Selective ion monitoring
PCBs = Polychlorinated biphenyls
ICP-MS = Inductively coupled plasma-mass spectrometry

SAP WORKSHEET #23: ANALYTICAL SOP REFERENCES TABLE (Continued)

(UFP-QAPP Manual Section 3.2.1)

Laboratory Name and Address: ALS Environmental, 1565 Jefferson Road, Building 300, Suite 360, Rochester, New York 14623

Laboratory Point of Contact/Project Manager: Deb Patton, dpatton@caslab.com, 585-288-5380

Laboratory SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to Quality Systems Manual	Modified for Project Work?
GEN-AVS/SEM	*Sulfides, Acid Volatile, and Simultaneously Extracted Metals*, Revision 4, 13 November 2008.	Definitive[1]	Sediment, AVS/SEM	Spectrophotometer	No	No
MET-200.7/6010C	*Determination of Metal and Trace Elements by Inductively Coupled Plasma Atomic Emission Spectrometry*, Revision 12, 3 September 2010	Definitive[1]	Sediment, AVS/SEM	ICP-AES	No	No
MET-7470A/245.1	*Determination of Mercury in Water by Cold Vapor Atomic Absorption Spectrometry*, Revision 6, 17 December 2009.	Definitive[1]	Sediment, AVS/SEM	CVAA	No	No
MET-3010A	*Metals Digestion, Waters for ICP Analysis,* Revision 5, 21 September 2009	Definitive[1]	Sediment, AVS/SEM	Not Applicable	No	No

Notes:

[1]Analytical procedure produces definitive results; however, the end use of the data will be as a screening level tool to assess sediment chemistry.

Laboratory SOPs may be provided upon request.

SOP = Standard operating procedure
AVS = Acid volatile sulfide
SEM = Simultaneously extracted metals
ICP-AES = Inductively coupled plasma-atomic emission spectrometry
CVAA = Cold-vapor atomic absorption

SAP WORKSHEET #23: ANALYTICAL SOP REFERENCES TABLE (Continued)

(UFP-QAPP Manual Section 3.2.1)

Laboratory Name and Address: Geotechnics, 544 Braddock Ave., East Pittsburgh, Pennsylvania 15112

Laboratory Point of Contact/Project Manager: Randy O'Rourke, rorourke@geotechnics.net, 412-823-7600

Laboratory SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to Quality Systems Manual	Modified for Project Work?
S3	*Test Method for Particle-size of Soils (Sieve and Hydrometer Analyses),* Revision 1, 5 March 2008	Screening	Sediment, Grain size	Drying Oven, Balance, Sieves	Not Applicable	No

Note:
SOP = Standard operating procedure (provided upon request)

Laboratory Name and Address: Hydrosphere Research, 11842 Research Circle, Alachua, Florida 32615-6817

Laboratory Point of Contact/Project Manager: Craig Watts, craig@hydrosphere.net, 386-462-7889

Laboratory SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to Quality Systems Manual	Modified for Project Work?
TST-017	*Conducting 28-day Chronic Toxicity Tests on Marine and Estuarine Sediments with the amphipod Leptocheirus plumulosus*, Revision 0, — June 2013	Definitive	Sediment Toxicity, Saltwater	Not Applicable	Not Applicable	No
TST-013	*Conducting Test Method 100.4, 42-day Survival, Growth & Reproduction Test for Sediments with the amphipod Hyalella azteca*, Revision 0, 6 June 2013	Definitive	Sediment Toxicity, Freshwater	Not Applicable	Not Applicable	No
TST-007	*Conducting Test Method 1007.0, Chronic Toxicity of Saltwater to the Mysid Shrimp, Mysidopsis bahia*, Revision 0, 19 July 2013	Definitive	Surface Water Toxicity, Saltwater	Not Applicable	Not Applicable	No
TST-005	*Conducting Test Method 1002.0, Chronic Toxicity of Freshwater to the Water Flea, Ceriodaphnia dubia*, Revision 3, 21 March 2012	Definitive	Sediment and Toxicity, Freshwater	Not Applicable	Not Applicable	No

Note:
SOP = Standard operating procedure (provided in Appendix G)

SAP WORKSHEET #24: ANALYTICAL INSTRUMENT CALIBRATION TABLE

(UFP-QAPP Manual Section 3.2.2)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
GC/MS SVOCs/PAHs via SIM	TUNE	Beginning of each 12-hour shift	Meet criteria in Table IV, S-VO-002; Meet criteria in Section 10.3, S-SV-021	Re-tune as needed, re-analyze	Analyst, Supervisor	S-SV-021
GC/MS SVOCs/PAHs via SIM	Breakdown check (DDT)	At the beginning of each 12-hour period, prior to analysis of samples	Degradation ≤ 20% for DDT. Benzidine and pentachlorophenol should be present at their normal responses, and should not exceed a tailing factor of 2.	Correct problem then repeat the breakdown check. No samples shall be run until degradation ≤ 20%.	Analyst, Supervisor	S-SV-021
GC/MS SVOCs/PAHs via SIM	ICAL Minimum five-point initial calibration for all analytes	Initial calibration prior to sample analysis and as needed	Average RF for SPCCs: ≥ 0.05 %RSD ≤30 for RFs of the CCCs; Average %RSD ≤ 15% for all target compounds, linear with r ≥ 0.995 or quadratic curve fit with COD r^2 ≥ 0.99	Repeat calibration if criterion is not met.	Analyst, Supervisor	S-SV-021
GC/MS SVOCs/PAHs via SIM	ICV	Once after each ICAL, prior to beginning a sample run	All analytes within ± 20% of expected value	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.	Analyst, Supervisor	S-SV-021
GC/MS SVOCs/PAHs via SIM	RRT Evaluation	Prior to sample analysis.	RRT of each target analyte within ± 0.06 RRT units of the RRT standard.	Correct problem, then rerun ICAL.	Analyst, Supervisor	S-SV-021
GC/MS SVOCs/PAHs via SIM	CCV	Beginning of each 12-hour shift	Average RF for SPCCs: ≥ 0.05 All targets ≤ 20 %D	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.	Analyst, Supervisor	S-SV-021
GC/ECD, Pesticides, PCBs	Breakdown check (DDT)	At the beginning of each 12-hour period, prior to analysis of samples	Degradation ≤ 15% for both DDT and Endrin.	Correct problem then repeat the breakdown check. No samples shall be run until degradation ≤ 15%.	Analyst, Supervisor	S-SV-003
GC/ECD, Pesticides, PCBs	ICAL Minimum five-point initial calibration for all analytes	Initial calibration prior to sample analysis and as needed	%RSD <20% for all compounds; linear least squares regression: r ≥ 0.995; or non-linear regression COD r2 ≥ 0.990	Repeat calibration if criterion is not met.	Analyst, Supervisor	S-SV-003
GC/ECD, Pesticides, PCBs	ICV	Once after each ICAL, prior to beginning a sample run	All analytes within ± 20% of expected value	Correct problem and verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.	Analyst, Supervisor	S-SV-003

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
GC/ECD, Pesticides, PCBs	CCV	Beginning of each analytical sequence/ after every 10 samples & at the end of a sequence	± 20% of expected value from the ICAL	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Analyst, Supervisor	S-SV-003
ICP/MS, Metals, Hardness	TUNE	Prior to ICAL	Mass calibration ≤ 0.1 amu from the true value; Resolution < 0.9 amu full width at 10% peak height; For stability, %RSD ≤ 5% for at least four replicate analyses.	Retune instrument then reanalyze tuning solutions.	Analyst, Supervisor	S-IM-021
ICP/MS, Metals, Hardness	ICAL	Minimum one high standard and a calibration blank daily prior to sample analysis	r ≥ 0.995	Correct the problem; Recalibrate	Analyst, Supervisor	S-IM-021
ICP/MS, Metals, Hardness	ICV	Once after each ICAL, prior to beginning a sample run	± 10% of true value	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Analyst, Supervisor	S-IM-021
ICP/MS, Metals, Hardness	CCV	Every 10 analyses and end of sequence	± 10% of true value	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Analyst, Supervisor	S-IM-021
ICP/MS, Metals, Hardness	Low-level calibration check standard	Daily after one-point ICAL	Within ± 20% of true value	Correct problem, reanalyze	Analyst, Section Supervisor	S-IM-021
ICP/MS, Metals, Hardness	Linear dynamic range/high-level check	Every 6 months and with major maintenance	Within ± 10% of true value.	Perform maintenance and/or reanalyze at lower concentration.	Analyst, Supervisor	S-IM-021
ICP/MS, Metals, Hardness	Calibration blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence	No analytes detected > LOD.	Correct problem. Re-prepare and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst, Supervisor	S-IM-021
ICP/MS, Metals, Hardness	ICS	At the beginning of an analytical run and every 12 hours.	ICS-A : Absolute value of concentration for all non-spiked analytes < LOD ICS-AB: within 20% of true value	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze affected samples.	Analyst, Supervisor	S-IM-021
CVAA, Mercury	ICAL	Minimum 5 standards and a calibration blank, daily prior to sample analysis	r ≥ 0.995	Terminate analysis; correct the problem; recalibrate	Analyst, Supervisor	S-IM-006
CVAA, Mercury	ICV	Once after each ICAL, prior to beginning a sample run	± 10% of true value	Correct the problem and verify second source standard. Rerun ICV. If that fails correct problem and repeat ICAL.	Analyst, Supervisor	S-IM-006

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
CVAA, Mercury	CCV	Every 10 analyses and end of sequence	± 20% of true value	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.	Analyst, Supervisor	S-IM-006
CVAA, Mercury	Calibration blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence.	No analytes detected > LOD	Correct problem. Re-prepare and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst, Supervisor	S-IM-006
ICP-AES, SEM Metals	ICAL	Each analytical sequence — 3 Standards and a blank	r ≥ 0.995	Correct the problem; Recalibrate	Analyst, Section Supervisor	MET-200.7/6010C
ICP-AES, SEM Metals	ICV	Once after each ICAL, prior to beginning a sample run	Analytes must agree within 10% of the expected value	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Analyst, Section Supervisor	MET-200.7/6010C
ICP-AES, SEM Metals	CCV	Every 10 samples and at the end of the analytical sequence	Analytes must agree within 10% of the expected value	Correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last acceptable CCV.	Analyst, Section Supervisor	MET-200.7/6010C
ICP-AES, SEM Metals	Low-level calibration check standard	Daily after one-point ICAL	Within ± 20% of true value	Correct problem, reanalyze	Analyst, Section Supervisor	MET-200.7/6010C
ICP-AES, SEM Metals	Linear dynamic range/high-level check	Every 6 months and with major maintenance	Within ± 10% of true value	Perform maintenance and/or reanalyze at lower concentration.	Analyst, Section Supervisor	MET-200.7/6010C
ICP-AES, SEM Metals	Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence	No analytes detected > LOD	Correct problem. Re-prepare and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst, Section Supervisor	MET-200.7/6010C
ICP-AES, SEM Metals	ICS	At beginning and end of the daily sequence	ICS-A : Absolute value of concentration for all non-spiked analytes < LOD ICS-AB: within 20% of true value	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze affected samples.	Analyst, Section Supervisor	MET-200.7/6010C
CVAA, SEM Mercury	ICAL	Each analytical sequence (5 standards)	r of calibration curve ≥0.995	Correct problem, repeat ICAL	Analyst, Section Supervisor	MET-7470/245.1
CVAA, SEM Mercury	ICV	Once after each ICAL, prior to beginning a sample run	Analytes must agree within 10% of the expected value	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.	Analyst, Section Supervisor	MET-7470/245.1
CVAA, SEM Mercury	CCV	Every 10 samples and at the end of the analytical sequence	Analyte must agree within 20% of the expected value	Correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last acceptable CCV.	Analyst, Section Supervisor	MET-7470/245.1

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
CVAA, SEM Mercury	Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOD	Correct problem. Re-prepare and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst, Section Supervisor	MET-7470/245.1
Spectrophotometer, AVS	ICAL	As needed	r ≥ 0.995	Correct problem then repeat ICAL	Analyst, Section Supervisor	GEN-AVS
Spectrophotometer, AVS	ICV	Once after each ICAL, prior to beginning a sample run	± 10% of the expected value	Correct problem and rerun ICV. If that fails, correct problem and repeat ICAL.	Analyst, Section Supervisor	GEN-AVS
Spectrophotometer, AVS	CCV	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence	± 10% of the expected value	Correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last acceptable CCV.	Analyst, Section Supervisor	GEN-AVS
Spectrophotometer, AVS	CCV	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence	± 10% of the expected value	Correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last acceptable CCV.	Analyst, Section Supervisor	GEN-AVS
Spectrophotometer, AVS	Calibration Blank	Between each preparation batch	No analytes detected > LOD	Correct problem. Re-prepare and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst, Section Supervisor	GEN-AVS
Total Organic Carbon Analyzer	ICAL Minimum 5 standards	Initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Recalibrate and/or perform necessary equipment maintenance.	Analyst, Supervisor	S-IN-008
Total Organic Carbon Analyzer	ICV	Beginning of each batch	±10% of true value	Reanalyze once. If the second ICV passes, the run may continue. If the second CCV fails, recalibrate	Analyst, Supervisor	S-IN-008
Total Organic Carbon Analyzer	CCV	After every 10 samples and at the end of the analytical day	±10% of true value	2 consecutive CCVs must be analyzed and show results within 20% of the true value. Samples associated with failing CCV must be reanalyzed.	Analyst, Supervisor	S-IN-008
Total Organic Carbon Analyzer	Calibration Blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence.	No analytes detected > LOQ	Reanalyze once. If the second calibration blank passes, the run may continue. If the second calibration blank fails, recalibrate.	Analyst, Supervisor	S-IN-008
Titration Total Organic Carbon	Normality check	Prior to sample analysis.	±20% of true value	Recalibrate and/or perform necessary equipment maintenance.	Analyst, Supervisor	S-IN-030
Titration Total Organic Carbon	ICV	Beginning of each batch	±20% of true value	Reanalyze once. If the second ICV passes, the run may continue. If the second ICV fails, recalibrate.	Analyst, Supervisor	S-IN-030

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
Titration Total Organic Carbon	CCV	After every 10 samples and at the end of the analytical day	±20% of true value	2 consecutive CCVs must be analyzed and show results within 20% of the true value. Samples associated with failing CCV must be reanalyzed.	Analyst, Supervisor	S-IN-030
Titration Total Organic Carbon	Calibration Blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence	No analytes detected > LOQ	Reanalyze once. If the second calibration blank passes, the run may continue. If the second calibration blank fails, recalibrate.	Analyst, Supervisor	S-IN-030
pH Meter	ICAL two buffers (7 and 10)	Prior to sample analysis	Percent efficiency between 92-102%	Repeat calibration if criterion is not met.	Analyst, Supervisor	S-IN-016
pH Meter	ICV (second source)	Prior to sample analysis	±0.05 pH unit	Reanalyze once. If the second ICV passes, the run may continue. If the second ICV fails, recalibrate.	Analyst, Supervisor	S-IN-016
pH Meter	CCV	Every 10 samples and at the end of the day	±0.05 pH unit	Reanalyze once. If the second CCV passes, the run may continue. If the second CCV fails, recalibrate.	Analyst, Supervisor	S-IN-016
pH Meter	Calibration Blank	Every 10 samples and at the end of the day	Between 5.5 and 7.5 pH units	Reanalyze calibration blank and preceding 10 samples.	Analyst, Supervisor	S-IN-016
Titrator — Alkalinity	ICAL 2 standards	Prior to sample analysis	±10% of true value	Repeat calibration if criterion is not met.	Analyst, Supervisor	S-IN-014
Titrator — Alkalinity	ICV (second source)	Prior to sample analysis.	±10% of true value	Reanalyze once. If the second ICV passes, the run may continue. If the second ICV fails, recalibrate.	Analyst, Supervisor	S-IN-014
Titrator — Alkalinity	CCV	Every 10 titrations	±10% of true value	Reanalyze once. If the second CCV passes, the run may continue. If the second CCV fails, recalibrate.	Analyst, Supervisor	S-IN-014
Titrator — Alkalinity	Calibration Blank	Every 10 titrations and at end of the analysis sequence	No analytes detected > ½ LOQ	In all cases, when blank concentration is > ½ LOQ, reanalyze preceding 10 samples.	Analyst, Section Supervisor	S-IN-014
Titrator — Acidity	ICAL 2 standards	Prior to sample analysis	±10% of true value	Repeat calibration if criterion is not met.	Analyst, Supervisor	S-IN-068
Titrator — Acidity	ICV (second source)	Prior to sample analysis.	±10% of true value	Reanalyze once. If the second ICV passes, the run may continue. If the second ICV fails, recalibrate.	Analyst, Supervisor	S-IN-068
Titrator — Acidity	CCV	Every 10 titrations	±10% of true value	Reanalyze once. If the second CCV passes, the run may continue. If the second CCV fails, recalibrate.	Analyst, Supervisor	S-IN-068

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
Titrator — Acidity	Calibration Blank	Every 10 titrations and at end of the analysis sequence.	No analytes detected > ½ LOQ	In all cases, when blank concentration is > ½ LOQ, reanalyze preceding 10 samples.	Analyst, Section Supervisor	S-IN-068
Ion Chromatograph	ICAL Minimum 5 standards and a blank	Initial calibration prior to sample analysis.	Correlation coefficient ≥ 0.995 for linear regression	Recalibrate and/or perform necessary equipment maintenance.	Analyst, Supervisor	S-IN-010
Ion Chromatograph	CCV	CCV after every 10 samples and at the end of the analytical sequence.	All analytes within ± 10% of expected value	Repeat initial calibration and reanalyze all samples analyzed since the last successful calibration verification.	Analyst, Supervisor	S-IN-010
Ion Chromatograph	ICV (Second source)	Once after ICAL	All analytes within ± 10% of expected value	Repeat initial calibration and reanalyze all samples analyzed since the last successful calibration verification.	Analyst, Supervisor	S-IN-010
Ion Chromatograph	Calibration Blank	After CCV and at the end of the sequence.	No analytes detected > ½ LOQ	In Reanalyze once. If the second calibration blank passes, the run may continue but preceding sample set is reanalyzed. If the second calibration blank fails, recalibrate.	Analyst, Supervisor	S-IN-010
Konelab Analyzer Ammonia	ICAL Minimum 3 standards and a blank	Initial calibration prior to sample analysis.	±10% of true value	Repeat calibration if criterion is not met.	Analyst, Supervisor	S-IN-002
Konelab Analyzer Ammonia	ICV	Prior to sample analysis.	±10% of true value	Repeat calibration if criterion is not met.	Analyst, Supervisor	S-IN-002
Konelab Analyzer Ammonia	CCV	Every 10 injections	±10% of true value	Repeat CCV and re-analyze all associated samples.	Analyst, Supervisor	S-IN-002
Konelab Analyzer Ammonia	Calibration Blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence.	No analytes detected > LOD	Reanalyze once. If the second calibration blank passes, the run may continue. If the second calibration blank fails, recalibrate.	Analyst, Section Supervisor	S-IN-002
Konelab Analyzer Total Phosphorus	ICAL Minimum 3 standards and calibration blank	Initial calibration prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Recalibrate and/or perform necessary equipment maintenance.	Analyst, Supervisor	S-IN-063
Konelab Analyzer Total Phosphorus	CCV	Start a batch if no ICAL, every 10 samples and at the end of the analytical sequence.	Within ± 10% of expected value	Repeat initial calibration and reanalyze all samples analyzed since the last successful calibration verification.	Analyst, Supervisor	S-IN-063
Konelab Analyzer Total Phosphorus	ICV	Once after ICAL	Within ± 10% of expected value	Remake standard, recalibrate if necessary.	Analyst, Supervisor	S-IN-063
Konelab Analyzer Total Phosphorus	Calibration Blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence.	No analytes detected > LOD	Reanalyze once. If the second calibration blank passes, the run may continue. If the second calibration blank fails, recalibrate.	Analyst, Section Supervisor	S-IN-063

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action	Person Responsible for Corrective Action	SOP Reference
Lachat Analyzer Total Kjeldahl Nitrogen	ICAL Minimum 5 standards and a blank	Prior to sample analysis	Correlation coefficient ≥ 0.995 for linear regression	Repeat calibration if criterion is not met.	Analyst, Supervisor	S-IN-006
Lachat Analyzer Total Kjeldahl Nitrogen	ICV	Once after ICAL	Within ± 10% of expected value	Reanalyze once. If the second ICV passes, then run may continue, otherwise, recalibrate.	Analyst, Supervisor	S-IN-006
Lachat Total Kjeldahl Nitrogen	CCV	Start a batch if no ICAL, every 10 samples and at the end of the analytical sequence.	Within ± 10% of expected value	Reanalyze once. If the second CCV passes, reanalyze all samples since the last successful calibration verification.	Analyst, Supervisor	S-IN-006
Lachat Total Kjeldahl Nitrogen	Calibration Blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence.	No analytes detected > LOD	Reanalyze once. If the second calibration blank passes, the run may continue, otherwise, recalibrate.	Analyst, Section Supervisor	S-IN-006
Drying Oven, Balance TDS	ICV	Before sample analysis	+/- 0.1%	Recalibrate balance, repeat tests.	Analyst/Supervisor	S-IN-024
Drying Oven, Balance TDS	CCV	At end of batch	+/- 0.1%	Recalibrate balance, repeat tests.	Analyst/Supervisor	S-IN-024
Drying Oven, Balance TSS	ICV	Before sample analysis	+/- 0.5 %	Recalibrate balance, repeat tests.	Analyst/Supervisor	S-IN-025
Drying Oven, Balance TSS	CCV	At end of batch	+/- 0.1 %	Recalibrate balance, repeat tests.	Analyst/Supervisor	S-IN-025

Notes:

SOP = Standard operating procedure
SVOCs = Semi-volatile organic compounds
SIM = Selective ion monitoring
PCBs = Polychlorinated biphenyl compounds
CVAA = Cold vapor atomic absorption
SEM = Simultaneously extracted metals
DDT = 4,4'-Dichlorodiphenyltrichloroethane
RF = Response factor
CCCs = Calibration check compounds
r = Correlation coefficient
ICV = Initial calibration verification
CCV = Continuing calibration verification
amu = Atomic mass units
ICS = Interference check solutions
ICS-AB = Interference check solution AB
COD = Coefficient of determination
TSS = Total suspended solids
GC/MS = Gas chromatograph/mass spectrometer
PAH = Polynuclear aromatic hydrocarbons
GC/ECD = Gas chromatography/electron capture detector
ICP/MS = Inductively coupled plasma spectroscopy/mass spectrometer
ICP-AES = Inductively coupled plasma-atomic emission spectrometry
AVS = Acid volatile sulfide
ICAL = Initial calibration
SPCC = System performance check compound
%RSD = Relative standard deviation
r^2 = Coefficient of determination
RRT = Relative retention time
%D = Percent difference/percent drift
LOD = Limit of detection
ICS-A = Interference check solution A
LOQ = Limit of quantitation
TDS = Total dissolved solids

SAP WORKSHEET #25: ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION TABLE

(UFP-QAPP Manual Section 3.2.3)

Laboratory preventive maintenance will be implemented in accordance with the Laboratory QA Plan and associated SOPs. At a minimum, all major instrumentation will have associated records and logbooks, including schedules and criteria for maintenance.

The laboratory's QA Manual and SOPs incorporate procedures for critical supplies and consumables, including standard supply sources, acceptance criteria, and for tracking and retrieving these materials. Each analytical SOP provides comprehensive lists and acceptance criteria of consumables such as solvents, reagents, buffer solutions, and other consumables required for each analytical method. Each laboratory analyst is responsible for checking and inspecting supplies and consumables for the task or analytical method they are assigned. Replacement consumable items will be obtained using the approved procedures and suppliers identified in the laboratory purchasing SOP. The following table identifies all analytical instrumentation that requires maintenance, testing, and inspection frequency, provides acceptance criteria, and corrective action requirements, and applicable laboratory SOP numbers.

SAP WORKSHEET #25: ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION TABLE (Continued)

(UFP-QAPP Manual Section 3.2.3)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GC/MS	Check pressure and gas supply daily. Bake trap/column, manual tune if DFTPP not in criteria. Perform the following as needed: change septa, cut/replace column, change trap, clean source, clean injection port/liner.	SVOCs/PAHs via SIM	Ion source, injector liner, column, column flow. Monitor instrument performance via calibrations and blanks.	Prior to ICAL and/or as necessary.	Calibration and QC criteria met	Repeat maintenance activity, correct problem, or remove from service.	Analyst, Supervisor	S-SV-021
GC/ECD	Check pressure and gas supply daily. Bake column, change septa as needed, cut column as needed.	Pesticides/ PCBs	Injector liner, septa, column, column flow. Monitor instrument performance via calibrations and blanks.	Prior to ICAL and/or as necessary.	Calibration and QC criteria met	Repeat maintenance activity, correct problem, or remove from service.	Analyst, Supervisor	S-SV-003
ICP/MS	Check pressure and gas supply daily. Replace pump tubing as needed. Clean nebulizer, spray chamber and torch as needed. Replace or clean sample and skimmer cone.	Metals	Torch, nebulizer, spray chamber, pump tubing. Monitor instrument performance via calibrations and blanks.	Prior to ICAL and/or as necessary.	Calibration and QC criteria met	Repeat maintenance activity, correct problem, or remove from service.	Analyst, Supervisor	S-IM-021
CVAA	Check pressure and gas supply daily. Replace pump tubing, clean/replace optical cell, replace lamp as needed.	Mercury	Tubing, sample probe, optical cell. Monitor instrument performance via calibrations and blanks.	Prior to ICAL and/or as necessary.	Calibration and QC criteria met	Repeat maintenance activity, correct problem, or remove from service.	Analyst, Supervisor	S-IM-006
ICP-AES	Clean plasma torch, clean filters, clean spray and nebulizer chambers, replace pump tubing	SEM Metals	Torch, nebulizer, spray chamber, pump tubing. Monitor instrument performance via calibrations and blanks.	Prior to ICAL and/or as necessary.	Calibration and QC criteria met	Repeat maintenance activity, correct problem, or remove from service.	Analyst, Section Supervisor	MET-200.7/ 6010C
CVAA	Clean or replace dehydrator tubing and sample mixing coil tubing, replace sample probe, replace pump tubing, clean optical cell.	SEM Mercury	Tubing, sample probe, optical cell. Monitor instrument performance via calibrations and blanks.	Prior to ICAL and/or as necessary.	Calibration and QC criteria met	Repeat maintenance activity, correct problem, or remove from service.	Analyst, Section Supervisor	MET-7470A/ 245.1

SAP WORKSHEET #25: ANALYTICAL INSTRUMENT AND EQUIPMENT MAINTENANCE, TESTING, AND INSPECTION TABLE (Continued)

(UFP-QAPP Manual Section 3.2.3)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Spectro-photometer	Inspect lamp alignment. Adjust zero. Replace lamp as needed. Check wavelengths against NIST traceable standards.	AVS	Cuvettes, cuvette holder, lenses, lamp alignment, wavelength. Monitor instrument performance via calibrations and blanks.	Every 6 months and/or as necessary.	Within 3% of certified transmittance density values or 2 nanometers for holmium oxide	Repeat maintenance activity, correct problem, or remove from service.	Analyst, Section Supervisor	GEN-AVS
Total Organic Carbon Analyzer	Inspect Injection port, Injection needle, Catalyst	Total Organic Carbon	Monitor instrument performance via Continuing Calibration Verification and Blank	Daily	No maintenance is required as long as calibration meets SOP criteria.	Replace as needed.	Analyst, Supervisor	S-IN-008
Titrator	Burette Drive, pH electrode, and tubing	Total Organic Carbon Alkalinity, Acidity	Calibration check of the burette drive is checked annually by a contractor. Tubing is changed when necessary.	Annual calibration of burrette; maintenance of other parts as needed	Burrette delivery volume accuracy 5000 to 1. Electrode passes calibration.	Instrument maintenance.	Analyst, Supervisor	S-IN-030, S-IN-014, S-IN-068
Ion Chromatograph	Prime pump, change column	Sulfate, Nitrate, Nitrite	Instrument will be inspected prior to each ICAL and/or as needed. Routine maintenance as necessary.	As needed	No maintenance is required as long as calibration meets DoD QSM criteria.	Change column; recalibrate and reanalyze affected data.	Analyst, Supervisor	S-IN-010
Konelab Analyzer	Burette Drive, pH electrode, and tubing	Ammonia, Phosphorus	Monitor instrument performance via Continuing Calibration Verification and Blank	Daily	No maintenance is required as long as calibration meets SOP criteria.	Instrument maintenance.	Analyst, Supervisor	S-IN-002, S-IN-063
pH Meter	Change buffer solutions or pH probe	Alkalinity, Acidity, pH	Change buffer solutions or pH probe	Before analysis begins, check every 3 hours	4 and 7 $\pm$ 0.05 pH units, pH 10 $\pm$ 0.10 pH units, $\pm$ 0.20 pH units for check	Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data	Analyst, Supervisor	S-IN-014, S-IN-068, S-IN-016
Lachat	Inspect tubing and pump	Total Kjeldahl Nitrogen	Monitor instrument performance via Continuing Calibration Verification and Blank	Daily	No maintenance is required as long as calibration meets SOP criteria	Replace as needed.	Analyst, Supervisor	S-IN-006

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
Balance	Clean/Inspect	Total Dissolved Solids, Total Suspended Solids	Calibrate	Daily	1% if ≤10 mg, 0.5% if <10 grams 0.1% if ≥ 10 grams	Make sure balance is level, recalibrate	Analyst, Supervisor	S-IN-024, S-IN-025
Drying Oven	Adjust temperature if needed.	Total Dissolved Solids, Total Suspended Solids	Check temperature	Twice daily	104 ±1°C; 180 ±2°C	Drying oven: adjust temperature	Analyst, Supervisor	S-IN-024, S-IN-025

Notes:

SOP	=	Standard operating procedure
GC/MS	=	Gas chromatograph/mass spectrometer
DFTPP	=	Decafluorotriphenylphosphine
SVOCs	=	Semi-volatile organic compounds
PAH	=	Polynuclear aromatic hydrocarbons
SIM	=	Selective ion monitoring
ICAL	=	Initial calibration
QC	=	Quality control
GC/ECD	=	Gas chromatography/electron capture detector
PCBs	=	Polychlorinated biphenyl compounds
ICP/MS	=	Inductively coupled plasma spectroscopy/mass spectrometer
CVAA	=	Cold vapor atomic absorption
ICP-AES	=	Inductively coupled plasma-atomic emission spectrometry
SEM	=	Simultaneously extracted metals
NIST	=	National Institute of Standards and Technology
AVS	=	Acid volatile sulfide
nm	=	Nanometer
mg	=	Milligrams
°C	=	Degrees Celsius

SAP WORKSHEET #26: SAMPLE HANDLING SYSTEM

(UFP-QAPP Manual Appendix A)

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT	
Sample Collection (Personnel/Organization):	Field Team Leader/Resolution Consultants
Sample Packaging (Personnel/Organization):	Field Team Leader/Resolution Consultants
Coordination of Shipment (Personnel/Organization):	Field Team Leader/Resolution Consultants
Type of Shipment/Carrier:	Overnight via FedEx
SAMPLE RECEIPT AND ANALYSIS	
Sample Receipt (Personnel/Organization):	Sample Receiving Supervisor: Shealy Environmental, ALS Environmental, Geotechnics, Hydrosphere Research
Sample Custody and Storage (Personnel/Organization):	Sample Receiving Supervisor: Shealy Environmental, ALS Environmental, Geotechnics, Hydrosphere Research
Sample Preparation (Personnel/Organization):	Sample Preparation/Extractions Group Leader: Shealy Environmental, ALS Environmental, Geotechnics, Hydrosphere Research
Sample Determinative Analysis (Personnel/Organization):	Laboratory Manager/Director: Shealy Environmental, ALS Environmental, Geotechnics, Hydrosphere Research
SAMPLE ARCHIVING	
Field Sample Storage (No. of days from sample collection):	180 Days from Receipt of Samples
Sample Extract/Digestate Storage (No. of days from extraction/digestion):	180 Days from Receipt of Samples
SAMPLE DISPOSAL	
Personnel/Organization:	Waste Manager: Shealy Environmental, ALS Environmental, Geotechnics, Hydrosphere Research
Number of Days from Analysis:	180 Days from Receipt of Samples

SAP WORKSHEET #27: SAMPLE CUSTODY REQUIREMENTS

(UFP-QAPP Manual Section 3.3.3)

The following sections outline the procedures that will be used to document project activities and sample collection, handling, tracking, and custody procedures during the investigation. All forms must be filled in as completely as possible.

Sample Nomenclature

Sample labeling will be conducted in general accordance with the procedures outlined in Resolution Consultant SOP-3-03A. Sample nomenclature put forth for this field event has been selected based on historical usage. The sample nomenclature includes the historical location identifier and the sample depth. Duplicate samples will be submitted to the laboratory as blind duplicates. The field QC blank codes that will be used during this investigation are as follows: EB for equipment rinsate blanks. Field QC blanks will be labeled sequentially followed by the month, day, and year sampled (i.e., TBMMDDYY, EBMMDDYY, etc.). Samples to be used for MS/MSD will be labeled MS/MSD on the container label and noted on the chain-of-custody; however, "MS/MSD" will not be part of the unique sample identifier in order to maintain consistency with the project database. Worksheet #18 provides anticipated sample identifiers for this scope of work.

Sample Collection Documentation

Documentation of field observations will be recorded in a field logbook and/or field log sheets. Field logbooks utilized on this project will consist of a bound, water-resistant logbook. All pages of the logbook will be numbered sequentially and observations will be recorded with indelible ink.

Field sample log sheets will be used to document sample collection details and other observations, and activities will be recorded in the field logbook. Instrument calibration logs will be used to record the daily instrument calibration.

For sampling and field activities, the following types of information will be recorded in the field logbook as appropriate:

- Site name and location
- Date and time of logbook entries
- Personnel and their affiliations
- Weather conditions

- Activities involved with the sampling
- Subcontractor activity summary
- Site observations including site entry and exit times
- Site sketches made onsite
- Visitor names, affiliations, arrival and departure times
- Health and safety issues, including personal protective equipment

Sample Handling and Tracking System

Following collection, all samples will be immediately placed on ice in a cooler. The glass sample containers will be enclosed in bubble-wrap to protect the bottle ware during shipment. The cooler will be secured using strapping tape along with a signed custody seal. Sample coolers will be delivered to a local courier location for priority overnight delivery to the selected laboratory for analysis. The laboratories will provide clean sample containers for sample collection. Samples will be preserved, as indicated on Worksheet #19, based on the analytical method. Unless otherwise indicated on Worksheet #19, samples will be maintained at 0 to 6 degrees Celsius until delivery to the laboratory. Proper custody procedures will be followed throughout all phases of sample collection and handling.

After collection, each sample will be maintained in the sampler's custody until formally transferred to another party (e.g., FedEx). For all samples collected, chain-of-custody forms will document the date and time of sample collection, the sampler's name, and the names of all others who subsequently held custody of the sample. Specifications for chemical analyses will also be documented on the chain-of-custody form. Resolution Consultants SOP-3-03A provides further details on the chain-of-custody procedure.

These subsections outline the procedures that will be used by field and laboratory personnel to document project activities and sample collection procedures. All forms must be filled in as completely as possible.

Resolution Consultants personnel will collect the samples. The samplers will take care not to contaminate samples through improper handling. Samples will be sealed in appropriate containers, packaged by Resolution Consultant personnel and placed into sealed coolers under chain-of-custody in accordance with the applicable SOP. All coolers will contain a temperature blank. Samples will be transferred under chain-of-custody to a courier as described below. Once received by the laboratory(s), receipt will be documented on the chain-of-custody form and the samples will be

checked in. The samples will remain under chain-of-custody throughout the analysis period to ensure their integrity is preserved. Details are provided below.

Field Sample Custody Procedures

Chain-of-custody protocols will be used throughout sample handling to establish the evidentiary integrity of sample containers. These protocols will be used to demonstrate that the samples were handled and transferred in a manner that would eliminate possible tampering. Samples for the laboratory will be packaged and shipped in accordance with Resolution Consultants SOP-3-04A.

A sample is under custody if:

- The sample is in the physical possession of an authorized person.
- The sample is in view of an authorized person after being in his/her possession.
- The sample is placed in a secure area by an authorized person after being in his/her possession.
- The sample is in a secure area, restricted to authorized personnel only.

Custody documentation is designed to provide documentation of preparation, handling, storage, and shipping of all samples collected. A multi-part form is used with each page of the form signed and dated by the recipient of a sample or portion of sample. The person releasing the sample and the person receiving the sample each will retain a copy of the form each time a sample transfer occurs.

Integrity of the samples collected will be the responsibility of identified persons from the time the samples are collected until the samples, or their derived data, are incorporated into the final report.

The Resolution Consultants FTL is responsible for the care and custody of the samples collected until they are delivered to the laboratory or are entrusted to a carrier. When transferring samples, the individuals relinquishing and receiving them will sign, date, and note the time on the chain-of-custody form. This record documents the sample custody transfer from the sampler to the

laboratory, often through another person or agency (e.g., FedEx). Upon arrival at the laboratory, internal sample custody procedures will be followed as defined in the Laboratory SOPs.

Laboratory Chain of Custody

Laboratory sample custody procedures (receipt of samples, archiving, and disposal) will be performed according to each laboratory's SOPs. Coolers are received and checked for proper temperature. A sample cooler receipt form will be filled out to note conditions and any discrepancies. The chain-of-custody form will be checked against the sample containers for accuracy. Samples will be logged into the laboratory information management system and given a unique log number which can be tracked through processing. The laboratory project manager will notify the Resolution Consultants FTL verbally or via e-mail immediately if any problems are identified. Discrepancies and resolutions will be documented on the sample receiving checklist.

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE

(UFP-QAPP Manual Section 3.4)

Matrix:	Sediment, Surface Water
Analytical Group:	SVOCs/PAHs via SIM
Analytical Method:	SW-846 8270D
SOP Reference:	S-SV-021

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method Blank	One per batch of 20 or fewer samples per matrix	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (See Box D-1 in QSM V4.2.)	Correct problem; re-prepare and/or reanalyze any sample associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias Contamination	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 in QSM V4.2.)
Surrogates	All field and QC samples	QC acceptance criteria specified in DoD QSM Version 4.2 See Appendix H for Laboratory acceptance limits	Re-prepare and/or reanalyze if sufficient sample is available. If reanalysis confirms failing recoveries, report and narrate.	Analyst, Supervisor, QA Manager	Accuracy Bias	QC acceptance criteria specified in DoD QSM Version 4.2 See Appendix H for Laboratory acceptance limits
LCS and LCSD (if MS/MSD pair is not performed)	One per batch of 20 or fewer samples per matrix	QC acceptance criteria specified in DoD QSM Version 4.2 See Appendix H for Laboratory acceptance limits	Re-prepare and/or reanalyze all associated samples.	Analyst, Supervisor, QA Manager	Accuracy Bias	QC acceptance criteria specified in DoD QSM Version 4.2 See Appendix H for Laboratory acceptance limits
Internal Standards	In all field samples and standards	Retention time ± 30 seconds from retention time of the midpoint standard in the ICAL; EICP area within -50% to +100% of ICAL midpoint standard	Inspect MS or GC for malfunctions. Reanalyze all samples with internal standard. If reanalysis confirms matrix interference, report sample and narrate.	Analyst, Supervisor, QA Manager	Accuracy Bias	Retention time ± 30 seconds; EICP area within -50% to +100% of midpoint of ICAL
MS/MSD	One per batch of 20 or fewer samples per matrix	For matrix evaluation, use LCS recovery criteria; RPD ≤30.	Contact the client to determine if additional measures are required.	Analyst, Supervisor, QA Manager	Accuracy, Bias Precision	For matrix evaluation, use LCS recovery criteria; RPD ≤30.

Notes:

SVOCs	=	Semivolatile organic compounds	LCS	=	Laboratory control sample
PAHs	=	Polynuclear aromatic hydrocarbons	LCSD	=	Laboratory control sample duplicate
SIM	=	Selective ion monitoring	ICAL	=	Initial calibration
SOP	=	Standard operating procedure	EICP	=	Extracted ion current profile
QC	=	Quality control	MS	=	Mass Spectrometer
LOQ	=	Limit of quantitation	GC	=	Gas chromatograph
QA	=	Quality assurance	MS/MSD	=	Matrix spike/matrix spike duplicate
DoD QSM	=	Department of Defense Quality Systems Manual	RPD	=	Relative percent difference

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Sediment, Surface Water
Analytical Group:	Pesticides/ Polychlorinated Biphenyl Compounds
Analytical Method:	SW-846 8081B/8082A
SOP Reference:	S-SV-003

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method Blank	One per batch of 20 or fewer samples per matrix	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. (See Box D-1 in QSM V4.2.)	Correct problem; Re-prepare and/or reanalyze any sample associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias Contamination	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. (See Box D-1 in QSM V4.2.)
Surrogates	All field and QC samples	QC acceptance criteria specified in DoD QSM Version 4.2 See Appendix H for Laboratory acceptance limits	Re-prepare and/or reanalyze if sufficient sample is available. If reanalysis confirms failing recoveries, report and narrate.	Analyst, Supervisor, QA Manager	Accuracy Bias	QC acceptance criteria specified in DoD QSM Version 4.2 see Appendix H for Laboratory acceptance limits
LCS and LCSD (if MS/MSD pair is not performed)	One per batch of 20 or fewer samples per matrix	QC acceptance criteria specified in DoD QSM Version 4.2 See Appendix H for Laboratory acceptance limits	Re-prepare and/or reanalyze all associated samples.	Analyst, Supervisor, QA Manager	Accuracy Bias	QC acceptance criteria specified in DoD QSM Version 4.2 see Appendix H for Laboratory acceptance limits
MS/MSD	One per batch of 20 or fewer samples per matrix	For matrix evaluation, use LCS recovery criteria; RPD ≤30.	Contact the client to determine if additional measures are required.	Analyst, Supervisor, QA Manager	Accuracy Bias Precision	For matrix evaluation, use LCS recovery criteria; RPD ≤30.
Second Column Confirmation of Positive Results	All positive results must be confirmed using two dissimilar columns	Calibration and QC criteria same as for initial or primary column analysis. Results between primary and second column RPD ≤ 40.	Examine chromatograms for overlapping peaks or mis-integration. If no chromatographic evidence is identified, then it may be appropriate to report the lower result in accordance with Method 8000C. Both results must be reported.	Analyst, Supervisor, QA Manager	Bias Precision	Apply J-flag if RPD > 40.

Notes:

SOP	=	Standard operating procedure	DoD QSM	=	Department of Defense Quality Systems Manual
QC	=	Quality control	LCS	=	Laboratory control sample
LOQ	=	Limit of quantitation	MS/MSD	=	Matrix spike/matrix spike duplicate
QA	=	Quality assurance	RPD	=	Relative percent difference

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Sediment, Surface Water
Analytical Group:	Metals
Analytical Method:	SW-846 6020A
SOP Reference:	S-IM-021

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method Blank	One per batch of 20 or fewer samples per matrix	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (See Box D-1 in QSM V4.2.)	Correct problem; re-prepare and/or reanalyze any sample associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias Contamination	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 in QSM V4.2.)
LCS and LCSD (if MS/MSD pair is not performed)	One per batch of 20 or fewer samples per matrix	%R 80-120% See Appendix H for Laboratory acceptance limits	Re-prepare and/or reanalyze all associated samples.	Analyst, Supervisor, QA Manager	Accuracy Bias	%R 80-120% see Appendix H for Laboratory acceptance limits
Internal Standards	In all field samples and standards	Internal standard intensity within 30-120% of intensity of the internal standard in the ICAL.	Dilute and reanalyze all samples with internal standard failures. If reanalysis confirms matrix interference, report sample and narrate.	Analyst, Supervisor, QA Manager	Accuracy Bias	Internal standard intensity within 30-120% of intensity of the internal standard in the ICAL.
Sample Duplicate or MSD	One per preparatory batch	MSD: %R 80-120% MSD or Sample Duplicate: RPD <20	Contact the client to determine if additional measures are required.	Analyst, Supervisor, QA Manager	Precision	MSD: %R 80-120% MSD or Sample Duplicate: RPD <20
Matrix Spike	One per batch of 20 or fewer samples per matrix	%R 80-120%	Contact the client to determine if additional measures are required.	Analyst, Supervisor, QA Manager	Accuracy Bias	%R 80-120%
Dilution Test	One per preparatory batch	Five-fold dilution must agree within ± 10% of the original measurement for samples with concentrations > 50 x LOQ	Perform post-digestion spike	Analyst, Supervisor, QA Manager	Accuracy Bias	Five-fold dilution must agree within ± 10% of the original measurement for samples with concentrations > 50 times LOQ

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Sediment, Surface Water
Analytical Group:	Metals
Analytical Method:	SW-846 6020A
SOP Reference:	S-IM-021

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Post Digestion Spike	Perform if MS/MSD fails. One per preparatory batch (using the same sample as used for the MS/MSD if possible).	%R 80-120%	Contact the client to determine if additional measures are required.	Analyst, Supervisor, QA Manager	Accuracy Bias	%R 80-120%

Notes:

SOP = Standard operating procedure
QC = Quality control
LOQ = Limit of quantitation
QA = Quality assurance
LCS = Laboratory control sample
ICAL = Initial calibration
DoD QSM = Department of Defense Quality Systems Manual
MSD = Matrix spike duplicate
%R = Percent recovery
RPD = Relative percent difference
LOD = Limit of detection

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Sediment, Surface Water
Analytical Group:	Mercury
Analytical Method:	SW-846 7471B
SOP Reference:	S-IM-006

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method Blank	One per batch of 20 or fewer samples per matrix	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. (See Box D-1 in QSM V4.2.)	Correct problem; re-prepare and/or reanalyze any sample associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias Contamination	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. (See Box D-1 in QSM V4.2.)
LCS and LCSD (if MS/MSD pair is not performed	One per batch of 20 or fewer samples per matrix	QC acceptance criteria specified in DoD QSM Version 4.2 See Appendix H for Laboratory acceptance limits	Re-prepare and/or reanalyze all associated samples.	Analyst, Supervisor, QA Manager	Accuracy Bias	QC acceptance criteria specified in DOD QSM Version 4.2 see Appendix H for Laboratory acceptance limits
Sample Duplicate or MSD	One per preparatory batch	MSD: %R 80-120% MSD or Sample Duplicate: RPD <20	Contact the client to determine if additional measures are required.	Analyst, Supervisor, QA Manager	Precision	MSD: %R 80-120% MSD or Sample Duplicate: RPD <20
Matrix Spike	One per batch of 20 or fewer samples per matrix	For matrix evaluation, use LCS recovery criteria	Contact the client to determine if additional measures are required.	Analyst, Supervisor, QA Manager	Accuracy Bias	For matrix evaluation, use LCS recovery criteria

Notes:

SOP = Standard operating procedure
QC = Quality control
LOQ = Limit of quantitation
QA = Quality assurance
LCS = Laboratory control sample
DoD QSM = Department of Defense Quality Systems Manual
ICAL = Initial calibration
MSD = Matrix spike duplicate
RPD = Relative percent difference
%R = Percent recovery

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Sediment
Analytical Group:	Total Organic Carbon (Ancillary Test)
Analytical Method:	Walkley Black
SOP Reference:	S-IN-030

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method blank	One per batch of 20 or fewer samples per matrix.	No analytes detected > ½ LOQ.	Correct problem; reanalyze any sample associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias Contamination	No analytes detected > ½ LOQ.
LCS and LCSD (optional)	One per preparatory batch of 20 or fewer samples.	%R 80-120% RPD <20 (if performed)	Correct problem, re-prepare, and reanalyze the LCS along with all associated samples.	Analyst, Supervisor, QA Manager	Accuracy Bias	%R 80-110% RPD <20 (if performed)
MS/MSD[1]	One per preparatory batch of 20 or fewer samples per matrix.	%R 70-130% RPD ≤20.	Corrective action will not be taken for samples when recoveries are outside limits and LCS criteria are met. If both the LCS and MS/MSD %Rs are unacceptable, then re-prepare and reanalyze the samples and QC.	Analyst, Supervisor, QA Manager	Accuracy Bias Precision	%R 70-130% RPD ≤20.

Notes:

[1] MS/MSDs for ancillary tests will not be collected or identified in the field, but are analyzed as part of the laboratory's SOP, and may or may not be analyzed on site samples.

SOP = Standard operating procedure
QC = Quality control
LOQ = Limit of quantitation
QA = Quality assurance
LCS = Laboratory control sample
LCSD = Laboratory control duplicate
%R = Percent recovery
RPD = Relative percent difference
MS = Matrix spike
MSD = Matrix spike duplicate

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Sediment
Analytical Group:	Acid Volatile Sulfide and Simultaneously Extracted Metals (Ancillary Test)
Analytical Method:	EPA 821/R-91-100
SOP Reference:	MET-200.7/6010C

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method Blank	One per batch of 20 or fewer samples per matrix. This blank carries through AVS extraction and SEM digestion and analysis.	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. (See Box D-1 in QSM V4.2.)	Correct the problem; if acceptance limits still not met, re-prepare and reanalyze the method blank and all samples processed with the contaminated blank.	Analyst, Laboratory Area Supervisor	Bias Contamination	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. (See Box D-1 in QSM V4.2.)
Digestion Blank	One per batch of 20 or fewer samples per matrix. This blank does not undergo AVS extraction. It only undergoes SEM digestion and analysis.	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. (See Box D-1 in QSM V4.2.)	Correct the problem; if acceptance limits still not met, re-prepare and reanalyze the blank and all samples processed with the contaminated blank	Analyst, Laboratory Area Supervisor	Bias Contamination	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. (See Box D-1 in QSM V4.2.)
LCS	One per batch of 20 or fewer samples per matrix. The LCS is spiked after AVS extraction and before SEM digestion.	%R 80-120%	Re-prepare and analyze all associated samples.	Analyst, Laboratory Area Supervisor	Accuracy Bias	%R 80-120%
MS/MSD[1]	One per batch of 20 or fewer samples per matrix. The MS is spiked after AVS extraction and before SEM digestion.	%R 80-120% RPD ≤20.	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.	Analyst, Laboratory Area Supervisor	Precision Accuracy Bias	%R 80-120% RPD ≤20.

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Sediment
Analytical Group:	Acid Volatile Sulfide and Simultaneously Extracted Metals (Ancillary Test)
Analytical Method:	EPA 821/R-91-100
SOP Reference:	MET-200.7/6010C

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Serial Dilution	One per batch of 20 or fewer samples per matrix	Five-fold dilution must agree within ± 10% of the original measurement for samples with concentrations > 50 x LOQ	Perform post-digestion spike	Analyst, Laboratory Area Supervisor	Precision Accuracy	Five-fold dilution must agree within ± 10% of the original measurement for samples with concentrations > 50 x LOQ
Post Digestion Spike	Perform if MS/MSD fails. One per batch of 20 or fewer samples per matrix (using the same sample as used for the MS/MSD if possible).	%R 80-120%	Run all associate samples in the preparatory batch by method of standard additions or qualify results.	Analyst, Laboratory Area Supervisor	Precision Accuracy	%R 80-120%

Notes:

[1] MS/MSDs for ancillary tests will not be collected or identified in the field, but are analyzed as part of the laboratory's SOP, and may or may not be analyzed on site samples.

SOP = Standard operating procedure
QC = Quality control
AVS = Acid volatile sulfide
SEM = Simultaneously extracted metals
LOQ = Limit of quantitation
LCS = Laboratory control sample
DoD QSM = Department of Defense Quality Systems Manual
MS/MSD = Matrix spike/matrix spike duplicate
%R = Percent recovery
RPD = Relative percent difference
LOD = Limit of detection

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Sediment
Analytical Group:	Acid Volatile Sulfide and Simultaneously Extracted Mercury (Ancillary Test)
Analytical Method:	EPA 821/R-91-100
SOP Reference:	MET-7470A/245.1

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method Blank	One per batch of 20 or fewer samples per matrix One is performed for each batch of up to 20 samples. This blank carries through AVS extraction and SEM digestion and analysis.	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. (See Box D-1 in QSM V4.2.)	Correct the problem; if acceptance limits still not met, re-prepare and reanalyze the method blank and all samples processed with the contaminated blank.	Analyst, Laboratory Area Supervisor	Bias Contamination	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. (See Box D-1 in QSM V4.2.)
Digestion Blank	One per batch of 20 or fewer samples per matrix. This blank does not undergo AVS extraction. It only undergoes SEM digestion and analysis.	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. (See Box D-1 in QSM V4.2.)	Correct the problem; if acceptance limits still not met, re-prepare and reanalyze the blank and all samples processed with the contaminated blank	Analyst, Laboratory Area Supervisor	Bias Contamination	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. (See Box D-1 in QSM V4.2.)
LCS	One per batch of 20 or fewer samples per matrix. The LCS is spiked after AVS extraction and before SEM digestion.	%R 80-120%	Re-prepare and analyze all associated samples.	Analyst, Laboratory Area Supervisor	Accuracy Bias	80-120%
MS/MSD[1]	One per batch of 20 or fewer samples per matrix. The MS is spiked after AVS extraction and before SEM digestion.	%R 80-120% RPD ≤20.	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.	Analyst, Laboratory Area Supervisor	Precision Accuracy Bias	%R 80-120% RPD ≤20.

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Sediment
Analytical Group:	Acid Volatile Sulfide and Simultaneously Extracted Metals (Ancillary Test)
Analytical Method:	EPA 821/R-91-100
SOP Reference:	GEN-AVS

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method Blank	One per batch of 20 or fewer samples per matrix.	If measured sample result <10 times LOQ, No analytes detected > LOQ in the blank. If measured sample result ≥10 times LOQ, no analytes detected in the blank > 1/10 the amount measured in any sample.	Correct the problem; if acceptance limits still not met, re-prepare and reanalyze the method blank and all samples processed with the contaminated blank.	Analyst, Laboratory Area Supervisor	Contamination Bias	If measured sample result <10 times LOQ, No analytes detected > LOQ in the blank. If measured sample result ≥10 times LOQ, no analytes detected in the blank > 1/10 the amount measured in any sample.
LCS	One per batch of 20 or fewer samples per matrix.	%R 50 - 150%	Re-prepare and analyze all associated samples.	Analyst, Laboratory Area Supervisor	Accuracy Bias	%R 50-150%
MS[1]	One per batch of 20 or fewer samples per matrix.	%R 50 - 150%	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.	Analyst, Laboratory Area Supervisor	Accuracy Bias	%R 50-150%
Duplicate [1]	One per batch of 20 or fewer samples per matrix.	RPD ≤30.	Note outlier in case narrative	Analyst, Laboratory Area Supervisor	Precision	RPD ≤30.

Notes:

[1] MS/duplicate for ancillary tests will not be collected or identified in the field, but are analyzed as part of the laboratory's SOP, and may or may not be analyzed on site samples.

SOP = Standard operating procedure
QC = Quality control
AVS = Acid volatile sulfide
SEM = Simultaneously extracted metals
LOQ = Limit of quantitation
LCS = Laboratory control sample
DoD QSM = Department of Defense Quality Systems Manual
MS = Matrix spike
%R = Percent recovery
RPD = Relative percent difference
LOD = Limit of detection

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Surface Water
Analytical Group:	Alkalinity, Acidity (Ancillary Tests)
Analytical Method:	Standard Methods 2320B, SM 2310B
SOP Reference:	S-IN-014, S-IN-068

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method blank	One per batch of 10 or fewer samples per matrix.	No analytes detected > ½ LOQ.	Correct problem; reanalyze any sample associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias Contamination	No analytes detected > ½ LOQ.
LCS LCSD (if MS/MSD pair is not performed)	One per batch of 10 or fewer samples per matrix.	%R 90-110% RPD <20 (if performed)	Correct problem, re-prepare, and reanalyze the LCS along with all associated samples.	Analyst, Supervisor, QA Manager	Accuracy Bias	%R 90-110% RPD <20 (if performed)
MS/MSD[1]	One per preparatory batch of 10 or fewer samples per matrix.	%R 70-130% RPD ≤20.	Corrective action will not be taken for samples when recoveries are outside limits and LCS criteria are met. If both the LCS and MS/MSD %Rs are unacceptable, then re-prepare and reanalyze the samples and QC.	Analyst, Supervisor, QA Manager	Accuracy Bias Precision	%R 70-130% RPD ≤20.

Notes:

[1] MS/MSDs for ancillary tests will not be collected or identified in the field, but are analyzed as part of the laboratory's SOP, and may or may not be analyzed on site samples.

SOP = Standard operating procedure
QC = Quality control
LOQ = Limit of quantitation
QA = Quality assurance
LCS = Laboratory control sample
LCSD = Laboratory control duplicate
%R = Percent recovery
RPD = Relative percent difference
MS = Matrix spike
MSD = Matrix spike duplicate

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Surface Water
Analytical Group:	Anions —Nitrate, nitrite, sulfate (Ancillary Test)
Analytical Method:	SW-846 9056A
SOP Reference:	S-IN-010

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method Blank	One per batch of 20 or fewer samples per matrix.	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. (See Box D-1 in QSM V4.2).	Correct problem; reanalyze any samples associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias, Contamination	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. (See Box D-1 in QSM V4.2).
LCS LCSD (Optional)	One per batch of 20 or fewer samples per matrix.	%R 90-110% RPD <20 (if performed)	Reanalyze and/or re-prepare all associated samples unless recoveries are high with no detection of analytes.	Analyst, Supervisor, QA Manager	Accuracy, Bias	%R 90-110% RPD <20 (if performed)
MS/MSD[1]	One per batch of 20 or fewer samples per matrix.	%R 90-110%	Contact the client to determine if additional measures are required.	Analyst, Supervisor, QA Manager	Accuracy, Bias, Precision	%R 90-110%

Notes:

[1] MS/MSDs for ancillary tests will not be collected or identified in the field, but are analyzed as part of the laboratory's SOP, and may or may not be analyzed on site samples.

SOP = Standard operating procedure
QC = Quality control
LOQ = Limit of quantitation
QA = Quality assurance
LCS = Laboratory control sample
LCSD = Laboratory control duplicate
%R = Percent recovery
RPD = Relative percent difference
MS = Matrix spike
MSD = Matrix spike duplicate

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Surface Water
Analytical Group:	Total Phosphorus (Ancillary Test)
Analytical Method:	U.S. EPA 365.1
SOP Reference:	S-IN-063

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method blank	One per batch of 10 or fewer samples per matrix.	No analytes detected > LOQ.	Correct problem; reanalyze any samples associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias Contamination	No analytes detected > LOQ.
LCS LCSD (if MS/MSD pair is not performed)	One per batch of 10 or fewer samples per matrix.	%R 90-110% RPD <20 (if performed)	Correct problem; reanalyze any sample associated with an LCS that fails criteria.	Analyst, Supervisor, QA Manager	Accuracy Bias	%R 90-110% RPD <20 (if performed)
MS/MSD[1]	One per batch of 10 or fewer samples per matrix.	%R 90-110% RPD <20	Report data with a narrative stating the sample is affected by matrix interference.	Analyst, Supervisor, QA Manager	Accuracy Bias	%R 90-110% RPD <20

Notes:

[1] MS/MSDs for ancillary tests will not be collected or identified in the field, but are analyzed as part of the laboratory's SOP, and may or may not be analyzed on site samples.

SOP = Standard operating procedure
QC = Quality control
LOQ = Limit of quantitation
QA = Quality assurance
LCS = Laboratory control sample
LCSD = Laboratory control duplicate
%R = Percent recovery
RPD = Relative percent difference
MS = Matrix spike
MSD = Matrix spike duplicate

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Surface Water
Analytical Group:	Total Kjeldahl Nitrogen (Ancillary Test)
Analytical Method:	Standard Methods 4500NH3 B/E
SOP Reference:	S-IN-006

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method blank	One per batch of 20 or fewer samples per matrix.	No analytes detected > LOQ.	Correct problem; reanalyze any samples associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias Contamination	No analytes detected > LOQ.
LCS LCSD (if MS/MSD pair is not performed)	One per batch of 20 or fewer samples per matrix.	%R 90-110% RPD <20 (if performed)	Correct problem; reanalyze any sample associated with an LCS that fails criteria.	Analyst, Supervisor, QA Manager	Accuracy Bias	%R 90-110% RPD <20 (if performed)
MS/MSD[1]	One per batch of 10 or fewer samples per matrix.	%R 70-130% RPD <20	Report data with a narrative stating the sample is affected by matrix interference.	Analyst, Supervisor, QA Manager	Accuracy Bias	%R 70-130% RPD <20

Notes:

[1] MS/MSDs for ancillary tests will not be collected or identified in the field, but are analyzed as part of the laboratory's SOP, and may or may not be analyzed on site samples.

SOP = Standard operating procedure
QC = Quality control
LOQ = Limit of quantitation
QA = Quality assurance
LCS = Laboratory control sample
LCSD = Laboratory control duplicate
%R = Percent recovery
RPD = Relative percent difference
MS = Matrix spike
MSD = Matrix spike duplicate

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Surface Water
Analytical Group:	Ammonia (Ancillary Test)
Analytical Method:	Standard Methods 4500NH3 B/E
SOP Reference:	S-IN-002

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method blank	One per batch of 20 or fewer samples per matrix.	No analytes detected > ½ LOQ.	Correct problem; reanalyze any samples associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias Contamination	No analytes detected > ½ LOQ.
LCS LCSD (if MS/MSD pair is not performed)	One per batch of 20 or fewer samples per matrix.	%R 90-110% RPD <20 (if performed)	Correct problem; reanalyze any sample associated with an LCS that fails criteria.	Analyst, Supervisor, QA Manager	Accuracy Bias	%R 90-110% RPD <20 (if performed)
MS/MSD[1]	One per batch of 10 or fewer samples per matrix.	%R 90-110% RPD <20	Report data with a narrative stating the sample is affected by matrix interference.	Analyst, Supervisor, QA Manager	Accuracy Bias	%R 90-110% RPD <20

Notes:

[1] MS/MSDs for ancillary tests will not be collected or identified in the field, but are analyzed as part of the laboratory's SOP, and may or may not be analyzed on site samples.

SOP = Standard operating procedure
QC = Quality control
LOQ = Limit of quantitation
QA = Quality assurance
LCS = Laboratory control sample
LCSD = Laboratory control duplicate
%R = Percent recovery
RPD = Relative percent difference
MS = Matrix spike
MSD = Matrix spike duplicate

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Surface Water
Analytical Group:	Total Dissolved Solids (Ancillary Test)
Analytical Method:	Standard Methods 2540C
SOP Reference:	S-IN-024

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method blank	One per batch of 20 or fewer samples per matrix.	No analytes detected > ½ LOQ.	Correct problem; reanalyze any samples associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias Contamination	No analytes detected > ½ LOQ.
LCS	One per batch of 20 or fewer samples per matrix.	%R 90-110%	Correct problem; reanalyze any sample associated with an LCS that fails criteria.	Analyst, Supervisor, QA Manager	Accuracy, Bias	%R 90-110%
Sample Duplicate[1]	One per batch of 10 or fewer samples per matrix.	RPD ≤ 20	Repeat analysis.	Analyst, Supervisor, QA Manager	Precision	RPD ≤ 20

Notes:

[1] Sample duplicate for ancillary tests will not be collected or identified in the field, but are analyzed as part of the laboratory's SOP, and may or may not be analyzed on site samples.

SOP = Standard operating procedure
QC = Quality control
LOQ = Limit of quantitation
QA = Quality assurance
LCS = Laboratory control sample
%R = Percent recovery
RPD = Relative percent difference

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Surface Water
Analytical Group:	Total Suspended Solids (Ancillary Test)
Analytical Method:	Standard Methods 2540D
SOP Reference:	S-IN-025

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method blank	One per batch of 20 or fewer samples per matrix.	No analytes detected > LOQ.	Correct problem; reanalyze any samples associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias Contamination	No analytes detected > LOQ.
LCS	One per batch of 20 or fewer samples per matrix.	%R 90-110%	Correct problem; reanalyze any sample associated with an LCS that fails criteria.	Analyst, Supervisor, QA Manager	Accuracy, Bias	%R 90-110%
Sample Duplicate[1]	One per batch of 10 or fewer samples per matrix.	RPD ≤ 20	Repeat analysis.	Analyst, Supervisor, QA Manager	Precision	RPD ≤ 20

Notes:

[1] Sample duplicate for ancillary tests will not be collected or identified in the field, but are analyzed as part of the laboratory's SOP, and may or may not be analyzed on site samples.

SOP = Standard operating procedure
QC = Quality control
LOQ = Limit of quantitation
QA = Quality assurance
LCS = Laboratory control sample
%R = Percent recovery
RPD = Relative percent difference

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Surface Water
Analytical Group:	Total Organic Carbon (Ancillary Test)
Analytical Method:	SW-846 9060A
SOP Reference:	S-IN-008

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Method blank	One per batch of 20 or fewer samples per matrix.	No analytes detected > ½ LOQ.	Correct problem; reanalyze any samples associated with a blank that fails criteria.	Analyst, Supervisor, QA Manager	Bias Contamination	No analytes detected > ½ LOQ.
LCS LCSD (if MS/MSD pair is not performed)	One per batch of 20 or fewer samples per matrix.	%R 90-110% RPD <20 (if performed)	Correct problem; reanalyze any sample associated with an LCS that fails criteria.	Analyst, Supervisor, QA Manager	Accuracy Bias	%R 90-110% RPD <20 (if performed)
MS/MSD[1]	One per batch of 10 or fewer samples per matrix.	%R 90-110% RPD <20	Report data with a narrative stating the sample is affected by matrix interference.	Analyst, Supervisor, QA Manager	Accuracy Bias	%R 90-110% RPD <20

Notes:

[1] MS/MSDs for ancillary tests will not be collected or identified in the field, but are analyzed as part of the laboratory's SOP, and may or may not be analyzed on site samples.

SOP = Standard operating procedure
QC = Quality control
RL = Reporting limit
QA = Quality assurance
LCS = Laboratory control sample
MS/MSD = Matrix spike/matrix spike duplicate
RPD = Relative percent difference
LOQ = Limit of quantitation

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Sediment
Analytical Group:	Toxicity — Saltwater (Contingent Test)
Analytical Method:	EPA 600/R-01/020
SOP Reference:	TST-017, *28-day Chronic Toxicity Tests on Marine and Estuarine Sediments with the amphipod Leptocheirus plumulosus*

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Test Organisms	Initiation of Test; all organisms	Neonate *L. plumulosus* used to initiate test are size-selected (0.25-mm and 0.6-mm screens).	Test invalid. Repeat.	Laboratory Manager	Representativeness	Test organisms size selected to be 0.25 mm to 0.6 mm.
Control Survival	End of test; each control replicate	Minimum mean control survival 80% No single control replicate with ≤60% survival.	Test invalid. Repeat.	Laboratory Manager	Comparability, Precision	Minimum control survival 80%; No control replicate with ≤ 60% survival
Control Growth and Reproduction	End of test; each control replicate	Measurable growth and reproduction observed in all replicates of negative control treatment.	Test invalid. Repeat	Laboratory Manager	Comparability, Precision	Measurable growth and reproduction in all control replicates
Temperature	Daily in water bath; one replicate per treatment 3 times per week	Temperature daily limits: 25°C (±3°C); 28-day mean: 25°C (±2°C)	Correct problem. Include narrative in laboratory report indicating variance from acceptable criteria and likely impact on results.	Laboratory Manager	Accuracy, Bias, Precision	Temperature within acceptable limits
Salinity	3 times per week	Salinity (overlying water) Daily limits: 5‰ (+3‰) if pore water is 1‰ to 10‰, 20‰ (+3‰) if pore water is >10‰ to 35‰; 28-day mean: 5‰ (+2‰) or 20‰ (+2‰)	Correct problem. Include narrative in laboratory report indicating variance from acceptable criteria and likely impact on results.	Laboratory Manager	Accuracy, Bias	Salinity within acceptable limits

Notes:

SOP = Standard operating procedure
QC = Quality control
mm = millimeter
°C = Degrees Celsius
‰ = Parts per thousand

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Sediment
Analytical Group:	Toxicity — Freshwater (Contingent Test)
Analytical Method:	EPA 600/R-99/064 Method 100.4
SOP Reference:	TST-013, *42-day Survival, Growth & Reproduction Test for Sediments with the amphipod Hyalella azteca*

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Test Organisms	Initiation of Test; all organisms	All organisms 7- to 8-days old	Test invalid. Repeat.	Laboratory Manager	Representativeness	Test organisms are 7- to 8-days old
Control Survival	Day 28; each control replicate	Minimum mean control survival 80% at day 28	Test invalid. Repeat.	Laboratory Manager	Comparability, Precision	Minimum mean control survival 80% at day 28
Temperature	Daily	The mean daily temperature must be within ±1°C of 23°C. The instantaneous temperature must always be within ±3°C of 23°C.	Correct problem. Include narrative in laboratory report indicating variance from acceptable criteria and likely impact on results.	Laboratory Manager	Accuracy/bias	Temperature within acceptable limits
Hardness, Alkalinity, Ammonia in overlying water	Day 0 and Day 28	Variance less than 50% during sediment exposure	Include narrative in laboratory report indicating variance from acceptable criteria and likely impact on results.	Laboratory Manager	Accuracy/bias	Hardness, alkalinity, and ammonia variance <50%
Dissolved Oxygen in overlying water	3 times per week	>2.5 mg/L	Correct problem. Include narrative in laboratory report indicating variance from acceptable criteria and likely impact on results.	Laboratory Manager	Accuracy/bias	Dissolved oxygen >2.5 mg/L

Notes:

SOP = Standard operating procedure
QC = Quality control
mm = millimeter
°C = Degrees Celsius
mg/L = Milligrams per liter

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Surface Water
Analytical Group:	Toxicity — Saltwater (Contingent Test)
Analytical Method:	EPA-821-R-02-014, Method 1007.0
SOP Reference:	TST-007, *Chronic Toxicity of Saltwater to the Mysid Shrimp, Mysidopsis bahia*

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Test Organisms	Initiation of Test; all organisms	All organisms 7-days old	Test invalid. Repeat.	Laboratory Manager	Representativeness	Test organisms are 7-days old
Control Survival	End of test; each control replicate	Minimum mean control survival 80%	Test invalid. Repeat.	Laboratory Manager	Comparability, Precision	Minimum mean control survival 80%
Control mass	End of test; each control replicate	Minimum mean mass 0.20 mg/surviving mysid in controls	Test invalid. Repeat.	Laboratory Manager	Comparability, Precision	Minimum mean control weight 0.20 mg/surviving mysid

Notes:
SOP = Standard operating procedure
QC = Quality control
mg = milligram

SAP WORKSHEET #28: LABORATORY QC SAMPLES TABLE (Continued)

(UFP-QAPP Manual Section 3.4)

Matrix:	Surface Water
Analytical Group:	Toxicity — Freshwater (Contingent Test)
Analytical Method:	EPA-821-R-02-013, Method 1002.0
SOP Reference:	TST-005, *Chronic Toxicity of Freshwater to the Water Flea, Ceriodaphnia dubia*

QC Sample	Frequency & Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicators	Measurement Performance Criteria
Test Organisms	Initiation of Test; all organisms	All organisms less than 24-hours old; all released within an 8-hous period	Test invalid. Repeat.	Laboratory Manager	Representativeness	Test organisms meet age criteria
Control Survival	End of test	Minimum mean control survival 80%	Test invalid. Repeat.	Laboratory Manager	Comparability	Minimum mean control survival 80%
Fecundity	End of test	Minimum of 60% of surviving control females must produce at least 3 broods, with an average of 15 young per surviving female	Test invalid. Repeat.	Laboratory Manager	Comparability	Minimum 60% surviving control females produce at least 3 broods; average at least 15 young per surviving female

Notes:
SOP = Standard operating procedure
QC = Quality control

SAP WORKSHEET #29: PROJECT DOCUMENTS AND RECORDS TABLE

(UFP-QAPP Manual Section 3.5.1)

Document	Where Maintained
Sample Collection Documents and Records Project personnel sign-off record Field logbook (and sampling notes) Field sample forms (e.g., sample log sheets, drilling logs, etc.) Chain-of-custody records Sample shipment air bills Equipment calibration logs Photographs Sampling and Analysis Plan (SAP) including field sampling standard operating procedures (SOPs) Regulatory agency comments on SAP (if received) Signed Project Personnel Sign-Off Sheet (SAP Worksheet #4) Safe work permit forms	Sample collection documents and records (may include printed copy as well as electronic information) will be maintained at the Resolution Consultants office at 5724 Summer Trees Drive, Memphis, Tennessee 38134. These files will be retained for fifty (50) years after the last decision document is signed for NAS Pensacola.
Analytical Results Documents and Records Sample receipt/log-in forms Sample preparation logs Equipment calibration logs Sample analysis run logs Reported field sample results Reported results for standards, quality control checks Reported results for standards, quality control samples Data completeness checklists Data validation memoranda	Analytical results, documents and records will be provided by the laboratory in printed and electronic formats. Although available in the Administrative Record file, laboratory reports are typically filed at a separate location and are available upon request. Printed copies of laboratory data will be stored at a third-party secure professional document storage firm until transfer to the Federal Records Center (FRC). The records will be transferred to FRC 3 years after completion of a response action. These files will be retained for fifty (50) years after the last decision document is signed for NAS Pensacola. Electronic analytical results will also be verified, entered, and maintained in a database on a password protected Structured Query Language server. Data qualifiers will be added to the database during data validation. After validation, the validated data files will be transferred to the Navy's Naval Installation Restoration Information Solution (NIRIS) data management system.

Document	Where Maintained
Other Documents Personnel training records Health and Safety certifications Health and Safety Plan Field Sampling Audit Checklist Letter reports, Investigation Reports, etc. Analytical Audit Checklist	Personnel training records and health and safety certificates will be stored in personnel records and electronically in the Resolution Consultant's training database located at project file at 5724 Summer Trees Drive, Memphis, Tennessee 38134. Plans and reports will be stored in printed version and electronically in the Administrative Record file. Printed copies will be stored at a third-party secure professional document storage firm until transfer to the FRC. The records will be transferred to FRC 3 years after completion of a response action. These files will be retained for fifty (50) years after the last decision document is signed for NAS Pensacola. Field Audit Checklists are not considered part of the Administrative Record file and will be stored in the Resolution Consultants project file at 5724 Summer Trees Drive, Memphis, Tennessee 38134, and electronically in the server library. Analytical Audit Checklists will be retained by the respective accreditation authorities.
Final Document/Records Repository Administrative Record files Site files Post decision files Analytical data Spatial data Maps	All final documents/Records repositories will be stored in accordance with in the NAVFAC Environmental Restoration Recordkeeping Manual. Printed copies will be stored at a third-party secure professional document storage firm until transfer to the FRC, and electronic copies will be maintained, verified, and stored on the Navy's NIRIS data management system. The records will be transferred to FRC 3 years after completion of a response action. These files will be retained for fifty (50) years after the last decision document is signed for NAS Pensacola.

SAP WORKSHEET #30: ANALYTICAL SERVICES TABLE

(UFP-QAPP Manual Section 3.5.2.3)

Matrix	Analytical Group	Sample Locations/ID Numbers	Analytical SOP	Final Data Package Turnaround Time	Laboratory/Organization[1] (name and address, contact person and telephone number)	Backup Laboratory/ Organization
Sediment	SVOCs/PAHs via SIM	See Worksheet #18	S-SV-021	21 Days	Shealy Environmental Services, Inc. 106 Vantage Point Drive West Columbia, South Carolina 29172 Kelly Maberry, kmaberry@shealylab.com, 803-227-2706	None
Sediment	Pesticides/PCBs	See Worksheet #18	S-SV-003	21 Days	Shealy Environmental Services, Inc. 106 Vantage Point Drive West Columbia, South Carolina 29172 Kelly Maberry, kmaberry@shealylab.com, 803-227-2706	None
Sediment, Surface Water	Metals, Hardness	See Worksheet #18	S-IM-021; S-IN-044	21 Days	Shealy Environmental Services, Inc. 106 Vantage Point Drive West Columbia, South Carolina 29172 Kelly Maberry, kmaberry@shealylab.com, 803-227-2706	None
Sediment	Mercury	See Worksheet #18	S-IM-006	21 Days	Shealy Environmental Services, Inc. 106 Vantage Point Drive West Columbia, South Carolina 29172 Kelly Maberry, kmaberry@shealylab.com, 803-227-2706	None
Sediment	Total Organic Carbon	See Worksheet #18	S-IN-030	21 Days	Shealy Environmental Services, Inc. 106 Vantage Point Drive West Columbia, South Carolina 29172 Kelly Maberry, kmaberry@shealylab.com, 803-227-2706	None
Sediment	pH	See Worksheet #18	S-IN-016	21 Days	Shealy Environmental Services, Inc. 106 Vantage Point Drive West Columbia, South Carolina 29172 Kelly Maberry, kmaberry@shealylab.com, 803-227-2706	None
Sediment	AVS/SEM	See Worksheet #18	GEN-AVS/SEM, MET-200.7/6010C, MET-7470A/245.1	21 Days	ALS Environmental 1565 Jefferson Road, Building 300, Suite 360 Rochester, New York 14623 Deb Patton, dpatton@caslab.com, 585-288-5380	None

Matrix	Analytical Group	Sample Locations/ID Numbers	Analytical SOP	Final Data Package Turnaround Time	Laboratory/Organization[1] (name and address, contact person and telephone number)	Backup Laboratory/ Organization
Sediment	Grain Size	See Worksheet #18	S3	21 Days	Geotechnics 544 Braddock Avenue East Pittsburgh, Pennsylvania 15112 Randy O'Rourke, rorourke@geotechnics.net, 412-823-7600	None
Sediment	*28-day Chronic Toxicity with the amphipod Leptocheirus plumulosus*	See Worksheet #18	TST-017	45 days	Hydrosphere Research 11842 Research Circle Alachua, Florida 32615-6817 Craig Watts, craig@hydrosphere.net, 386-462-7889	None
Sediment	*42-day Survival, Growth & Reproduction with the amphipod Hyalella azteca*	See Worksheet #18	TST-013	60 Days	Hydrosphere Research 11842 Research Circle Alachua, Florida 32615-6817 Craig Watts, craig@hydrosphere.net, 386-462-7889	None
Sediment	*Chronic Toxicity of Saltwater to the Mysid Shrimp*	See Worksheet #18	TST-007	21 Days	Hydrosphere Research 11842 Research Circle Alachua, Florida 32615-6817 Craig Watts, craig@hydrosphere.net, 386-462-7889	None
Sediment	*Chronic Toxicity of Freshwater to the Water Flea, Ceriodaphnia dubia*	See Worksheet #18	TST-005	21 Days	Hydrosphere Research 11842 Research Circle Alachua, Florida 32615-6817 Craig Watts, craig@hydrosphere.net, 386-462-7889	None
Surface Water	General Chemistry Ancillary Tests: Alkalinity, Acidity, Sulfate, Nitrate, Nitrite, Total Phosphorus, TKN, Ammonia-Nitrogen, TDS, TSS, Total Organic Carbon	See Worksheet #18	S-IN-014, S-IN-068, S-IN-010, S-IN-063, S-IN-006, S-IN-002, S-IN-024, S-IN-025, S-IN-008	21 Days	Shealy Environmental Services, Inc. 106 Vantage Point Drive West Columbia, South Carolina 29172 Kelly Maberry, kmaberry@shealylab.com, 803-227-2706	None

Notes:

[1] Laboratory meets accreditation requirements to support project needs.

SOP = Standard operating procedure
ID = Identification
SVOCs = Semivolatile organic compounds
PAH = Polynuclear aromatic hydrocarbons
SIM = Selective ion monitoring
PCBs = Polychlorinated biphenyls
AVS = Acid volatile sulfide
SEM = Simultaneously extracted metals
TKN = Total Kjeldahl Nitrogen
TDS = Total Dissolved Solids
TSS = Total Suspended Solids

SAP WORKSHEET #31: PLANNED PROJECT ASSESSMENTS TABLE

(UFP-QAPP Manual Section 4.1.1)

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing Corrective Action	Person(s) Responsible for Monitoring Effectiveness of Corrective Action
Onsite Laboratory Systems Audit	Every 18 months	External	DoD ELAP	DoD ELAP Auditor	Laboratory Quality Assurance Officers: Shealy Environmental Services, Inc. and ALS Environmental	Laboratory Quality Assurance Officers: Shealy Environmental Services, Inc. and ALS Environmental	Laboratory Quality Assurance Officers: Shealy Environmental Services, Inc. and ALS Environmental
Onsite Laboratory Systems Audit	Every 2 years	External	NELAP	NELAP Auditor	Laboratory Quality Assurance Officers: Shealy Environmental Services, Inc., ALS Environmental, and Hydrosphere Research	Laboratory Quality Assurance Officers: Shealy Environmental Services, Inc., ALS Environmental, and Hydrosphere Research	Laboratory Quality Assurance Officers: Shealy Environmental Services, Inc., ALS Environmental, and Hydrosphere Research
Onsite Field Sampling Systems Audit	One per contract year	Internal	Resolution Consultants	Tina Cantwell, QAO (or designee), Resolution Consultants	Allison Harris, TOM Resolution Consultants	Tina Cantwell, QAO and Allison Harris, TOM Resolution Consultants	Tina Cantwell, QAO and Allison Harris, TOM Resolution Consultants

Notes:
Laboratory audits will be performed by appropriate accreditation authorities, as indicated above.
Field sampling systems audit checklist may be found in Appendix I.
DoD ELAP = Department of Defense Environmental Laboratory Accreditation Program
QAO = Quality assurance officer
NELAP = National Environmental Laboratory Accreditation Program
TOM = Task order manager
HSM = Health and safety manager

SAP WORKSHEET #32: ASSESSMENT FINDINGS AND CORRECTIVE ACTION RESPONSES TABLE

(UFP-QAPP Manual Section 4.1.2)

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Laboratory Systems Audit	Verbal debriefing, Written audit report	Laboratory Quality Assurance Officers	Not specified by DoD ELAP or NELAP	Corrective action plan, Letter	DoD ELAP and NELAP Accrediting Authorities	Specified by DoD ELAP and NELAP Accrediting Authorities
Field Sampling Systems Audit	Audit checklist and written audit finding summary	Allison Harris, TOM, Resolution Consultants; Paul Jobmann, FTL, Resolution Consultants	Dependent on findings; if major, a stop work may be issued immediately; however, if minor, within 1 week of audit	Written memo	Tina Cantwell, QAO, Resolution Consultants	Within 21 days of notification
Field Supervision	Site log book and sample collection logs	Allison Harris, TOM, Resolution Consultants; Paul Jobmann, FTL, Resolution Consultants	Immediately, when discovered	Entry in site log book, potential retraining	Allison Harris, TOM, Resolution Consultants; Paul Jobmann, FTL, Resolution Consultants	Within 24 hours

Notes:
Assessment findings will be communicated with appropriate staff during verbal audit debriefings and in the written audit report and will be documented on audit checklists and audit reports.

DoD ELAP = Department of Defense Environmental Laboratory Accreditation Program
NELAP = National Environmental Laboratory Accreditation Program
TOM = Task order manager
FTL = Field team leader
QAO = Quality assurance officer
HSM = Health and safety manager

SAP WORKSHEET #33: QUALITY ASSURANCE MANAGEMENT REPORTS TABLE

(UFP QAPP Manual Section 4.2)

Type of Report	Frequency (daily, weekly monthly, quarterly, annually, etc.)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (title and organizational affiliation)	Report Recipient(s) (title and organizational affiliation)
Data Validation Report	Per sample delivery group	Within 4 weeks after receiving the data from the laboratory	Project Chemist or Data Validator, Resolution Consultants	TOM, Resolution Consultants; project file
Project Monthly Progress Report	Monthly for duration of the project	Monthly	TOM, Resolution Consultants	TOM, Resolution Consultants; Program Manager, Resolution Consultants; NAVFAC SE RPM; project file
Laboratory QA Report	When significant plan deviations result from unanticipated circumstances	Immediately upon detection of problem (on the same day)	Laboratory PM, Shealy Environmental Services, ALS Environmental, Geotechnics, and Hydrosphere Research	TOM and project file, Resolution Consultants

Notes:

TOM	=	Task order manager
PM	=	Project Manager
NAVFAC	=	Naval Facilities Engineering Command
SE	=	Southeast
RPM	=	Remedial project manager
QA	=	Quality assurance

SAP WORKSHEETS #34-36: DATA VERIFICATION AND VALIDATION (STEPS I AND IIA/IIB) PROCESS TABLE

(UFP-QAPP Manual Section 5.2.1), (UFP-QAPP Manual Section 5.2.2), (Figure 37 UFP-QAPP Manual), (Table 9 UFP-QAPP Manual)

Data Review Input	Description	Responsible for Verification (name, organization)	Step I/ IIa/IIb [1]	Internal/ External[2]
Verification Chain-of-custody forms Sample Login/Receipt	Review the sample shipment for completeness, integrity, and sign accepting the shipment. All sample labels will be checked against the chain-of-custody form, and any discrepancies will be identified, investigated, and corrected. The samples will be logged in at every storage area and work station required by the designated analyses. Individual analysts will verify the completeness and accuracy of the data recorded on the forms. Verification of sample login/receipt and chain-of-custody forms will be documented on the laboratory sample receipt form.	Laboratory sample custodians and analysts, Shealy Environmental Services, ALS Environmental, Geotechnics, and Hydrosphere Research	I	Internal
Verification Chain-of-custody forms	Check that the chain-of-custody form was signed/dated by the sampler relinquishing the samples and by the laboratory sample custodian receiving the samples for analyses. Verification of chain-of-custody forms will be documented in the DVA workbook.	Project chemist or data validators, Resolution Consultants	I	External
Verification SAP sample tables	Verify that all proposed samples listed in the SAP tables have been collected. Sample completeness will be documented in the data validation report.	FTL or designee, Resolution Consultants	I	Internal
Verification Sample log sheets and field notes	Verify that information recorded in the log sheets and field notes are accurate and complete. Sample log sheet verification will be documented by dated signature on the last page or page immediately following the review material.	FTL or designee, Resolution Consultants	I	Internal
Verification Field QC samples	Check that field QC samples, described in Worksheet #12 and listed in Worksheet #20 were collected as required. QC sample completeness will be documented in the data validation report.	FTL or designee, Resolution Consultants	I	Internal
Verification Analytical data package	Verify all analytical data packages will be verified internally for completeness by the laboratory performing the work. The laboratory project manager (or designee) will sign the case narrative for each data package. All laboratory data package reviews will be documented in the laboratory narratives.	Laboratory project manager, Shealy Environmental Services, ALS Environmental, Geotechnics, and Hydrosphere Research	I	Internal
Verification Analytical data package	Verify the data package for completeness. Missing information will be requested from the laboratory and validation (if performed) will be suspended until missing data are received. Data package completeness will be documented in the DVA workbook.	FTL, Project chemist or data validators, Resolution Consultants	I	External
Verification Electronic data deliverables	Verify the electronic data against the chain-of-custody and hard copy data package for accuracy and completeness before loading into project database. Electronic data deliverable verification will be documented in the DVA workbook.	Data manager and/or validator, Resolution Consultants	I	External
Validation Chain-of-custody	Examine the traceability of the data from time of sample collection until reporting of data. Ensure that the custody and integrity of the samples were maintained from collection to analysis and the custody records are complete and any deviations are recorded. Chain-of-custody verification will be documented in the DVA workbook and data validation report.	Project chemist or data validators, Resolution Consultants	IIa	External

Data Review Input	Description	Responsible for Verification (name, organization)	Step I/ IIa/IIb [1]	Internal/ External[2]
Validation Holding Times	Review that the samples were shipped and stored at the required temperature and sample pH for chemically-preserved samples meet the requirements listed in Worksheet #19. Ensure that the analyses were performed within the holding times. If holding times were not met, confirm that deviations were documented. Holding time examination will be documented in the DVA workbook and data validation report.	Project chemist or data validators, Resolution Consultants	IIa	External
Validation Sample results for representativeness	Check that the laboratory recorded the temperature at sample receipt and the pH of the chemically preserved samples to ensure sample integrity from sample collection to analysis. Representativeness will be documented in the DVA workbook and data validation report.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Laboratory data results for accuracy	Ensure that the laboratory QC samples were analyzed and that the measurement performance criteria, listed in Worksheet #28, were met for all field samples and QC analyses. Check that specified field QC samples were collected and analyzed, as listed in Worksheet #12, and that the analytical QC criteria were met. Accuracy will be documented in the DVA workbook and data validation report.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Field and laboratory duplicate analyses for precision	Check the field sampling precision by calculating the RPD for field duplicate samples. Check the laboratory precision by reviewing the RPD or percent difference values from laboratory duplicate analyses; MS/MSDs; and LCS/LCSDs. Ensure compliance with the precision goals listed in Worksheet #12 and 28. Precision will be documented in the DVA workbook and data validation report.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Project action limits	Assess and document the impact on matrix interferences or sample dilutions performed because of the high concentration of one or more contaminant, on the other target compounds reported as undetected. Project action limit achievement will be documented in the DVA workbook and data validation report.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Data quality assessment report	Summarize deviations from methods, procedures, or contracts. Qualify data results based on method or QC deviation and explain all the data qualifications. Present tabular qualified data and data qualifier codes and summarize data qualification outliers. Determine if the data met the measurement performance criteria and determine the impact of any deviations on the technical usability of the data. Result qualification will be documented in the in the DVA workbook and data validation report.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation SAP QC sample documentation	Ensure that all QC samples specified in the SAP were collected and analyzed and that the associated results were within acceptance limits. QC sample documentation will be documented in the DVA workbook and data validation report	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Analytical data deviations	Determine the impact of any deviation from sampling or analytical methods and laboratory SOP requirements and matrix interferences effect on the analytical results. Data deviations will be documented in the DVA workbook and data validation report.	Project chemist or data validators, Resolution Consultants	IIb	External

Data Review Input	Description	Responsible for Verification (name, organization)	Step I/ IIa/IIb [1]	Internal/ External[2]
Validation Project quantitation limits for sensitivity	Ensure that the project detection limits were achieved. Project quantitation limit achievement will be documented in the DVA workbook and data validation report.	Project chemist or data validators, Resolution Consultants	IIb	External
Validation Sediment — Organic Analyses: SVOCs/PAHs via SIM, Pesticides and Polychlorinated Biphenyls	Assess organic analytical data against MPC identified in Worksheets #12, 19, 24, and 28. *U.S. EPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review*, (June 2008) will be used as a guidance on applying qualifiers when MPC identified in Worksheets #12, 19, 24, and 28 are not met, including identifying when samples will be qualified estimated or rejected and when individual or all samples in a batch will be qualified. As described in Worksheet #14, checklists will not be used for validation because it will be performed using a combination of electronic automated data review and data package review. All findings will be documented on the DVA workbook and in the data validation report.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Sediment and Surface Water — Metals	Assess metals data against MPC identified in Worksheets #12, 19, 24, and 28. *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review*, (January 2010) will be used as a guidance on applying qualifiers when MPC identified in Worksheets #12, 19, 24, and 28 are not met, including identifying when samples will be qualified estimated or rejected and when individual or all samples in a batch will be qualified. As described in Worksheet #14, checklists will not be used for validation because it will be performed using a combination of electronic automated data review and data package review. All findings will be documented on the DVA workbook and in the data validation report.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External
Validation Sediment and Surface Water — Ancillary Tests: TOC, AVS/SEM, grain size, pH, Alkalinity, Acidity, Sulfate, Nitrate, Nitrite, Total Phosphorus, Total Kjeldahl Nitrogen Ammonia-Nitrogen, Total Dissolved Solids, Total Suspended Solids	Assess ancillary test data against MPC identified in Worksheets #12, 19, 24, and 28. *U.S. EPA Contract Laboratory Program National Functional Guidelines for Inorganic Superfund Data Review*, (January 2010) will be used as a guidance on applying qualifiers when MPC identified in Worksheets #12, 19, 24, and 28 are not met, including identifying when samples will be qualified estimated or rejected and when individual or all samples in a batch will be qualified. The end use of the ancillary test data will be as a screening level tool to assess sediment and/or surface water chemistry. Therefore, validation will be limited to the following elements: holding times, blank analyses, and laboratory control samples. As described in Worksheet #14, checklists will not be used for validation because it will be performed using a combination of electronic automated data review and data package review. All findings will be documented on the DVA workbook and in the data validation report.	Project chemist or data validators, Resolution Consultants	IIa/IIb	External

<table>
<tr><th>Data Review Input</th><th>Description</th><th>Responsible for Verification (name, organization)</th><th>Step I/ IIa/IIb [1]</th><th>Internal/ External[2]</th></tr>
<tr><td>Validation
Sediment and Surface Water — Toxicity Data</td><td>The laboratory will perform toxicity tests using SOPs provided in Worksheet #23. All results will be reviewed by the laboratory manager who will narrate test results and any deviations from the SOPs. External verification and validation is not planned due to the nature of toxicity testing results and presentation, which are mostly statistical comparisons in accordance with the toxicity testing methods and SOPs.</td><td>Laboratory project manager, Hydrosphere Research</td><td>IIa/IIb</td><td>Internal</td></tr>
<tr><td>Validation
Data qualifiers</td><td>Qualifiers that will be applied during the data validation process are summarized below and, as indicated, results will be considered usable unless qualified by an R-flag. Rejected data will be evaluated and may be used in circumstances identified by the Partnering Team.
<table>
<tr><th>Data Qualifier</th><th>Qualifier Definition</th><th>Interpret Result As a Detection?</th><th>Result Usable?</th><th>Potential Result Bias</th></tr>
<tr><td>no qualifier</td><td>Acceptable</td><td>Yes</td><td>Yes</td><td>None expected</td></tr>
<tr><td>J</td><td>Estimated</td><td>Yes</td><td>Yes</td><td>High or Low</td></tr>
<tr><td>U</td><td>Undetected</td><td>No</td><td>Yes</td><td>None expected</td></tr>
<tr><td>UJ</td><td>Undetected and Estimated</td><td>No</td><td>Yes</td><td>High or Low</td></tr>
<tr><td>UR</td><td>Undetected and Rejected</td><td>No</td><td>No</td><td>Unspecified</td></tr>
<tr><td>R</td><td>Rejected</td><td>No</td><td>No</td><td>Unspecified</td></tr>
</table></td><td>Project chemist or data validators, Resolution Consultants</td><td>IIa/IIb</td><td>External</td></tr>
</table>

Notes:

[1]IIa = Compliance with methods, procedures, and contracts [see Table 10, page 117, UFP-QAPP manual, V.1, March 2005.]
[1]IIb = Comparison with measurement performance criteria in the SAP [see Table 11, page 118, UFP-QAPP manual, V.1, March 2005]
[2] = Internal or external (independent) from the data generation activities.
SAP = Sampling and analysis plan
FTL = Field team leader
QC = Quality control
RPD = Relative percent difference
MS/MSD = Matrix spike/Matrix Spike duplicate
LCS/LCSD = Laboratory control sample/laboratory control sample duplicate
SOP = Standard operating procedure
SVOCs = Semivolatile organic compounds
PAHs via SIM = Polynuclear aromatic hydrocarbons via selective ion monitoring
TOC = Total organic carbon
AVS = Acid volatile sulfide
SEM = Simultaneously extracted metals
DoD QSM = *Department of Defense Quality Systems Manual for Environmental Laboratories*, Version 4.2, October 2010
MPC = Measurement performance criteria
U.S. EPA = U.S. Environmental Protection Agency

SAP WORKSHEET #37: USABILITY ASSESSMENT

(UFP-QAPP Manual Section 5.2.3)

Data Review

The usability of the data directly affects whether project objectives can be achieved. Data usability will be assessed using the guidance provided in *Process for Assessing Data Usability* (FDEP 2008), and the characteristics described below will be evaluated at a minimum. The results of these evaluations will be included in the project report. To the extent required by the type of data being reviewed, the assessors will consult with other technically competent individuals to render sound technical assessments of these data characteristics:

- Completeness — Completeness is a measure of the amount of valid data obtained from a measurement system compared to the amount expected to be obtained under correct normal conditions. It is expected that 100% of the planned sampling points will be collected. The completeness goal for field measurements will be greater than 90%. Laboratory analysis for this project will have a completeness goal greater than 95% to account for unanticipated results that may be rejected during data validation. Completeness can be calculated using the following equation.

$$\%Completeness = \frac{No.\ of\ Valid\ Tests}{Total\ Tests\ Taken} x\,100$$

  The FTL, acting on behalf of the Project Team, will determine whether deviations from the scheduled sample collection or analyses occurred. If they have occurred and the Resolution Consultants TOM determines that the deviations compromise the ability to meet project objectives, she will consult with the Navy RPM and other project team members, as necessary (determined by the Navy RPM), to develop appropriate corrective actions.

- Precision — Precision measures the reproducibility of measurements and methods, and is defined for qualitative data as a group of values' variability compared with its average value. To assess the precision of the measurement systems used in this project, field duplicates will be obtained and analyzed with the samples collected. Precision of laboratory analysis will be assessed by comparing the relative percent difference (RPD) of analytical results between MS and MSDs (or sample duplicates) and the measurement quality objectives will be those cited in Worksheets #12 and #28. The RPD will be calculated for each pair of duplicate analysis using the following equation:

$$RPD = \frac{(S - D)}{(S + D)/2} x100$$

Where:

S = sample result
D = duplicate result

The project chemist, acting on behalf of the Project Team, will determine whether precision goals for field duplicates and laboratory duplicates were met. This will be accomplished by comparing duplicate results to precision goals identified in Worksheets #12 and #28. This will also include a comparison of field and laboratory precision with the expectation that laboratory duplicate results will be no less precise than field duplicate results. If the goals are not met or data have been flagged as estimated (J qualifier) limitations on the use of the data will be described in the project report.

- Accuracy — Accuracy is the degree to which a given result agrees with the true value. The accuracy of an entire measurement system is an indication of any bias that exists. Spiked sample results provide information needed to assess the accuracy of analyses. Specifically, surrogate spike, MS/MSD, and laboratory control sample (LCS) percent recoveries (%Rs) are used to assess accuracy. Every organic sample is spiked with known quantities of non-target surrogate compounds. Five percent of all samples analyzed are spiked with target chemicals for the MS/MSD (or sample duplicates). If the calculated %Rs for the known spike concentrations are within defined control limits set by each method, the reported sample concentrations are considered accurate. The accuracy measurement quality objectives will be those cited in Worksheets #12 and #28. Accuracy is calculated using the following equation:

$$\%R = \frac{(SSR - SR)}{SA} x100$$

Where:

SSR = spike sample recovery
SR = sample recovery
SA = concentration of spike added

The project chemist, acting on behalf of the Project Team, will determine whether the accuracy/bias goals were met for project data. This assessment will include an evaluation of field and laboratory contamination; instrument calibration variability; and analyte recoveries for surrogates, matrix spike, matrix spike duplicate, and

laboratory control samples against the goals identified in worksheets #24 and #28. If the goals are not met, limitations on the use of the data will be described in the project report. Bias of the qualified results and a description of the impact of identified non-compliances on a specific data package or on the overall project data will be described in the project report.

- Representativeness — A project scientist, identified by the Resolution Consultants TOM and acting on behalf of the Project Team, will determine whether the data are adequately representative of intended populations, both spatially and temporally. This will be accomplished by verifying that samples were collected and analyzed in accordance with this SAP, by reviewing spatial and temporal data variations, and by comparing these characteristics to expectations. The usability report will describe the representativeness of the data for each matrix and analytical fraction. This will not require quantitative comparisons unless professional judgment of the project scientist indicates that a quantitative analysis is required.

- Comparability — The project chemist, acting on behalf of the Project Team, will determine whether the data generated under this project are sufficiently comparable to historical property data generated by different methods and for samples collected using different procedures and under different property conditions. This will be accomplished by comparing overall precision and bias among data sets for each matrix and analytical fraction. This will not require quantitative comparisons unless the project chemist indicates that such quantitative analysis is required.

- Sensitivity — The project chemist, acting on behalf of the Project Team, will determine whether project sensitivity goals listed in Worksheet #15 are achieved. The overall sensitivity and quantitation limits from multiple data sets for each matrix and analysis will be compared. If sensitivity goals are not achieved, the limitations on the data will be described.

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

After completion of the data validation, the data and data quality will be reviewed to determine whether sufficient data of acceptable quality are available for decision making. In addition to the evaluations described above, a series of inspections and statistical analyses will be performed to estimate these characteristics. The statistical evaluations will include simple summary statistics for

target analytes, such as maximum concentration, minimum concentration, number of samples exhibiting non-detected results, number of samples exhibiting positive results, and the proportion of samples with detected and non-detected results. The Project Team members, identified by the Resolution Consultants TOM, will assess whether the data collectively support the attainment of project objectives. They will consider whether any missing or rejected data have compromised the ability to make decisions or to make the decisions with the desired level of confidence. The data will be evaluated to determine whether missing or rejected data can be compensated by other data. Although rejected data will generally not be used, there may be reason to use them in a weight-of-evidence argument, especially when they supplement data that have not been rejected. Rejected data will be evaluated and may be used in circumstances identified by the Team. If rejected data are used, their use will be supported by technically defensible rationales.

Identify the personnel responsible for performing the usability assessment:

The Resolution Consultants TOM, project chemist, FTL, and technical specialists, will be responsible for conducting the listed data usability assessments. The data usability assessment will include the elements provided in Table 37-1.

Table 37-1
Data Usability Process

Step 1	**Review the project's objectives and sampling design** The sampling design, data quality objectives, and measurement performance criteria provided in this SAP will be reviewed to assess that they are still applicable.
Step 2	**Review the data verification and validation outputs which will include:** • Review available quality assurance reports, including the data verification and data validation reports. • Summarize data into tables and trend charts and assess patterns and anomalies. • Review deviations from planned activities (e.g., number and locations of samples, holding time exceedances, damaged samples, and procedural deviations) and assess their impacts on the data usability. • Evaluate implications of unacceptable quality control sample results.
Step 3	**Verify the assumptions of the selected statistical method which will include:** Verifying whether underlying assumptions for statistical method are valid. Common assumptions include the distributional form of the data, independence of the data, dispersion characteristics, homogeneity, etc. Minor deviations from assumptions will not be considered critical to statistical analysis and data interpretation. However, if serious deviations from assumptions are discovered, then another statistical method may need to be selected.

Table 37-1
Data Usability Process

Step 4	**Implement the statistical method** Data analysis will include: • Calculating revised background concentrations using statistical tests such as Kolmogorov-Smirnov or Wilcoxon Mann-Whitney at a 95% confidence level • Calculating site-specific preliminary remedial goals based on current data • Refine ecological risk estimates (if necessary) • Perform food web models (if necessary) • Aluminum regression analysis • Other weight-of-evidence analysis, as needed • Data summary with comparison against action levels identified on worksheet #15, and any action level refinements, as necessary. Using these data analysis tools, data will be evaluated to assess whether the underlying assumptions hold, or whether departures are acceptable, given the actual data and other information.
Step 5	**Document data usability and draw conclusions** Data usability will be documented in the FS Addendums for OU 1 and 2 and the technical memorandum for OU 16 and will include: • Assessment on whether data can be used as intended, considering implications of deviations and corrective actions. • Discussion of data quality indicators and identification of data use limitations. • Sampling design performance evaluation. • Conceptual site model update (if warranted) and document conclusions.

The data usability assessment will be reviewed with the Project Team. If deficiencies affecting the attainment of project objectives are identified, the review will take place either in a face to face meeting or a teleconference depending on the extent of identified deficiencies. If no significant deficiencies are identified, the data usability assessment will simply be documented in the project report and reviewed during the normal document review cycle.

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

The data will be presented in tabular format, including data qualifications such as estimation (J, UJ) or rejection (R). The project reports will identify and describe the data usability limitations and suggest re-sampling or other corrective actions, if necessary. Graphical presentations of the data such as concentration tag maps will be generated as part of the overall data evaluation process.

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Appendix A
27 and 28 March 2012 Partnering Meeting Minutes

NAS Pensacola OU16, Site 41 Wetlands Briefing Meeting Minutes
March 27 & 28, 2012
Jacksonville, Florida

ATTENDEES:

David Grabka	FDEP
Linda George	EPA
Joe Owusu	ILS/EPA
Claire Marcussen	TechLaw
Gerry Walker	Tetra Tech
Brian Caldwell	Tetra Tech
Allison Harris	EnSafe
Roxana Weil	UF (Day 1)
Ligia Mora-Applegate	FDEP
Leah Stuchal	UF
Steve Roberts	UF/FDEP
Ken Bowers	NAVFAC
Patty Marajh-Whittemore	NAVFAC, SE
Dave Barclift	NAVFAC Atlantic
Tim Woolheater	USEPA
Ron Kotun	Tetra Tech
Aaron Bernhardt	Tetra Tech
Greg Campbell	NAS Pensacola
Leigh Ciofani	Tetra Tech Scribe

MINUTES:

1st Day Check In/Opening Remarks

The team completed introductions and moved forward to the meeting agenda.

Wetlands – Historic Perspective (presentation by Allison)

The presentation presented the following information:

- Which wetlands were removed from further evaluation and why.
- The investigation was a collaborative process involving EPA, FDEP, and NOAA.
- Decisions about the grouping of the sites into OUs and grouping all of the wetlands into one OU were made in the late ‘80s.
- Three primary Phases of RI were conducted.
- Phase I Investigation – reviewed all of the wetlands; determined which wetlands should be eliminated from further evaluation; identified and justified all sediment and surface water samples for Phase IIA. Phase I data are provided in the RI/FS SAP (1995).
- Identified reference Wetlands 25, 27, 32, 33.

- Identified wetlands that did not have an indication of impact from an IR site; those were not sampled or evaluated further.

Tim asked whether a protocol was used to determine what was impacted. Allison said the wetlands were visually inspected to determine whether there were any nearby IR sites. Tim asked whether any new IR sites have been identified near any of the wetlands that were eliminated because they were not near any sites. Allison said there were none.

- A table showing the IR sites and associated wetlands was then presented, which was used in part to develop the Phase II sampling scheme.

- Based on Phase IIA results, wetlands were color coded red, orange, or blue.
    - Red = Contamination appears related to IR site.
    - Orange = contamination may be related – however, limited.
    - Blue = Isolated or no contamination.
- The wetlands were also separated wetlands into groups (A, B, C, D, and E) based on their similarity to each other to limit the amount of Phase III sampling that was needed.

Claire asked why some wetlands were used to represent others, and therefore, not all of the wetlands were sampled in Phase III. Allison explained that rationale, which was provided in the presentation slides.

Allison listed the wetlands associated with each area.

OU1 – Wetlands 3, 4, 15, 16, 17A, 18A and 18B
OU2 – 5A, 5B, 6
Wetland 64 Complex – 7, 8, 64
OU 10 – 10, 12, 13, 11
S. Field complex – Wetland 63A and B
UST 18 – Wetland W1
Wetlands 48 and 49

Tim noted that there were two Wetland 65 labels on the map, but could not find Wetland 54 and asked if the Wetland 65 label in the south-western portion of the facility was really Wetland 54. Allison will look into this as an action item.

Tim asked for further clarification regarding why certain wetlands were not sampled or retained for the FS. For example, Wetland 18B (a Group C wetland) was carried through to the FS, but other Group C wetlands that were not sampled were not carried through to FS. Allison said Wetland 18 was retained for the FS based on a risk management decision because of sample variability between the Phase II and Phase III results. Brian pointed out that thorough field reconnaissance was done to determine where sampling locations would be, so sampling locations were biased to find contamination, if present.

- The Site 41 ERA process was then presented. The process included a screening step and then several refinement steps. Based on the results of the refinement steps, several wetlands were recommended for evaluation in the FS.

OU1

- Includes Wetlands 1A, 1B, 3, 4, 15, 16, 17, 18A and 18B
- Primary source of contamination was the discharge of contaminated groundwater from the Site 1 Landfill and surface runoff.
- The wetlands sampled in Phase III included Wetlands 3, 16, and 18B

Tim asked how the basewide DDD, DDE, and DDT levels were established. Allison said that all the data across the facility were plotted and the levels were based on obvious inflection points in the data. This is described in more detail in Appendix G of Remedial Investigation report. The basewide level is 110 ppm for total DDT.

Joe asked why reference wetlands were not used for development of the basewide DDT levels. Allison said that background was evaluated using a few different methods, and that in the beginning reference wetlands weren't acceptable. Joe asked whether a correction factor was applied.

Tim questions whether the same DDT values were still valid, 15 years later, or would they need to be re-calculated. Ligia said the concentrations probably have not changed in a long time. Tim asked whether DDT would metabolize into DDD and DDE and if so, what would be the time frame. Joe said depends of the conditions, but the food chain model should be able to account for metabolism.

Tim asked whether there are records for how often drainage ditch wetlands were dredged. Greg said the vegetation along the ditches is typically cut back annually, but the last dredging occurred about 3 or 4 years ago; the removed sediment was properly disposed. Tim said if wetlands are eliminated due to dredging, then more information on the dredging activities is needed.

Tim asked whether the storm storm events, in particular hurricanes, have redistributed sediment across the wetlands. Ken asked whether any historical information is available on the storm events. Greg did not think there was much data. Ligia asked whether the wetlands have changed a lot. Greg did not think so because many of the wetlands are isolated, and most of the changes would probably be to the tidally influenced wetlands. Ditches 7, 4, 5 (tidally influenced) are always silting in and were dredged a few years ago; the ditch at Wetland 1B also silts in and was dredged. Tim asked whether they were sampled when cleaned. Greg said yes, for TCLP. Tim asked whether there is any way to know what was left behind after dredging. Greg said no. Added action item to find out which of the wetlands failed the TCLP and also get all analytical results – Greg will check manifests.

Leah asked how some wetlands were eliminated without sampling. Allison said the wetlands not associated with an IR site were eliminated. Patty said this was done because an area can only be investigated under CERCLA if it is impacted by an IR site. Gerry noted that initially, all wetlands at NAS Pensacola were identified, and then the process of eliminating certain wetlands

began. More than 30 wetlands were eliminated because they were not potentially impacted by an IR site.

Claire asked whether any benthic diversity studies were conducted at Wetland 4D, and why it was not recommended for evaluation in the FS. However, Wetland 18, which was recommended for the FS, was supposed to represent Wetland 4D because they were in the same group. Allison reiterated that the inclusion of Wetland 18 was a risk management decision based on the variability of the Phase II and Phase III data. It was suggested that a figure be created to show all of the wetlands that were eliminated, and which wetlands are associated with which IR sites. Basically, the figure should clear show which wetlands were evaluated during each phase. Allison will complete this action item.

Claire asked whether the food chain results trumps toxicity tests, or were other receptors considered important too, such as benthic invertebrates. Allison said the food chain model showed pesticides are not an issue for higher organisms. Dave B. stated that one receptor does not trump the other. Claire asked if risks were not a problem for one receptor (or wetland) but was for others, what is the basis for management decisions. Allison said that Wetlands 18, 16, 3 were selected for the Phase III sampling because the Phase II concentrations were higher in those wetlands than the other wetlands in their group. Therefore, if toxicity was not observed in those wetlands, they would not be expected in the other wetlands in the same group. Steve R. asked why 18 was carried through to the FS. Allison again stated it was due to variability in the sediment concentrations between Phase II and Phase III. Steve R. said if the rationale is there for excluding based on the toxicity etc., then that's fine.

Tim asked which wetlands were not sampled in Phase III in which similar variability as seen in Wetland 18 may have been observed. Allison said Wetland 4D may be one, but the concentrations were much lower in the Phase III samples. Tim asked why Wetland 18 was included in the FS. Allison said it was originally NFA. Then, because of regulator resistance, a management decision was made to include it in the FS.

Steve R. was evaluating the toxicity test results to determine how decisions were made. Joe said the toxicity test data presentation could be clearer to explain the results better.

Claire was not concerned with 30 or so wetlands that were dropped because they are not located near IR sites. Tim needs a figure to confirm that the wetlands were not near IR sites. Tim asked whether there were 81 wetlands initially, how many were eliminated in Phase I. Allison said 49 were eliminated (slides 6 through 10). The 4 reference wetlands are included in the 81 total.

Dave G. understands that toxicity testing was done at Wetlands 3, 16, and 18 but it is still not clear why Wetland 4D was eliminated. Dave G. asked whether the Navy could find the rationale for excluding Wetland 4D, although he is not sure the rationale would be accepted now. Claire said that there may be a comfort issue with how the toxicity test results were interpreted. Dave B. asked whether there is an issue conducting the toxicity tests on samples with the highest concentrations in Wetlands 16 and 18 and because no toxicity was observed in these samples, stating that no toxicity should be observed at Wetland 4D. Leah has concern with Wetland18 because of DDT and Wetland 4D also has a high HQ for DDT. She still was not clear on the

rationale for why Wetland 4D was eliminated. Allison said the HQ is for the entire OU. Tim asked about the rationale for using all wetlands in an operable unit for the food chain model. Allison said all wetlands in an OU were combined because of the home range for the receptors.

Gerry asked whether there was a list of wetlands that were not evaluated in the FS that the regulators would like to discuss. Claire's list of wetlands in question: 4D, 1A, 1B, 6, 7, 10, 12, 49, 63A.

Leah asked whether there was a rationale for eliminated COPCs from the RI to the FS. Aaron said that the revised Table 16-1, which is Attachment A of the Tech Memo (Appendix A of the FS), presents the rationale for the initial refinement. Leah suggested including lead, DDD, DDT, total DDT, and delta-BHC for Wetland 15 and DDT, DDD, total DDT, delta-BHC for Wetland 18A.

Wetland 10

Allison said Wetland 10 is a drainage ditch subject to periodic clearing by the facility because it fills in frequently. Greg noted that it was dredged about 3 years ago but he needed to determine whether the entire ditch was dredged, or only a portion of it. Allison said that sampling for chemistry and toxicity was done in 2007 and is presented in the RI Addendum report for Wetlands 10 and 48. Chemical concentrations were much lower in 2007 and no samples were toxic and there was not a food chain risk from DDT.

The wetland drains from west to east. Dave G. thought that the metals were essentially gone. Tim asked whether that is considered a lot of variability. Allison said no and that the sediment concentrations have decreased. Joe needed to look at data more closely, because the results in the site samples were compared to laboratory control samples, not reference samples, which is usually done. If the lab control did not do well, the comparison may not be valid. Allison said there was a justification in the report for why the control weight was low – but statistically it wasn't a problem. Aaron asked whether there is a lower limit for the growth which indicates that the lab control would not be acceptable. Joe thought there was for the new test method. Patty asked Linda whether she was OK with what was presented for Wetland 10. Linda thought there may be a question regarding the detection limits but this question was clarified.

Dave G. said that the previously high concentrations were not confirmed with the resampling in 2007 and there was no toxicity. Tim asked whether the elevated concentrations of metals would return after the hurricane and why were metals elevated in the wetland to begin with. Could the variability in concentrations be from sampling variability? Greg said the wetland is usually covered with water and is tidally influenced. Dave G. said the source of metals may have been the wastewater treatment plant or plating operations. Tim asked whether those sources have stopped. Greg said they have been discontinued; the treatment plant is closed. Tim asked whether there are separate results for sediment for each one of the areas. Greg said he can't remember but thinks it was stored and tested. Tim asked whether there are other sources and Greg said fire training occurs in the area, but nothing industrial.

Patty asked Claire whether she was comfortable not including Wetland 10 in the FS or the resampling effort. Claire said other than the toxicity testing. Steve R. is not prepared to answer

that until Joe's question is answered. Aaron asked what information is needed to answer Joe's question. Joe said the information he needs may be in the toxicity reports. Dave G. questioned whether it matters how the toxicity testing was done because the resampling found low chemical concentrations and no toxicity. Tim said the issue is which set of data are correct and representative of the site. Dave G. believes the more recent 2007 is representative. Gerry said Hurricane Ivan occurred in 2004, the sampling was conducted in 2007, and the dredging occurred in 2009.

Patty asked whether there was a decision on Wetland 10. Dave G. agreed that it can be eliminated based on what was presented in the RI Addendum. Aaron reviewed the toxicity test report on the screen and said it was a 10 day test, with survival and growth as the endpoints. Joe pointed out that one replicate in one of the samples had 20 percent survival. Therefore, he needs to look at the toxicity data more thoroughly. Aaron points out that the other replicates were fine. Dave B. said these data will not be used to develop cleanup levels; they are just a line of evidence supporting risks are acceptable at Wetland 10 for benthic invertebrates. Patty asked Joe whether based on the toxicity data, is he comfortable that Wetland 10 does not need to be resampled. Joe said Wetland 10 does not need resampled. Tim agreed that Wetland 10 does not need to be resampled, but he would like to see some clarification on the ditch cleanouts. Gerry pointed out the same general timeline previously provided, but said it will be clarified. Dave G thought it was cleaned out in 2004 as well as 2009. Greg agreed that it was cleaned out in 2004 or 2005.

Wetland 12

Allison said Wetland 12 is a bilgewater spill site handled under the Florida Petroleum Program. Tim said the petroleum program is an ARAR but he needs to make sure the petroleum program looked at the wetland with the same level of effort that is done under CERCLA. Dave B. asked what was done as part of the petroleum program. Greg said they removed soil and if any sediment was dredged, it was only the end of the wetland. Tim said is there nothing indicating that the concentrations are no longer present. Dave G. said that was true unless there was confirmatory sampling. Allison said there was none. Patty asked whether the concentrations were very high. Allison said yes and presented figure with detected concentrations. Claire questioned the ERM-Q but since it was a petroleum site, she did not have a problem with the further explanation. Tim said that it should be verified that that wetland is not contaminated. Greg said a well was installed and samples were collected to verify it was cleaned up. Brian said he remembers collecting sediment samples out there the morning after it happened. Greg will determine whether there is a report on the post spill sampling. Tim asked what the category 3 contaminant was in the presentation. Allison responded that it was for PAHs. Tim said that PAHs are addressed under both programs. Tim and Dave B. asked whether food chain modeling was done. Allison said not for PAHs because that is more of a direct toxicant. Ligia asked whether the wetland should be resampled or wait to see whether the spill report can be located. Patty said if the report cannot be located than the wetland should be resampled.

Wetland 7

Claire included Wetland 7 on her list because of DDT and PAHs. Allison said that Wetland 7 is included in the footprint of the Wetland 64 complex. Claire asked whether it was included in the FS. Aaron said it was not, and if Wetland 7 is included that Wetland 8 should also be included.

Patty asked if it is sufficient in the UFP SAP to say that Wetlands 7 and 8 are included in the Wetland 64 complex. Gerry said the wetlands will be included the Revised FS and the SAP.

Wetland 6

Claire's concern with Wetland 6 was the elevated DDT detections in the southern end of the wetland, and asked about the source of the DDT. Allison said the food chain models were done for the entire OU, and DDT was above basewide levels; the maximum detected concentration was 393 ppb, background was 110 ppb. Claire said it was more of a source question than a question regarding risks to ecological receptors. Allison said DDT wasn't identified as a COC for any of the sites around there. Patty asked whether this wetland needs to be resampled. Dave G. noted that the ditch is subject to periodic cleaning, is man-made, and ecological receptors are limited. Tim said that it is above reference concentrations. Allison said the food chain models, which used all of the data in the OU, did not show risks. Joe said if TOC is high, it would be tightly bound to the organic content, and therefore is not available to receptors. Aaron said the TOC was low at 0.362%. Tim asked whether there was a source that needs to be addressed. Patty would consider Wetland 6 for resampling pending field verification of potential sources.

Wetland 4D

Leah's concern with Wetland 4D was the lack of sampling during Phase III, and the use of Wetlands 16 and 18 as representative wetlands. Leah concern is primarily for lead. This was already discussed earlier and Patty said Wetland 4D will be resampled.

Wetlands 1A and 1B

Wetland 1A was eliminated from further evaluation after a brief discussion and it was determined that chemical concentrations were low. Claire asked whether the NPDES program monitors surface water in Wetland 1B. Greg said that all they do are visual observations (i.e., oil and grease). Claire was concerned about elevated levels of PAHs, the ERM-Q, and the category level. Allison indicated that it is a stormwater ditch. Greg does not believe that all of Wetland 1B gets dredged, although it appears to be a ditch that is maintained and maybe a small portion is cleaned out. Joe said there incomplete documentation here, but if additional information is obtained it could probably be excluded from further evaluation. Patty asked whether Wetland 1B can be excluded. Joe said that based on a comparison to Florida sediment criteria, additional samples should be collected for analysis of PAHs. Patty asked Linda and Joe whether additional samples would be sufficient. Tim said the source of the PAHs does not appear to be known at this point but sample could be collected along the ditch and average the results for comparison to the sediment criteria. Ken asked whether more samples were needed because the results from two existing samples could be averaged. Tim said the two samples may not be representative of the entire ditch. Greg said this ditch does not have water all the time. Linda asked whether there is a depositional area in the wetland; the samples were collected right by the culvert pipe and it usually is not depositional there because of the high flow discharging from the pipe. Linda and Joe agreed that collecting additional samples and averaging the results would be acceptable for comparison to sediment criteria. Ligia did not believe that sampling was necessary but if it were conducted, an incremental sampling design should be considered. Greg said the stormwater pipe in the ditch has been replaced which could have resulted in some removal of sediment in the ditch. Patty said that she will consider additional samples in the wetland.

Wetland 63A

Claire included this wetland on her list for the same reason as Wetland 4D. Claire said during Phase III Wetlands 16 and 18 were sampled instead of 63A, so she wanted to better understand risks in this wetland. Joe asked whether PCBs were detected in the sediment. Allison said the PCBs were detected but the food chain models were acceptable. Claire said concentrations were not exceptionally high and the team agreed that Wetland 63A should not be retained for further evaluation.

Tim said that there needs to be justification for the wetlands that are eliminated in the FS. Patty said all decisions will be documented in the minutes and in the UFP SAP. Tim said that the entire project team should receive copies of the minutes. Patty said that everyone at the meeting would receive the minutes.

Wetland 49

Claire asked whether there was a roadside source of total DDT in this wetland. Allison said the highest DDT concentration was 113 ppb at Wetland 49, and 110 ppb was the reference concentration. Therefore, the highest concentration was roughly equivalent to background. Allison and Patty say the rationale for eliminating Wetland 49 was presented in Table 16-1. Tim said he agrees with not retaining this wetland for further evaluation. Dave G. is not concerned with Wetland 49 either and the team agreed that Wetland 49 does not need to be retained for further evaluation.

Summary of Additional Wetland Evaluation:

- Wetland 4D will be resampled
- Wetland 1B will be resampled
- Wetlands 7 and 8 will be included in the Wetland 64 complex
- Additional sampling at Wetlands 12 and 6 is still pending
  - A removal action occurred in the soil surrounding Wetland 12. If the spill report can be located and it is determined that the wetland was no longer impacted than additional sampling will not be required.
  - A field verification will be conducted at the southern end of Wetland 6 to determine whether there are any sources to this wetland and whether additional sampling is needed.
- Wetlands 1A, 10, 49, and 63A do not need to be further evaluated.

2nd Day, Gerry – OU2 GSI Investigation

- Site 11 and Site 30
- Site 30 - Industrial Buildings and industrial wastewater treatment plant) – likely discharges to 5A and 5B.
- Site 11 - Former landfill. Likely discharges to Wetland 7.
- OU2 ROD – Alternative S-5 Excavation and offside disposal with LUCs and GW-3 (LTM, LUCs, GSI investigation).

- ROD lists COCs for each site: metals, volatiles, pesticides.
- UFP SAP Problem Statement
- OU2 target analyte list – a combination of the two individual COC lists
- Analytical Approach presented
- Proposed sampling maps – DPT, Nested wells, and pore water for both the North and South.

Gerry said that pore water samples would only be collected if there is at least 1 foot of water present at the location. Tim asked whether any seeps are present and is there a connection between groundwater and surface water. Gerry said the potentiometric maps indicate that there is a connection. Brian said that Wetland 5A was originally designed as a wetland catchment and Allison agreed.

Gerry said the investigation will focus on determining whether there is hydrologic conductivity and whether chemical concentrations are impacting the wetlands. The collected data will not be used to evaluate ecological risks for this investigation, but could be evaluated in Site 41.

Dave B. asked which OU2 wetlands were included in FS that are associated with this investigation. Aaron said 5A and Wetland 64 (now the Wetland 64 complex will be included).

Dave B. noted that the OU2 GSI investigation includes analysis of different chemicals (i.e., VOCs) than those being evaluated in the wetlands. Gerry said conducting the GSI investigation was contingent in the ROD; the investigation is being conducted to fill in a data gap. Patty asked whether this was a contingency ROD. Gerry said no. Tim asked why the data should not just be evaluated under OU2, and not Site 41. Gerry said because evaluation of data in the wetlands is Site 41. Dave G. would prefer keeping the data separate. Gerry said the data could be used as part of the ecological risk assessment for Site 41. Dave G. believes that it should be evaluated as part of OU2. Patty agreed with Dave G. Tim said there is a point where the sites merge together. Claire asked why data are being collected with no ecological screening. Gerry said the ROD specifies collecting data for hydrologic conditions. Dave G said this was part of the groundwater monitoring program – to determine if the discharge point was in the wetlands and if the contaminants are adversely impacting the wetland. Tim said the only way to determine if it is affecting is to do the assessment with a risk assessment. Aaron said surface water was already evaluated in the RI as part of the risk assessment. Patty agreed that a risk assessment was done in the RI. Tim asked what will be done with the data. Patty said it is for a groundwater monitoring program. Tim said that if there is a discharge to the wetland, it needs to be evaluated. It does not matter what the ROD stated. Claire said if PALs are not exceeded then question of impacts is answered. Gerry said the data will be compared to surface water criteria, and if there are exceedences, the project team will discuss to decide the next stage. Dave B. asked why compare pore water to the groundwater criteria if groundwater criteria are PALs. Gerry said because it is the pore water and groundwater interface. Tim said the question remains how to evaluate ecological risk. Gerry said that we will discuss if we exceed the PALs. Tim asked do the PALs compare to the ecological screening criteria. Patty said why not do two screens, one for human health and one for ecological. Ligia said the lowest criteria are used as the PALs, so it should be protective of the both ecological and human health except for noncarcinogenic PAHs, which were not of concern here. If there is a mixture Dave G said that he sees using this data for

OU2, but for the wetlands, can tie in groundwater causing surface water problems, then taking pore water and take it further under OU16…groundwater and surface water is an OU16 issue, but groundwater is an OU2 issue. Patty asked if we need to revise the problem statement to say that; we are looking at groundwater for OU2, but if we see anything, evaluate wetlands as part of OU16. Tim said that he thinks it makes sense to evaluate both at the same time. Patty said we are trying to fulfill the OU2 ROD; we will screen against the PALs, if it fails the PALs, add ecological screening at that time. Tim said if it fail the screen for the ecological, at that point, throw into OU16; but if it fails, how does that tie into groundwater. Dave B said at that point, pull back into OU2. Allison said originally it was thought that nothing would trigger risks. Ron said it would automatically trigger. Patty said that 5A, 7, 64, and 6 are evaluated as part of OU16. Gerry said the question is whether this data will be used for that. Patty said she thinks yes, if data is collected. Aaron said surface water was already collected as part of the RI and analyzed for VOCs in '94, '95, and '97. Allison said they didn't identify anything exceeding screening values. Tim said groundwater/surface water investigation is typically done in an RI – had the data been available during the RI, it would have been through risk assessment, but that wasn't done, but should be now. Patty said the ROD was for groundwater monitoring, we did the RI and didn't show anything. Tim said ecological assessments are snapshots at a time, if more data is collected, assess for ecological risk; if below screening values, then it is assessed. Patty said the ecological values are low, so something will likely exceed. Tim said then refinement values are available. Patty said do what need to do for OU2 ROD, screen against PALs, then move 5A, 7, 6 to the OU16 evaluation; the COCs for OU2 are different. Tim said assess the COCs for OU2 for ecological creatures because more data is being collected. Dave G said if we determine pore water is below criteria (human health and eco SLs), then everything is good because it is in compliance with groundwater monitoring for OU2; if there are issues, move straight to OU16 and start the groundwater to surface water ecological risk process. Tim said if get through first 3 steps of the assessment, move to OU16.

Aaron shows Part 1 and Part 2 in Section 11 of the SAP. Dave B. asked if we take groundwater and compare to the surface water criteria PAL, then no pore water data. Aaron said yes. Aaron said maybe on Table 15 add the eco numbers. Gerry said look at this table and determine if it has the numbers for eco. Patty said for the interest of time, we will look at this again, but the decision is based on what Dave G. said "if we determine pore water is below criteria (human health and eco SLs), then everything is good because it is in compliance with groundwater monitoring for OU2; if there are issues, move straight to OU16 and start the groundwater to surface water eco risk process."

Tim asked if Wetland 64 is being sampled as part of the FS. Aaron said that has not yet been decided. Tim said EPA will look at the preliminary report to determine if it is OK to eliminate Wetland 64 from the GSI investigation. Dave G. said he will revisit it as well.

Linda requested the backup data to toxicity report data for the SPAWAR study; Sending her the SPAWAR toxicity report was recorded as action item (Gerry to address).

OU1 Presentation – Aaron

- Background information, CSMs, and proposed analytes presented.

- VOCs, SVOCs, metals detected in groundwater; contamination limited to perimeter of landfill. Soil impact limited to perimeter as well.
- Includes freshwater Wetlands 3 and 18A and tidal Wetlands 15, 16, and 18B; Wetlands 4D and 1B will be added based on yesterday's decisions.

Dave G. asked about the groundwater flow based on a high reading in the middle of the landfill. Brian said that it could be an anomalous data point because there has been a lot of activity on the landfill (e.g., keeping the roads clear).

Wetland 3

- A seep is present where GW discharges into Wetland 3.
- Samples collected in 1994, 1995, and 1997; toxicity samples in 1997.
- COCs for FS: Cadmium (ecological) and arsenic (human health)
- COCs eliminated for eco had low FOD, pesticides indicate legal application; for HH the initial COPC was detected in surface water, not sediment.
- Proposed additional sampling

Ken asked for the question that we are trying to answer at this site. Aaron said one objective is better vertical and horizontal extent of contamination in the sediment (specifically cadmium and arsenic).

Tim asked whether the iron system was still functioning. Dave G. said no. Tim said it was surprising that there have not been any iron exceedances in surface water in Wetland 3. Dave G. said there is elevated iron in the surface water, but not sure if there is a criterion for iron in the sediments. Aaron said that there is an iron criterion. Tim asked whether iron was an issue. Dave G. said it is exceeds background values, but the compliance point was moved to Wetland 4D. Aaron said iron was not carried through the RI as a COPC. Allison said iron was not a risk driver, but it exceeded the surface water ARAR. Dave G. said the interceptor ditch was added because the iron levels in groundwater were high, which could impact ecological receptors, but the interceptor ditch did not work. Surface water iron background is 2360 ug/L. Tim asked whether a study was done for using the Wetland 3 as a treatment. Gerry said an optimization study was done to shut down the interceptor trench and move the compliance point to Wetland 4. Patty said it was a partnering team decision. Tim asked whether someone could send him a copy of the optimization study. Gerry said he will resend (action item).

Patty asked if everyone agreed on the proposed sampling locations for Wetland 3. Linda asked why there were no proposed samples by the seeps. Aaron focused on locations with previously high sample contamination. Aaron asked whether the toxicity testing should be redone to calculate PRGs using more recent data. Linda did not recommend any toxicity tests until the concentration of the samples is known. Aaron proposed holding the samples for toxicity tests until the results of the sediment chemical concentrations are reviewed and then determine which samples should undergo toxicity testing. Linda asked if there are reference locations. Aaron said none are proposed but if toxicity tests are conducted, there would need to be some. Linda said the samples selected for toxicity tests should be analyzed for the full suite of analytes. Patty asked if that meant all samples need TAL/TCL. Dave G. said that for example, if elevated concentrations of metals are found, and toxicity testing is conducted, it needs to be determined

whether a different contaminant is contributing to the toxicity seen so that the toxicity is not incorrectly attributed to the metals. Aaron said there might be a problem with the analytical hold times for some parameters, but they could be extended by freezing samples, if allowed. The Navy has done that on Sites in Region 1. Allison asked whether it mattered that Wetland 3 had elevated levels of chemicals since it is being used as a treatment wetland. Tim said he recommends backup on OU1, put on hold for OU16, do a design for Wetland 3, find out if it will meet wetland design criteria, and see if that will meet the need for any further ecological assessment. Tim recommends that Wetland 3 get pulled out of the FS and get addressed as part of OU1. Tim will look at the Optimization Study. Gerry said we will include the Optimization Study with the ESD.

Wetland 15

- Wetland 15 – tidal wetland
- 4 samples collected in 1995, no toxicity testing
- COCs for FS: arsenic, manganese, and selenium for eco, arsenic for human health
- COCs that were eliminated for eco were less than PRGs or not site related; for hh were less than PRG.

Leah asked why lead and pesticides was excluded from the FS. Allison said DDT was dropped due to the food chain model but was not sure why lead was eliminated. Aaron said because of the refined PRG, some of the human health chemicals were eliminated. Ligia asked if toxicity testing will be done for this wetland. Aaron said the decisions for Wetland 3 (see above) apply. Patty asked if lead should be included in the COCs. Allison said yes. Aaron said the locations where lead concentrations are high needs to be determined.

Ken asked about the problem statement for this wetland. Dave B. said the horizontal and vertical extent of contamination needs refined to better define remedial alternatives. Leah noted that because the ecological receptors of concern includes benthic invertebrates and higher trophic level organisms, total DDT (DDD, DDE, and DDT) should be included to address those receptors, even though it was dropped due to food chain model because DDT is a direct toxicant to benthic invertebrates. Dave B. said that total DDT would be included as a COC. Aaron said that concentrations of other pesticides were pretty low concentrations and were eliminated because they were not site related.

Ligia asked whether the proposed sample locations in the presentation were acceptable. Ken asked whether adding these new parameters will affect the sampling locations. Aaron said probably, but need to look at the data in more detail. Tim asked whether other parameters such as TOC, grain size should be included in the analytical suite. Aaron said the samples should be analyzed for TOC, but was not sure how grain size data would be used. Dave B. asked whether grain size is needed for engineers. Joe O said TOC is more helpful than grain size. Patty said no grain size analysis will be done.

Aaron said that for selenium, 1 mg/kg was the highest concentration tested for toxicity in Wetland 16 and 18B, so it is known that selenium was not toxic at that level. However, it is not known if toxicity would have been seen above that level. Joe said for now, we should keep

selenium in the COC list because historically, there have been issues in analysis of selenium in laboratories, not necessarily for these date, though.

Aaron asked whether it is acceptable to freeze samples to extend hold time. Linda said they will have to ask their chemists.

Dave G. asked how much of the contamination (in particular arsenic) is from golf course runoff. Dave G. suggested collecting samples along several transects across wetland to help determine this. Ken asked whether sediment samples were difficult to collect at this site. Dave G said yes because of the thick vegetation and because it is dry; but if the concern was for human health, it makes sense to take the sample whether wet or dry because exposure is still possible.

Aaron said initial depths proposed are 0-4, 4-12, and 12-24" samples; but samples from the bottom two depths would be held for analysis until the results in the top interval (the biologically active zone) are reviewed. If the top interval is clean, the samples from the deeper intervals will not be analyzed. Dave G. asked what if it is dry. Aaron said if dry, then not issue for benthic invertebrates. Ken asked how it will be determined that the 0-4" interval is clean. Aaron said that initial PRGs would be used, but some new PRGs may need to be developed for chemicals that do not have PRGs. Joe said that it may not be appropriate to use toxicity testing to develop PRGs. Aaron said these were used to refine the list of COCs. Ken asked what would drive the toxicity testing to be done. Aaron said the team would need to evaluate the data to determine if the toxicity testing would be done, but it would only be done on the surface interval. Aaron asked whether the sampling depths were acceptable. Linda said 0-4" for the surface is acceptable. Ron said that step out samples may need collected if the sample results exceed the PRGs. Dave B. said step outs should be done so post FS sampling is not needed to define extent of contamination. Aaron said it is probably easier to do the step outs while in the field rather than remobilizing. Dave B. asked what is quickest turnaround for the analytical that can done cost effectively so that a second field mobilization is not required. Aaron will look into that. Aaron said DDE, DDD, DDT and lead results would be added to the tag map.

Dave G. said that the FS has certain remedial strategies to deal with contamination and is not sure whether the current sampling strategy would refine area. Aaron said having samples along transects should address that concern. Patty said some of this could be done in a pre-design phase but Gerry said based on comments, delineation should be fairly complete before the FS. Patty asked whether additional samples should be added. Aaron said that additional samples will be added for this wetland.

<u>Wetland 16</u>

- Tidal wetland on the shore of the Bayou Grande
- Previous sediment samples: 1 collected in 1994, 3 in 1995, 1 in 1995 and was resampled in 1997.
- 1 location sampled in 1997 for benthic community/sediment toxicity test
- COCs for FS: none retained for either eco or human health; eliminated after the refinement.
- Metals for ecological and Aroclor-1254 human health were carried through the RI.

- For ecological COCs, eliminations were because concentrations were less than PRGs or due to toxicity tests; for human health, eliminations were because concentrations were less than the PRG.

Tim asked which samples drove it to Phase III. Aaron said 41M1603. Allison said it was driven by the inorganics. Aaron asked whether everyone agrees that Wetland 16 can be excluded from the FS. Team agrees that Wetland 16 is not going into the FS.

Wetland 18A

- 4 samples collected previously (1994 and 1995).
- Fed by groundwater seeps from Wetland 1.
- COC for FS: arsenic for human health (none for ecological).
- Ecological COCs were eliminated because either less than PRG or not site related; for human health, concentrations were less than PRGs.

Tim asked which ecological chemicals were not site related. Aaron said 1,4-dichlorobenzene and the 4-methyphenol. Tim asked whether these chemicals are expected to create an ecological concern. Allison said 4-methylphenol was not detected at the landfill, but 1,4-dichlorobenzene was detected in groundwater. Tim asked whether the documentation is available to remove these chemicals. Aaron will look into the documentation and may be able to use the high TOC values in the sediment to adjust the sediment criteria for 1,4-dichlorobenzene. Linda and Joe said that the rationale should be change from "not site-related".

Leah said this is another site where DDT, DDD, and DDE need to be added in because of risks to benthic invertebrates. Aaron agreed that DDT, DDD, and DDE should be added, and will add the results for these pesticides to the tag map. Aaron said additional sample locations will be needed for the DDT. Aaron asked whether everyone is OK with all samples staying within the defined channel. Linda said it might be better to collect samples along transects if the whole area is a wetland. Aaron said we will take transects across to bound arsenic and DDT (2 or 3 transects); compare to the PRGs (though will need to develop PRGs for the DDT); same rationale as previously discussed (for Wetland 15).

Wetland 18B

- One sample collected close to the mouth in 1995.
- Hit of arsenic; resampled in 1997 along with toxicity testing.
- Carried through due to variability; concentration considerably lower in the 1997 resample.
- Tidal wetland.
- No COCs for FS for ecological; for human health, arsenic.

Claire questioned the removal of the DDT from the COCs. Allison said previously DDT was eliminated due to the food chain model. Aaron said it should probably be added back in; although the toxicity testing shows no toxicity, the 1995 sample result was higher. Dave B. asked whether we are adding it in due to variability. Claire agreed. Linda said Wetland 18A also has DDTx and Wetland 18A discharges to Wetland 18B.

Tim asked whether the chemicals added back in will be COPCs or COCs; will data be re-evaluated. Aaron said they are COPCs until they are carried through to the FS. Tim asked whether the 15 years will have capped the contamination; suggested we need to at least evaluate two depths instead of just one to determine if more contaminated sediment is covered by cleaner sediment. Tim suggested that the deeper interval should be analyzed at 10 to 20 percent of the locations. Dave G. said if there are 4" of clean sediment at the surface, does it matter that there is deeper contamination. Is the concern that the deeper sediment could become exposed? Ligia said the facility is located in an area with hurricanes and other large storm events. Tim asked whether the top 4" could become recontaminated. Brian said that at a similar site, there was not a lot of variability noted before and after storm events. Linda suggested analyzing a subset of the deeper samples since they will already have been collected. Dave G. suggested that if one surface sample appeared to be most contaminated, analyze the deeper sample from that location; if not, then randomly analyze a location for depth. Aaron suggested that if all of the surface samples are clean, analyze the depth sample from the location closest to where the contamination was in the previous samples. Aaron asked what if surface sediment is clean, but some subsurface contamination is found. Dave B said that no actions would likely be taken but it would provide evidence that natural capping is occurring. Tim asked whether it would have to be monitored that the natural cap stays in place. Dave B. said that this site was already selected for an FS. Tim said that if contamination is found at depth, it needs to be managed. Tim said rationale for this is to rule out anything at depth. Dave B. said if there is no risk in the wetland, it does not need to be carried into the FS; if there is risk, develop nature and extent of contamination needs to be determined.

Two problem statements:

1) Re-evaluate ecological risk by the ecological risk process. If there is no risk, then do not carry the wetland through to the FS.

2) Objective is better vertical and horizontal extent of contamination in the sediment

    - Analyze 0-4" samples. If all are clean, then analyze a subset (10-20% of samples; minimum of 1) at depth. If 4-12" subsurface clean, NFA. If dirty, MNR seems to be occurring and the team will discuss next steps.

    - If the 0-4" samples are not clean, then analyze the 4-12" sample. If the 4-12" sample is clean, then no more samples will be analyzed. If 4-12" sample is not clean, analyze the 12-24" sample. Determine whether contamination is present at depth to justify the need for management (MNR).

    - Conduct an ecological risk evaluation on all of the samples (compare to PRGs).

    - Collect additional 0-4" samples to define horizontal extent if concentrations exceed PRGs to refine remedial footprint.

Aaron asked if the 4-12" sample was contaminated, would the other deeper interval samples need to be analyzed to delineate the area to manage, or just manage the whole wetland. It was

agreed that more analysis was probably not necessary because the entire wetland would just be managed at that point.

Claire asked about the depth of the mixing zone of the sediment because contamination below the mixing zone does not tend to be a concern for risk. Dave B. said there are methods that can be used to the mixing zone, such as radiological methods, but it probably not necessary for this site.

Patty asked if this approach will be used for all sites. Allison said it probably would not be needed for the freshwater wetlands. There is more erosion, etc. in the tidal wetlands.

Linda asked why arsenic was eliminated for ecological for Wetland 18B. Dave B. said risk for human health for arsenic was based on the maintenance worker – not realistic. Tim said there could be land use controls (LUCs), so it would only be another justification for the LUCs. Dave B. asked whether just focus on the eco. Tim said yes, will re-evaluate human health.

Leah said she thinks it is the same case for Wetland 3 – arsenic will already be a COC for human health, but thinks it should also be one for ecological. Tim said that both human health and ecological risks will be evaluated.

Team agrees to the sampling approach outlined for Wetland 18B.

OU2

Aaron presents OU2 presentation.

Wetland 5

- Freshwater wetland
- Habitat to species surrounding wetland
- Connected to Wetland 5B
- Had some high metals concentrations in previous samples
- Some toxicity testing was conducted
- Water level raised by beaver dams
- 3 stormwater outfalls discharge to wetland
- Two sites were tin/cadmium plating and a plating shop
- Dense vegetation
- Sediment samples: 7 in 1995; 3 locations resampled in 1997 with benthic/toxicity testing
- COCs for FS: Copper, lead, zinc (ecological); none for human health
- Proposed to collect 11 samples in the presentation (changed to 13 after discussion); will focus on ecological COC areas – increase spatial coverage

Brian said the industrial activities were located near to Building 649; however, the location of the ditch referenced in the RI report is not known. Linda asked whether other metals concentrations need evaluated. Dave G. notes that remediation for metals contamination in soil in OU2 stopped at the wetland boundary; sample data from that remediation may help determine where wetland samples should be located and what parameters should be included in the analytical list. Linda suggested total metals analysis plus tin. Patty asked why not just analyze for tin because other

metals were analyzed in the RI. A question was asked regarding why chromium and cadmium were not retained as COCs. Allison said chromium and cadmium were below the refinement value in the 1997 samples. Gerry asked how tin would be evaluated since there are few sediment criteria for total tin and no site-specific background data. Dave B. said there is an AET for tin, but it is a marine criterion. Linda requested tin analyzed because it was used at the site. Linda will review all the data and suggest a refined parameter list [action item].

1) Re-evaluate risk using newly collected data. If risk unacceptable, move to FS. Otherwise, wetland is not carried through to the FS.

2) Determine the nature and extent of COC contamination in sediment to determine and evaluate remedial alternatives.

Allison said that an interim removal action for what appeared to be a primitive oil-water separator was located in the northwestern corner of the wetland. Samples were collected after the removal action but she was not sure that a report was available. Aaron said if the report or data from that report cannon be located, additional samples will be collected in that area.

Aaron asked whether the three depth interval sampling scheme developed previously will be applied at all wetlands. Allison noted that the industrial wastewater treatment line follows the wetlands (underground). Dave G. said probably only need surface (0-4") unless there is contamination, then do nature and extent. Tim said need depth for nature and extent. Tim said clearing northwest of the wetland had cadmium and PAHs in soil there so at least one deeper sample should be collected, preferably from the northwest portion. Aaron said we would end up taking more samples at depth if the 0-4" is not clean. The team agreed to collect at the same three depth intervals defined before. The team agrees that for Wetland 5A, the same rationale will be followed as for Wetland 18B (i.e., sample at least 1 sample at depth even if all clean at the surface).

Dave G. said there could be a radiological issue from two of the sites associated with the wetlands. Allison said she looked at the stormwater map, and there is not a direct connection between the wetlands and the sites with rad radiological issues.

- Analyze 0-4" samples. If all are clean, then analyze a subset (10-20% of samples; minimum of 1) at depth. If 4-12" subsurface clean, NFA. If dirty, MNR and team discuss.

- If the 0-4" samples are not clean, then analyze the 4-12" sample. If the 4-12" sample clean, then no more analyzed. If 4-12" sample not clean, analyze 12-24" sample. Determine whether contamination is present at depth to justify the need for management (MNR).

- Run eco risk on all of the samples (compare to PRGs [existing or if not, develop like for DDT].

- Collect additional 0-4" samples to define horizontal extent if concentrations exceed PRGs to refine remedial footprint.

Wetland 64

- In presentation, no COCs were retained.

Leah questioned why 3 ecological COCs were dropped: mercury, copper, and silver

Aaron said mercury was eliminated for risks to piscivorous fish for reasons discussed in the Tech Memo in the FS. Leah said that her concern is for benthic invertebrates. Aaron said copper and silver were retained for the FS, but mercury was not retained. Gerry said that Wetland 64 is not impacted by the groundwater to surface water analysis. Greg said part of the marina is occasionally dredged (last time approximately 2 years ago). Aaron said the parameter list is select metals, but mercury will be added. Aaron asked about potential sources of metals in the area. Allison said CCA treated pilings. Aaron asked where the marina begins and the Wetland 64 ends. Allison said a management decision was made previously to include the marina and bayou in Wetland 64.

Leah said in the Tech Memo some samples were labeled as not toxic that she considered were toxic (5A0501, 5A0601, 640501) so the PRGs were developed incorrectly. Aaron said the rationale for not including the first two is that they had the highest benthic diversity. Leah said that they would still need to be considered toxic. Aaron recalled that the PRGs were redeveloped as part of the Tech Memo and are presented as uncertainty analysis tables in Attachment C of the Tech Memo. In most cases, the chemicals selected as COPCs for evaluation in the FS would not change. Joe said typically a concentration gradient is needed to use the toxicity testing approach. Aaron said the PRGs incorporate the Florida screening levels and higher effects levels and in many cases the PRGs are based on those values. Ken suggested everyone re-read Attachment C of Appendix A (Tech Memo) of the FS [action item].

Joe said that 10 day tests are considered acute – need to adjust these for chronic exposures using an adjustment factor; 28 day tests are chronic. He did not know what those adjustment factors were.

Patty said that need to look at the data and regroup – possibly have a conference call to discuss.

Tim asked whether we can use previous sampling locations to determine the locations for the future sampling. Aaron said previous toxicity testing was done south of the marina area and asked where the boundary of the investigation for Wetland 64 should end. Dave B said the only the area south of the marina should be investigated.

Wetland 48

- Freshwater wetland
- Grid sampling proposed
- Source unknown – wetland is located in more pristine part of the base
- DDTx

- Petroleum release from Site 37

Dave G. said there were higher concentrations of DDT at depth. Aaron said maybe collect depth samples where there are already surface samples. Greg said the wetland is not always wet. Aaron said that some sampels could be collected in the northwestern area and held for analysis. Aaron said greatest concentrations were in the middle of the previously-sampled area.

- Take samples at depth where we had previous high hits; where we don't have surface data, we will use the same 0-4" and then 4-12" sampling approach defined previously.

Aaron to send out new figures, information, etc. by April 25th

Appendix B

9 May 2012 Teleconference Partnering Meeting Minutes

NAS Pensacola OU16, Site 41 Wetlands
Follow-Up Teleconference Minutes
May 9, 2012

ATTENDEES:

Patty Marajh-Whittemore	NAVFAC, SE	patty.whittemore@navy.mil
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MINUTES:

Check In/Opening Remarks

Aaron B. stated a Tech Memo describing the sampling approach for the collection of additional sediment samples was distributed – the goal is to get consensus on key issues before submitting the draft sampling plan.

General Methodology (presented by Aaron B.)

- Receptors of concern: benthic invertebrates (ecological) and maintenance workers (human health)

Aaron B. asked whether there was agreement that these are the only receptors to be evaluated. Leah S. asked about the management goal. For example, is it only protection of benthic invertebrates or is it protection of benthic invertebrates with the ultimate protection of wildlife consuming the invertebrates. Aaron B. said other receptors were evaluated in the remedial Investigation (RI), but risks to those receptors were lower. Allison H. agreed, with the exception of potential impacts to wildlife at Site 48. Per Leah's suggestion, the sampling approach will

provide the rationale as to why the ecological focus is solely on benthic invertebrates. Overall, there was agreement among the participants on the identified receptors.

For the sampling approach, the Navy will collect sediment samples from 0-4", 4-12", and 12-24". At some wetlands, the Navy will collect both primary samples and step-out samples. The primary samples will be analyzed first and if there are exceedances of PRGs in those samples, the adjacent step-out (or deeper) samples will be analyzed. The step out (and deeper) samples will be held for analysis until the primary results are reviewed. If there are no PRG exceedances, 10-20% (probably 1 or 2) of the deeper samples will be analyzed to determine whether sediment is contaminated at depth.

Sediment samples also will be collected from wetlands not impacted by known sites to 1) obtain reference samples for toxicity testing, and 2) obtain updated background data for metals and background data for PAHs. The previous reference samples did not include data for PAHs. Allison H. was going to verify if PAH data were previously available; Allison believed that it may have been collected, but the use of the data as reference concentrations was not allowed. [Post Meeting Note: Appendix B in the RI presents the analytical results for all of the Phase II sediment samples. The reference samples were analyzed for the full suite of analytes. Very few PAHs were detected in the samples but their detection limits were elevated.]

Aaron B. asked whether everyone agreed with the sampling approach. Ken B. asked whether 10-20% of the deeper samples would be analyzed at all wetlands even if the primary samples do not have PRG exceedences, or is this to occur at only certain wetlands. Tim W. said EPA wants at least a few deeper samples analyzed at all the wetlands that will be sampled.

Aaron B. next discussed the PRGs. He said there was some disagreement on which samples were considered toxic; therefore, two sets of tables were developed in the technical memorandum in the FS. One set of tables was developed based on the samples that the Navy believed were toxic, while the other set of tables was developed based on the samples that the regulators believed were toxic. This was only done for the wetlands in which there was a disagreement between which samples were considered toxic. Aaron said that the tables from the uncertainty analysis were used as the PRGs for those wetlands in which there was a disagreement. Otherwise, the tables from the main section of the technical memorandum were used. For human health, the PRGs were developed based on protection of the maintenance worker receptor; maintenance workers will be used only at wetlands where exposure may be likely. Also, the PRGs may be adjusted based on the wetland if exposures differ at a particular

wetland from what was assumed. Leah S. said she will review the PRGs further but that the PRGs are probably acceptable now that the samples in disagreement for toxicity were considered toxic.

There was additional discussion on why benthic invertebrates are the focus of the evaluation. Leah S. stated that rationale for why only the benthic invertebrates are evaluated needs to be presented and justified in the SAP. Claire M. said if it is found that there are high levels of bioaccumulative chemicals, the Navy should be careful about only evaluating impacts to benthic invertebrates, especially if higher concentrations of bioaccumulative chemicals are found in the newly collected samples. Aaron B. said only toxicity testing is proposed, not bioaccumulation testing. Tim W. asked what would be done if the data indicated that bioaccumulation through the food chain could be a problem. Aaron B. said that would need to be discussed in the SAP. Dave B. asked aside from Wetland 48, is the primary receptor the benthic invertebrates. Aaron B. said yes. The Team agreed to revisit the issue of bioaccumulation when discussing Wetland 48. However, no fish are believed to be present at Wetland 48.

Aaron B. presented the methodology that will be used for the sampling and decision making and asked if anyone has any concern with how the testing will be done. In summary, if chemical concentrations in samples are greater than PRGs, then toxicity tests will be conducted. However, professional judgment may also be used to determine whether testing is necessary. If professional judgment is used to determine that testing is not necessary, it will be discussed with the Team first to get consensus. The samples will be picked along a concentration gradient for toxicity testing. The samples selected for toxicity testing may undergo additional chemical analysis to account for all chemicals that could cause toxicity. The PRGs would then be recalculated using the new toxicity test data. Leah S. asked whether the old toxicity data would be used to develop the PRGs. The Team agreed that only new toxicity data will be used.

Claire M. asked if waterfowl eat benthic invertebrates. Dave B. said that the wildlife receptors were not an issue at the majority of the sites. Dave B. suggested that the SAP could include a decision tree to address how the issue of high concentrations of chemicals like DDT will be addressed if detected (e.g., a food chain model). The Team agreed.

- Aaron B. continued the presentation with Section 1.5 of Tech Memo – hold time and freezing of samples. Aaron B. said wetland-specific sections discuss what samples will be analyzed for specific wetlands. It is proposed that deeper and step out samples be frozen to extend sample hold times.

Aaron B. asked if everyone agreed with freezing samples to extend hold times. Linda G. said that EPA should have an answer from their chemists about that issue in a few days. Aaron B. asked if Florida agreed with freezing samples to extend hold times. Ligia said yes, if EPA agreed that it was acceptable.

Aaron B. asked if everyone agreed with not analyzing the sediment for VOCs. Joe O. said that usually sediment is analyzed for the full suite analysis (VOCs, SVOCs, etc.) when toxicity testing is conducted. Tim W. said if toxicity testing is done and VOCs were not analytes, then it would not be known if VOCs were causing the toxicity. Allison H. said that prior results from the RI did not show that VOCs were a concern. Tim W. said that not including VOCs is a risk because of the age of the previous samples. Aaron B. said VOCs typically are not expected to be found in sediment, and because samples are homogenized in the lab, there is even less of a chance of finding VOCs. Joe O. agreed that it is likely that VOCs would disappear anyway. Aaron B. stated that sediment samples would not be analyzed for VOCs.

Aaron B. asked whether any toxicity test samples should be analyzed for SVOCs because the Navy proposed just analyzing the samples for PAHs. Joe O. said that PAHs plus BEHP, instead of the whole SVOC list, may be acceptable because BEHP was detected in some of the wetlands. Ken B. said BEHP is a common lab contaminant. Aaron B. said there are screening levels for ecological receptors for BEHP. Claire M. said that in the RI, BEHP was a COC in Wetland 64, not in any other wetlands; however, after the refinement memo as part of the RI, BEHP dropped out of the COC list for Wetland 64. EPA said that Region IV policy is that full scan SVOC be done if toxicity testing is done. Aaron B. said that PAHs and SVOCs would be a separate analysis because the low level (SIM) method would be used for the PAHs. Aaron B. said the samples would also be analyzed for TAL metals and tin (at Wetland 5A) and asked whether any other parameters are needed. Joe O. said the samples should also be analyzed for pH and salinity. Aaron B. said salinity and pH will be included along with organic carbon.

Aaron B. summarized that for toxicity testing, the samples will be analyzed for PAHs using SIM method, SVOCs, TAL metals, pH, TOC, salinity – in specific wetlands, additional parameters may be added, but this is the general list.

Discussion of Individual Wetlands (led by Aaron B.)

<u>Wetland 1B</u>

Joe O. said that having one PRG for total PAHs would make everything easier than using individual PAHs. Claire M. asked if there are two PRGs – one for low MW and one for high MW. Aaron B. said that PRGs were not initially developed for PAHs because the equilibrium partitioning that was done as part of the RI indicated that PAHs were not a concern at the sites. Therefore, it was suggested that the PECs for freshwater or PELs for saltwater would be used as the PRGs. The Team agreed to compare the total PAH results to PELs or PECs for the evaluation [Post Meeting Note: The total PAH concentrations for the PEC and PEL are calculated by summing 13 of the individual PAH concentrations). Aaron B. said that if background concentrations are higher than the PELs or PECs, then the results would be compared to the reference concentrations. Leah S. said that the TECs and TELs should be used for screening. Aaron B. said this is not really a screening level assessment because the sites are past that stage in the risk assessment process. The comparison to the PECs and PELs are being done to determine whether any further actions need to be taken. Leah S. asked if the PECs and PELs are not-to-exceed values. Aaron B. said that at Wetland 1B, it was agreed during the last meeting to calculate an average PAH concentration across the ditch and compare that concentration to the PRG. Leah S. said her concern is with the PEC because 60-80% of the population shows adverse effects above that level. Aaron B. said Wetland 1B is a stormwater ditch with little ecological habitat so it was the only wetland where an averaging approach was proposed. Leah S. said that if it is just a maintenance ditch, there will probably not be a benthic community.

Greg C. said that he reviewed the TCLP data for the wetland for disposal purposes and the material was acceptable for disposal in non-hazardous landfill. Patty asked if it was agreeable to drop Wetland 1B from the list. Leah S. agreed. Aaron B. said there were not likely to be significant benthic invertebrates in the ditch and asked what decisions would be made based on the results of the comparison of PAH concentrations to the PRGs. Claire M. said that a concern might be that chemicals can migrate to a better habitat downstream. Aaron B. said that if high concentrations are detected, then the downstream area may need to be investigated. Claire M. agreed that her concern was a mode of transport and agreed that toxicity testing is not needed for Wetland 1B. Aaron asked where Wetland 1B discharges. Allison H. said it discharges to Wetland W2, another ditch, which then discharges into the bayou. Aaron B. said if no toxicity testing is conducted, but if concentrations exceed PRGs, then the Team would need to convene and discuss future steps.

Tim W. asked if the step out samples would be analyzed before conducting the toxicity testing. Aaron said yes, to ensure that concentrations are not higher in step outs than in the samples chosen for toxicity testing. Dave B. agreed that it would help capture the range of concentrations at the site, which is needed for toxicity testing. The Team agreed that all step out samples will be analyzed before deciding which samples should undergo toxicity testing.

Joe O. said that EPA will review the PRGs again, to see if they agree with the ones selected. Aaron B. said the PRG table that was distributed presents the sources of the values used for the PRGs. For many chemicals, they were refinement values. Joe O. said the PRG review will be done before the sampling plan is implemented. Aaron said the PRGs are needed for the SAP because they are the concentrations that the analytical laboratory will use to meet with their detection limits. Dave B. said if there are problems with the PRGs, they should be addressed before the SAP is finalized.

Wetland 5A

Aaron B. said the Navy received EPA's comments regarding which chemicals to add to the COPC list and to analyze the samples for full metals scan including tin. Aaron B. agreed that the Navy would analyze sediment samples for TAL metals and tin to address EPA's concern.

Joe O. asked why AVS/SEM is needed. Aaron B. said that if certain metals exceed PRGs, but AVS/SEM shows those metals are not bioavailable, then toxicity testing may not be needed. Joe O. asked that this rationale be explained in the SAP. Aaron B. agreed that this rationale will be included in the decision logic in the SAP.

Aaron B. asked if everyone agreed with the proposed sample locations. Aaron B. said no step out samples were proposed in this wetland because there is already good coverage across the wetland. Claire M. said the SAP should provide the rationale regarding why step outs are not proposed (especially around the location in the middle of the wetland), and provide specific rationale for the proposed samples. Aaron said it was assumed that the sample in the middle would not be contaminated if the ones more to the north were not contaminated. Aaron B. agreed that the rationale for the sample locations would be provided in the SAP. Tim W. asked that another sample be added near 41M5A06 to ensure that contamination is not migrating from the wetland. Aaron agreed to add that location.

Ken B. asked whether EPA's comment requesting analysis for full TAL metals be conducted. Linda G. said yes, but they also wanted the COPCs they listed added back in for the risk

assessment. Aaron B. asked whether those COPCs are to be added to the PRG list. Linda G. said yes. Joe O. said PRGs are only needed for the COPCs, not all the analytes. Aaron B. said the Navy will decide internally if sediment samples will be analyzed for the full TAL metals, and then if toxicity testing is conducted, the full TAL metals analysis will be conducted.

Wetland 64

Aaron B. said Wetlands 7 and 8 were included in the Wetland 64 complex and the goal is to get current sediment data. EPA commented on the Technical Memorandum that the sediment samples should be analyzed for antimony (in addition to the other metals), SVOCs, and PCBs. EPA requested that antimony, PAHs, bis(2-ethylhexyl)phthalate, and PCBs should be added as COPCs. Aaron B. asked if there is a concern about the phthalate, is the full SVOC analysis needed. Linda G. said they would like to see the full SVOC analysis. Aaron B. said for abiotic samples the Navy will analyze the samples for the select list of metals, PAHs, PCBs, phthalate, and then if toxicity testing is conducted, the full SVOC analysis would be conducted. Ken B. asked if antimony is added back into the COPC list. Aaron B. said analysis of TAL metals was already proposed. Ken B. said the same logic should be followed as agreed upon for Wetland 5A. Aaron asked if everyone agreed with just including the select list of metals (including antimony and other COPCs) initially and then analyzing full list if toxicity testing is conducted. The Team agreed.

Tim W. asked if there was toxicity testing conducted in the marina area. Aaron B. said no toxicity testing samples were proposed in main portion of the marina. Tim W. asked why sampling is only proposed for the southern portion when the FS proposed a larger area. Dave B. said based on the CSM, releases from the marina are not IR releases. Tim W. asked whether the contamination from the marina could be differentiated from other contamination, and why the sampling area changed from what was in the FS. Ken B. said that the FS will be revised. Aaron B. said that there were PRGs in the FS, and there were samples in the marina that exceeded PRGs. Ken B. asked if Tim W. is looking for rationale as to why some of that area is excluded. Tim W. said yes. Aaron said there are many sources that can be contributing to the contamination in the marina besides the IR sources. Ken B. asked how the marina has changed. Greg C. said the marina is still there, but now it is a floating marina as opposed to the treated pilings. Aaron B. asked if treated pilings were used in the marina and Greg C. said yes. He should have an “as-built” prior to the hurricane, and also aerials. Tim W. asked if it was a base marina. Greg C. said yes, but treated pilings were used throughout Florida. When the

marina was rebuilt in 2005, PVC/concrete pilings were used. Aaron B. asked if a lot of dredging was conducted when the marina was rebuilt. Greg C. said no, not inside the marina. Aaron B. asked if the area where the boats are located fills in with sediment. Greg C. said he doesn't believe so. Aaron B. said that this issue would be discussed internally with the Navy team. Tim W. said it would be good to know where the marina is on the figure. Aaron B. said the pilings would be added to the current figure.

Additional Discussion

Patty W. asked if FDEP had any comments on the sampling. Ligia A. and Leah S. say no. Aaron B. said the information from the technical memorandum would be incorporated into the SAP. Dave B. said that outstanding issues should be discussed before the draft SAP is prepared. Aaron B. agreed and can perhaps send out an email with new figures and other details before the SAP.

Claire M. asked about Wetland 12 – previously it was agreed that it might be sampled if the spill report was not found. Allison H. said this area was the bilge water spill site, and she found excerpts from the spill report, but not the whole report. Greg C. said he could not find the report. Patty W. said it appears that wetland would need to be sampled. Aaron B. said that a sample location figure and a one-page sheet will be prepared for this wetland and e-mailed to the team.

Tim W. asked about Wetland 18A and suggested that additional samples be added between some of the proposed points – equidistant between 41M18A1 and 001M0018, down the center of the wetland, and also between 41M18A1 and 41M18A2. Aaron agreed to include those samples and also noted that the figure for Wetland 18A and 18B overlap and some of the same samples are on both figures

Claire M. commented on previous meeting minutes for Wetland 6, as the minutes said field verification for the DDT detected would be conducted. Claire M. said the DDT detected was more of a transport concern versus an ecological risk concern because Wetland 6 is a storm water ditch with little habitat. Claire M. said her concern was the source of the DDT. Greg C. said he does not know of any source and Allison H. said she looked at the data and could not locate any sources. Aaron B. said no sampling is currently proposed for Wetland 6, but a decision would be made pending field verification. Aaron B. said that based on some drawings, it appeared that sediment was excavated from the wetland. Greg C. agreed and said he would

take some photos of the area to see if any sediment is located there. Aaron B. said he will send Greg a figure of the area in question. Aaron B. said a few samples in the ditch may be included in the SAP to provide another line of evidence, to ensure contamination is not extending.

Dave G. said at the southernmost point of Wetland 15 has elevated arsenic (141 mg/kg) and asked if there is human health risk associated with it. Dave G. asked if there can be more samples north, west, and northwest of that point. Aaron B. asked if these would be within the wetland boundary. Dave G. said yes for now, but because there may be a human health concern, a removal of the soil should be considered. Allison H. said that wetland is pretty dry. Aaron B. said a few samples around the 141 mg/kg arsenic detection would be added.

Closing Remarks

Patty W. reviewed the action items. Tim W. said we need to come to resolution on the PRGs. Aaron B. said we need resolution on the freezing of samples to extend hold times. Dave G. said FDEP will agree with what EPA said on that issue, and Joe O. said they will provide that answer. Patty W. asked if there were any other outstanding issues. EPA said they had no further issues to discuss at this time.

NAS Pensacola OU 16 Site 41 Briefing March 27 & 28 2012 - Action Items				
Action Item No.	**Responsible Party**	**Status**	**Due Date**	**Action Item**
A01-032712	Allison H.			Will determine the location and available information for Wetland 54 which is not shown on the wetlands map and will look into why there are two wetlands labeled "Wetland 65" on the map.
A02-032712	Greg C.	Completed		Look into historical activities of wetland dredging at the base.
A03-032712	Greg C.	Completed		Will check the wetland dredging manifests to obtain the analytical results and determine which of the wetlands failed TCLP testing. (Greg thinks one analysis failed).
A04-032712	Allison H.			Will create figures showing IR site locations and • Non-sampled wetlands (i.e. not near any sites) • Progression of wetland screening for various phases of investigation
A05-032712	Greg C.	Completed		Will clarify the significant timeline related to the ditch cleanup and specific to Wetland 10.
A06-032712	Greg C./Dave G.			Will look for a report on the post-petroleum spill sampling conducted at Wetland 12.
A07-032712	Gerry			Will revise the OU 16, Site 41 Feasibility Study to indicate that Wetlands 7 & 8 are part of the Wetland 64 complex and not separate investigation areas.
A08-032712	Greg C.			Will complete a field verification of Wetland 6.
A09-032712	Dave B.	Completed		Will obtain addition information on the Wetland 64 SPAWAR toxicity report and send it to the group.
A10-032712	Gerry W.	Competed		Will resend the OU 1 Optimization Report to Tim W. so he can review the finding related to Wetland 3.
A11-032712	Linda G.	Completed		Will look at the data for Wetland 5A in OU2 to determine if a few more analytes need to be added to the parameter list.
A12-032712	Aaron B./Patty M.			Patty will obtain the COC list and analytical results from CH2M Hill for the OU 2 soil excavations north of Wetland 5A. Aaron and the Navy will consider the addition of these COCs to the Wetland 5A analyte list.
A13-032712	All Parties	Completed		Will re-read the Feasibly Study Appendix A (the Tech Memo Revised List of COCs for Feasibility Study and Development of PRGs for Sediment - Site 41 NASP) specifically Attachment C (Uncertainty Analysis Tables).

A14-032712	Linda G.			Will query EPA chemists on the acceptability of freezing samples to extend holding times.

NAS Pensacola OU 16 Site 41 Teleconference May 9, 2012 - Action Items

Action Item No.	Responsible Party	Status	Due Date	Action Item
A01-0520912	Aaron B./Allison H.			Will prepare a sample location figure and a one-page sample rational sheet for wetland 12 and e-mailed to the team.
A02-050912	Aaron B./Greg C.			Aaron B. will send Greg C. a figure of the wetland 6 area that may have had sediments removed from the wetland and Greg C. will take some photos of the area to see if any sediment is located there.

Appendix C
7 June 2013 Teleconference Meeting Minutes

NAS Pensacola OU16, Site 41 Wetlands
Responses to the Comments on the Response to Comments
Sampling and Analysis Plan
Conference Call Minutes, 7 June 2013

ATTENDEES:

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MINUTES:

Opening Remarks

Meeting started at 10:00 AM central time/11:00 AM eastern and had a 1 hour duration. This meeting followed a monthly project team call on 3 June 2013 to discuss Operable Unit (OU) 16.

The Navy proposed transferring wetlands 1B, 15, 16, 18 (A/B), 3, and 4D back to OU 1. EPA suggested doing the same thing for OU2.

A discussion followed about how the sampling and analysis plan (SAP) would be revised or would there be separates SAPs for OU 1, OU 2, and OU 16. Could we use the same plan? Many of the sections would be the same if separated. The OU 1 wetlands could be pulled into the existing OU 1 SAP that is currently being completed or would it make more sense for it to be separate SAP or an addendum? Would the OU 1 LTM sampling need to be delayed to allow for the inclusion of the wetlands?

The discussion continued on how the LTM would proceed if the wetlands were added. EPA and FDEP agreed that the OU 1 LTM sampling could move forward with the wetlands included as an addendum.

EPA discussed that OU 2 be handled similarly suggesting it was a good idea because of the groundwater sampling, groundwater/surface water (GSI) sampling, and now an ecosystem sampling on top of it. The Navy will need Management approval before moving forward with separating OU 2 for OU 16 wetlands.

The only wetlands remaining in OU 16 are Wetlands 48, 12, and W2. Depending on what is found, it may be that the risk is such that it could be handled with an interim remedial action (IRA) and then they could get a no further action (NFA).

EPA and the Navy agreed that OU 1 and OU 2 should be handled consistently.

The team moved on with review of comments and responses:

U.S. EPA Comment 1:
EPA suggested that they would be patient with this.

U.S. EPA Comment 2:
EPA indicated that W2 was mentioned but there is nothing in the response. The Navy confirmed that it is included.

EPA indicated that a few (not at all locations) surface water samples should be collected. The Navy stated that if there was a complete pathway from groundwater to surface water, then surface water needed to be sampled. The Navy said by readjusting the wetlands associated with OU 16 back to OU 1, and by potentially moving the wetlands from OU 16 to OU 2, no other wetlands in OU 16 had a complete pathway. For OU16, they're trying to focus on the wetlands that have a conceptual site model (CSM) showing that overland flow and residual contamination is in the sediments. The remaining wetlands serve as sinks for the contaminants. From that perspective, surface water sampling is not necessary for OU 16, but for other wetlands moving out of OU 16, it may be appropriate.

Discussion continued on surface water on whether the lack of groundwater to surface water pathway would be a sufficient justification for not collecting surface water. From an eco-perspective, how could they eliminate taking surface water samples? If there is a surface water issue, EPA would want to know if there is a continuing issue. The Navy stated that it depends on the CSM and the types of COCs (DDx, PAHs, and metals). Many contaminants sorb to the sediment and the surface water is transient.

EPA stated that surface water is an exposure pathway, so if modeling to higher trophic animals for contaminants like selenium or mercury, we need surface water data. If it not collected, it would be a data gap. To support the feasibility study (FS), ingestion would be more likely the

result of prey items and solids, not surface water. Technically, it would be a data gap but that it will not be significant.

EPA states that to collect a few surface water samples, there would not be that many more samples and it would give a complete picture; the ecological risk guidance suggests surface water samples, but it isn't required. FDEP stated that their primary concern for surface water was metals concentration, not organic contaminants. FDEP also stated that if there is not a groundwater to surface water pathway, not sure if surface water samples are needed.

EPA stated that they were trying to determine if there is an eco-risk. Animals live in both sediment and surface water, so it needs to be analyzed. A minimal number of samples would at least allow you to know for sure. The Navy summarized that the surface water is transient and has a short residence time in the wetlands.

Conclusion: The Navy said that they would do some samples of surface water for OU 1, and they would think about Wetlands 48, W2, and 12. Fate and transport analysis would be performed to show a connection. Insolubles should not be in the water column much, so it might be appropriate for some and not others.

U.S. EPA Comment 3:
The Navy agreed to sample the Wetlands 6/7 area near the weir for DDx.

U.S. EPA Comments 4 and 5 have been adequately addressed.

U.S. EPA Comment 6:
EPA said that some of the preliminary remediation goals (PRGs) weren't acceptable, so they recommended using probable effects levels (PELs) instead. EPA said use the TELs for delineation. The Navy proposes to use site-specific PRG, PEL, and background concentration for comparison with to the new data and then to use those to decide if step-out needs to be performed. The new toxicity tests and chemistry results would be used to develop remedial goals. EPA said that it was agreeable, but overall they weren't comfortable with using the PRGs. PRGs will be evaluated individually.

U.S. EPA Comment 7:
The response is acceptable.

Florida Department of Environmental Protection (FDEP)
FDEP summarized that the PRGs had been addressed and to use the TELs for delineation. Other FDEP comments had been addressed. Standard operating procedures for the chronic sediment toxicity tests will be added to the response to comments.

Appendix D
Food Web Model

Food Web Model

Constituents that bioaccumulate or biomagnify within the food web and into upper trophic level receptors require additional analysis to evaluate risk. To evaluate this exposure route, a food web model will be developed using sediment and surface water concentrations to estimate dietary exposure. The dietary exposure estimate will be compared to literature-based values related to no observed adverse effects levels (NOAELs) and lowest observed adverse effects levels (LOAELs) to determine the potential for unacceptable risk based on this exposure route. Two assessment endpoints were selected to represent conservative estimates for ecological exposure:

1. Health and survival of the piscivorous bird community (green heron)
2. Health and survival of the piscivorous mammal community (mink)

Food Web Model Methodology

Food web models will be conducted for "important bioaccumulative chemicals" (USEPA 2000) that are detected in sediment at concentrations greater than those detected in the 2007 RI (within individual wetlands) and that are not limited to hot spots of contamination.

General Food Web Model Equation

The food web model estimates dietary exposure as a body-weight normalized total daily dose for each receptor species. The general structure of the food web exposure model is described by the following equation modified from USEPA (1993):

$$DI_{xj} = \frac{[[\sum_i [(FIR_j)(FC_{xi})(PDF_i)]]+[(FIR_j)(SC_x)(PDS)]+[(WIR_j)(WC_x)]][AUF_j]}{BW_j}$$

where:

DI_{xj} = Dietary intake of chemical x by receptor j (mg chemical/kg body weight/day)
FIR_j = Food ingestion rate for receptor j (kilograms per day [kg/day]; dry-weight)
FC_{xi} = Concentration of chemical x in food item i (mg/kg; dry weight)
PDF_i = Proportion of diet composed of food item i (unitless; dry weight basis)
SC_x = Concentration of chemical x in sediment (mg/kg; dry weight)
PDS = Proportion of diet composed of sediment (unitless; dry weight basis)
WIR_j = Water ingestion rate for receptor j (liters per day [L/day])
WC_x = Concentration of chemical x in water source (mg/L)
BW_j = Body weight of receptor j (kg; wet weight basis)
AUF_j = Area Use Factor for receptor j (unitless)

Input Parameters for Food Web Model

Input parameters for the food web model are summarized in Table D-1. Exposure parameters are those provided by USEPA Region 4 (USEPA 2013). Diets of both the mink and green heron are assumed to be 100% fish. Concentrations of chemicals in whole body fish are calculated by multiplying the sediment concentration by chemical-specific sediment-to-fish bioaccumulation factors (BAFs) from the literature. The sediment-to-fish BAF values used are based on the ratio between dry-weight sediment and dry-weight fish tissue. Literature values based on the ratio between dry-weight sediment and wet-weight fish tissue are converted to a dry-weight basis by dividing the wet-weight BAF by the estimated solids content for fish (25 percent [0.25]; USEPA 1993). A summary of the sediment-to-fish BAFs to be used in the food web model is provided in Table D-2. When BAFs were not available, they were calculated using biota-to-sediment accumulation factors (BSAFs) obtained from the literature. Full data on BSAFs used to derive BAF values are presented in Table D-3. BSAFs are ratios of lipid-normalized tissue concentrations to organic carbon-normalized sediment concentrations. Lipid concentrations in fish tissue were used to convert BSAFs to BAFs; these values are in Table D-4. Sediment organic carbon content was assumed to be 1 percent. For chemicals without literature based sediment-to-fish BAFs, a BAF of 1.0 is assumed.

The list of chemicals included in the food web assessment will be determined based on criteria specified in the SAP; as such, these tables may be expanded or reduced in the final risk assessment. Exposure point concentrations in sediment and surface water will be maximum concentrations (conservative assessment) and average concentrations (less conservative assessment).

Food Web Model Evaluation of Risk

The exposure estimates calculated above are compared to toxicity reference values from the scientific literature using the hazard quotient approach. Where possible, both a no observed adverse effects level (NOAEL) and a lowest observed adverse effects level (LOAEL) are obtained from the literature, so a protective range of hazard quotients can be evaluated. Table D-3 presents NOAELs and LOAELs for the constituents anticipated to be included in food web model evaluations. This list may expand based on data findings (e.g., concentrations of contaminants relative to historical maximum concentrations). Hazard quotients greater than 1.0 indicate ecological effects could occur and that additional evaluation or action may be warranted. Hazard quotients derived on this basis will be presented to the partnering team, and professional judgment and the weight of evidence available will be presented for use in risk management decisions.

References

USEPA. *Wildlife Exposure Factors Handbook*. Office of Research and Development, Washington, D.C. EPA/600/R-93/187a. 1993.

USEPA. *Bioaccumulation Testing and Interpretation for the Purpose of Sediment Quality Assessment. Status and Needs*. Office of Water and Office of Solid Waste. EPA-823-R-00-001. February 2000.

USEPA. *Draft. EPA Region 4 Wildlife Exposure Parameters Table Version 3* — Last Revised 20 May 2013.

Table D-1
Food Web Model Exposure Parameters

Exposure Scenario	Body Weight (kg)		Dietary Composition	Area Use Factor	Chemical Concentration in Media (biotic/abiotic)	Food Ingestion Rate (kg/day wet weight)	Surface Water Ingestion Rate (L/day)	Sediment/Soil Ingestion Rate (decimal percent (%/100) of Food Ingestion Rate)	Home Range (ha)
ASSESSMENT ENDPOINT 1 — Piscivorous Bird									
Representative Species — Green Heron (*Butorides virescens*)									
	0.2		100 percent fish	1.0	UCL of Mean	0.12	0.0234	0.02	4.5
ASSESSMENT ENDPOINT 2 — Piscivorous Mammal									
Representative Species — Mink (*Mustela vison*)									
	0.896		100 percent fish	1.0	UCL of Mean	0.1434	0.0707	0.094	8

Notes:
Parameters are in dry weight
kg = kilogram
AUF = area use factor
L = liter
ha = hectacre
UCL = upper confidence limit
All values from USEPA 2013
USEPA. 2013. Draft. EPA Region 4 Wildlife Exposure Parameters Table Version 3 — Last Revised May 20, 2013.

Table D-2
Sediment-Fish
Bioaccumulation Factors (BAFs) (dry weight)

CAS No.	Analyte	Value	Basis	Reference
95-94-3	1,2,4,5-Tetrachlorobenzene	1	assumed	—
101-55-3	4-Bromophenyl-phenylether	1	assumed	—
7005-72-3	4-Chlorophenyl-phenyl ether	1	assumed	—
83-32-9	Acenaphthene	0.828	Derived from median BSAF value	—
208-96-8	Acenaphthylene	0.326	Derived from median BSAF value	—
120-12-7	Anthracene	0.198	Derived from median BSAF value	—
56-55-3	Benzo(a)anthracene	0.057	Derived from median BSAF value	—
50-32-8	Benzo(a)pyrene	0.050	Derived from median BSAF value	—
205-99-2	Benzo(b)fluoranthene	0.059	Derived from median BSAF value	—
191-24-2	Benzo(g,h,i)perylene	0.094	Derived from median BSAF value	—
207-08-9	Benzo(k)fluoranthene	0.057	Derived from median BSAF value	—
218-01-9	Chrysene	0.064	Derived from median BSAF value	—
53-70-3	Dibenzo(a,h)anthracene	0.052	Derived from median BSAF value	—
206-44-0	Fluoranthene	0.068	Derived from median BSAF value	—
86-73-7	Fluorene	0.559	Derived from median BSAF value	—
118-74-1	Hexachlorobenzene	2.124	Derived from the single available BSAF value	—
87-68-3	Hexachlorobutadiene	1	assumed	—
77-47-4	Hexachlorocyclo-pentadiene	1	assumed	—
67-72-1	Hexachloroethane	1	assumed	—
193-39-5	Indeno(1,2,3-cd)pyrene	0.059	Derived from median BSAF value	—
87-86-5	Pentachlorophenol	1	assumed	—
85-01-8	Phenanthrene	0.196	Derived from median BSAF value	—
129-00-0	Pyrene	0.080	Derived from median BSAF value	—
72-54-8	4,4'-DDD	26.423	Derived from median BSAF value	—
72-55-9	4,4'-DDE	132.665	Derived from median BSAF value	—
50-29-3	4,4'-DDT	16.081	Derived from median BSAF value	—
—	Total DDx			
309-00-2	Aldrin	42.480	Derived from the single available BSAF value	—
319-84-6	alpha-BHC	42.480	Derived from the single available BSAF value	—
5103-71-9	alpha-Chlordane	19.428	Derived from median BSAF value	—
319-85-7	beta-BHC	42.480	Derived from the single available BSAF value	—
319-86-8	delta-BHC	42.480	Derived from the single available BSAF value	—
60-57-1	Dieldrin	25.877	Derived from median BSAF value	—
959-98-8	Endosulfan I	42.480	Derived from the single available BSAF value	—
33213-65-9	Endosulfan II	42.480	Derived from the single available BSAF value	—
72-20-8	Endrin	42.480	Derived from the single available BSAF value	—
58-89-9	gamma-BHC (Lindane)	42.480	Derived from the single available BSAF value	—
5103-74-2	gamma-Chlordane	30.586	Derived from median BSAF value	—
76-44-8	Heptachlor	42.480	Derived from the single available BSAF value	—
1024-57-3	Heptachlor epoxide	42.480	Derived from the single available BSAF value	—
72-43-5	Methoxychlor	42.480	Derived from the single available BSAF value	—
8001-35-2	Toxaphene	42.480	Derived from the single available BSAF value	—
12674-11-2	Aroclor-1016	43.660	Derived from the single available BSAF value	—
11104-28-2	Aroclor-1221	43.660	Derived from the single available BSAF value	—
11141-16-5	Aroclor-1232	43.660	Derived from the single available BSAF value	—
53469-21-9	Aroclor-1242	43.660	Derived from the single available BSAF value	—
12672-29-6	Aroclor-1248	43.660	Derived from the single available BSAF value	—
11097-69-1	Aroclor-1254	43.660	Derived from the single available BSAF value	—

Table D-2
Sediment-Fish
Bioaccumulation Factors (BAFs) (dry weight)

CAS No.	Analyte	Value	Basis	Reference
11096-82-5	Aroclor-1260	43.660	Derived from the single available BSAF value	—
11100-14-4	Aroclor-1268	43.660	Derived from the single available BSAF value	—
7440-38-2	Arsenic	0.126	Mean BAF	Pascoe et al 1996
7440-43-9	Cadmium	0.22	Median BAF	PTI Environmental Services 1995
7440-47-3	Chromium	0.038	Mean BAF	Krantzberg and Boyd 1992
7440-50-8	Copper	0.1	Mean BAF	Krantzberg and Boyd 1992
7439-92-1	Lead	0.13	Median BAF	PTI Environmental Services 1995
7439-97-6	Mercury	3.25	avg mean	Cope et al. 1990
7440-02-0	Nickel	1	assumed	—
7782-49-2	Selenium	1	assumed	—
7440-22-4	Silver	1	assumed	—
7440-31-5	Tin	1	assumed	—
7440-66-6	Zinc	1.25	Median BAF	PTI Environmental Services 1995

Notes:
Values
BSAF = Biota-to-sediment accumulation factor data from the literature; presented in Table D-3.

References:

Cope, W.G., J.G. Wiener, and R.G. Rada. 1990. Mercury accumulation in yellow perch in Wisconsin seepage lakes: relation to lake characteristics. *Environmental Toxicology and Chemistry.* 9:931-940.

Krantzberg, G. and D. Boyd .1992. The biological significance of contaminants in sediment from Hamiltorn Harbor, lake Ontario. *Environmental Toxicology and Chemistry.* 11(11):1527-1540.

Pascoe, G.A., R.J. Blanchet, G. Linder. 1996. Food chain analysis of exposure and risks to wildlife at a metals-contaminated wetland. *Archives of Environmental Contamination and Toxicology.* 30:306-318.

PTI. 1995. *Analysis of BSAF values for nonpolar organic compounds in finfish and shellfish.* PTI Environmental Services, final report prepared for Washington State Department of Ecology, Olympia, WA.

Table D-3
Literature-based Biota-Sediment Accumulation Factors
Used to Derive Sediment-to-Fish Bioaccumulation Factors

Chemical	Organism	BSAF (wet weight)	Reference	Median BSAF (wet weight)
PAHs:				
2-Methylnaphthalene	American eel (*Anguilla rostrata*)	0.0284	USACE 2010	0.0788
		0.0109	USACE 2010	
		0.0518	USACE 2010	
	White sucker (*Catostomus commersoni*)	0.0721	USACE 2010	
		0.0832	USACE 2010	
		0.0703	USACE 2010	
		0.0743	USACE 2010	
		0.0267	USACE 2010	
		0.1031	USACE 2010	
		0.1190	USACE 2010	
		0.0895	USACE 2010	
	Killifish (*Fundulus* sp.)	0.9717	USACE 2010	
		0.1935	USACE 2010	
	Largemouth bass (*Micropterus salmoides*)	0.1561	USACE 2010	
Acenaphthene	American eel (*Anguilla rostrata*)	0.0293	USACE 2010	0.0351
		0.0048	USACE 2010	
		0.0145	USACE 2010	
	White sucker (*Catostomus commersoni*)	0.0365	USACE 2010	
		0.0428	USACE 2010	
		0.0417	USACE 2010	
		0.0602	USACE 2010	
		0.0089	USACE 2010	
		0.0306	USACE 2010	
		0.0401	USACE 2010	
		0.0351	USACE 2010	
Acenaphthylene	American eel (*Anguilla rostrata*)	0.0037	USACE 2010	0.0138
		0.0024	USACE 2010	
		0.0003	USACE 2010	
	White sucker (*Catostomus commersoni*)	0.0150	USACE 2010	
		0.0149	USACE 2010	
		0.0136	USACE 2010	
		0.0138	USACE 2010	
		0.0085	USACE 2010	
		0.0266	USACE 2010	
		0.0287	USACE 2010	
		0.0244	USACE 2010	
Anthracene	American eel (*Anguilla rostrata*)	0.0031	USACE 2010	0.0084
		0.0008	USACE 2010	
		0.0002	USACE 2010	
	White sucker (*Catostomus commersoni*)	0.0119	USACE 2010	
		0.0106	USACE 2010	
		0.0099	USACE 2010	
		0.0105	USACE 2010	
		0.0032	USACE 2010	
		0.0139	USACE 2010	
		0.0109	USACE 2010	
		0.0148	USACE 2010	
	Largemouth bass (*Micropterus salmoides*)	0.0072	USACE 2010	
		0.0062	USACE 2010	
	Mummichog (*Fundulus heteroclitus*)	0.0084	USACE 2010	
	Cunner (*Tautogolabrus adspersus*)	0.0061	USACE 2010	

Table D-3
Literature-based Biota-Sediment Accumulation Factors
Used to Derive Sediment-to-Fish Bioaccumulation Factors

Chemical	Organism	BSAF (wet weight)	Reference	Median BSAF (wet weight)
Benzo(a)anthracene	White sucker (*Catostomus commersoni*)	0.0021	USACE 2010	0.0024
		0.0040	USACE 2010	
		0.0029	USACE 2010	
		0.0026	USACE 2010	
		0.0003	USACE 2010	
		0.0014	USACE 2010	
		0.0009	USACE 2010	
	Killifish (*Fundulus* sp.)	0.0941	USACE 2010	
Benzo(a)pyrene	White sucker (*Catostomus commersoni*)	0.0018	USACE 2010	0.0021
		0.0023	USACE 2010	
		0.0040	USACE 2010	
		0.0002	USACE 2010	
Benzo(b)fluoranthene	White sucker (*Catostomus commersoni*)	0.0043	USACE 2010	0.0025
		0.0034	USACE 2010	
		0.0019	USACE 2010	
		0.0025	USACE 2010	
		0.0002	USACE 2010	
Benzo(g,h,i)perylene	White sucker (*Catostomus commersoni*)	0.0040	USACE 2010	0.0040
		0.0012	USACE 2010	
		0.0699	USACE 2010	
Benzo(k)fluoranthene	White sucker (*Catostomus commersoni*)	0.0018	USACE 2010	0.0024
		0.0024	USACE 2010	
		0.0030	USACE 2010	
		0.0041	USACE 2010	
		0.0002	USACE 2010	
Chrysene	White sucker (*Catostomus commersoni*)	0.0046	USACE 2010	0.0027
		0.0029	USACE 2010	
		0.0024	USACE 2010	
		0.0034	USACE 2010	
		0.0003	USACE 2010	
		0.0010	USACE 2010	
		0.0017	USACE 2010	
		0.0636	USACE 2010	
Dibenzo(a,h)anthracene	White sucker (*Catostomus commersoni*)	0.0022	USACE 2010	0.0022
		0.0014	USACE 2010	
		0.0027	USACE 2010	
		0.0043	USACE 2010	
		0.0003	USACE 2010	
Fluoranthene	American eel (*Anguilla rostrata*)	0.0011	USACE 2010	0.0029
		0.0003	USACE 2010	
		0.0001	USACE 2010	
	White sucker (*Catostomus commersoni*)	0.0045	USACE 2010	
		0.0048	USACE 2010	
		0.0065	USACE 2010	
		0.0040	USACE 2010	
		0.0007	USACE 2010	
		0.0027	USACE 2010	
		0.0035	USACE 2010	
		0.0026	USACE 2010	
	Cunner (*Tautogolabrus adspersus*)	0.0117	USACE 2010	
		0.0029	USACE 2010	
		0.0001	USACE 2010	
	Killifish (*Fundulus* sp.)	0.0383	USACE 2010	

Table D-3
Literature-based Biota-Sediment Accumulation Factors
Used to Derive Sediment-to-Fish Bioaccumulation Factors

Chemical	Organism	BSAF (wet weight)	Reference	Median BSAF (wet weight)
Indeno(1,2,3-cd)pyrene	White sucker (*Catostomus commersoni*)	0.0043	USACE 2010	0.0025
		0.0020	USACE 2010	
		0.0013	USACE 2010	
		0.0029	USACE 2010	
		0.0002	USACE 2010	
	Killifish (*Fundulus* sp.)	0.0756	USACE 2010	
Fluorene	American eel (*Anguilla rostrata*)	0.0063	USACE 2010	0.0237
		0.0016	USACE 2010	
		0.0006	USACE 2010	
		0.0039	USACE 2010	
	White sucker (*Catostomus commersoni*)	0.0415	USACE 2010	
		0.0238	USACE 2010	
		0.0236	USACE 2010	
		0.0225	USACE 2010	
		0.0081	USACE 2010	
		0.0324	USACE 2010	
		0.0280	USACE 2010	
		0.0280	USACE 2010	
	Largemouth bass (*Micropterus salmoides*)	0.0302	USACE 2010	
		0.0189	USACE 2010	
	Mummichog (*Fundulus heteroclitus*)	0.5256	USACE 2010	
	Cunner (*Tautogolabrus adspersus*)	0.2073	USACE 2010	
Naphthalene	American eel (*Anguilla rostrata*)	0.0265	USACE 2010	0.0408
		0.0123	USACE 2010	
	White sucker (*Catostomus commersoni*)	0.0408	USACE 2010	
		0.0430	USACE 2010	
		0.0428	USACE 2010	
		0.0387	USACE 2010	
		0.0170	USACE 2010	
	Killifish (*Fundulus* sp.)	0.8125	USACE 2010	
		0.1575	USACE 2010	
		0.0366	USACE 2010	
	White perch (*Morone americana*)	0.2517	USACE 2010	
Pyrene	White sucker (*Catostomus commersoni*)	0.0022	USACE 2010	0.0034
		0.0027	USACE 2010	
		0.0041	USACE 2010	
		0.0026	USACE 2010	
		0.0003	USACE 2010	
	Mummichog (*Fundulus heteroclitus*)	0.0387	USACE 2010	
	Cunner (*Tautogolabrus adspersus*)	0.0122	USACE 2010	
	Killifish (*Fundulus* sp.)	0.0638	USACE 2010	

Table D-3
Literature-based Biota-Sediment Accumulation Factors
Used to Derive Sediment-to-Fish Bioaccumulation Factors

Chemical	Organism	BSAF (wet weight)	Reference	Median BSAF (wet weight)
Phenanthrene	American eel (*Anguilla rostrata*)	0.0027	USACE 2010	0.0083
		0.0006	USACE 2010	
		0.0002	USACE 2010	
	White sucker (*Catostomus commersoni*)	0.0055	USACE 2010	
		0.0109	USACE 2010	
		0.0068	USACE 2010	
		0.0072	USACE 2010	
		0.0016	USACE 2010	
		0.0083	USACE 2010	
		0.0099	USACE 2010	
		0.0085	USACE 2010	
	Killifish (*Fundulus* sp.)	0.1128	USACE 2010	
		0.1611	USACE 2010	
	Cunner (*Tautogolabrus adspersus*)	0.0289	USACE 2010	
		0.0135	USACE 2010	
	Largemouth bass (*Micropterus salmoides*)	0.0064	USACE 2010	
	Mummichog (*Fundulus heteroclitus*)	0.0184	USACE 2010	
Organochlorine Pesticides:				
Aldrin	Not reported	1.8000	USEPA 2004	Not applicable
alpha-BHC	Not reported	1.8000	USEPA 2004	Not applicable
beta-BHC	Not reported	1.8000	USEPA 2004	Not applicable
delta-BHC	Not reported	1.8000	USEPA 2004	Not applicable
gamma-BHC	Not reported	1.8000	USEPA 2004	Not applicable
4,4'-DDT	White sucker (*Catostomus commersoni*)	0.9585	USACE 2010	0.6814
		0.6270	USACE 2010	
		0.4678	USACE 2010	
		0.7359	USACE 2010	
	Largemouth bass (*Micropterus salmoides*)	1.7134	USACE 2010	
	Cunner (*Tautogolabrus adspersus*)	0.2320	USACE 2010	
4,4'-DDD	American eel (*Anguilla rostrata*)	0.2044	USACE 2010	1.1196
		0.1077	USACE 2010	
		0.6946	USACE 2010	
	White sucker (*Catostomus commersoni*)	1.4395	USACE 2010	
		1.2702	USACE 2010	
		1.1092	USACE 2010	
		2.2362	USACE 2010	
		0.2380	USACE 2010	
		1.4602	USACE 2010	
		1.5347	USACE 2010	
		1.1300	USACE 2010	
	Largemouth bass (*Micropterus salmoides*)	0.8150	USACE 2010	
		1.5323	USACE 2010	
	Cunner (*Tautogolabrus adspersus*)	0.2548	USACE 2010	

Table D-3
Literature-based Biota-Sediment Accumulation Factors
Used to Derive Sediment-to-Fish Bioaccumulation Factors

Chemical	Organism	BSAF (wet weight)	Reference	Median BSAF (wet weight)
4,4'-DDE	American eel (*Anguilla rostrata*)	0.8158	USACE 2010	5.6214
		0.7514	USACE 2010	
		1.1633	USACE 2010	
	White sucker (*Catostomus commersoni*)	5.8285	USACE 2010	
		8.2411	USACE 2010	
		5.7078	USACE 2010	
		5.6214	USACE 2010	
		2.0276	USACE 2010	
		2.1681	USACE 2010	
		2.2127	USACE 2010	
		3.8183	USACE 2010	
	Killifish (*Fundulus* sp.)	5.7143	USACE 2010	
		20.6833	USACE 2010	
		0.9367	USACE 2010	
	Largemouth bass (*Micropterus salmoides*)	10.3861	USACE 2010	
		20.2167	USACE 2010	
	Cunner (*Tautogolabrus adspersus*)	8.4328	USACE 2010	
		34.7724	USACE 2010	
	Bluegill (*Lepomis macrochirus*)	4.1949	USACE 2010	
	Spot (*Leiostomus xanthurus*)	0.1114	USACE 2010	
	Mummichog (*Fundulus heteroclitus*)	20.4027	USACE 2010	
Organochlorine Pesticides:				
alpha-Chlordane	American eel (*Anguilla rostrata*)	0.1459	USACE 2010	0.8232
		0.3550	USACE 2010	
		0.7662	USACE 2010	
	White sucker (*Catostomus commersoni*)	0.6327	USACE 2010	
		0.8802	USACE 2010	
		1.1314	USACE 2010	
		0.6116	USACE 2010	
		0.7051	USACE 2010	
		1.6644	USACE 2010	
		1.8995	USACE 2010	
		1.6206	USACE 2010	
	Largemouth bass (*Micropterus salmoides*)	0.4099	USACE 2010	
		1.2316	USACE 2010	
	Bluegill (*Lepomis macrochirus*)	5.3575	USACE 2010	
Dieldrin	American eel (*Anguilla rostrata*)	0.6369	USACE 2010	1.0965
		0.1267	USACE 2010	
		0.6054	USACE 2010	
	White sucker (*Catostomus commersoni*)	1.1887	USACE 2010	
		1.3458	USACE 2010	
		0.7671	USACE 2010	
		1.0904	USACE 2010	
		0.1899	USACE 2010	
	Killifish (*Fundulus* sp.)	17.9341	USACE 2010	
		1.5686	USACE 2010	
	Bluegill (*Lepomis macrochirus*)	10.2554	USACE 2010	
	Largemouth bass (*Micropterus salmoides*)	1.1026	USACE 2010	
Endosulfan I	Not reported	1.8000	USEPA 2004	Not applicable
Endosulfan II	Not reported	1.8000	USEPA 2004	Not applicable
Endosulfan sulfate	Not reported	1.8000	USEPA 2004	Not applicable

Table D-3
Literature-based Biota-Sediment Accumulation Factors
Used to Derive Sediment-to-Fish Bioaccumulation Factors

Chemical	Organism	BSAF (wet weight)	Reference	Median BSAF (wet weight)
Endrin	Not reported	1.8000	USEPA 2004	Not applicable
Endrin aldehyde	Not reported	1.8000	USEPA 2004	Not applicable
Heptachlor	Not reported	1.8000	USEPA 2004	Not applicable
Heptachlor epoxide	Not reported	1.8000	USEPA 2004	Not applicable
Methoxychlor	Not reported	1.8000	USEPA 2004	Not applicable
Toxaphene	Not reported	1.8000	USEPA 2004	Not applicable
gamma-Chlordane	American eel (*Anguilla rostrata*)	0.4868	USACE 2010	1.2960
	White sucker (*Catostomus commersoni*)	1.2960	USACE 2010	
		1.7671	USACE 2010	
		1.5533	USACE 2010	
	Bluegill (*Lepomis macrochirus*)	0.6495	USACE 2010	
Polychlorinated Biphenyls:				
Aroclor-1016	Not reported	1.8500	USEPA 2004	Not Applicable
Aroclor-1221	Not reported	1.8500	USEPA 2004	Not Applicable
Aroclor-1232	Not reported	1.8500	USEPA 2004	Not Applicable
Aroclor-1242	Not reported	1.8500	USEPA 2004	Not Applicable
Aroclor-1248	Not reported	1.8500	USEPA 2004	Not Applicable
Aroclor-1254	Not reported	1.8500	USEPA 2004	Not Applicable
Aroclor-1260	Not reported	1.8500	USEPA 2004	Not Applicable
Semi-Volatile Organics:				
1,1-Biphenyl	White sucker (*Catostomus commersoni*)	0.0138	USACE 2010	0.0384
		0.0642	USACE 2010	
		0.0681	USACE 2010	
		0.0582	USACE 2010	
		0.0337	USACE 2010	
		0.0357	USACE 2010	
		0.0347	USACE 2010	
		0.0410	USACE 2010	
	Largmouth Bass (*Micropterus salmoides*)	0.0519	USACE 2010	
	Anerican eel (*Anguilla rostrata*)	0.0106	USACE 2010	
1,2,4-Trichlorobenzene	Killifish (*Fundulus* sp.)	0.0770	USACE 2010	0.1315
		0.1861	USACE 2010	
1,2-Dichlorobenzene	killifish (*Fundulus* sp.)	0.1119	USACE 2010	Not Applicable
1,3-Dichlorobenzene	killifish (*Fundulus* sp.)	0.0202	USACE 2010	Not Applicable
1,4-Dichlorobenzene	killifish (*Fundulus* sp.)	0.0136	USACE 2010	Not Applicable
Dibenzofuran	American eel (*Anguilla rostrata*)	0.0021	USACE 2010	0.0317
		0.0067	USACE 2010	
	White sucker (*Catostomus commersoni*)	0.0093	USACE 2010	
		0.0320	USACE 2010	
		0.0359	USACE 2010	
		0.0333	USACE 2010	
		0.0305	USACE 2010	
		0.0327	USACE 2010	
		0.0338	USACE 2010	
		0.0496	USACE 2010	
	Largemouth bass (*Micropterus salmoides*)	0.0138	USACE 2010	
		0.0315	USACE 2010	

Table D-3
Literature-based Biota-Sediment Accumulation Factors
Used to Derive Sediment-to-Fish Bioaccumulation Factors

Chemical	Organism	BSAF (wet weight)	Reference	Median BSAF (wet weight)
Bis(2-ethylhexyl)phthalate	Killifish (*Fundulus* sp.)	2.8785	USACE 2010	1.1577
		3.2242	USACE 2010	
		1.1577	USACE 2010	
	Largescale sucker (*Catostomus macrocheilus*)	0.2988	USACE 2010	
		0.1175	USACE 2010	
Hexachlorobenzene	Not reported	0.0900	USEPA 2004	Not Applicable
Pentachlorobenzene	Not reported	0.0400	USEPA 2004	Not Applicable

Notes:
PAH = Polynuclear Aromatic Hydrocarbon
BSAF = Biota-Sediment Accumulation Factor
USEPA = United States Environmental Protection Agency

Table References:

United States Army Corps of Engineers (USACE). 2010. BSAF Database. USACE Engineer Research and Development Center, Environmental Laboratory. Accessed May 30, 2010.
http://el.erdc.usace.army.mil/bsaf/BSAF.html

USEPA. 2004. *The Incidence and Severity of Sediment Contamination in Surface Waters of the United States. National Sediment Quality Survey: Second Edition* EPA-823-R-04-007. November, 2004.

Table D-4 Percent Lipid Content of Fish		
Organism [1]	**Percent Lipid (wet weight)** [2]	**Reference**
Bridgelip sucker (*Catostomus columbianus*)	12.22	USACE 2010
White sucker (*Catostomus commersoni*)	5.995	USACE 2010
Largescale sucker (*Catostomus macrocheilus*)	6.95	USACE 2010
Speckled sanddab (*Citharichthys stigmaeus*)	1.682 [3]	USACE 2010
Paiute sculpin (*Cottus beldingii*)	2.6	USACE 2010
Sculpin (*Cottus* spp.)	5.35	USACE 2010
Common carp (*Cyprinus carpio*)	6.314	USACE 2010
Channel catfish (*Ictalurus punctatus*)	3.3	USACE 2010
Flathead mullet (*Mugil cephalus*)	0.46	USACE 2010
Round goby (*Neogobius melanstomus*)	2.825 [3]	USACE 2010
Silver perch (*Bairdiella chrysoura*)	3.7	USACE 2010
Popeye lampfish (*Bolinichthys longipes*)	4.4	USACE 2010
Dogtooth lampfish (*Ceratoscopelus townsendi*)	8.6 [3]	USACE 2010
California headlightfish (*Diaphus theta*)	7.8 [3]	USACE 2010
Lanternfish (*Electrona antarctica*)	18.9	USACE 2010
Lanternfish (*Electrona carlsbergi*)	11.2	USACE 2010
Eastern mosquitofish (*Gambusia holbrooki*)	4.367	USACE 2010
Slendertail lanternfish (*Gonichthys tenuiculus*)	2.6	USACE 2010
Thickhead lanternfish (*Hygophum atratum*)	1.8	USACE 2010
Sunbeam lampfish (*Lampadena urophaos*)	8.9 [3]	USACE 2010
Northern lampfish (*Lampanyctus ingens*)	1.2	USACE 2010
Slimtail lampfish (*Lampanyctus parvicauda*)	12.3	USACE 2010
Pinpoint lanternfish (*Lampanyctus regalis*)	1.7	USACE 2010
Broadfin lampfish (*Lampanyctus ritteri*)	8.85 [3]	USACE 2010
Smallmouth bass (*Micropterus dolomieu*)	1.9	USACE 2010

Table D-4 Percent Lipid Content of Fish		
Organism [1]	**Percent Lipid (wet weight)** [2]	**Reference**
Lanternfish (*Nannobrachium idostigma*)	5.8	USACE 2010
Patchwork lampfish (*Notoscopelus resplendens*)	5.6	USACE 2010
Columbia River redband trout (*Oncorhynchus mykiss gairdneri*)	4.203 [3]	USACE 2010
Antarctic silverfish (*Pleuragramma antarcticum*)	4.3	USACE 2010
Japanese ricefish (*Oryzias latipes*)	4.765 [3]	USACE 2010
Rainbow smelt (*Osmerus mordax*)	7.0 [3]	USACE 2010
Fathead minnow (*Pimephales promelas*)	2.05 [3]	USACE 2010
Guppy (*Poecilia reticulata*)	9.7	USACE 2010
Bluefish (*Pomatomus saltatrix*)	1.8 [3]	USACE 2010
Lanternfish (*Protomyctophum bolini*)	8.5	USACE 2010
California flashlightfish (*Protomyctophum crockeri*)	5.2	USACE 2010
Brown trout (*Salmo trutta*)	4.8	USACE 2010
Deepwater lanternfish (*Taaningichthys bathyphilus*)	3.8	USACE 2010
Blue lanternfish (*Tarletonbeania crenularis*)	2.6	USACE 2010
Lake trout (*Salvelinus namaycush*)	13.60 [3]	USACE 2010
Pacific blackchin (*Scopelengys tristis*)	3.8	USACE 2010
California lanternfish (*Symbolophorus californiensis*)	5.76 [3]	USACE 2010
Mexican lampfish (*Triphoturus mexicanus*)	11.7 [3]	USACE 2010
Atlantic herring (*Clupea harengus*)	8.75	USACE 2010

Notes:

USACE = United States Army Corp of Engineers

[1] The organisms listed include freshwater and marine species.

[2] Arithmetic average of the listed percent lipid data was used to convert biota-sediment accumulation factors to bioaccumulation factors (arithmetic average = 5.90 percent).

[3] The value shown represents an average of two or more percent lipid values.

Table References:

United States Army Corps of Engineers (USACE). 2010. BSAF Database. USACE Engineer Research and Development Center, Environmental Laboratory. Accessed May 30, 2010. http://el.erdc.usace.army.mil/bsaf/BSAF.html

Table D-5
Toxicity Reference Values for Mammalian and Avian Receptors

	Mammalian Toxicity Reference Value			Avian Toxicity Reference Value		
Analyte	**LOAEL mg/kg/d**	**NOAEL mg/kg/d**	**Reference**	**LOAEL mg/kg/d**	**NOAEL mg/kg/d**	**Reference**
1,2,4,5-Tetrachlorobenzene	NA	NA	—	NA	NA	—
4-Bromophenyl-phenylether	NA	NA	—	NA	NA	—
4-Chlorophenyl-phenyl ether	NA	NA	—	NA	NA	—
Acenaphthene	110	65.6	USEPA 2007b	1.43	0.143	USEPA 2013
Acenaphthylene	110	65.6	USEPA 2007b	1.43	0.143	USEPA 2013
Anthracene	110	65.6	USEPA 2007b	1.43	0.143	USEPA 2013
Benzo(a)anthracene	3.07	0.615	USEPA 2013	1.43	0.143	USEPA 2013
Benzo(a)pyrene	3.07	0.615	USEPA 2013	1.43	0.143	USEPA 2013
Benzo(b)fluoranthene	3.07	0.615	USEPA 2013	1.43	0.143	USEPA 2013
Benzo(g,h,i)perylene	3.07	0.615	USEPA 2013	1.43	0.143	USEPA 2013
Benzo(k)fluoranthene	3.07	0.615	USEPA 2013	1.43	0.143	USEPA 2013
Chrysene	3.07	0.615	USEPA 2013	1.43	0.143	USEPA 2013
Dibenzo(a,h)anthracene	3.07	0.615	USEPA 2013	1.43	0.143	USEPA 2013
Fluoranthene	110	65.6	USEPA 2007b	1.43	0.143	USEPA 2013
Fluorene	110	65.6	USEPA 2007b	1.43	0.143	USEPA 2013
Hexachlorobenzene	16	8	ATSDR 2002	0.57	0.11	Coulston and Kolbye 1994
Hexachlorobutadiene	20	4.0	IPCS 1994	17.0	3.39	Coulston and Kolbye 1994
Hexachlorocyclo-pentadiene	30	10	USEPA 1984	NA	NA	—
Hexachloroethane	NA	NA	—	NA	NA	—
Indeno(1,2,3-cd)pyrene	3.07	0.615	USEPA 2013	1.43	0.143	USEPA 2013
Pentachlorophenol	22.65	8.42	USEPA 2007a	67.3	6.73	USEPA 2007a
Phenanthrene	110	65.6	USEPA 2007b	1.43	0.143	USEPA 2013
Pyrene	3.07	0.615	USEPA 2013	1.43	0.143	USEPA 2013
4,4'-DDD	0.274	0.147	USEPA 2013	0.281	0.227	Values for 4,4'-DDT used as surrogates
4,4'-DDE	0.274	0.147	USEPA 2013	0.281	0.227	Values for 4,4'-DDT used as surrogates
4,4'-DDT	0.274	0.147	USEPA 2013	0.281	0.227	USEPA 2013
Aldrin	1	0.2	Sample et al. 1996	0.35	0.07	Hill et al. 1975
alpha-BHC	0.137	0.0137	Sample et al. 1996	2.25	0.563	Sample et al. 1996
alpha-Chlordane	0.75	0.15	USEPA 2011	10.7	2.14	Sample et al. 1996
beta-BHC	2	0.4	Sample et al. 1996	2.25	0.563	Sample et al. 1996
delta-BHC	0.137	0.0137	Sample et al. 1996	2.25	0.563	Sample et al. 1996
Dieldrin	0.03	0.015	USEPA 2013	3.78	0.709	USEPA 2005a
Endosulfan I	0.75	0.15	Sample et al. 1996	50.0	10.0	Sample et al. 1996
Endosulfan II	0.75	0.15	Sample et al. 1996	50.0	10.0	Sample et al. 1996
Endrin	0.92	0.092	Sample et al. 1996	0.104	0.021	Sample et al. 1996
gamma-BHC (Lindane)	0.137	0.0137	Sample et al. 1996	20.0	4.0	Sample et al. 1996
gamma-Chlordane	0.75	0.15	USEPA 2011	10.7	2.14	Sample et al. 1996
Heptachlor	0.25	0.15	USEPA 2011	2.17	0.49	Stickel et al. 1965
Heptachlor epoxide	0.25	0.15	USEPA 2011	2.17	0.49	Values for heptachlor used as surrogates
Methoxychlor	35.5	5.01	USEPA 2011	1,775	355	Wiemeyer 1996
Toxaphene	40	8	Sample et al. 1996	5.0	1.0	Wiemeyer 1996
Aroclor-1016	2.43	1.37	Sample et al. 1996	0.4	0.1	Values for Aroclor-1242 used as surrogates
Aroclor-1221	0.685	0.137	Sample et al. 1996	0.4	0.1	Values for Aroclor-1242 used as surrogates
Aroclor-1232	0.685	0.137	Sample et al. 1996	0.4	0.1	Values for Aroclor-1242 used as surrogates

Table D-5
Toxicity Reference Values for Mammalian and Avian Receptors

	Mammalian Toxicity Reference Value			Avian Toxicity Reference Value		
Analyte	**LOAEL mg/kg/d**	**NOAEL mg/kg/d**	**Reference**	**LOAEL mg/kg/d**	**NOAEL mg/kg/d**	**Reference**
Aroclor-1242	1.4	1.3	Chapman 2003 mg/kg wet weight in diet	0.4	0.1	USEPA 2013
Aroclor-1248	0.6	0.5	Chapman 2003 mg/kg wet weight in diet	0.5	0.4	USEPA 2013
Aroclor-1254	0.6	0.5	Chapman 2003 mg/kg wet weight in diet	1.2	0.6	USEPA 2013
Aroclor-1260	0.68	0.136	Sample et al. 1996	0.4	0.1	Values for Aroclor-1242 used as surrogates
Aroclor-1268	0.68	0.136	Sample et al. 1996	0.4	0.1	Values for Aroclor-1242 used as surrogates
Arsenic	1.26	0.25	USEPA 2013	3.55	2.24	USEPA 2013
Cadmium	1	0.77	USEPA 2013	6.35	1.47	USEPA 2013
Chromium	58.2	2.4	USEPA 2013 (Cr3)	5	1	USEPA 2013 (Cr3)
Copper	6.79	5.6	USEPA 2013	4.68	4.05	USEPA 2013
Lead	5.00	4.7	USEPA 2013	1.94	1.63	USEPA 2013
Mercury	0.25	0.15	USEPA 2013	0.078	0.03	USEPA 2013
Nickel	2.71	1.7	USEPA 2013	18.6	6.71	USEPA 2013
Selenium	0.157	0.143	USEPA 2013	0.37	0.29	USEPA 2013
Silver	45.3	6.02	USEPA 2013	20.2	2.02	USEPA 2013
Tin	35	23.4	Sample et al. 1996	16.9	6.80	Sample et al. 1996
Zinc	104	20.8	USEPA 2013	170	66.1	USEPA 2013

Notes:
Values are in dry weights
mg/kg/d = milligram chemical per kilogram body weight of receptor per day

References:

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Appendix E
Field Standard Operating Procedures

Logbooks

Procedure 3-02

1.0 Purpose and Scope

1.1 This standard operating procedure (SOP) describes the activities and responsibilities pertaining to the identification, use, and control of logbooks and associated field data records.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

2.1 In order to keep the logbook clean, store it in a clean location and use it only when outer gloves used for PPE have been removed.

3.0 Terms and Definitions

3.1 **Logbook**

A logbook is a bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the relevant activity, the person assigned responsibility for maintenance of the logbook, and the beginning and ending dates of the entries.

3.2 **Data Form**

A data form is a predetermined format utilized for recording field data that may become, by reference, a part of the logbook (e.g., soil boring logs, trenching logs, surface soil sampling logs, groundwater sample logs, and well construction logs are data forms).

4.0 Training and Qualifications

4.1 The **Contract Task Order (CTO) Manager** or **designee** is responsible for determining which team members shall record information in field logbooks and for obtaining and maintaining control of the required logbooks. The **CTO Manager** shall review the field logbook on at least a monthly basis. The **CTO Manager** or **designee** is responsible for reviewing logbook entries to determine compliance with this procedure and to ensure that the entries meet the project requirements.

4.2 A knowledgeable individual such as the **Field Manager**, **CTO Manager**, or **Program Quality Manager** shall perform a technical review of each logbook at a frequency commensurate with the level of activity (weekly is suggested, or, at a minimum, monthly). Document these reviews by the dated signature of the reviewer on the last page or page immediately following the material reviewed.

4.3 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

4.4 The **Field Manager** is responsible for ensuring that all **field personnel** follow these procedures and that the logbook is completed properly and daily. The **Field Manager** is also responsible for submitting copies to the **CTO Manager**, who is responsible for filing them and submitting a copy (if required by the CTO Statement of Work).

4.5 The **logbook user** is responsible for recording pertinent data into the logbook to satisfy project requirements and for attesting to the accuracy of the entries by dated signature. The **logbook user** is also responsible for safeguarding the logbook while having custody of it.

PRINTED COPIES ARE UNCONTROLLED. CONTROLLED COPY IS AVAILABLE ON COMPANY INTRANET.

4.6 All **field personnel** are responsible for the implementation of this procedure.

5.0 Equipment and Supplies

5.1 Field logbooks shall be bound field notebooks with water-repellent pages.

5.2 Pens shall have indelible black ink.

6.0 Procedure

6.1 The field logbook serves as the primary record of field activities. Make entries chronologically and in sufficient detail to allow the writer or a knowledgeable reviewer to reconstruct the applicable events. Store the logbook in a clean location and use it only when outer gloves used for personal protective equipment (PPE) have been removed.

6.2 Individual data forms may be generated to provide systematic data collection documentation. Entries on these forms shall meet the same requirements as entries in the logbook and shall be referenced in the applicable logbook entry. Individual data forms shall reference the applicable logbook and page number. At a minimum, include names of all samples collected in the logbook even if they are recorded elsewhere.

6.3 Enter field descriptions and observations into the logbook, as described in Attachment 1, using indelible black ink.

6.4 Typical information to be entered includes the following:

- Dates (month/day/year) and times (military) of all on-site activities and entries made in logbooks/forms;
- Site name and description;
- Site location by longitude and latitude, if known;
- Weather conditions, including temperature and relative humidity;
- Fieldwork documentation, including site entry and exit times;
- Descriptions of, and rationale for, approved deviations from the work plan (WP) or field sampling plan;
- Field instrumentation readings;
- Names, job functions, and organizational affiliations of on-site personnel;
- Photograph references;
- Site sketches and diagrams made on site;
- Identification and description of sample morphology, collection locations, and sample numbers;
- Sample collection information, including dates (month/day/year) and times (military) of sample collections, sample collection methods and devices, station location numbers, sample collection depths/heights, sample preservation information, sample pH (if applicable), analysis requested (analytical groups), etc., as well as chain-of-custody (COC) information such as sample identification numbers cross-referenced to COC sample numbers;
- Sample naming convention;
- Field quality control (QC) sample information;
- Site observations, field descriptions, equipment used, and field activities accomplished to reconstruct field operations;

- Meeting information;
- Important times and dates of telephone conversations, correspondence, or deliverables;
- Field calculations;
- PPE level;
- Calibration records;
- Contractor and subcontractor information (address, names of personnel, job functions, organizational affiliations, contract number, contract name, and work assignment number);
- Equipment decontamination procedures and effectiveness;
- Laboratories receiving samples and shipping information, such as carrier, shipment time, number of sample containers shipped, and analyses requested; and
- User signatures.

6.5 The logbook shall reference data maintained in other logs, forms, etc. Correct entry errors by drawing a single line through the incorrect entry, then initialing and dating this change. Enter an explanation for the correction if the correction is more than for a mistake.

6.6 At least at the end of each day, the person making the entry shall sign or initial each entry or group of entries.

6.7 Enter logbook page numbers on each page to facilitate identification of photocopies.

6.8 If a person's initials are used for identification, or if uncommon acronyms are used, identify these on a page at the beginning of the logbook.

6.9 At least weekly and preferably daily, the **preparer** shall photocopy and retain the pages completed during that session for backup. This will prevent loss of a large amount of information if the logbook is lost.

7.0 Quality Control and Assurance

7.1 Review per Section 4.2 shall be recorded.

8.0 Records, Data Analysis, Calculations

8.1 Retain the field logbook as a permanent project record. If a particular CTO requires submittal of photocopies of logbooks, perform this as required.

8.2 Deviations from this procedure shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

9.0 Attachments or References

9.1 Attachment 1 – Description of Logbook Entries

9.2 Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

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Author	Reviewer	Revisions (Technical or Editorial)
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue

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Attachment 1
Description of Logbook Entries

Logbook entries shall be consistent with Section A.1.4 *Field Documentation SOPs* of the UFP-QAPP Manual (DoD 2005) and contain the following information, as applicable, for each activity recorded. Some of these details may be entered on data forms, as described previously.

Name of Activity	For example, Asbestos Bulk Sampling, Charcoal Canister Sampling, Aquifer Testing.
Task Team Members and Equipment	Name all members on the field team involved in the specified activity. List equipment used by serial number or other unique identification, including calibration information.
Activity Location	Indicate location of sampling area as indicated in the field sampling plan.
Weather	Indicate general weather and precipitation conditions.
Level of PPE	Record the level of PPE (e.g., Level D).
Methods	Indicate method or procedure number employed for the activity.
Sample Numbers	Indicate the unique numbers associated with the physical samples. Identify QC samples.
Sample Type and Volume	Indicate the medium, container type, preservative, and the volume for each sample.
Time and Date	Record the time and date when the activity was performed (e.g., 0830/08/OCT/89). Use the 24-hour clock for recording the time and two digits for recording the day of the month and the year.
Analyses	Indicate the appropriate code for analyses to be performed on each sample, as specified in the WP.
Field Measurements	Indicate measurements and field instrument readings taken during the activity.
Chain of Custody and Distribution	Indicate chain-of-custody for each sample collected and indicate to whom the samples are transferred and the destination.
References	If appropriate, indicate references to other logs or forms, drawings, or photographs employed in the activity.
Narrative (including time and location)	Create a factual, chronological record of the team's activities throughout the day including the time and location of each activity. Include descriptions of general problems encountered and their resolution. Provide the names and affiliations of non-field team personnel who visit the site, request changes in activity, impact the work schedule, request information, or observe team activities. Record any visual or other observations relevant to the activity, the contamination source, or the sample itself. It should be emphasized that logbook entries are for recording data and chronologies of events. The logbook author must include observations and descriptive notations, taking care to be objective and recording no opinions or subjective comments unless appropriate.
Recorded by	Include the signature of the individual responsible for the entries contained in the logbook and referenced forms.
Checked by	Include the signature of the individual who performs the review of the completed entries.

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Sample Labeling and Chain of Custody Procedures
Procedure 3-03A

1.0 Purpose and Scope

1.1 The purpose of this standard operating procedure is to establish standard protocols for all field personnel for use in maintaining field and sampling activity records, labeling samples, ensuring that proper sample custody procedures are utilized, and completing chain-of-custody/analytical request forms.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

Not applicable

3.0 Definitions

3.1 **Logbook**

A logbook is a bound field notebook with consecutively numbered, water-repellent pages that is clearly identified with the name of the relevant activity, the person responsible for maintenance of the logbook, and the beginning and ending dates of the entries.

3.2 **Chain-of-Custody**

Chain-of-custody (COC) is documentation of the process of custody control. Custody control includes possession of a sample from the time of its collection in the field to its receipt by the analytical laboratory, and through analysis and storage prior to disposal.

4.0 Training and Qualifications

4.1 The **CTO Manager**, or designee, is responsible for determining which team members shall record information in the field logbook and for checking sample logbooks and COC forms to ensure compliance with these procedures. The **CTO Manager**, or designee, shall review COC forms at the completion of each sampling event.

4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

4.3 The **Field Manager** is responsible for ensuring that all field equipment is decontaminated according to this procedure.

4.4 The **Project Chemist**, or designee, is responsible for verifying that the COC/analytical request forms have been completed properly and match the sampling and analytical plan. The **Project Chemist**, or designee, is responsible for notifying the laboratory, data managers, and data validators in writing if analytical request changes are required as a corrective action. These small changes are different from change orders, which involve changes to the scope of the subcontract with the laboratory and must be made in accordance with a respective contract.

4.5 All **Field Personnel** are are responsible for recording pertinent data onto the COC forms to satisfy project requirements and for attesting to the accuracy of the entries by dated signature.

5.0 Procedure

This procedure provides standards for labeling the samples, documenting sample custody, and completing COC/analytical request forms. The standards presented in this section shall be followed to ensure that samples collected are maintained for their intended purpose and that the conditions encountered during field activities are documented.

5.1 Sample Labeling

Affix a waterproof sample label with adhesive backing to each individual sample container. Record the following information with a waterproof marker on each label:

- Project name or number (optional)
- COC sample number
- Date and time of collection
- Sampler's initials
- Matrix (optional)
- Sample preservatives (if applicable)
- Analysis to be performed on sample (This shall be identified by the method number or name identified in the subcontract with the laboratory)

These labels may be obtained from the analytical laboratory or printed from a computer file onto adhesive labels.

5.2 Custody Procedures

For samples intended for chemical analysis, sample custody procedures shall be followed through collection, transfer, analysis, and disposal to ensure that the integrity of the samples is maintained. A description of sample custody procedures is provided below.

Sample Collection Custody Procedures

According to the EPA guidelines, a sample is considered to be in custody if one of the following conditions is met:

- It is in one's actual physical possession or view
- It is in one's physical possession and has not been tampered with (i.e., it is under lock or official seal)
- It is retained in a secured area with restricted access
- It is placed in a container and secured with an official seal such that the sample cannot be reached without breaking the seal

Place custody seals on shipping coolers (and sample jars, if required) if the cooler/container is to be removed from the sampler's custody. Place a minimum of two custody seals in such a manner that they must be broken to open the containers or coolers. Label the custody seals with the following information:

- Sampler's name or initials
- Date and time that the sample/cooler was sealed

These seals are designed to enable detection of sample tampering. An example of a custody seal is shown in Attachment 1.

Field personnel shall also log individual samples onto COC forms (carbon copy or computer generated) when a sample is collected. These forms may also serve as the request for analyses. Procedures for completing these forms are discussed in Section 0, indicating sample identification number, matrix, date and time of collection, number of containers, analytical methods to be performed on the sample, and preservatives added (if any). The samplers will also sign the COC form signifying that they were the personnel who collected the samples. The COC form shall accompany the samples from the field to the laboratory. When a cooler is ready for shipment to the analytical laboratory, the person delivering the samples for transport will sign and indicate the date and time on the accompanying COC form. One copy of the COC form will be retained by the sampler and the remaining copies of the COC form shall be placed inside a self-sealing bag and taped to the inside of the cooler. Each cooler must be associated with a unique COC form. Whenever a transfer of custody takes place, both parties shall sign and date the accompanying carbon copy COC forms, and the individual relinquishing the samples shall retain a copy of each form. One exception is when the samples are shipped; the delivery service personnel will not sign or receive a copy because they do not open the coolers. The laboratory shall attach copies of the completed COC forms to the reports containing the results of the analytical tests. An example COC form is provided in Attachment 2.

5.3 Completing COC/Analytical Request Forms

COC form/analytical request form completion procedures are crucial in properly transferring the custody and responsibility of samples from field personnel to the laboratory. This form is important for accurately and concisely requesting analyses for each sample; it is essentially a release order from the analysis subcontract.

Attachment 2 is an example of a completed COC/analytical request form that may be used by field personnel, with box numbers identified and discussed in text below. Multiple copies may be tailored to each project so that much of the information described below need not be handwritten each time. Each record on the form (Attachment 2) is identified with a bold number corresponding to the instructions given below.

1. Record the project name, site location.
2. Record the site location, including the state.
3. Record the Contract Task Order number
4. Record the Resolution Consultants Task Order Manager
5. Record the sampler/site phone or cell number (if applicable).
6. Record the laboratory name where the samples were sent.
7. Record the requested turnaround time, in days. If a specific turnaround time is required to meet project objectives, but was not indicated on the laboratory service request form submitted to the purchasing department, the sampler, project manager, or site manager should contact the purchasing department so the laboratory contract can be modified.
8. Record the COC number that is defined by the sampler and should be unique throughout the project's history. An example would be to use the sampler's initials followed by the data. If multiple custodies are generated on a given day, use a unique sequential identifier. Example: CRC040105A, CRC040105B
9. Record the purchase order number provided by the purchasing department.
10. Record the page and total number of COC forms used in a shipment.
11. Record the project, and phase applicable to the sampling task.
12. Record the two-character code corresponding to the *chemical* preservation type, which is found on the bottom of the COC form. If no chemical preservation was added to the sample, the field should be left blank. Temperature preservation need not be documented at this location, but will be indicated elsewhere on the COC form (see 33).

13. List the requested analysis. Whenever possible, list the corresponding analytical method. (e.g., VOCs, 8260).

14. For Lab identification use only.

15. Record the full *unique* sample identification as detailed in the Site's Sampling and Analysis Plan.

16. Record the location identification, which is a shortened ID used for presentation and mapping, as detailed in the Site's Sampling and Analysis Plan.

17. Record the sample date using the format mm/dd/yy.

18. Record the sample time using the military format of hhmm.

19. Record the matrix code of the sample, which is located at the bottom of the COC form. The matrix code is a crucial element of the Navy's data management system. For simplicity, only typical matrix codes are listed on the bottom COC form, but below is a complete listing of all applicable Navy matrix codes:

Table 1
Navy Matrix Codes

Matrix Code	Matrix Code Description	Matrix Code	Matrix Code Description
AA	Ambient air	RK	Rock
AC	Composite air sample	SB	Bentonite
AD	Air - Drilling	SBS	Sub-surface soil (> 6")
AIN	Integrated air sample (under sample form of gas)	SC	Cement/Concrete
AQ	Air quality control matrix	SD	Drill cuttings — solid matrix
AQS	Aqueous	SE	Sediment
ASB	Asbestos	SEEP	SEEP
ASBF	Asbestos-Fibrous	SF	Filter sand pack
ASBNF	Asbestos-Non-Fibrous	SJ	Sand
AVE	Air-Vapor extraction, effluent	SK	Asphalt
AX	Air sample from unknown origin	SL	Sludge
BK	Brick	SM	Water filter (solid material used to filter water)
BS	Brackish sediment	SN	Miscellaneous solid/building materials
CA	Cinder ash	SO	Soil
CK	Caulk	SP	Casing (PVC, stainless steel, cast iron, iron pipe
CN	Container	SQ	Soil/Solid quality control matrix
CR	Carbon (usually for a remediation system)	SS	Scrapings
DF	Dust/Fallout	SSD	Subsurface sediment
DR	Debris/rubble	STKG	Stack gas
DS	Storm drain sediment	STPM	Stripper Tower Packing Media
DT	Trapped debris	SU	Surface soil (less than 6 inches)
EF	Emissions flux	SW	Swab or wipe
EW	Elutriate water	SZ	Wood
FB	Fibers	TA	Animal tissue
FL	Forest litter	TP	Plant tissue
GE	Soil gas effluent — stack gas (from system)	TQ	Tissue QC
GI	Soil gas influent (into system)	TX	Tissue
GL	Headspace of liquid sample	UNK	Unknown
GQ	Gaseous or Headspace QC	W	Water (not groundwater, unspecified)
GR	Gravel	WA	Drill cuttings - aqueous mix
GS	Soil gas	WB	Brackish Water

Table 1
Navy Matrix Codes

Matrix Code	Matrix Code Description	Matrix Code	Matrix Code Description
GT	Grit	WC	Drilling water (used for well construction)
IC	IDW Concrete	WD	Well development water
IDD	IDW Solid	WF	Freshwater (not groundwater)
IDS	IDW soil	WG	Ground water
IDW	IDW Water	WH	Equipment wash water
IW	Interstitial water	WI	Ground water influent (into system)
LA	Aqueous phase of a multiphase liquid/soil	WL	Leachate
LF	Product (floating or free)	WM	Marine water
LQ	Organic liquid quality control matrix	WN	Pore water
MA	Mastic	WO	Ocean water
MO	Mortar	WP	Drinking water
MR	Marine sediment	WQ	Water for QC samples
MS	Metal shavings	WR	Ground water effluent (from system)
NS	Near-surface soil	WS	Surface water
PA	Paper	WT	Composite groundwater sample
PC	Paint Chips	WU	Storm water
PP	Precipitate	WW	Waste water
RE	Residue		

Field QC blanks will require matrix codes that identify the type of blank associated with parent sample. Aqueous field QC blanks are not automatically identified with a matrix code of "WQ," indicating a water quality control blank; they are only identified with a matrix code of "WQ" if the associated samples are also aqueous. Trip blanks, field blanks, and equipment rinsate blanks collected in association with ***soil*** samples will be identified with a matrix code of "SQ," even though the actual matrix is aqueous, because the blanks were collected to assess potential contamination imparted during decontamination activities or transport of ***soil*** samples.

20. Record the sample type code, which is located at the bottom of the COC form. The sample type is a crucial element of the EQuIS data management system. For simplicity, only typical sample type codes are listed on the bottom of the COC form, but below is a list of all applicable Navy field sample type codes:

Table 2
Navy Sample Type Codes

Sample Type Code	Sample Type Code Description
AB	Ambient condition blank
BIOCON	Bioassay control sample
BS	Blank spike
BSD	Blank spike duplicate
EB	Equipment blank
EBD	Equipment blank/rinsate duplicate
FB	Field blank
FD	Field duplicate
FS	Field spike
IDW	Purge and rinsate water
LB	Lab Blank

Table 2
Navy Sample Type Codes

Sample Type Code	Sample Type Code Description
LR	Lab Replicate
MB	Material blank
MIS	Multi-Incremental Sample
MS	Matrix spike
N	Normal (Regular)
PE	Performance evaluation
PURGE	Purge water sample
RD	Regulatory duplicate
SB	Source blank
SBD	Source blank duplicate
SCREEN	Screening Sample
SD	Matrix spike duplicate
SPLIT	Sample split
SRM	Standard reference material
TB	Trip Blank
TBD	Trip blank duplicate
TBR	Trip blank replicate

Field duplicate samples — Field duplicates will be identified using the format detailed in the Site's Sampling and Analysis Plan. However, field duplicates will also be differentiated from the parent sample on the chain-of-custody form. The parent sample will have a sample type code of "N," for normal environmental sample; while its duplicate will have a sample type code of "FD."

21. Record whether the sample is field filtered with a "Y" or not field filtered with an "N." If a project requires collecting samples for both total and dissolved constituents, the same sample and location ID is used for both (see 15 and 16); however, the sampler will indicate whether the sample is field filtered at this location on the COC form. This field must always be filled out; even when soil samples are collected (where "N" appropriately applies, in most cases).

22. Record the total number of containers that are submitted for all of the tests. This must add up to the total number of containers listed for each individual test in 23.

23. Record the number of containers for each test. Do not use Xs, rather indicate the number of containers submitted for each test listed in 14. For example, Sample 010MW007002 requires analysis for VOCs (8260), and SVOCs (8270). Record 3 under the VOC analysis and 2 under the SVOC (assuming 3 containers were submitted for VOCs and 2 were submitted for SVOCs). The total number of containers in this example is 5, which should be the total number of containers listed in 22. Extra containers submitted for matrix spike/matrix spike duplicates (MS/MSDs) will be appropriately recorded.

24. Indicate if extra sample volume was included for MS/MSD analysis using an "X." Samples to be used for MS/MSDs will use the same sample ID and location ID (see 15 and 16), but will be collected in triplicate, particularly for liquid samples, to ensure the analytical laboratory receives sufficient volume for the analyses.

25. Indicate if the samples should be held by the laboratory for future testing using an "X."

26. Record any field comments.

27. Reserved for laboratory comments.

28. Indicate the total number of coolers in each shipment. *Note*: When multiple coolers are submitted, each should contain a COC form.

29. Signature(s) of the person(s) relinquishing sample custody.

30. Signature(s) of the person(s) receiving sample custody.

31. Indicate whether the samples are iced, by checking the appropriate response.

32. Indicate the method of shipment (e.g., FedEx, hand-delivered, laboratory courier).

33. Record the airbill number when a commercial courier is used. This is particularly important when multiple coolers are sent in the same shipment or when the laboratory is sent the COC form in advance of receiving samples because it aids in tracking lost coolers.

34. Record the date the coolers were shipped.

COC forms tailored to each CTO can be drafted and printed onto multiple forms. This eliminates the need to rewrite the analytical methods column headers each time. It also eliminates the need to write the project manager, name, and number; QC Level; turnaround time; and the same general comments each time.

Complete one COC form per cooler. Whenever possible, place all volatile organic analyte vials into one cooler in order to reduce the number of trip blanks. Complete all sections and be sure to sign and date the COC form. One copy of the COC form must remain with the field personnel.

6.0 Records

The COC/analytical request form shall be faxed or emailed approximately daily to the Project Chemist, or designee for verification of accuracy. Following the completion of sampling activities, the sample logbook and COC forms will be transmitted to the CTO Manager for storage in project files. The original COC/analytical request form shall be submitted by the laboratory along with the data delivered. Any changes to the analytical requests that are required shall be made in writing to the laboratory. A copy of this written change shall be sent to the data validators and placed in the project files. The reason for the change shall be included in the project files so that recurring problems can be easily identified.

7.0 References and Attachments

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/-fedfac/pdf/ufp_qapp_v1_0305.pdf.

Attachment 1: Chain-of-Custody Seal

Attachment 2: Generic Chain-of-Custody/Analytical Request Form

Author	Reviewer	Revisions (Technical or Editorial)
Tina Cantwell QA Officer	Ben Brantley Project Manager	Rev 0 — Initial Issue

Attachment 1
Chain-of-Custody Seal

EXAMPLE CHAIN-OF-CUSTODY SEAL

[LABORATORY]	SAMPLE NO.	DATE	SEAL BROKEN BY
	SIGNATURE		DATE
	PRINT NAME AND TITLE *(Inspector, Analyst or Technician*		

Attachment 2
Example Chain-of-Custody/Analytical Request Form

RESOLUTION CONSULTANTS

CHAIN OF CUSTODY AND ANALYTICAL REQUEST RECORD

Project Name: 1	COC No. 7	Page of 9
Site Location: 2	PO No. 8	Project No. 10
Contract Task Order No. 3		Lab Name 11

Sampler/Site Phone# 4

Send Results To: 5

Data Shipping Address: 6

Sample Analysis Requested (Enter number of containers for each test)

Lab ID	Sample ID (sys_samp_code)	Location ID (sys_loc_code)	Date (mm/dd/yy)	Time (Military) (hhmm)	Matrix Code (1)	Sample Type (2)	Field Filtered (Y/N)	Total No. of Containers	12										Extra Volumen for MS/MSD	HOLD
									13											
14	15	16	17	18	19	20	21	22	23										24	25

Turnaround Time(specify): 26 **Final** _____ days **Email** (if applicable) _____ days

Deliverable(check): 27 Level 2_____ Level 3_____ Full/Level 4_____ TX TRRP-13_____

Field **Comments:** 28

Lab **Comments:** 29

Sample Shipment and Delivery Details

Number of coolers in shipment: 30

Relinquished by (signature)	Date	Time	Received by (signature)	Date	Time
1 31			1 32		
2			2		
3			3		

Samples Iced?(check) 33 Yes___ No___

Method of Shipment: 34

Airbill No: 35

Date Shipped: 36

(1) AA=Ambient air, **AQ**=Air quality control, **ASB**=Asbestos, **CK**=Caulk, **DS**=Storm drain sediment, **GS**=Soil gas, **IC**=IDW Concrete, **IDD**=IDW Solid, **IDS**=IDW soil, **IDW**=IDW Water, **LF**=Free Product, **MA**=Mastic, **PC**=Paint Chips, **SC**=Cement/Concrete, **SE**=Sediment, **SL**=Sludge, **SO**=Soil, **SQ**=Soil/Solid quality control, **SSD**=Subsurface sediment, **SU**=Surface soil (<6 in), **SW**=Swab or wipe, **TA**=Animal tissue, **TP**=Plant tissue, **TQ**=Tissue quality control, **WG**=Ground water, **WL**=Leachate, **WO**=Ocean water, **WP**=Drinking water, **WQ**=Water quality control, **WR**=Ground water effluent, **WS**=Surface water, **WU**=Storm water, **WW**=Waste water

(2) Sample Type: AB=Ambient Blk, **EB**=Equipment Blk, **FB**=Field Blk, **FD**=Field Duplicate Sample, **IDW**=Investigative-Derived Waste, **MIS**=Incremental Sampling Methodology, **N**=Normal Environmental Sample, **PE**=Performance Eval., **TB**=Trip Blk

(3) Preservative added: HA=Hydrochloric Acid, **NI**=Nitric Acid, **SH**=Sodium Hydroxide, **SA**=Sulfuric Acid, **AA**=Ascorbic Acid, **HX**=Hexane, **ME**=Methanol, **SB**=sodium bisulfate, **ST**=Sodium Thiosulfate, If **NO preservative** added leave blank

Sample Handling, Storage, and Shipping of Low Level Environmental Samples

Procedure 3-04A

1.0 Purpose and Scope

1.1 This Standard Operating Procedure (SOP) sets forth the methods for use by personnel engaged in handling, storing, and transporting low level environmental samples.

1.2 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review.

2.0 Safety

2.1 To avoid lifting injuries associated with heavy coolers, use the large muscles of the legs, not the back. Use dollies if possible.

2.2 When using tools for cutting purposes, cut away from yourself. The use of appropriate, task specific cutting tools is recommended.

2.3 Wear proper gloves, such as blue nitrile and latex, as defined in the site-specific project health and safety plan, when handling sample containers to avoid contacting any materials that may have spilled out of the sample containers.

3.0 Terms and Definitions

DOT — Department of Transportation

4.0 Training and Qualifications

4.1 The **Contract Task Order** (CTO) **Manager** is responsible for verifying that these procedures are performed prior to the initiation of active subsurface exploration.

4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

4.3 The **Field Manager** is responsible for ensuring that sample handling, storage, and shipping are performed in accordance with this procedure.

4.4 All **Field Personnel** are responsible for the implementation of this procedure.

5.0 Procedures

5.1 Handling and Packaging

Environmental samples should be packaged prior to shipment using the following procedures:

1. Allow sufficient headspace in all bottles (except volatile organic analysis containers with a septum seal) to compensate for any pressure and temperature changes (approximately 1 percent of the volume of the container).

2. Ensure that the lids on all bottles are tight (will not leak).

3. Glass bottles should be wrapped in bubble wrap — preferably sealable bubble wrap sample bags, if available. Place bottles in separate and appropriately-sized polyethylene bags and seal the bags.

4. Select a sturdy cooler in good repair. Secure and tape the drain plug with fiber or duct tape inside and outside. Line the cooler with a large heavy-duty plastic bag.

5. Place cushioning/absorbent material in the bottom of the cooler, if available, and then place the containers in the cooler with sufficient space to allow for the addition of cushioning between the containers.

6. Put "blue ice" (or ice that has been "double bagged" in heavy-duty polyethylene bags and properly sealed) on top of and/or between the containers. Fill all remaining space between the containers with bubble wrap or other suitable absorbent material.

7. Securely fasten the top of the large garbage bag with packaging tape.

8. Place the completed Chain-of-Custody (COC) Record into a sealed plastic bag, and tape the bag to the inner side of the cooler lid.

9. Close the cooler and securely tape (preferably with fiber tape) the top of the cooler shut. COC seals should be affixed to opposing sides of the cooler within the securing tape so that the cooler cannot be opened without breaking the seal.

5.2 Shipping

Follow all appropriate DOT regulations (e.g., 49 Code of Federal Regulations, Parts 171-179) for shipment of air, soil, water, and other samples. Elements of these procedures are summarized in the following subsections.

5.2.1 Non-hazardous Materials Shipment

If the samples are suspected to be non-hazardous based on previous site sample results, field screening results, or visual observations, if applicable, then samples may be shipped as non-hazardous.

When a cooler is ready for shipment to the laboratory, prepare standard air bill paperwork for shipment of the samples to the laboratory. Write the shippers tracking/airbill number on the COC form. Place two copies of the COC form inside a self-sealing bag and tape it to the inside of the cooler. Seal the cooler with waterproof tape and label it with “Fragile,” “This-End-Up” (or directional arrows pointing up), or other appropriate notices. Affix a label stating the destination (laboratory address) to each cooler. Personnel should be aware of carrier weight or other policy restrictions.

5.2.2 Hazardous Materials Shipment

Shipment of Hazardous Material is not covered in this SOP; all samples handled under this SOP are anticipated to be non-hazardous or not dangerous goods. The CTO Manager, or designee, is responsible for determining if samples collected during a specific field investigation meet the definitions for dangerous goods. If a sample is collected of a material that is listed in the Dangerous Goods List, Section 4.2, of International Air Transport Authority (IATA), then that sample must be identified, packaged, marked,

labeled, and shipped according to the instructions given for that material. If the composition of the collected sample(s) is unknown, and the project leader knows or suspects that it is a regulated material (dangerous goods), the sample may not be offered for air transport. If the composition and properties of a waste sample or a highly contaminated soil, sediment, or water sample are unknown, or only partially known, the sample may not be offered for air transport.

6.0 Records

Maintain all copies of chain of custodies and air bills with the project file. .

7.0 Attachments or References

International Air Transport Authority (IATA). Dangerous Goods Regulations

http://www.iata.org/whatwedo/cargo/dangerous_goods/Documents/DGR52-significant-changes.pdf

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Author	Reviewer	Revisions (Technical or Editorial)
Ben Brantley	Tina Cantwell	Rev 0 — Initial Issue
Program Manager	QA Officer	

Investigation Derived Waste Management

Procedure 3-05

1.0 Purpose and Scope

This standard operating procedure (SOP) describes activities and responsibilities of the United States (U.S.) Navy Environmental Restoration (ER) Program, Naval Facilities Engineering Command, Atlantic (NAVFAC Atlantic) with regard to management of investigation-derived waste (IDW). The purpose of this procedure is to provide guidance for the minimization, handling, labelling, temporary storage, inventory, classification, and disposal of IDW generated under the ER Program. This procedure will also apply to personal protective equipment (PPE), sampling equipment, decontamination fluids, non-IDW trash, non-indigenous IDW, and hazardous waste generated during implementation of removal or remedial actions. The information presented will be used to prepare and implement work plans (WPs) for IDW-related field activities. The results from implementation of WPs will then be used to develop and implement final IDW disposal plans.

If there are procedures whether it be from Resolution Consultants, state and/or federal that are not addressed in this SOP and are applicable to IDW then those procedures may be added as an appendix to the project specific SAP.

This procedure applies to all Navy ER projects performed in the NAVFAC Atlantic Area of Responsibility.

This procedure shall serve as management-approved professional guidance for the ER Program and is consistent with protocol in the Uniform Federal Policy-Quality Assurance Project Plan (DoD 2005). As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by both the Contract Task Order (CTO) Manager and the Quality Assurance (QA) Manager or Technical Director, and documented.

This procedure was developed to serve as management-approved professional guidance for the management of IDW generated under the ER Program. It focuses on the requirements for minimizing, segregating, handling, labeling, storing, and inventorying IDW in the field. Certain drum inventory requirements related to the screening, sampling, classification, and disposal of IDW are also noted in this procedure.

2.0 Safety

The health and safety considerations for the work associated with this SOP, including both potential physical and chemical hazards, will be addressed in the project Health and Safety Plan (HASP). In the absence of a HASP, work will be conducted according to the CTO WP and/or direction from the **Site Safety Officer (SSO)**.

All **Field Personnel** responsible for IDW management must adhere to the HASP and must wear the PPE specified in the site-specific HASP. Generally, this includes, at a minimum, steel-toed boots or steel-toed rubber boots, safety glasses, American National Standards Institute-standard hard hats, and hearing protection (if heavy equipment is in operation). If safe alternatives are not achievable, discontinue site activities immediately.

3.0 Terms and Definitions

None.

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4.0 Training and Qualifications

4.1 The **CTO Manager** is responsible for ensuring that IDW management activities comply with this procedure. The **CTO Manager** is responsible for ensuring that all personnel involved in IDW management shall have the appropriate education, experience, and training to perform their assigned tasks.

4.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

4.3 The **Field Manager** is responsible for ensuring that all IDW is managed according to this procedure.

4.4 All **Field Personnel** are responsible for the implementation of this procedure.

5.0 Equipment and Supplies

The equipment and supplies required for implementation of this SOP include the following:

- Containers for waste (e.g., [U.S. Department of Transportation] DOT approved 55-gallon open and closed top drums) and material to cover waste to protect from weather (e.g., plastic covering);
- Hazardous /non-hazardous waste drum labels (weatherproof);
- Permanent marking pens;
- Inventory forms for project file;
- Plastic garbage bags, zip lock storage bags, roll of plastic sheeting; and
- Steel-toed boots, chemical resistant gloves, coveralls, safety glasses, and any other PPE required in the HASP.

6.0 Procedure

The following procedures are used to handle the IDW.

6.1 Drum Handling

6.1.1 IDW shall be containerized using DOT approved drums. The drums shall be made of steel or plastic, have a 55-gallon capacity, be completely painted or opaque, and have removable lids (i.e., United Nations Code 1A2 or 1H2). Typically 55-gallon drums are used, however small drums may be used depending on the amount of waste generated. New steel drums are preferred over recycled drums.

6.1.2 Recycled drums should not be used for hazardous waste, PCBs or other regulated shipments. For short-term storage of liquid IDW prior to discharge, double-walled bulk steel or plastic storage tanks may be used. For this scenario, consider the scheduling and cost-effectiveness of this type of bulk storage, treatment, and discharge system versus longer-term drum storage.

6.1.3 For long-term IDW storage at other project locations, the DOT approved drums with removable lids are recommended. Verify the integrity of the foam or rubber sealing ring located on the underside of some drum lids prior to sealing drums containing IDW liquids.

6.1.4 If the ring is only partially attached to the drum lid, or if a portion of the ring is missing, select another drum lid with a sealing ring that is in sound condition.

6.1.5 To prepare IDW drums for labeling, wipe clean the outer wall surfaces and drum lids of all material that might prevent legible and permanent labeling. If potentially contaminated material adheres to the outer surface of a drum, wipe that material from the drum, and segregate the paper towel or rag used to remove the material with visibly soiled PPE and

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disposable sampling equipment. Label all IDW drums and place them on pallets prior to storage.

6.2 Labelling

6.2.1 Containers used to store IDW must be properly labelled. Two general conditions exist: 1) from previous studies or on-site data, waste characteristics are known to be either hazardous or nonhazardous; or 2) waste characteristics are unknown until additional data are obtained.

6.2.2 For situations where the waste characteristics are known, the waste containers should be packaged and labelled in accordance with state regulations and any federal regulations that may govern the labelling of waste.

6.2.3 The following information shall be placed on all non-hazardous waste labels:

- Description of waste (i.e., purge water, soil cuttings);
- Contact information (i.e., contact name and telephone number);
- Date when the waste was first accumulated.

6.2.4 The following information shall be placed on all hazardous waste labels:

- Description of waste (i.e., purge water, soil cuttings);
- Generator information (i.e., name, address, contact telephone number);
- EPA identification number (supplied by on-site client representative);
- Date when the waste was first accumulated.

6.2.5 When the final characterization of a waste is unknown, a notification label should be placed on the drum with the words “waste characterization pending analysis” and the following information included on the label:

- Description of waste (i.e., purge water, soil cuttings);
- Contact information (i.e., contact name and telephone number);
- Date when the waste was first accumulated.

6.2.6 Once the waste has been characterized, the label should be changed as appropriate for a nonhazardous or hazardous waste.

6.2.7 Waste labels should be constructed of a weatherproof material and filled out with a permanent marker to prevent being washed off or becoming faded by sunlight. It is recommended that waste labels be placed on the side of the container, since the top is more subject to weathering. However, when multiple containers are accumulated together, it also may be helpful to include labels on the top of the containers to facilitate organization and disposal.

6.2.8 Each container of waste generated shall be recorded in the field notebook used by the person responsible for labelling the waste. After the waste is disposed of, either by transportation off-site or disposal on-site in an approved disposal area, an appropriate record shall be made in the same field notebook to document proper disposition of IDW.

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6.3 Types of Site Investigation Waste

Several types of waste are generated during site investigations that may require special handling. These include solid, liquid, and used PPE, as discussed further below.

Solid Waste

Soil cuttings from boreholes will typically be placed in containers unless site specific requirements allow for soil cuttings to be placed back into the borehole after drilling is complete. Drilling mud generated during investigation activities shall be collected in containers. Covers should be included on the containers and must be secured at all times and only open during filling activities. The containers shall be labelled in accordance with this SOP. An inventory containing the source, volume, and description of material put in the containers shall be logged on prescribed forms and kept in the project file.

Non-hazardous solid waste can be disposed on-site in the designated site landfill or in a designated evaporation pond if it is liquefied. Hazardous wastes must be disposed off-site at an approved hazardous waste landfill.

Liquid Waste

Groundwater generated during monitoring well development, purging, and sampling can be collected in truck-mounted containers and/or other transportable containers (i.e., 55-gallon drums). Lids or bungs on drums must be secured at all times and only open during filling or pumping activities. The containers shall be labelled in accordance with this SOP. Non-hazardous liquid waste can be disposed of in one of the designated lined evaporation ponds on-site. Hazardous wastes must be handled separately and disposed off-site at an approved hazardous waste facility.

Personal Protective Equipment

PPE that is generated throughout investigation activities shall be placed in plastic garbage bags. If the solid or liquid waste that was being handled is characterized as hazardous waste, then the corresponding PPE should also be disposed as hazardous waste. If not, all PPE should be disposed as non-hazardous waste in the designated on-site landfill. Trash that is generated as part of field activities may be disposed of in the landfill as long as the trash was not exposed to hazardous media.

6.4 Waste Accumulation On-Site

6.4.1 Solid, liquid, or PPE waste generated during investigation activities that are classified as nonhazardous or “characterization pending analysis” should be disposed of as soon as possible. Until disposal, such containers should be inventoried, stored as securely as possible, and inspected regularly, as a general good practice.

6.4.2 Solid, liquid, or PPE waste generated during investigation activities that are classified as hazardous shall not be accumulated on-site longer than 90 days. All hazardous waste containers shall be stored in a secured storage area. The following requirements for the hazardous waste storage area must be implemented:

- Proper hazardous waste signs shall be posted as required by any state or federal statutes that may govern the labelling of waste;
- Secondary containment to contain spills;
- Spill containment equipment must be available;
- Fire extinguisher;
- Adequate aisle space for unobstructed movement of personnel.

6.4.3 Weekly storage area inspections shall be performed and documented to ensure compliance with these requirements. Throughout the project, an inventory shall be maintained to itemize the type and quantity of the waste generated.

6.5 Waste Disposal

6.5.1 Solid, liquid, and PPE waste will be characterized for disposal through the use of client knowledge, laboratory analytical data created from soil or groundwater samples gathered during the field activities, and/or composite samples from individual containers.

6.5.2 All waste generated during field activities will be stored, transported, and disposed of according to applicable state, federal, and local regulations. All wastes classified as hazardous will be disposed of at a licensed treatment storage and disposal facility or managed in other approved manners.

6.5.3 In general, waste disposal should be carefully coordinated with the facility receiving the waste. Facilities receiving waste have specific requirements that vary even for non-hazardous waste, so characterization should be conducted to support both applicable regulations and facility requirements.

6.6 Regulatory Requirements

The following federal and state regulations shall be used as resources for determining waste characteristics and requirements for waste storage, transportation, and disposal:

- Code of Federal Regulations (CFR), Title 40, Part 261;
- CFR, Title 49, Parts 172, 173, 178, and 179.

6.7 Waste Transport

A state-certified hazardous waste hauler shall transport all wastes classified as hazardous. Typically, the facility receiving any waste can coordinate a hauler to transport the waste. Shipped hazardous waste shall be disposed of in accordance with all RCRA/USEPA requirements. All waste manifests or bills of lading will be signed either by the client or the client's designee.

7.0 Quality Control and Assurance

7.1 Management of IDW must incorporate quality control measures to ensure conformance to these and the project requirements.

8.0 Records, Data Analysis, Calculations

8.1 Maintain records as required by implanting the procedures in this SOP.

8.2 Deviations from this procedure or the sampling and analysis plan shall be documented in field records. Significant changes shall be approved by the **Program Quality Manager**.

9.0 Attachments or References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual.* Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/-fedfac/pdf/ufp_qapp_v1_0305.pdf.

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Author	Reviewer	Revisions (Technical or Editorial)
Mark Kromis Program Chemist	Chris Barr Program Quality Manager	Rev 0 – Initial Issue (May 2012)

Land Surveying

Procedure 3-07

1.0 Purpose and Scope

1.1 The purpose of this document is to define the standard operating procedure (SOP) for acquiring land surveying data to facilitate the location and mapping of geologic, hydrologic, geotechnical data, and analytical sampling points and to establish topographic control over project sites.

1.2 This procedure is the Program-approved professional guidance for work performed by Resolution Consultants under the Comprehensive Long-Term Environmental Action Navy (CLEAN) contract (Contract Number N62470-11-D-8013).

1.3 As guidance for specific activities, this procedure does not obviate the need for professional judgment. Deviations from this procedure while planning or executing planned activities must be approved in accordance with Program requirements for technical planning and review. If there are procedures whether it be from Resolution Consultants, state and/or federal that are not addressed in this SOP and are applicable to surface water sampling then those procedures may be added as an appendix to the project specific SAP.

1.4 It is fully expected that the procedures outlined in this SOP will be followed. Procedural modifications may be warranted depending upon field conditions, equipment limitations, or limitations imposed by the procedure. Substantive modification to this SOP will be approved in advance by the Program Quality Manager. Deviations to this SOP will be documented in the field records.

1.5 If there are procedures, whether it be from Resolution Consultants, state and/or federal, that are not addressed in this SOP and are applicable to land surveying then those procedures may be added as an appendix to the project specific Sampling and Analysis Plan (SAP).

2.0 Safety

2.1 Depending upon the site-specific contaminants, various protective programs must be implemented prior to conducting fieldwork. All **field sampling personnel** must review the project-specific health and safety plan (HASP) paying particular attention to the control measures planned for the specific field tasks. Conduct preliminary area monitoring to determine the potential hazard to field sampling personnel. If significant contamination is observed, minimize contact with potential contaminants in both the vapor and liquid phase through the use of respirators and disposable clothing.

2.2 In addition, observe standard health and safety practices according to the project-specific HASP. Suggested minimum protection includes inner disposable vinyl gloves, outer chemical-protective nitrile gloves, rubberized steel-toed boots, and an American National Standards Institute-standard hard hat. Half-face respirators and cartridges and Tyvek® suits may be necessary depending on the contaminant concentrations, and shall always be available on site.

2.3 Daily safety briefs will be conducted at the start of each working day before any work commences. These daily briefs will be facilitated by the **Site Safety Officer (SSO)** or designee to discuss the day's events and any potential health risk areas covering every aspect of the work to be completed. Weather conditions are often part of these discussions. As detailed in the HASP, everyone on the field team has the authority to stop work if an unsafe condition is perceived until the conditions are fully remedied to the satisfaction of the SSO.

2.4 The health and safety considerations for the work associated with land surveying include:

- Slip, trips and falls associated with work in the field;

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- Biological hazards associated with work in the field; and,
- Potential hazards associated with contaminants of concern (COC) that may be located in the survey area,

3.0 Terms and Definitions

3.1 Boundary Survey

Boundary surveys are conducted by Certified Land Surveyors in order to delineate a legal property line for a site or section of a site.

3.2 Global Positioning System (GPS)

A system of satellites, computers, and receivers that is able to determine the latitude and longitude of a receiver on Earth by calculating the time difference for signals from different satellites to reach the receiver.

4.0 Interferences

4.1 Commercially available GPS units typically have a level of precision of (±) 3 to 5 meters. Field corrections can be made as described in Section 8.3 below.

5.0 Training and Qualifications

5.1 Qualifications and Training

5.1.1 The individual executing these procedures must have read, and be familiar with, the requirements of this SOP.

5.2 Responsibilities

5.2.1 The **Contract Task Order (CTO) Manager** is responsible for ensuring that land surveying activities comply with this procedure. The CTO Manager is responsible for ensuring that all field sampling personnel involved in land surveying shall have the appropriate education, experience, and training to perform their assigned tasks.

5.2.2 The **Program Quality Manager** is responsible for ensuring overall compliance with this procedure.

5.2.3 The **Field Manager (FM)** is responsible for ensuring that all field personnel follow these procedures. In virtually all cases, subcontractors will conduct these procedures. The FM or designee is responsible for overseeing the activities of the subcontractor and ensuring that sampling points and topographic features are properly surveyed.

6.0 Equipment and Supplies

6.1 The following equipment list contains materials that may be needed in carrying out the procedures outlined in this SOP. Not all equipment listed below may be necessary for a specific activity. Additional equipment may be required, pending field conditions.

- Personal protective equipment (PPE) and other safety equipment, as required by the HASP;
- Commercially available GPS unit; and,
- Field Logbook.

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7.0 Calibration or Standardization

7.1 An authorized manufacturer's representative shall inspect and calibrate survey instruments in accordance with the manufacturer's specifications regarding procedures and frequencies. At a minimum, instruments shall be calibrated no more than six months prior to the start of the survey work.

7.2 Standards for all survey work shall be in accordance with National Oceanic and Atmospheric Administration standards and, at a minimum, with accuracy standards set forth below. The horizontal accuracy for the location of all grid intersection and planimetric features shall be (±) 0.1 feet. The horizontal accuracy for boundary surveys shall be 1 in 10,000 feet (1:10,000). The vertical accuracy for ground surface elevations shall be (±) 0.1 feet. Benchmark elevation accuracy and elevation of other permanent features, including monitoring wellheads, shall be (±) 0.01 feet.

8.0 Procedure

8.1 Theodolite/Electronic Distance Measurement (EDM)

Follow the procedures listed below during theodolite/EDM land surveying conducted under the NAVFAC CLEAN Program:

- A land surveyor registered in the state or territory in which the work is being performed shall directly supervise all surveying work.
- Reference surveys to the local established coordinate systems and base all elevations and benchmarks established on U.S. Geological Survey datum, 1929 general adjustment.
- Reference surveyed points to Mean Sea Level (Lower Low Water Level).
- Jointly determine appropriate horizontal and vertical control points prior to the start of survey activities. If discrepancies in the survey (e.g., anomalous water level elevations) are observed, the surveyor may be required to verify the survey by comparison to a known survey mark. If necessary, a verification survey may be conducted by a qualified third party.
- All field notes, sketches, and drawings shall clearly identify the horizontal and vertical control points by number designation, description, coordinates, and elevations. Map all surveyed locations using a base map or other site mapping, as specified by the project Work Plan or SAP.
- Begin and end all surveys at the designated horizontal and vertical control points to determine the degree of accuracy of the surveys.
- Iron pins used to mark control points shall be made of reinforcement steel or an equivalent material and shall be 18 inches long with a minimum diameter of 5/8 inch. Drive pins to a depth of 18 inches into the soil.
- Stakes used to mark survey lines and points shall be made from 3-foot lengths of 2-inch by 2-inch lumber and pointed at one end. Clearly mark them with brightly colored weatherproof flagging and paint.
- Clearly mark the point on a monitoring well casing or well riser that is surveyed by filing grooves into the casing/riser on either side of the surveyed point, or by marking the riser with a permanent ink marker.

8.2 Global Positioning System (GPS) to Conduct Land Survey

Follow the procedures listed below during land surveying using GPS:

- A land surveyor registered in the state or territory in which the work is being performed shall directly supervise all surveying work.
- Reference surveys to the local established coordinate systems and base all elevations and benchmarks established on U.S. Geological Survey datum, 1929 general adjustment.

- All field notes, sketches, and drawings shall clearly identify the horizontal and vertical control points by number designation, description, coordinates, and elevations. Map all surveyed locations using a base map or other site mapping, as specified in the project Work Plan or SAP.
- Begin and end all surveys at the designated horizontal and vertical control points (as applicable) to determine the degree of accuracy of the surveys.
- Iron pins used to mark control points shall be made of reinforcement steel or an equivalent material and shall be 18 inches long with a minimum diameter of 5/8 inch. Drive pins to a depth of 18 inches into the soil.
- Stakes used to mark survey lines and points shall be made from 3-foot lengths of 2-inch by 2-inch lumber and pointed at one end. Clearly mark them with brightly colored weatherproof flagging and paint.
- Clearly mark the point on a monitoring well casing that is surveyed by filing grooves into the casing on either side of the surveyed point.

8.3 Global Positioning System (GPS) to Position Sample Locations or Locate Site Features

Experienced field personnel may use a GPS system unit to position sample locations (e.g. grid positioned samples, soil boring locations) at a site. The decision to use field personnel or a licensed land surveyor will depend on the objectives of the survey (e.g. vertical elevation is not required) and the levels of precision required. Typically when a level of precision greater than (±) 3 to 5 meters is required, a licensed surveyor will be required. When a level of precision of (±) 3 to 5 meters is sufficient to meet project requirements (i.e. when laying sampling grids, identifying significant site features, or locating features identified in GIS figures) experienced field personnel may use commercially available, consumer-grade GPS units. Follow the procedures listed below to locate samples or site features using GPS:

- A commercially available GPS unit with Wide Angle Averaging System (WAAS), topographic map display, and waypoint storage capabilities should be used.
- If waypoints are to be imported into a GIS database, the same grid projection system should be used.
- If a permanent reference point near the site is available, it is recommended that a waypoint at this location be taken every day waypoints are stored.
- When laying out a sampling grid from a GIS map, upload the coordinates from GIS to the GPS unit, including coordinates for an easily identified, permanent, nearby feature (i.e. building corner, roadway intersection, or USGS benchmark).
- If during the initial site walk, the permanent feature identified does not overlay within (±) 5 meters as identified in the GPS unit, field corrections of the waypoints should be made.
- Field corrections can be made by adding/subtracting the difference in x,y coordinates between the field measurement of the permanent site feature and the anticipated x,y coordinates. This correction should then be applied to the x,y coordinates for each sampling location to be marked. Corrected x,y coordinates can then be uploaded into the GPS unit.
- Sampling points and site features can then be located in the field using the GPS units “Go To” function. When the distance to the sampling point or feature remains close to zero, the location can be marked.
- If no field corrections to the sampling location need to be made, or if sampling locations are to be surveyed by a licensed surveyor at a later date, no additional waypoints need to be taken. If significant changes to the sampling location are made, GPS coordinates at the corrected location shall be stored and labeled.

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- It is recommended that GPS coordinates be uploaded to a storage device such as PC at the end of each day.
- Field logs shall indicate manufacturer and model number for GPS unit used, map datum and projection used, and any field corrections made. If the GPS unit cannot lock onto a WAAS system at the site, this should also be noted.

9.0 Quality Control and Assurance

None.

10.0 Data and Records Management

The surveyor shall record field notes daily using generally accepted practices. The data shall be neat, legible, in indelible ink, and easily reproducible. Copies of the surveyor's field notes and calculation forms generated during the work shall be obtained and placed in the project files.

Surveyor's field notes shall, at a minimum, clearly indicate:

- The date of the survey;
- General weather conditions;
- The name of the surveying firm;
- The names and job titles of personnel performing the survey work;
- Equipment used, including serial numbers; and,
- Field book designations, including page numbers.

A land surveyor registered in the state or territory in which the work was done shall sign, seal, and certify the drawings and calculations submitted by the surveyor.

Dated records of land surveying equipment calibration shall be provided by the surveyor and placed in the project files. Equipment serial numbers shall be provided in the calibration records.

11.0 Attachments or References

Department of Defense, United States (DoD). 2005. *Uniform Federal Policy for Quality Assurance Project Plans, Part 1: UFP-QAPP Manual*. Final Version 1. DoD: DTIC ADA 427785, EPA-505-B-04-900A. In conjunction with the U. S. Environmental Protection Agency and the Department of Energy. Washington: Intergovernmental Data Quality Task Force. March. On-line updates available at: http://www.epa.gov/fedfac/pdf/ufp_qapp_v1_0305.pdf.

Author	*Reviewer*	*Revisions (Technical or Editorial)*
Robert Shoemaker Senior Scientist	Naomi Ouellette, Project Manager	Rev 0 – Initial Issue

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1.0 PURPOSE

This standard operating procedure (SOP) represents minimum standard of practice. State and federal requirements may vary, and this SOP does not replace state and federal requirements that must be consulted before work begins. Further, if a project-specific work plan has been created, the work plan should be considered the ruling document. This SOP may be modified to meet specific regulatory, client, or project specific criteria.

If there are procedures whether it be from Resolution Consultants, state and/or federal that are not addressed in this SOP and are applicable to water quality parameter testing, then those procedures may be added as an appendix to the project-specific Sampling and Analysis Plan (SAP).

2.0 SCOPE

This procedure provides guidance for expected sampling methods and protocols by all personnel related to the measurement of water quality parameters.

Field measurements of water quality parameters are commonly performed to evaluate surface water and groundwater. These tests are often performed to evaluate basic water quality parameters, to evaluate natural attenuation parameters, and to assess the presence of pore water entering a well.

As professional guidance for specific activities, this procedure is not intended to obviate the need for professional judgment during unforeseen circumstances. Deviations from this procedure while planning or executing planned activities must be approved by either the Contract Task Order (CTO) Manager or the Quality Assurance (QA) Manager, and documented.

3.0 DEFINITIONS

3.1 Barometric Pressure (BP)

The density of the atmosphere, which varies according to altitude and weather conditions.

3.2 Conductivity/Specific Conductance

A measure of the ability of water to pass electrical current, which increases with the amount of dissolved ionic substances (i.e., salts). Conductivity is inversely related to the resistance of a solution and is measured in units of mhos per centimeter (mhos/cm) (inverse ohms/cm, Siemens/cm). The conductivity of water increases with increasing temperature.

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Specific Conductance is corrected for 25 degrees Celsius (°C); for this reason, it is best to record Specific Conductance. If Conductivity is recorded, the temperature of the sample MUST recorded.

3.3 Dissolved Oxygen (DO)

The amount of oxygen present in water and available for respiration. DO is typically measured in milligrams per liter (mg/L). Oxygen is less soluble in warm and salty waters, so the instrument compensates the apparent percent saturation for changes in temperature and conductivity. Most probes measure the current resulting from the electrochemical reduction of oxygen (at a gold cathode) diffusing through a selective membrane. Because oxygen is being removed from the sample to perform the measurement, sample flow is required to prevent false low readings due to depletion of oxygen in the solution in front of the probe. Optical DO probes do not remove oxygen from the sample and are less affected by salts. The common range of DO in groundwater is 0.0 to 3.0 mg/L. Measurements outside of this range suggest that the meter may not be operating correctly.

3.4 Nephelometric Turbidity Unit (NTU)

The measurement of light passing through a sample based on the scattering of light caused by suspended particles.

3.5 pH

A measure of acidity and alkalinity of a solution using a logarithmic scale on which a value of 7 represents neutrality, lower numbers indicate increasing acidity, and higher numbers are increasingly basic.

3.6 Oxidation-Reduction Potential (ORP)

Also known as redox or eH, ORP is a measurement of the potential for a reaction to occur, which generally indicates the oxygen status of a sample. The probe consists of a platinum electrode, the potential of which is measured with respect to a reference electrode that rapidly equilibrates with the potential of the sample solution. A positive value indicates that oxygen is present. A negative value indicates an anaerobic environment or reducing condition. For this reason, negative ORP readings should be associated with DO readings of less than 0.5 mg/l; with negative ORP readings the water may exhibit a sulfur odor or gray color. Positive ORP readings should be associated with DO readings greater than 0.5 mg/L and lack of sulfur odors. Because of the complex relationship between ORP and temperature, no compensation is attempted; it is thus best to report both the ORP and temperature of a water sample.

3.7 Total Dissolved Solids

A measure of the quantity of materials in water that are either dissolved or too small to be filtered.

3.8 Turbidity

Measure of the clarity of water in NTUs. Potable water typically has NTU values between 0.0 and 0.3 NTUs, depending on the state or regulatory program.

4.0 RESPONSIBILITIES

The CTO Manager, or designee, is responsible for ensuring that these standard groundwater sampling activities are followed and shall review all groundwater sampling forms at the conclusion of a sampling event. The CTO Manager is responsible for ensuring that all personnel involved in monitoring well sampling shall have the appropriate education, experience, and training to perform their assigned tasks. The QA Manager or Technical Director is responsible for ensuring overall compliance with this procedure. The Field Manager is responsible for ensuring that all project field staff follows these procedures.

Field sampling personnel are responsible for the implementation of this procedure. Personnel are required to be knowledgeable of the procedures in this SOP. Training and familiarization with this SOP shall be documented in the training file for each employee. The field sampler and/or Field Manager is responsible for directly supervising the calibration procedures to ensure that they are conducted according to this procedure, and for recording all pertinent data. If deviations from the procedure are required because of anomalous field conditions, they must first be approved by the CTO Manager, QA Manager, or Technical Director and then documented in the field logbook and associated report or equivalent document.

5.0 PROCEDURES

5.1 Purpose

The procedures will vary depending on parameters being measured, method of sampling, and the method of measurement used. The information here is a general guidance and the site-specific documents and manufacturer manuals supersede these procedures.

5.2 Cautions

Improper use of water quality testing equipment could result in equipment damage or compromised sampling results. Personnel should be trained to operate the test equipment being used for a field operation and should be trained in the proper techniques for collecting and

logging water quality parameters. Personnel should also be able to recognize problems with test equipment and have someone available for basic troubleshooting and repair.

5.3 Interferences

During field testing, water quality data that is documented from field testing equipment may be influenced by certain outside factors that are unrelated to the actual site water quality. Such parameters and equipment include the following:

pH Meters

- Coatings of oils, greases, and particles may impair the electrode's response. Pat the electrode bulb dry with lint-free paper or cloth and rinse with de-ionized water. For cleaning hard-to-remove films, use isopropyl alcohol very sparingly so that the electronic surface is not damaged.

- Poorly buffered solutions with low specific conductance (less than 200 microsiemens per centimeter) may cause fluctuations in the pH readings. Equilibrate electrode by immersing in several aliquots of sample before taking pH.

Dissolved Oxygen

- Dissolved gases (e.g., hydrogen sulfide, halogens, sulfur dioxide) are a factor with the performance of DO probes. The effect is less pronounced on optical DO meters. Meter type and potential interferences should be considered based on potential sulfate/sulfide or nitrate/nitrite reducing environments.

- Exposure of the sample to the atmosphere will cause elevated DO measurements.

Turbidity Meter

- If the weather is warm and humidity is high, condensation may collect on the cuvet. To avoid this, allow the sample to warm and dry the outside of the cuvet before making the measurement. One method used to accomplish this is to place the cuvet against one's body (armpits work well).

Temperature

- Sample temperature will change rapidly when there are significant differences between the sample and ambient air.

5.4 Apparatus and Materials

Field personnel shall consult the site work plan and SAP to review the equipment requirements for the sampling procedures to be followed during the sampling effort. The specific apparatus and materials required will depend on the water quality parameters being monitored. Table 1 shows the common equipment used in water quality parameter testing.

Table 1
Water Quality Parameter Testing — Common Equipment

Water Quality Parameter Instrument	Calibration Standards Required	Other Equipment
pH Meter	Yes - 2 or 3 Point Standards depending on groundwater range. Calibration must cover the range to be measured. If samples are above or below typical buffer standards (4, 7 and 10), special order buffers that fall outside groundwater pH range.	Container or flow thru cell for holding sample
Specific Conductance	Yes	Container or flow thru cell for holding sample
ORP Meter	Yes	Container or flow thru cell for holding sample
Turbidity Meter	Yes	Container or flow thru cell for holding sample
DO	No	Container or flow thru cell for holding sample
Thermometer	No	Container or flow thru cell for holding sample
Flow Rate	No	Calibrated Container

Notes:
ORP = Oxidation-Reduction Potential
DO = Dissolved Oxygen

5.5 Instrument or Method Calibration

Most monitoring instruments require calibration before use, and this calibration must be conducted in the field under the ambient climatic conditions that will be present during field sampling. Calibration of monitoring instruments shall be performed in accordance with the manufacturer's specifications and recorded in the provided form in Attachment 1. Site-specific instrument calibration requirements should be specified in the SAP. The following minimum calibration requirements apply to the various types of meters used to gather water quality measurements.

Initial Calibration (IC): Before use, the instrument or meter electronics are adjusted (manually or automatically) to a theoretical value (e.g., DO saturation) or a known value of a

calibration standard. An IC is performed in preparation for the first use of an instrument or if a calibration verification does not meet acceptance criteria.

Initial Calibration Verification (ICV): The instrument or meter calibration is checked or verified directly following IC by measuring a calibration standard of known value as if it were a sample and comparing the measured result to the calibration acceptance criteria for the instrument/parameter. If an ICV fails to meet acceptance criteria, immediately recalibrate the instrument using the applicable initial calibration procedure or remove it from service.

Continuing Calibration Verification (CCV): After use, the instrument or meter calibration is checked or verified by measuring a calibration standard of known value as if it were a sample and comparing the measured result to the calibration acceptance criteria for the instrument/parameter.

5.5.1 Calibration Checks

Calibration checks are conducted by measuring a known standard. They must be completed after calibration and should be performed at least one other time (i.e., after lunch) and anytime suspect measurements are encountered. Table 2 provides general acceptance ranges to be used during calibration checks. If a meter is found to be outside of the acceptance range, the meter **must** be recalibrated. If the meter remains out of range, the project manager and/or the supplier of the meter should be contacted to determine alternative measures.

Table 2
Calibration Check Acceptance Limits

Parameter	Acceptance Criteria
Dissolved Oxygen	±0.3 mg/L of the theoretical oxygen solubility
Oxidation-Reduction Potential	±10 mv from the theoretical standard value at that temperature
pH	±0.2 Standard pH Units
Specific Conductance	±5% of the standard
Turbidity	0.1 to 10 NTU: ±10% of the standard 11 to 40 NTU: ±8% of the standard 41 to 100 NTU: ±6.5% of the standard

Notes:
mg/L = milligrams per liter
mv = millivolts
NTU = nephelometric turbidity units

5.5.2 Possible and Suspected Ranges

The concentration for each parameter range should be known so that concentrations outside of the range can be noted. Table 3 presents the maximum range of the parameter in groundwater. The table also presents the suspected range. Measurements outside of the maximum/minimum range should be considered in error and the measurement method should be checked. Concentrations outside the normal range should be treated as suspect but may be the result of contaminant impact. For example, a pH of 2.0 would be out of the normally suspected range for groundwater but not at a site impacted with an acid.

Table 3
Minimum and Maximum Result Ranges

Parameter	Units	Possible Min	Possible Max	Normal Min	Normal Max	Notes
Dissolved Oxygen	mg/L	0.0	14.6 (0°C) 10.1 (15°C) 8.3 (2°C)	0.0	5	The colder the sample, the higher the DO reading. DO greater than 1 mg/L, ORP positive should not have sulfur odor, sulfide, ferrous iron and/or gray color. DO less than 1 mg/L, ORP negative, may have sulfur odor, sulfide, ferrous iron and/or gray color.
pH	SU	0	14	5	9	pH values exceeding 10 could indicate grout contamination
ORP	mv					DO greater than 1 mg/L, ORP positive should not have sulfur odor, sulfide, ferrous iron and/or gray color. DO less than 1 mg/L, ORP negative, may have sulfur odor, sulfide, ferrous iron and/or gray color.
Specific Conductance	µS/cm			varies	varies	
Temperature	°C	0	100	5	30	
Turbidity	NTU	0	Greater than 1,000	0	Greater than 1,000	50 NTU or greater suggests cloudiness.

Notes:

mg/L = milligrams per liter
°C = degrees Celsius
DO = dissolved oxygen
SU = standard units
ORP = oxidation reduction potential
mv = millivolts
mS/cm = micro Siemens per cm
NTU = nephelometric turbidity units

5.5.3 Field Instruments and Calibration Criteria

The calibration acceptance criteria for each instrument are summarized in Table 4 along with special considerations related to each field instrument.

Table 4
Calibration Check Acceptance Limits

Parameter	Acceptance Criteria
Dissolved Oxygen	±0.3 mg/L of the theoretical oxygen solubility.
Oxidation-Reduction Potential	±10 mv from the theoretical standard value at that temperature.
pH	±0.2 Standard pH Units
Specific Conductance	±5% of the standard
Turbidity	0.1 to 10 NTU: ±10% of the standard 11 to 40 NTU: ±8% of the standard 41 to 100 NTU: ±6.5% of the standard

Notes:
mg/L = milligrams per liter
mv = millivolts
NTU = nephelometric turbidity units

pH Meters

- For the most accurate of pH measurements, pH meters should receive a three-point calibration. However, if a two-point calibration will bracket the groundwater pH of the site, a two-point calibration is acceptable. Three-point calibrations typically include calibrating to solutions of pH 7.00, 4.00, and 10.00. If groundwater pH is outside the calibration range of the solution standards, special buffers must be ordered to bracket the pH. Some meters will report the slope of the calibration and this may be used in checking the meter calibration (refer to the meter's manual). When performing an ICV, the result must be within +/- 0.2 pH units of the stated buffer value.

- pH meters should be calibrated across the range of values to be measured. The maximum and minimum calibration solutions shall be outside the range of anticipated values. For example, if the expected range is between 7.50 and 9.00, the 7.00 and the 10.00 standard should be used for calibration. Perform the IC using at least two buffers, and always use the pH 7.00 buffer first. A reading that is above the maximum (or below the minimum) calibration standard is an estimate only and is not valid. This condition requires obtaining a new standard that is above (or below) the reported value, depending on the measurement.

- A percent slope of less than 90 percent indicates a bad electrode that must be changed or repaired. If percent slope cannot be determined, or the manufacturer's optimum specifications are different, follow the manufacturer's recommendation for maintaining optimum meter performance.

Specific Conductivity Meters

- For IC, when the sample measurements are expected to be 100 microsiemens per centimeter (µS/cm) or greater, use two standard potassium chloride (KCl) solutions that bracket the range of expected sample conductivities. Calibrate the instrument with the first standard. Verify the calibration of the instrument with the second standard, bracketing the range of expected sample values.

- If the instrument can be calibrated with more than one standard, choose additional calibration standards within the range of expected sample values.

- When the sample measurements are expected to be less than 100 µS/cm, a lower bracket is not required, but one standard (KCl) solution that is within the range of expected measurements must be used for the IC and the ICV.

- Accept the calibration if the meter reads within +/- 5 percent of the value of any calibration standard used to verify the calibration.

- Most field instruments read conductivity directly. Record all readings and calculations in the calibration records.

- For CCV, check the meter with at least one KCl standard with a specific conductance in the range of conductivity measured in environmental samples. The reading for the calibration verification must also be within +/- 5 percent of the standard value.

- If new environmental samples are encountered outside the range of the IC, verify the instrument calibration with two standards bracketing the range of sample values. If these calibration verifications fail, recalibrate the instrument.

Dissolved Oxygen Meters

- Before calibrating, check the probe membrane for bubbles, tears, or wrinkles. These conditions require replacement of the membrane in accordance with the manufacturer's directions.

- If the meter provides readings that are off-scale, will not calibrate, or drift, check the leads, contacts, etc., for corrosion and/or short circuits. These conditions require replacement maintenance in accordance with the manufacturer's directions.
- Most DO meters must be calibrated based on an environment of 100 percent humidity and a known elevation and barometric pressure (BP).

- For 100 percent humidity, place the probe in the calibration container with a moist towel and allow the probe to remain, undisturbed, for 10 to 20 minutes.

- The IC is an air calibration at 100% saturation. Before use, verify the meter calibration in water-saturated air to make sure it is properly calibrated and operating correctly. Make a similar verification at the end of the day or sampling event. Follow the manufacturer's instructions for your specific instrument. Allow an appropriate warm up period before IC. Wet the inside of the calibration chamber with water, pour out the excess water (leave a few drops), wipe any droplets off the membrane/sensor and insert the sensor into the chamber (this ensures 100 percent humidity). Allow adequate time for the DO sensor and the air inside the calibration chamber to equilibrate. Once the probe/calibration chamber is stable at ambient temperature, check the air temperature and determine, from the DO versus temperature table (see Attachment 2) what DO should measure. The acceptance criterion for DO ICV is +/- 0.3 mg/L.

- Use the same procedure as above for CCV.

ORP Meters

- Verify electrode response before use in the field.

- Equilibrate the standard solution to the temperature of the sample. The standard solution is based on a 25°C temperature; however, the calibration solution standard's value will require adjustment based on the temperature.

- Immerse the electrodes and gently stir the standard solution in a beaker (or flow cell). Turn the meter on, placing the function switch in the millivolt (mv) mode.

- Let the electrode equilibrate and record the reading to the nearest millivolt. The reading must be within ±10 mv from the theoretical redox standard value at that temperature. If not, determine the problem and correct it before proceeding. Switch to temperature display and read the value.

- Record the mv reading and temperature in the field notebook or in form. Rinse the electrode with distilled water and proceed with the sample measurement, unless using a flow cell. If a flow cell is used, rinse between sample locations.

Turbidity Meters

- Perform an initial calibration using at least two primary standards.

- If the instrument cannot be calibrated with two standards, calibrate the instrument with one standard and verify with a second standard.

- Perform an ICV by reading at least one primary standard as a sample. The acceptance criterion for the ICV depends on the range of turbidity of the standard value:

    1. Standard Value = 0.1 to 10 NTU: the response must be within 10 percent of the standard;

    2. Standard Value = 11 to 40 NTU: the response must be within 8 percent of the standard;

    3. Standard Value = 41 to 100 NTU: the response must be within 6.5 percent of the standard; and

    4. Standard Value greater than 100 NTU: the response must be within 5 percent of the standard.

- Determining the Values of Secondary Standards: Use only those certified by the manufacturer for a specific instrument. Secondary standards may be used for CCVs.

To initially determine the value of a secondary standard, assign the value that is determined immediately after an ICV or verification with primary standards. This is done by reading the secondary standard as a sample. This result must be within the manufacturer's stated tolerance range and +/- 10 percent of the assigned standard value. If the +/- 10 percent criterion is not met, assign this reading as the value of the standard. If the reading is outside the manufacturer's stated tolerance range, discard the secondary standard.

- CCV: Perform a CCV using at least one primary or secondary standard. The calibration acceptance criteria are the same as those for an ICV.

5.6 Direct Measurements

Direct measurements with meters are the most common methods and can be accomplished by placing a sample in a container with the probe or by allowing the water to flow past the probe in a flow cell. The use of a flow-through cell improves measurement quality by allowing the constant flow of water over the probes and reduces interaction of the sample with the atmosphere. Sample cups should be avoided. The quantity of samples, timing, and methodology should be described in the project SAP.

Following calibration of required probes, connect the bottom flow-cell port to the discharge line of the pump. Connect the top port to a discharge line directed to a bucket to collect the purge water. Allow the flow cell to completely fill. As the water flows over the probe, record the measurements. Continue to record the measurements at regular intervals, as specified in the SAP.

When the ambient air temperatures are much higher or lower than the temperature of the water sample, it is best to keep the length of tubing between the wellhead and the flow cell as short as possible to prevent heating or cooling of the water. Tubing and flow-through cell should not be exposed to direct sunlight, particularly in the summer, if at all possible, to avoid heating of water samples.

5.7 Data Acquisitions, Calculations, and Data Reduction

5.7.1 Specific Conductivity Correction Factions

If the meter does not automatically correct for temperature (i.e., read Specific Conductivity) record Conductivity and adjust for temperature upon returning to the office. The following equation can be used to convert Conductivity to Specific Conductivity.

$$K = \frac{(Km)(C))}{1 + 0.0191(\mathrm{T} - 25)}$$

Where:

K = Conductivity in μmhos/cm at 25°C
Km = Measured conductivity in μmhos/cm at T degrees Celsius
C = Cell constant
T = Measured temperature of the sample in degrees Celsius;

If the cell constant is 1, the formula for determining conductivity becomes:

$$K = \frac{(Km)}{1 + 0.0191(\mathrm{T} - 25)}$$

5.7.2 Percentage Difference Calculation

For evaluating slope of readings from either a flow cell or a sample cup.

$$\%Difference = \frac{(Highest\ Value - Lowest\ Value)}{(Highest\ Value)}\ x\ 100$$

5.7.3 Convert mm mercury (mmHG) to inches mercury (inHG)

$$mmHG = inHG\ x\ 25.4$$

5.7.4 True Barometric Pressure

For converting BP obtained from a public domain source that is expressed in BP at sea level to BP at the subject site.

$$TrueBP = (BP) - \frac{(2.5\ x\ [Local\ Altitude])}{100}$$

Where: BP is in mmHG and Local Altitude is in feet

Example: BP at site A is 30.49 inHg and elevation is 544 feet, calculate TrueBP

Convert inHG to mmgHG:

mmHg = 30.49 inHg x 25.4 = 774.4 mmHg

Calculate True BP:

TrueBP = (774.4 mmHg) – [2.5 * (544 /100)] = 774.4-13.6 = 760.8 mmHg

6.0 RECORDS

Data will be recorded promptly, legibly, and in indelible ink on the appropriate logbooks and forms. At the completion of a field effort, all logbooks, field data forms, and calibration logs shall be scanned and made electronically available to the project team. The original field forms, calibrations logs, and log book will be maintained in the project file.

7.0 HEALTH AND SAFETY

Detailed Health and Safety requirements can be found in the site specific Health and Safety Plan. Ensure that a Safe Work Assessment and Permit form is filled out daily prior to any work in the field and reviewed with all project personnel in a daily safety brief.

Safety glasses with side shields or goggles and disposable gloves shall be worn during calibration activities.

8.0 REFERENCES

None

9.0 ATTACHMENTS

Attachment 1: Example Field Instrument Calibration Form
Attachment 2: Solubility of Oxygen at Given Temperatures
Attachment 3: Example Field Data Form

Attachment 1
Example Field Instrument Calibration Form

Field Instrument Calibration Form

Calibrated by: _____ Equipment (Make/Model/Serial#): _____

Date: _____ Equipment (Make/Model/Serial#): _____

pH (su) — Standard: ± 0.2 standard units

Initial Calibration

	Hach SL	Reading	Pine SL	Reading
pH7				
pH4				

Continuing Calibration Verification

	Hach SL	Reading	Deviation	Acceptable Variance (Y/N)
pH7				
pH4				

DO (mg/L) — Standard: ± 0.3 mg/L of theoretical*

IC (Temp:) **ICV (Temp:)**

Saturation (%)	Reading (%)	Theoretical (mg/L)	Reading (mg/L)
100			

CCV (Temp:)

Saturation (%)	Reading (%)	Deviation	Acceptable Variance (Y/N)
100			

Theoretical (mg/L)	Reading (mg/L)	Deviation	Acceptable Variance (Y/N)

ORP (mV) — Standard: NA

IC (Zobell SL:) **ICV (Pine SL:)**

TCS (Std/Temp)	Reading	TCS (Std/Temp)	Reading

CCV (Zobell SL:)

TCS (Std/Temp)	Reading	Deviation	Acceptable Variance (Y/N)

Turbidity (ntu) — Standard: ±10% of Standard

Initial Calibration

Standard	Reading

Continuing Calibration Verification

Standard	Reading	Deviation	Acceptable Variance (Y/N)

Conductivity (ms^{C}/cm) — Standard: ± 5% of standard value

IC (YSI SL:) **ICV (Pine SL:)**

Standard	Reading	Standard	Reading

CCV (YSI SL:)

Standard	Reading	Deviation	Acceptable Variance (Y/N)

Comments:

Notes:

SL	solution lot		su	standard units		ntu	Nephelometric Turbidity Units
TCS	temperature corrected standard		mV	millivolts		°C	degrees Celsius
Std	standard		%	percent		ms^{C}/cm	millisiemens per centimeter (temperature corrected)
Temp	temperature		mg/L	milligrams per liter		*	Theoretical value

Attachment 2
Solubility of Oxygen at Given Temperatures

Field Measurement of Dissolved Oxygen

Solubility of Oxygen in Water at Atmospheric Pressure			
Temperature	**Oxygen Solubility**	**Temperature**	**Oxygen Solubility**
°C	**mg/L**	**°C**	**mg/L**
0.0	14.621	26.0	8.113
1.0	14.216	27.0	7.968
2.0	13.829	28.0	7.827
3.0	13.460	29.0	7.691
4.0	13.107	30.0	7.559
5.0	12.770	31.0	7.430
6.0	12.447	32.0	7.305
7.0	12.139	33.0	7.183
8.0	11.843	34.0	7.065
9.0	11.559	35.0	6.950
10.0	11.288	36.0	6.837
11.0	11.027	37.0	6.727
12.0	10.777	38.0	6.620
13.0	10.537	39.0	6.515
14.0	10.306	40.0	6.412
15.0	10.084	41.0	6.312
16.0	9.870	42.0	6.213
17.0	9.665	43.0	6.116
18.0	9.467	44.0	6.021
19.0	9.276	45.0	5.927
20.0	9.092	46.0	5.835
21.0	8.915	47.0	5.744
22.0	8.743	48.0	5.654
23.0	8.578	49.0	5.565
24.0	8.418	50.0	5.477
25.0	8.263		

Notes:

The table provides three decimals to aid interpolation

Under equilibrium conditions, the partial pressure of oxygen in air-saturated water is equal to that of the oxygen in water saturated

°C = degrees Celsius

mg/L = milligrams per liter

Attachment 3
Example Field Data Form

WELL DEVELOPMENT & GROUNDWATER SAMPLING FORM

DATE:	JOB NUMBER:	EQUIPMENT (Make/Model #/Serial #):
PROJECT:	EVENT:	/ /
WELL ID:	LOCATION:	/ /
WEATHER CONDITIONS:	AMBIENT TEMP:	/ /
REVIEWED BY:	PERSONNEL:	/ /

WELL DIA:	**WELL DEVELOPMENT**	
TOTAL DEPTH from TOC (ft.):	START:	FINISH:
DEPTH TO WATER from TOC (ft.):	VOLUME PURGED (gal):	
LENGTH OF WATER COL. (ft.):	**GROUNDWATER SAMPLING**	
1 VOLUME OF WATER (gal):	START:	FINISH:
3 VOLUMES OF WATER (gal):	VOLUME PURGED (gal):	
	ANALYSIS:	

WELL DEVELOPMENT PARAMETERS		GW SAMPLING PARAMETERS	
Temperature:	± 1.0° C	Temperature:	± 0.2° C
pH:	± 0.5 standard units	pH:	± 0.2 standard units
Specific Conductance:	± 10% of the past measurement	Specific Conductance:	± 5% of the past measurement
Turbidity:	relatively stable	DO:	≤ 20% saturation
		ORP:	± 10 millivolts
		Turbidity:	≤ 10 NTU

IN-SITU TESTING

Circle one: DEVELOPMENT SAMPLING							☐ Bailer ☐ Pump		Description:			
Time (hh:mm):												
pH (units):												
Conductivity (mS/cm):												
Turbidity (NTU):												
DO (mg/L): YSI 556												
DO (mg/L): YSI 550												
Temperature (C°):												
ORP (mV):												
Volume Purged (gal):												
Depth to Water (ft):												
									Well Goes Dry While Purging ☐			

SAMPLE DATA ☐ Bailer ☐ Pump Description:

Sample ID	Date (m/d/y)	Time (hh:mm)	Bottles (total to lab)	Filtered (0.45 µm)	Remarks
Purging/Sampling Device Decon Process:					

COMMENTS:

Purge water placed in drum#_____

FC 1000. CLEANING / DECONTAMINATION PROCEDURES

1. PERFORMANCE CRITERIA

   1.1. The cleaning/decontamination procedures must ensure that all equipment that contacts a sample during sample collection is free from the analytes of interest and constituents that would interfere with the analytes of interest.

   1.2. The detergents and other cleaning supplies cannot contribute analytes of interest or interfering constituents unless these are effectively removed during a subsequent step in the cleaning procedure.

   1.3. The effectiveness of any cleaning procedure (including all cleaning reagents) must be supported by equipment blanks with reported non-detected values.

The cleaning procedures outlined in this SOP are designed to meet the above-mentioned performance criteria. Alternative cleaning reagents or procedures may be used. However, the organization must be prepared to demonstrate through documentation (i.e., company-written protocols and analytical records) and historical data (i.e., absence of analytes of interest in equipment blanks) that it consistently meets these performance criteria. Field quality control measures (see FQ 1210) must support the use of alternative reagents or procedures.

FC 1001. *Cleaning Reagents*

Recommendations for the types and grades of various cleaning supplies are outlined below. The recommended reagent types or grades were selected to ensure that the cleaned equipment is free from any detectable contamination.

1. DETERGENTS: Use Luminox (or a non-phosphate solvent based equivalent), Liqui-Nox (or a non-phosphate equivalent) or Alconox (or equivalent). EPA recommends Luminox (or equivalent) since solvent rinses can be eliminated from the cleaning process. Liquinox (or equivalent) may be substituted (solvent rinses, when applicable, must be performed), and Alconox (or equivalent) may be substituted if the sampling equipment will not be used to collect phosphorus or phosphorus-containing compounds.

2. SOLVENTS

Note: If the detergent Luminox (or equivalent) is used, solvent rinses are not required.

   2.1. Use pesticide grade isopropanol as the rinse solvent in routine equipment cleaning procedures. This grade of alcohol must be purchased from a laboratory supply vendor.

   2.2. Other solvents, such as acetone or methanol, may be used as the final rinse solvent if they are pesticide grade. However, methanol is more toxic to the environment and acetone may be an analyte of interest for volatile organics.

      2.2.1. **Do not use** acetone if volatile organics are of interest.

   2.3. Properly dispose of all wastes according to applicable regulations. Containerize all solvents (including rinsates) for on-site remediation or off-site disposal, as required.

   2.4. Pre-clean equipment that is heavily contaminated (see FC 1120, section 3) with organic analytes with reagent grade acetone and hexane or other suitable solvents.

   2.5. Use pesticide grade methylene chloride when cleaning sample containers.

   2.6. Store all solvents away from potential sources of contamination (gas, copier supplies, etc.).

3. ANALYTE-FREE WATER SOURCES

3.1. Analyte-free water is water in which all analytes of interest and all interferences are below method detection limits.

3.2. Maintain documentation (such as results from equipment blanks) to demonstrate the reliability and purity of analyte-free water source(s).

3.3. The source of the water must meet the requirements of the analytical method and must be free from the analytes of interest. In general, the following water types are associated with specific analyte groups:

- Milli-Q (or equivalent polished water): suitable for all analyses.
- Organic-free: suitable for volatile and extractable organics.
- Deionized water: not suitable for volatile and extractable organics if the analytes of interest are present in concentrations that affect the result.
- Distilled water: not suitable for volatile and extractable organics, metals or ultra-trace metals.

3.4. Use analyte-free water for blank preparation and the final decontamination water rinse.

3.5. In order to minimize long-term storage and potential leaching problems, obtain or purchase analyte-free water just prior to the sampling event. If obtained from a source (such as a laboratory), fill the transport containers and use the contents for a single sampling event. Empty the transport container(s) at the end of the sampling event. If long-term storage of analyte-free water is necessary, see FC 1002, section 3.3.

3.6. Discard any analyte-free water that is transferred to a dispensing container (such as a wash bottle) at the end of each sampling day.

4. ACIDS

4.1. Reagent Grade Nitric Acid: 10 - 15% (one volume concentrated nitric acid and five volumes deionized water).

4.1.1. Use for the acid rinse unless nitrogen components (e.g., nitrate, nitrite, etc.) are to be sampled.

4.1.2. If sampling for ultra-trace levels of metals, use an ultra-pure grade acid.

4.2. Reagent Grade Hydrochloric Acid: 10% hydrochloric acid (one volume concentrated hydrochloric and three volumes deionized water).

4.2.1. Use when nitrogen components are to be sampled.

4.3. If samples for both metals and the nitrogen-containing components (see FC 1001, section 4.1.1 above) are collected with the equipment, use the hydrochloric acid rinse, or thoroughly rinse with hydrochloric acid after a nitric acid rinse.

4.4. If sampling for ultra trace levels of metals, use an ultra-pure grade acid.

4.5. Freshly prepared acid solutions may be recycled during the sampling event or cleaning process. Dispose appropriately at the end of the sampling event, cleaning process or if acid is discolored or appears otherwise contaminated (e.g., floating particulates).

4.5.1. Transport only the quantity necessary to complete the sampling event.

4.6. Dispose of any unused acids according to FDEP and local ordinances.

FC 1002. *Reagent Storage Containers*

The contents of all containers must be clearly marked.

1. DETERGENTS: Store in the original container or in a high density polyethylene (HDPE) or polypropylene (PP) container.

2. SOLVENTS

2.1. Store solvents to be used for cleaning or decontamination in the original container until use in the field. If transferred to another container for field use, the container must be either glass or Teflon.

2.2. Use dispensing containers constructed of glass, Teflon, or stainless steel. Note: if stainless steel sprayers are used, any components (including gaskets and transfer lines) that contact the solvents must be constructed of inert materials.

3. ANALYTE-FREE WATER: Transport in containers appropriate to the type of water to be stored. If the water is commercially purchased (e.g., grocery store), use the original containers when transporting the water to the field. Containers made of glass, Teflon, polypropylene, or Polyethylene (PE) are acceptable.

3.1. Use glass, Teflon, polypropylene or PE to transport organic-free sources of water on-site.

3.2. Dispense water from containers made of glass, Teflon, PE or polypropylene.

3.3. Do not store water in transport containers before beginning a sampling event, unless satisfactory long-term storage of analyte-free water for a specified maximum storage time has been documented for the analytes of interest. The water should be replaced and the maximum storage time shortened if it is determined that the analyte-free water has been contaminated, e.g., by the analysis of field-QC blanks or other QC blanks that have been composed using the water stored in the container.

3.4. Store and dispense acids using containers made of glass, Teflon, PE or polypropylene.

FC 1003. *General Requirements*

1. Before using any equipment, clean/decontaminate all sampling equipment (pumps, tubing, lanyards, split spoons, etc.) that are exposed to the sample.

1.1. Before installing, clean (or obtain as certified precleaned) all equipment that is dedicated to a single sampling point and remains in contact with the sample medium (e.g., permanently installed groundwater pump (see FS 2220, section 3.3.4).

1.2. Clean this equipment any time it is removed for maintenance or repair.

1.3. Replace dedicated tubing if discolored or damaged.

2. Clean all equipment in a designated area having a controlled environment (house, laboratory, or base of field operations) and transport to the field precleaned and ready to use, unless otherwise justified.

3. Rinse all equipment with water after use, even if it is to be field-cleaned for other sites. Rinse equipment used at contaminated sites or used to collect in-process (e.g., untreated or partially treated wastewater) samples immediately with water.

4. Whenever possible, transport sufficient clean equipment to the field so that an entire sampling event can be conducted without the need for cleaning equipment in the field.

5. Segregate equipment that is only used once (i.e., not cleaned in the field) from clean equipment and return to the in-house cleaning facility to be cleaned in a controlled environment.

6. Protect decontaminated field equipment (including well sounders) from environmental contamination by securely wrapping and sealing with one of the following:

6.1. Aluminum foil (commercial grade is acceptable);

6.2. Untreated butcher paper; or

6.3. Clean, untreated, disposable plastic bags. Plastic bags may be used:

- For all analyte groups except volatile and extractable organics;
- For volatile and extractable organics, if the equipment is first wrapped in foil or butcher paper or if the equipment is completely dry.

7. Containerize all solvent rinsing wastes, detergent wastes and other chemical wastes requiring off-site or regulated disposal. Dispose of all wastes in conformance with applicable regulations.

FC 1100. Cleaning Sample Collection Equipment

FC 1110. ON-SITE/IN-FIELD CLEANING

1. Cleaning equipment on-site is not recommended because:
   1.1. Environmental conditions cannot be controlled.
   1.2. Wastes (solvents and acids) must be containerized for proper disposal.
2. If performed, follow the appropriate cleaning procedure as outlined in FC 1130. Ambient temperature water may be substituted in the hot, sudsy water bath, and hot water rinses.

Note: Properly dispose of all solvents and acids.

3. Rinse all equipment with water after use, even if it is to be field-cleaned for other sites. Rinse equipment used at contaminated sites or used to collect in-process (e.g., untreated or partially treated wastewater) samples immediately with water.

FC 1120. HEAVILY CONTAMINATED EQUIPMENT

In order to avoid contaminating other samples, isolate heavily contaminated equipment from other equipment and thoroughly decontaminate the equipment before further use. Equipment is considered heavily contaminated if it:

- Has been used to collect samples from a source known to contain significantly higher levels than background;
- Has been used to collect free product; or
- Has been used to collect industrial products (e.g., pesticides or solvents) or their by-products.

1. Cleaning heavily contaminated equipment in the field is not recommended.
2. ON-SITE PROCEDURES
   2.1. Protect all other equipment, personnel and samples from exposure by isolating the equipment immediately after use.
   2.2. At a minimum, place the equipment in a tightly sealed untreated plastic bag.
   2.3. Do not store or ship the contaminated equipment next to clean, decontaminated equipment, unused sample containers, or filled sample containers.
   2.4. Transport the equipment back to the base of operations for thorough decontamination.
   2.5. If cleaning must occur in the field, and in order to document the effectiveness of the procedure, collect and analyze blanks on the cleaned equipment (see FQ 1000).
3. CLEANING PROCEDURES
   3.1. If organic contamination cannot be readily removed with scrubbing and a detergent solution, prerinse equipment by thoroughly rinsing or soaking the equipment in acetone.
      3.1.1. Do not use solvent soaks or rinses if the material is clear acrylic.

3.1.2. Use hexane only if preceded and followed by acetone.

3.2. In extreme cases, it may be necessary to steam clean the field equipment before proceeding with routine cleaning procedures.

3.3. After the solvent rinses (and/or steam cleaning), use the appropriate cleaning procedure (see FC 1130).

3.3.1. Scrub, rather than soak all equipment with sudsy water.

3.3.2. If high levels of metals are suspected and the equipment cannot be cleaned without acid rinsing, soak the equipment in the appropriate acid. Do not use stainless steel equipment when heavy metal contamination is suspected or present, since stainless steel cannot be exposed to prolonged acid soaks.

3.4. If the field equipment cannot be cleaned utilizing these procedures, discard unless further cleaning with stronger solvents and/or oxidizing solutions is effective as evidenced by visual observation and blanks.

3.5. Clearly mark or disable all discarded equipment to discourage use.

FC 1130. GENERAL CLEANING

Follow these procedures when cleaning equipment under controlled conditions. See FC 1110 for modifications if cleaning is performed on-site. Check manufacturer's instructions for cleaning restrictions and/or recommendations.

FC 1131. *Procedure for Teflon, Stainless Steel and Glass Sampling Equipment*

This procedure must be used when sampling for **ALL** analyte groups: extractable organics, metals, nutrients, etc. or if a single decontamination protocol is desired to clean all Teflon, stainless steel and glass equipment.

1. Rinse equipment with hot tap water.
2. Soak equipment in a hot, sudsy water solution (Liqui-Nox or equivalent - see FC 1001, section 1).
3. If necessary, use a brush to remove particulate matter or surface film.
4. Rinse thoroughly with hot tap water.
5. If samples for trace metals or inorganic analytes will be collected with the equipment and the equipment **is not** stainless steel, thoroughly rinse (wet all surfaces) with the appropriate acid solution (see FC 1001, section 4).
6. Rinse thoroughly with analyte-free water. Use enough water to ensure that all equipment surfaces are thoroughly flushed with water.
7. If samples for volatile or extractable organics will be collected, rinse with isopropanol. Wet equipment surfaces thoroughly with free-flowing solvent. Rinse thoroughly with analyte-free water (see FC 1001, section 3).
8. Allow to air dry. Wrap and seal according to FC 1003, section 6 as soon as the equipment is air-dried.
9. If isopropanol is used, the equipment may be air-dried without the final analyte-free water rinse (see FC 1131, section 8 above); however, **the equipment must be completely dry before wrapping or use**.
10. Wrap clean sampling equipment according to the procedure described in FC 1003, section 6.

FC 1132. *General Cleaning Procedure for Plastic Sampling Equipment*

1. Rinse equipment with hot tap water.
2. Soak equipment in a hot, sudsy water solution (Liqui-Nox or equivalent - see FC 1001, section 1).
3. If necessary, use a brush to remove particulate matter or surface film.
4. Rinse thoroughly with hot tap water.
5. Thoroughly rinse (wet all surfaces) with the appropriate acid solution (see FC 1001, section 4). Check manufacturer's instructions for cleaning restrictions and/or recommendations.
6. Rinse thoroughly with analyte-free water. Use enough water to ensure that all equipment surfaces are thoroughly flushed with water. Allow to air dry as long as possible.
7. Wrap clean sampling equipment according to the procedure described in FC 1003, section 6.

FC 1133. *Cleaning Procedure by Analyte Group*

See Table FC 1000-1 for the procedures to be used to decontaminate equipment based on construction of sampling equipment, and analyte groups to be sampled.

FC 1140. AUTOMATIC SAMPLERS, SAMPLING TRAINS AND BOTTLES

1. When automatic samplers are deployed for extended time periods, clean the sampler using the following procedures when routine maintenance is performed. Inspect deployed samplers prior to each use. At a minimum, change the tubing if it has become discolored or has lost elasticity (FC 1140, section 2.3 below).
2. Clean all automatic samplers (such as ISCO) as follows:

   2.1. Wash the exterior and accessible interior portions of the automatic samplers (excluding the waterproof timing mechanisms) with laboratory detergent (see FC 1001, section 1) and rinse with tap water.

   2.2. Clean the face of the timing case mechanisms with a clean, damp cloth.

   2.3. Check all tubing (sample intake and pump tubing). Change the tubing every six months (if used frequently) or if it has become discolored (i.e., affected by mold and algae) or if it has lost its elasticity.

   2.4. See FC 1160, section 4 for the procedures associated with cleaning the tubing in the pump head.

3. AUTOMATIC SAMPLER ROTARY FUNNEL AND DISTRIBUTOR

   3.1. Clean with hot sudsy water and a brush (see FC 1001, section 1 for appropriate detergent type).

   3.2. Rinse thoroughly with analyte-free water.

   3.3. Air dry.

   3.4. Replace in sampler.

4. SAMPLER METAL TUBE: Clean as outlined in FC 1160, section 5.
5. REUSABLE GLASS COMPOSITE SAMPLE CONTAINERS

   5.1. If containers are used to collect samples that contain oil, grease or other hard to remove materials, it may be necessary to rinse the container several times with reagent-grade acetone before the detergent wash. If material cannot be removed with acetone, discard the container.

5.2. Wash containers following the procedure outlined in FC 1131 above. End with a final solvent rinse if organics are to be sampled.

5.3. Invert containers to drain and air dry for at least 24 hours.

5.4. Cap with aluminum foil, Teflon film or the decontaminated Teflon-lined lid.

5.5. After use, rinse with water in the field, seal with aluminum foil to keep the interior of the container wet, and return to the laboratory or base of operations.

5.6. **Do not recycle or reuse containers if**:

5.6.1. They were used to collect in-process (i.e., untreated or partially treated) wastewater samples at industrial facilities;

5.6.2. A visible film, scale or discoloration remains in the container after the cleaning procedures have been used; or

5.6.3. The containers were used to collect samples at pesticide, herbicide or other chemical manufacturing facilities that produce toxic or noxious compounds. Such containers must be properly disposed of (preferably at the facility) at the conclusion of the sampling activities.

5.6.4. If the containers described above are reused, check no less than 10% of the cleaned containers for the analytes of interest **before** use. If found to be contaminated, (i.e., constituents of interest are found at method detection levels or higher), then **discard the containers**.

6. REUSABLE PLASTIC COMPOSITE SAMPLE CONTAINERS

6.1. Follow FC 1132.

6.2. Inspect the containers. Determine if the containers can be reused by the criteria in FC 1140, section 5 above.

7. GLASS SEQUENTIAL SAMPLE BOTTLES FOR AUTOMATIC SAMPLER BASED FOR SEQUENTIAL MODE

7.1. Clean glass sequential sample bottles to be used for collecting inorganic samples by using a laboratory dishwasher (see FC 1140, sections 7.1.1 through 7.1.3 below) or manually following the procedures in FC 1131.

7.1.1. Rinse with appropriate acid solution (see FC 1001, section 4).

7.1.2. Rinse thoroughly with tap water.

7.1.3. Wash in dishwasher at wash cycle, using laboratory detergent cycle, followed by tap and analyte-free water rinse cycles.

7.2. Replace bottles in covered, automatic sampler base; cover with aluminum foil for storage.

7.3. Rinse bottles in the field with water as soon as possible after sampling event.

8. Glass Sequential Sample Bottles (Automatic Sampler based for Sequential Mode) to be used for Collecting Samples for Organic Compounds

8.1. Use cleaning procedures outlined in FC 1131. Allow containers to thoroughly air dry before use.

8.2. Replace bottles in covered, automatic sampler base; cover with aluminum foil for storage.

9. BOTTLE SIPHONS USED TO TRANSFER SAMPLES FROM COMPOSITE CONTAINERS

9.1. Rinse tubing with solvent and dry overnight in a drying oven.

9.2. Cap ends with aluminum foil and/or Teflon film for storage.

9.3. Seal in plastic for storage and transport.

9.4. Flush siphon thoroughly with sample before use.

10. REUSABLE TEFLON COMPOSITE MIXER RODS

10.1. Follow procedures outlined in FC 1131.

10.2. Wrap in aluminum foil for storage.

FC 1150. FILTRATION EQUIPMENT

1. Dissolved Constituents using in-line, Molded and Disposable Filter Units

1.1. Peristaltic Pump

1.1.1. Clean the pump following procedures in FC 1170, section 2.2.

1.1.2. Clean the pump head tubing following FC 1160, section 4.

1.1.3. If Teflon tubing is used, clean following the procedures in FC 1160, section 3.

1.1.4. Clean other tubing types such as polyethylene according to the appropriate procedures listed in FC 1160, section 7.

1.2. Other Equipment Types (e.g., pressurized Teflon bailer)

1.2.1. Follow the appropriate cleaning regimen specified in FC 1131 through FC 1132 for other types of equipment that utilize in-line, molded and disposable filters.

2. Dissolved Constituents using Non-disposable Filtration Units (e.g., syringes, "tripod assembly")

2.1. Stainless Steel or Glass Units

2.1.1. Follow FC 1131, assembling and applying pressure to the apparatus after each rinse step (water and acid) to drive rinsing solution through the porous filter holder in the bottom of the apparatus.

2.1.2. Remove and clean any transfer tubing according to the appropriate cleaning procedures (see FC 1160).

2.1.3. Assemble the unit and cap both the pressure inlet and sample discharge lines (or whole unit if a syringe) with aluminum foil to prevent contamination during storage.

2.1.4. If the unit will **not** be used to filter volatile or extractable organics, seal the unit in an untreated plastic bag to prevent contamination.

2.2. Reusable In-Line Filter Holders

2.2.1. Clean, using FC 1131, (if Teflon, glass or stainless steel) or FC 1132 (if plastic) assembling and applying pressure to the apparatus after each rinse step (water and acid) to drive rinsing solution through the porous filter holder in the bottom of the apparatus.

2.2.2. Assemble the unit and wrap with aluminum foil to prevent contamination during storage.

2.2.3. If the unit will **not** be used to filter volatile or extractable organics, seal the unit in an untreated plastic bag to prevent contamination.

3. FILTERS

3.1. Do not clean filters. Instructions for rinsing the filters prior to use are discussed in the applicable sampling SOPs (FS 2000 - FS 8000).

FC 1160. SAMPLE TUBING DECONTAMINATION

1. Check tubing:

1.1. For discoloration: Remove discolored tubing from use until it can be cleaned. If the discoloration cannot be removed, discard the tubing.

1.2. For elasticity (if used in a peristaltic-type pump): Discard any tubing that has lost its elasticity.

2. Transport all tubing to the field in precut, **precleaned** sections.

3. TEFLON, POLYETHYLENE AND POLYPROPYLENE TUBING

3.1. New Tubing: Follow this procedure unless the manufacturer/supplier provides certification that the tubing is clean.

3.1.1. Teflon

3.1.1.1. Rinse outside of tubing with pesticide-grade solvent (see FC 1001, section 2).

3.1.1.2. Flush inside of tubing with pesticide-grade solvent.

3.1.1.3. Dry overnight in drying oven or equivalent (zero air, nitrogen, etc.).

3.1.2. Polyethylene and Polypropylene

3.1.2.1. Clean the exterior and interior of the tubing by soaking in hot, sudsy water.

3.1.2.2. Thoroughly rinse the exterior and interior of the tubing with tap water, followed by analyte-free water.

3.2. Reused Tubing

Use the following procedure for in-lab cleaning. **Field cleaning is not recommended**:

3.2.1. Clean the exterior of the tubing by soaking in hot, sudsy water (see FC 1001, section 1) in a stainless steel sink (or equivalent non-contaminating material). Use a brush to remove any particulates, if necessary.

3.2.2. Use a small bottle brush and clean the inside of the tubing ends where the barbs are to be inserted or cut 1-2 inches from the ends of the tubing after cleaning.

3.2.3. Rinse tubing exterior and ends liberally with tap water.

3.2.4. Rinse tubing surfaces and ends with the appropriate acid solution (see FC 1001, section 4), tap water, isopropanol (see FC 1001, section 2), and finally analyte-free water.

3.2.4.1. Note: Eliminate the isopropanol rinse for polyethylene or polypropylene tubing.

3.2.5. Place tubing on fresh aluminum foil or clean polyethylene sheeting. Connect all of the precut lengths of tubing with Teflon inserts or barbs.

3.2.6. Cleaning configuration:

3.2.6.1. Place cleaning reagents: [sudsy water (see FC 1001, section 1); acid (see FC 1001, section 4); isopropanol (see FC 1001, section 2)] in an appropriately cleaned container (2-liter glass jar is recommended).

3.2.6.2. Place one end of the Teflon tubing into the cleaning solution.

3.2.6.3. Attach the other end of the Teflon tubing set to the influent end of a pump.

3.2.6.4. Recycle the effluent from the pump by connecting a length of Teflon tubing from the effluent to the glass jar with the cleaning reagents.

3.2.6.5. Recycling as described above may be done for all reagents listed in FC 1160, section 3.2.6.1 above, **except** the final isopropanol rinse and the final analyte-free water rinse. Disconnect the tubing between the effluent end of the pump and the jar of cleaning reagents.

3.2.6.6. Containerize isopropanol in a waste container for proper disposal.

3.2.6.7. Analyte-free water may be discarded down the drain.

3.2.7. Using the above configuration described in FS 1160, section 3.2.6 above:

3.2.7.1. Pump hot, sudsy water through the connected lengths. Allow the pump to run long enough to pump at least three complete tubing volumes through the tubing set.

3.2.7.2. Using the same procedure, successively pump tap water, the acid solution(s), tap water, isopropanol, and finally analyte-free water through the system.

3.2.7.3. Leave the Teflon inserts or barbs between the precut lengths and cap or connect the remaining ends.

3.2.8. After the interior has been cleaned as described in FC 1160, section 3.2.7 above, rinse the exterior of the tubing with analyte-free water.

3.2.9. Wrap the connected lengths in aluminum foil or untreated butcher paper and store in a clean, dry area until use.

4. Flexible Tubing used in Pump Heads of Automatic Samplers and other Peristaltic Pumps

Replace tubing after each sampling point if samples are collected through the tubing. Unless the pump is deployed to collect samples from the same location over a long period of time, remove and wash the tubing after each sampling event (see FC 1140, section 1).

4.1. Flush tubing with hot tap water then sudsy water (see FC 1001, section 1).

4.2. Rinse thoroughly with hot tap water.

4.3. Rinse thoroughly with analyte-free water.

4.4. If used to collect metals samples, flush the tubing with an appropriate acid solution (see FC 1001, section 4), followed by thorough rinsing with analyte-free water. If used to collect both metals and nitrogen components use hydrochloric acid (see FC 1001, section 4.1.1).

4.5. Install tubing in peristaltic pump or automatic sampler.

4.6. Cap both ends with aluminum foil or equivalent.

Note: Change tubing at specified frequencies as part of routine preventative maintenance.

5. STAINLESS STEEL TUBING

Clean the exterior and interior of stainless steel tubing as follows:

5.1. Using sudsy water (see FC 1001, section 1), scrub the interior and exterior surfaces.

5.2. Rinse with hot tap water.

5.3. Rinse with analyte-free water.

5.4. If volatile or extractable organics are to be sampled, rinse all surfaces with isopropanol (see FC 1001, section 2). Use enough solvent to wet all surfaces with free flowing solvent.

5.5. Allow to air dry or thoroughly rinse with analyte-free water.

6. GLASS TUBING

6.1. Use new glass tubing.

6.2. If volatile or extractable organics are to be sampled, rinse with isopropanol (see FC 1001, section 2).

6.3. Air dry for at least 24 hours.

6.4. Wrap in aluminum foil or untreated butcher paper to prevent contamination during storage.

6.5. Discard tubing after use.

7. MISCELLANEOUS NON-INERT TUBING TYPES (TYGON, RUBBER, PVC, ETC.)

7.1. New Tubing

7.1.1. As a general rule, new tubing may be used without preliminary cleaning.

7.1.2. Protect new tubing from potential environmental contamination by wrapping in aluminum foil and sealing in untreated plastic bags or keep in the original sealed packaging until use.

7.1.3. If new tubing is exposed to potential contamination, rinse the exterior and interior tubing surfaces with hot tap water followed by a thorough rinse with analyte-free water.

7.1.4. If new tubing is to be used to collect samples, thoroughly rinse the tubing with sample water (i.e., pump sample water through the tubing) before collecting samples.

7.2. Reused Tubing

7.2.1. Flush tubing with sudsy solution of hot tap water and laboratory detergent (see FC 1001, section 1).

7.2.2. Rinse exterior and interior thoroughly with hot tap water.

7.2.3. Rinse exterior and interior thoroughly with analyte-free water.

7.2.4. If used to collect only metals samples, flush the tubing with nitric acid (see FC 1001, section 4.1), followed by a thorough rinse with analyte-free water.

7.2.5. If used to collect metals and nitrogen-containing compounds, see FC 1001, section 4.3.

7.2.6. Cap ends in aluminum foil and store in clean, untreated plastic bags to prevent contamination during storage and transport.

FC 1170. PUMPS

1. SUBMERSIBLE PUMPS

1.1. Pumps used for Purging and Sampling Metals and/or Volatile and Extractable Organics

1.1.1. Construction of pump body and internal mechanisms (bladders, impellers, etc.), including seals and connections, must follow Tables FS 1000-1, FS 1000-2 and FS 1000-3.

1.1.2. Tubing material must follow Tables FS 1000-1, FS 1000-2 and FS 1000-3.

1.1.3. Clean pump exterior following FC 1132. Note: omit the solvent rinse if the pump body is constructed of plastic (e.g., ABS, PVC, etc.).

1.1.4. Clean the pump internal cavity and mechanism as follows:

1.1.4.1. If used only for purging, thoroughly flush the pump with water before purging the next well.

1.1.4.2. When used for purging and sampling, completely disassemble the pump (if practical) and decontaminate between each well.

1.1.4.3. When used for purging and sampling and the pump cannot be (practicably) disassembled, then clean the internal cavity/mechanism by pumping several gallons of sudsy water (see FC 1001, section 1), followed by several gallons of tap water, and finally, several gallons of analyte-free water.

1.1.4.4. If multiple sampling points are located in an area that is not accessible by a vehicle, and it is difficult to return to the vehicle for cleaning or to transport all cleaning materials to the staging location, at a minimum thoroughly rinse the pump with water.

1.1.5. Refer to FC 1160, section 3 to clean Teflon tubing.

1.1.6. Refer to FC 1160, section 5 for stainless steel tubing.

1.1.7. Clean other types of tubing according to FC 1160, sections 6 and 7.

1.2. Pumps used for Purging and Sampling all Analytes except Metals, Volatile and Extractable Organics

1.2.1. Pump construction: no restrictions.

1.2.2. Pump tubing material: no restrictions.

1.2.3. Scrub the exterior of the pump with appropriate metal-free, phosphate-free or ammonia-free detergent solution.

1.2.4. Rinse the exterior with tap water and analyte-free water.

1.2.5. Rinse the interior of the pump and tubing by pumping tap or analyte-free water through the system using a clean bucket or drum.

2. ABOVE-GROUND PUMPS USED FOR PURGING AND SAMPLING

2.1. Pumps used only for Purging

2.1.1. The exterior of the pump must be free of oil and grease.

2.1.2. Select tubing according to Tables FS 1000-1, FS 1000-2 and FS 1000-3.

2.1.3. Clean the tubing that contacts the formation water according to the appropriate protocol for construction materials specified in FC 1160.

2.2. Pumps used for Sampling

2.2.1. Clean the exterior of the pump with a detergent solution followed by a tap water rinse. Use clean cloths or unbleached paper towels that have been moistened with the appropriate solution to wipe down the pump.

2.2.2. Select tubing according to Tables FS 1000-1, FS 1000-2 and FS 1000-3.

2.2.3. Clean the tubing that contacts the formation water according to the appropriate protocol for construction materials specified in FC 1160.

FC 1180. ANALYTE-FREE WATER CONTAINERS

This section pertains to containers that are purchased to transport, store and dispense analyte-free water. It does not apply to water that has been purchased in containers. See FC 1002, section 3 for appropriate construction materials.

1. NEW CONTAINERS

1.1. Wash containers and caps according to FC 1131, omitting the solvent rinse if plastic (polyethylene or polypropylene) containers are being cleaned.

1.2. Cap with Teflon film or the bottle cap. The bottle cap must be composed of the same material as the container and cannot be lined.

2. REUSED CONTAINERS

2.1. Immediately after emptying, cap with aluminum foil, Teflon film or the container cap.

2.2. Wash the exterior of the container with lab-grade detergent solution (see FC 1001, section 1) and rinse with analyte-free water.

2.3. Rinse the interior thoroughly with analyte-free water.

2.4. Invert and allow to drain and dry.

FC 1190. ICE CHESTS AND SHIPPING CONTAINERS

1. Wash the exterior and interior of all ice chests with laboratory detergent (see FC 1001, section 1) after each use.

2. Rinse with tap water and air dry before storing.

3. If the ice chest becomes severely contaminated with concentrated waste or other toxic or hazardous materials clean as thoroughly as possible, render unusable, and properly dispose.

FC 1200. Field Instruments and Drilling Equipment

FC 1210. FIELD INSTRUMENTS (TAPES, METERS, ETC.)

Follow manufacturer's recommendations for cleaning instruments. At a minimum:

1. Wipe down equipment body, probes, and cables with lab-grade detergent solution (see FC 1001, section 1). Check manufacturer's instructions for recommendations and/or restrictions on cleaning.

2. Rinse thoroughly with tap water.

3. Rinse thoroughly with analyte-free water.

4. Store equipment according to the manufacturer's recommendation or wrap equipment in aluminum foil, untreated butcher paper or untreated plastic bags to eliminate potential environmental contamination.

FC 1220. SOIL BORING EQUIPMENT

This section pertains only to equipment that is not used to collect samples. Clean split spoons, bucket augers and other sampling devices according to FC 1131.

1. Remove oil, grease, and hydraulic fluid from the exterior of the engine and power head, auger stems, bits and other associated equipment with a power washer or steam jenny or wash by hand with a brush and sudsy waster (no degreasers).

2. Rinse thoroughly with tap water.

FC 1230. WELL CASING CLEANING

These are recommended procedures for cleaning well casing and riser pipes. Use procedures specified by a FDEP contract, order, permit, or rule, if different or more stringent than the procedures outlined below.

1. FDEP recommends only using casing that is designed for subsurface environmental groundwater monitoring.

2. Casing that has been contaminated with grease, hydraulic fluid, petroleum fuel, etc. may require additional cleaning or deemed unusable.

3. All casings and riser pipes should be cleaned before installation, unless the casing is received wrapped and ready for installation:

   3.1. Steam clean all casings and riser pipes except PVC. Steam cleaning criteria shall meet the following: water pressure - 2500 psi; water temperature - 200°F.

   3.2. Rinse thoroughly with tap (potable) water. This tap water must be free of the analytes of interest.

FC 1300. Sample Containers

FC 1310. Obtaining Clean Containers

1. Obtain clean sample containers in one of three ways:

   1.1. From commercial vendors as precleaned containers. The cleaning grades must meet EPA analyte specific requirements. Keep all records for these containers (lot numbers, certification statements, date of receipt, etc.) and document the container's intended uses;

   1.2. From internal groups within the organization that are responsible for cleaning and maintaining containers according to the procedures outlined in FC 1320; or

   1.3. From a subcontracted laboratory that is accredited under the National Environmental Laboratory Accreditation Program (NELAP).

      1.3.1. The contractor must verify that the laboratory follows the container cleaning procedures outlined in FC 1320.

      1.3.2. If the laboratory cleaning procedures are different, the contractor must require that the laboratory use the following cleaning procedures or provide documentation and historical records to show that their in-house procedure produces containers that are free from the analytes of interest.

FC 1320. Container Cleaning Procedures

1. Refer to Table FC 1000-2. Follow the cleaning steps in the order specified in the chart.

2. Cleaning procedures that are different from those outlined in FC 1320 may be used as long as blanks collected in the containers are free from the analytes of interest and any analytical interferences and the cleaning procedures are supported by historical and continuing documentation.

3. Inspect all containers before cleaning.

   3.1. **Do not recycle or reuse containers if**:

      3.1.1. Containers were used to collect in-process (i.e., untreated or partially treated) wastewater samples at industrial facilities;

      3.1.2. A visible film, scale or discoloration remains in the container after the cleaning procedures have been used; or

      3.1.3. Containers were used to collect samples at pesticide, herbicide or other chemical manufacturing facilities that produce toxic or noxious compounds. Such containers shall be properly disposed of (preferably at the facility) at the conclusion of the sampling activities.

      3.1.4. If the containers described above are reused, check no less than 10% of the cleaned containers for the analytes of interest before use. If found to be contaminated (i.e., analytes of interest are found at MDL levels or higher), discard the containers.

FC 1400. Documentation

Document cleaning procedures described below for the indicated activities. See FD 1000 for additional information about required records and retention of documents.

FC 1410. Field Equipment

1. In-field Cleaning

1.1. Initially identify the procedures that are used to clean equipment in the field by SOP numbers and dates of usage.

1.2. Record the date and time that equipment was cleaned.

2. IN-HOUSE CLEANING

2.1. Retain any cleaning certificates, whether from a laboratory or commercial vendor.

2.2. Identify the procedure(s) that are used to clean equipment by the SOP number and dates of usage.

2.3. Record the date that the equipment was cleaned.

FC 1420. SAMPLE CONTAINERS

1. Organizations that order precleaned containers must retain the packing slips, and lot numbers of each shipment, any certification statements provided by the vendor and the vendor cleaning procedures.

2. Organizations that clean containers must maintain permanent records of the following:

2.1. Procedure(s) used to clean containers by SOP number and dates of usage.

2.2. If containers are certified clean by the laboratory the laboratory must record:

- Type of container;
- Date cleaned;
- SOP used;
- Person responsible for cleaning;
- Lot number (date of cleaning may be used) of the batch of containers that were cleaned using the same reagent lots and the same procedure;
- The results of quality control tests that were run on lot numbers; and
- Any additional cleaning or problems that were encountered with a specific lot.

FC 1430. REAGENTS AND OTHER CLEANING SUPPLIES

Maintain a record of the lot number with the inclusive dates of use for all acids, solvents, and other cleaning supplies.

Appendix FC 1000
Tables, Figures and Forms

Table FC 1000-1 Procedures for Decontamination at the Base of Operations or On-site
Table FC 1000-2 Container Cleaning Procedures

Table FC 1000-1
Procedures for Decontamination at the Base of Operations or On-Site

Construction Material	Analyte Group Sampled	SOP Reference	Base of Operations	On-Site
Teflon or Glass	All	FC 1131	Follow as written	May substitute ambient temperature water for the hot water rinses and hot detergent solution
	Extractable & Volatile Organics Petroleum Hydrocarbons		May omit acid rinse	May substitute ambient temperature water for the hot water rinses and hot detergent solution May omit acid rinse
	Metals[l] Radionuclides For ultra trace metals, refer to FS 8200		May omit solvent rinse	May substitute ambient temperature water for the hot water rinses and hot detergent solution May omit solvent rinse
	Inorganic Nonmetallics Physical & Aggregate Properties Aggregate Organics Biologicals Volatile Inorganics		May omit solvent rinse	Rinse several times with water Rinse several times with sample water from the next sampling location
	Microbiological – Viruses Microbiological - Bacteria		Omit solvent and acid rinses	Rinse several times with water Rinse several times with sample water from the next sampling location
Metallic (stainless steel, brass, etc.)	All Extractable & Volatile Organics Petroleum Hydrocarbons	FC 1131	Omit the acid rinse	May substitute ambient temperature water for the hot water rinses and hot detergent solution Omit the acid rinse
	Metals Radionuclides		Omit the acid rinse May omit the solvent rinse	May substitute ambient temperature water for the hot water rinses and hot detergent solution Omit the acid rinse May omit the solvent rinse
	Inorganic Nonmetallics Physical & Aggregate Properties Aggregate Organics Biologicals Volatile Inorganics		Omit solvent rinse May omit the acid rinse	Rinse several times with water Rinse several times with sample water from the next sampling location

Table FC 1000-1
Procedures for Decontamination at the Base of Operations or On-Site

Construction Material	Analyte Group Sampled	SOP Reference	Base of Operations	On-Site
	Microbiological – Viruses Microbiological - Bacteria		Omit solvent and acid rinses	Rinse several times with water Rinse several times with sample water from the next sampling location
Plastic (Polyethylene, polypropylene, PVC, silicone, acrylic	Volatile and Extractable Organics;	FC 1132	Follow as written.	May substitute ambient temperature water for the hot water rinses and hot detergent solution
	Inorganic Nonmetallics Physical & Aggregate Properties Aggregate Organics Biologicals Volatile Inorganics		May omit the acid rinse	Rinse several times with water Rinse several times with sample water from the next sampling location
	Microbiological – Viruses Microbiological - Bacteria		Omit acid rinse	Rinse several times with water Rinse several times with sample water from the next sampling location

[i] Do not use glass if collecting samples for boron or silica.

Table FC 1000-2
Container Cleaning Procedures

ANALYSIS / ANALYTE GROUP	CLEANING STEPS See Description Below
Extractable Organics	1, 2, 4, 6 (not required if Luminox (or equivalent is used), (5 and 7 optional), 11
Volatile Organics	1, 2, 4, (6 optional, methanol only), 7
Metals	1, 2, 3, 4, 8, 11 ** **Procedures to clean containers for ultra-trace metals are found in FS 8200
Inorganic Nonmetallics, Radionuclides, Physical and Aggregate Properties, Aggregate Inorganics, and Volatile Inorganics	1, 2, 3*, 4, 8, 11 * For nutrients, replace nitric acid with hydrochloric acid, or use a hydrochloric acid rinse after the nitric acid rinse. See FC 1001, section 4
Petroleum Hydrocarbons, and Oil and Grease	1, 2, 3, 4, (5, 6, 7 optional), 11
Microbiological (all)	1, 2, 4, 8, 9, 11
Toxicity Tests (Includes Bioassays)	1, 2, 10, 2, 4, 6.1, (10 optional), 11

NOTE: Steps 1 and 2 may be omitted when cleaning new, uncertified containers.

1. Wash with hot tap water and a brush using a suitable laboratory-grade detergent:
   1.1. Volatile and Extractable Organics, Petroleum Hydrocarbon, Oil and Grease: Luminox, Liqui-Nox, Alconox or equivalent;
   1.2. Inorganic nonmetallics: Liqui-Nox or equivalent;
   1.3. Metals: Liqui-Nox, Acationox, Micro or equivalents:
   1.4. Microbiologicals (all): Must pass an inhibitory residue test.
2. Rinse thoroughly with hot tap water.
3. Rinse with 10% nitric acid solution.
4. Rinse thoroughly with analyte-free water (deionized or better).
5. Rinse thoroughly with pesticide-grade methylene chloride.
6. Rinse thoroughly with pesticide-grade isopropanol, acetone or methanol.
   6.1. For bioassays, use only acetone, and only when containers are glass.
7. Oven dry at 103°C to 125°C for at least 1 hour.
   7.1. VOC vials and containers must remain in the oven in a contaminant-free environment until needed. They should be capped in a contaminant-free environment just prior to dispatch to the field.
8. Invert and air-dry in a contaminant-free environment.
9. Sterilize containers:

Table FC 1000-2
Container Cleaning Procedures

9.1. Plastic: 60 min at 170°C, loosen caps to prevent distortion.

9.2. Glass: 15 min at 121°C.

10. Rinse with 10% hydrochloric acid followed by a sodium bicarbonate solution.

11. Cap tightly and store in a contaminant-free environment until use. Do not use glass if collecting samples for boron or silica.

FS 1000. GENERAL SAMPLING PROCEDURES

See also the following Standard Operating Procedures:

- FA 1000 and 2000 Administrative Procedures
- FC 1000 Cleaning/Decontamination Procedures
- FD 1000-9000 Documentation Procedures
- FM 1000 Field Planning and Mobilization
- FQ 1000 Field Quality Control Requirements

FS 1001. *Preliminary Activities*

1. Begin each sampling trip with some planning and coordination. Refer to FM 1000 for recommendations and suggestions on laboratory selection and communication, and field mobilization.

   1.1. DEP recommends that a minimum of two people be assigned to a field team. In addition to safety concerns, the process of collecting the samples, labeling the containers and completing the field records is much easier if more than one person is present.

   1.2. If responding to incidents involving hazardous substances, DEP recommends that four or five people be assigned to the team.

2. EQUIPMENT

   2.1. Select appropriate equipment based on the sampling source (see FS 2000 to FS 8200), the analytes of interest and the sampling procedure.

      2.1.1. If properly cleaned, sample containers may be used as collection devices or intermediate containers.

   2.2. The equipment construction must be consistent with the analytes or analyte groups to be collected (see Tables FS 1000-1 through FS 1000-3).

   2.3. Bring precleaned equipment to the field or use equipment that has been certified clean by the vendor or laboratory.

3. DEDICATED EQUIPMENT STORAGE

   3.1. Store all dedicated equipment (except dedicated pump systems or dedicated drop pipes) in a controlled environment.

   3.2. If possible, store equipment in an area that is located away from the sampling site. If equipment other than dedicated pumps or dedicated drop pipes is stored in monitoring wells, suspend the equipment above the formation water.

   3.3. Securely seal the monitoring well in order to prevent tampering between sampling events.

   3.4. Decontaminate all equipment (except dedicated pumps or drop pipes) before use according to the applicable procedures in FC 1000.

4. SAMPLE CONTAINERS

   4.1. The analyses to be performed on the sample determine the construction of sample containers.

   4.2. Inspect all containers and lids for flaws (cracks, chips, etc.) before use. Do not use any container with visible defects or discoloration.

FS 1002. *Contamination Prevention*

1. CONTAMINATION PREVENTION

1.1. Take special effort to prevent cross contamination and contamination of the environment when collecting samples. Protect equipment, sample containers and supplies from accidental contamination.

1.1.1. Do not insert pump tubing, measurement probes, other implements, fingers, etc. into sample containers or into samples that have been collected for laboratory analysis.

1.1.1.1. If it is necessary to insert an item into the container or sample, ensure that the item is adequately decontaminated for the analytes of interest to be analyzed in the sample.

1.1.2. If possible, collect samples from the least contaminated sampling location (or background sampling location) to the most contaminated sampling location.

1.1.2.1. Collect the ambient or background samples first and store them in separate ice chests or shipping containers.

1.1.3. Collect samples in flowing water from downstream to upstream.

1.1.4. Do not store or ship highly contaminated samples (concentrated wastes, free product, etc.) or samples suspected of containing high concentrations of contaminants in the same ice chest or shipping container with other environmental samples.

1.1.4.1. Isolate these sample containers by sealing them in separate, untreated plastic bags immediately after collecting, preserving, labeling, etc.

1.1.4.2. Use a clean, untreated plastic bag to line the ice chest or shipping container.

1.1.5. Segregate reagents such as preservation acids during storage and transport as necessary to prevent cross-contamination of samples or other reagents.

2. COMPOSITE SAMPLES

2.1. Do not collect composite samples unless required by permit or DEP program.

2.2. If compositing is required, use the following procedure:

2.2.1. Select sampling points from which to collect each aliquot.

2.2.2. Using the appropriate sampling technique, collect equal aliquots (same sample size) from each location and place in a properly cleaned container.

2.2.3. Record the approximate amount of each aliquot (volume or weight).

2.2.4. Add preservative(s), if required.

2.2.5. Label container and make appropriate field notes (see FD 1000-9000).

2.2.6. Notify the laboratory that the sample is a composite sample.

2.2.7. When collecting soil or sediment samples, combine the aliquots of the sample directly in the sample container with no pre-mixing. Notify the laboratory that the sample is an unmixed composite sample, and request that the laboratory thoroughly mix the sample before sample preparation or analysis.

2.2.8. When collecting water composites see FS 2000, section 1.3 or pertinent sections of other water matrix SOPs for specific details on collection.

FS 1003. *Protective Gloves*

1. Gloves serve a dual purpose to:

- Protect the sample collector from potential exposure to sample constituents
- Minimize accidental contamination of samples by the collector

2. The DEP recommends wearing protective gloves when conducting all sampling activities. They must be worn except when:
    - The sample source is considered to be non-hazardous
    - The samples will not be analyzed for trace constituents
    - The part of the sampling equipment that is handled without gloves does not contact the sample source
3. Do not let gloves come into contact with the sample or with the interior or lip of the sample container.
4. Use clean, new, unpowdered and disposable gloves.
    4.1. DEP recommends latex gloves, however, other types of gloves may be used as long as the construction materials do not contaminate the sample or if internal safety protocols require greater protection.
    4.2. Note that certain materials (as might be potentially present in concentrated effluent) may pass through certain glove types and be absorbed in the skin. Many vendor catalogs provide information about the permeability of different gloves and the circumstances under which the glove material might be applicable.
    4.3. The powder in powdered gloves can contribute significant contamination and DEP does not recommend wearing powdered gloves unless it can be demonstrated that the powder does not interfere with the sample analysis.
5. If gloves are used, change:
    - After preliminary activities such as pump placement;
    - After collecting all the samples at a single sampling point; or
    - If torn, or used to handle extremely dirty or highly contaminated surfaces.
6. Properly dispose of all used gloves.

FS 1004. *Container and Equipment Rinsing*

When collecting aqueous samples, rinse the sample collection equipment with a portion of the sample water before taking the actual sample. Sample containers do not need to be rinsed. In the case of petroleum hydrocarbons, oil & grease or containers with premeasured preservatives, the sample containers cannot be rinsed.

FS 1005. *Fuel-Powered Equipment and Related Activities*

1. Place all fuel-powered equipment away from, and downwind of, any site activities (e.g., purging, sampling, decontamination). If field conditions preclude such placement (i.e., the wind is from the upstream direction in a boat), place the fuel source(s) as far away as possible from the sampling activities and describe the conditions in the field notes.
2. Handle fuel (i.e., filling vehicles and equipment) prior to the sampling day. If such activities must be performed during sampling, the personnel must wear disposable gloves. Dispense all fuels, dispose of gloves downwind, and well away from the sampling activities.
3. If sampling at active gas stations, stop sample collection activities during fuel deliveries.

FS 1006. *Preservation, Holding Times and Container Types*

1. Preserve all samples according to the requirements specified in Tables FS 1000-4 through FS 1000-11.

1.1. The information listed in the above-referenced tables supersedes any preservation techniques, holding time or container type that might be discussed in individual analytical methods.

1.2. If samples are collected only for total phosphorus and are not for NPDES compliance, thermal preservation (ice) is not required if the sample containers are pre-preserved with acid.

2. The preservation procedures in the referenced tables specify immediate preservation. "Immediate" is defined as "within 15 minutes of sample collection." Perform all preservation on-site (in the field).

2.1. Preservation is not required if samples can be transported back to the laboratory within 15 minutes of collecting the sample and

2.1.1. The laboratory begins sample analysis within the 15-minute window and documents the exact time the analysis began, or

2.1.2. The laboratory adds the appropriate preservatives (including thermal preservation) within 15 minutes of sample collection and documents the exact time that the preservation was done.

3. PRESERVING COMPOSITE WATER SAMPLES

3.1. If the sample preservation requires thermal preservation (e.g., <6°C), the samples must be cooled to the specified temperature.

3.1.1. Manually collected samples to be composited must be refrigerated at a temperature equal to or less than the required temperature.

3.1.2. Automatic samplers must be able to maintain the required temperature by packed ice or refrigeration.

3.2. When chemical preservation is also required, begin the preservation process within 15 minutes of the last collected sample.

3.3. Holding Times for Automatic Samplers:

3.3.1. If the collection period is 24 hours or less, the holding time begins at the last scheduled sample collection;

3.3.2. If the collection period exceeds 24 hours, the holding time begins with the time that the first sample is collected.

4. PH ADJUSTED PRESERVATION - Check the pH of pH-adjusted samples according to these frequencies:

4.1. During the first sampling event at a particular site, check **all** samples (includes each groundwater monitoring well, surface water location, or influent/effluent sampling location) that are pH-adjusted except volatile organics.

4.2. During subsequent visits to a particular site, check at least one sample per parameter group that must be pH-adjusted.

4.3. If the frequency of sample collection at a specified location is greater than once per month (i.e., weekly or daily), check the pH of at least one sample per parameter group (except volatile organics) according to the following schedule:

4.3.1. Weekly sampling: 1 pH check per month

4.3.2. Daily sampling: 1 pH check per week

4.4. If the frequency of sample collection at a specified location is once per month, check the pH of at least one sample per parameter group (except volatile organics) quarterly.

4.5. If site conditions vary from sampling event to sampling event, perform pH checks at increased intervals.

5. THERMAL PRESERVATION

5.1. When preservation requirements indicate cooling to a specific temperature, samples must be placed in wet ice within 15 minutes of sample collection (see 1006, section 2 above). Unless specified, do not freeze samples.

5.2. All supplies (ice, dry ice, etc.) necessary to meet a thermal preservation requirement must be onsite for immediate use.

5.3. Ship samples in wet ice. If samples are cooled to the required temperature before shipment, samples may be shipped with frozen ice packs if the specified temperature is maintained during shipment. The sample temperature must not exceed the specified temperature.

5.4. If immediate freezing is required, dry ice must be available in the field to begin the freezing process.

FS 1007. *Preventive and Routine Maintenance*

Preventive maintenance activities are necessary to ensure that the equipment can be used to obtain the expected results and to avoid unusable or broken equipment while in the field. Equipment is properly maintained when:

- It functions as expected during mobilization; and
- It is not a source of sample contamination (e.g., dust).

1. Follow the manufacturer's suggested maintenance activities and document all maintenance. At a minimum, DEP recommends the activities listed on Table FS 1000-12.

2. Maintain documentation for the following information for each piece of equipment or instrumentation. See FD 3000 also.

2.1. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit employed. This identifier may include a manufacturer name, model number, serial number, inventory number or other unique identification.

2.2. Log all maintenance and repair performed for each instrument unit, including routine cleaning procedures and solution or parts replacement for instrument probes.

2.3. Include the calendar date for the procedures performed.

2.4. Record names of personnel performing the maintenance or repair tasks.

2.5. Describe any malfunctions necessitating repair or service.

2.6. Retain vendor service records for all affected instruments.

2.7. Record the following for rented equipment:

- Rental date(s)
- Equipment type and model or inventory number or other description

2.8. Retain the manufacturer’s operating and maintenance instructions.

FS 1008. *Documentation and References*

1. REFERENCES: All sampling references must be available for consultation in the field. These include:

- DEP SOPs;
- Internal SOPs;
- Sampling and analysis plans; and/or
- Quality Assurance Project Plans.

2. DOCUMENTATION: Complete and sign all documentation (see FD 1000).

FS 1009. *Sample Documentation and Evidentiary Custody*

1. SAMPLE DOCUMENTATION

1.1. Document all activities related to a sampling event, including sample collection, equipment calibration, equipment cleaning and sample transport.

1.2. The required documentation related to each sampling or other field activity is specified in the associated SOPs; i.e., FQ 1000, FC 1000, the FS series, and the FT series.

1.3. The documentation requirements are also summarized in FD 1000, Field Documentation. FD 1000 additionally contains a list of example forms published with the SOPs that may be used to document various activities or as templates for creating customized forms.

2. LEGAL CHAIN OF CUSTODY (COC)

The use of legal or evidentiary Chain-of-Custody (COC) protocols is not usually required by DEP, except for cases involving civil or criminal enforcement. Do not use these procedures for routine sampling for compliance unless evidentiary custody protocols are specifically mandated in a permit or other legal order or when required for enforcement actions.

Evidentiary sample custody protocols are used to demonstrate that the samples and/or sample containers were handled and transferred in such a manner as to eliminate possible tampering.

When a client or situation requires legal COC, use the procedures in FD 7000 to document and track all time periods associated with the physical possession and storage of sample containers, samples, and subsamples from point of origin through the final analytical result and sample disposal.

When legal or evidentiary COC is required, samples must be:

- In the actual possession of a person who is authorized to handle the samples (e.g., sample collector, laboratory technician);
- In the view of the same person after being in their physical possession;
- Secured by the same person to prevent tampering; or
- Stored in a designated secure area.

2.1. Control and document access to all evidentiary samples and subsamples with adequate tracking. Documentation must include records about each of the activities and situations listed below, when applicable to sample evidence, and must track the location and physical handling of all samples by all persons at all times.

2.1.1. Limit the number of individuals who physically handle the samples as much as practicable.

2.1.2. When storing samples and subsamples, place samples in locked storage (e.g., locked vehicle, locked storeroom, etc.) at all times when not in the possession or view of authorized personnel.

2.1.3. Alternatively, maintain restricted access to facilities where samples are stored. Ensure that unauthorized personnel are not able to gain access to the samples at any time.

2.1.4. Do not leave samples in unoccupied motel or hotel rooms or other areas where access cannot be controlled by the person(s) responsible for custody without first securing samples and shipping or storage containers with tamper-indicating evidence tape or custody seals. Ice chests or other storage containers used to store sample containers in hotel rooms may be sealed instead of sealing each sample container stored within.

2.2. Use a Chain of Custody form or other transmittal record to document sample transfers to other parties. Other records and forms may be used to document internal activities if they meet the requirements for legal chain of custody.

2.3. Legal COC begins when the precleaned sample containers are dispatched to the field.

2.3.1. The person who relinquishes the prepared sample kits or containers and the individual who receives the sample kits or containers must sign the COC form unless the same party provides the containers and collects the samples.

2.3.2. All parties handling the empty sample containers and samples are responsible for documenting sample custody, including relinquishing and receiving samples, except commercial common carriers.

2.4. Shipping Samples under Legal COC

2.4.1. Complete all relevant information on the COC transmittal form or record (see FD 7200, section 2).

2.4.2. Internal records must document the handling of the samples and shipping containers in preparation for shipment. The names of all persons who have prepared the shipment must be recorded. All time intervals associated with handling and preparation must be accounted for.

2.4.3. Place the forms in a sealed waterproof bag and place in the shipping container with the samples.

2.4.4. Seal the shipping container with tamper-proof seals (see 2.6 below) so that any tampering can be clearly seen by the individual who receives the samples.

2.4.5. Note: The common carrier does not sign COC records. However, the common carrier (when used) must be identified.

2.5. Delivering Samples to the Laboratory

2.5.1. All individuals who handle and relinquish the sample containers must sign the transmittal form. The legal custody responsibilities of the field operations end when the samples are relinquished to the laboratory.

2.6. Chain of Custody Seals: If required, affix tamper-indicating evidence tape or seals to all sample, storage and shipping container closures when transferring or shipping sample container kits or samples to another party.

2.6.1. Place the seal so that the closure cannot be opened without breaking the seal.

2.6.2. Record the time, calendar date and signatures of responsible personnel affixing and breaking all seals for each sample container and shipping container.

2.6.3. Affix new seals every time a seal is broken until continuation of evidentiary custody is no longer required.

FS 1010. *Health and Safety*

Implement all local, state and federal requirements relating to health and safety.

FS 1011. *Hazardous Wastes*

Investigators and sampling personnel should attempt to follow all local, state and federal requirements pertaining to the storage and disposal of any hazardous or investigation-derived wastes (IDW). The discussion below is not intended to describe these requirements and is provided for informational purposes only.

1. All IDW should be properly managed so that contamination is not spread into previously uncontaminated areas.

1.1. IDW typically includes all water, soil, drilling mud, decontamination wastes, discarded personal protective equipment (PPE), etc. from site investigations, exploratory borings, piezometer and monitoring well installation, refurbishment, and abandonment, and other investigative activities. IDW should be containerized at the time it is generated.

1.2. Investigators and sampling personnel should determine if the IDW must be managed as Resource Conservation and Recovery Act (RCRA) regulated hazardous waste through appropriate testing or generator knowledge. IDW that is determined to be RCRA regulated hazardous waste should be managed according to the applicable local, state and federal requirements.

1.3. IDW that is not a RCRA regulated hazardous waste but is contaminated above the Department's Soil Cleanup Target Levels or the state standards and/or minimum criteria for ground water quality should be properly disposed of according to the applicable local, state and federal requirements.

1.4. IDW that is not contaminated or contains contaminants below the Department's Soil Cleanup Target Levels or the state standards and/or minimum criteria for ground water quality may be disposed of onsite if the IDW will not cause a surface water violation. However, investigators and sampling personnel should first verify that all applicable regulations have been met before disposal of the IDW.

1.5. All containers holding IDW should be maintained in good condition:

1.5.1. Containers should be periodically inspected for damage

1.5.2. Personnel should ensure that all required labeling (DOT, RCRA, etc.) is clearly visible.

Appendix FS 1000
Tables, Figures and Forms

Table FS 1000-1 Equipment Construction Materials
Table FS 1000-2 Construction Material Selection for Equipment and Sample Containers
Table FS 1000-3 Equipment Use and Construction
Table FS 1000-4 40 CFR Part 136 Table II: Required Containers, Preservation Techniques, and Holding Times (Water/Wastewater Samples)
Table FS 1000-5 Approved Water and Wastewater Procedures, Containers, Preservation and Holding Times for Analytes not found in 40 CFR Part 136
Table FS 1000-6 Recommended Sample Containers, Sample Volumes, Preservation Techniques and Holding Times for Residuals, Soil and Sediment Samples.
Table FS 1000-7 Sample Handling, Preservation and Holding Time Table for SW 846 Method 5035
Table FS 1000-8 Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II
Table FS 1000-9 Containers, Preservation and Holding Times for Biosolids Samples and Protozoans
Table FS 1000-10 Container Materials, Preservation, and Holding Times for Fish and Shellfish
Table FS 1000-11 Holding Times for SPLP or TCLP Extraction, Sample Preparation and Determinative Analysis
Table FS 1000-12 Preventive Maintenance Tasks
Figure FS 1000-1 Organic Trap Configuration for Collecting Extractable Organics with a Peristaltic Pump

Table FS 1000-1
Equipment Construction Materials

Construction Material[1]	Acceptable Analyte Groups	Precautions
Metals		
316 Stainless Steel	All analyte groups. Recommended for inorganic nonmetallics, metals, volatile and extractable organics.	Do not use if weathered, corroded or pitted.[2]
300-Series Stainless Steel (304, 303, 302)	Suitable for all analyte groups (if used, check for corrosion before use). Recommended for inorganic nonmetallics, metals, volatile and extractable organics.	Do not use if weathered, corroded or pitted.[2] If corroded, there is a potential for samples to be contaminated with iron, chromium, copper or nickel. Check for compatibility with water chemistry for dedicated applications. Do not use in low pH, high chloride, or high TDS waters.
Low Carbon Steel Galvanized Steel Carbon Steel	Inorganic nonmetallics only.	Coring devices are acceptable for all analyte groups **if** appropriate liners are used. Use Teflon liners for organics. Use plastic or Teflon liners for metals. Do not use if weathered, corroded or pitted.[2] If corroded, there is a potential for samples to be contaminated with iron and manganese. Galvanized equipment will also contaminate with zinc and cadmium. If used to collect large samples (e.g., dredges), collect organic and metal samples may be collected from portions of the interior of the collected material.
Brass	Inorganic nonmetallics only.	Do not use if weathered, corroded or pitted.[2]
Plastics[3]		
Teflon and other fluorocarbon polymers	All analyte groups. Especially recommended for trace metals and organics.	Easily scratched. Do not use if scratched or discolored.
Polypropylene Polyethylene (All Types)	All analyte groups.	LDPE may not be used for pump tubing when collecting for VOCs. Easily scratched. Do not use if scratched or discolored.
Polyvinyl chloride (PVC)	All analyte groups except extractable and volatile organics.	Do not use when collecting extractable or volatile organics samples.

Table FS 1000-1
Equipment Construction Materials

Construction Material[1]	Acceptable Analyte Groups	Precautions
Tygon, Silicone, Neoprene	All analyte groups except extractable and volatile organics.	Do not use when collecting extractable or volatile organic samples (see Table FS 1000-3 for silicone tubing exceptions). Do not use silicone if sampling for silica.
Viton	All analyte groups except extractable and volatile organics.[4]	Minimize contact with sample. Use only if no alternative material exists.
Glass		
Glass, borosilicate	All analyte groups except silica and boron.	

Adapted from USGS Field Manual, Chapter 2, January 2000.

[1] Refers to construction material of the portions of the sampling equipment that come in contact with the sample (e.g., housing of variable speed submersible pump must be stainless steel if extractable organics are sampled; the housing of a variable speed submersible pump used to sample metals may be plastic.)

[2] Corroded/weathered surfaces are active sorption sites for organic compounds.

[3] Plastics used in connection with inorganic trace element samples (including metals) must be uncolored or white.

[4] May be allowable for specialized parts where no alternative material exists (e.g., Viton seals are the best available seal for some dedicated pump systems), however, contact with the sample must be minimized.

Table FS 1000-2
Construction Material Selection for Equipment and Sample Containers

Analyte Group	Acceptable Materials
Extractable Organics (see Table FS 1000-3 for silicone tubing exceptions)	Teflon Stainless steel Glass Polypropylene (All types) Polyethylene (All types) All parts of the system including connectors and gaskets must be considered – Viton may be used if no other material is acceptable.
Volatile Organics (see Table FS 1000-3 for silicone tubing exceptions)	Teflon Stainless steel Glass Polypropylene (All types) Polyethylene (All types excluding LDPE) All parts of the system including connectors and gaskets must be considered – Viton may be used if no other material is acceptable.
Metals	Teflon Stainless steel Polyethylene (All types) Polypropylene (All types) Tygon, Viton, Silicone, Neoprene PVC Glass (except silica and boron)
Ultratrace Metals	Teflon Polyethylene (All types) Polypropylene (All types) Polycarbonate Mercury must be in glass or Teflon
Inorganic Nonmetallics	Teflon Stainless steel Low carbon, Galvanized or Carbon steel Polyethylene (All types) Polypropylene (All types) Tygon, Viton, Silicone, Neoprene PVC Glass Brass

Table FS 1000-2
Construction Material Selection for Equipment and Sample Containers

Analyte Group	Acceptable Materials
Microbiological samples	Teflon Stainless steel Polyethylene (All types) Polypropylene (All types) Tygon, Viton, Silicone, Neoprene PVC Glass Sterilize all **sample** containers. Thoroughly clean **sampling equipment** and rinse several times with sample water before collection. Sampling equipment **does not require** sterilization **Do not rinse sample containers**

Table FS 1000-3
Equipment Use and Construction

EQUIPMENT	CONSTRUCTION		USE	PERMISSIBLE ANALYTE GROUPS	RESTRICTIONS AND PRECAUTIONS
	HOUSING[1]	TUBING			
WATER SAMPLING					
GROUNDWATER					
1 Positive displacement pumps[2]					
a. Submersible (turbine, helical rotor, gear driven)	SS, Teflon	SS, Teflon, PE[14], PP	Purging	All analyte groups	[3,4,5]; must be variable speed
			Sampling	All analyte groups	[3,4,5] must be variable speed
	SS, Teflon	Non-inert[6]	Purging	All analyte groups	[3,4,5] must be variable speed; polishing required[7]
			Sampling	All analyte groups except volatile and extractable organics	Must be variable speed If sampling for metals, the tubing must be non-metallic if not SS
	Non-inert[6]	Non-inert[6]	Purging	All analyte groups	[3,4,5] must be variable speed; polishing required[7]
			Sampling	All analyte groups except volatile and extractable organics	Must be variable speed If sampling for metals, the tubing must be non-metallic if not SS
b. Bladder pump (no gas contact)	SS, Teflon, PE, PP or PVC if permanently installed	SS, Teflon, PE[14], PP	Purging	All analyte groups	[3,4,5] must be variable speed
			Sampling	All analyte groups	[3,4] must be variable speed Bladder must be Teflon if sampling for volatile or extractable organics or PE or PP if used in portable pumps
	SS, Teflon, PE, PP	Non-inert[6]	Purging	All analyte groups	[3,4] must be variable speed; polishing required[7] **This configuration is not recommended**
			Sampling	All analyte groups except volatile and extractable organics	[3,4] must be variable speed If sampling for metals, the tubing must be non-metallic if not SS
	Non-inert[6]	Non-inert[6]	Purging	All analyte groups	[3,4] must be variable speed; polishing required[7]
			Sampling	All analyte groups except volatile and extractable organics	[3,4] must be variable speed; polishing required[7] If sampling for metals, the tubing must be non-metallic if not SS

Table FS 1000-3
Equipment Use and Construction

EQUIPMENT	CONSTRUCTION		USE	PERMISSIBLE ANALYTE GROUPS	RESTRICTIONS AND PRECAUTIONS
	HOUSING[1]	TUBING			
2. Suction lift pumps					
a. Centrifugal	N/A	SS, Teflon, PE[14], PP	Purging	All analyte groups	[4] foot-valve required Must be variable speed
	N/A	Non-inert[6]	Purging	All analyte groups	[4] foot-valve required; polishing required[7] Must be variable speed
b. Peristaltic	N/A	SS, Teflon, PE[14], PP	Purging	All analyte groups	[4] foot-valve required; polishing required[7] or continuous pumping required Must be variable speed
			Sampling	All analyte groups	[4] Silicone tubing in pump head Must be variable speed
	N/A	Non-inert[6]	Purging	All analyte groups	[4] foot-valve required Must be variable speed
			Sampling	All analyte groups except volatile and extractable organics	[4] Silicone tubing in pump head Must be variable speed
3. Bailers	SS, Teflon, PE, PP	N/A	Purging	All analyte groups	None; **not recommended**
		N/A	Sampling	All analyte groups	None; **not recommended**
	Non-inert[6]	N/A	Purging	All analyte groups except volatile and extractable organics	None; **not recommended** If sampling for metals, the tubing must be non-metallic if not SS
			Sampling	All analyte groups except volatile and extractable organics	None; **not recommended** If sampling for metals, the tubing must be non-metallic if not SS
SURFACE WATER					
1. Intermediate containers such as pond sampler, scoops, beakers, buckets, and dippers	SS, Teflon, Teflon-coated, PE, PP	N/A	Grab sampling	All analyte groups	None
	Glass	N/A		All analyte groups except boron and fluoride	None
	Non-inert[6]	N/A		All analyte groups except volatile and extractable organics	None

Table FS 1000-3
Equipment Use and Construction

EQUIPMENT	CONSTRUCTION		USE	PERMISSIBLE ANALYTE GROUPS	RESTRICTIONS AND PRECAUTIONS
	HOUSING[1]	TUBING			
2. Nansen, Kemmerer, Van Dorn, Alpha and Beta Samplers, Niskin (or equivalent)	SS, Teflon, Teflon-coated, PE, PP	N/A	Specific depth grab sampling	All analyte groups	None
	Non-inert[6]	N/A		All analyte groups except volatile and extractable organics	None
3. DO Dunker	SS, Teflon, glass, PE, PP	N/A	Water column composite sampling	All analyte groups	None
4 Bailers – double valve	SS, Teflon, PE, PP	N/A	Grab sampling	All analyte groups	None
	Non-inert[6]	N/A	Grab sampling	All analyte groups except volatile and extractable organics	None If sampling for metals, the tubing must be non-metallic if not SS
5. Peristaltic pump	N/A	SS, Teflon, PE[14], PP	Specific depth sampling	All analyte groups	Silicone tubing in pump head Must be variable speed
	N/A	Non-inert[6]		All analyte groups except volatile and extractable organics	Silicone tubing in pump head Must be variable speed
FIELD FILTRATION UNITS	N/A		Dissolved constituents	Inorganic nonmetallics and metals in surface water	Must use a 0.45 μm filter
				Inorganic nonmetallics in groundwater	Must use a 0.45 μm filter
				Metals in groundwater and static wastewater and surface water	Must use in-line, high capacity, one-piece molded filter that is connected to the outlet of a pump; no intermediate vessels; positive pressure PE, PP & Teflon bailers acceptable Must use a 1 μm filter in groundwater, a 0.45 μm filter in surface water
				Metals in moving surface water (i.e., river/stream)	Must use positive pressure device, but an intermediate vessel may be used. Use a 0.45 μm filter

Table FS 1000-3
Equipment Use and Construction

EQUIPMENT	CONSTRUCTION		USE	PERMISSIBLE ANALYTE GROUPS	RESTRICTIONS AND PRECAUTIONS
	HOUSING[1]	TUBING			
SOLID SAMPLING					
SOILS					
1. Core barrel (or liner)	SS, Teflon, glass, Teflon-coated, aluminum, PE, PP	N/A	Sampling	All analyte groups[8]	[9, 10, 11]
	Non-inert[6] nonmetallics	N/A	Sampling	All analyte groups	[12]
	Non-inert[6] metals	N/A	Sampling	All analyte groups	[12]
2. Trowel, scoop, spoon or spatula	SS, Teflon, Teflon-coated, PE, PP	N/A	Sampling	All analyte groups[8]	
			Compositing	All analyte groups except volatile organics	Samples for volatile organics must be grab samples
	Plastic	N/A	Sampling and compositing	All analyte groups except volatile and extractable organics	None Must be nonmetallic if not SS
3. Mixing tray (pan)	SS, Teflon, glass, Teflon-coated, aluminum , PE, PP	N/A	Sampling	All analyte groups[8]	[11]
			Compositing or homogenizing	All analyte groups except volatile organics	[11]
	Non-inert[6]	N/A	Compositing or homogenizing	All analyte groups	[10,11,12] must be nonmetallic if not SS
4. Shovel, bucket auger	SS	N/A	Sampling	All analyte groups[8]	None
	Non-SS	N/A	Sampling	All analyte groups[8]	[10,11,12]
5. Split spoon	SS or carbon steel w/ Teflon insert	N/A	Sampling	All analyte groups[8]	[10,11,12]
6. Shelby tube	SS	N/A	Sampling	All analyte groups[8]	[9]
	Carbon steel	N/A	Sampling	All analyte groups	[9,10,12]
SEDIMENT					
1. Coring devices	SS, Teflon, glass, Teflon-coated, aluminum, PE, PP	N/A	Sampling	All analyte groups[8]	[9,10,11]

Table FS 1000-3
Equipment Use and Construction

EQUIPMENT	CONSTRUCTION		USE	PERMISSIBLE ANALYTE GROUPS	RESTRICTIONS AND PRECAUTIONS
	HOUSING[1]	TUBING			
	Non-inert[6] nonmetallics	N/A	Sampling	All analyte groups	[12]
	Non-inert[6] metals	N/A	Sampling	All analyte groups	[9,10,11]
2. Grab – Young, Petersen, Shipek	Teflon, Teflon-lined, SS	N/A	Sampling	All analyte groups[8]	None
	Carbon steel	N/A	Sampling	All analyte groups	[10,11]
3. Dredges – Eckman, Ponar, Petit Ponar Van Veen	SS	N/A	Sampling	All analyte groups[8]	None
	Carbon steel, brass	N/A	Sampling	All analyte groups	[10,11]
4. Trowel, scoop, spoon or spatula	SS, Teflon, Teflon-coated, PE, PP	N/A	Sampling	All analyte groups[8]	
			Compositing	All analyte groups except volatile organics	Samples for volatile organics must be grab samples
	Plastic	N/A	Sampling and compositing	All analyte groups except volatile and extractable organics	None must be nonmetallic if not SS
5. Mixing tray (pan)	SS, Teflon, glass, Teflon-coated, aluminum, PE, PP	N/A	Sampling	All analyte groups[8]	[11]
			Compositing or homogenizing	All analyte groups except volatile organics	[11]
	Non-inert[6]	N/A	Compositing or homogenizing	All analyte groups except volatile and extractable organics	none [11] must be nonmetallic if not SS
WASTE[13]					
Scoop	SS	N/A	Liquids, solids & sludges	All analyte groups[8]	Cannot collect deeper phases
Spoon	SS	N/A	Solids, sludges	All analyte groups[8]	Cannot collect deeper phases
Push tube	SS	N/A	Solids, sludges	All analyte groups[8]	Cannot collect deeper phases
Auger	SS	N/A	Solids	All analyte groups[8]	None

Table FS 1000-3
Equipment Use and Construction

EQUIPMENT	CONSTRUCTION		USE	PERMISSIBLE ANALYTE GROUPS	RESTRICTIONS AND PRECAUTIONS
	HOUSING[1]	TUBING			
Sediment sampler	SS	N/A	Impoundments, piles	All analyte groups[8]	None
Ponar dredge	SS	N/A	Solids, sludges & sediments	All analyte groups[8]	None
Coliwasa, Drum thief	Glass	N/A	Liquids, sludges	All analyte groups	None
Mucksucker, Dipstick	Teflon		Liquids, sludges	All analyte groups	Not recommended for tanks > 11 feet deep
Bacon bomb	SS	N/A	Liquids	All analyte groups[8]	Not recommended for viscous wastes
Bailer	SS, Teflon	N/A	Liquids	All analyte groups[8]	Do not use with heterogeneous wastes Not recommended for viscous wastes
Peristaltic pump	N/A	Teflon, Glass	Liquids	All analyte groups except volatile organics	Do not use in flammable atmosphere Not recommended for viscous wastes
Backhoe bucket	Steel	N/A	Solids, Sludges		Difficult to clean Volatiles and metals must be taken from the interior part of the sample
Split spoon	SS	N/A	Solids	All analyte groups[8]	
Roto-Hammer	Steel	N/A	Solids	All analyte groups[8]	Physically breaks up sample Not for flammable atmospheres

Acronyms:

N/A	not applicable
SS	stainless steel
HDPE	high-density polyethylene
PE	polyethylene
PVC	polyvinyl chloride
PP	polypropylene
LDPE	low density polyethylene[14]

Table FS 1000-3
Equipment Use and Construction

[1] Refers to tubing and pump housings/internal parts that are in contact with purged or sampled water (interior and exterior of delivery tube, inner lining of the discharge tube, etc.).

[2] If used to collect volatile or extractable organics, all power cords and other tubing must be encased in Teflon, PE or PP.

[3] If used as a non-dedicated system, pump must be completely disassembled, if practical, and cleaned between wells.

[4] Delivery tubing must be precleaned and precut at the base of operations or laboratory. If the same tubing is used during the sampling event, it must be cleaned and decontaminated between uses.

[5] In-line check valve required.

[6] "Non-inert" pertains to materials that are reactive (adsorb, absorb, etc.) to the analytes being sampled. For organics, materials include rubber, plastics (except PE and PP), and PVC. For metals, materials include brass, galvanized, and carbon steel.

[7] "Polishing": When purging for volatile or extractable organics, the entire length of tubing or the portion which comes in contact with the formation water must be constructed of Teflon, SS, PE or PP. If other materials (e.g., PVC, garden hoses, etc.) are used, the following protocols must be followed: 1) slowly withdraw the pump from the water column during the last phase of purging, to remove any water from the well that may have contacted the exterior of the pump and/or tubing; 2) remove a single well volume with the sampling device before sampling begins. **Do not use Tygon** for purging if purgeable or extractable organics are of interest. Polishing **is not recommended;** use of sampling equipment constructed of appropriate materials is preferred.

[8] Do not use if collecting for hexavalent chromium ($Chromium^{+6}$)

[9] If samples are sealed in the liner for transport to the laboratory, the sample for VOC analysis must be taken from the interior part of the core.

[10] If a non-stainless steel (carbon steel, aluminum) liner, core barrel or implement is used, take the samples for metals, purgeable organics and organics from the interior part of the core sample.

[11] Aluminum foil, trays or liners may be used only if aluminum is not an analyte of interest.

[12] If non-inert-liner, core barrel or implement is used, take samples from the interior part of the collected sample.

[13] If disposable equipment of alternative construction materials is used, the construction material must be compatible with the chemical composition of the waste, cannot alter the characteristics of the waste sample in any way, and cannot contribute analytes of interest or any interfering components.

[14] LDPE may not be used for pump tubing when collecting VOCs.

Table FS1000-4
40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times*
Applicable to **all** Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

Parameter No./Name (refers to parameter number on Tables IA,B, C, D,E, F, G & H as noted)	**Container**[1]	**Preservation**[2, 3]	**Maximum holding time**[4]
Table IA—Bacterial Tests:			
1–5. Coliform, total, fecal, and *E. coli*	PA, G	Cool, <10 °C, 0.0008% $Na_2S_2O_3$[5]	8 hours [22 , 23]
6. Fecal streptococci	PA, G	Cool, <10 °C, 0.0008% $Na_2S_2O_3$[5]	8 hours [22]
7. Enterococci	PA, G	Cool, <10 °C, 0.0008% $Na_2S_2O_3$[5]	8 hours [22]
8. Salmonella	PA, G	Cool, <10 °C, 0.0008% $Na_2S_2O_3$[5]	8 hours [22]
Table IA— Aquatic Toxicity Tests:			
9–12. Toxicity, acute and chronic	P, FP, G	Cool, ≤6 °C [16]	36 hours
Table IB—Inorganic Tests:			
1. Acidity	P, FP, G	Cool, ≤6 °C[18]	14 days
2. Alkalinity	P, FP, G	Cool, ≤6 °C[18]	14 days
4. Ammonia	P, FP, G	Cool, ≤6 °C[18,] H_2SO_4 to pH<2	28 days
9. Biochemical oxygen demand	P, FP, G	Cool, ≤6 °C[18]	48 hours
10. Boron	P, FP, or Quartz	HNO_3 to pH<2	6 months
11. Bromide	P, FP, G	None required	28 days
14. Biochemical oxygen demand, carbonaceous	P, FP G	Cool, ≤6 °C[18]	48 hours
15. Chemical oxygen demand	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH<2	28 days
16. Chloride	P, FP, G	None required	28 days
17. Chlorine, total residual	P, G	None required	Analyze within 15 minutes
21. Color	P, FP, G	Cool, ≤6 °C[18]	48 hours
23–24. Cyanide, total or available (or CATC)and free	P, FP, G	Cool, ≤6 °C[18], NaOH to pH>10 reducing agent if oxidizer is present[, 5, 6]	14 days
25. Fluoride	P	None required	28 days
27. Hardness	P, FP, G	HNO_3 or H_2SO_4 to pH<2	6 months
28. Hydrogen ion (pH)	P, FP, G	None required	Analyze within 15 minutes
31, 43. Kjeldahl and organic N	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH<2	28 days
Table IB—Metals[7]:			
7 18. Chromium VI	P, FP, G	Cool, ≤6 °C[18], pH = 9.3–9.7[20]	28 days

Table FS1000-4
40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times*
Applicable to **all** Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

Parameter No./Name (refers to parameter number on Tables IA,B, C, D,E, F, G & H as noted)	**Container**[1]	**Preservation**[2, 3]	**Maximum holding time**[4]
35. Mercury (CVAA)	P, FP, G	HNO_3 to pH<2	28 days
35. Mercury (CVAFS)	FP, G; and FP-lined cap	5 mL/L 12N HCl or 5 mL/L BrCl[17]	90 days [17]
3, 5–8, 12, 13, 19, 20, 22, 26, 29, 30, 32–34, 36, 37, 45, 47, 51, 52, 58–60, 62, 63, 70– 72, 74, 75. Metals, except boron, chromium VI, and mercury.	P, FP, G	HNO_3 to pH<2, or at least 24 hours prior to analysis[19]	6 months
Table IB—Inorganic Tests (continued):			
38. Nitrate	P, FP, G	Cool, ≤6 °C[18]	48 hours
39. Nitrate-nitrite	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH<2	28 days
40. Nitrite	P, FP, G	Cool, ≤6 °C[18]	48 hours
41. Oil and grease	G	Cool, ≤6 °C[18], HCl or H2SO4 to pH<2	28 days
42. Organic Carbon	P, FP, G	Cool, ≤6 °C[18]HCl, H_2SO_4, or H_3PO_4 to pH<2.	28 days
44. Orthophosphate	P, FP, G	Cool, ≤6 °C[18, 24]	Filter within 15 minutes; Analyze within 48 hours
46. Oxygen, Dissolved Probe	G, Bottle and top	None required	Analyze within 15 minutes
47. Winkler	G, Bottle and top	Fix on site and store in dark	8 hours
48. Phenols	G	Cool, ≤6 °C[18], H_2SO_4 to pH<2	28 days
49. Phosphorous (elemental)	G	Cool, ≤6 °C[18]	48 hours
50. Phosphorous, total	P, FP, G	Cool, ≤6 °C[18], H_2SO_4 to pH<2	28 days
53. Residue, total	P, FP, G	Cool, ≤6 °C[18]	7 days
54. Residue, Filterable	P, FP, G	Cool, ≤6 °C[18]	7 days
55. Residue, Nonfilterable (TSS)	P, FP, G	Cool, ≤6 °C[18]	7 days
56. Residue, Settleable	P, FP, G	Cool, ≤6 °C[18]	48 hours
57. Residue, Volatile	P, FP, G	Cool, ≤6 °C[18]	7 days
61. Silica	P or Quartz	Cool, ≤6 °C[18]	28 days
64. Specific conductance	P, FP, G	Cool, ≤6 °C[18]	28 days
65. Sulfate	P, FP, G	Cool, ≤6 °C[18]	28 days
66. Sulfide	P, FP, G	Cool, ≤6 °C[18], add zinc acetate plus sodium hydroxide to pH>9	7 days

Table FS1000-4
40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times*
Applicable to **all** Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

Parameter No./Name (refers to parameter number on Tables IA,B, C, D,E, F, G & H as noted)	Container[1]	Preservation[2, 3]	Maximum holding time[4]
67. Sulfite	P, FP, G	None required	Analyze within 15 minutes
68. Surfactants	P, FP, G	Cool, ≤6 °C[18]	48 hours
69. Temperature	P, FP, G	None required	Analyze
73. Turbidity	P, FP, G	Cool, ≤6 °C[18]	48 hours
Table IC—Organic Tests[8]			
13, 18–20, 22, 24–28, 34–37, 39–43, 45–47, 56, 76, 104, 105, 108–111, 113. Purgeable Halocarbons	G, FP-lined septum	Cool, ≤6 °C[18], 0.008% $Na_2S_2O_3$[5]	14 days
6, 57, 106. Purgeable aromatic hydrocarbons	G, FP-lined septum	Cool, ≤6 °C[18], 0.008% $Na_2S_2O_3$[5], HCl to pH 2	14 days[9]
3, 4. Acrolein and acrylonitrile	G, FP-lined septum	Cool, ≤6 °C[18], 0.008% $Na_2S_2O_3$, pH to 4–5	14 days[10]
23, 30, 44, 49, 53, 77, 80, 81, 98, 100, 112. Phenols[11]	G, FP-lined cap	Cool, ≤6 °C[18], 0.008% $Na_2S_2O_3$	7 days until extraction, 40 days after extraction
7, 38. Benzidines[11 , 12]	G, FP-lined cap	Cool, ≤6 °C[18], 0.008% $Na_2S_2O_3$[5]	7 days until extraction [13]
14, 17, 48, 50–52. Phthalate esters [11]	G, FP-lined cap	Cool, ≤6 °C[18]	7 days until extraction, 40 days after extraction
82–84. Nitrosamines[11 , 14]	G, FP-lined cap	Cool, ≤6 °C[18], store in dark, 0.008% $Na_2S_2O_3$[5]	7 days until extraction, 40 days after extraction
88–94. PCBs[11]	G, FP-lined cap	Cool, ≤6 °C[18]	1 year until extraction, 1 year after extraction
54, 55, 75, 79. Nitroaromatics and isophorone [11]	G, FP-lined cap	Cool, ≤6 °C[18], store in dark, 0.008% $Na_2S_2O_3$[5]	7 days until extraction, 40 days after extraction
1, 2, 5, 8–12, 32, 33, 58, 59, 74, 78, 99, 101. Polynuclear aromatic hydrocarbons[11]	G, FP-lined cap	Cool, ≤6 °C[18]store in dark, 0.008% $Na_2S_2O_3$[5]	7 days until extraction, 40 days after extraction
15, 16, 21, 31, 87. Haloethers[11]	G, FP-lined cap	Cool, ≤6 °C[18], 0.008% $Na_2S_2O_3$[5]	7 days until extraction, 40 days after extraction
29, 35–37, 63–65, 107. Chlorinated hydrocarbons [11]	G, FP-lined cap	Cool, ≤6 °C[18]	7 days until extraction, 40 days after extraction

Table FS1000-4
40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times*
Applicable to **all** Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

Parameter No./Name (refers to parameter number on Tables IA,B, C, D,E, F, G & H as noted)	**Container**[1]	**Preservation**[2, 3]	**Maximum holding time**[4]
60–62, 66–72, 85, 86, 95–97, 102, 103. CDDs/CDFs [11]			
Aqueous Samples: Field and Lab Preservation	G	Cool, ≤6 °C[18], 0.008% $Na_2S_2O_3$[5] , pH<9	1 year
Solids and Mixed-Phase Samples: Field Preservation	G	Cool, ≤6 °C[18]	7 days
Tissue Samples: Field Preservation	G	Cool, ≤6 °C[18]	24 hours
Solids, Mixed-Phase, and Tissue Samples: Lab Preservation	G	Freeze, ≤-10 °C	1 year
114-118. Alkylated phenols	G	Cool, <6 °C, H_2SO_4 to pH<2	28 days until extraction, 40 days after extraction
119. Adsorbable Organic Halides (AOX)	G	Cool, <6 °C[18], 0.008% $Na_2S_2O_3$ HNO3 to pH<2	Hold at least 3 days, but not more than 6 months
120. Chlorinated Phenolics		Cool,<6 °C[18], 0.008% $Na_2S_2O_3$ H_2SO_4 to pH<2	30 days until acetylation, 30 days after acetylation.
Table ID—Pesticides			
Tests: 1–70. Pesticides[11]	G, FP-lined cap	Cool, ≤6 °C[18], pH 5–9 [15]	7 days until extraction, 40 days after extraction
Table IE—Radiological Tests:			
1–5. Alpha, beta, and radium	P, FP, G	HNO_3 to pH<2	6 months
Table IH—Bacterial Tests:			
1. *E. coli*	PA, G, G	Cool, <10 °C, 0.008% $Na_2S_2O_3$ $Na_2S_2O_3$[5]Cool, <10 °C, 0.008% $Na_2S_2O_3$ [5]	8 hours [22] hours[6]
2. Enterococci	PA, G	Cool, <10 °C, 0.008% $Na_2S_2O_3$ $Na_2S_2O_3$[5]	8 hours [22]
Table IH—Protozoan Tests:			
8. Cryptosporidium	LDPE; field filtration	0–10 °C	96 hours.[21]
9. Giardia	LDPE; field filtration	0–10 °C	96 hours[21]

[16], [17], [18] [19] [20] [21] [22] [23] [24]

*Reference: This table is adapted from Table II, 40 CFR, Ch.I, Part 136.3, *Identification of Test Procedures,* 7-1-13 Edition, including all footnotes listed below.

Table FS1000-4
40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times*
Applicable to **all** Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

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[1] ‘‘P’’ is polyethylene; ‘‘FP’’ is fluoropolymer (polytetrafluoroethylene (PTFE; Teflon®), or other fluoropolymer, unless stated otherwise in this Table II; ‘‘G’’ is glass; ‘‘PA’’ is any plastic that is made of a sterlizable material (polypropylene or other autoclavable plastic); ‘‘LDPE’’ is low density polyethylene.

[2] Except where noted in this Table II and the method for the parameter, preserve each grab sample within 15 minutes of collection. For a composite sample collected with an automated sampler (e.g., using a 24-hour composite sampler; see 40 CFR 122.21(g)(7)(i) or 40 CFR Part 403, Appendix E), refrigerate the sample at ≤6 °C during collection unless specified otherwise in this Table II or in the method(s). For a composite sample to be split into separate aliquots for preservation and/or analysis, maintain the sample at ≤6 °C, unless specified otherwise in this Table II or in the method(s), until collection, splitting, and preservation is completed. Add the preservative to the sample container prior to sample collection when the preservative will not compromise the integrity of a grab sample, a composite sample, or an aliquot split from a composite sample; otherwise, preserve the grab sample, composite sample, or aliquot split from a composite sample within 15 minutes of collection. If a composite measurement is required but a composite sample would compromise sample integrity, individual grab samples must be collected at prescribed time intervals (e.g., 4 samples over the course of a day, at 6-hour intervals). Grab samples must be analyzed separately and the concentrations averaged. Alternatively, grab samples may be collected in the field and composited in the laboratory if the compositing procedure produces results equivalent to results produced by arithmetic averaging of the results of analysis of individual grab samples. For examples of laboratory compositing procedures, see EPA Method 1664A (oil and grease) and the procedures at 40 CFR 141.34(f)(14)(iv) and (v) (volatile organics).

[3] When any sample is to be shipped by common carrier or sent via the U.S. Postal Service, it must comply with the Department of Transportation Hazardous Materials Regulations (49 CFR Part 172). The person offering such material for transportation is responsible for ensuring such compliance. For the preservation requirements of Table II, the Office of Hazardous Materials, Materials Transportation Bureau, Department of Transportation has determined that the Hazardous Materials Regulations do not apply to the following materials: Hydrochloric acid (HCl) in water solutions at concentrations of 0.04% by weight or less (pH about 1.96 or greater); Nitric acid (HNO3) in water solutions at concentrations of 0.15% by weight or less (pH about 1.62 or greater); Sulfuric acid (H2SO4) in water solutions at concentrations of 0.35% by weight or less (pH about 1.15 or greater); and Sodium hydroxide (NaOH) in water solutions at concentrations of 0.080% by weight or less (pH about 12.30 or less).

[4]Samples should be analyzed as soon as possible after collection. The times listed are the maximum times that samples may be held before the start of analysis and still be considered valid. Samples may be held for longer periods only if the permittee or monitoring laboratory has data on file to show that, for the specific types of samples under study, the analytes are stable for the longer time, and has received a variance from the Regional Administrator under Sec. 136.3(e). For a grab sample, the holding

Table FS1000-4
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Applicable to **all** Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

time begins at the time of collection. For a composite sample collected with an automated sampler (e.g., using a 24-hour composite sampler; see 40 CFR 22.21(g)(7)(i) or 40 CFR part 403, Appendix E), the holding time begins at the time of the end of collection of the composite sample. For a set of grab samples composited in the field or laboratory, the holding time begins at the time of collection of the last grab sample in the set. Some samples may not be stable for the maximum time period given in the table. A permittee or monitoring laboratory is obligated to hold the sample for a shorter time if it knows that a shorter time is necessary to maintain sample stability. See 136.3(e) for details. The date and time of collection of an individual grab sample is the date and time at which the sample is collected. For a set of grab samples to be composited, and that are all collected on the same calendar date, the date of collection is the date on which the samples are collected. For a set of grab samples to be composited, and that are collected across two calendar dates, the date of collection is the dates of the two days; e.g., November 14 – 15. For a composite sample collected automatically on a given date, the date of collection is the date on which the sample is collected. For a composite sample collected automatically, and that is collected across two calendar dates, the date of collection is the dates of the two days; e.g., November 14 - 15. For static-renewal toxicity tests, each grab or composite sample may also be used to prepare test solutions for renewal at 24 h, 48 h, and/or 72 h after first use, if stored at 0 –6 °C, with minimum headspace.

[5] ASTM D7365-09a specifies treatment options for samples containing oxidants (e.g., chlorine). Also, Section 9060A of Standard Methods for the Examination of Water and Wastewater (20th and 21st editions) addresses dechlorination procedures.

[6] Sampling, preservation and mitigating interferences in water samples for analysis of cyanide are described in ASTM D7365-09a. There may be interferences that are not mitigated by the analytical test methods or D7365-09a. Any technique for removal or suppression of interference may be employed, provided the laboratory demonstrates that it more accurately measures cyanide through quality control measures described in the analytical test method. Any removal or suppression technique not described in D7365-09a or the analytical test method must be documented along with supporting data.

[7] For dissolved metals, filter grab samples within 15 minutes of collection and before adding preservatives. For a composite sample collected with an automated sampler (e.g., using a 24-hour composite sampler; see 40 CFR 122.21(g)(7)(i) or 40 CFR Part 403, Appendix E), filter the sample within 15 minutes after completion of collection and before adding preservatives. If it is known or suspected that dissolved sample integrity will be compromised during collection of a composite sample collected automatically over time (e.g., by interchange of a metal between dissolved and suspended forms), collect and filter grab samples to be composited (footnote 2) in place of a composite sample collected automatically.

[8] Guidance applies to samples to be analyzed by GC, LC, or GC/MS for specific compounds.

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[9] If the sample is not adjusted to pH 2, then the sample must be analyzed within seven days of sampling.

[10] The pH adjustment is not required if acrolein will not be measured. Samples for acrolein receiving no pH adjustment must be analyzed within 3 days of sampling.

[11] When the extractable analytes of concern fall within a single chemical category, the specified preservative and maximum holding times should be observed for optimum safeguard of sample integrity (i.e., use all necessary preservatives and hold for the shortest time listed). When the analytes of concern fall within two or more chemical categories, the sample may be preserved by cooling to ≤6 °C, reducing residual chlorine with 0.008% sodium thiosulfate, storing in the dark, and adjusting the pH to 6–9; samples preserved in this manner may be held for seven days before extraction and for forty days after extraction. Exceptions to this optional preservation and holding time procedure are noted in footnote 5 (regarding the requirement for thiosulfate reduction), and footnotes 19, 20 (regarding the analysis of benzidine).

[12] If 1, 2-diphenylhydrazine is likely to be present, adjust the pH of the sample to 4.0 ± 0.2 to prevent rearrangement to benzidine.

[13] Extracts may be stored up to 30 days at <0º C.

[14] For the analysis of diphenylnitrosamine, add 0.008% $Na_2S_2O_3$ and adjust pH to 7–10 with NaOH within 24 hours of sampling

[15] The pH adjustment may be performed upon receipt at the laboratory and may be omitted if the samples are extracted within 72 hours of collection. For the analysis of aldrin, add 0.008% $Na_2S_2O_3$.

[16] Place sufficient ice with the samples in the shipping container to ensure that ice is still present when the samples arrive at the laboratory. However, even if ice is present when the samples arrive, immediately measure the temperature of the samples and confirm that the preservation temperature maximum has not been exceeded. In the isolated cases where it can be documented that this holding temperature cannot be met, the permittee can be given the option of on-site testing or can request a variance. The request for a variance should include supportive data which show that the toxicity of the effluent samples is not reduced because of

Table FS1000-4
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the increased holding temperature. Aqueous samples must not be frozen. Hand-delivered samples used on the day of collection do not need to be cooled to 0 to 6ºC prior to test initiation.

[17] Samples collected for the determination of trace level mercury (<100 ng/L) using EPA Method 1631 must be collected in tightly-capped fluoropolymer or glass bottles and preserved with BrCl or HCl solution within 48 hours of sample collection. The time to preservation may be extended to 28 days if a sample is oxidized in the sample bottle. A sample collected for dissolved trace level mercury should be filtered in the laboratory within 24 hours of the time of collection. However, if circumstances preclude overnight shipment, the sample should be filtered in a designated clean area in the field in accordance with procedures given in Method 1669. If sample integrity will not be maintained by shipment to and filtration in the laboratory, the sample must be filtered in a designated clean area in the field within the time period necessary to maintain sample integrity. A sample that has been collected for determination of total or dissolved trace level mercury must be analyzed within 90 days of sample collection.

[18] Aqueous samples must be preserved at ≤6 °C, and should not be frozen unless data demonstrating that sample freezing does not adversely impact sample integrity is maintained on file and accepted as valid by the regulatory authority. Also, for purposes of NPDES monitoring, the specification of ''≤°C'' is used in place of the ''4 °C'' and ''< 4 °C'' sample temperature requirements listed in some methods. It is not necessary to measure the sample temperature to three significant figures (1/100th of 1 degree); rather, three significant figures are specified so that rounding down to 6 °C may not be used to meet the ≤6 °C requirement. The preservation temperature does not apply to samples that are analyzed immediately (less than 15 minutes).

[19] An aqueous sample may be collected and shipped without acid preservation. However, acid must be added at least 24 hours before analysis to dissolve any metals that adsorb to the container walls. If the sample must be analyzed within 24 hours of collection, add the acid immediately (see footnote 2). Soil and sediment samples do not need to be preserved with acid. The allowances in this footnote supersede the preservation and holding time requirements in the approved metals methods.

[20] To achieve the 28-day holding time, use the ammonium sulfate buffer solution specified in EPA Method 218.6. The allowance in this footnote supersedes preservation and holding time requirements in the approved hexavalent chromium methods, unless this supersession would compromise the measurement, in which case requirements in the method must be followed.

[21] Holding time is calculated from time of sample collection to elution for samples shipped to the laboratory in bulk and calculated from the time of sample filtration to elution for samples filtered in the field.

Table FS1000-4
40 CFR Part 136 TABLE II: Required Containers, Preservation Techniques, and Holding Times*
Applicable to **all** Non-Potable Water Samples (includes wastewater, surface water, and groundwater)

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[22] Sample analysis should begin as soon as possible after receipt; sample incubation must be started no later than 8 hours from time of collection.

[23] For fecal coliform samples for sewage sludge (biosolids) only, the holding time is extended to 24 hours for the following sample types using either EPA Method 1680 (LTB-EC) or 1681 (A-1): Class A composted, Class B aerobically digested, and Class B anaerobically digested.

[24] The immediate filtration requirement in orthophosphate measurement is to assess the dissolved or bio-available form of orthophosphorus (i.e., that which passes through a 0.45-micron filter), hence the requirement to filter the sample immediately upon collection (i.e., within 15 minutes of collection).

Table FS 1000-5
Approved Water and Wastewater Procedures, Containers, Preservation and Holding Times
- **For Analytes not Found in 40 CFR 136***

Analyte	Methods	Reference [1]	Container[2]	Preservation[3]	Maximum Holding Time[4]
Bromine	DPD Colorimetric[5]	SM 4500-Cl-G	P, G	None required	Analyze immediately
Bromates	Ion Chromatography	EPA 300.0 [6]	P, G	Cool 4°C	30 days
Chlorophylls	Spectrophotometric	SM 10200 H	P, G[7]	Dark 4°C Filtered, dark, ˉ20°C	48 hours chilled until filtration[8], and analyze immediately or 48 hours chilled until filtration[8],and 28 days (frozen)after filtration
Corrosivity	Calculated ($CaCO_3$ Stability, Langelier Index)	SM 2330 ASTM D513-92	P, G	Cool 4°C[9]	7 days[9]
Cyanotoxin	ELISA and LC/MSMS		FP, G	Cool 6°C[16]	7 days until extraction, 40 days after extraction
FL-PRO	Gas Chromatography	DEP (11/1/95)[18]	G, PTFE lined cap only	Cool 4°C, H_2SO_4 or HCl to pH<2	7 days until extraction, 40 days after extraction
Odor	Human Panel	SM 2150	G only	Cool 4°C	6 hours
Salinity	Electrometric [10] Hydrometric[10]	SM 2520 B SM 2520 C	G, wax seal	Analyze immediately or use wax seal	30 days[10]
Taste	Human Panel	SM 2160 B, C, D ASTM E679-91	G only	Cool 4°C	24 hours
Total Dissolved Gases	Direct-sensing Membrane-diffusion	SM 2810	_____	_____	Analyze in-situ
Total Petroleum Hydrocarbons	Gravimetry	EPA 1664[17]	G only	Cool 4°C, H_2SO_4 or HCl to pH<2	28 days
Transparency	Irradiometric[11]	62-302.200(6), FAC	_____	_____	Analyze in-situ
Un-ionized Ammonia	Calculated[12]	DEP-SOP[13]	P, G	Cool 4°C $Na_2S_2O_3$ [12]	8 hours unpreserved 28 days preserved [12]
Organic Pesticides[14]	GC and HPLC	EPA (600-series) [14]	[15]	[15]	[15] [16]

*40 CFR, Ch. I, Part 136.3, *Identification of Test Procedures,* 7-1-13 Edition. Reference provided for informational purposes only.

Table FS 1000-5
Approved Water and Wastewater Procedures, Containers, Preservation and Holding Times
• For Analytes not Found in 40 CFR 136*

[1] SM XXXX = procedures from "Standard Methods for the Examination of Water and Wastewater"; see Standard Methods Online (http://www.standardmethods.org/store/). Reference methods are listed for informational purposes only.

ASTM XXXX-YY = procedure from "Annual Book of ASTM Standards", Water and Environmental Technology, Volumes 11.01 and 11.02 (Water I and II). See American Society for Testing and Materials (ASTM International), http://www.astm.org/Standard/index.shtml. Reference methods are listed for informational purposes only.

[2] P = plastic, G = glass.

[3] When specified, sample preservation should be performed immediately upon sample collection.

[4] The times listed are the maximum times that samples may be held before analysis and still be considered valid.

[5] The approved procedure is for residual chlorine. However, in the absence of chlorine, the DPD colorimetric procedure can be adapted to measure bromine content of the sample. In such case, the validity of this assumption must be verified by using another procedure for chlorine which is not affected by the presence of bromine (i.e., negligible interference).

[6] "The Determination of Inorganic Anions in Water by Ion Chromatography", EPA Method 300.0, Revision 2.1,, Revised August 1993, by John D. Pfaff, U. S. EPA Cincinnati, Ohio 45268. Reference methods are listed for informational purposes only.

[7] Collect samples in opaque bottles and process under reduced light. A secondary device, such as a Van Dorn/Niskin or bucket, may be used to collect the sample and then expeditiously transfer into an opaque bottle.

[8] Samples must be filtered within 48 hours of collection. Add magnesium carbonate to the filter while the last of the sample passes through the filter.

[9] Temperature and pH must be measured on site at the time of sample collection. 7 days is the maximum time for laboratory analysis of total alkalinity, calcium ion and total solids.

[10] The electrometric and hydrometric analytical methods are suited for field use. The argentometric method is suited for laboratory use. Samples collected for laboratory analysis, when properly sealed with paraffin waxed stopper, may be held indefinitely. The maximum holding time of 30 days is recommended as a practical regulatory limit.

[11] Transparency in surface waters is defined as a compensation point for photosynthetic activity, i.e., the depth at which one percent of the light intensity entering at the water surface remains unabsorbed. The DEP Chapter 62-302, FAC requires that the light intensities at the surface and subsurface be measured simultaneously by irradiance meters such as the Kahlsico Underwater Irradiometer, Model No. 268 WA 310, or an equivalent device having a comparable spectral response.

[12] The results of the measurements of pH, temperature, salinity (if applicable) and the ammonium ion concentration in the sample are used to calculate the concentration of ammonia in the unionized state. Temperature, pH and salinity must be measured on-site at the time of sample collection. Laboratory analysis of the ammonium ion concentration should be conducted within eight hours of sample collection. If prompt analysis of ammonia is impossible, preserve samples with H_2SO_4 to pH between 1.5 and 2. Acid-preserved samples, stored at 4°C, may be held up to 28 days for ammonia determination. Sodium thiosulfate should only be used if fresh samples contain residual chlorine.

[13] Calculation of Un-ionized Ammonia in Fresh Water, Chemistry Laboratory Methods Manual, Florida Department of Environmental Protection, Revision 2, 2/12/2001. The document is available from the DEP Standards & Assessment Section. Reference method listed for informational purposes only.

[14] Other pesticides listed in approved EPA methods (608.1, 608.2, 614, 614.1, 615, 617, 618, 619, 622, 622.1, 627, 629, 631, 632, 632.1, 633, 642, 643, 644 and 645) that are not included in Table ID of 40 CFR Part 136.3 (7-1-13 Edition). Reference methods and CFR citation listed for informational purposes only.

Table FS 1000-5
Approved Water and Wastewater Procedures, Containers, Preservation and Holding Times
- **For Analytes not Found in 40 CFR 136***

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[15] Container, preservation and holding time as specified in each individual method must be followed.

[16] Sample preservation procedures, container material and maximum allowable holding times for analytes not specified in DEP-SOP-001/01 (March 1, 2014) shall follow the preservation, container and holding time requirements specified in the selected analytical method. If no method-specified requirements exist, the best available scientific knowledge shall be used as guidance for determining the appropriate procedures for use, per 62-160.400(2), F.A.C.

[17] Method 1664, n-Hexane Extractable Material (HEM; Oil and Grease) and Silica Gel Treated n-Hexane Extractable Material (SGT-HEM; Non-polar Material) by Extraction and Gravimetry. Revision A, February 1999. EPA-821-R-98-002, and, Revision B, February 2010. EPA-821-R-10-001. Reference methods listed for informational purposes only.

[18] FL-PRO - Method for Determination of Petroleum Range Organics, Revision 1, November 1, 1995, Florida Department of Environmental Protection

Table FS 1000-6
Recommended Sample Containers, Sample Volumes, Preservation Techniques and Holding Times for Residuals, Soil and Sediment Samples

Analyte	Methods	References*	Container	Preservation	Maximum Holding Times
Volatile Organics	Purge-and-Trap GC and GC-MS	8015, 8260, 8021, 5035	See Table 1000-7		
Semivolatile Organics	GC, HPLC, and GC-MS	8041, 8061, 8070, 8081, 8082, 8091, 8111, 8121, 8131, 8141, 8151, 8270, 8275, 8280, 8290, 8310, 8315, 8316, 8318, 8321, 8325, 8330, 8331, 8332, 8410, 8430, 8440, FL-PRO, MADEP, TPHWG	Glass, 8 oz widemouth with Teflon® -Lined lid	Cool ≤6°C [1]	14 days until extraction, 40 days after extraction
Dioxins		8290	Amber Glass, 8 oz widemouth with Teflon® -Lined lid	Cool ≤6°C[1] in dark	30 days until extraction, 45 days after extraction
Total Metals-except mercury and chromium VI methods	Flame AA, Furnace AA, Hydride and ICP	All 7000-series (except 7195, 7196, 7197, 7198, 7470 and 7471), 6010 (ICP) and 6020 (ICP)	Glass or plastic 8 oz widemouth (200 grams sample)	None	6 months
Chromium VI	Colorimetric, Chelation with Flame AA (200 gram sample)	7196 and 7197 (prep 3060)	Glass or plastic, 8 oz widemouth (200 gram sample)	Cool 4°± 2°C[1]	1 month until extraction, 4 days after extraction [2]
Mercury	Manual Cold Vapor AA	7471	Glass or plastic 8 oz widemouth (200 grams sample)	Cool 4°± 2°C[1]	28 days
Microbiology (MPN)		MPN	Sterile glass or plastic	Cool ≤6°C[1]	24 hours
Aggregate Properties			Glass or plastic	Cool ≤6°C[1]	14 days
Inorganic nonmetallics all except: Cyanide Sulfite, Nitrate, Nitrite & o-phosphate Elemental Phosphorus			Glass or plastic Glass or plastic Glass or plastic Glass	Cool ≤6°C[1]	28 days 14 days 48 hours 48 hours

Table FS 1000-6
Recommended Sample Containers, Sample Volumes, Preservation Techniques and Holding Times for Residuals, Soil and Sediment Samples

The term “residuals” include: (1) sludges of domestic origin having no specific requirements in Tables FS-1000-4 or FS-1000-9; (2) sludges of industrial origin; and (3) concentrated waste samples.

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[1] Keep soils, sediments and sludges cool at ≤6°C from collection time until analysis. No preservation is required for concentrated waste samples.

[2] Storage Temperature is 4°C, ±2°C

* Reference method numbers are listed for informational purposes only and are found in SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (http://www.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm), except for the additional informational method sources listed below:

FL-PRO - Method for Determination of Petroleum Range Organics, Revision 1, November 1, 1995, Florida Department of Environmental Protection

MADEP – Method for the Determination of Extractable Petroleum Hydrocarbons (EPH), Revision 1.1, May 2004, Massachusetts Department of Environmental Protection

MPN – Microbiological test methods utilizing Most Probable Number procedures

TPHWG - TPH Working Group Series

Table FS 1000-7

Sample Handling, Preservation and Holding Time Table for SW 846 Method 5035*

			Sample Container					
Conc. Level	Sampling Device	Collection Procedure*	Type	Vial Preparation*	Preservation	Sample Preparation*	Max HT①	Determinative Procedure^
≤200 ug/kg	Coring Device	5035 - Section 6.2.1	Glass Vial w/ PTFE-silicone Septum	5035 - 6.1.1	$NaHSO_4$ / 4ºC (see 5035 – 6.4.3)	5035 - Section 7.2.3	14 D	Any recognized VOC Method (see 5035 – 7.2)
≤200 ug/kg	Coring Device	5035 - Section 6.2.1	Glass Vial w/ PTFE-silicone Septum	5035 - 6.1.1②	4ºC	5035 - Section 7.2.3	48 H	Any recognized VOC Method (see 5035 – 7.2)
≤200 ug/kg	Coring Device	5035 - Section 6.2.1	Glass Vial w/ PTFE-silicone Septum	5035 - 6.1.1②	4ºC / -10ºC③'④	5035 - Section 7.2.3	48 H / 14 D⑤	Any recognized VOC Method (see 5035 – 7.2)
≤200 ug/kg	EnCore or equivalent	5035 - Section 6.2.1	EnCore or equivalent	5035 - 6.1.1②,⑥'⑦	4ºC	5035 - Section 7.2.3	48 H	Any recognized VOC Method (see 5035 – 7.2)
≤200 ug/kg	EnCore or equivalent	5035 - Section 6.2.1	EnCore or equivalent	5035 - 6.1.1⑥,⑦	$NaHSO_4$ / 4ºC (see 5035 – 6.4.3)	5035 - Section 7.2.3⑤	48 H / 14 D⑤	Any recognized VOC Method (see 5035 – 7.2)
≤200 ug/kg	EnCore or equivalent	5035 - Section 6.2.1	EnCore or equivalent	5035-6.1.1②⑥⑦	4ºC / -10ºC③,④	5035 - Section 7.2⑤	48 H / 14 D⑤	Any recognized VOC Method (see 5035 – 7.2)
>200 ug/kg	EnCore or equivalent	5035 - Section 6.2.2.3⑥	EnCore or equivalent	5035 - 6.1.3⑥,⑦	4ºC	5035 - Sections 7.3.2 & 7.3.3⑤	48 H / 14 D⑤	Any recognized VOC Method (see 5035 – 7.3)
>200 ug/kg⑧	Coring Device	5035 - Section 6.2.2.3⑨	Glass Vial w/ PTFE-silicone Septum	5035 - 6.1.3⑨	Methanol/PEG + 4ºC	5035 - Section 7.3.4	14 D	Any recognized VOC Method (see 5035 – 7.3)
>200 ug/kg[8]	Conventional Devices	DEP SOP - Section 5.	Glass w/ PTFE-silicone Septum	5035 - 6.1.2	4ºC	5035 - Sections 7.3.1 - 7.3.3	14 D	Any recognized VOC Method (see 5035 – 7.3)
Oily Waste	Conventional Devices	5035 - Section 6.2.4.2	Glass w/ PTFE-silicone Septum	5035 - 6.1.4	4ºC	5035 - Sections 7.4.1 - 7.4.2	14 D	Any recognized VOC Method (see 5035 – 7.4)
Oily Waste	Conventional Devices	5035 - Section 6.2.4.1	Glass w/ PTFE-silicone Septum	5035 - 6.1.4	Methanol/PEG + 4ºC	5035 - Sections 7.4.3	14 D	Any recognized VOC Method (see 5035 – 7.4)
Dry Wt.	Conventional Devices	5035 - Sections 6.2.1.6, 6.2.2.7,	Glass with Teflon	5035 – 4.4.1	4ºC	5035 - Section 7.5	Not applicable	5035 - Section 7.5

Table FS 1000-7

Sample Handling, Preservation and Holding Time Table for SW 846 Method 5035*

		6.2.3	liner					
Soil Screen	Conventional Devices	5035 - Sections 6.2.1.6, 6.2.3	Glass w/ PTFE-silicone Septum	5035 – 4.4.1	4ºC	5035 - Section 7.1	14 D	Any recognized VOC Method (see 5035 – 7.1)

[1]Maximum time allowable from time/date of collection to sample analysis.

[2]Eliminate 6.1.1.2; use only organic-free water.

[3]Contents of sampling device must be transported to the laboratory at 4ºC and stored at -10ºC.

[4]In order to ensure that vials do not break during freezing, they should be stored on their side or at a slanted angle to maximize surface area.

[5]Maximum allowable time at 4ºC is 48 hours; maximum allowable time to sample analysis is 14 days (from time of sample collection).

[6]Conducted in the laboratory.

[7]Entire contents of sampling device are extruded into the sample analysis vial containing the appropriate solvent.

[8]Procedures are limited only to those situations or programs in which the maximum contamination level does not exceed 200 ug/kg.

[9]Methanolic preservation in the field is not recommended, but may be used if approved by DEP for a project.

*See method 5035 in SW-846, Test Methods for Evaluating Solid Waste, Physical/Chemical Methods (http://www.epa.gov/epawaste/hazard/testmethods/sw846/online/index.htm) and DEP SOP FS 3000, Soil, in DEP-SOP-001/01, 9/19/12.

^See 62-160.320, F.A.C., Approved Laboratory Methods

FS 1000-8
Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II

Analyte or EPA Method Number*	Preservation[1]	Holding Time[2]	Holding Time for Extract[3]	Container[4]
MICROBIOLOGICAL-BACTERIA	Cool < 10°C, $Na_2S_2O_3$[5]			P or G
Total Coliforms, fecal coliforms & *E. coli* in drinking water	Cool < 10°C[6], $Na_2S_2O_3$[5]	30 Hours[7]		P or G
Total coliforms and fecal coliforms in source water Heterotrophic bacteria in drinking water	Cool < 10°C, $Na_2S_2O_3$[5]	8 hours		P or G
Gross Alpha	Conc. HCl or HNO_3 to pH <2 [8,9]	6 mo		P or G
Gross beta	Conc. HCl or HNO to pH <2[8,9]	6 mo		P or G
Strontium-89	Conc. HCl or HNO to pH <2[8,9]	6 mo		P or G
Strontium-90	Conc. HCl or HNO to pH <2[8,9]	6 mo		P or G
Radium-226	Conc. HCl or HNO to pH <2[8,9]	6 mo		P or G
Radium-228	Conc. HCl or HNO to pH <2[8,9]	6 mo		P or G
Cesium-134	Concentrated HCl to pH <<2[8,9]	6 mo		P or G
Iodine-131	None	8 days		P or G
Tritium	None	6 months		G
Uranium	Conc. HCl or HNO_3 to pH <2[8,9]	6 mo		P or G
Photon emitters	Conc. HCl or HNO_3 to pH <2[8,9]	6 mo		P or G
Asbestos	Cool 4°C	48 hours		P or G
Bromate	Ethylenediamine (50mg/L)	28 days		P or G
Cyanide	Cool, 4C, Ascorbic acid (if chlorinated), NaOH pH>12	14 days		P or G
Nitrate	Cool, 4°C	48 hours		P or G
Nitrate (chlorinated source)	Cool, 4°C	14 days		P or G
Odor	Cool 4°C	24 hours		G
502.2	Sodium Thiosulfate or Ascorbic Acid, 4°C HCl pH<2 if Ascorbic Acid is used	14 days		Glass with PFTE Lined Septum

FS 1000-8
Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II

Analyte or EPA Method Number*	Preservation[1]	Holding Time[2]	Holding Time for Extract[3]	Container[4]
504.1	Sodium Thiosulfate Cool, 4°C,	14 days	4°C, 24 hours	Glass with PFTE-Lined Septum
505	Sodium Thiosulfate Cool, 4°C	14 days (7 days for Heptachlor)	4°C, 24 hours	Glass with PFTE-Lined Septum
506	Sodium Thiosulfate Cool, 4°C, Dark	14 days	4°C, dark, 14 days	Amber Glass with PFTE-lined Cap
507	Sodium Thiosulfate Cool, 4°C, Dark	14 days (see method for exceptions)	4°C, dark, 14 days	Amber Glass with PFTE-lined Cap
508	Sodium Thiosulfate Cool, 4°C, Dark	7 days (see method for exceptions)	4°C, dark, 14 days	Glass with PFTE-lined Cap
508A	Cool, 4°C	14 days	30 days	Glass with PFTE-lined Cap
508.1	Sodium Sulfite, HCl pH<2, Cool, 4°C	14 days (see method for exceptions)	30 days	Glass with PFTE-lined Cap
515.1	Sodium Thiosulfate Cool, 4°C, Dark	14 days	4°C, dark, 28 days	Amber Glass with PFTE-lined Cap
515.2	Sodium Thiosulfate HCl pH<2, Cool, 4°C, Dark	14 days	≤ 4°C, dark, 14 days	Amber Glass with PFTE-lined Cap
515.3	Sodium Thiosulfate HCl pH<2, Cool, 4°C, Dark	14 days	≤ 4°C, dark, 14 days	Amber Glass with PFTE-lined Cap
515.4	Sodium Sulfite, HCl pH<2, Cool, ≤10°C for first 48 hours ≤6°C thereafter, Dark	14 days	≤0°C, 21 days	
524.2	Ascorbic Acid, HCl pH<2, Cool 4°C	14 days		Glass with PFTE-lined Septum
525.2	Sodium Sulfite, Dark, Cool, 4°C, HCl pH<2	14 days (see method for exceptions)	≤ 4°C, 30 days from collection	Amber Glass with PFTE-lined Cap
531.1, 6610	Sodium Thiosulfate Monochloroacetic acid, pH<3, Cool, 4°C	Cool 4°C, 28 days		Glass with PFTE-lined Septum
531.2	Sodium Thiosulfate, Potassium Dihydrogen Citrate buffer to pH 4,	28 days		

FS 1000-8
Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II

Analyte or EPA Method Number*	Preservation[1]	Holding Time[2]	Holding Time for Extract[3]	Container[4]
	dark, ≤10°C for first 48 hr, ≤6°C thereafter			
547	Sodium Thiosulfate Cool, 4°C	14 days (18 mo. frozen)		Glass with PFTE-lined Septum
548.1	Sodium Thiosulfate (HCl pH 1.5-2 if high biological activity), Cool, 4°C, Dark	7 days	≤4°C 14 days	Amber Glass with PFTE-lined Septum
549.2	Sodium Thiosulfate (H_2SO_4 pH<2 if biologically active), Cool, 4°C, Dark	7 days	21 days	High Density Amber Plastic or Silanized Amber Glass
550, 550.1	Sodium Thiosulfate Cool, 4°C, HCl pH<2	7 days	550, 30 days 550.1, 40 days Dark, 4°C	Amber Glass with PFTE-lined Cap
551.1	Sodium Thiosulfate, Sodium Sulfite, Ammonium Chloride, pH 4.5-5.0 with phosphate buffer, Cool, 4°C	14 days		Glass with PFTE-lined Septum
552.1	Ammonium chloride, Cool, 4°C, Dark	14 days	≤4°C, dark 48 hours	Amber Glass with PFTE-lined cap
552.2	Ammonium chloride, Cool, 4°C, Dark	14 days	≤4°C, dark 7 days ≤-10°C 14 days	Amber Glass with PFTE-lined cap
555	Sodium Sulfite, HCl, pH ≤ 2, Dark, Cool 4°C	14 days		Glass with PFTE-lined cap
1613B	Sodium Thiosulfate, Cool, 0-4°C, Dark		Recommend 40 days	Amber Glass with PFTE-lined Cap

[1] Preservation, when required, must be done immediately upon sample collection.
[2] Stated values are the maximum regulatory holding times. Sample processing must begin by the stated time.
[3] Stated time is the maximum time a prepared sample extract may be held before analysis.
[4] (P) polyethylene or (G) or glass. For microbiology, plastic sample containers must be made of sterilizable materials (poly-propylene or other autoclavable plastic).
[5] Addition of sodium thiosulfate is only required if the sample has a detectable amount of residual chlorine, as indicated by a field test using EPA Method 330.4 or 330.2 or equivalent.

FS 1000-8
Preservation Methods and Holding Times for Drinking Water Samples that Differ from 40 CFR Part 136, Table II

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[6] Temperature requirement applies only to source water samples, however once received by the laboratory, if sample processing does not begin on the same working day, samples must be refrigerated.

[7] If samples are analyzed after 30 hours, but within 48 hours of collection, the laboratory is to indicate in the analytical report that the data may be invalid because of excessive delay in sample processing. No samples received after 48 hours are to be accepted or analyzed for compliance with the regulations of the Department of Environmental Protection or the Department of Health.

[8] It is recommended that the preservative be added at the time of collection unless suspended solids activity is to be measured. It is also recommended that samples be filtered, if suspended or settleable solids are present, prior to adding preservative, at the time of collection. However, if the sample has to be shipped to a laboratory or storage area, acidification of the sample (in its original container) may be delayed for a period not to exceed 5 days. A minimum of 16 hours must elapse between acidification and analysis.

[9] If HCl is used to acidify samples, which are to be analyzed for gross alpha or gross beta activities, the acid salts must be converted to nitrate salts before transfer of the samples to planchets.

*EPA method numbers are provided as informational references only.

Table FS 1000-9
Containers, Preservation and Holding Times for Biosolids Samples and Protozoans

ANALYTE NAME	*CONTAINER*	*PRESERVATION*	*MAX HOLDING TIME*
Fecal Coliform	Plastic or Glass	Cool 4°C	24 hours
Salmonella	Plastic or Glass	< 10°C	24 hours
Enteric Viruses	Plastic or Glass	Up to 25°C	2 hours
Enteric Viruses	Plastic or Glass	2 to 10°C	48 hours
Specific Oxygen Uptake Rate	Plastic or Glass	None	As Soon As Possible
Helminth OVA	Plastic or Glass	< 4°C (Do not Freeze)	24 hours
Cryptosporidium/Giardia	Plastic or Glass	0 - 10°C (Do not Freeze)*	96 Hours
Total Solids	Plastic or Glass	≤6°C (Do not Freeze)	7 days
Metallics	Plastic or Glass	See Tables FS 1000-4, FS 1000-5 and FS 1000-6	
Other Inorganic Pollutants	Plastic or Glass	See Tables FS 1000-4, FS 1000-5 and FS 1000-6	

***Dechlorinate bulk samples when applicable**

Table FS 1000-10
Container Materials, Preservation, and Holding Times for Fish and Shellfish

Analyte	Matrix	Sample Container	Field (Transport to Lab)		Laboratory	
			Preservation	Maximum Shipping Time	Storage	Holding Time
	Whole Organism (Fish, shellfish, etc.	Foil-wrap each organism (or composite for shellfish) and transport in waterproof plastic bag				
Mercury	Tissue (fillets and edible portions, homogenates)	Plastic, borosilicate glass, quartz, PTFE			Freeze at <-20°C	1 year
Other metals	Tissue (fillets and edible portions, homogenates)	Plastic, borosilicate glass, quartz, PTFE	Cool in wet ice or:	24 hours	Freeze at <-20°C	6 months
Organics	Tissue (fillets and edible portions, homogenates)	Borosilicate glass, PTFE, quartz, aluminum foil	Freeze on dry ice	48 hours	Freeze at <-20°C	1 year
Dioxin	Tissue (fillets and edible portions, homogenates)	Amber containers: Borosilicate glass, PTFE, quartz, aluminum foil			Freeze at <-20°C	30 days until extraction, 15 days after extraction
Lipids	Tissue (fillets and edible portions, homogenates)	Plastic, borosilicate glass, quartz, PTFE			Freeze at <-20°C	1 year

PTFE = Polytetrafluoroethylene (Teflon)

Table FS 1000-11
Holding Times for SPLP or TCLP Extraction, Sample Preparation and Determinative Analysis

Holding Time (Days)				
	From: Field Collection To: SPLP or TCLP Extraction	From: SPLP or TCLP Extraction To: Preparative Extraction	From: Preparative Extraction To: Determinative Analysis	Total Elapsed Time
Volatiles	14	NA	14	28
Semi-Volatiles	14	7	40	61
Mercury	28	NA	28	56
Metals, except Mercury	180	NA	180	360

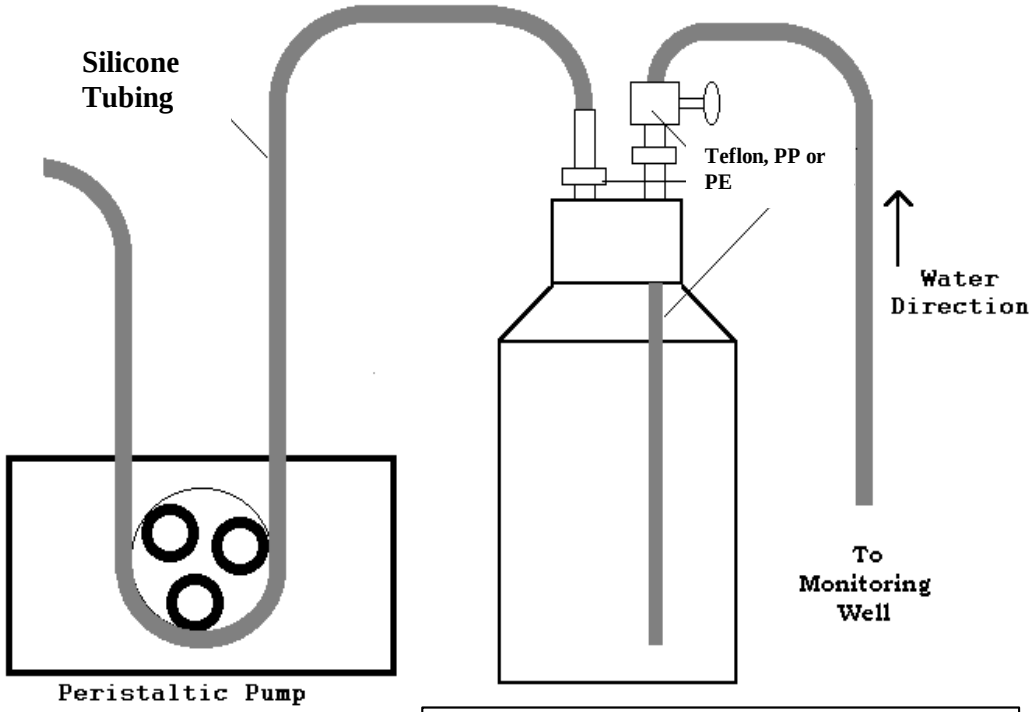
NA – Not Applicable

Table FS 1000-12
Preventive Maintenance Tasks

INSTRUMENT/ACTIVITY	FREQUENCY
REFRIGERATORS, INCUBATORS, OVENS	
Clean interior	Monthly
Check thermometer temperature against certified thermometer or equivalent	Annually
ANYTICAL BALANCES	
Clean pan and compartment	Daily[1]
Check with Class S weights	Monthly
Manufacturer cleaning and calibration	Annually
pH AND ION SELECTIVE ELECTRODES	
PROBE	
Check probe for cracks and proper levels of filling solution; check reference junction; clean electrode	Daily, Replace as necessary
Check response time	Daily[1]
METER	
Check batteries and electronics for loose connections and cracked leads	Daily[1], Replace as necessary
TURBIDIMETER	
Clean instrument housing	Monthly
Clean cells	Daily[1]
CONDUCTIVITY METER	
Check batteries and probe cables	Daily[1]
Replatinize Probe	Per manufacturer's recommendations
DISSOLVED OXYGEN METERS	
PROBE	
Check membrane for deterioration; check filling solution	Daily[1], Replace as necessary
METER	
Battery level and electronics checked	Daily[1], Replace as necessary
THERMOMETERS	
Check for cracks and gaps in the mercury	Daily[1], Replace as necessary
TEMPERATURE PROBE	
Check connections, cables	Daily[1]
Check against calibrated thermometer	Daily[1]
AUTOMATIC SAMPLE COLLECTION SYSTEMS (e.g., ISCO, Sigma)	
Check sampler operation (forward, reverse, automatic through three cycles of the purge-pump-purge cycle)	Daily[1]Prior to Sampling Event
Check purge-pump-purge cycle when sampler is installed	Daily[1]Prior to Sampling Event
Check the flow pacer that activates the sampler to assure proper operation	Daily[1]Prior to Sampling Event
Check desiccant	Daily[1], Replace as Necessary
Check batteries	Daily[1], Replace as Necessary
Check pumping rate against manufacturer's specifications	Daily[1], Replace as Necessary

[1]Daily is defined as prior to use or a 12-hour period if equipment is run continuously

Figure FS 1000-1
Organic Trap Configuration for Collecting Extractable Organics with a Peristaltic Pump



The glass sample bottle must be threaded to use a reusable sampling cap lined and installed with fittings made of Teflon, polypropylene or polyethylene, similar to the design shown.

FS 2000. GENERAL AQUEOUS SAMPLING

See also the following Standard Operating Procedures:

- FA 1000 Administrative Procedures
- FC 1000 Cleaning/Decontamination Procedures
- FD 1000-9000 Documentation Procedures
- FM 1000 Field Planning and Mobilization
- FQ 1000 Field Quality Control Requirements

1. COMMON PROCEDURES

The following procedures are applicable to the collection of all water samples.

1.1. Refer to FS 1000 for procedures that are common to all types of sample collection including general preservation and thermal preservation procedures.

1.2. Grab Samples

1.2.1.1. This is an individual sample collected over a period of time, usually all in one motion, generally not exceeding 15 minutes. The 15-minute time limit applies to aqueous samples only. No time limit applies to the collection of solid samples (e.g., residuals).

1.2.1.2. Grab samples represent the conditions that exist at the moment the sample is collected and do not necessarily represent conditions at any other time. Grab sampling is the preferred method of sampling under the following conditions:

- A snapshot of the water quality at a particular instant in time is desired.
- The water or wastewater stream is not continuous (e.g., batch discharges or intermittent flow).
- The characteristics of the water or waste stream are known to be constant or nearly so.
- When conditions are relatively constant over the period of discharge. In lieu of complex sampling activities, a grab sample provides a simple and accurate method of establishing waste characteristics.
- The sample is to be analyzed for analytes whose characteristics are likely to change significantly with time (e.g., dissolved gases, microbiological tests, pH).
- The sample is to be collected for analytes such as Oil and Grease, bacteriological tests or other parameters listed in number 3 of this section where the compositing process could significantly affect the actual concentration.
- Data on maximum/minimum concentrations are desired for a continuous water or wastewater stream.
- When identifying and tracking slug loads and spills.

1.2.1.3. If required, measure the following parameters on grab samples or in-situ.

NOTE: If the permit specifies a composite sample for any of the parameters mentioned below, **FOLLOW THE PERMIT CONDITIONS**

Cyanide	Oil and Grease
Residual Chlorine	pH
Dissolved constituents in field-filtered samples (ortho-phosphorus, metals, etc.)	Specific Conductance
Dissolved Oxygen and other dissolved gases	Un-ionized Ammonia
Microbiological Parameters	Volatile Organic Compounds
TRPHs	Temperature
Total Phenols	

1.3. Composite Samples

1.3.1. A composite sample is a sample collected over time, formed either by continuous sampling or by mixing discrete samples. Composite samples reflect the average characteristics during the compositing period.

1.3.2. Composite samples are used when stipulated in a permit or when:

- The water or wastewater stream is continuous;
- Analytical capabilities are limited;
- Determining average pollutant concentration during the compositing period;
- Calculating mass/unit time loadings; or
- Associating average flow data to parameter concentrations

1.3.3. Composite samples may be collected individually at equal time intervals if the flow rate of the sample stream does not vary more than plus or minus ten percent of the average flow rate or they may be collected proportional to the flow rate. The permit or work plan will specify which composite sample type to use, either time composites or flow proportional composites. The compositing methods, all of which depend on either continuous or periodic sampling, are described in the following discussions.

1.3.3.1. Time Composite Sample: Time composite samples are based on a constant time interval between samples. A time composite sample can be collected manually or with an automatic sampler. This type of composite is composed of discrete sample aliquots collected in one container at constant time intervals. This method provides representative samples when the flow of the sampled wastewater stream is constant. This type of sample is similar to a sequential composite sample described in number 3.3 of this section.

1.3.3.2. Flow Proportional Composite Sample: Flow proportional samples can be collected automatically with an automatic sampler and a compatible pacing flow measuring device, semi-automatically with a flow chart and an automatic sampler capable of collecting discrete samples, or manually. There are two methods used to collect this type of sample:

- Method 1: Collect a constant sample volume per stream flow (e.g., a 200 mL sample collected for every 5,000 gallons of stream flow) at time intervals proportional to stream flow. This method provides representative samples of all waste streams when the flow is measured accurately.
- Method 2: Collect a sample by increasing the volume of each aliquot as the flow increases, while maintaining a constant time interval between the aliquots (e.g., hourly samples are taken with the sample volume being proportional to the flow at the time the sample is taken).

1.3.3.3. Sequential Composite Sample: Sequential composite samples are composed of discrete samples taken into individual containers at constant time intervals or constant discharge increments. For example, samples collected every 15 minutes are composited for each hour.

- The 24-hour composite is made up from the individual one-hour composites. Each of the 24 individual samples is manually flow-proportioned according to the flow recorded for the hour that the sample represents. Each flow-proportioned sample is then added to the composite samples. The actual compositing of the samples is done by hand and may be done in the field or the laboratory. In most cases, compositing in the field is preferable since only one sample container must be cooled, and then transported to, and handled, in the laboratory. A 24-hour composite is frequently used since an automatic sampler can easily collect the individual samples.
- A variation of the 24-hour composite is to collect a constant volume of sample taken at constant discharge increments, which are measured with a totalizer. For example, one aliquot is collected for every 10,000 gallons of flow
- Sequential sampling is useful to characterize the waste stream because you can determine the variability of the wastewater constituents over a daily period. For example, for pretreatment studies you can visually determine when high strength wastes are being discharged from a facility or when heavy solid loads are being discharged during a 24-hour cycle. You can measure the pH throughout the day. The value of this type of sampling must be weighed against the manpower constraints and sampling goals

1.3.3.4. Continuous Composite Sample: Collected continuously from the stream. The sample may be a constant volume that is similar to the time composite, or the volume may vary in proportion to the flow rate of the waste stream, in which case the sample is similar to the flow proportional composite.

1.3.3.5. Areal Composite: A sample composited from individual grab samples collected on an areal or cross-sectional basis. Areal composites must be made up of equal volumes of grab samples; each grab sample must be collected in an identical manner. Examples include residual samples from grid system points on a land application site, water samples collected at various depths at the same point or from quarter points in a stream, etc. Sample is similar to the flow proportional composite.

1.4. Collection Techniques

1.4.1. When filling a sample container that already contains premeasured preservative, slowly pour the sample down the side of the container so that the preservative does not splatter. If the preservative is concentrated acid, and the sample water is added too

quickly, the reaction between the water and the acid can generate enough heat to burn unprotected skin or could splatter and cause acid burning.

1.4.2. Collect grab samples (single, discrete samples) unless directed by permit, program, or approved sampling plan or work plan to collect composite samples.

1.4.3. Except for volatile organic compounds and sulfide, leave ample headspace in the sample bottle to allow for expansion, effervescence and proper mixing at the laboratory.

1.5. Collecting Filtered/Dissolved Samples

1.5.1. Certain studies or projects require collection of dissolved (i.e., filtered) samples. Identify all analytes in samples that are filtered as "dissolved" or "filtered" in field notes or laboratory transmittal forms and on final reports.

1.5.2. Collect both filtered and unfiltered samples from the same water in a collection device (e.g., bailer, intermediate container) or consecutively if sampling from a pump.

1.5.3. Collect dissolved metals in groundwater according to the procedures discussed in FS 2225. **Do not** collect filtered samples for metals from groundwater sources unless:

1.5.3.1. The DEP has required or approved the protocol and the DEP program allows the use of the procedure; or

1.5.3.2. The organization is documenting that a filtered groundwater sample is as or more representative of the groundwater quality. In this case, collect **both** unfiltered and filtered samples for analysis. Submit the results of both samples the DEP for review.

1.5.4. Filtration, when performed, must be completed within 15 minutes of sample collection.

1.5.5. Collect dissolved groundwater samples for metals with a one-piece molded construction 1 µm filter unless otherwise specified by a DEP program. Use a 0.45 µm filter when filtering all other constituents **including** metals in surface water.

1.5.6. The filter must be compatible with the analyte to be filtered (e.g., zero carbon content for carbon analysis; non-protein binding filters for nitrogen).

1.5.7. Equipment blanks, when collected, must be processed through the filtration apparatus and analyzed for the analytes of interest.

1.5.8. Filters and filtration equipment are intermediate devices and therefore must be adequately rinsed per FS 2110 section 1.1.2.1.

THE FOLLOWING ARE SPECIAL CONSIDERATIONS FOR VARIOUS ANALYTE GROUPS:

FS 2001. *pH-Preserved Samples*

1. SAMPLE CONTAINERS

1.1. Use properly cleaned sample containers (see FC 1300).

1.2. Inspect all containers for visual defects or contamination. Discard if defects are present or containers do not appear clean.

2. SAMPLE COLLECTION PROCEDURES

2.1. Perform any filtration **before** the sample is poured into the container and **before** the sample is preserved.

2.2. Remove the cap from the sample container, and carefully pour the sample into the container without allowing sampling equipment or hands to touch the rim of the sample container.

2.3. If the preservative is added after the sample is collected, (the container is not prepreserved), do not fill the container to the rim.

3. PRESERVATION

3.1. Preserve the sample within 15 minutes of sample collection or filtration (if applicable) unless collected as a composite sample (see FS 1006, section 3.3) or for analysis of lead and copper for drinking water compliance (see FS 2310, section 2).

3.2. Preserve the sample with the chemical specified by the method or preservation tables (Tables FS 1000-4 to FS 1000-10).

3.2.1. The chemical reagents must be pure enough so that the reagent does not contribute contamination or interferences to the analytes of interest.

3.3. Preserve the sample by adding an accurately measured amount of preservative to the container. Premeasured vials of the preservative, or a graduated container or pipet, may be used.

3.3.1. Tightly cap the sample container and gently tip the container two to three times to distribute the chemical.

3.4. The pH of the preserved sample must meet the pH criterion of the applicable preservation tables (see Tables FS 1000-4 to FS 1000-10). **Do not over preserve the sample.**

3.4.1. Pour an aliquot of the preserved sample into a disposable container (e.g., sampling cup) or onto a piece of **narrow** range pH paper to determine if the pH meets the required level. **Do not put the pH paper directly into the sample container.**

3.4.2. If the pH does not meet the required level, add additional measured amounts of preservative and test with narrow range pH paper (see section 3.4.1 above) until the pH meets the pH requirement.

3.4.3. Record the total amount of preservative that was added to the sample. This documentation is necessary for the next site visit, since additional acid may be needed to adequately preserve the sample on subsequent visits.

3.5. Cooling to less than 6°C in wet ice (see FS 1006, section 5) may be required.

3.6. If required, protect from direct sunlight and store in dark (see tables FS 1000-4, FS 1000-5 and FS 1000-8)

3.7. Preserve all field blanks or equipment blanks with the **greatest** amount of preservative that was required in the associated sample set and note the amount in field documentation. However, do not preserve with excess acid where this may interfere with laboratory analysis of the sample.

3.8. After the sample has been preserved, screw the cap on tightly.

4. Verifying pH-Preserved Samples: Verify the pH of all pH-preserved samples (except volatile organics) in the field (see FS 2001, section 3.4). If samples are routinely collected from the same sample location, a pH check is not required each time samples are collected.

4.1. If the frequency of sample collection at a specified location is once per month or greater (e.g., weekly or daily), check the pH of **at least one** sample per parameter group according to the following schedule:

4.1.1. Weekly sampling: 1 pH check per month

4.1.2. Daily sampling: 1 pH check per week

4.2. If the frequency of sample collection at a specified location is once per month, check the pH of at least one sample per parameter group (except volatile organics) quarterly.

4.2.1. If site conditions vary from sampling event to sampling event, perform pH checks at increased intervals.

4.2.2. For all other sample collection frequencies, pH checks may be reduced as follows:

4.2.2.1. During the first sampling event at a particular site, check **all** samples (except volatile organics) that are pH-adjusted, and

4.2.2.2. During subsequent visits to a particular site, check **at least one** sample per parameter group that must be pH-adjusted.

5. DOCUMENTATION

5.1. Complete the sample container label and stick firmly on the container.

5.2. Complete the field notes.

5.3. Make notes on the transmittal form and in field records about any relevant observations or problems such as entrained sediment or preservation problems.

FS 2002. *Metals*

1. SAMPLE CONTAINERS

1.1. Use properly cleaned containers (see FC 1300).

1.2. Inspect the containers and caps for visual defects or contamination. Do not use containers if defects are present or if they do not appear clean.

2. SAMPLE COLLECTION PROCEDURES

2.1. Perform any filtration **before** the sample is poured into the container and **before** the sample is preserved.

2.2. Remove the cap from the sample container and carefully pour the sample into the container without allowing sampling equipment or hands to touch the rim of the sample container.

3. PRESERVATION - Follow preservation procedures outlined in FS 2001 above.

3.1. Requirements for specific metals:

3.1.1. For boron or cold-vapor atomic absorption Mercury with a grade of nitric acid (HNO_3) that is suitable for use for metals analysis. Use concentrated HNO_3 or 1:1 HNO_3.to lower the pH of less than 2 S.U., but greater than 1.62 S.U.

3.1.2. For Chromium VI add sufficient ammonium sulfate buffer solution specified per Table FS 1000-4 to the sample to raise the pH of the sample to a pH of 9.3 – 9.7 and place in ice (see FS 2002).

3.1.3. Trace Level Mercury

3.1.3.1. Collect samples for trace level mercury (<100 ug/L) in tightly-capped fluoropolymer or glass bottles.

3.1.3.2. If the samples cannot be received by the laboratory within 48 hours of sample collection, preserve the sample with BrCl or HCl solution.

3.1.3.3. For dissolved trace level mercury, samples must be filtered through a 0.45 µm filter within 24 hours of sample collection. If the samples cannot be transported to the laboratory within 24 hours, follow the procedures in FS 8200 for field filtration.

3.1.4. Samples collected for lead and copper for drinking water compliance and metals other than those listed above do not require immediate acid preservation.

3.1.4.1. When samples are not acidified with acid, the transmittal form to the laboratory must:

- Clearly state that the samples are unpreserved; and
- Request that the laboratory preserve the samples.

3.1.4.2. If samples are acidified, use concentrated HNO_3 or 1:1 HNO_3.to lower the pH of less than 2 S.U., but greater than 1.62 S.U.

3.2. After the sample has been preserved, screw the cap on tightly.

4. DOCUMENTATION

4.1. Complete the sample container label and stick firmly on the container.

4.2. Complete the field notes.

4.3. Make notes on the transmittal form and in field records about any relevant observations or problems such as entrained sediment.

4.4. On the transmittal form, clearly identify samples that must be acidified by the laboratory (FS 2002, 3.1.3 or 3.1.4 above).

FS 2003. *Extractable Organics*

1. SAMPLE CONTAINERS

1.1. Most samples are collected in glass containers with Teflon-lined caps. Note: Teflon containers are also acceptable. There are some exceptions such as collecting samples in amber glass (e.g., nitroamines, nitroaromatics, etc.). If in doubt, verify the proper container type in Tables FS 1000-4 through FS 1000-10.

1.2. Inspect glass bottles to assure that there are no visual glass or liner defects. If defects are present and/or the sample containers do not appear clean, the bottles must be discarded.

1.3. Collect composite samples from automatic sample collection devices in refrigerated glass or Teflon containers through Teflon, polyethylene or polypropylene tubing.

2. SAMPLE COLLECTION PROCEDURES

2.1. Remove the cap from the sample container without touching the interior Teflon liner.

2.2. Carefully pour the sample into the container without allowing sampling equipment or hands to touch the rim of the sample container.

2.3. Fill bottle with sample to almost full capacity.

3. PRESERVATION

3.1. In general, these types of samples must be preserved by cooling to 4°C.

3.1.1. Some analyte groups require a chemical preservation. See Tables FS 1000-4 through FS 1000-10 for any additional preservation.

3.1.2. If the samples for pesticides cannot be extracted within 72 hours of collection, the sample pH must be in the range of 5 to 9. If needed, adjust sample to the specified pH range with sodium hydroxide or sulfuric acid.

3.1.3. Add sodium thiosulfate if residual chlorine is present.

3.2. Place samples in **wet** ice within 15 minutes of sample collection (see FS 1006, section 5).

4. DOCUMENTATION

4.1. Complete the sample container label and stick firmly on the container.

4.2. Document when samples were placed in wet ice immediately (see FS 1006, section 5).

4.3. Complete the field notes.

4.4. Make notes on the lab transmittal form and the field records about any sample that appears highly contaminated or exhibits other abnormal characteristics (i.e., foaming, odor, etc.).

FS 2004. *Volatile Organics*

1. SAMPLE CONTAINERS

1.1. Use a screw cap glass sample vial that is sealed with a Teflon-coated septum.

1.2. Collect **at least two** vials of each sample. Some laboratories may require three or more vials, therefore verify the laboratory's policy on the number of vials they require unless the laboratory provides the sampling kit.

1.3. Inspect the vials for glass or septum defects (e.g., rim must not have nicks or visible depressions and the septum must not be deformed). Do not use containers if defects are present or if they do not appear clean.

2. SAMPLE COLLECTION PROCEDURES

2.1. Special precautions for petroleum sources:

2.1.1. If possible, transport and store fuels in a separate vehicle from sampling equipment, empty vials and collected samples. If these items must be transported in the same vehicle as fuel, store the fuels as far away from the vials as possible.

2.1.2. Place all fuel or exhaust sources downwind of the sampling location.

2.1.3. Position all petroleum-fueled engines (including the vehicle) downwind of the sampling operations.

2.2. Do not allow the sampling equipment or hands to touch the rim of the sample container.

2.3. Do not remove septum caps from VOC vials until just prior to filling. Cap vials immediately after filling with sample.

2.4. **DO NOT PRERINSE VOC VIALS.**

2.5. Do not aerate the sample during sample collection. If collecting from a spigot, reduce the flow rate to less than 100 mL/min. If collecting samples with a pump, maximize the flow rate within the range of 100 mL/min to 400 mL/min, depending on the sample source and pump and tubing configuration. See further discussion about sampling VOCs with pumps in FS 2200.

2.6. If preservation is required, proceed to section 3 below unless the laboratory supplied vials with premeasured quantities of acid, and the sample does not need to be dechlorinated (see 3.2 below).

2.6.1. If no preservation is required or if the vials are prepreserved (see 2.5 above), slowly and carefully allow the sample to flow down the **side** of the vial to minimize turbulence. Fill the vial until the surface tension holds the water in a "convex meniscus".

2.6.2. If a vial overflows during the filling process, document the problem and notify the laboratory that the vial may not contain sufficient acid.

2.6.3. If using a bailer, the bailer must be equipped with a controlled flow bottom assembly.

3. PRESERVATION

3.1. Preserve the sample **during** the sample collection process.

3.2. Dechlorination: Some treated water samples (drinking water and treated wastewater) may contain residual chlorine that must be removed with a declorination agent such as sodium thiosulfate or ascorbic acid. This process must occur **before** any additional preservatives (i.e., acid) are added. The dechlorination agent must be **in the vial** before the sample is added.

3.2.1. Laboratories may supply vials with premeasured quantities of declorination agent. If acid preservation **is not required**, fill the vials (see section 2.5.1 above) and proceed to section 4 below.

3.2.2. For chlorinated drinking water samples, add 3 mg sodium thiosulfate per 40 mL vial.

3.2.3. If the chlorine level is unknown, the concentration must be measured (see FT 2000). For sources other than drinking water (e.g., chlorinated effluent), 10 mg sodium thiosulfate per 40 mL vial will remove up to 5 ppm Cl_2.

3.3. Acid Preservation

3.3.1. Chlorinated Samples

3.3.1.1. If acid preservation is required, carefully fill the vial with sample, but not to a convex meniscus as described in section 2.5.1 above.

3.3.1.2. Add four drops of concentrated HCl (more acid may be needed if the sample is known to contain high levels of bicarbonate or is otherwise buffered).

3.3.1.3. Add additional sample to create a convex meniscus.

NOTE: If the sample reacts with the acid by generating gas, do not submit preserved samples for analysis. Instead, collect unpreserved samples (seven-day holding time must be met).

3.3.2. Unchlorinated Samples

3.3.2.1. The laboratory may supply vials with premeasured quantities of acid. In this case, proceed to section 2.5.1 above. If a vial overflows during the filling process, document the problem and notify the laboratory that the vial may not contain sufficient acid.

3.3.2.2. If the samples are preserved in the field, follow the procedure in section 3.3 above.

4. CAPPING THE VIAL

4.1. Fill the vial so that the sample surface is above the container rim (convex meniscus).

4.1.1. **Do not pour** sample into cap.

4.1.2. Fill vial from the original source (tubing, spigot, etc.) **Do not fill vial from sample collected in the cap**.

4.2. **Immediately** cap the vial with the Teflon seal contacting the sample. Some sample may overflow while tightening the cap.

4.3. If acid has been added to the sample, tip the vial gently two or three times to distribute the preservative.

4.4. Turn the vial over and tap it to check for the presence of bubbles.

4.4.1. If bubbles are present, and the total volume of the bubbles is less than 5 mm in diameter, the sample may be submitted.

4.4.2. If the total volume of the bubbles is greater than 5 mm in diameter, discard the vial and fill a new one.

4.4.3. **Do not reopen a vial to add additional sample.**

5. SAMPLE PACKING

5.1. Label each vial with an appropriate field ID number and preservation (e.g., preserved with acid, sodium thiosulfate/acid, etc.).

5.2. Wrap each vial in a protective material (e.g., bubble wrap).

5.3. Place the set of vials in a small, sealable, untreated plastic bag unless the laboratory supplies an alternate method of packing.

5.4. Place samples in **wet** ice within 15 minutes of sample collection (see FS 1006, section 5).

5.5. Protect samples from environmental contamination during storage and transport to the laboratory.

5.6. As an added measure, DEP recommends wrapping the set of replicate samples in bubble wrap and sealing them in a container. This procedure will add further protection from potential contamination.

6. DOCUMENTATION

6.1. Label all the vials.

6.2. Complete field records.

6.3. Make note in the field records of any samples that appear highly contaminated or appear to effervesce when acid is added.

FS 2005. *Bacteriological Sampling*

1. SAMPLE CONTAINERS

1.1. Collect the samples in properly sterilized containers.

1.1.1. Presterilized Whirl-pak bags (or equivalent) are generally used.

1.1.2. If Whirl-pak bags are not used, the sample container must have a volume of at least 125 mL.

1.1.3. If using bottles, the caps must be sterilized. If the caps are lined, there must be documentation to show that the liner does not produce toxic compounds when sterilized.

1.1.4. Bottles and caps must be sterilized according to procedures in FC 1320 or purchased presterilized from a commercial vendor.

2. SAMPLE COLLECTION PROCEDURES

2.1. Unless a composite is specified by permit, all samples must be grab samples.

2.2. Do not open the container once it has been sealed.

2.3. Do not rinse sample container before collecting the sample.

2.4. Use aseptic techniques to collect the sample:

2.4.1. If an intermediate device is used, thoroughly rinse with sample water. To ensure proper rinsing, DEP recommends that microbiological samples be the last sample collected with the sampling device.

2.4.2. Do not put fingers into the mouth of the container or on the interior of the cap.

2.4.3. Do not disinfect the sample equipment or sampling port.

2.4.3.1. If special sampling requirements suggest disinfection is required because of a questionable condition of the sampling port or spigot, e.g., for drinking water sampling, follow procedures for potable water sampling in Section 9060, *Samples*, subsection 9060 A.3.a., Potable Water, 2006, in Standard Methods for the Examination of Water and Wastewater (see Standard Methods Online, http://www.standardmethods.org/store/).

2.5. Rinse the sampling equipment with sample water before collecting the sample. Therefore, collect microbiological samples at the end of a sampling sequence.

2.6. Wells with In-Place Plumbing, Spigots and/or Faucets

2.6.1. Do not disinfect the spigot with bleach, alcohol or heat. Turn on spigot and flush at maximum velocity (see FS 2310).

2.6.2. After flushing, reduce the water flow to approximately 500 mL/min and allow the water to flow for a few minutes before collecting samples. If other samples (metals, nutrients, etc.) are to be collected, collect these samples first.

2.6.3. **Do not stop the flow before or during the filling process.**

2.7. Direct Grab Sample Collection

2.7.1. Hold a rigid container near the base and plunge neck downward, below the surface. Turn container until the neck points slightly upward with the mouth directed toward the current. Fill to within about 1/2 inch of the top and cap immediately.

2.7.2. Whirl-pak bags (or equivalent)

- Open the bag by zipping off the top and pulling the white tabs to open the bag. Hold the bag behind the wire ties, and plunge neck downward and up in one sweeping arc; or
- Zip off the top of the bag. Hold bag so that the mouth and wire ties are in front of the hands and fingers. Immerse the bag, and open the bag into the current.
- The above procedures may also be accomplished by attaching the bag to a pole.

2.7.2.1. Bring the bag to the surface, and press out excess water.

2.7.2.2. Seal the bag by folding the open ends at least three times and securely twisting the wire ties.

2.8. Intermediate Device Collection

2.8.1. When using an intermediate sampling device (bailer, DO dunker, niskin bottle, etc.), obtain sufficient sample in the sample collection device to completely fill the sample container. Begin pouring sample out of the device BEFORE collecting into the container. Continue to pour sample out of the device, place container under flowing stream, and fill. **Do not stop the flow before or during the filling process.**

3. PRESERVATION

3.1. Preserve samples according to Tables FS 1000-4 through FS 1000-10.

3.2. Place all samples in wet ice immediately after sample collection (see FS 1006, section 5).

3.3. When the sample contains residual chlorine, add a dechlorinating agent such as sodium thiosulfate to the sample container.

3.3.1. The final concentration of sodium thiosulfate must be approximately 100 milligrams per liter (mg/L) in the sample (add 0.1 mL of a 10% solution of thiosulfate to a 125 mL sample).

3.3.2. Some vendors or laboratories provide sterile containers with premeasured amounts of dechlorinating agent. Determine if the source of the field containers already contain a dechlorinating agent.

3.3.3. **Do not use containers with dechlorinating chemicals** when collecting samples from sources that are known to be free from residual chlorine.

4. HOLDING TIME

4.1. The holding time for microbiological samples is very short. Let the laboratory know the approximate time that samples will be collected and when they are expected to be delivered to the laboratory.

4.2. The holding time begins at the time (hours and minutes) the sample is collected and ends at the time that the sample is placed on the applicable growth media.

4.3. Consult Tables FS 1000-4, -6, -8, and -9 for holding times.

5. DOCUMENTATION

5.1. Label each sample container with an appropriate field ID number.

5.2. Place samples in **wet** ice within 15 minutes of sample collection (see FS 1006, section 5).

5.3. Complete field records.

5.4. Make note in the field records of any unusual sample appearances or sampling conditions.

FS 2006. *Oil and Grease (O&G) and Total Recoverable Petroleum Hydrocarbons (TRPHs)*

1. SAMPLE CONTAINERS

1.1. Collect samples for O&G and TRPHs in 1-liter wide mouth amber glass bottles.

1.2. The cap must have a Teflon liner.

1.3. Visually inspect glass bottles and caps for defects. Do not use container if defects are present or if they do not appear clean.

2. SELECTION OF SAMPLING POINTS

2.1. Oil and grease may be present in wastewater as a surface film, an emulsion, a solution, or as a combination of these forms. Since it is very difficult to collect a representative ambient sample for oil and grease analysis, the sampler must carefully evaluate the location of the sampling point.

2.1.1. Select a point of greatest mixing.

2.1.2. For compliance samples at a facility, collect samples from a point that best represents oil and grease concentrations.

3. SAMPLE COLLECTION PROCEDURES

3.1. All samples must be grab samples.

3.1.1. If composite data are required, collect individual grab samples over the specified time period.

3.1.2. Submit all samples for analysis.

3.1.3. Average the concentrations of the results to determine the average concentration over time.

3.2. Do not collect the sample by skimming the surface.

3.3. Collect a discrete sample that will be used for analysis. Do not use this sample for any other test.

3.4. Remove the cap from the glass bottle without touching the interior of the container or lid.

3.5. Do not rinse the sampling device or the sample container with sample water.

3.6. Collect the sample directly into the container.

3.6.1. If intermediate sampling equipment is needed, do not allow the sampling equipment to touch the rim of the sample container.

3.6.2. Do not use automatic samplers to collect these types of samples.

3.6.3. Fill the bottle with the sample water to almost full capacity.

3.6.4. Add preservatives (see section 4 below).

3.6.5. Quickly cap the container and tighten securely.

4. PRESERVATION

4.1. Preserve the sample within 15 minutes of sample collection.

4.2. The pH of the acidified sample must be less than 2. **Do not over acidify the sample.**

4.3. Preserve the sample by adding an accurately measured amount of sulfuric or hydrochloric acid to the container. Premeasured vials of acid, or a graduated container or pipet, may be used.

4.3.1. Tightly cap the sample container and shake to distribute the acid.

4.3.2. Pour an aliquot of the acidified sample into a disposable container (e.g., sampling cup) or onto a piece of **narrow** range pH paper to determine if the pH is less than 2. **Do not put the pH paper directly into the sample container.**

4.3.3. If the pH is greater than 2, add additional measured amounts of acid and test with narrow range pH paper (see section 4.3.2 above) until the pH has been reduced to below 2 pH units.

4.3.4. Record the total amount of acid that was added to the sample.

4.4. Acidify at least one of the equipment blanks with the **greatest** amount of acid that was required in the sample set and note the amount in field documentation.

4.5. After the sample has been preserved, screw the cap on tightly.

4.6. Immediately place the sample in **wet** ice after preserving with acid (see FS 1006, section 5).

5. DOCUMENTATION

5.1. Label each vial with an appropriate field ID number.

5.2. Protect glass container from breakage (“bubble wrap” is recommended).

5.3. Complete field records.

5.4. Make notes on the transmittal form and in field records about any relevant observations or problems such as entrained sediment.

FS 2007. *Radiological Sampling (Excludes Radon)*

1. SAMPLE CONTAINERS

1.1. Use polyethylene, polyvinyl chloride (PVC), or Teflon containers.

1.2. Visually inspect the containers and caps for defects. If defects are present and/or sample containers do not appear to be clean, do not use the containers.

2. SAMPLE COLLECTION PROCEDURES

2.1. On unknown sites, survey the area with a beta-gamma survey instrument, such as a Geiger-Müller meter.

2.1.1. If radiation levels are above instrument background, consult a radiation safety specialist to determine appropriate safety procedures.

2.2. Remove the cap from the sample container and carefully pour the sample into the container without allowing sampling equipment or hands to touch the rim of the sample container.

3. PRESERVATION

3.1. Preserve the sample with a suitable grade of nitric acid (HNO_3).

3.2. Preserve the sample within 15 minutes of sample collection.

3.3. The pH of the acidified sample must be less than 2. **Do not over acidify the sample.**

3.4. If the preservative is added after the sample is collected (the container is not prepreserved), do not fill the container to the rim.

3.5. Preserve the sample by adding an accurately measured volume of concentrated HNO_3 or 1:1 HNO_3 to the container. Premeasured vials of acid, or a graduated container or pipet, may be used.

3.5.1. Tightly cap the sample container and shake to distribute the acid.

3.5.2. Pour an aliquot of the acidified sample into a disposable container (e.g., sampling cup) or onto a piece of **narrow** range pH paper to determine if the pH is less than 2. **Do not put the pH paper directly into the sample container.**

3.5.3. If the pH is greater than 2, add additional measured amounts of acid and test with narrow range pH paper (see section 3.5.2 above) until the pH has been reduced to just below 2 pH units.

3.5.4. Record the total amount of acid that was added to the sample.

3.5.5. Cooling to 4°C is not required.

3.6. Acidify at least one of the equipment blanks with the **greatest** amount of acid that was required in the sample set and note the amount in field documentation.

3.7. After the sample has been preserved, screw the cap on tightly.

4. DOCUMENTATION

4.1. Complete the sample container label and stick firmly on the container.

4.2. Complete the field notes.

4.3. Make notes on the transmittal form and in field records about any relevant observations or problems such as entrained sediment.

FS 2008. *Radon Sampling*

Radon is a gas and is easily removed from water sources. Therefore, follow the same precautions and care used to collect volatile organic samples. Minimize contact with air during sample collection. Other sample collection techniques may be appropriate, depending on the analytical method or as specified in the project data quality objectives.

1. SAMPLE CONTAINERS

1.1. Use glass sample vials containing a premeasured portion of the scintillation "cocktail."

1.2. Visually inspect the containers and caps for defects. If defects are present and/or sample containers do not appear to be clean, do not use the containers.

1.3. Collect at least two samples.

2. PRESERVATION: The scintillation cocktail is the only required preservative.

3. SAMPLE COLLECTION PROCEDURES Obtain specific sample collection instructions from the laboratory that will analyze the samples. These instructions must include proper handling as

well as sample size and packing instructions. The following are general instructions for collecting the samples:

3.1. Carefully fill a syringe (usually 10 mL) with sample water so that air bubbles are not pulled in with the sample before, during or after filling.

3.2. Place the tip of the syringe BELOW the scintillation cocktail and slowly dispense the sample BENEATH the cocktail surface.

3.3. Replace the lid and cap tightly.

3.4. Generally, the vial is used in the laboratory analytical instrument and labels or ID numbers on the sides of the containers may interfere with the analysis. Check with the laboratory for proper placement of labels or field ID numbers.

3.5. Ship in an upright position in the shipping containers that have been provided by the laboratory. If none are provided, protect vials from breakage ("bubble wrap" is recommended), segregate replicate samples in separate plastic bags, and ship to the laboratory in an upright position.

4. DOCUMENTATION

4.1. Complete the field notes.

4.2. Make notes on the transmittal form and in field records about any relevant observations or problems such as entrained sediment.

FS 2009. *Cyanide Sampling*

Cyanide is a very reactive and unstable species and is highly toxic. Samples suspected of containing cyanide must be handled very carefully.

1. SAMPLE CONTAINERS

1.1. Use polyethylene or glass sample containers.

1.2. Use properly cleaned containers (see FC 1300).

1.3. Visually inspect the containers and caps for defects. If defects are present and/or sample containers do not appear to be clean, do not use the containers.

2. SAMPLE COLLECTION PROCEDURES

2.1. Remove the cap from the sample container, and carefully pour the sample into the container without allowing sampling equipment or hands to touch the rim of the sample container.

3. PRESERVATION

3.1. Many different analytes interfere with the cyanide analysis (e.g., sulfides). If any interferences are known to be present, pretreat the sample for interferences by following the applicable footnotes in Table FS 1000-4.

3.2. Preserve the sample within 15 minutes of sample collection.

3.3. Preserve samples with sodium hydroxide to a pH greater than 10.

3.4. Preserve the sample by adding an accurately measured amount of a sodium hydroxide solution or sodium hydroxide pellets to the container. Use a graduated container or pipet to add the solution.

3.4.1. Tightly cap the sample container and shake to distribute the preservative.

3.4.2. Pour an aliquot of the preserved sample into a disposable container (e.g., sampling cup) or onto a piece of **narrow** range pH paper to determine if the pH is greater than 10. **Do not put the pH paper directly into the sample container.**

3.4.3. If the pH is less than 10, add additional measured amounts of the preservative and test with narrow range pH paper (see section 3.4.2 above) until the pH has been raised to above 10 pH units.

3.4.4. Record the total amount of preservative that was added to the sample.

3.5. After the sample has been preserved, screw the cap on tightly.

3.6. Immediately put the sample in **wet** ice (see FS 1006, section 5).

3.7. Preserve at least one of the equipment blanks with all the reagents and the **greatest** amount of sodium hydroxide that was required in the sample set and note the amount in field documentation.

4. DOCUMENTATION

4.1. Complete the sample container label and stick firmly on the container.

4.2. Complete the field notes.

4.3. Make notes on the transmittal form and in field records about any relevant observations or problems such as entrained sediment.

4.4. Ensure that all preservation measures are part of the field notes.

FS 2010 *Sulfide Sampling*

1. Analyze samples within 15 minutes of collection, or the preserve the sample within 15 minutes for later analysis. If preservation is required add the zinc acetate and sodium hydroxide to the container **before** filling with sample.

2. Avoid aerating the sample during collection. Pour the sample slowly and carefully allow the sample to flow down the **side** of the container to minimize turbulence.

3. Check the pH (if necessary) before completing the filling process.

4. Complete the filling process. **Do not leave a head space.**

FS 2100. SURFACE WATER SAMPLING

See also the following Standard Operating Procedures:

- FA 1000 Administrative Procedures
- FC 1000 Cleaning/Decontamination Procedures
- FD 1000Documentation Procedures
- FM 1000 Field Planning and Mobilization
- FQ 1000 Field Quality Control Requirements
- FS 1000 General Sampling Procedures
- FS 2000 General Aqueous Sampling
- FS 2400 Wastewater Sampling
- FT 1000 – FT 2000 Field Testing and Calibration Procedures

1. INTRODUCTION AND SCOPE

   1.1. This section presents standard operating procedures to be used to consistently collect representative surface water samples. Each collection event must be performed so that samples are neither contaminated nor altered from improper handling.

   1.2. The following topics include acceptable equipment selection and equipment construction materials; and standard grab, depth-specific and depth-composited surface water sampling techniques. Information regarding sample types and flow- or time-weighted aqueous sampling is found in FS 2420.

2. GENERAL CAUTIONS

   2.1. When using watercraft, take samples near the bow, away and upwind from any gasoline outboard engine. Orient watercraft so that bow is positioned in the upstream direction.

   2.2. When wading, collect samples upstream from the body.

   2.3. Avoid disturbing sediments in immediate area of sample collection.

   2.4. Collect water samples prior to taking sediment samples when obtaining both from the same area (site).

   2.5. Consider the representativeness of selected sampling locations, for example, when attempting to characterize a water body that may be stratified or heterogeneous.

   2.6. Unless dictated by permit, program or order, sampling at or near structures (e.g., dams, weirs or bridges) may not provide representative data because of unnatural flow patterns.

   2.7. Collect surface water samples from downstream towards upstream.

3. EQUIPMENT AND SUPPLIES

   3.1. Use sampling equipment constructed of materials consistent with the analytes of interest. Refer to FS 1000, Tables 1000-1 and 1000-2 for material selection. Select equipment based on the analytes of interest, the specific equipment use and the available equipment. Refer to FS 1000, Table 1000-3 for selection of appropriate equipment.

   3.2. For information on sample container size and construction, preservation and holding time requirements, see FS 1000, Tables 1000-4, 1000-5, 1000-8, 1000-9 and 1000-11.

   3.3. For information on sampling equipment cleaning requirements, see FC 1000.

   3.4. For information on documentation requirements, see FD 1000.

FS 2110. SURFACE WATER SAMPLING TECHNIQUES

Use the following protocols when collecting surface water samples. Adhere to all general protocols applicable to aqueous sampling detailed in FS 2000 when following the surface water sampling procedures addressed below.

1. MANUAL SAMPLING: Use manual sampling for collecting grab samples for immediate in-situ field analyses. Also use manual sampling in lieu of automatic equipment over extended periods of time for composite sampling, especially when it is necessary to observe and/or note unusual conditions.

1.1. Surface Grab Samples

See FS 2000, section 1.2 for discussions concerning the appropriate uses of grab samples.

Collect surface grab samples within the top 12 inches of the water column. Avoid skimming the surface of the water during collection unless specifically required by the sampling plan. Very shallow water bodies require careful techniques of sample collection to avoid disturbing sediments (1.1.4 below).

Where practical, use the actual sample container as the collection device (direct grab). Sample containers attached to poles are also considered direct grabs.

The use of unpreserved sample containers is encouraged since the same container can be submitted for laboratory analysis after appropriate preservation. This procedure reduces sample handling and potential loss of analytes or contamination of the sample from other sources (e.g., additional sampling equipment, environment, etc.).

1.1.1. Direct Grab Technique

1.1.1.1. Using an unpreserved sample container to collect the sample:

- Remove the container cap and slowly submerge the container, opening first, into the water.
- Invert the bottle so the opening is upright and pointing upstream into the oncoming direction of water flow (if applicable). Allow water to run slowly into the container until filled.
- Return the filled container quickly to the surface.
- Pour out a small volume of sample away from and downstream of the sampling location. This procedure allows for addition of preservatives and sample expansion. Do not use this step for volatile organics or other analytes where headspace is not allowed in the sample container.
- Add preservatives, if required, securely cap container, label and complete field notes.

1.1.1.2. Using a sample container with premeasured preservative to collect the sample. (An unpreserved sample container may also be used with this technique.)

- Submerge the unopened sample container to the appropriate level.
- Turn the container so that the opening is upright and pointing upstream into the oncoming direction of water flow (if applicable).
- Open the container and allow the water to run into the container almost full (leave an air space).
- Cap the container and return to the surface.

1.1.1.3. If preservatives have been added, invert the container several times to ensure sufficient mixing of sample and preservatives.

1.1.1.4. Check preservation of the sample and adjust pH with additional preservative, if necessary. When a pH adjustment is made and a prepreserved container was used to collect the sample, always check all containers for proper preservation.

1.1.2. Sampling with an Intermediate Vessel or Container: If the sample cannot be collected directly into the sample container to be submitted to the laboratory, use an unpreserved sample container or an intermediate vessel (e.g., beakers, buckets or dippers) to obtain the sample. Where applicable, ensure that the bulk sample collected with the intermediate device is well mixed before distribution into individual sample containers in order to maintain homogeneity of the samples. These vessels must be appropriately cleaned and constructed including any poles or extension arms used to access the sample location.

1.1.2.1. Rinse the intermediate vessel with ample amounts of site water prior to collecting the first sample. Discard rinsate away from or downstream of the sampling location.

1.1.2.2. After adequate rinsing, fill the intermediate vessel with sample water. Minimize agitation or aeration of the sample if volatile organic compounds are to be collected.

1.1.2.3. Fill sample containers from the intermediate vessel. Minimize agitation or aeration during filling if volatile organic compounds are to be collected. Do not touch the sample container with the intermediate vessel.

1.1.2.4. Leave adequate headspace in the sample container. This procedure allows for addition of preservatives (if required) and sample expansion. Do not use this step for volatile organics or other analytes where headspace is not allowed in the sample container.

1.1.2.5. Add preservatives if required, securely cap container, label and complete field notes.

1.1.2.6. Invert the container several times to ensure sufficient mixing of sample and preservatives.

1.1.2.7. Check preservation of the sample and adjust pH with additional preservative, if necessary.

1.1.3. Pump and Tubing: Use appropriate pumps, equipment, and tubing. (See restrictions listed in FS 1000 Tables FS 1000-1 through 1000-3).

Do not collect oil & grease, TRPH or FL-PRO samples with a pump. See FS 2000 for proper collection procedures for extractable organics and volatile organic compounds.

1.1.3.1. Lower tubing to a depth 6-12 inches below water surface, where possible.

1.1.3.2. Pump several tubing volumes through the system to flush the tubing prior to collecting the first sample.

1.1.3.3. Fill individual sample bottles via the discharge tubing, being careful not to remove the inlet tubing from the water.

1.1.3.4. Do not touch the discharge tubing to the sample container.

1.1.3.5. Leave adequate headspace in the sample container. This procedure allows for addition of preservatives (if required) and sample expansion. Do not use this step for volatile organics or other analytes where headspace is not allowed in the sample container.

1.1.3.6. Add preservatives if required, securely cap container, label and complete field notes.

1.1.3.7. Invert the container several times to ensure sufficient mixing of sample and preservatives.

1.1.3.8. Check preservation of the sample and adjust pH with additional preservative, if necessary.

1.1.4 Sampling in shallow water

1.1.4.1. Do not collect a grab sample from water less than ten (10) cm deep due to the risk of disturbing sediment or flocculent bottom material.

1.1.4.2. Especially for waters with low or no flow, use extreme caution to avoid disturbing the sediment.

1.1.4.3. Use of an intermediate device may be appropriate to avoid creation of a sediment plume in cases of low or no flow.

1.2. Depth Grab Samples: Examples of equipment that may be used for depth grab sampling include Kemmerer, Niskin, Van Dorn and similar samplers; pumps with tubing and double check-valve bailers. See restrictions listed in FS 1000 Tables 1000-1, 1000-2 and 1000-3. Do not collect oil & grease, TRPH or FL-PRO samples with a pump. See FS 2000 for proper collection procedures for extractable organics and volatile organic compounds.

1.2.1. Kemmerer, Niskin and Van Dorn Type Devices

1.2.1.1. Many of these samplers are constructed of plastic and rubber that preclude their use for all volatile and extractable organic sampling. Some newer devices are constructed of stainless steel or are all Teflon or Teflon-coated. These are acceptable for all analyte groups without restriction.

1.2.1.2. Measure the water column to determine maximum depth and sampling depth prior to lowering the sampling device.

1.2.1.3. Mark the line attached to the sampler with depth increments so that the sampling depth can be accurately recorded.

1.2.1.4. Lower the sampler slowly to the appropriate sampling depth, taking care not to disturb the sediments.

1.2.1.5. At the desired depth, send the messenger weight down to trip the closure mechanism.

1.2.1.6. Retrieve the sampler slowly.

1.2.1.7. Rinse the sampling device with ample amounts of site water prior to collecting the first sample. Discard rinsate away from and downstream of the sampling location.

1.2.1.8. Fill the individual sample bottles via the discharge tube. Sample bottles must be handled as described in sections 1.1.3.3 – 1.1.3.8 above.

1.2.2. Double Check-Valve Bailers: Collect samples using double check-valve bailers if the data requirements do not necessitate a sample from a strictly discrete interval of the water column. Bailers with an upper and lower check-valve can be lowered through the water column and water will continually be displaced through the bailer until the desired depth is reached, at which point the bailer is retrieved.

1.2.2.1. Sampling with this type of bailer must follow the same protocols outlined in section 1.2.1 above except that a messenger weight is not applicable.

1.2.2.2. Although not designed specifically for this kind of sampling, a bailer is acceptable when a mid-depth sample is required.

1.2.2.3. Note: This sampler does not perform as well as the devices described above or the pump and tubing described in section 1.2.3 below.

1.2.2.4. As the bailer is dropped through the water column, water is displaced through the body of the bailer. The degree of displacement depends upon the check-valve ball movement to allow water to flow freely through the bailer body.

1.2.2.5. Slowly lower the bailer to the appropriate depth. Upon retrieval, the two check-valves seat, preventing water from escaping or entering the bailer.

1.2.2.6. Rinse the sampling device with ample amounts of site water prior to collecting the first sample.

1.2.2.7. Fill the individual sample bottles via the discharge tube. Sample bottles must be handled as described in sections 1.1.3.3 – 1.1.3.8 above.

1.2.3. Pump and Tubing: Use appropriate pumps, equipment and tubing. (See restrictions listed in FS 1000 Tables 1000-1, 1000-2 and 1000-3). Do not collect oil & grease, TRPH or FL-PRO samples with a pump. See FS 2000 for proper collection procedures for extractable organics and volatile organic compounds.

1.2.3.1. Measure the water column to determine the maximum depth and the sampling depth.

1.2.3.2. Tubing will need to be tied to a stiff pole or be weighted down so the tubing placement will be secure. Do not use a lead or metallic weight if collecting metals samples. Any dense, non-contaminating, non-interfering material will work (brick, stainless steel weight, etc.). Tie the weight with a lanyard (braided or monofilament nylon, etc.) so that it is located below the inlet of the tubing.

1.2.3.3. Pump several tubing volumes through the system to flush the tubing prior to collecting the first sample.

1.2.3.4. Fill the individual sample bottles via the discharge tube, being careful not to remove the inlet tubing from the water. Do not touch the discharge tubing to the sample container.

1.2.3.5. Leave adequate headspace in the sample container. This procedure allows for addition of preservatives (if required) and sample expansion. Do not use this step for volatile organics or other analytes where headspace is not allowed in the sample container.

1.2.3.6. Add preservatives if required, securely cap container, label and complete field notes.

1.2.3.7. Invert the container several times to ensure sufficient mixing of sample and preservatives.

1.2.3.8. Check preservation of the sample and adjust pH with additional preservative, if necessary.

2. AUTOMATIC SAMPLERS: Use automatic samplers when several sites are to be sampled at frequent intervals or when a continuous sample is required. Composite samplers can be used to collect time composite or flow proportional samples (see FS 2000, section 1.3 for discussions on types of composite and appropriate used of composite sampling). Use appropriate equipment and tubing. (See restrictions listed in FS 1000 Tables 1000-1, 1000-2 and 1000-3). Do not collect oil & grease, TRPH or FL-PRO samples with automatic samplers unless required by the sampling plan. See FS 2000 for proper collection procedures for extractable organics and volatile organic compounds.

The use of automatic samplers for collecting surface water samples will more frequently run into situations where sampling equipment is deployed on-site for a long term or dedicated to the site.

2.1. Installing and Programming the Composite Sampler

2.1.1. Use all new or precleaned pump tubing each time the sampler is brought to the field and set up. If the automatic sampler is deployed in the field for extended periods, it is recommended to replace the tubing at a minimum of every six months. Other replacement schedules may be required, depending on the specific installation and project requirements. Inspect the tubing each time the composite-sample container is picked up. If there is evidence of loss of elasticity or discoloration or other conditions that would impact the quality of the sample (such as algal growth), or the pumping flow rate, then replace the tubing. Select the tubing for the pump head and sampling train according to the analytes of interest and the allowable construction materials specified in FS 1000 Table FS 1000-1, 1000-2 and 1000-3.

2.1.1.1. Cut the proper length of precleaned Teflon or Tygon tubing.

2.1.1.2. Equipment Blanks: Collect equipment blanks each time the tubing is changed or at a frequency of 5% of the tubing changes, whichever is less. Collect a minimum of one blank each year. Collect the blank by passing analyte-free water through the equipment that is exposed to the sample.

- Composite sample containers may be cleaned either in the field or in a fixed base operation. Demonstrate cleaning effectiveness by collecting equipment blanks on the composite sample containers according to the frequency specified in FQ 1000. Collect sample container equipment blanks by adding analyte-free water to the cleaned sample container, mix the water thoroughly within the container and then pour off an aliquot for analysis.

2.1.1.3. Put the collection sieve and tubing in the appropriate sample location, using conduit if necessary to hold it in place. Ensure the supporting conduit does not contaminate the incoming sample water.

2.1.1.4. Program the sampler per manufacturer's directions and as required in the permit or work plan conditions.

2.1.1.5. Automatic Sampler Security: Place a lock or seal on the sampler to prevent or detect tampering. This procedure, however, does not prevent tampering with the sampler tubing. See additional discussions on sample security in FS 2410, section 2.3.2.

2.2. Sample Acquisition

2.2.1. At the end of each sampling period, stir the contents of the composite jug and transfer the contents into the respective containers. If the sampler was configured to collect discrete samples ensure that the contents of each container are adequately mixed while pouring the sample into the sample container.

2.2.2. Immediately preserve the sample, if required, securely cap container, label and complete field notes.

2.3. Long Term Deployment of Automatic Composite Samplers: In certain sampling situations, automatic composite samplers are permanently installed at surface water stations and remain in the field for months or even years. Under these conditions, there are specific sampling issues that need to be addressed.

2.3.1. Sample Preservation

2.3.1.1. If the only analyte of interest is Total Phosphorus and the project is unrelated to an NPDES permit, the sample must be chemically preserved with sulfuric acid (H_2SO_4) but it need not be cooled to ≤6°C in wet ice.

2.3.1.2. The acid must be in the container prior to drawing the first composite sample into the container.

2.3.1.3. When using large (i.e., 3 gallon) composite sample containers, and there is potential for the sample size to vary greatly due to variable flow rates at the site, the volume of acid for preservation should be small (e.g., 1 to 2 mL of 50% H_2SO_4). **Do not over acidify the sample**. Upon sample pick-up, if needed, add additional acid to achieve the proper pH adjustment for preservation.

2.3.1.4. If parameters other than total phosphorus are to be analyzed, appropriate additional preservation (e.g., cooling with ice or refrigeration) is required.

2.3.1.5. Deviations from these SOPs concerning preservation and holding times relating to remote and long term deployments due to site specific considerations must be agreed upon by project management.

2.3.2. Cleaning Requirements

2.3.2.1. Clean composite sampler containers after collection of each composite sample using cleaning solutions and procedures specified in FC 1140, sections 5 through 9.

2.3.2.2. Composite sample containers may be cleaned either in the field or in a fixed based operation. Demonstrate cleaning effectiveness by collecting equipment blanks on the composite sample containers according to the frequency specified in FQ 1000. Collect sampler container equipment blanks by adding analyte-free water to the cleaned sample container, mix the water thoroughly within the container and then pour off an aliquot for analysis.

2.3.2.3. Inspect and replace tubing at a minimum of every six months or when applicable, as discussed in section 2.1.1 above. Collect equipment blanks as specified in section 2.1.1.2 above. If the tubing is being replaced for multiple autosamplers at the same time, one equipment blank may be collected on the entire length of replacement tubing. Collect this equipment blank by passing analyte-free water through the entire length of new tubing.

FS 2200. Groundwater Sampling

1. INTRODUCTION AND SCOPE

1.1 Use these Standard Operating Procedures to collect groundwater samples. They are designed to ensure that the collected samples will be representative of water in the aquifer or target formation and that the samples have not been altered or contaminated by the sampling and handling procedures. These procedures apply to permanently and temporarily installed monitoring wells, wells constructed using "direct-push" techniques, wells with installed plumbing, remedial groundwater treatment systems and excavations where groundwater is present. Use of alternative, DEP-approved and properly documented procedures (e.g., Corporate SOP, ASTM Standards, alternative equipment, etc.) is acceptable if they meet the intent (e.g., sample representativeness and integrity) of this standard (see FA 1000).

1.2 The topics in this SOP include equipment and supply selection, equipment construction materials, and purging and sampling techniques.

1.3 Use the following DEP SOPs in conjunction with FS 2200:

- FA 1000 Regulatory Scope and Administrative Procedures for Use of DEP SOPs
- FC 1000 Cleaning/Decontamination Procedures
- FD 1000 Documentation Procedures
- FQ 1000 Field Quality Control Requirements
- FS 1000 General Sampling Procedures
- FS 2000 General Aqueous Sampling
- FT 1000 Field Testing and Measurement
- FT 1100 Field pH
- FT 1200 Field Specific Conductance
- FT 1400 Field Temperature
- FT 1500 Field Dissolved Oxygen
- FT 1600 Field Turbidity

2. Groundwater samples may be collected from a number of different configurations. Each configuration is associated with a unique set of sampling equipment requirements and techniques:

3. Wells without Plumbing: These wells require that equipment be brought to the well to purge and sample unless dedicated equipment is placed in the well.

4. Wells with In-Place Plumbing: Wells with in-place plumbing do not require that equipment be brought to the well to purge and sample. In-place plumbing is generally considered permanent equipment routinely used for purposes other than purging and sampling, such as for water supply. They are generally found at wellfields, industrial facilities, and private residences. See FS 2300 for procedures to sample potable water wells. Air Strippers or Remedial Systems: These types of systems are installed as remediation devices. Sample these wells like drinking water wells (see FS 2300).

FS 2201 *Equipment and Supplies*

Use groundwater purging and sampling equipment constructed of only non-reactive, non-leachable materials that are compatible with the environment and the selected analytes. In selecting groundwater purging and sampling equipment, give consideration to the depth of the

well, the depth to groundwater, the volume of water to be evacuated, the sampling and purging technique, and the analytes of interest. Refer to Tables FS 1000-1, FS 1000-2, FS 1000-3 and FS 2200-1 for selection of appropriate equipment.

Additional supplies such as reagents, preservatives, and field measurement equipment are often necessary.

1. FLOW CONTAINER: DEP recommends using a flow-through cell or container when collecting measurements for purging stabilization. The design must ensure that fresh formation water continuously contacts the measuring devices and does not aerate the sample or otherwise affect the groundwater properties.

2. PUMPS: All pumps or pump tubing must be lowered and retrieved from the well slowly and carefully to minimize disturbance to the formation water. This is especially critical at the air/water interface. Avoid the resuspension of sediment particles (turbidity) at the bottom of the well or adhered to the well casing during positioning of the pump or tubing.

2.1 Above-Ground Pumps

2.1.1 Variable Speed Peristaltic Pump: Use a variable speed peristaltic pump to purge groundwater from wells when the static water level in the well is no greater than 20-25 feet below land surface (BLS). If the water levels are deeper than 18-20 feet BLS, the pumping velocity will decrease.

2.1.1.1 A variable speed peristaltic pump can be used for normal purging and sampling (see FS 2213 and FS 2221), sampling low permeability aquifers or formations (see FS 2222) and collecting filtered groundwater samples (see FS 2225, section 1).

2.1.1.2 Most analyte groups can be sampled with a peristaltic pump if the tubing and pump configurations are appropriate. See Table FS 1000-3 for proper tubing selection and pump configurations.

2.1.2 Variable Speed Centrifugal Pump: A variable speed centrifugal pump can be used to purge groundwater from 2-inch and larger internal diameter wells. Do not use this type of pump to collect groundwater samples.

2.1.2.1 When purging is complete, do not allow the water that remains in the tubing to fall back into the well. Install a check valve at the end of the purge tubing, and withdraw the tubing slowly from the well while the pump is still running.

2.1.2.2 See Table FS 1000-3 for proper tubing selection and allowable analyte groups.

2.2 Submersible Pumps

2.2.1 Variable Speed Electric Submersible Pump: A variable speed submersible pump can be used to purge and sample groundwater from 2-inch and larger internal diameter wells.

2.2.1.1 A variable speed submersible pump can be used for normal purging and sampling (see FS 2213 and FS 2221), sampling low permeability aquifers or formations (see FS 2222) and collecting filtered groundwater samples (see FS 2225, section 1).

2.2.1.2 Make sure that the pump housing, fittings, check valves and associated hardware are constructed of stainless steel. Make sure that any other materials are compatible with the analytes of interest. See Table FS 1000-3 for restrictions.

2.2.1.3 Install a check valve at the output side of the pump to prevent backflow.

2.2.1.4 If purging and sampling for organics:

- The entire length of the delivery tube must be Teflon, Polyethylene or Polypropylene tubing. Do not use low-density polyethylene for the collection of samples for analysis of volatile organic compounds (VOCs).
- The electrical cord must be sealed in Teflon, Polyethylene or Polypropylene and any cabling must be sealed in Teflon, Polyethylene or Polypropylene, or be constructed of stainless steel.
- All interior components that contact the sample water (impeller, seals, gaskets, etc.) must be constructed of stainless steel or Teflon.

2.2.2 Variable Speed Bladder Pump: A variable speed positive displacement bladder pump (no-gas contact) can be used to purge and sample groundwater from 3/4-inch and larger internal diameter wells.

2.2.2.1 A variable speed bladder pump can be used for normal purging and sampling (see FS 2213 and FS 2221), sampling low permeability aquifers or formations (see FS 2222) and collecting filtered groundwater samples (see FS 2225, section 1).

2.2.2.2 The bladder pump system is composed of the pump, the compressed air tubing, the water discharge tubing, the controller and a compressor or compressed gas supply.

2.2.2.3 The pump consists of a bladder and an exterior casing or pump body that surrounds the bladder and two (2) check valves. These parts can be composed of various materials, usually combinations of polyvinyl chloride (PVC), Teflon, Polyethylene, and stainless steel. Other materials must be compatible with the analytes of interest. See Table FS 1000-3 for restrictions.

2.2.2.4 If purging and sampling for organics:

- The pump body must be constructed of stainless steel and the valves and bladder must be Teflon, Polyethylene or Polypropylene.
- The entire length of the delivery tube must be Teflon, Polyethylene or Polypropylene. Do not use low-density polyethylene for VOCs.
- Any cabling must be sealed in Teflon, Polyethylene or Polypropylene, or be constructed of stainless steel.
- Permanently installed pumps may have a PVC pump body as long as the pump remains in contact with the water in the well.

3. BAILERS:

3.1 Purging: DEP does not recommend using bailers for purging unless no other equipment can be used or purging with a bailer has been specifically authorized by a DEP program, permit, contract or order (see Table FS 2200-3). Use a bailer if there is non-aqueous phase liquid (free product) in the well or non-aqueous phase liquid is suspected to be in the well. If in doubt about the appropriateness of using a bailer at a site or during a particular sampling event, contact the appropriate DEP program or project manager. If a bailer is used, follow FS 2213, section 4, with no deviations.

3.2 Sampling: Bailers may be used to routinely collect some analyte groups or under specific circumstances for other analyte groups (see Table FS 2200-3).

3.3 Construction and Type:

3.3.1 Bailers must be constructed of materials compatible with the analytes of interest. See Table FS 1000-3 for restrictions.

3.3.2 Stainless steel, Teflon, Polyethylene and Polypropylene bailers may be used to sample all analytes. Low-density polyethylene is not suitable for the collection of VOCs.

3.3.3 Use disposable bailers when sampling grossly contaminated sample sources.

3.3.4 DEP recommends using dual check valve bailers when collecting samples.

3.3.5 Use bailers with a controlled flow bottom when collecting volatile organic samples.

3.3.6 Use bailers that can be pressurized when collecting filtered samples for metals.

3.4 Contamination Prevention:

3.4.1 Keep the bailer wrapped (foil, butcher paper, etc.) until just before use.

3.4.2 Use protective gloves to handle the bailer once it is removed from its wrapping.

3.4.3 Handle the bailer by the lanyard to minimize contact with the bailer surface.

4. LANYARDS

4.1 Lanyards must be made of non-reactive, non-leachable material such as cotton twine, nylon, or stainless steel; or, coated with Teflon, Polyethylene or Polypropylene.

4.1.1 Evaluate the appropriateness of the lanyard material with analyses of equipment blanks for the analytes of interest, as necessary.

4.2 Discard cotton twine, nylon, and non-stainless steel braided lanyards after sampling each monitoring well.

4.3 Decontaminate stainless steel, coated Teflon, Polyethylene and Polypropylene lanyards between monitoring wells (see FC 1003). They do not need to be decontaminated between purging and sampling operations.

4.4 Securely fasten lanyards to downhole equipment (bailers, pumps, etc.).

4.5 Do not allow lanyards used for downhole equipment to touch the ground surface.

FS 2210. GROUNDWATER PURGING

Perform procedures in the following sections to calculate purging parameters and to purge groundwater from monitoring wells, wells with installed plumbing, high-volume wells, air stripper systems and other remedial treatment systems.

FS 2211 *Water Level and Purge Volume Determination*

Collect representative groundwater samples from the aquifer. The amount of water that must be purged from a well is determined by the volume of water and/or field parameter stabilization.

1. GENERAL EQUIPMENT CONSIDERATIONS

1.1 Selection of appropriate purging equipment depends on the analytes of interest, the well diameter, transmissivity of the aquifer, the depth to groundwater and other site conditions.

1.2 Use a pump to purge the well.

1.3 Use a bailer if there is non-aqueous phase liquid in the well or non-aqueous phase liquid is suspected to be in the well.

1.4 Bailers may be used if approved by a DEP program, or if bailer use is specified in a permit, contract or DEP order (see Table FS 2200-3). If used, bailers must be of appropriate type and construction, and the user must follow the procedure outlined in FS 2213, section 4, with no deviations. If in doubt about the appropriateness of using a bailer at a site or during a particular sampling event, contact the appropriate DEP program or project manager. DEP does not recommend using bailers because improper bailing:

1.4.1 Introduces atmospheric oxygen which precipitates metals (i.e., iron) or causes other changes in the chemistry of the water in the sample (i.e., pH)

1.4.2 Agitates groundwater which biases volatile and semi-volatile organic analyses due to volatilization

1.4.3 Agitates the water in the aquifer and resuspends fine particulate matter

1.4.4 Surges the well, loosening particulate matter in the annular space around the well screen

1.4.5 Introduces dirt into the water column if the sides of the casing wall are scraped

2. INITIAL INSPECTION

2.1 Verify the identification of the monitoring well by examining markings, sign plates, placards or other designations.

2.2 Remove the well cover and remove all standing water around the top of the well casing (manhole) before opening the well cap.

2.3 Inspect the exterior protective casing of the monitoring well for damage and document the results of the inspection if there is a problem.

2.4 It is recommended that you place a protective covering around the well head. Replace the covering if it becomes soiled or ripped.

2.5 Inspect the well lock and determine whether the cap fits tightly. Replace the cap if necessary.

3. WATER LEVEL MEASUREMENTS: Use an electronic probe or chalked tape to determine the water level.

3.1 General Procedures

Perform these steps using either the electronic probe or chalked tape method.

3.1.1 Decontaminate all equipment that will contact the groundwater in the well before use.

3.1.2 Measure the depth to groundwater from the top of well casing to the nearest 0.01 foot and always measure from the same reference point or survey mark on the well casing. If there is no reference mark, measure from the north side of the casing.

3.1.3 Record the measurement and the reference point.

3.2 Electronic Probe

3.2.1 Follow the manufacturer's instructions for use.

3.2.2 Record the measurement.

3.3 Chalked Line Method: This method is not recommended if collecting samples for organic or inorganic parameters.

3.3.1 Lower chalked tape into the well until the lower end is in the water (usually determined by the sound of the weight hitting the water).

3.3.2 Record the length of the tape relative to the reference point (see section 3.2 above).

3.3.3 Quickly remove the tape from the well.

3.3.4 Record the length of the wetted portion to the nearest 0.01 foot.

3.3.5 Determine the depth to water by subtracting the length of the wetted portion (see section 3.5.3 above) from the total length (see section 3.5.2 above). Record the result.

4. WATER COLUMN DETERMINATION

4.1 Do not determine the total depth of the well by lowering the probe to the bottom of the well immediately before purging and sampling. If the well must be sounded, delay purging and sampling activities for at least 24 hours after the well was sounded or for a time sufficient to meet the purge stabilization criterion for turbidity. Alternatively, collect samples before sounding the well.

4.2 Subtract the depth to the top of the water column from the total well depth to determine the length of the water column.

4.3 The total well depth depends on the well construction. Some wells may be drilled in areas of sinkhole or karst formations or rock leaving an open borehole. Attempt to find the total borehole depth in cases where there is an open borehole below the cased portion.

5. WELL WATER VOLUME

5.1 Calculate the total volume of water in gallons in the well using the following equation:

V = (0.041)d x d x h

Where: V = volume in gallons
d = well diameter in inches
h = height of the water column in feet

5.2 The total volume of water in the well may also be determined with the following equation by using a casing volume per foot factor (Gallons per Foot of Water) for the appropriate diameter well:

V = [Gallons per Foot of Water] x h

Where: V = volume in gallons
h = height of the water column in feet

Casing Internal Diameter	Approximate Gallons per Foot of Water
0.75”	0.02
1”	0.04
1.25”	0.06
2”	0.16
3”	0.37
4”	0.65
5”	1.02
6”	1.47
12”	5.88

5.3 Record all measurements and calculations in the field records.

6. Purging Equipment Volume

Calculate the total volume of the pump, associated tubing and container that is used for in situ measurements (flow container), if used, using the following equation:

V = p + ((0.041)d x d x l) + fc

Where: V = volume in gallons

p = volume of pump in gallons

d = tubing diameter in inches

l = length of tubing in feet

fc = volume of flow cell in gallons

7. When collecting samples from multiple wells on a site, if the groundwater elevation data are to be used to construct groundwater elevation contour maps, all water level measurements must be taken within the same 24-hour time interval unless a shorter time period is required by a DEP program. If the site is tidally influenced, complete the water level measurements within the time frame of an incoming or outgoing tide.

FS 2212 *Well Purging Techniques*

The selection of the purging technique and equipment is dependent on the hydrogeologic properties of the aquifer, especially depth to groundwater and hydraulic conductivity. The intent of proper purging is to stabilize the water level in the well and minimize the hydraulic stress to the hydrogeologic formation.

Every attempt must be made to match the pumping rate with the recharge rate of the well before evaluating the purging completion criteria.

A flowchart which summarizes purging procedure options is presented in Figure FS 2200-2.

Select equipment using the construction and configuration requirements specified in Table FS 2200-1. See the discussions in FS 2201.

1. MEASURING THE PURGE VOLUME: The volume of water that is removed during purging must be recorded. Measure the volume during the purging operation.

1.1 Collect the water in a graduated container and multiply the number of times the container was emptied by the volume of the container, or

1.2 Estimate the volume based on pumping rate. Use this technique only if the pumping rate is constant. Determine the pumping rate by measuring the amount of water that is pumped for a fixed period of time or use a flow meter.

1.2.1 Calculate the amount of water that is discharged per minute:

$$D = \frac{\text{Measured amount}}{\text{Total time in minutes}}$$

1.2.2 Calculate the time needed to purge one (1) well volume or one (1) purging equipment volume:

$$\text{Time} = \frac{V}{D}$$

Where: V = well volume determined from FS 2211, section 5, or purging equipment volume

D = discharge rate calculated in section 1.2.1. above

1.2.3 Make new measurements (see section 1.2.1 above) each time the pumping rate is changed, or

1.3 Use a totalizing flow meter.

1.3.1 Record the reading on the totalizer prior to purging.

1.3.2 Record the reading on the totalizer at the end of purging.

1.3.3 Subtract the reading on the totalizer prior to purging from the reading on the totalizer at the end of purging to obtain the volume purged.

1.4 Record in the field records the times that purging begins and ends.

2. Stabilization Measurement Frequency

2.1 Begin to record stabilization measurements after pumping the minimum volume as prescribed in options 2.3 – 2.5 below. Every attempt must be made to match the pumping rate with the recharge rate of the well before evaluating the purging criteria.

2.2 If the well screened interval is not known, use option 2.3, below.

2.3 Wells with Fully Submerged Screen and Pump or Intake Tubing Placed at the Top of the Water Column (conventional purge): Purge until the water level has stabilized (well recovery rate equals the purge rate), then purge a minimum of one (1) well volume prior to collecting measurements of the stabilization parameters. Allow at least one quarter (1/4) well volume to purge between subsequent measurements.

2.4 Wells with Fully Submerged Screen and Pump or Intake Tubing Placed Within the Screened Interval (minimizing purge volume): Purge until the water level has stabilized (well recovery rate equals the purge rate), then purge a minimum of one (1) volume of the pump, associated tubing and flow container (if used) prior to collecting measurements of the stabilization parameters. Take measurements of the stabilization parameters no sooner than two (2) minutes apart. Purge at least three (3) volumes of the pump, associated tubing and flow container, if used, prior to collecting a sample.

If the water level drops into the screened interval during purging, lower the pump or tubing intake as in FS 2213, section 1.3 below and follow purging procedures for partially submerged well screens (2.5 below).

2.5 Wells with a Partially Submerged Well Screen: Purge until the water level has stabilized (well recovery rate equals the purge rate), then purge a minimum of one (1) well volume prior to collecting measurements of the stabilization parameters. Take measurements of the stabilization parameters no sooner than two (2) minutes apart.

3. PURGING COMPLETION: DEP recommends the use of a flow-through container to measure the stabilization parameters discussed below. Alternatively, measure all parameters *in situ* by inserting measurement probes into the well at the depth appropriate for the purging option. Purging is considered complete if the criteria in section 3.1, 3.2 or 3.3 below are satisfied. Make every attempt to satisfy the criteria in section 3.1. Every attempt must be made to match the pumping rate with the recharge rate of the well before evaluating the purging criteria.

3.1 Three (3) consecutive measurements of the five (5) parameters listed below must be within the stated limits. The measurements evaluated must be the last three consecutive measurements taken before purging is stopped. The range between the highest and the lowest values for the last three measurements of temperature, pH and specific conductance cannot exceed the stated limits. The last three consecutive measurements of dissolved oxygen and turbidity must all be at or below the listed thresholds.

- Temperature: ± 0.2° C
- pH: ± 0.2 Standard Units
- Specific Conductance: ± 5.0% of reading
- Dissolved Oxygen: ≤20% Saturation
- Turbidity: ≤20 NTU

3.2 Naturally occurring conditions may prevent attaining the ≤20% saturation criterion for dissolved oxygen, typically in surficial aquifers. See section 3.5, below.

3.3 Naturally occurring conditions may prevent attaining the ≤20 NTU criterion for turbidity. However, when collecting groundwater samples for metals or certain inorganic (e.g., phosphorus forms) or extractable organic (e.g. polynuclear aromatic hydrocarbons) chemicals, make every attempt to reduce turbidity to ≤20 NTU to avoid a potential turbidity-associated bias for these analytes. See section 3.5, below.

3.4 Document and report the following, as applicable, except that the last four (4) items only need to be submitted once:

- Purging rate.
- Drawdown in the well, if any.
- Pump or tubing intake placement.
- Length and location of the screened interval.
- A description of the process and the data used to design the well.
- The equipment and procedure used to install the well.
- The well development procedure.
- Pertinent lithologic or hydrogeologic information.

3.5 If the criteria in section 3.1 above for dissolved oxygen and/or turbidity cannot be met, then three (3) consecutive measurements of the five (5) parameters listed below must be within the stated limits.

3.5.1 The measurements evaluated must be the last three consecutive measurements taken before purging is stopped. The range between the highest and the lowest values for the last three measurements cannot exceed the stated limits.

- Temperature: ± 0.2° C
- pH: ± 0.2 Standard Units
- Specific Conductance: ± 5.0% of reading
- Dissolved Oxygen: ± 0.2 mg/L or 10%, whichever is greater
- Turbidity: ± 5 NTUs or 10%, whichever is greater

3.5.2 Additionally, document and report the following, as applicable, except that the last four (4) items only need to be submitted once:

- Purging rate.
- Drawdown in the well, if any.
- Pump or tubing intake placement.
- Length and location of the screened interval.
- A description of conditions at the site that cause the dissolved oxygen to be high and/or dissolved oxygen measurements made within the screened or open borehole portion of the well with a downhole dissolved oxygen probe.
- A description of conditions at the site that cause the turbidity to be high and any procedures that will be used to minimize turbidity in the future.
- A description of the process and the data used to design the well.
- The equipment and procedure used to install the well.
- The well development procedure.
- Pertinent lithologic or hydrogeologic information.

3.5.3 If from review of the submitted data the Department determines that both the elevated Dissolved Oxygen and Turbidity measurements are due to naturally occurring

conditions, then only the first four (4) items are required to be submitted in future reports. However, if the Department cannot determine if the Dissolved Oxygen or Turbidity is elevated due to naturally occurring conditions, then in addition to the first four (4) items, a description of the conditions at the site that caused the affected parameter(s) to be high is required to be submitted in future reports.

3.6 If the stabilization parameters in either section 3.1 or 3.2 cannot be met, and all attempts have been made to minimize the drawdown, check the instrument condition and calibration, purging flow rate and all tubing connections to determine if they might be affecting the ability to achieve stable measurements. All measurements that were made during the attempt must be documented. The sampling team leader may decide whether or not to collect a sample or to continue purging after five (5) well volumes (conventional purge section 2.1 or 2.3 above) or five (5) volumes of the screened interval (minimizing purge volumes in section 2.2 above).

Further, the report in which the data are submitted must include the following, as applicable, except that the last four (4) items only need to be submitted once:

- Purging rate.
- Pump or tubing intake placement.
- Length and location of the screened interval.
- Drawdown in the well, if any.
- A description of conditions at the site that caused the dissolved oxygen to be high and/or dissolved oxygen measurements made within the screened or open borehole portion of the well with a downhole dissolved oxygen probe.
- A description of conditions at the site that caused the turbidity to be high and any procedures that will be used to minimize turbidity in the future.
- A description of the process and the data used to design the well.
- The equipment and procedure used to install the well.
- The well development procedure.
- Pertinent lithologic or hydrogeologic information.

If from review of the submitted data the DEP determines that both the elevated Dissolved Oxygen and Turbidity measurements are due to naturally occurring conditions, then only the first four (4) items are required to be submitted in future reports. However, if the DEP cannot determine if the Dissolved Oxygen or Turbidity is elevated due to naturally occurring conditions, then in addition to the first four (4) items, a description of the conditions at the site that caused the affected parameter(s) to be high is required to be submitted in future reports.

3.7 One fully dry purge (not recommended). This criterion applies only if purging was attempted per FS 2212, FS 2213, and section 3.4.1 below, and if it is impossible to balance the pumping rate with the rate of recharge at very low pumping rates (< 100 mL/minute).

3.7.1 If wells have previously and consistently purged dry, when purged according to FS 2212 and FS 2213, and the current depth to groundwater indicates that the well will purge dry during the current sampling event, minimize the amount of water removed from the well by using the same pump to purge and collect the sample:

3.7.1.1 Place the pump or tubing intake within the well screened interval.

3.7.1.2 Use very small diameter Teflon, Polyethylene or Polypropylene tubing and the smallest possible pump chamber volume to minimize the total volume of

water pumped from the well and to reduce drawdown. If samples will be collected for VOCs, do not use low-density polyethylene tubing.

3.7.1.3 Select tubing that is thick enough to minimize oxygen transfer through the tubing walls while pumping.

3.7.1.4 Pump at the lowest possible rate (100 mL/minute or less) to reduce drawdown to a minimum.

3.7.1.5 Purge at least two (2) volumes of the pumping system (pump, tubing and flow cell, if used).

3.7.1.6 Measure pH, Specific Conductance, Temperature, Dissolved Oxygen and Turbidity and begin to collect the samples (see FS 2222).

4. Collect samples immediately after purging is complete.

4.1 The time period between completing the purge and sampling cannot exceed six (6) hours.

4.2 If sample collection does not occur within one (1) hour of purging completion, re-measure the five (5) field parameters Temperature, pH, Specific Conductance, Dissolved Oxygen and Turbidity just prior to collecting the sample.

4.2.1 If the measured values are not within 10 percent of the previous measurements, re-purge the well.

4.2.2 See section 3.4 above when collecting samples from wells that have purged dry.

FS 2213 *Purging Wells Without Plumbing (Monitoring Wells)*

1. TUBING/PUMP PLACEMENT

1.1 Do not lower the pump or intake hose (tubing) to the bottom of the well. Pump or tubing placement procedures will be determined by the purging option selected in FS 2212, section 2 above or FS 2214 below.

1.1.1 Minimizing Purge Volume: If the following conditions can be met, position the intake hose (tubing) or pump in the screened or open borehole interval.

- The same pump must be used for both purging and sampling,
- The well screen or borehole interval must be less than or equal to 10 feet, and
- The well screen or borehole must be fully submerged.

1.1.2 If the position or length of the screened interval or open borehole is unknown or estimated, place the intake hose (tubing) or pump to perform conventional purging in 1.2 below.

1.1.3 Position the pump or intake hose when purging large-diameter deep wells with open boreholes using the procedure in FS 2214 below.

1.2 Conventional Purging: Position the pump or intake tubing in the top one foot of the water column or no deeper than necessary for the type of pump.

1.2.1 If purging with a bailer, see section 4 below.

1.3 Partially Submerged Screened Interval: If the well screen or open borehole is partially submerged, and the pump will be used for both purging and sampling, position the pump or intake hose (tubing) in the portion of the water column within the submerged screened or open borehole interval.

1.3.1 If the position or length of the screened interval or open borehole is unknown or estimated, place the intake hose (tubing) or pump to perform conventional purging in 1.2 above.

1.3.2 Purge large-volume, high-recharge wells as in FS 2214 below.

1.3.3 If purging with a bailer, see section 4 below.

2. NON-DEDICATED (PORTABLE) PUMPS

2.1 Variable Speed Peristaltic Pump

2.1.1 Install a new, 1-foot maximum length of silicone tubing in the peristaltic pump head.

2.1.2 Attach a short section of tubing to the discharge side of the pump-head silicone tubing and into a graduated container.

2.1.3 Attach one end of a length of new or precleaned transport tubing to the intake side of the pump head silicone tubing.

2.1.4 Place the transport tubing in the monitoring well per one of the options in FS 2213, section 1 above.

2.1.5 Measure the depth to groundwater at frequent intervals.

2.1.6 Record these measurements.

2.1.7 Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

2.1.8 If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.

2.1.9 If the water table continues to drop during pumping, lower the tubing at the approximate rate of drawdown so that the water is removed from the top of the water column.

2.1.10 Record the purging rate each time the rate changes.

2.1.11 Measure the purge volume by one of the methods outlined in FS 2212, section 1.

2.1.12 Record this measurement.

2.1.13 Decontaminate the pump and tubing between wells (see FC 1000) or only the pump if precleaned tubing is used for each well.

2.2 Variable Speed Centrifugal Pump

2.2.1 Position fuel powered equipment **downwind** and at least 10 feet from the well head. Make sure that the exhaust faces downwind.

2.2.2 Place the decontaminated suction hose so that water is always pumped from the top of the water column.

2.2.3 Equip the suction hose with a foot valve to prevent purge water from re-entering the well.

2.2.4 Measure the depth to groundwater at frequent intervals.

2.2.5 Record these measurements.

2.2.6 Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

2.2.7 If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.

2.2.8 If the water table continues to drop during pumping, lower the tubing at the approximate rate of drawdown so that the water is removed from the top of the water column.

2.2.9 Record the purging rate each time the rate changes.

2.2.10 Measure the purge volume by one of the methods outlined in FS 2212, section 1.

2.2.11 Record this measurement.

2.2.12 Decontaminate the pump and tubing between wells (see FC 1000) or only the pump if precleaned tubing is used for each well.

2.3 Variable Speed Electric Submersible Pump

2.3.1 Position fuel powered equipment downwind and at least 10 feet from the well head. Make sure that the exhaust faces downwind.

2.3.2 Carefully position the decontaminated pump per one of the options in FS 2213, section 1 above.

2.3.3 Measure the depth to groundwater at frequent intervals.

2.3.4 Record these measurements.

2.3.5 Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

2.3.6 If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.

2.3.7 If the water table continues to drop during pumping, lower the tubing or pump at the approximate rate of drawdown so that the water is removed from the top of the water column.

2.3.8 Record the purging rate each time the rate changes.

2.3.9 Measure the purge volume by one of the methods outlined in FS 2212, section 1.

2.3.10 Record this measurement.

2.3.11 Decontaminate the pump and tubing between wells (see FC 1000) or only the pump if precleaned tubing is used for each well.

2.4 Variable Speed Bladder Pump

2.4.1 Position fuel powered equipment **downwind** and at least 10 feet from the well head. Make sure that the exhaust faces downwind.

2.4.2 Attach the tubing and carefully position the pump per one of the options in FS 2213, section 1 above.

2.4.3 Measure the depth to groundwater at frequent intervals.

2.4.4 Record these measurements.

2.4.5 Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

2.4.6 If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal rate with the recharge rate.

2.4.7 If the water table continues to drop during pumping, lower the tubing or pump at the approximate rate of drawdown so that the water is removed from the top of the water column.

2.4.8 Record the purging rate each time the rate changes.

2.4.9 Measure the purge volume by one of the methods outlined in FS 2212, section 1.

2.4.10 Record this measurement.

2.4.11 Decontaminate the pump and tubing between wells (see FC 1000) or only the pump if precleaned tubing is used for each well.

3. DEDICATED PORTABLE PUMPS: Place dedicated pumps per one of the options in FS 2213, section 1 above.

3.1 Variable Speed Electric Submersible Pump

3.1.1 Position fuel powered equipment **downwind** and at least 10 feet from the well head. Make sure that the exhaust faces downwind.

3.1.2 Measure the depth to groundwater at frequent intervals.

3.1.3 Record these measurements.

3.1.4 Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

3.1.5 If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal with the recharge rate.

3.1.6 Record the purging rate each time the rate changes.

3.1.7 Measure the purge volume by one of the methods outlined in FS 2212, section 1.

3.1.8 Record this measurement.

3.2 Variable Speed Bladder Pump

3.2.1 Position fuel powered equipment **downwind** and at least 10 feet from the well head. Make sure that the exhaust faces downwind.

3.2.2 Measure the depth to groundwater at frequent intervals.

3.2.3 Record these measurements.

3.2.4 Adjust the purging rate so that it is equivalent to the well recovery rate to minimize drawdown.

3.2.5 If the purging rate exceeds the well recovery rate, reduce the pumping rate to balance the withdrawal with the recharge rate.

3.2.6 Record the purging rate each time the rate changes.

3.2.7 Measure the purge volume by one of the methods outlined in FS 2212, section 1.

3.2.8 Record this measurement.

4. BAILERS: DEP recommends against using bailers for purging except as a last contingency, or if free product is present in the well or suspected to be in the well. However, they may be used if approved by a DEP program, or specified in a permit, contract or DEP order (see Table FS 2200-3 and FS 2211, section 1.3). If in doubt about the appropriateness of using a bailer at a site or during a particular sampling event, contact the appropriate DEP program or project manager.

4.1 Minimize handling the bailer as much as possible.

4.1.1 Remove the bailer from its protective wrapping just before use.

4.1.2 Attach a lanyard of appropriate material (see FS 2201, section 4).

4.1.3 Use the lanyard to move and position the bailer.

4.2 Lower and retrieve the bailer slowly and smoothly.

4.3 Lower the bailer carefully into the well to a depth approximately a foot above the water column.

4.3.1 Do not lower the top of the bailer more than one (1) foot below the top of the water table so that water is removed from the top of the water column. Ensure that the length of the bailer does not exceed the length of the water column.

4.3.2 Allow time for the bailer to fill with aquifer water as it descends into the water column.

4.4 Carefully raise the bailer.

4.4.1 Retrieve the bailer at the same rate of 2 cm/sec until the bottom of the bailer has cleared to top of the water column.

4.5 Measure the purge volume by one of the methods outlined in FS 2212, section 1.

4.5.1 Record the volume of the bailer.

4.6 Continue to carefully lower and retrieve the bailer as described above until the purging completion conditions specified in FS 2212, section 3, have been satisfied.

4.6.1 Remove at least one (1) well volume before collecting measurements of the field parameters. Take each subsequent set of measurements after removing at least one quarter (1/4) well volume between measurements.

FS 2214 *Purging Large-Volume, High-Recharge Wells With Portable Pumps*

If a well originally constructed for high-flow-rate pumping will be sampled as a monitoring well, use these guidelines to develop a purging procedure applicable to the specific details of the well construction. Typical wells constructed for this purpose may be deep, large-diameter wells with a section of open borehole. Evaluate each well on a case-by-case basis and consider any available information on the construction and hydraulic performance of the well.

1. PURGING PROCEDURE

1.1 Place the pump at the top of the open borehole segment of the well.

1.2 Start purging while monitoring stabilization parameters as in FS 2212, section 3 above.

1.3 Purge at least one equipment volume before measuring stabilization parameters.

1.4 If the well is being purged for the first time using these guidelines, monitor stabilization parameters for an extended period until confident that sufficient volume has been pumped from the open borehole to draw fresh formation water into the pump tubing and flow-through container. Use the information obtained from the first-time purging of the well to determine the pumping rate and duration of purging required for future sampling events at the well.

1.5 Purge at least three equipment volumes before evaluating purging completion.

2. PURGING COMPLETION

2.1 Complete the purging of the well when the last three consecutive measurements of the purge stabilization parameters have met the applicable criteria specified in FS 2212, section 3 above.

3. Collect samples from the well using the procedures in FS 2221, section 1 below.

FS 2215. *Purging Wells With Plumbing (production wells or permanently installed pumps equipped with sampling ports or sampling spigots)*

Wells with in-place plumbing are commonly found at municipal water treatment plants, industrial water supplies, private residences, etc. Depending on the sampling objective for collecting samples using installed plumbing, purge the system and collect samples closest to the point of consumption, or, as close to the source well as possible. When purging is required and the purge volume of the plumbing system is not known, purge the system until the purging completion criteria in FS 2212, section 3, have been met.

1. CONTINUOUSLY RUNNING PUMPS

1.1 Select the spigot that is closest to the pump and before any storage tanks (if possible).

1.2 Remove all hoses, aerators and filters (if possible).

1.3 Open the spigot and purge at maximum flow.

1.4 If a storage tank is located between the pump and the spigot, purge the volume of the tank, lines and spigot.

1.5 If the spigot is before any storage tank, purge until sufficient volume is removed to flush the stagnant water from the spigot and the tap line to the spigot.

1.6 Reduce the flow rate to ≤ 500 mL/minute (a 1/8" stream) or approximately 0.1 gal/minute before collecting samples. When sampling for volatile organic compounds, reduce the flow to ≤100 mL/minute before collecting the samples.

2. INTERMITTENTLY RUNNING PUMPS

2.1 Select the spigot that is closest to the pump and before any storage tanks (if possible).

2.2 Remove all hoses, aerators and filters (if possible).

2.3 Open the spigot and purge sufficient volume at a maximum, practical flow rate to flush the spigot and lines and until the purging completion criteria in FS 2212, section 3, have been met.

2.4 If a storage tank is located between the pump and the spigot, purge the volume of the tank, lines and spigot.

2.5 Ensure that the purge stabilization measurement of dissolved oxygen is not biased with aeration of the sample by a high flow rate in the flow-through container.

2.6 Reduce the flow rate to ≤ 500 mL/minute (a 1/8" stream) or approximately 0.1 gal/minute before collecting samples. When sampling for volatile organic compounds, reduce the flow to ≤ 100 mL/minute before collecting the samples.

FS 2216. *Purging Airstrippers and Remedial Treatment Systems*

If collecting samples for groundwater contamination monitoring, follow FS 2215above.

FS 2220. GROUNDWATER SAMPLING TECHNIQUES

1. Purge wells using the techniques outlined in FS 2210.

2. Replace the protective covering around the well if it is soiled or torn after completing the purging operations.

3. GENERAL CONSIDERATIONS FOR SAMPLING EQUIPMENT AND PROCEDURES

Follow all notes and restrictions as indicated in Table FS 2200-1 and as discussed in FS 2201.

NOTE: The only pumps that are currently approved for use in collecting samples for the analysis of volatile organic compounds (VOCs) through the pump without additional restrictions are stainless steel and Teflon variable speed submersible pumps; stainless steel and Teflon or Polyethylene variable speed bladder pumps; and, permanently installed variable speed bladder or submersible pumps with PVC bodies, as long as the PVC pump remains in contact with the water in the well at all times. Peristaltic pumps may be used for VOC sample collection only according to the requirements in this SOP.

3.1 Collect the sample into the sample container to be sent to the laboratory directly from the sampling tap or spigot, the pump delivery tubing or other sampling device. **Do not** use intermediate containers.

3.2 In order to avoid contaminating the sample or loss of analytes from the sample:

3.2.1 Handle the sampling equipment as little as possible.

3.2.2 Minimize the amount of equipment that is exposed to the sample, where possible.

3.2.3 Employ precautions and procedures specific to the collection of samples for VOC analysis.

3.2.3.1 Minimize aeration of samples collected for VOC analysis.

3.2.3.2 Reduce flow rates to 100 - 400 mL/minute when using a pump to collect VOC samples. Attempt to maximize the flow rate within this range. Do not sample at flow rates lower than 100 mL/minute or higher than 400 mL/minute.

3.2.3.3 See subpart FS 2221, section 1, including subsections 1.1 – 1.1.3.9, 1.2 – 1.2.3.3, 1.3.2 – 1.3.3.1, 1.3.4 – 1.3.4.2 and 1.4 for additional VOC sampling instructions, restrictions, precautions and criteria.

3.3 Dedicated Sampling Equipment

3.3.1 Whenever possible, use dedicated equipment because it significantly reduces the chance of cross-contamination.

3.3.2 Dedicated is defined as equipment that is to be used solely for one location for the life of that equipment (e.g., permanently mounted pump).

3.3.3 All material construction and restrictions from Table FS 2200-1 also apply to dedicated equipment. Purchase equipment with the most sensitive analyte of interest in mind.

3.4 Cleaning/Decontamination

3.4.1 Clean or ensure dedicated pumps are clean before installation. They do not need to be cleaned prior to each use but must be cleaned if they are withdrawn for repair or servicing.

3.4.2 Clean or make sure any permanently mounted tubing is clean before installation.

3.4.3 Change or clean tubing when the pump is withdrawn for servicing.

3.4.4 Clean any replaceable or temporary parts as specified in FC 1000.

3.4.5 Collect equipment blanks on dedicated pumping systems when the tubing is cleaned or replaced.

3.4.6 Clean or ensure dedicated bailers are clean before placing them into the well.

3.4.7 Collect an equipment blank on dedicated bailers before introducing them into the water column.

3.4.8 Suspend dedicated bailers above the water column if they are stored in the well.

FS 2221. *Sampling Wells Without Plumbing*

1. SAMPLING WITH PUMPS: Variable speed stainless steel and Teflon submersible pumps; stainless steel, Teflon or Polyethylene bladder pumps; and, permanently installed variable speed submersible or bladder pumps with PVC bodies (as long as the pump remains in contact with the water in the well at all times), may be used to sample for all organics. The pump tubing must be Teflon, polyethylene or polypropylene. Do not use low-density polyethylene (LDPE) bladders or tubing to collect samples for volatile organic compounds (VOCs). **Extractable organics** may be collected through a peristaltic pump if ≤ 1 foot of silicone tubing is used in the pump head or a vacuum trap is used (see Figure FS 2200-1 for specific configuration). Samples for **volatile organic compounds** (VOCs) may be collected through the peristaltic pump roller tubing if ≤ 1 foot of silicone tubing is used in the pump roller head, according to the instructions and restrictions listed in section 1.1.1, below. Follow all notes and restrictions as defined in Table FS 2200-1 and discussed in Equipment and Supplies (FS 2201) when using pumps to collect samples. Do not lower the pump or tubing to the bottom of the well.

1.1 Peristaltic Pump

1.1.1 Volatile Organics Collected Through the Pump Roller Tubing: Ensure that no more than a maximum length of one foot of new silicone tubing is installed in the peristaltic pump roller head assembly before the well is purged, if the same pump and tubing assembly is used to purge and sample the well. Otherwise, install a new length of silicone roller tubing as described above before beginning to sample (see NOTE below). If the pump will be used to sample more than one well, replace the silicone roller tubing before purging and sampling each new well. Use Teflon, Kynar, high-density polyethylene (HDPE) or similarly inert material for the drop (down-hole) and delivery tubing. Do not use low-density polyethylene (LDPE) tubing. Minimize aeration of the sample during collection. If samples for additional analytes other than VOCs will be collected, fill the VOC sample containers last, if possible. For low-recharge wells, collect VOCs first after purging is completed, where excessive drawdown or dry purging occurs. NOTE: Depending on the recharge characteristics of the well and sampler skill, attempt to maximize the flow rate for VOC sample collection within the range stipulated below in sections 1.1.1.1 and 1.1.1.2. Collect the VOC sample directly into the sample container from the discharge flow exiting from the pump delivery tubing. Disconnect flow-through containers, manifolds, valves or other devices from the delivery tubing before collecting the VOC samples, if applicable. If the tubing assembly intended for VOC sample collection was not used to purge the well, begin pumping using the new sampling tubing assembly, adjust the pumping rate for the maximum possible flow rate for VOC sampling and pump a minimum of 3 equipment volumes (pump and tubing volume) through the entire tubing assembly before collecting the VOC samples. If the pump tubing is placed within the screened interval, new tubing cannot be reinserted into the well and the same tubing must be used for purging and sampling.

1.1.1.1 For wells with sufficient recharge where the pumping rate can be matched with the recharge rate, use tubing with the smallest practical inside diameter and collect VOC samples with a pumping rate in the range of 100 mL/minute – 400 mL/minute. Attempt to maximize the flow rate within this range. Do not reduce the flow rate below 100 mL/minute or exceed 400 mL/minute while sampling. Minimize aeration of the sample during collection, and observe all other precautions as indicated in FS 2000, subpart FS 2004. If samples for additional analytes other than VOCs will be collected, fill the VOC sample containers last, if possible.

1.1.1.2 For low-recharge wells, use tubing with the smallest practical inside diameter and collect VOC samples with a pumping rate in the range of 100 mL/minute – 400 mL/minute. Attempt to maximize the flow rate within this range. Do not reduce the flow rate below 100 mL/minute (if possible) or exceed 400 mL/minute while sampling. Minimize aeration of the sample during collection, and observe all other precautions as indicated in FS 2000, subpart FS 2004. If samples for additional analytes other than VOCs will be collected, fill the VOC sample containers last, if possible. Collect VOCs first after purging is completed, where excessive drawdown or dry purging occurs. See subpart FS 2212, section 3.7 for wells that purge dry.

1.1.2 Volatile Organics Using Manual Fill and Drain Method: This method is also denoted as the “straw” method (with gravity drain). Collect volatile organics last. If the pump tubing is placed within the screened interval, do not reinsert the tubing into the well after withdrawing, and do not repeat steps 1.1.2.3 through 1.1.2.6.

1.1.2.1 Insert sufficient length of drop tubing to provide enough sample volume to fill all necessary VOC sample containers, if possible.

1.1.2.2 Remove the drop tubing from the inlet side of the pump.

1.1.2.3 Submerse the drop tubing into the water column and allow it fill.

1.1.2.4 Remove the drop tubing from the well.

1.1.2.5 Prevent the water in the tubing from flowing back into the well.

1.1.2.6 Carefully allow the groundwater to drain by gravity into the VOC sample containers. Avoid turbulence. Do not aerate the sample.

1.1.2.7 Repeat steps 1.1.2.3 - 1.1.2.6 until enough sample containers are filled.

1.1.3 Volatile Organics Using the Pump to Fill and Drain the Tubing: This method is also denoted as the "straw" method with reverse-flow. Collect volatile organics last. If the pump tubing is placed within the screened interval, do not reinsert the tubing into the well after withdrawing, and do not repeat steps 1.1.3.2 through 1.1.3.8, below. Do not reduce the flow rate below 100 mL/minute or exceed 400 mL/minute while pumping. Do not collect sample that has passed through the pump roller head silicone tubing.

1.1.3.1 Insert sufficient length of drop tubing to provide enough sample volume to fill all necessary VOC sample containers, if possible.

1.1.3.2 Submerse the drop tubing into the water column.

1.1.3.3 Use the pump to fill the drop tubing.

1.1.3.4 Quickly remove the tubing from inlet side of the pump.

1.1.3.5 Prevent the water in the tubing from flowing back into the well.

1.1.3.6 Remove the drop tubing from the well and fill the VOC sample containers using the reverse-flow or gravity-drain methods in steps 1.1.3.7 or 1.1.3.8 below.

1.1.3.7 Reverse the flow on the peristaltic pump to deliver the sample into the VOC sample containers at a slow, steady rate. Avoid turbulence. Do not aerate the sample.

1.1.3.8 Or, remove the drop tubing from the inlet side of the pump and carefully allow the groundwater to drain into the VOC sample containers. Avoid turbulence. Do not aerate the sample.

1.1.3.9 Repeat steps 1.1.3.2 - 1.1.3.8 until enough VOC sample containers are filled.

1.1.4 Extractable Organics Collected Through Silicone Pump-Head Tubing:

1.1.4.1 Ensure that a 1-foot maximum length of new silicone tubing was installed in the peristaltic pump head assembly before the well was purged if the same pump is being used to purge and sample the well. Otherwise, install a new length of tubing as described above.

1.1.4.2 Collect extractable organic samples directly from the effluent delivery tubing (attached to discharge side of the silicone pump head tubing) into the sample container.

1.1.4.3 If there is a concern that sample analytes are absorbed, adsorbed, leached or otherwise affected or lost by pumping through the silicone pump-head tubing, sample the well using the organic trap assembly in 1.1.4 below.

1.1.5 Extractable Organics Using an Optional Organic Trap Assembly

1.1.5.1 Assemble the components of the pump and trap according to Figure FS 2200-1.

1.1.5.2 The sample container should be the trap bottle.

1.1.5.3 All equipment that contacts the groundwater **before** the sample container must be constructed of Teflon, Polyethylene, Polypropylene, stainless steel or glass, including the transport tubing to and from the sample container, the interior liner of the container cap and all fittings. **Do not use a rubber stopper as a cap.**

1.1.5.4 Connect the outflow tubing from the container to the influent side of the peristaltic pump.

1.1.5.5 Prevent the water in the down-hole delivery tubing from flowing back into the well while performing this connection.

1.1.5.6 Turn the pump on and reduce the flow rate to a smooth and even flow.

1.1.5.7 Discard a small portion of the sample to allow an air space.

1.1.5.8 Preserve (if required), label and complete the field notes.

1.1.6 Inorganics

1.1.6.1 Inorganic samples may be collected from the effluent tubing.

1.1.6.2 If samples are collected from the pump, decontaminate all tubing (including the tubing in the head) or change it between wells.

1.1.6.3 Preserve (if required), label and complete field notes.

1.2 Variable Speed Bladder Pump

1.2.1 If sampling for organics the pump body must be constructed of stainless steel and the valves and bladder must be Teflon, polyethylene or polypropylene. All tubing must be Teflon, Polyethylene, or Polypropylene and any cabling must be sealed in Teflon, Polyethylene or Polypropylene, or made of stainless steel. Do not use low-density polyethylene (LDPE) tubing or bladders for the collection of VOC samples.

1.2.2 After purging to a smooth even flow, reduce the flow rate.

1.2.2.1 When sampling for volatile organic compounds, reduce the flow rate to 100 – 400 mL/minute, if possible. Attempt to maximize the flow rate within this range.

1.2.3 Sampling for Volatile Organic Compounds (VOCs)

1.2.3.1 Use Teflon, Kynar, HDPE or similarly inert material for the bladder or tubing. Do not use LDPE bladders or tubing. Minimize aeration of the sample during collection. If samples for additional analytes other than VOCs will be collected, fill the VOC sample containers last, if possible. For low-recharge wells, collect VOCs first after purging is completed, where excessive drawdown or dry purging occurs. Depending on the recharge characteristics of the well and sampler skill, attempt to maximize the flow rate for VOC sample collection within the range stipulated above in section 1.2.3. Collect the VOC sample directly into the sample container from the discharge flow exiting from the pump delivery tubing. Disconnect flow-through containers, manifolds, valves or other devices from the delivery tubing before collecting the VOC samples, if applicable.

1.2.3.2 If the pump and/or tubing assembly intended for VOC sample collection was not used to purge the well, begin pumping using the sampling pump and/or tubing assembly, adjust the pumping rate for the maximum possible flow rate for VOC sampling and pump a minimum of 3 equipment volumes (pump and tubing volume) through the entire tubing assembly before collecting the VOC samples.

1.2.3.3 If the pump is placed within the screened interval, use the same pump and tubing assembly for both purging and sampling.

1.3 Variable Speed Submersible Pump

1.3.1 The housing must be stainless steel.

1.3.2 If sampling for organics, the internal impellers, seals and gaskets must be constructed of stainless steel, Teflon, Polyethylene or Polypropylene. The delivery tubing must be Teflon, Polyethylene or Polypropylene. Do not use low-density polyethylene (LDPE) for the collection of VOC samples. The electrical cord must be sealed in Teflon, Polyethylene or Polypropylene, and any cabling must be sealed in Teflon, Polyethylene or Polypropylene, or constructed of stainless steel.

1.3.3 After purging to a smooth even flow, reduce the flow rate.

1.3.3.1 When sampling for volatile organic compounds, reduce the flow rate to 100 – 400 mL/minute, if possible. Attempt to maximize the flow rate within this range.

1.3.4 Sampling for Volatile Organic Compounds (VOCs)

1.3.4.1 Use Teflon, Kynar, HDPE or similarly inert material for the pump tubing. Do not use LDPE tubing. Minimize aeration of the sample during collection. If samples for additional analytes other than VOCs will be collected, fill the VOC sample containers last, if possible. For low-recharge wells, collect VOCs first after purging is completed, where excessive drawdown or dry purging occurs. Depending on the recharge characteristics of the well and sampler skill, attempt to maximize the flow rate for VOC sample collection within the range stipulated above in section 1.3.4. Collect the VOC sample directly into the sample container from the discharge flow exiting from the pump delivery tubing. Disconnect flow-through containers, manifolds, valves or other devices from the delivery tubing before collecting the VOC samples, if applicable.

1.3.4.2 If the pump and/or tubing assembly intended for VOC sample collection was not used to purge the well, begin pumping using the sampling pump and/or tubing assembly, adjust the pumping rate for the maximum possible flow rate for VOC sampling and pump a minimum of 3 equipment volumes (pump and tubing volume) through the entire tubing assembly before collecting the VOC samples.

1.4 For all analytes, if the pump is placed within the screened interval, use the same pump and tubing assembly for both purging and sampling.

2. SAMPLING WITH BAILERS: A high degree of skill and coordination are necessary to collect representative samples with a bailer. When properly used, bailers may be used to collect samples for certain analyte groups and under specific conditions (see Table FS 2200-3). They must be of an appropriate type and construction (see FS 2201, section 3), and must be used as outlined below. If in doubt about the appropriateness of using a bailer at a site or during a particular sampling event, contact the appropriate DEP program or project manager.

2.1 General Considerations

2.1.1 Minimize handling the bailer as much as possible.

2.1.1.1 Wear sampling gloves.

2.1.1.2 Remove the bailer from its protective wrapping just before use.

2.1.1.3 Attach a lanyard of appropriate material (see FS 2201, section 4).

2.1.1.4 Use the lanyard to move and position the bailers.

2.1.2 Do not allow the bailer or lanyard to touch the ground.

2.1.3 Rinsing

2.1.3.1 If the bailer is certified precleaned, no rinsing is necessary.

2.1.3.2 If both a pump and a bailer are to be used to collect samples, rinse the exterior and interior of the bailer with sample water from the pump before removing the pump.

2.1.3.3 If the purge pump is not appropriate for collecting samples (e.g., non-inert components), rinse the bailer with by collecting a single bailer of the groundwater to be sampled. Use the technique described in section 2.2, Bailing Technique, below.

2.1.3.4 Discard the water appropriately.

2.1.3.5 **Do not** rinse the bailer if Oil & Grease, TRPHs, etc., (see FS 2006) are to be collected.

2.2 Bailing Technique

2.2.1 Collect all samples that are required to be collected with a pump before collecting samples with the bailer.

2.2.2 Raise and lower the bailer gently to minimize stirring up particulate matter in the well and the water column which can increase sample turbidity.

2.2.3 Lower the bailer carefully into the well to a depth approximately a foot above the water column. Ensure that the length of the bailer does not exceed the length of the water column.

2.2.3.1 When the bailer is in position, lower the bailer into the water column at a rate of 2 cm/sec until the desired depth is reached (see section 2.2.3 above).

2.2.4 Do not lower the top of the bailer more than one (1) foot below the top of the water table so that water is removed from the top of the water column.

2.2.5 Allow time for the bailer to fill with aquifer water as it descends into the water column.

2.2.6 Do not allow the bailer to touch the bottom of the well or particulate matter will be incorporated into the sample.

2.2.6.1 Carefully raise the bailer (see section 2.2.2 above). Retrieve the bailer at the same rate of 2 cm/sec until the bottom of the bailer has cleared to top of the water column.

2.2.7 Lower the bailer to approximately the same depth each time.

2.2.8 Collect the sample.

2.2.8.1 Install a device to control the flow from the bottom of the bailer and discard the first few inches of water. Reduce the flow to $\leq$ 100 mL/minute when collecting VOC samples.

2.2.8.2 Fill the appropriate sample containers by allowing the sample to slowly flow down the side of the container. Minimize aeration of VOC samples.

2.2.8.3 Discard the last few inches of water in the bailer.

2.2.9 Repeat steps 2.2.1 through 2.2.8.3 for additional samples.

2.2.10 Measure the DO, pH, temperature, turbidity and specific conductance after the final sample has been collected.

2.2.10.1 Record all measurements and note the time that sampling was completed.

3. SAMPLING WELLS WITH FLOATING NON-AQUEOUS PHASE LIQUID: DEP does not recommend the sampling of wells with floating non-aqueous phase liquid for trace contaminants. This concerns primarily petroleum related sites, but includes any chemical product (e.g., solvent) that floats on the water table. Sampling is acceptable if the information is to be used for the purpose of remedial design.

Sample data from such wells cannot provide useful information regarding the level of contamination. Furthermore, these wells typically do not provide legitimate data because of

permanent chemical contamination from product contact with the well casing for an extended period of time.

DEP does reserve the right to require sampling of these wells, not for levels of trace contaminants, but for confirmation of an appropriate remediation technique. This type of sampling is performed **below** the non-aqueous phase layer (see section 3.2 below).

3.1 Non-Aqueous Phase Liquid Sampling: Non-aqueous phase liquid may be evident in a cased monitoring well or in an open excavation.

3.1.1 Non-aqueous phase liquid is normally sampled for two reasons:

- Documentation for its existence and thickness; and
- Determination of the type of product so that the proper analyses can be performed to determine extent. This is only feasible for relatively recent releases as it may not be possible to identify weathered product.

3.1.2 Disposable plastic (acrylic, clear PVC) bailers are recommended for sampling. Disposable Polyethylene and Polypropylene bailers are also acceptable. Other wide mouth vessels may be used for sampling non-aqueous phase liquid in an excavation.

3.1.3 Monitoring Well

3.1.3.1 If a non-aqueous phase liquid is identified in a monitoring well during the water level measurement, measure its thickness in the well. If the thickness of the non-aqueous phase liquid is greater than 0.01 foot or product globules are present, collect a sample using a precleaned disposable bailer.

3.1.3.2 Measure the product thickness to the nearest 0.01 foot after withdrawing the bailer.

3.1.3.3 Pour a portion of the product into a glass sample container.

3.1.3.4 This sample is considered a concentrated waste. Therefore, package the container in protective wrapping to prevent breakage, isolate from other samples, and ice to 4°C.

3.1.4 Excavation

3.1.4.1 If non-aqueous phase liquid is observed in an open excavation, a glass sample container or a precleaned intermediate vessel may be used to collect the sample.

3.1.4.2 Securely tie a lanyard to the container and lower it into the excavation.

3.1.4.3 Gently lower and retrieve the container so that no solid material is released or collected.

3.1.4.4 If sufficient water is available, a bailer can be used.

3.1.4.5 Although not recommended, screened casing can be placed (or augered and placed) in the bottom of the excavation and the product sampled with a bailer.

3.1.4.6 Avoid dangerous situations, such as standing too close to the edge of an excavation, riding in the backhoe bucket, or entering a trench or excavation that may collapse.

3.1.4.7 DEP recommends following all applicable OSHA regulations.

3.2 Sampling Below Product

3.2.1 This type of depth-specific sampling to attempt to sample the dissolved constituents in the water column below the product layer is performed only at the request of DEP or its designee.

3.2.2 These data provide information that helps define adequate groundwater treatment. Without these data, incorrect (and sometimes unnecessarily expensive) remediation techniques may be designed for a situation where they are not required.

3.2.3 There are some substantial logistical problems involved with sending a sampler through non-aqueous phase liquid to sample the groundwater below. Although there are some products designed specifically for this type of sampling, they are expensive and the results may not be commensurate with their cost. The use of "self-engineered" equipment or coverings may be the best option.

3.2.4 These data are only to be used for qualitative use and will aid in deciding on an appropriate remediation technique.

3.2.5 Wrapping bailers and tubing in plastic seems to be the most popular technique in getting past the product layer.

3.2.6 Although not recommended, some have wrapped submersible pumps in several layers of plastic and retrieved each layer by a separate lanyard. One suggestion would be to use a rigid piece of stainless steel tubing wrapped in plastic.

3.2.6.1 Once the covered tubing is past the layer, pull up on the plastic, piercing the plastic and exposing the (somewhat) clean tubing inlet.

3.2.6.2 Introduce the wrapped hose slowly to not entrain any more product into the dissolved layer located below.

3.2.6.3 Also, perform this procedure with a peristaltic pump or a vacuum pump linked to a trap bottle. To use this setup, the water table must be no deeper than 15-20 feet, realizing that actual sampling may be occurring several feet below the product layer.

FS 2222. *Sampling Low Permeability Aquifers or Wells That Have Purged Dry*

1. Collect the sample(s) after the well has been purged according to FS 2212, section 3.4. Minimize the amount of water removed from the well by using the same pump to purge and collect the sample. If the well has purged dry, collect samples as soon as sufficient sample water is available. If samples for additional analytes other than VOCs will be collected, fill the VOC sample containers last, if possible. However, collect VOCs first after purging is completed, where excessive drawdown or dry purging occurs.

2. Measure the five (5) field parameters Temperature, pH, Specific Conductance, Dissolved Oxygen and Turbidity at the time of sample collection.

3. Advise the analytical laboratory and the client that the usual amount of sample for analysis may not be available.

FS 2223. *Sampling Wells With In-Place Plumbing*

1. If a storage tank is present, locate a cold water spigot, valve or other sampling point close to the well head between the pump and the storage tank. If there is no sampling location between the pump and the storage tank, locate the spigot, valve or other sampling point closest to the tank.

1.1 Depending on the sampling objective for collecting samples using installed plumbing, purge the system and collect samples closest to the point of consumption, or, as close to the source well as possible.

2. Remove all screens or aerators and reduce the flow rate to no more than 500 mL/minute. If collecting samples for volatile organic compounds, reduce the flow rate to 100 mL/minute or less. Collect the samples directly into the appropriate containers.

FS 2224. *Sampling Airstripper and Remedial Treatment System Sampling*

1. Reduce the flow rate to less than 500 mL/minute and begin sample collection.
2. If collecting samples for volatile organic compounds, reduce the flow rate to 100 mL/minute or less.
3. Collect the samples directly into the appropriate containers.

FS 2225. *Filtering Groundwater Samples*

Filtered groundwater samples can only be collected after approval from the DEP program or project manager. If filtering is approved, the DEP program or permit condition may require both filtered and unfiltered samples to be collected, analyzed and reported.

1. FILTERING GROUNDWATER FOR METALS:

1.1 Unless specified otherwise by the DEP program, use a new, disposable, high capacity, 1-µm in-line filter.

1.2 Use a variable speed peristaltic, bladder or submersible pump with the in-line filter fitted on the outlet end.

1.2.1 Peristaltic pumps, bladder pumps or submersible pumps can be used when water levels are no greater than 20 to 25 feet deep.

1.2.2 Bladder pumps or submersible pumps must be used when water levels are greater than 20 to 25 feet deep.

1.3 Ensure that a 1-foot maximum length of new, silicone tubing was installed in the peristaltic pump head assembly before the well was purged if the same pump is being used to purge and sample the well. Otherwise, install a new length of tubing as described above.

1.4 Ensure that new or precleaned delivery tubing was assembled with the peristaltic pump before the well was purged if the same pump is being used to purge and sample the well. Otherwise, assemble the pump with new or precleaned delivery tubing and the new filter.

1.5 Insert the filter on the high pressure side (i.e., on the delivery side) of the pump.

1.5.1 Flush the filter before attaching to the pump tubing assembly with 30-50 mL of analyte free water or an inert gas (nitrogen) to remove atmospheric oxygen;

1.5.2 Or, with the filter attached to the pump tubing assembly, hold the filter upright with the inlet and outlet in the vertical position and pump water from the aquifer through the filter until all atmospheric oxygen has been removed.

1.6 Collect the filtered samples directly into the sample container from the high-pressure (delivery) side of the pump tubing assembly.

1.6.1 Collect filtered samples by either of the methods in 1.6.1.3 or 1.6.1.4 below if the static water level in the well is too deep for a variable speed peristaltic pump and a variable speed electric submersible pump or variable speed bladder pump is not available.

1.6.1.1 Do not agitate the sample or expose it to atmospheric oxygen.

1.6.1.2 **Do not** pour the sample into any intermediate vessel for subsequent filtration.

1.6.1.3 Collect the sample in a Polyethylene, Teflon or Polypropylene bailer that can be pressurized. When the bailer has been retrieved, immediately connect the filter and begin to pressurize the bailer;

1.6.1.4 Or, collect the sample with a bailer and immediately place the intake tube of the peristaltic pump into the full bailer and begin pumping the water through the filter as described in section 1.2 above.

1.7 **Do not** use the following equipment for filtering groundwater samples for metals:

1.7.1 Any pump and apparatus combination in which the filter is on the vacuum (suction) side of the pump.

1.7.2 Any type of syringe or barrel filtration apparatus.

1.7.3 Any filter that is not encased in a one-piece, molded unit.

2. Filtering groundwater for non-metallic analytes

2.1 The following analytes cannot be filtered:

- Oil and Grease
- Total Recoverable Petroleum Hydrocarbons (TRPH)
- FL-PRO
- Volatile Organic Compounds (VOC)
- Microbiological Analytes
- Volatile Inorganic Compounds (e.g., Hydrogen Sulfide)

2.2 Unless specified otherwise by the regulatory program, use a new, disposable, high capacity, 0.45 µm in-line filter.

2.3 Assemble the pump, tubing and filter as in 1.2 – 1.5 above.

2.4 Flush the filter as in 1.5.1 or 1.5.2 above.

2.5 Collect the samples as in 1.6 – 1.6.1.4 above.

Appendix FS 2200
Tables, Figures and Forms

Table FS 2200-1 Equipment for Collecting Groundwater Samples
Table FS 2200-2 Dissolved Oxygen Saturation
Table FS 2200-3 Allowable Uses for Bailers
Figure FS 2200-1 Pump and Trap for Extractable Organics
Figure FS 2200-2 Groundwater Purging Procedures

Table FS 2200-1
Equipment for Collecting Groundwater Samples

Activity	Equipment Type
Well Purging	Variable speed centrifugal pump Variable speed submersible pump Variable speed bladder pump Variable speed peristaltic pump Bailer with lanyard: Not Recommended
Well Stabilization	pH meter DO meter Conductivity meter Thermometer/Thermistor Turbidimeter Flow-through cell Multi-function meters
Sample Collection	Variable speed peristaltic pump Variable speed submersible pump Variable speed bladder pump Bailer with lanyard (See Table FS 2200-3)
Filtration	Variable speed peristaltic pump Variable speed submersible pump Variable speed bladder pump Pressurized bailer 1.0 µm high capacity molded filter 0.45 µm high capacity molded filter
Groundwater Level	Electronic sensor Chalked tape

Table FS 2200-2
Dissolved Oxygen Saturation

TEMP	D.O.	mg/L	TEMP	D.O.	mg/L	TEMP	D.O.	mg/L	TEMP	D.O.	mg/L
deg C	SAT.	20%	deg C	SAT.	20%	deg C	SAT.	20%	deg C	SAT.	20%
15.0	10.084	2.017	19.0	9.276	1.855	23.0	8.578	1.716	27.0	7.968	1.594
15.1	10.062	2.012	19.1	9.258	1.852	23.1	8.562	1.712	27.1	7.954	1.591
15.2	10.040	2.008	19.2	9.239	1.848	23.2	8.546	1.709	27.2	7.940	1.588
15.3	10.019	2.004	19.3	9.220	1.844	23.3	8.530	1.706	27.3	7.926	1.585
15.4	9.997	1.999	19.4	9.202	1.840	23.4	8.514	1.703	27.4	7.912	1.582
15.5	9.976	1.995	19.5	9.184	1.837	23.5	8.498	1.700	27.5	7.898	1.580
15.6	9.955	1.991	19.6	9.165	1.833	23.6	8.482	1.696	27.6	7.884	1.577
15.7	9.934	1.987	19.7	9.147	1.829	23.7	8.466	1.693	27.7	7.870	1.574
15.8	9.912	1.982	19.8	9.129	1.826	23.8	8.450	1.690	27.8	7.856	1.571
15.9	9.891	1.978	19.9	9.111	1.822	23.9	8.434	1.687	27.9	7.842	1.568
16.0	9.870	1.974	20.0	9.092	1.818	24.0	8.418	1.684	28.0	7.828	1.566
16.1	9.849	1.970	20.1	9.074	1.815	24.1	8.403	1.681	28.1	7.814	1.563
16.2	9.829	1.966	20.2	9.056	1.811	24.2	8.387	1.677	28.2	7.800	1.560
16.3	9.808	1.962	20.3	9.039	1.808	24.3	8.371	1.674	28.3	7.786	1.557
16.4	9.787	1.957	20.4	9.021	1.804	24.4	8.356	1.671	28.4	7.773	1.555
16.5	9.767	1.953	20.5	9.003	1.801	24.5	8.340	1.668	28.5	7.759	1.552
16.6	9.746	1.949	20.6	8.985	1.797	24.6	8.325	1.665	28.6	7.745	1.549
16.7	9.726	1.945	20.7	8.968	1.794	24.7	8.309	1.662	28.7	7.732	1.546
16.8	9.705	1.941	20.8	8.950	1.790	24.8	8.294	1.659	28.8	7.718	1.544
16.9	9.685	1.937	20.9	8.932	1.786	24.9	8.279	1.656	28.9	7.705	1.541
17.0	9.665	1.933	21.0	8.915	1.783	25.0	8.263	1.653	29.0	7.691	1.538
17.1	9.645	1.929	21.1	8.898	1.780	25.1	8.248	1.650	29.1	7.678	1.536
17.2	9.625	1.925	21.2	8.880	1.776	25.2	8.233	1.647	29.2	7.664	1.533
17.3	9.605	1.921	21.3	8.863	1.773	25.3	8.218	1.644	29.3	7.651	1.530
17.4	9.585	1.917	21.4	8.846	1.769	25.4	8.203	1.641	29.4	7.638	1.528
17.5	9.565	1.913	21.5	8.829	1.766	25.5	8.188	1.638	29.5	7.625	1.525
17.6	9.545	1.909	21.6	8.812	1.762	25.6	8.173	1.635	29.6	7.611	1.522
17.7	9.526	1.905	21.7	8.794	1.759	25.7	8.158	1.632	29.7	7.598	1.520
17.8	9.506	1.901	21.8	8.777	1.755	25.8	8.143	1.629	29.8	7.585	1.517
17.9	9.486	1.897	21.9	8.761	1.752	25.9	8.128	1.626	29.9	7.572	1.514
18.0	9.467	1.893	22.0	8.744	1.749	26.0	8.114	1.623	30.0	7.559	1.512
18.1	9.448	1.890	22.1	8.727	1.745	26.1	8.099	1.620	30.1	7.546	1.509
18.2	9.428	1.886	22.2	8.710	1.742	26.2	8.084	1.617	30.2	7.533	1.507
18.3	9.409	1.882	22.3	8.693	1.739	26.3	8.070	1.614	30.3	7.520	1.504
18.4	9.390	1.878	22.4	8.677	1.735	26.4	8.055	1.611	30.4	7.507	1.501
18.5	9.371	1.874	22.5	8.660	1.732	26.5	8.040	1.608	30.5	7.494	1.499
18.6	9.352	1.870	22.6	8.644	1.729	26.6	8.026	1.605	30.6	7.481	1.496
18.7	9.333	1.867	22.7	8.627	1.725	26.7	8.012	1.602	30.7	7.468	1.494
18.8	9.314	1.863	22.8	8.611	1.722	26.8	7.997	1.599	30.8	7.456	1.491
18.9	9.295	1.859	22.9	8.595	1.719	26.9	7.983	1.597	30.9	7.443	1.489

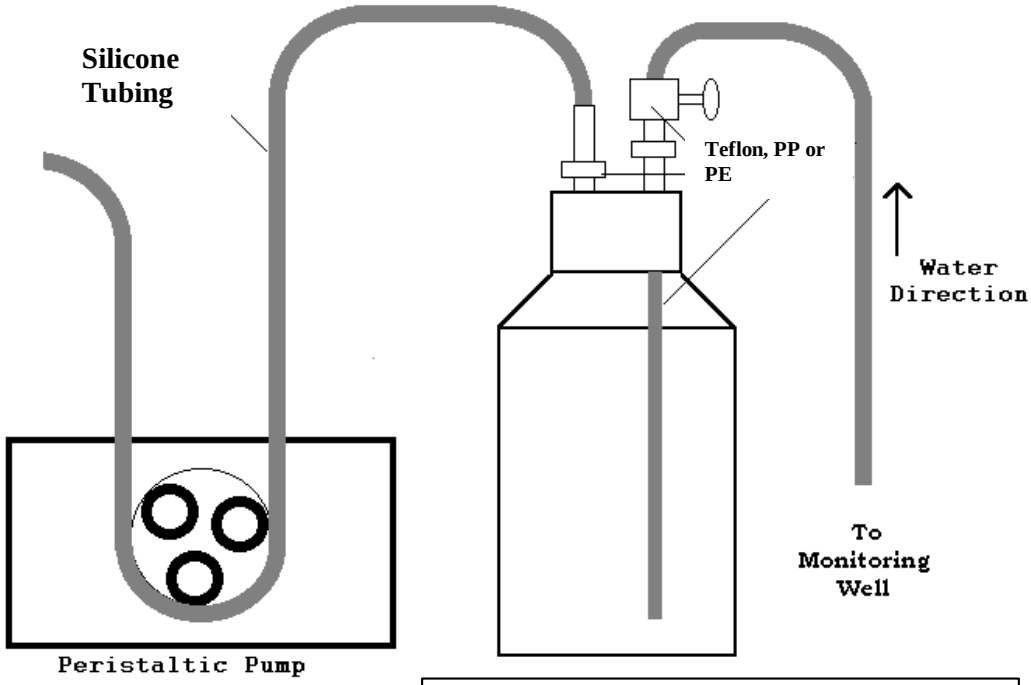
Derived using the formula in Standard Methods for the Examination of Water and Wastewater, Page 4-101, 18th Edition, 1992

Table FS 2200-3
Allowable Uses for Bailers

• **ANALYTE GROUP(S)**	• **PURGING** (Not Recommended)	• **SAMPLING**	
	Use:	Use:	Not Recommended:
Volatile Organics Extractable Organics Radionuclides, including Radon Metals Volatile Sulfides	If allowed by permit, program, contract or order or If operated by a skilled individual with documented training in proper techniques. Field documentation must demonstrate that the procedure in FS 2213, section 4 was followed without deviation.	If concentrations exceed action levels, the purpose is to monitor effective treatment, and the DEP program allows the use of bailers; or If specified by DEP permit, program, contract or order. or If operated by a skilled individual with documented training in proper techniques and using appropriate equipment. Field documentation must demonstrate that the procedure in FS 2221, section 2 was followed without deviation.	If concentrations are near or below the stated action levels; or If a critical decision (e.g., clean closure) will be made based on the data; or If data are to demonstrate compliance with a permit or order.
Petroleum Hydrocarbons (TRPH) & Oil & Grease	If allowed by permit, program, contract or order or If operated by a skilled individual with documented training in proper techniques. Field documentation must demonstrate that the procedure in FS 2213, section 4 was followed without deviation.	Only if allowed by permit, program, contract or order as samples should be collected into the container without intermediate devices.	Unless allowed by permit, program, contract or order.

• **ANALYTE GROUP(S)**	• **PURGING** (Not Recommended)	• **SAMPLING**	
	Use:	Use:	Not Recommended:
Biologicals Inorganic Non-Metallics Aggregate Organics Microbiological Physical and Aggregate Properties	If allowed by permit, program, contract or order or If operated by a skilled individual with documented training in proper techniques. Field documentation must demonstrate that the procedure in FS 2213, section 4 was followed without deviation.	If all analytes collected from the well can be collected with a bailer; or If collected after collecting all analytes that require the use of a pump.	Before collecting any analytes that must be collected with a pump.
Ultra-Trace Metals	Never	Never	

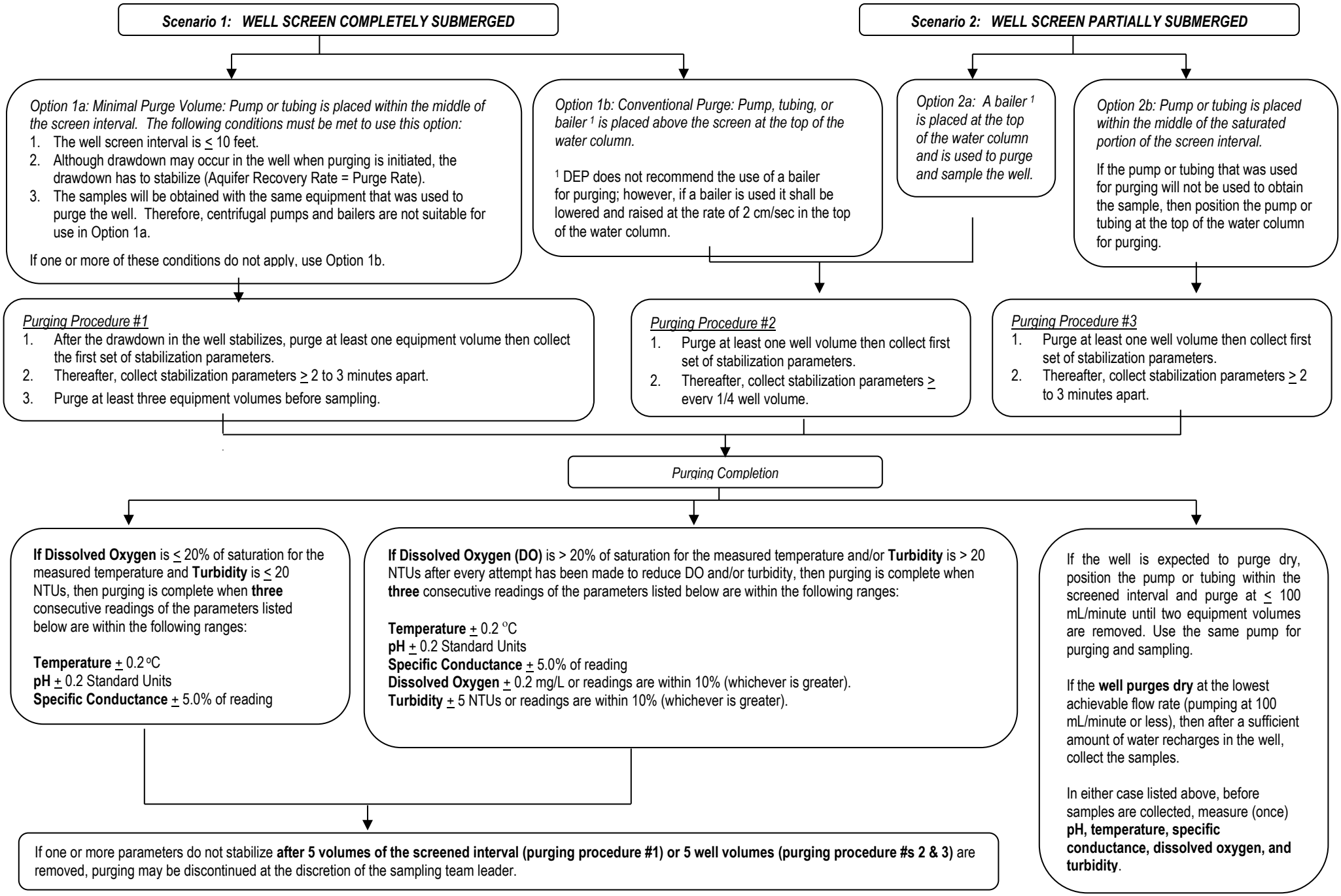
Figure FS 2200-1
Pump and Trap for Extractable Organics



The glass sample bottle must be threaded to use a reusable sampling cap lined and installed with fittings made of Teflon, polypropylene or polyethylene, similar to the design shown.

Groundwater Purging Procedures

Figure FS 2200-2



FS 4000. SEDIMENT SAMPLING

See also the following Standard Operating Procedures:

- FA 1000 Administrative
- FC 1000 Field Cleaning
- FD 1000 Documentation
- FM 1000 Field Mobilization
- FQ 1000 Quality Control
- FS 1000 General Sampling
- FS 7400 Benthic Macroinvertebate Sampling
- FT 1000 – 2000 Field Testing

1. INTRODUCTION AND SCOPE

Sediments occur in freshwater and marine environments such as streams/rivers, ponds/lakes, canals, ditches, wetlands, lagoons, and estuaries. Recently exposed sediment (due to low water levels) may also be sampled, but exposure to air could affect the characteristics of the sediment (for example, redox) and hence, the interpretation of the results of chemical or other analyses. The following methods are for physical, chemical, and toxicological sampling. See FS 7400 for benthic invertebrate sampling.

1.1. Select sampling locations for sediments depending upon the project objectives. Collect:

1.1.1. Sediment samples as an adjunct to surface water samples;

1.1.2. A series of sediment samples for compositing to determine water or sediment quality in a system;

1.1.3. Sediment samples above and below an outfall to document degradation due to a point source discharge; or

1.1.4. Sediment samples if stressed shore vegetation or visible surface water contamination is evident.

1.2. Decisions related to the selection of sampling locations will not be discussed in this document.

1.3. Collect, preserve and containerize surface water samples prior to collecting sediment samples (see FS 2100).

2. EQUIPMENT AND SUPPLIES

2.1. Refer to Table FS 4000-1 and FS 1000, Tables FS 1000-1, 1000-2 and 1000-3, for selection of sampling equipment and construction.

2.2. For information on the selection of appropriate sample containers, see FS 1000 Table FS 1000-6.

2.3. For information on cleaning requirements for sample containers, equipment and utensils, see FC 1000.

2.4. For information on documentation requirements, see FD 1000.

2.5. For information on preservation and holding time requirements, see FS 1000 Table FS 1000-6.

3. SAMPLE COLLECTION PROTOCOLS

Take sediment samples using one of three different types of equipment: scoops, corers and dredges or grab samplers.

3.1. Soil sampling equipment is generally not applicable to sediments because of the low cohesion of the medium.

3.2. When selecting the appropriate sampling equipment, consider sampling location (edge or middle of lagoon), depth of water and sediment, sediment grain size (fineness), water velocity and analytes of interest.

3.3. Direct collection with the appropriate sample container may be appropriate in very low water or where sediment is exposed.

3.4. Use dredges for hard or rocky substrates. They are heavy enough to use in high velocity streams.

3.5. Use coring devices in quiescent waters, unless water depth precludes effective sample collection.

3.6. Scoops or Similar Equipment

3.6.1. Scooping is generally most useful around the margin or shore of the water body or by wading in shallow waters.

3.6.1.1. Stand facing the direction of flow and approach the location from the downstream direction.

3.6.1.2. Take precautions not to disturb the bottom prior to scooping.

3.6.1.3. Scoop the sample in the upstream direction of flow.

3.6.2. For obtaining samples several feet from shore or from a boat, DEP recommends attaching the scoop to an extendible pole.

3.6.3. Transfer sample to the appropriate sample container(s), using a clean non-reactive utensil.

3.6.4. Label, preserve to 4°C with wet ice and complete field notes.

3.7. Corers

3.7.1. Coring devices can be easily fabricated from many materials. Although stainless steel, glass or Teflon must be used for sampling extractable organics, volatile organics and inorganics, aggregate organics, petroleum hydrocarbons and oil & grease, other inexpensive material (e.g., PVC, carbon steel, etc.) may be used for inorganic non-metallics and metals.

3.7.2. Some corers are simple “push tubes,” whereas other more sophisticated models may be finned, gravity driven devices.

3.7.3. A core may be useful for preserving the historical layering of sediments.

3.7.4. Upon descent, water displacement is minimal with core samplers, which minimizes the shock wave produced by other equipment such as dredges.

3.7.5. The corer is an acceptable choice for sampling fine sediments in static waters, especially those containing trace organics and metals.

3.7.6. Corer diameter, grain size and sample consistency will determine if the sample will remain in the corer upon withdrawal.

3.7.7. Sample washout can be a problem and there are several ways to reduce or prevent it.

3.7.7.1. Fit the leading edge of the corer with a nosepiece or core catcher that physically keeps the sample from slipping back out of the corer. The core catcher material must also be compatible with the analytes of interest.

3.7.7.2. A second option is fit the top or back end with a check valve which creates negative pressure on the back of the sample as it is being pulled from the substrate and prevents surface water from washing out the top portion of the sample.

3.7.8. Rotate the corer, if needed, as it is pushed into the sediment.

3.7.8.1. Rotate be around its axis (do not rock the coring device back and forth).

3.7.8.2. Rotation improves penetration and prevents compaction of the sample as it is pushed to the full length of the corer.

3.7.9. Upon withdrawal from the water surface, place a cap on the bottom to prevent the sample from sliding out.

3.7.10. Corers can also be fitted with liners. This is advantageous if a complete core is desired that has not been in contact with the atmosphere. It is also advantageous if the coring device is not constructed of the proper material (e.g., PVC) and one of the analytes requires a sampler of inert construction (glass, stainless steel or Teflon).

3.7.11. As the core is extruded, carefully remove the sample with a clean, non-reactive utensil and transfer into the appropriate sample container(s).

3.7.12. Label, preserve to 4°C with wet ice and complete field notes.

3.8. Dredges or Grab Samplers

3.8.1. The three main types of devices used in freshwater are the Ekman, Peterson and Ponar. Heavier oceanographic dredges are used in marine and estuarine waters.

3.8.2. Refer to Table FS 4000-1 for additional types of dredges. The Peterson and Ponar dredges are suitable for hard or rocky substrates or deep water bodies.

3.8.2.1. The Peterson and Ponar are virtually the same, except that the Ponar has been adapted with a top screen and side plates to prevent sample loss upon ascent. For this reason, the Ponar is the dredge of choice for rocky substrates. These dredges are heavy enough to use in streams with fast currents.

3.8.2.2. Open the jaws and place the cross bar into the proper notch.

3.8.2.3. Lower the dredge to the bottom, making sure it settles flat.

3.8.2.4. When tension is removed from the line, the cross bar will drop, enabling the dredge to close as the line is pulled upward during retrieval.

3.8.2.5. Pull the sampler to the surface. Check to make sure the jaws are fully closed and that no sample was lost while lifting the dredge.

3.8.2.6. Carefully open the jaws, remove the sample with a clean, non-reactive utensil and transfer the sample into the appropriate sample container(s), label, preserve to 4°C with wet ice and complete field notes.

3.8.3. The Ekman is designed for sampling soft substrates (e.g., sand, silt or mud) in areas with little current.

3.8.3.1. Open the spring-loaded jaws and attach the chains to the pegs at the top of the sampler.

3.8.3.2. Lower the dredge to the bottom, making sure it settles flat.

3.8.3.3. Holding the line taut and send down the messenger to close the jaws of the dredge.

3.8.3.4. Pull the sampler to the surface. Check to make sure the jaws are fully closed and that no sample was lost while lifting the dredge.

3.8.3.5. Carefully open the jaws, remove the sample with a clean, non-reactive utensil and transfer the sample into the appropriate sample container(s).

3.8.3.6. Label, preserve to 4°C with wet ice and complete field notes.

4. PROCEDURES FOR COMPOSITING

4.1. The following is not a complete discussion regarding all available sampling protocols nor the appropriateness or inappropriateness of compositing sediment samples. The appropriateness of compositing sediment samples will depend on the data quality objectives of the project. However, it is sometimes advantageous to composite sediment samples to minimize the number of samples to be analyzed when sampling highly contaminated areas. Obtain permission from the DEP program.

4.1.1. Select sampling points from which to collect each aliquot.

4.1.2. Using the appropriate sampling technique, collect equal aliquots (same sample size) from each location and place in a properly cleaned container.

4.1.3. **Combine the aliquots of the sample directly in the sample container with no pre-mixing**.

4.1.4. Record the amount of each aliquot (volume or weight).

4.1.5. Label container, preserve on wet ice to 4°C and complete field notes.

4.1.6. Notify the laboratory that the sample is an unmixed composite sample, and request that the sample be thoroughly mixed before sample preparation or analysis.

5. COLLECTION OF INTERSTITIAL OR PORE WATER SAMPLES

5.1. ASTM identifies interstitial water or pore water as the "water occupying the space between sediment…particles." It "is often isolated to provide either a matrix for toxicity testing or an indication of the concentration and partitioning of contaminants with a sediment matrix." See *Standard Guide for Collection, Storage, Characterization and Manipulation of Sediments for Toxicological Testing and for Selection of Samplers Used to Collect Benthic Invertebrates*, ASTM E 1391-03(2008) ASTM International. Collect pore water using available technology that will preserve the integrity of the analytes of interest during collection. Pore water may be extracted in the laboratory from field-collected sediments. Consult the detailed discussion in the ASTM guidance if pore water is to be extracted and analyzed as part of the sampling design. Use of pore water wells (e.g., shallow PVC wells) or pore water equilibrators (e.g., Plexiglas plates with built-in wells or other appropriate construction) is also acceptable.

5.2. Collect adequate amounts of sample in the field to obtain desired quantities of pore water for testing. Sandy sediments retain less water than fine sediments do; thus, the substrate type will dictate the amount of additional sample needed. In all cases, consult the laboratory conducting the analyses to provide estimates of the amount of sediment necessary to obtain the desired quantity of pore water.

Appendix FS 4000
Tables, Figures and Forms

Table FS 4000-1: Summary of Bottom Sampling Equipment [from ASTM E 1391-94]

TABLE FS 4000-1 Summary of Bottom Sampling Equipment [from ASTM E 1391-94]

Device	Use	Advantages	Disadvantages
Teflon or glass tube	Shallow wadeable waters or deep waters if SCUBA available. Soft or semi-consolidated deposits.	Preserves layering and permits historical study of sediment deposition. Rapid - samples immediately ready for laboratory shipment. Minimal risk of contamination.	Small sample size requires repetitive sampling.
Hand corer with removable teflon or glass liners	Same as above except more consolidated sediments can be obtained.	Handles provide for greater ease of substrate penetration. Above advantages.	Careful handling necessary to prevent spillage. Requires removal of liners before repetitive sampling. Slight risk of metal contamination from barrel and core cutter.
Box corer	Same as above.	Collection of large sample undisturbed, allowing for subsampling.	Hard to handle.
Gravity corers, such as Phleger Corer	Deep lakes and rivers. Semi-consolidated sediments.	Low risk of sample contamination. Maintains sediment integrity relatively well.	Careful handling necessary to avoid sediment spillage. Small sample, require repetitive operation and removal of liners. Time consuming.
Young grab (Teflon or kynar-lined, modified 0.1-m^2 Van Veen)	Lakes and marine areas.	Eliminates metal contamination. Reduced bow wake.	Expensive. Requires winch.
Ekman or box dredge	Soft to semi-soft sediments. Can be used from boat, bridge, or pier in waters of various depths.	Obtains a larger sample than coring tubes. Can be subsampled through box lid.	Possible incomplete jaw closure and sample loss. Possible shock wave, which may disturb the "fines". Metal construction may introduce contaminants. Possible loss of "fines" on retrieval.
PONAR grab sampler Petite PONAR grab sampler	Deep lakes, rivers and estuaries. Useful on sand, silt, or clay.	Most universal grab sampler. Adequate on most substrates. Large sample obtained intact, permitting subsampling.	Shock wave from descent may disturb "fines." Possible incomplete closure of jaws results in sample loss. Possible contamination from metal frame construction. Sample must be further prepared for analysis.
BMH-53 piston corer	Waters of 4 to 6 ft deep when used with extension rod. Soft to semi-consolidated deposits.	Piston provides for greater sample retention.	Cores must be extruded on-site to other containers. Metal barrels introduce risk of metal contamination.
Van Veen dredge	Deep lakes, rivers and estuaries. Useful on sand, silt, or clay.	Adequate on most substrates. Large sample obtained intact, permitting subsampling.	Shock wave from descent may disturb "fines." Possible incomplete closure of jaws results in sample loss. Possible contamination from metal frame construction. Sample must be further prepared for analysis.
BMH-60 grab sampler	Sampling moving waters from a fixed platform.	Streamlined configuration allows sampling where other devices could not achieve proper orientation.	Possible contamination from metal construction. Subsampling difficult. Not effective for sampling fine sediments.
Petersen grab sampler	Deep lakes, rivers and estuaries. Useful on most substrates.	Large sample; can penetrate most substrates.	Heavy. May require winch. No cover lid to permit subsampling. All other disadvantages of Ekman and Ponar.
Shipek grab sampler	Used primarily in marine waters and large inland lakes and reservoirs.	Sample bucket may be opened to permit subsampling. Retains fine- grained sediments effectively.	Possible contamination from metal construction. Heavy. May require winch.
Orange-Peel grab Smith-McIntyre grab	Deep lakes, rivers and estuaries. Useful on most substrates.	Designed for sampling hard substrates.	Loss of fines. Heavy. May require winch. Possible metal contamination.
Scoops Drag Buckets	Various environments, depending on depth and substrate.	Inexpensive, easy to handle.	Loss of fines on retrieval through water column.

FT 1000. GENERAL FIELD TESTING AND MEASUREMENT

Use the following SOPs in conjunction with FT 1000:

- FD 1000 Documentation Procedures
- FM 1000 Field Planning and Mobilization
- FS 1000 General Sampling Procedures
- FT 1100 through FT 3000 Specific Field Testing Procedures

1. INTRODUCTION

1.1. Scope and Applicability: SOPs FT 1100 to FT 3000 outline procedures to conduct field testing measurements and observations. They include the parameters that are measured *in-situ* or in a field-collected sample. Additionally some samples with allowable extended holding times may be collected for laboratory measurement, as described in the specific FT-series SOPs. Included in SOPs FT 1100 to FT 3000 are:

- FT 1100 Field Measurement of Hydrogen Ion Activity (pH)
- FT 1200 Field Measurement of Specific Conductance (Conductivity)
- FT 1300 Field Measurement of Salinity
- FT 1400 Field Measurement of Temperature
- FT 1500 Field Measurement of Dissolved Oxygen (DO)
- FT 1600 Field Measurement of Turbidity
- FT 1700 Field Measurement of Light Penetration (Secchi Depth and Transparency)
- FT 1800 Field Measurement of Water Flow and Velocity
- FT 1900 Continuous Monitoring with Installed Meters
- FT 2000 Field Measurement of Residual Chlorine
- FT 3000 Aquatic Habitat Characterization

1.2. Exclusions: **If proposed for experimental purposes, field-screening procedures employing techniques not addressed in these SOPs** must be submitted to the DEP site or project manager. Such procedures must be addressed for each program or project dealing specifically with the planning and design of sampling events. Data quality objectives for quantitative assessment preclude the use of field-screening procedures for regulatory purposes.

1.3. Expectations and Requirements:

1.3.1. In some cases, specific instruments are identified in the SOP, with detailed instruction provided on their use. If you are using a different instrument from that identified in the SOP, follow the manufacturer's instructions for assembly, operation, and maintenance.

1.3.2. When required, the FT-series SOPs outline the instrument specifications. A field instrument must meet the stated requirements.

1.3.3. The FT-Series SOPs specify the calibration requirements for each method. Although instruments may vary in configuration or operation, the specified calibration requirements must be met.

1.3.3.1. Where applicable to the FT-series SOP, use the minimum number of calibration standards specified.

1.3.3.2. Do not establish the lower limit of the quantitative calibration bracket with "zero" solutions, quality control blanks or reagent dilution water. . However, the user may set the zero point of the instrument according to the manufacturer's instructions, if applicable.

1.3.4. Ensure that all equipment is in proper working condition, calibrated, and that batteries are properly charged before using the equipment for field testing measurements.

1.3.5. If reagents or standards are prepared from stock chemicals, they must be analytical reagent grade or better. Some procedures may specify a higher grade or assay of reagent or standard.

1.4. Recommendations for Use of Grab Samples or *in situ* Field Testing Measurements:

1.4.1. Use *in situ* readings where practical for field measurements in surface water and wastewater.

1.4.2. Use *in situ* readings or flow-through containers for field measurements for groundwater stabilization during purging and for other applications where groundwater monitoring measurements are required.

1.4.3. If grab samples are collected for measurement where allowed in the individual FT-series SOP, measure samples within fifteen (15) minutes of collection when immediate analysis is specified per Table FS 1000-4 and FS 1000-5. Otherwise, analyze grab samples within the applicable holding times specified in Table FS 1000-4 and FS 1000-5.

2. MINIMUM CALIBRATION REQUIREMENTS:

2.1. Calibration Definitions: This section outlines the essential calibration concepts that must be applied to each field test. Specific requirements for calibration are addressed in the individual SOPs.

2.1.1. Initial Calibration (IC): The instrument or meter electronics are adjusted (manually or automatically) to a theoretical value (e.g., dissolved oxygen saturation) or a known value of a calibration standard.

2.1.2. Initial Calibration Verification (ICV): The instrument or meter calibration is checked or verified directly following initial calibration by measuring a calibration standard of known value as if it were a sample and comparing the measured result to the calibration acceptance criteria listed in the SOP.

2.1.3. Continuing Calibration Verification (CCV): The instrument or meter calibration is checked or verified by measuring a calibration standard of known value as if it were a sample and comparing the measured result to the calibration acceptance criteria listed in the SOP.

2.1.4. Chronological Calibration Bracket: The interval of time between verifications within which environmental sample measurements must occur. The instrument or meter is calibrated or verified before and verified after the time of environmental sample measurement(s).

2.1.5. Quantitative Calibration Bracket: The instrument or meter is calibrated or verified at two known values that encompass the range of observed environmental sample measurement(s).

2.1.6. Acceptance Criteria: The numerical limits within which calibration verifications are acceptable.

2.2. Calibration Activities: Specific calibration procedures are given in the individual SOPs.

2.2.1. Chronological Calibration Bracket:

2.2.1.1. Ensure that the field test result is preceded by an acceptable ICV or CCV and followed by an acceptable CCV.

2.2.1.2. Specific requirements for chronological bracketing are addressed in the individual FT-series SOPs.

2.2.2. Quantitative Calibration Bracket:

2.2.2.1. Choose two standards that bracket the range of sample measurements. These standards may be used for initial calibrations or for verifications.

2.2.2.2. Specific requirements for quantitative bracketing are addressed in the individual FT-series SOPs.

2.2.3. Initial Calibration: Calibrate if no initial calibration has been performed or if a calibration verification does not meet acceptance criteria. Do not reuse standards for initial calibrations.

2.2.4. Initial Calibration Verification:

2.2.4.1. Perform an ICV immediately after calibration. All ICVs must meet the calibration acceptance criteria specified in the applicable FT-series SOP. See Table FT 1000-1 for a list of acceptance criteria for the most common field testing procedures.

2.2.4.2. If an ICV fails to meet acceptance criteria, immediately recalibrate the instrument using the applicable initial calibration procedure or remove it from service.

2.2.5. Continuing Calibration Verification: Perform a CCV at no more than 24-hour intervals from previous verification, except where noted for individual FT-series SOPs.

2.2.5.1. If historically generated data demonstrate that a specific instrument remains stable for longer periods of time, the time interval between calibration verifications may be increased.

2.2.5.2. Base the selected time interval on the shortest interval that the instrument maintains stability. If CCVs consistently fail, shorten the time period between verifications or replace/repair the instrument.

2.2.5.3. All CCVs must meet the calibration acceptance criteria specified in the applicable FT-series SOP. See Table FT 1000-1 for a list of acceptance criteria for the most common field testing procedures.

2.2.5.4. If a CCV fails to meet acceptance criteria perform one or more of the following procedures as necessary:

- Reattempt the CCV again within the chronological bracket time interval without changing the instrument calibration. Do not perform maintenance, repair, or cleaning of the instrument or probe. Probes may be rinsed with analyte-free water or fresh verification standard. The CCV may be reattempted with a fresh aliquot of verification standard.
- Perform the initial calibration, perform an ICV, re-analyze the sample(s), and perform a CCV.
- Report all results between the last acceptable calibration verification and the failed calibration verification as estimated (report the value

with a "J"). Include a narrative description of the problem in the field notes.

2.2.5.5. For installed instruments that are used for continuous monitoring, see FT 1900.

2.2.5.6. For unattended instrument deployment, refer to FT 1000 sections 2.2.5.1-2.2.5.4.

2.2.6. Determining the Values of Secondary Standards: Use only those standards recommended by the manufacturer for a specific instrument. Only use secondary standards for continuing calibration verifications. See the individual FT-series SOPs for specific procedures for use of secondary standards. At documented intervals, determine or verify the values of secondary standards immediately after performing an initial calibration or after verifying the calibration with primary standards. Read each secondary standard as a sample. Compare the assigned or stated standard value with the reading. This reading must be within the manufacturer's stated tolerance range and the acceptance criterion required in the individual FT-series SOP. If the SOP criterion is not met, assign this reading as the new value of the secondary standard. If the reading is outside the manufacturer's stated tolerance range, discard the secondary standard.

2.2.7. **More frequent calibration verifications may be required for discharge permit compliance measurements or other regulatory requirements.**

3. PREVENTIVE MAINTENANCE: Record all maintenance and repair notes in the maintenance logbook for each meter (see FS 1007). If rental equipment is used, a log is not required. However, the origin (i.e., rental company), rental date, equipment type, model number, and identification number (if applicable) must be entered into the field notes or a rental equipment notebook.

4. DOCUMENTATION

4.1. Standard and Reagent Documentation: Document information about standards and reagents used for calibrations, verifications, and sample measurements.

4.1.1. Note the date of receipt, the expiration date and the date of first use for all standards and reagents.

4.1.1.1. Document acceptable verification of any standard used after its expiration date.

4.1.2. Record the concentration or other value for the standard in the appropriate measurement units.

4.1.2.1. Note vendor catalog number and description for pre-formulated solutions as well as for neat liquids and powdered standards.

4.1.2.2. Retain vendor assay specifications for standards as part of the calibration record.

4.1.3. Record the grade of standard or reagent used.

4.1.4. When formulated in-house, document all calculations used to formulate calibration standards.

4.1.4.1. Record the date of preparation for all in-house formulations.

4.1.5. Describe or cite the procedure(s) used to prepare any standards in-house (DEP SOP or internal SOP).

4.2. Field Instrument Calibration Documentation: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.

4.2.1. Retain vendor certifications of all factory-calibrated instrumentation.

4.2.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used.

4.2.2.1. Record the manufacturer name, model number, and identifying number such as a serial number for each instrument unit.

4.2.3. Record the time and date of all initial calibrations and all calibration verifications.

4.2.4. Record the instrument reading (value in appropriate measurement units) of all calibration verifications.

4.2.5. Record the name of the analyst(s) performing the calibration.

4.2.6. Document the specific standards used to calibrate or verify the instrument or field test with the following information:

- Type of standard or standard name (e.g., pH buffer)
- Value of standard, including correct units (e.g., pH = 7.0 SU)
- Manufacturer's tolerance range for secondary standards
- Link to information recorded according to section 4.1 above

4.2.7. Retain manufacturers' instrument specifications.

4.2.8. Document whether successful initial calibration occurred.

4.2.9. Document whether each calibration verification passed or failed.

4.2.10. Document any corrective actions taken to correct instrument performance according to records requirements of FD 3000.

4.2.10.1. Document the date and time of any corrective actions.

4.2.10.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.

4.2.11. Describe or cite the specific calibration or verification procedure performed (DEP SOP or internal SOP).

4.3. Record all field-testing measurement data, to include the following:

- Project name
- Date and time of measurement or test (including time zone, if applicable)
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
- Latitude and longitude of sampling source location (if required)
- Analyte or parameter measured
- Measurement or test sample value
- Reporting units
- Initials or name of analyst performing the measurement
- Unique identification of the specific instrument unit(s) used for the test(s)

Appendix FT 1000
Tables, Figures and Forms

Table FT 1000-1 Field Testing Acceptance Criteria

Table FT 1000-1: Field Testing Acceptance Criteria	
Parameter	**Acceptance Criteria**
pH (FT 1100)	**± 0.2 Standard pH Units of buffer or more stringent program criteria**
Specific Conductance (FT 1200)	**± 5% of standard value**
Temperature (FT 1400)	**± 0.5°C of NIST-traceable value (with correction factors)** **Verification over range of applicable values**
Dissolved Oxygen (FT 1500)	**± 0.3 mg/L of theoretical value (see Table FT 1500-1)**
Turbidity (FT 1600)	**0.1-10 NTU: ± 10% of standard value** **11-40 NTU: ± 8% of standard value** **41-100 NTU: ± 6.5% of standard value** **> 100 NTU: ± 5% of standard value**
Total Residual Chlorine (FT 2000)	**0.995 calibration curve correlation coefficient** **± 10% of primary standard value** **± 10% of secondary standard value** **Color comparator acceptance criterion: ± 10% of primary standard value**

FT 1100. Field Measurement of Hydrogen Ion Activity (pH)

Use in conjunction with:

- FT 1000 General Field Testing and Measurement
- FQ 1000 Field Quality Control Requirements
- FS 1000 General Sampling Procedures
- FD 1000 Documentation Procedures

1. Equipment and Supplies

1.1. Field Instrument: Use any pH meter consisting of a potentiometer, a glass electrode, a reference electrode, and a temperature-compensating device.

1.1.1. For routine fieldwork use a pH meter accurate and reproducible to at least 0.2-unit in the range of 0.0 to 14.0 units, and equipped with temperature-compensation adjustment. Record the pH value in pH units to one decimal place.

1.1.2. Advanced silicon chip pH sensors (with digital meters) may be used if demonstrated to yield equivalent performance to glass electrode sensors for the intended application.

1.2. Standards: Purchased or laboratory-prepared standard buffer solutions of pH values that bracket the expected sample pH range. Use buffers with nominal values of 4.0, 7.0 and 10.0 units for most situations. If the sample pH is outside the range of 4.0 to 10.0, then use two buffers that bracket the expected range with the pH 7 buffer being one of the two buffers. Alternatively, prepare appropriate standards per Table 4500-H^+:I in method SM4500-H^+-B (see Standard Methods for the Examination of Water and Wastewater (see Standard Methods Online, http://www.standardmethods.org/store/).

1.3. Recordkeeping and Documentation Supplies:

- Field notebook (w/ waterproof paper is recommended) or forms
- Indelible pens

2. Calibration and Use

2.1. General Concerns

2.1.1. The acceptance criterion for the initial calibration or the calibration verification is a reading of the standard within +/- 0.2-unit of the expected value.

2.1.2. On a weekly basis, check the calibration to ensure the % theoretical slope is greater than 90% (if applicable to your instrument type).

2.1.2.1. Note the % slope in the calibration records.

2.1.2.2. A % slope of less than 90% indicates a bad electrode that must be changed or repaired.

2.1.2.3. If % slope cannot be determined on your meter, or the manufacturer's optimum specifications are different, follow the manufacturer's recommendation for maintaining optimum meter performance.

2.2. Interferences

2.2.1. Sodium at pH $\geq$ 10.0 units can be reduced or eliminated by using a low sodium error electrode.

2.2.2. Coatings of oils, greases, and particles may impair the electrode's response. Pat the electrode bulb dry with lint-free paper or cloth and rinse with de-ionized water. For cleaning hard-to-remove films, use acetone very sparingly so that the electronic surface is not damaged.

2.2.3. Temperature effects on the electrometric measurement of pH are controlled by using instruments having temperature compensation or by calibrating the meter at the temperature of the samples.

2.2.4. Poorly buffered solutions with low specific conductance (< 200 μmhos/cm) may cause fluctuations in the pH readings. Equilibrate electrode by immersing in several aliquots of sample before taking pH.

2.2.5. Ensure stable sample and sensor temperature before calibrating or taking sample readings. Drifting sensor or sample temperature may produce erroneous sample measurements, calibrations, or verifications.

2.2.6. Thoroughly rinse the pH sensor with deionized water or fresh buffer standard when calibrating or verifying the calibration or when taking sample measurements. For in-situ measurements, ensure adequate flushing of the sensor with fresh sample water prior to taking measurements. Any residual standard, sample or deionized water remaining on the sensor may affect the measurement of the subsequent standard or sample. This is especially true when samples or standards of widely different pH value are successively measured.

2.2.7. Drifting readings or an inability to calibrate the sensor may also indicate a fouled electrode. Clean the electrode per the manufacturer's instructions or replace.

2.3. Calibration: Follow the manufacturer's calibration instructions specific to your meter. Most instruments allow for a two-point calibration and a few models can perform a three-point calibration. Use the appropriate number of standard buffer solutions for calibration. Do not reuse buffers for initial calibrations.

2.3.1. Rinse the probe with de-ionized water (DI) before and between each standard buffer solution.

2.3.2. Follow the calibration activities specified in FT 1000, section 2.2.

2.3.2.1. Perform an initial calibration using at least two buffers. Always use a pH 7 buffer first.

2.3.2.2. If the pH sample range is expected to be wider than the range established by a two-point calibration (e.g., some samples at pH 4 and others at pH 8), then add a third calibration point. If the instrument cannot be calibrated with three buffers, the third buffer may be used as the initial calibration verification to extend the range.

2.3.2.3. After initial calibration, immediately perform an initial calibration verification (ICV). Read a buffer as a sample. To be acceptable, a calibration verification must be within +/- 0.2 pH units of the stated buffer value. For example, if reading the pH 4.0 buffer, the result must be in the 3.8 to 4.2 range. Certain regulatory programs may have more stringent acceptance criteria.

2.3.2.4. After sample measurement(s), perform a continuing calibration verification (CCV). Read a buffer as a sample. To be acceptable, a calibration verification must be within +/- 0.2 pH units of the stated buffer value. This CCV (if within acceptance criteria) can be used as the beginning of the chronological bracket. Certain regulatory programs may have more stringent acceptance criteria.

2.4. Measuring pH *in situ*: After calibrating the multi-probe sensors as outlined in 2.3 above, follow the meter's instructions to select the display for reading the pH of the

sample. Immerse the probe at the desired depth in the water and wait for stabilization of the reading before recording the measurement.

2.5. Measuring pH in Flow-through Cells: When using a flow-through cell, the procedure described above in section 2.4 is applicable.

2.6. Measuring pH in Samples: After an acceptable initial calibration or calibration verification, follow these procedures to take a pH reading of a freshly collected sample (within 15 minutes of collection).

2.6.1. Pour enough of the fresh sample into a clean cup to take the reading.

2.6.2. Place the pH electrode in the sample (in the cup) and swirl the electrode.

2.6.3. Wait for stabilization, and read the pH value.

2.6.4. Turn the meter off after the last sample reading, rinse the electrode thoroughly with de-ionized water and replace the electrode's cap.

3. PREVENTIVE MAINTENANCE: Refer to FT 1000, section 3.

4. DOCUMENTATION

4.1. Standard and Reagent Documentation: Document information about standards and reagents used for calibrations, verifications, and sample measurements.

4.1.1. Note the date of receipt, the expiration date and the date of first use for all standards and reagents.

4.1.1.1. Document acceptable verification of any standard used after its expiration date.

4.1.2. Record the concentration or other value for the standard in the appropriate measurement units.

4.1.2.1. Note vendor catalog number and description for preformulated solutions as well as for neat liquids and powdered standards.

4.1.2.2. Retain vendor assay specifications for standards as part of the calibration record.

4.1.3. Record the grade of standard or reagent used.

4.1.4. When formulated in-house, document all calculations used to formulate calibration standards.

4.1.4.1. Record the date of preparation for all in-house formulations.

4.1.5. Describe or cite the procedure(s) used to prepare any standards in-house (DEP SOP or internal SOP).

4.2. Field Instrument Calibration Documentation: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.

4.2.1. Retain vendor certifications of all factory-calibrated instrumentation.

4.2.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used.

4.2.2.1. Record manufacturer name, model number, and identifying number such as a serial number for each instrument unit.

4.2.3. Record the time and date of all initial calibrations and all calibration verifications.

4.2.4. Record the instrument reading (value in appropriate measurement units) of all calibration verifications.

4.2.5. Record the name of the analyst(s) performing the calibration.

4.2.6. Document the specific standards used to calibrate or verify the instrument or field test with the following information:

- Type of standard or standard name (e.g., pH buffer)
- Value of standard, including correct units (e.g., pH = 7.0 SU)
- Link to information recorded according to section 4.1 above

4.2.7. Retain manufacturers' instrument specifications.

4.2.8. Document whether successful initial calibration occurred.

4.2.9. Document whether each calibration verification passed or failed.

4.2.10. Document any corrective actions taken to correct instrument performance according to records requirements of FD 3000.

4.2.10.1. Document date and time of any corrective action.

4.2.10.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.

4.2.11. Describe or cite the specific calibration or verification procedure performed (DEP SOP or internal SOP).

4.3. Record all field-testing measurement data, to include the following:

- Project name
- Date and time of measurement or test (including time zone, if applicable)
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
- Latitude and longitude of sampling source location (if required)
- Analyte or parameter measured
- Measurement or test sample value
- Reporting units
- Initials or name of analyst performing the measurement
- Unique identification of the specific instrument unit(s) used for the test(s)

FT 1200. Field Measurement of Specific Conductance (Conductivity)

Use in conjunction with:

- FT 1000 General Field Testing and Measurement
- FQ 1000 Field Quality Control Requirements
- FS 1000 General Sampling
- FD 1000 Documentation Procedures

1. INTRODUCTION: Specific conductance is a useful method to approximate the total amount of inorganic dissolved solids.

1.1. Conductivity varies with temperature. For example, the conductivity of salt water increases 3%/degree C at 0°C, and only 2%/degree C at 25°C.

1.2. Record the sample temperature or adjust the temperature of the samples prior to measuring specific conductance if the conductivity instrument does not employ automatic temperature compensation and correction of the instrument display value.

2. EQUIPMENT AND SUPPLIES

2.1. Field Instrument: Any self-contained conductivity instrument suitable for field work, accurate and reproducible to 5% or better over the operational range of the instrument, and preferably equipped with temperature-compensation adjustment. See references in FT 1210 below for additional information about instruments.

2.2. Standards: Purchased or laboratory-prepared standard potassium chloride (KCl) solutions with conductivity values that bracket the expected samples' range. In the laboratory, prepare standards of appropriate conductivities per method 2510, *Conductivity*, in *Standard Methods for the Examination of Water and Wastewater, 2011* (see Standard Methods Online, http://www.standardmethods.org/store/). Do not reuse standards for initial calibrations.

2.3. Recordkeeping and Documentation Supplies:

- Field notebook (w/ waterproof paper is recommended) or forms
- Indelible pens

3. CALIBRATION AND USE

3.1. General Concerns

3.1.1. **Follow the instrument manufacturer's instructions for the details of operating the instrument.**

3.1.2. For instruments without automatic temperature compensation, attempt to adjust the temperature of the samples to 25°C. If the temperature cannot be adjusted, measure the temperature with a calibrated device (see FT 1400), record the temperature, correct for temperature (per section 3.4 below) and report the results corrected to 25°C. See references in FT 1210 below for further information about temperature correction.

3.1.3. Ensure stable sample and sensor temperature before calibrating or taking sample readings. Drifting sensor or sample temperature may produce erroneous sample measurements, calibrations or verifications.

3.1.4. Thoroughly rinse the conductivity sensor with deionized water and fresh standard when calibrating or verifying the calibration or when taking sample measurements. For in-situ measurements, ensure adequate flushing of the sensor with fresh sample water

prior to taking measurements. Any residual standard, sample or deionized water remaining on the sensor may affect the measurement of the subsequent standard or sample. This is especially true when samples or low-concentration standards are measured subsequent to measuring high-concentration standards.

3.1.5. Drifting readings or an inability to calibrate the sensor may also indicate a fouled electrode. Clean the electrodes per the manufacturer's instructions.

3.1.6. When successful calibration and verification cannot be achieved after ensuring that temperatures have stabilized and the sensor electrodes are clean and free of residual sample or standard from the previous measurement, suspect opened containers of standards, especially after repeated openings, when near the manufacturer's expiration date or when little standard volume remains in the container. Low-concentration conductivity standards are seldom stable for an extended period after opening.

3.2. Calibration and Calibration Verification:

3.2.1. Follow the calibration activities specified in FT 1000, section 2.2.1 – 2.2.7.

3.2.2. Initial Calibration: Calibrate the meter prior to use according to the following steps:

3.2.2.1. **Calibrate according to the manufacturers recommendations.**

3.2.2.2. When the sample measurements are expected to be 100 μmhos/cm or greater, use two standard potassium chloride solutions that bracket the range of expected sample conductivities. A single standard at 100 μmhos/cm standard potassium chloride solution is acceptable for situations in which all sample measurements are expected to be less than 100 μmhos/cm. See also FT 1000 section 1.3.3.2.

3.2.2.3. Calibrate the instrument with one of the two standards to create an upper or lower boundary for the quantitative bracket.

3.2.2.4. Verify the calibration of the instrument with the second standard, quantitatively bracketing the range of expected sample values.

3.2.2.5. If the instrument can be calibrated with more than one standard, choose additional calibration standards within the range of expected sample values. The second standard in section 3.2.2.3 above may be used as an additional calibration standard.

3.2.2.6. Note: If all samples are expected to be less than 100 μmhos/cm, only one standard at 100 μmhos/cm standard potassium chloride solution is required.

3.2.3. Acceptability: Accept the calibration if the meter reads within +/- 5% of the value of any calibration standard used to verify the calibration. For example, the acceptance range for a 100 μmhos/cm standard is 95 to 105 μmhos/cm. If the meter does not read within +/- 5% of each calibration verification standard, determine the cause of the problem and correct before proceeding.

3.2.4. Temperature Correction: Most field instruments read conductivity directly. If the meter does not automatically correct values to 25°C, calculate correction factors using the procedure in section 3.4 below. Record all readings and calculations in the calibration records.

3.2.5. Continuing Calibration Verification: Check the meter in read mode with at least one KCl standard with a specific conductance that quantitatively brackets the conductivity measured in environmental samples. The reading for the calibration verification must also be within +/- 5% of the standard value (see 3.2.3 above).

3.2.5.1. If new environmental samples are encountered outside the range of the initial calibration in 3.2.2 above, verify the instrument calibration with an additional standard that brackets the range of new sample values. If these calibration verifications fail, recalibrate the instrument as in 3.2.2.

3.2.5.2. **More frequent calibration verifications may be required for discharge permit compliance measurements or other regulatory requirements.**

3.3. Measuring Specific Conductance of Samples:

3.3.1. Follow manufacturer's instructions for sample measurement.

3.3.2. Immerse or place the conductivity probe or sensor in situ at a measuring location representative of the sampling source.

3.3.3. Allow the conductivity instrument to stabilize.

3.3.4. Measure the water temperature (if necessary for manual temperature compensation) and record the temperature. See FT 1400 for temperature measurement procedures.

3.3.5. If the meter is equipped with manual temperature compensation, adjust the conductivity meter to the water temperature per manufacturer's instructions.

3.3.6. If the conductivity meter has a set of positions that multiply the reading by powers of ten in order to measure the full range of potential conductivities, set this dial to the correct range in order to take a reading.

3.3.7. Record the sample conductivity measurement reading within 15 minutes of water sample collection.

3.3.8. Rinse off the probe with de-ionized water. Follow manufacturer's instructions for probe storage between use.

3.4 Calculations for Temperature Compensation

If the meter does not automatically correct for temperature (manual or automatic adjustment), or if a probe with a cell constant other than 1 is used, the following formula must be used to normalize the data to 25°C:

$$K = \frac{(K_m)(C)}{1 + 0.0191(T-25)}.$$

Where: K = conductivity in μmhos/cm at 25°C

K_m = measured conductivity in μmhos/cm at T degrees C

C = cell constant

T = measured temperature of the sample in degrees C

If the cell constant is 1, the formula for determining conductivity becomes:

$$K = \frac{(K_m)}{1 + 0.0191(T-25)}.$$

Refer to SM2510B, 20th edition, if other calculations (i.e., determining cell constant, etc.) are required. See FT 1210 below.

3.5 *In situ* Measurements at Depth or With Flow-through Cells: After calibrating the instrument as outlined in 3.2 above, **follow the manufacturer's instructions** to measure the conductivity of the sample.

3.5.1. For *in situ* measurements immerse the probe at the desired depth and wait for stabilization of the reading and record its value. Follow a similar procedure when using a flow-through cell.

3.5.1.1 Preferably measure groundwater sample conductivity *in situ* with a downhole probe or in a flow-through system.

4. PREVENTATIVE MAINTENANCE: Refer to FT 1000, section 3.

5. DOCUMENTATION

5.1. Standard and Reagent Documentation: Document information about standards and reagents used for calibrations, verifications and sample measurements.

5.1.1. Note the date of receipt, the expiration date and the date of first use for all standards and reagents.

5.1.1.1. Document acceptable verification of any standard used after its expiration date.

5.1.2. Record the concentration or other value for the standard in the appropriate measurement units.

5.1.2.1. Note vendor catalog number and description for preformulated solutions as well as for neat liquids and powdered standards.

5.1.2.2. Retain vendor assay specifications for standards as part of the calibration record.

5.1.3. Record the grade of standard or reagent used.

5.1.4. When formulated in-house, document all calculations used to formulate calibration standards.

5.1.4.1. Record the date of preparation for all in-house formulations.

5.1.5. Describe or cite the procedure(s) used to prepare any standards in-house (DEP SOP or internal SOP).

5.2. Field Instrument Calibration Documentation: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.

5.2.1. Retain vendor certifications of all factory-calibrated instrumentation.

5.2.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used.

5.2.2.1. Record manufacturer name, model number, and identifying number such as a serial number for each instrument unit.

5.2.3. Record the time and date of all initial calibrations and all calibration verifications.

5.2.4. Record the instrument reading (value in appropriate measurement units) of all calibration verifications.

5.2.5. Record the name of the analyst(s) performing the calibration.

5.2.6. Document the specific standards used to calibrate or verify the instrument or field test with the following information:

- Type of standard or standard name (e.g., conductivity standard)
- Value of standard, including correct units (e.g., conductivity = 100 µmhos/cm)
- Link to information recorded according to section 5.1 above

5.2.7. Retain manufacturers' instrument specifications.

5.2.8. Document whether successful initial calibration occurred.

5.2.9. Document whether each calibration verification passed or failed.

5.2.10. Document any corrective actions taken to correct instrument performance according to records requirements of FD 3000.

5.2.10.1. Document date and time of any corrective action.

5.2.10.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.

5.2.11. Describe or cite the specific calibration or verification procedure performed (DEP SOP or internal SOP).

5.3. Record all field-testing measurement data, to include the following:

- Project name
- Date and time of measurement or test (including time zone, if applicable)
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
- Latitude and longitude of sampling source location (if required)
- Analyte or parameter measured
- Measurement or test sample value
- Reporting units
- Initials or name of analyst performing the measurement
- Unique identification of the specific instrument unit(s) used for the test(s)

FT 1300. Field Measurement of Salinity

Use in conjunction with:

- FT 1000 General Field Testing and Measurement
- FQ 1000 Field Quality Control Requirements
- FS 1000 General Sampling Procedures
- FD 1000 Documentation Procedures

1. INTRODUCTION: Salinity is an important property of industrial and natural waters. This field parameter is also important for assessing the source or origin of effluents and of the mixing between fresh and marine waters in coastal regions, in both surface water and groundwater.

1.1. Salinity is a unit-less parameter since by definition it is the ratio of the mass of dissolved salts to the total mass of a given volume of water. Thus, salinity values are commonly expressed as "grams of salt/kilograms of water" or $^{o}/_{oo}$.

1.2. Salinity is determined by using indirect methods involving the measurement of a related physical property such as conductivity, density, sound speed, or refractive index. The commonly used procedures in the field are determination of conductivity or density of the sample.

1.3. The sample salinity is calculated from an empirical relationship between salinity and the physical property as determined from a standard solution. Refer to the referenced method SM 2520 (2011) for further discussions on these topics.

1.4. Because of its high sensitivity and easy of measurement, the conductivity method is most often used to determine the salinity. (Note – using a hydrometer to measure the density or the specific gravity to obtain an approximate salinity value is not recommended for reporting purposes.)

2. EQUIPMENT AND SUPPLIES

2.1. Field Instrument: Depending on the chosen method, use:

2.1.1. Any self-contained conductivity instrument with a platinum or graphite electrode type cell, and a temperature sensor. Some conductivity instruments have meter scales pre-calibrated for salinity and are sometimes referred to as Salinometers. For routine fieldwork use a conductivity meter accurate and reproducible to at least 5% or 1 μmho/cm (whichever is greater), and equipped with temperature-compensation adjustment; or

2.1.2. A precision "vibrating flow densimeter" and a field thermometer. For informational purposes, see Millero & Poisson, 1981a, International one-atmosphere equation of state of seawater. *Deep-Sea Research* 28:625–629.

2.2. Standards:

2.2.1. Purchased or laboratory-prepared Standard Seawater and/or potassium chloride (KCl) standards of appropriate equivalent salinities.

2.2.1.1. See methods 2510, *Conductivity*, and 2520, *Salinity* (2011 versions), in Standard Methods for the Examination of Water and Wastewater (see Standard Methods Online, http://www.standardmethods.org/store/).

2.2.2. De-ionized water for calibration of the densimeter (if used).

2.3. Recordkeeping and Documentation Supplies:

- Field logbook (w/ waterproof paper is recommended) or field forms
- Indelible pens

3. CALIBRATION AND USE

3.1. Conductivity Method

3.1.1. Calibration: - Calibrate the instrument per manufacturer's instructions using one calibration standard, either standard seawater or a KCl solution, as applicable, or follow the manufacturer's specific instructions. The acceptance criterion for initial calibration or a calibration verification is that the instrument reading is within +/- 5% of the standard value. For example, when calibrating with standard seawater, S = 35, the meter must read in the 34 to 36 range in order to be acceptable.

3.1.1.1. Use standard seawater (S = 35) when measuring salinity in the open ocean or estuaries with a predominance of seawater.

3.1.1.2. KCl may be used in estuarine waters with low salinity (S = 0 – 40).

3.1.1.3. If verifying or calibrating with a "zero" standard, do not use analyte-free water or air check (dry electrode) as the blank. However, the user may set the zero point of the instrument according to the manufacturer's instructions, if applicable.

3.1.1.4. If the meter does not provide a direct reading of salinity, use the equation found in SM 2520B (2011) to convert the readings to salinity.

3.1.1.5. Follow the calibration activities in FT 1000, section 2.2.

3.1.1.6. Do not reuse standards for initial calibrations.

3.1.2. Field Use: - Rinse the probe with DI water after calibration, verification and before each sample measurements. Follow the manufacturer's instructions for temperature compensation, if needed. Report salinities with only one decimal figure.

3.1.3. General Concerns for Conductivity Method

3.1.3.1. Ensure stable sample and sensor temperature before calibrating or taking sample readings. Drifting sensor or sample temperature may produce erroneous sample measurements, calibrations, or verifications.

3.1.3.2. Thoroughly rinse the conductivity (salinity) sensor with deionized water and fresh standard when calibrating or verifying the calibration or when taking sample measurements. For in-situ measurements, ensure adequate flushing of the sensor with fresh sample water prior to taking measurements. Any residual standard, sample, or deionized water remaining on the sensor may affect the measurement of the subsequent standard or sample. This is especially true when samples or low-concentration standards are measured subsequent to measuring high-concentration standards.

3.1.3.3. Drifting readings or an inability to calibrate the sensor may also indicate a fouled electrode. Clean the electrodes per the manufacturer's instructions.

3.1.3.4. When successful calibration and verification cannot be achieved after ensuring that temperatures have stabilized and the sensor electrodes are clean and free of residual sample or standard from the previous measurement, suspect opened containers of standards, especially after repeated openings, when near the manufacturer's expiration date or when little standard volume remains in the container. Low-concentration conductivity standards are seldom stable for an extended period after opening.

3.2. Density Method

The vibrating flow densimeter is an instrument that allows for precise and rapid measurements of the density of a liquid, such as water. The principle of operation is the effect of the density of the sample on the frequency of a vibrating tube encased in a constant-temperature jacket. The measurement is made by passing the water (sample) through the vibrating tube and reading the period of vibration that is electronically sensed and displayed by the densimeter. The sample density (D) is proportional to the square of the period of vibration (T):

$$D = a + bT^2$$

Where a and b are terms determined by calibration, b being determined by calibration of the densimeter with Standard Seawater. The difference between the density of the sample (D) and that of pure water (D_0) is given by:

$$D - D_0 = b\,(T^2 - T_0^2)$$

Where T and T_0 are, respectively, the periods of the sample and that of pure (de-ionized) water. Using this second equation, you only have to deal with the term b for calibration purposes. Hence, the system can be calibrated with two liquids: pure water and Standard Seawater. Follow the manufacturer's instruction for calibration of the densimeter.

The salinity of the sample is determined by the one-atmosphere international equation of state for seawater. This equation relates the difference ($D - D_0$) to the practical salinity as a function of the temperature of the sample (which is also measured by the densimeter or the field thermometer). For further details on this calculation read the referenced method SM 2520C (2011).

4. PREVENTIVE MAINTENANCE: Refer to FT 1000, section 3.

5. DOCUMENTATION

5.1. Standard and Reagent Documentation: Document information about standards and reagents used for calibrations, verifications, and sample measurements.

5.1.1. Note the date of receipt, the expiration date and the date of first use for all standards and reagents.

5.1.1.1. Document acceptable verification of any standard used after its expiration date.

5.1.2. Record the concentration or other value for the standard in the appropriate measurement units.

5.1.2.1. Note vendor catalog number and description for preformulated solutions as well as for neat liquids and powdered standards.

5.1.2.2. Retain vendor assay specifications for standards as part of the calibration record.

5.1.3. Record the grade of standard or reagent used.

5.1.4. When formulated in-house, document all calculations used to formulate calibration standards.

5.1.4.1. Record the date of preparation for all in-house formulations.

5.1.5. Describe or cite the procedure(s) used to prepare any standards in-house (DEP SOP or internal SOP).

5.2. Field Instrument Calibration Documentation: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.

5.2.1. Retain vendor certifications of all factory-calibrated instrumentation.

5.2.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used.

5.2.2.1. Record manufacturer name, model number, and identifying number such as a serial number for each instrument unit.

5.2.3. Record the time and date of all initial calibrations and all calibration verifications.

5.2.4. Record the instrument reading (value in appropriate measurement units) of all calibration verifications.

5.2.5. Record the name of the analyst(s) performing the calibration.

5.2.6. Document the specific standards used to calibrate or verify the instrument or field test with the following information:

- Type of standard or standard name (e.g., salinity standard)
- Value of standard, including correct units (e.g., salinity = 20 $^{o}/_{oo}$)
- Link to information recorded according to section 5.1 above

5.2.7. Retain manufacturers' instrument specifications.

5.2.8. Document whether successful initial calibration occurred.

5.2.9. Document whether each calibration verification passed or failed.

5.2.10. Document any corrective actions taken to correct instrument performance according to records requirements of FD 3000.

5.2.10.1. Document date and time of any corrective action.

5.2.10.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.

5.2.11. Describe or cite the specific calibration or verification procedure performed (DEP SOP or internal SOP).

5.3. Record all field-testing measurement data, to include the following:

- Project name
- Date and time of measurement or test (including time zone, if applicable)
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
- Latitude and longitude of sampling source location (if required)
- Analyte or parameter measured
- Measurement or test sample value
- Reporting units
- Initials or name of analyst performing the measurement
- Unique identification of the specific instrument unit(s) used for the test(s)

FT 1400. Field Measurement of Temperature

The use of this SOP is not required when using field temperature measurement devices to monitor groundwater stabilization during the purging of groundwater monitoring wells. Field temperature measurement devices installed for automatic temperature compensation (correction) for other measurements such as dissolved oxygen, specific conductance or pH are also exempted from the requirements of this SOP. FT 1400 must be used for all other field temperature measurements required by DEP.

Use this SOP in conjunction with the following DEP SOPs:

- FT 1000 General Field Testing and Measurement
- FQ 1000 Field Quality Control Requirements
- FS 1000 General Sampling Procedures
- FD 1000 Documentation Procedures

1. EQUIPMENT AND SUPPLIES

1.1. Field Instruments: Use any of the following instrument types for performing field measurements:

- Digital thermistor (thermocouple type) and meter typical of field instruments
- Glass bulb, mercury-filled thermometer (not recommended for field ruggedness)
- Glass bulb, alcohol-filled thermometer with protective case
- Bi-metal strip/dial-type thermometer
- Advanced silicon chip temperature sensor and digital meter

1.1.1. Field instruments must be capable of measuring temperature in 0.1°C increments.

1.2. Standard Thermometer: NIST-traceable Celsius certified thermometer with scale marks for every 0.1°C increment, a range of 0°C to 100°C (or a range bracketing expected sample temperatures) and correction chart supplied with certification. The standard thermometer must have a valid certification for the period of measurement.

1.3. Recordkeeping and Documentation Supplies:

- Field notebook or forms
- Indelible pens

2. CALIBRATION AND USE

2.1. General Concerns

2.1.1. Select a temperature measuring device meeting the requirements of section 1.1 above.

2.1.2. Dial-type and thermocouple-type devices with meters are preferred over the glass thermometers for fieldwork because of their durability and ease of reading.

2.1.2.1. Transport glass thermometers in protective cases.

2.1.2.2. Inspect glass thermometers for liquid separation. Do not use a thermometer if the liquid has separated.

2.1.2.3. Most instruments with digital display will provide more decimal figures than are significant. Record the temperature reading with only one rounded decimal figure (e.g., 25.9 instead of 25.86°C).

2.2. Calibration

2.2.1. Follow the calibration activities specified in FT 1000, section 2.2.

2.2.2. Verify all thermistor (meter) devices and field thermometers against the NIST-traceable standard thermometer at several temperatures in the expected sample measurement range, using any correction factor indicated by the certificate supplied with the NIST-traceable thermometer.

2.2.2.1. See the US Geological Survey, National Field Manual for the Collection of Water-Quality Data, Book 9, Chapter A6, Field Measurements, Section 6.1, Temperature, Techniques of Water-Resources Investigations, Version 2, 3/2006 for additional guidance about making temperature comparisons with the standard thermometer.

2.2.2.2. Make note of the calibration in the calibration records. See section 4 below.

2.2.2.3. The field measurement device may be used with a linear correction factor provided that the observed temperature difference with the standard thermometer is documented at incremental temperatures over the range of expected sample temperatures.

2.2.2.4. Use the resulting correction factor when making temperature measurements of samples with the field measurement device.

2.2.2.5. Prominently display the correction factor on the field measurement device, with the date last verified. A calibration correction curve or plot may also be used.

2.2.2.6 To be acceptable, a calibration verification must be within +/- 0.5^{o}C of the corrected reading of the NIST-traceable thermometer.

2.2.2.7 Properly dispose of glass-bulb thermometers that do not meet the above calibration acceptance criteria.

2.2.3. Continuing Calibration Verifications:

2.2.3.1. Determine the maximum time between continuing calibration verifications for the specific field temperature measurement device based on instrument stability.

2.2.3.2. Verify the field measurement device against the standard NIST-traceable thermometer as in section 2.2.2 above.

2.2.4. Refer to additional calibration requirements in FT 1000, section 2.2.

2.2.5. **More frequent calibration verifications may be required for discharge permit compliance measurements or other regulatory requirements.**

2.3. Measuring Sample Temperature

2.3.1. Insert or place the thermometer or sensor *in situ* at a measuring location representative of the sampling source.

2.3.2. Allow the thermometer or temperature sensor to equilibrate to ambient *in situ* temperature.

2.3.2.1. Groundwater samples must be measured *in situ* with a downhole probe or in a flow-through container. Do not measure bailed or pumped samples in an intermediate container containing static sample.

2.3.3. Record the temperature to the nearest 0.1^{o}C after the reading stabilizes and remains constant.

3. PREVENTIVE MAINTENANCE: Refer to FT 1000, section 3.

4. DOCUMENTATION

4.1. Standards Documentation: Document information about the NIST-traceable standard thermometer in the calibration record, including:

- Unique identification for the thermometer
- Vendor certificate of calibration, including any correction factor
- Vendor's expiration date for the certificate of calibration

4.2. Field Instrument Calibration Documentation: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.

4.2.1. Retain vendor certifications of all factory-calibrated instrumentation.

4.2.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used.

4.2.2.1. Record manufacturer name, model number, and identifying number such as a serial number for each instrument unit.

4.2.3. Record the time and date of all initial calibrations and all calibration verifications.

4.2.4. Record the instrument reading (value in appropriate measurement units) of all calibration verifications.

4.2.5. Record the name of the analyst(s) performing the calibration.

4.2.6. Document the following information about initial calibration and calibration verifications and link to information recorded according to section 4.1 above:

- Details of the method used to compare the field measurement device to the NIST-traceable standard thermometer.
- Results of each calibration verification, including the expected reading (per the NIST-traceable standard thermometer)
- The actual reading of the field measurement device, using any established correction factors and correct units.

4.2.7. Retain manufacturers' instrument specifications.

4.2.8. Document whether successful initial calibration occurred.

4.2.9. Document whether each calibration verification passed or failed.

4.2.10. Document any corrective actions taken to correct instrument performance (such as a new correction factor) according to records requirements of FD 3000.

4.2.10.1. Document date and time of any corrective action.

4.2.10.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.

4.2.11. Describe or cite the specific calibration or verification procedure performed (DEP SOP or internal SOP).

4.3. Record all field-testing measurement data, to include the following:

- Project name
- Date and time of measurement or test (including time zone, if applicable)
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
- Latitude and longitude of sampling source location (if required)

- Analyte or parameter measured
- Measurement or test sample value
- Reporting units
- Initials or name of analyst performing the measurement
- Unique identification of the specific instrument unit(s) used for the test(s)

FT 1500. Field Measurement of Dissolved Oxygen (DO)

Use in conjunction with:

- FT 1000 General Field Testing and Measurement
- FS 1000 General Sampling Procedures
- FD 1000 Documentation Procedures

1. EQUIPMENT AND SUPPLIES

1.1. Field Instruments

1.1.1. Membrane-type polarographic or galvanic electrode DO sensor with dedicated meter or configured with multi-parameter sonde

1.1.2. Luminescence-based DO sensor with dedicated meter or configured with multi-parameter sonde (see ASTM International, Standard Test Methods for Dissolved Oxygen in Water, Test Method C, - Luminescence-based Sensor, D 888-12e1, 2012).

1.1.3. Select instrument assemblies that provide minimum precision of +/- 0.2 mg DO/L and a minimum accuracy of +/- 0.2 mg DO/L.

1.1.4. Compensate for temperature dependence of DO measurements by using instruments employing automatic temperature compensation or by manually correcting measurements in accordance with method 4500-O, Oxygen (Dissolved), 2011, in Standard Methods for the Examination of Water and Wastewater (see Standard Methods Online, http://www.standardmethods.org/store/).

1.1.4.1. Calibrate on-board temperature sensors as described in FT 1400.

1.2. Standards

1.2.1. NIST-traceable Celsius thermometer with a scale marked for every 0.1°C and a range of 0 to 100°C.

1.2.2. Access to an organization with capability to perform the Winkler titration procedure is recommended but not mandatory.

1.2.3. A "zero-DO standard", prepared on-site with an aliquot of the sample water, is optional. Prepare by adding excess sodium sulfite and a trace of cobalt chloride to bring the DO to zero.

1.3. Recordkeeping and Documentation Supplies:

- Field notebook (w/ waterproof paper is recommended) or forms
- Indelible pens

2. CALIBRATION AND USE: the electrode method is predominantly used *in-situ* for dissolved oxygen determinations.

2.1. General Concerns

2.1.1. Turbulence is necessary to keep a constant flow of water across the membrane-sample interface. Make sure the appropriate mechanism is working before using the probe.

2.1.2. Follow instrument manufacturer's instructions for probe storage. For example, store the probe with a cover that creates a saturated atmosphere. A cap, with a wet sponge in it, will suffice for single-parameter probes. If the sensor is in a multi-probe device, keep the protective cap chamber moist during storage.

2.1.3. Before mobilizing, check to make sure there are no bubbles beneath the probe membrane, or any wrinkles or tears in the probe membrane. If so, replace the membrane and KCL solution. Follow manufacturers recommendation for conditioning

newly installed membranes in order to ensure stable readings. Check the leads, contacts, etc. for corrosion and/or shorts if meter pointer remains off-scale, does not calibrate, or drifts.

2.1.4. Dissolved inorganic salts interfere with the performance of DO probes. For example, DO readings in salt water are affected by the salinity and must be corrected. The DO meter may adjust automatically based on readings taken from the specific conductivity/salinity probe. If corrections are not automatic the appropriate calculations must be used to correct for salinity. If automatic adjustments are used the specific conductivity/salinity probe calibration must be verified or calibrated in accordance with FT1200.

2.1.5. Reactive gases, which pass through the membrane, may interfere. For example, chlorine will depolarize the cathode and cause a high probe output. Long-term exposures to chlorine will coat the anode with the chloride of the anode metal and eventually desensitize the probe. Sulfide (from H_2S) will undergo oxidation if high enough potential (voltage) is applied, creating current flow, yielding faulty readings. If such interferences are suspected, change the membrane electrode more frequently and calibrate at more frequent intervals.

2.1.6. Ensure that the temperature of the sensor and sample are stable. Unstable temperatures will produce erroneous calibrations, verifications or sample measurements.

2.1.7. Erroneous calibrations or verifications may result if the saturated air chamber is not vented to atmospheric pressure, properly humidified and protected from temperature fluctuations produced by common field conditions such as evaporation or fluctuation in sunlight intensity.

2.2. Follow the quality control requirements for calibration (see activities in FT 1000, section 2.2).

2.3. Initial Calibration and Initial Calibration Verification

2.3.1. Air Calibration and Initial Calibration Verification (ICV): Calibrate the meter at 100% saturation. Before use, verify the meter calibration in water-saturated air to make sure it is properly calibrated and operating correctly. Make a similar verification at the end of the day, sampling event or at other appropriate intervals. **Follow the manufacturer's instructions for operation of a ~~-~~specific instrument.**

2.3.1.1. Allow an appropriate warm up period before initial ~~-~~calibration or verification.

2.3.1.2. Wet the inside of the calibration chamber with water, pour out the excess water (leave a few drops), wipe any droplets off the membrane/sensor and insert the sensor into the chamber (this ensures 100% humidity).

2.3.1.3. Allow adequate time for the DO sensor and the air inside the calibration chamber to equilibrate.

2.3.1.4. Once the probe/calibration chamber is stable at ambient temperature, check the air temperature and determine, from the DO versus temperature table, what the DO saturation value should be at the observed temperature (see Table FT 1500-1, below). A stable and accurate temperature is required for a valid calibration. The acceptance criterion for DO calibration verification is +/- 0.3 mg DO/L at the observed temperature of the verification.

2.4. Continuous Calibration Verification

2.4.1. Air-Calibration Verification: DO sensor or instrument is calibrated against air that is saturated with water at a known temperature and ambient atmospheric pressure. Use Table FT 1500-1 below to verify calibration at specified temperature.

2.4.1.1. Wet the inside of the calibration chamber with water, pour out the excess water (leave a few drops) and insert the sensor into the chamber (this ensures 100-percent humidity)

2.4.1.2. Allow adequate time for the DO sensor and the air inside the calibration chamber to equilibrate.

2.4.1.3. Measure the temperature in the calibration chamber and observe the readings until the instrument stabilizes.

2.4.1.4. Use the oxygen solubility Table FT 1500-1 below to determine the DO saturation at a measured temperature and atmospheric pressure. Calculate values to the nearest tenth degree by interpolation or use an expanded version of this table found in FS 2200, which provides saturation data in 0.1 ^{o}C increments for a selected temperature range (see Table FS 2200-2).

2.4.1.5. Compare DO meter reading with value obtained from Table FT 1500-1 below to verify continuous calibration.

2.5. Additional Verifications: The following methods may be used as additional checks to verify calibration. These additional checks may be required as part of a specific permit.

2.5.1. Winkler method: This check is useful to assess the condition of the DO sensor (i.e., its degradation with time/use) and that the instrument can still maintain a valid calibration (see method 4500-O C).

2.5.1.1. **Perform the Winkler method when required by permit or other regulation at the required calendar frequency.**

2.5.1.2. For an accuracy calibration verification using the Winkler method, follow method 4500-O C.

2.5.1.3. Fill a clean bucket with uncontaminated or de-ionized water and place the probe into the bucket (with stirrer or equivalent mechanism turned off). Fill at least two biological oxygen demand (BOD) bottles without entraining atmospheric oxygen into the bottles. Carefully submerge the bottom of the bottle (one at a time) into the water and allow the water to fill the bottle. Place the bottle on the bottom of the bucket and carefully place stopper into it without adding atmospheric oxygen. Retrieve the bottles and determine their DO by the Winkler method (see method 4500-O-C for more details). Turn the stirrer or equivalent mechanism on and read the DO of the water in the bucket.

2.5.1.4. Adjust the DO meter according to manufacturer's instructions. Be sure to adjust the meter to the temperature of water in the bucket, and then calibrate the DO meter to read the average DO concentration of the two samples determined by the Winkler test.

2.5.2. Zero-DO Verification: The air calibration and the interfering effects of the sample can be further checked in the field by means of a “zero-DO standard” (see method 4500-O G).

2.5.2.1. Prepare this standard on-site with an aliquot of the sample by adding excess sodium sulfite and a trace of cobalt chloride to bring the DO to zero. Prepare this zero-DO standard in a beaker or a large-mouth sample container of appropriate size to insert the DO probe.

2.5.2.2. After adding the chemicals, gently swirl the water and let it sit for about 30 seconds before inserting the probe.

2.5.2.3. Read the DO of the sample. If the reading is outside the acceptance interval, the instrument must be recalibrated and/or zero-adjusted if the meter allows for this adjustment.

2.5.3. Air-Saturated Water: The DO sensor or instrument system is calibrated against water that is saturated with oxygen at a known temperature and ambient atmospheric pressure.

2.5.3.1. The temperature and conductivity of water used for calibration should be about the same as the temperature and conductivity of the water to be measured.

2.5.3.2. Place DO sensor and calibration water in a large beaker or open-mouth container.

2.5.3.3. Aerate the water for an adequate amount of time.

2.5.3.4. Determine if the water is 100 percent saturated with oxygen, and take a temperature reading. Temperature must be calibrated or verified for accuracy before DO calibration verification.

2.5.3.5. Use Table FT 1500-1 above to determine the DO saturation value at the measured water temperature. Compare DO meter reading with value obtained from Table FT 1500-1 to ensure continuous calibration.

2.6. Measuring DO in Samples:

2.6.1. Insert or place the DO probe *in situ* at a measuring location representative of the sampling source:

2.6.1.1. Take the DO of an effluent just before it enters the receiving water. If the effluent aerated prior to entering the surface water, take the DO reading in the receiving water right where it enters.

2.6.1.2. For well mixed surface waters, e.g., fast flowing streams, take the DO reading at approximately 1-2 feet below the surface or at mid-depth.

2.6.1.3. For still or sluggish surface waters, take a reading at one foot below the surface, one foot above the bottom, and at mid-depth.

2.6.1.4. If it is shallow surface waters, (less than two feet) take the reading at mid-depth.

2.6.1.5. Do not take a reading in frothy or aerated water unless required by the sampling plan.

2.6.1.6. Groundwater samples must be measured *in situ* with a downhole probe or in a flow-through container. Do not measure bailed or pumped samples in an intermediate container containing static sample.

2.6.2. Rinse probe with de-ionized water and keep the probe in the saturated atmosphere (see 2.1.2 above) between sites and events.

2.6.3. If the readings show distinct, unexplainable changes in DO levels, or when the probe has been in waters with high sulfides, recalibrate or perform maintenance per manufacturer's instructions. While taking a reading, if it is very low (e.g., below 1.0 mg/L), allow the meter to stabilize, record it and then, remove and rinse the probe, as the environment is very likely anoxic and may contain hydrogen sulfide, which can damage the probe.

2.6.4. Salinity and Temperature corrections may be necessary. Follow manufacturer instructions for automatic corrections or perform manual calculations (see method 4500-O G).

3. PREVENTIVE MAINTENANCE: Refer to FT 1000, section 3.

4. DOCUMENTATION

4.1. Standard and Reagent Documentation: Document information about standards and reagents used for verifications.

4.1.1. Note the date of receipt, the expiration date and the date of first use for all standards and reagents.

4.1.1.1. Document acceptable verification of any standard used after its expiration date.

4.1.2. Record the concentration or other value for the standard in the appropriate measurement units.

4.1.2.1. Note vendor catalog number and description for pre-formulated solutions as well as for neat liquids and powdered standards.

4.1.2.2. Retain vendor assay specifications for standards as part of the calibration record.

4.1.3. Record the grade of standard or reagent used.

4.1.4. When formulated in-house, document all calculations used to formulate calibration standards.

4.1.4.1. Record the date of preparation for all in-house formulations.

4.1.5. Describe or cite the procedure(s) used to prepare any standards in-house (DEP SOP or internal SOP).

4.2. Field Instrument Calibration Documentation: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.

4.2.1. Retain vendor certifications of all factory-calibrated instrumentation.

4.2.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used.

4.2.2.1. Record the manufacturer name, model number and identifying number such as a serial number for each instrument unit.

4.2.3. Record the time and date of all initial calibrations and all calibration verifications.

4.2.4. Record the instrument reading (value in appropriate measurement units) of all calibration verifications.

4.2.5. Record the temperature associated with all calibration verifications.

4.2.6. Record the name of the analyst(s) performing the calibration.

4.2.7. Document the specific standards used to calibrate or verify the instrument or field test with the following information:

- Type of standard or standard name (e.g., saturation)
- Value of standard, including correct units (e.g., mg/L at ^{o}C)
- Link to information recorded according to section 4.1 above

4.2.8. Retain manufacturers' instrument specifications.

4.2.9. Document whether successful initial calibration occurred.

4.2.10. Document whether each calibration verification passed or failed.

4.2.11. Document any corrective actions taken to correct instrument performance according to records requirements of FD 3000.

4.2.11.1. Document the date and time of any corrective action.

4.2.11.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.

4.2.12. Describe or cite the specific calibration or verification procedure performed (DEP SOP or internal SOP).

4.3. Record all field-testing measurement data, to include the following:

- Project name
- Date and time of measurement or test (including time zone, if applicable)
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
- Latitude and longitude of sampling source location (if required)
- Analyte or parameter measured
- Measurement or test sample value
- Reporting units
- Initials or name of analyst performing the measurement
- Unique identification of the specific instrument unit(s) used for the test(s)

Appendix FT 1500
Tables, Figures and Forms

Table FT 1500-1: Solubility of Oxygen in Water at Atmospheric Pressure [1,2]

Temperature ºC	Oxygen Solubility mg/L	Temperature ºC	Oxygen Solubility mg/L
0.0	14.621	26.0	8.113
1.0	14.216	27.0	7.968
2.0	13.829	28.0	7.827
3.0	13.460	29.0	7.691
4.0	13.107	30.0	7.559
5.0	12.770	31.0	7.43
6.0	12.447	32.0	7.305
7.0	12.139	33.0	7.183
8.0	11.843	34.0	7.065
9.0	11.559	35.0	9.65
10.0	11.288	36.0	6.837
11.0	11.027	37.0	6.727
12.0	10.777	38.0	6.62
13.0	10.537	39.0	6.515
14.0	10.306	40.0	6.412
15.0	10.084	41.0	6.312
16.0	9.870	42.0	6.213
17.0	9.665	43.0	6.116
18.0	9.467	44.0	6.021
19.0	9.276	45.0	5.927
20.0	9.092	46.0	8.835
21.0	8.915	47.0	5.744
22.0	8.743	48.0	5.654
23.0	8.578	49.0	5.565
24.0	8.418	50.0	5.477
25.0	8.263		

1. The table provides three decimal places to aid interpolation

2. Under equilibrium conditions, the partial pressure of oxygen in air-saturated water is equal to that of the oxygen in water-saturated air.

Table FT 1500-1: Solubility of Oxygen in Water at Atmospheric Pressure [1,2]			
Temperature °C	Oxygen Solubility mg/L	Temperature °C	Oxygen Solubility mg/L
0.0	14.621	26.0	8.113
1.0	14.216	27.0	7.968
2.0	13.829	28.0	7.827
3.0	13.460	29.0	7.691
4.0	13.107	30.0	7.559
5.0	12.770	31.0	7.430
6.0	12.447	32.0	7.305
7.0	12.139	33.0	7.183
8.0	11.843	34.0	7.065
9.0	11.559	35.0	6.950
10.0	11.288	36.0	6.837
11.0	11.027	37.0	6.727
12.0	10.777	38.0	6.620
13.0	10.537	39.0	6.515
14.0	10.306	40.0	6.412
15.0	10.084	41.0	6.312
16.0	9.870	42.0	6.213
17.0	9.665	43.0	6.116
18.0	9.467	44.0	6.021
19.0	9.276	45.0	5.927
20.0	9.092	46.0	5.835
21.0	8.915	47.0	5.744
22.0	8.743	48.0	5.654
23.0	8.578	49.0	5.565
24.0	8.418	50.0	5.477
25.0	8.263		

1. The table provides three decimal places to aid interpolation
2. Under equilibrium conditions, the partial pressure of oxygen in air-saturated water is equal to that of the oxygen in water-saturated air

FT 1600. Field Measurement of Turbidity

Use in conjunction with:

- FT 1000 General Field Testing and Measurement
- FS 1000 General Sampling Procedures
- FD 1000 Documentation Procedures

1. INTRODUCTION: Turbidity measures the scattering effect that suspended solids have on the propagation of light through a body of water (surface or ground waters). The higher the effect (i.e., intensity of scattered light), the higher the turbidity value. Suspended and colloidal matter such as clay, silt, finely divided organic and inorganic matter, and plankton and other microscopic organisms cause turbidity in water.

This SOP describes the use of true nephelometric measurement using instruments meeting the specifications outlined in 2.1.

Exceptions to the requirements specified in 2.1 below include:

1.1. *In situ* probes with turbidity sensors used for screening purposes (e.g., groundwater purge stabilization measurements).

1.2. Non standard light sources, detectors or other turbidity measuring devices may be proposed for use in studies that entail comparison measurements (dredge and fill) or unattended deployment for monitoring purposes.

1.3. **Do not report results from "non standard" sensors or configurations for regulatory purposes such as permit compliance unless the Department has approved the use for the specific project.**

1.4. All "non-standard" instruments must be calibrated and verified according to the requirements in this SOP.

2. EQUIPMENT AND SUPPLIES

2.1. Field Instrument: Use a turbidimeter (nephelometer) or a spectrophotometer consisting of a light source and one or more photoelectric detectors with a readout device to indicate the intensity of light. The instrument must meet these specifications:

2.1.1. The light source must have a tungsten-filament lamp operated at a color temperature between 2000 and 3000 K.

2.1.2. The distance traversed by the incident light and scattered light within the sample tube must not exceed 10 cm.

2.1.3. The light detector, positioned at 90^{o} to the incident light, must have an acceptance angle that does not exceed $\pm$ 30^{o} from 90^{o}.

2.1.4. The detector and any filter system must have a spectral peak response between 400 and 600 nanometers.

2.1.5. The instrument sensitivity must permit detection of a turbidity difference of 0.02 NTU at the 0 – 1.0 NTU scale.

2.1.6. Note: using the appropriate equipment and following the procedures in this SOP, the field accuracy of this measurement is close to %R = 100 $\pm$ 10% for turbidities in the range of 1 to 100 NTU.

2.2. Sample Cells (cuvettes): Use sample cells or tubes of clear, colorless glass or plastic.

2.2.1. Keep cells clean, both inside and out, and discard if scratched or etched.

2.2.1.1. Never handle them where the light beam strikes the sample.

2.2.1.2. Clean sample cells by thorough washing with laboratory soap (inside and out) followed by multiple rinses with distilled or de-ionized water, and let air-dry.

2.2.2. Use a very thin layer of silicone oil on the outside surfaces to mask minor imperfections or scratches in the cells.

2.2.2.1. Use silicone oil with the same refractive index of the glass; making sure the cell appear to be nearly dry with little or no visible signs of oil.

2.2.3. Because small differences between cells significantly impact measurement, use either matched pairs or the same cell for standardization and sample measurement.

2.3. Standards:

2.3.1. Primary standards: Use these standards for initial calibration.

2.3.1.1. Formazin standards can be either obtained commercially or prepared according to method 2130B (2011), section 3. in Standard Methods for the Examination of Water and Wastewater (see Standard Methods Online, http://www.standardmethods.org/store/).

2.3.1.2. Some instruments may require the use of styrene divinylbenzene (SDVB) standards for calibration.

2.3.2. Secondary Standards: Use only those certified by the manufacturer for a specific instrument. Secondary standards must only be used for continuing calibration verifications according to the procedures in section 3.4 below. Determine or verify the values of secondary standards according to the procedure in section 3.3 below.

2.3.3. Turbidity-free water: Use filtered, laboratory reagent water demonstrated to be free of measurable turbidity (<0.01 NTU) or purchase commercially prepared turbidity-free water.

3. CALIBRATION AND USE

3.1. General Concerns

3.1.1. Light absorption by dissolved and suspended matter may cause a negative bias on the turbidity measurement. When present in significant concentrations, particles of light-absorbing materials such as activated carbon will cause a negative interference. Likewise, the presence of dissolved, color-causing substances that absorb light may also cause a negative interference. Some commercial instruments may have the capability of either correcting for slight color interference or optically blanking out the color effect.

3.1.2. Handle samples with natural effervescence as described in 3.5.5.1 below.

3.2. Calibration and Initial Calibration Verification

3.2.1. Follow the calibration activities in FT 1000, section 2.2.

3.2.2. Perform an initial calibration using at least two primary standards.

3.2.2.1. If the instrument cannot be calibrated with two standards, calibrate the instrument with one standard and verify with a second standard per 3.2.3 below.

3.2.2.2. For measurement of samples of very low turbidity, select the lowest standard commercially available for bracketing the lower end of the anticipated sample turbidity range or dilute higher turbidity standards with turbidity-free water.

3.2.2.3. Do not use turbidity-free water as a calibration verification standard.

3.2.3. Perform an initial calibration verification by reading at least one primary standard as a sample. The acceptance criterion for the initial calibration verification depends on the range of turbidity of the standard value:

- Standard Value = 0.1-10 NTU: the response must be within 10% of the standard except specified in 3.2.3.1 below;
- Standard Value = 11-40 NTU: the response must be within 8% of the standard;
- Standard Value = 41-100 NTU: the response must be within 6.5% of the standard; and
- Standard Value > 100 NTU: the response must be within 5% of the standard.

3.2.3.1. Turbidity–free water sold as a standard by a vendor (i.e., a blank) does not have to meet the acceptance requirement of ± 10%, but must meet the vendor's stated value (typically < 0.1 NTU) or be less than the reporting limit. The user may still use this blank to set the zero point according to the instrument manufacturer's manual.

3.3. Determining the Values of Secondary Standards

3.3.1. Use only those standards certified by the manufacturer for a specific instrument.

3.3.2. Use verified secondary standards only for continuing calibration verifications.

3.3.3. Determining the initial value(s) of secondary standard(s):

3.3.3.1. Calibrate or verify the instrument with primary standards. Select primary standards that bracket the range of the secondary standards.

3.3.3.2. Immediately after the an initial calibration with primary standards or verification with a primary standard, read each secondary standard as a sample use the reading from the instrument as the first assigned value.

3.3.4. Verifying Secondary Standards

3.3.4.1. At least once per quarter or at other documented intervals (see 3.3.5 below), determine or verify the values of secondary standards immediately after the instrument has been calibrated or verified with primary standards.

3.3.4.2. Read each secondary standard as a sample. This reading must be within the manufacturer's stated tolerance range and within the acceptance ranges of the assigned standard value as listed in 3.2.3., above. If the criteria in section 3.2.3., above are not met, assign this reading as the value of the standard. If the reading is outside the manufacturer's stated tolerance range, discard the secondary standard.

3.3.5. **More frequent calibration verifications may be required for discharge permit compliance measurements or other regulatory requirements.**

3.4. Continuing Calibration Verification: Perform a continuing calibration verification using at least one primary or secondary standard. The calibration acceptance criteria are the same as those listed in section 3.2.3 above.

3.5. Measuring Turbidity in Samples

3.5.1. Gently agitate the sample and wait until air bubbles disappear.

3.5.2. Double-rinse the sample cell or cuvette with a small amount of the sample. Discard, and pour an aliquot into the sample cell or cuvette.

3.5.3. Gently dry out its external surface with lint-free paper.

3.5.4. Insert the cell in the instrument and read the turbidity directly from the meter display.

3.5.5. Do not use vacuum degassing, ultrasonic bath or other devices to remove bubbles from the sample. If the sample contains visible bubbles or if it effervesces (as in groundwater, with changes in pressure and temperature), make a note of this in the field records and collect a sample for laboratory measurement.

3.5.5.1. If effervescing samples are collected for laboratory analysis collect the sample without leaving headspace in the container and ship it as soon as possible to the laboratory (the holding time for this measurement is only 48 hrs). Ship this sample in wet ice at 4°C.

3.5.6. Pour out the sample, double-rinse the cuvette with de-ionized water in preparation for the next sample.

4. PREVENTIVE MAINTENANCE: Refer to FT 1000, section 3.

5. DOCUMENTATION

5.1. Standard and Reagent Documentation: Document information about standards and reagents used for calibrations, verifications, and sample measurements.

5.1.1. Note the date of receipt, the expiration date and the date of first use for all standards and reagents.

5.1.1.1. Document acceptable verification of any standard used after its expiration date.

5.1.2. Record the concentration or other value for the standard in the appropriate measurement units.

5.1.2.1. Note vendor catalog number and description for preformulated solutions as well as for neat liquids and powdered standards.

5.1.2.2. Retain vendor assay specifications for standards as part of the calibration record.

5.1.3. Record the grade of standard or reagent used.

5.1.4. When formulated in-house, document all calculations used to formulate calibration standards.

5.1.4.1. Record the date of preparation for all in-house formulations.

5.1.5. Describe or cite the procedure(s) used to prepare any standards in-house (DEP SOP or internal SOP).

5.2. Field Instrument Calibration Documentation: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.

5.2.1. Retain vendor certifications of all factory-calibrated instrumentation.

5.2.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used.

5.2.2.1. Record manufacturer name, model number, and identifying number (such as a serial number) for each instrument unit.

5.2.3. Record the time and date of all initial calibrations and all calibration verifications.

5.2.4. Record the instrument reading (value in appropriate measurement units) of all calibration verifications.

5.2.5. Record the name of the analyst(s) performing the calibration.

5.2.6. Document the specific standards used to calibrate or verify the instrument or field test with the following information:

- Type of standard or standard name (e.g., formazin)
- Value of standard, including correct units (e.g., 20 NTU)
- Link to information recorded according to section 5.1 above

5.2.7. Retain manufacturers' instrument specifications.

5.2.8. Document whether successful initial calibration occurred.

5.2.9. Document whether each calibration verification passed or failed.

5.2.10. Document any corrective actions taken to correct instrument performance according to records requirements of FD 3000.

5.2.10.1. Document date and time of any corrective action.

5.2.10.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.

5.2.11. Describe or cite the specific calibration or verification procedure performed (DEP SOP or internal SOP).

5.3. Record all field-testing measurement data, to include the following:

- Project name
- Date and time of measurement or test (including time zone, if applicable)
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
- Latitude and longitude of sampling source location (if required)
- Analyte or parameter measured
- Measurement or test sample value
- Reporting units
- Initials or name of analyst performing the measurement
- Unique identification of the specific instrument unit(s) used for the test(s)

FT 1800. Field Measurement of Water Flow and Velocity

Use in conjunction with:

- FT 1000 General Field Testing and Measurement
- FQ 1000 Field Quality Control Requirements
- FS 1000 General Sampling Procedures
- FD 1000 Documentation Procedures

1. INTRODUCTION

This SOP describes the procedures used during intensive surveys of water bodies (rivers and streams) where the discharge measurement (Q) is an important parameter in the calculation of wasteload allocations by DEP. These procedures are applicable to shallow rivers and streams (depth less than 4 feet) where the measurements are conducted by wading with assistance from other personnel.

1.1. Site Selection: Survey the study area before taking flow measurements, and carefully select flow sites that will allow the most accurate flow measurements.

1.1.1. Constricted areas are usually the most convenient and allow greater accuracy because the constriction reduces the width of each subsection and increases the current velocity.

1.1.2. Flow sites should have a uniform flow and should be free of eddies, slack water, and excessive turbulence.

1.1.3. In addition, the streambed should be free of boulders or aquatic vegetation. Obstructions in the stream may need to be removed both at the measurement site and upstream of the flow site. Obstruction removal allows for more accurate flow measurements and should not affect the actual stream flow.

1.1.4. These site selection criteria introduce a bias that tends to overestimate the stream velocity. In general, velocities taken for flow measurements are not representative of the average stream velocity. Time-of-travel dye studies should be used to determine average stream velocities.

1.2. Current Meter Selection: After the flow sites have been determined, select the appropriate current meter for each site.

1.2.1. DEP recommends electronic current meters such as the Marsh-McBirney or SonTek ADV because these meters are more sensitive than mechanical meters and are easier (quicker) to use. In order to have the most flexibility when using a meter, consider using meters that measure flow at a variety of depths and can be attached to a wading rod, a long staff, or even to the sounding unit of the bridgeboard.

1.2.2. Do not change or substitute current meters during a transect. If a meter malfunctions mid-way through a cross-section, then repeat the entire transect with a new meter.

1.2.3. DEP recommends that the same type of current meter be used during subsequent intensive surveys at the same site.

2. EQUIPMENT AND SUPPLIES

2.1. Field instruments: DEP personnel use the Marsh-McBirney Model 201D or Flo-Mate Model 2000 Flow Meter. Both measure water velocity by creating a magnetic field and measuring the voltage produced when water (a conductor) flows through the field. Other flow meters with the sensitivity and accuracy required for the study are acceptable.

2.2. Recordkeeping and Documentation Supplies:

- Field notebook (w/ waterproof paper is recommended) or forms Indelible pens

3. CALIBRATION AND USE: The following are instructions for the Marsh-McBirney Flow Meters, however, other flow meter types are acceptable. Follow the manufacturer's instructions for calibration and use.

3.1. Marsh-McBirney 201D

3.1.1. Assembly: Assemble the 201D per manufacturer's instructions.

3.1.2. Calibration

3.1.2.1. After the unit has been assembled, perform a calibration to determine if the internal circuitry is functioning properly:

- Turn the selector switch to the CAL position and the time constant switch to 2.
- The reading must be in the range of 9.8 and 10.2 after a 10-second warm-up.
- If the reading is not within the above-mentioned range, turn the meter off and check the batteries, then repeat the above two steps.
- If the unit fails the CAL test after the battery charge, send the unit to the manufacturer for maintenance.

3.1.3. Measurements with the Marsh-McBirney 201D- once this meter has been properly mounted onto the wading rod and calibrated, current measurements can be obtained:

3.1.3.1. Position the submersible sensor perpendicular to the current at the depth determined for the appropriate velocity method, and allow several seconds for the meter to adjust to the current.

3.1.3.2. Follow the manufacturer's instructions for operation.

3.1.3.3. Record the measurement on the Discharge Measurement Notes (form FD 9000-11).

3.1.3.4. Turn the SCALE switch to the off position and move to the next sampling location.

3.2. Marsh-McBirney Flo-Mate 2000

3.2.1. Calibration: Following assembly per manufacturer's instructions, perform a zero calibration check to determine if the internal circuitry is functioning properly:

3.2.1.1. Clean the sensor to remove oil that can cause noisy readings.

3.2.1.2. Place the sensor in a five-gallon bucket of water keeping it at least three inches away from the sides and bottom of the bucket.

3.2.1.3. To make sure the water is not moving, wait 10 or 15 minutes after you have positioned the sensor before taking any zero readings.

3.2.1.4. For the Flo-Mate 2000, use a filter value of 5 seconds. Zero stability is +/- 0.05 ft/sec.

- To initiate the 'zero start sequence' press the STO and RCL keys at the same time. You will see the number 3 on the display.
- Decrement to zero with the down arrow key.
- The number 32 will be displayed.
- The unit will decrement itself to zero and turn off. The unit is now zeroed.

3.2.2. Measurements with the Marsh-McBirney Flo-Mate 2000: Current measurements can be made after the meter has been properly mounted onto the wading rod and calibrated:

3.2.2.1. Position the submersible sensor perpendicular to the current at the depth determined for the appropriate velocity method, and allow several seconds for the meter to adjust to the current.

3.2.2.2. Depress the ON/C button on the display unit.

3.2.2.3. Set the FPA (fixed point average) to five seconds by depressing either the up or down arrows.

3.2.2.4. Select the FT/SEC position by toggling between the ON/C and OFF buttons.

3.2.2.5. Record the measurement on the Discharge Measurement Notes (form FD 9000-11).

3.2.2.6. Depress the OFF button and move to the next sampling location.

4. FLOW MEASUREMENTS

4.1. Estimating Discharge

4.1.1. The instruments identified in section 3 above are designed to take individual velocity measurements. These measurements are sometimes used as point velocities to calibrate model velocities, but are more frequently used to determine the volume rate of flow (discharge) of a water body.

4.1.2. To determine discharge, divide the cross-section of the water body into subsections.

4.1.2.1. Measure and record the velocity, width, and depth of each subsection.

4.1.2.2. The sum of the products of the individual subsection observations provides an estimate of discharge using the following basic formula:

$$Q = \sum_{i=1}^{n} (A_i \times V_i)$$

Where:

Q = discharge in cfs
A_i = cross-sectional area of subsection i (ft^2)
V_i = velocity of subsection i (ft/s)

4.2. The Mid Section Method: This method determines the discharge using the subsection velocity measurements.

4.2.1. Secure the end of a tag line (tape measure) to the right bank of the stream (facing downstream).

4.2.2. Extend the line across the stream and secure the other end of the line to the left bank.

4.2.3. Make sure that the tape is tight and the numbers are visible.

4.2.4. Read and record the tape measurements corresponding to both the left and right edges of the water and calculate the total width of the stream.

4.2.5. Then divide the stream into approximately 15-20 subsections. While it is generally easier if subsections are of equal width, it may be necessary to vary the subsection widths if the flow varies significantly along the cross section.

4.2.5.1. Subsections must be narrower where the depth and velocity is highest.

4.2.6. Starting at the right edge of the water and standing on the downstream side of the tape, move along the tape to the first subsection.

4.2.6.1. Measure and record the depth (from the water surface) and the tape measure length.

4.2.6.2. If the depth is greater than 2.5 feet, measure the velocity at two points in each vertical at depths corresponding to two-tenths and eight-tenths the total depth.

4.2.6.3. If the depth is less than 2.5 feet, then measure velocity at a depth of six-tenths the total depth.

4.2.6.4. Do not stand in a position that interferes with the current. The USGS recommends placing the current meter at least three inches downstream from the tape measure and that the hydrologist stand at least 1.5 feet from the meter.

4.2.7. Repeat steps 4.2.6.1 through 4.2.6.4 above at each position corresponding to the distance of successive subsections. Continue the procedure until reaching the left edge of the water.

4.3. Sample Depths for Velocity Measurements:

4.3.1. An accurate estimate of the mean velocity in the vertical is made by averaging the velocity at two depths (see 4.2.6.2 above).

4.3.2. In shallow water (depth less than 2.5 feet), use top-setting wading rods that are designed to easily adjust to the six-tenths depth. To set the rod, first measure the depth of the water (to the nearest tenth of a foot) on the fixed support rod. Then adjust the sliding support rod so that the top scale reads the depth of the water. This automatically adjusts the meter to the six-tenths depth. Note that the sample depth terminology can be confusing when using the wading rod because the sample depths are referenced to the water surface and the natural tendency is to adjust the wading rod from the bottom up. For example, if the total depth is four feet, then the six-tenths depth is 2.4 feet (4 x .6 = 2.4) from the surface. This means that the current meter should be positioned 1.6 feet off the bottom (the remaining four-tenths of the depth).

5. PREVENTIVE MAINTENANCE: Refer to FT 1000, section 3.

6. DOCUMENTATION

6.1. Field Instrument Calibration Documentation: Document acceptable calibration and calibration verification for each instrument unit and field test or analysis, linking this record with affected sample measurements.

6.1.1. Retain vendor certifications of all factory-calibrated instrumentation.

6.2. Designate the identity of specific instrumentation in the documentation with a unique description or code for each instrument unit used.

6.2.1.1. Record manufacturer name, model number and identifying number such as a serial number for each instrument unit.

6.2.2. Record the time and date of all initial calibrations and all calibration verifications.

6.2.3. Record the instrument reading (value in appropriate measurement units) of all calibration verifications.

6.2.4. Record the name of the analyst(s) performing the calibration.

6.2.5. If applicable, document the specific standards used to calibrate or verify the instrument or field test with the following information:

- Type of standard or standard name
- Value of standard, including correct units

6.2.6. Retain manufacturers' instrument specifications.

6.2.7. Document whether successful initial calibration occurred.

6.2.8. Document whether each calibration verification passed or failed.

6.2.9. Document any corrective actions taken to correct instrument performance according to records requirements of FD 3000.

6.2.9.1. Document date and time of any corrective action.

6.2.9.2. Note any incidence of discontinuation of use of the instrument due to calibration failure.

6.2.10. Describe or cite the specific calibration or verification procedure performed (DEP SOP or internal SOP).

6.3. Field-Testing Measurement Data:

6.3.1. Record all flow readings and supporting information. For informational purposes, see United States Geological Survey (USGS) guidance on flow measurement for examples of standard documentation (*http://www.usgs.gov/pubprod/*).

6.3.2. Also record each of the following, if not addressed in 6.3.1 above

- Project name
- Date and time of measurement or test (including time zone, if applicable)
- Source and location of the measurement or test sample (e.g., monitoring well identification number, outfall number, station number or other description)
- Latitude and longitude of sampling source location (if required)
- Analyte or parameter measured
- Measurement or test sample value
- Reporting units
- Initials or name of analyst performing the measurement
- Unique identification of the specific instrument unit(s) used for the test(s)

DR/4000 PROCEDURE

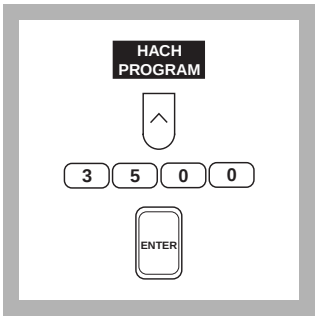
SULFIDE

✔ Method 8131 **Methylene Blue Method***

(0 to 800 µg/L)

Scope and Application: *For testing total sulfides, H_2S, HS^- and certain metal sulfides in groundwater, wastewater brines and seawater; USEPA accepted for reporting wastewater analysis***

* Adapted from *Standard Methods for the Examination of Water and Wastewater.*
** Procedure is equivalent to USEPA method 376.2 and Standard Method 4500-S^{2-} D for wastewater.



1. Press the soft key under ***HACH PROGRAM.***

Select the stored program number for sulfide (S^{2-}) by pressing **3500** with the numeric keys.

Press: **ENTER**

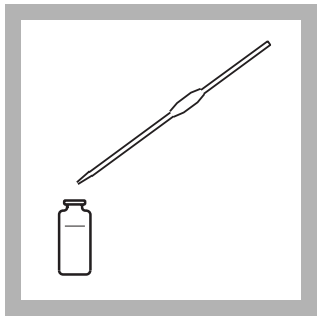
Note: *The Flow Cell and Sipper Modules can be used with this procedure.*

Note: *Samples must be analyzed immediately and cannot be preserved for later analysis. Avoid excessive agitation of samples.*

2. The display will show:

HACH PROGRAM: 3500 Sulfide

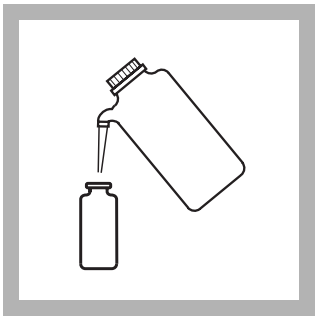
The wavelength (λ), **665 nm**, is automatically selected.



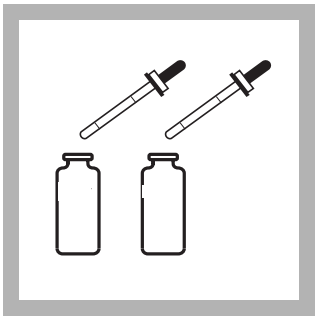
3. Measure 25 mL of sample into a sample cell. This will be the prepared sample.

Note: *For turbid samples, see Interferences (following these steps) for pretreatment instructions.*

Note: *Excessive agitation will cause loss of sulfide. Use a pipet to minimize sulfide loss.*

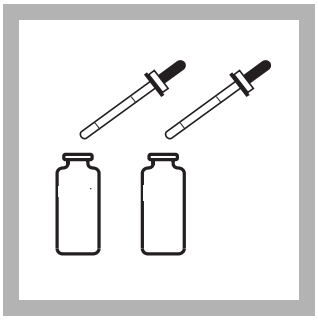


4. Measure 25 mL of deionized water into a second sample cell (the blank).



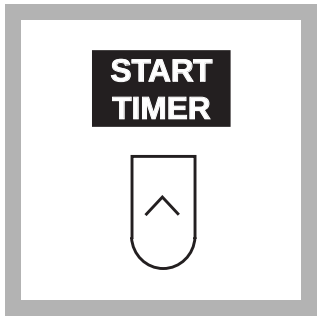
5. Add 1.0 mL of Sulfide 1 Reagent to each cell. Swirl to mix.

Note: *Use the calibrated 1-mL dropper.*



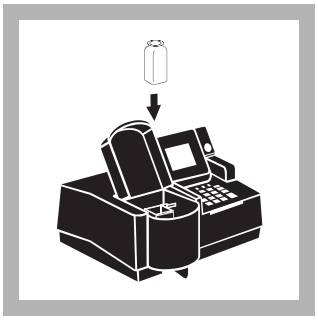
6. Add 1.0 mL of Sulfide 2 Reagent to each cell. Immediately swirl to mix.

Note: *A pink color will develop, then the solution will turn blue if sulfide is present.*

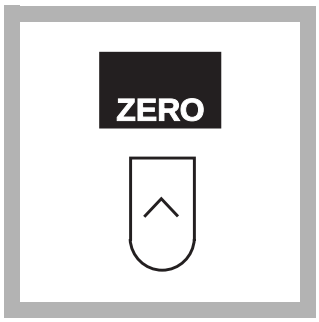


7. Press the soft key under ***START TIMER***.

A 5-minute reaction period will begin.



8. When the timer beeps, place the blank in the cell holder. Close the light shield.

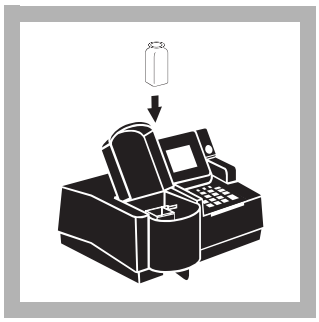


9. Press the soft key under ***ZERO***.

The display will show:

0 µg/L S^{2-}

Note: *For alternate concentration units, press the soft key under* ***OPTIONS****. Then press the soft key under* ***UNITS*** *to scroll through the available options. Press* **ENTER** *to return to the read screen.*



10. Place the prepared sample in the cell holder. Close the light shield. Results in µg/L sulfide (or chosen units) will be displayed.

Note: *Some sulfide loss may occur if dilution is necessary.*

Interferences

Table 1 Interfering Substances and Suggested Treatments

Interfering Substance	Interference Levels and Treatments
Strong reducing substances (sulfite, thiosulfate and hydrosulfite)	Interfere by reducing the blue color or preventing its development
Sulfide, high levels	High concentrations of sulfide may inhibit full color development and require sample dilution. Some sulfide loss may occur when the sample is diluted.
Turbidity	For turbid samples, prepare a sulfide-free blank as follows. Use it in place of the deionized water blank in the procedure. **1.** Measure 25 mL of sample into a 50-mL erlenmeyer flask. **2.** Add Bromine Water dropwise with constant swirling until a permanent yellow color just appears. **3.** Add Phenol Solution dropwise until the yellow color just disappears. Use this solution in place of deionized water in step 4.

Sample Collection, Storage and Preservation

Collect samples in clean plastic or glass bottles. Fill completely and cap tightly. Avoid excessive agitation or prolonged exposure to air. Analyze samples immediately.

Method Performance

Precision
Standard: 400 µg/L S^{2-}

Program	95% Confidence Limits
3500	399–401 µg/L S^{2-}

For more information on determining precision data and method detection limits, refer to Section *1.5*.

Estimated Detection Limit

Program	EDL
3500	2 µg/L S^{2}

For more information on derivation and use of Hach's estimated detection limit, see Section *1.5.2*. To determine a method detection limit (MDL) as defined by the 40 CFR part 136, appendix B, see Section *1.5.1*.

Sensitivity
Program Number: 3500

Portion of Curve	ΔAbs	ΔConcentration
Entire Range	0.010	4.9 µg/L

See Section *1.5.3 Sensitivity Explained* for more information.

Determining Soluble Sulfides

Determine soluble sulfides by centrifuging the sample in completely filled, capped tubes and analyzing the supernatant. Insoluble sulfides are then estimated by subtracting the soluble sulfide concentration from the total sulfide result.

Summary of Method

Hydrogen sulfide and acid-soluble metal sulfides react with N,N-dimethyl-p-phenylenediamine sulfate to form methylene blue. The intensity of the blue color is proportional to the sulfide concentration.

High sulfide levels in oil field waters may be determined after proper dilution.

Safety

Good safety habits and laboratory techniques should be used throughout the procedure. Consult the *Material Safety Data Sheet* for information specific to the reagents used. For additional information, refer to *Section 1*.

Pollution Prevention and Waste Management

Sulfide 2 reagent contains potassium dichromate. The final solution will contain hexavalent chromium (D007) at a concentration regulated as a hazardous waste by Federal RCRA. Please see *Section 1* for further information on proper disposal of these materials.

REQUIRED REAGENTS AND STANDARDS

	Cat. No.
Sulfide Reagent Set (100 tests)	22445-00

Includes: (2) 1816-32, (2) 1817-32

Description	Quantity Required per test	Unit	Cat. No.
Sulfide 1 Reagent	2 mL	100 mL MDB	1816-32
Sulfide 2 Reagent	2 mL	100 mL MDB	1817-32
Water, deionized	25 mL	4 liters	272-56

REQUIRED EQUIPMENT AND SUPPLIES

Cylinder, graduated, 25-mL	1	each	508-40
or			
Pipet, volumetric, Class A, 25-mL	1	each	14515-40
DR/4000 1-Inch Cell Adapter	1	each	48190-00
Pipet Filler, safety bulb	1	each	14651-00

OPTIONAL REAGENTS AND STANDARDS

Bromine Water, 30-g/L	29 mL	2211-20
Phenol Solution, 30-g/L	29 mL	2112-20

OPTIONAL EQUIPMENT AND SUPPLIES

DR/4000 Carousel Module Kit	each	48070-02
DR/4000 Flow Cell Module Kit, 1-inch	each	48070-04
DR/4000 Flow Cell Module Kit, 1-cm	each	48070-05
DR/4000 Sipper Module Kit, 1-inch	each	48090-03
Dropper, for 1-oz. bottle	each	2258-00
Flask, Erlenmeyer, 50-mL	each	505-41

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IRON, Ferrous

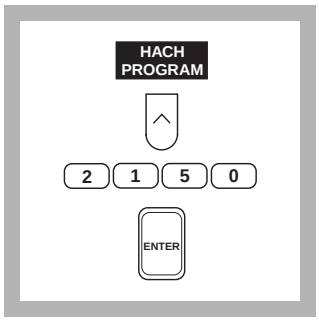
Method 8146 **1,10 Phenanthroline Method***

Powder Pillows or AccuVac® Ampuls **(0 to 3.000 mg/L)**

Scope and Application: *For water, wastewater and seawater. The estimated detection limit for program numbers 2150 and 2155 are 0.008 and 0.007 mg/L Fe^{2+}, respectively.*

* Adapted from *Standard Methods for the Examination of Water and Wastewater,* 15th ed. 201 (1980)

Using Powder Pillows



1. Press the soft key under ***HACH PROGRAM***.

Select the stored program number for ferrous iron (Fe^{2+}), by pressing **2150** with the numeric keys.

Press: **ENTER**

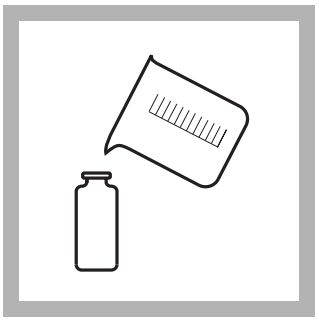
Note: *Analyze samples as soon as possible to prevent air oxidation of ferrous iron to ferric iron, which is not determined. See Sample Collection, Storage and Preservation following these steps.*

Note: *The Flow Cell and Sipper Modules can be used with this procedure.*

2. The display will show:

HACH PROGRAM: 2150
Iron, Ferrous

The wavelength (λ), **510 nm**, is automatically selected.



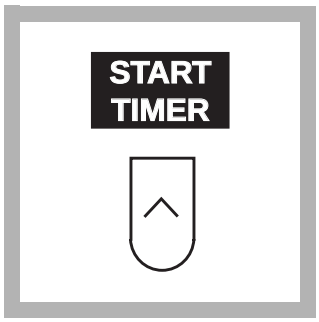
3. Fill a clean sample cell with 25 mL of sample.

Note: *For proof of accuracy, use a 1.0 mg/L ferrous iron standard solution (preparation given in the Accuracy Check section) in place of the sample.*

Note: *For best results, determine a reagent blank for each new lot of reagent as follows. Prepare a reagent blank by repeating steps 3 through 10, using deionized water as the sample. Zero the instrument on deionized water by pressing the soft key under* ***ZERO****. Insert the reagent blank and the blank value will be displayed. Correct for the reagent blank by pressing the soft keys under* ***OPTIONS, (MORE)****, and then* ***BLANK:OFF****. Enter the reagent blank value and press* **ENTER***. Repeat for each new lot of reagent.*

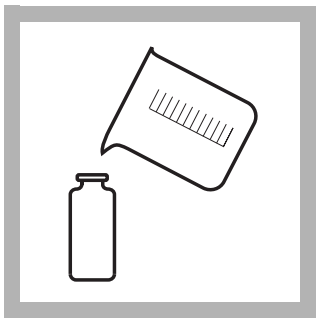
4. Add the contents of one Ferrous Iron Reagent Powder Pillow to the sample cell (the prepared sample). Swirl to mix.

Note: *An orange color will form if ferrous iron is present.*

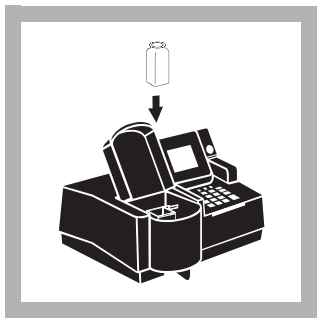


5. Press the soft key under ***START TIMER***.

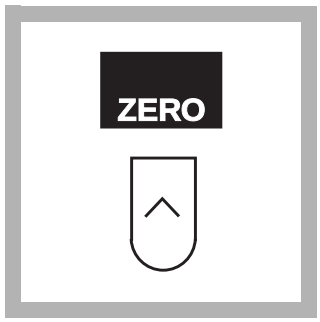
A 3-minute reaction period will begin.



6. Fill a second sample cell with 25 mL of sample (the blank).



7. When the timer beeps, place the blank into the cell holder. Close the light shield.



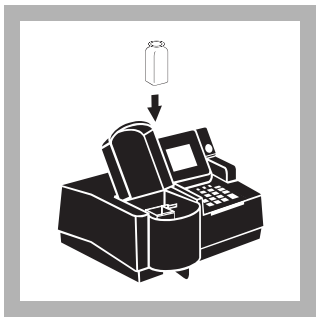
8. Press the soft key under ***ZERO***.

The display will show:

0.000 mg/L Fe^{2+}

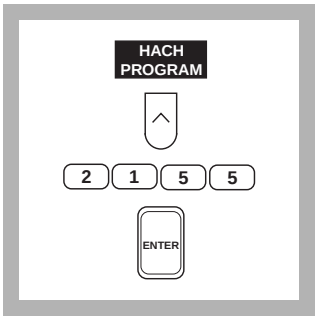
Note: *If you are using a reagent blank correction, the display will show the correction.*

Note: *For alternate concentration units, press the soft key under* ***OPTIONS****. Then press the soft key under* ***UNITS*** *to scroll through the available options. Press* **ENTER** *to return to the read screen.*



9. Place the prepared sample into the cell holder. Close the light shield. The results in mg/L Fe^{2+} (or chosen units) will be displayed.

Using AccuVac Ampuls



1. Press the soft key under ***HACH PROGRAM***.

Select the stored program number for ferrous iron (Fe^{2+}) by pressing **2155** with the numeric keys.

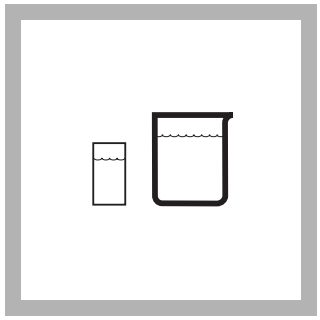
Press: **ENTER**

Note: *Analyze samples as soon as possible to prevent air oxidation of ferrous iron to ferric iron, which is not determined. See Sample Collection, Storage and Preservation following these steps.*

2. The display will show:

HACH PROGRAM: 2155
Iron, Ferrous AV

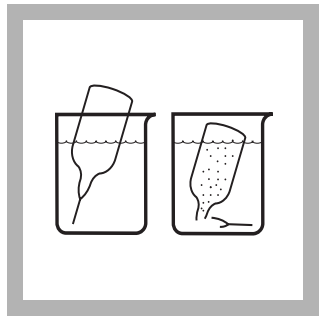
The wavelength (λ), **510 nm**, is automatically selected.



3. Fill a zeroing vial (the blank) with at least 10 mL of sample. Collect at least 40 mL of sample in a 50-mL beaker.

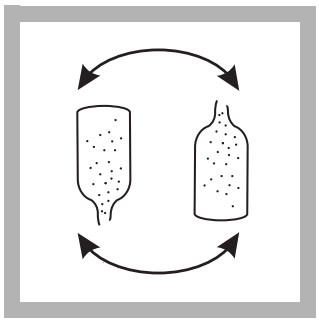
Note: *For proof of accuracy, a 1.0-mg/L ferrous iron standard solution (preparation given in the Accuracy Check section) can be used in place of the sample.*

Note: *For best results, determine a reagent blank for each new lot of reagent as follows. Prepare a reagent blank by repeating Steps 3 through 10, using deionized water as the sample. Zero the instrument on deionized water by pressing the soft key under* ***ZERO****. Insert the reagent blank and the blank value will be displayed. Correct for the reagent blank by pressing the soft keys under* ***OPTIONS, (MORE)****, and then* ***BLANK:OFF****. Enter the reagent blank value and press* **ENTER***. Repeat for each new lot of reagent.*



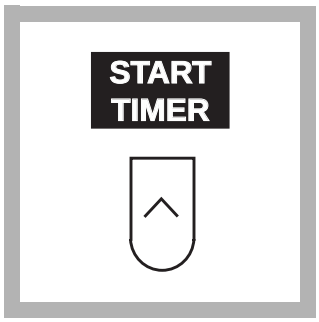
4. Fill a Ferrous Iron AccuVac Ampul with sample.

Note: *Keep the tip immersed while the ampul fills completely.*



5. Quickly invert the ampul several times to mix. Wipe off any liquid or fingerprints.

Note: *An orange color will form if ferrous iron is present.*



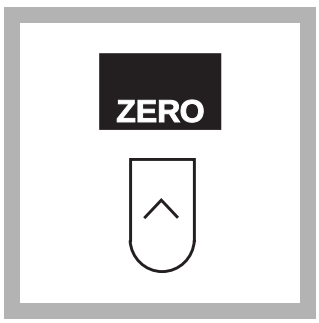
6. Press the soft key under ***START TIMER***.

A 3-minute reaction period will begin.

Note: *Complete Step 7 during the reaction period.*

7. Insert the AccuVac Ampul Adapter into the sample cell module by sliding it under the thumb screw and into the alignment grooves. Fasten with the thumb screw.

8. When the timer beeps place the blank into the cell holder. Close the light shield.



9. Press the soft key under ***ZERO***.

The display will show:

0.000 mg/L Fe^{2+}

Note: *If you are using a reagent blank correction, the display will show the correction.*

Note: *For alternate concentration units, press the soft key under* ***OPTIONS****. Then press the soft key under* ***UNITS*** *to scroll through the available options. Press* **ENTER** *to return to the read screen.*

10. Place the AccuVac Ampul into the cell holder. Close the light shield. Results in mg/L Fe^{2+} (or chosen units) will be displayed.

Sample Collection, Storage and Preservation

Collect samples in plastic or glass bottles. Analyze samples as soon as possible after collection.

Accuracy Check

Standard Solution Method

Prepare a ferrous iron stock solution (100-mg/L Fe^{2+}) by dissolving 0.7022 grams of Ferrous Ammonium Sulfate, hexahydrate, in deionized water. Dilute to one liter in a Class A volumetric flask. In a 100-mL Class A volumetric flask, dilute 1.00 mL of this solution to 100 mL with deionized water to make a 1.0-mg/L standard solution. Prepare this solution immediately before use. Perform the iron procedure as described above.

To adjust the calibration curve using the reading obtained with the 1.0 mg/L Fe^{2+} Standard Solution, press the soft keys under ***METHOD OPTIONS, (MORE)*** then ***STD: OFF***. Press **ENTER** to accept the default concentration, the value of which will depend on the selected units. If an alternate concentration is used, enter the actual concentration and press **ENTER** to return to the read screen. See Section *1.5.5 Adjusting the Standard Curve* for more information.

Method Performance

Precision

Standard: 1.000 mg/L Fe

Program	95% Confidence Limits
2150	0.997–1.003 mg/L Fe
2155	0.997–1.003 mg/L Fe

For more information on determining precision data and method detection limits, refer to Section *1.5*.

Estimated Detection Limit

Program	EDL
2150	0.008 mg/L Fe
2155	0.007 mg/L Fe

For more information on derivation and use of Hach's estimated detection limit, see Section *1.5.2*. To determine a method detection limit (MDL) as defined by the 40 CFR part 136, Appendix B, see Section *1.5.1*.

Sensitivity
Program Number: 2150

Portion of Curve:	ΔAbs	ΔConcentration
Entire Range	0.010	0.0210 mg/L

Program Number: 2155

Portion of Curve:	ΔAbs	ΔConcentration
Entire Range	0.010	0.0226 mg/L

See Section *1.5.3 Sensitivity Explained* for more information.

Calibration Standard Preparation

Preparing ferrous standards is difficult. These standards are very unstable and degrade rapidly. Only a trained chemist should prepare these standards.

To perform an ferrous iron calibration using the 1,10 phenanthroline method, prepare calibration standards containing 0.50, 1.00, 2.00, and 3.00 mg/L ferrous iron as follows:

a. Prepare a 100 mg/L ferrous iron stock solution by dissolving 0.7022 grams of Ferrous Ammonium Sulfate, hexahydrate, in deionized water. Dilute to one liter in a Class A volumetric flask. Stopper and invert several times to mix. Prepare this solution just before use.

b. Into four different 100-mL Class A volumetric flasks, pipet 0.50, 1.00, 2.00 and 3.00 mL of the 100-mg/L ferrous iron stock solution. Dilute each flask to volume with deionized water. Stopper and invert each flask to mix. Prepare these standards just before use.

c. Using the 1,10 phenanthroline method and the calibration procedure described in the *User-Entered Programs* section of the *DR/4000 Spectrophotometer Instrument Manual*, generate a calibration curve from the standards prepared above.

Summary of Method

The 1,10 phenanthroline indicator in the Ferrous Iron Reagent reacts with ferrous iron in the sample to form an orange color in proportion to the iron concentration. Ferric iron does not react. The ferric iron (Fe^{3+}) concentration can be determined by subtracting the ferrous iron concentration from the results of a total iron test.

Safety

Good safety habits and laboratory techniques should be used throughout the procedure. Consult the *Material Safety Data Sheet* for information specific to the reagents used. For additional information, refer to Section *1*.

Pollution Prevention and Waste Management

For information on pollution prevention and waste management, refer to Section *1*.

REQUIRED REAGENTS AND STANDARDS (Using Powder Pillows)

Description	Quantity Required per test	Unit	Cat. No.
Ferrous Iron Reagent Powder Pillows	1 pillow	100/pkg	1037-69

REQUIRED REAGENTS AND STANDARDS (Using AccuVac Ampuls)

Ferrous Iron Reagent AccuVac Ampuls	1 ampul	25/pkg	25140-25

REQUIRED EQUIPMENT AND SUPPLIES (Using Powder Pillows)

Clippers, for opening powder pillows	1	each	968-00
DR/4000 1-Inch Cell Adapter	1	each	48190-00

REQUIRED EQUIPMENT AND SUPPLIES (Using AccuVac Ampuls)

Beaker, 50-mL	1	each	500-41
DR/4000 AccuVac Ampul Adapter	1	each	48187-00
Sample Cell, 10-mL, with cap (zeroing vial)	1	each	21228-00

OPTIONAL REAGENTS AND STANDARDS

Ferrous Ammonium Sulfate, hexahydrate, ACS	113 g	11256-14
Water, deionized	4 liters	272-56

OPTIONAL EQUIPMENT AND SUPPLIES

AccuVac Snapper	each	24052-00
Balance, electronic, 110 VAC	each	26104-00
Balance, electronic, 220 VAC	each	26104-02
Clippers, shears, 7 ¼-inch	each	23694-00
DR/4000 Carousel Module Kit	each	48070-02
DR/4000 Flow Cell Module Kit, 1-inch	each	48070-04
DR/4000 Flow Cell Module Kit, 1-cm	each	48070-05
DR/4000 Sipper Module Kit, 1-inch	each	48070-03
Flask, volumetric, 100-mL, Class A	each	14574-42
Flask, volumetric, 1000-mL, Class A, with stopper	each	14574-53
pH Meter, *sens**ion**™1*, portable	each	51700-00
pH Paper, pH 1.0 to 11.0	5 rolls/pkg	391-33
Pipet, volumetric, 0.50-mL, Class A	each	14515-34
Pipet, volumetric, 1.00-mL, Class A	each	14515-35
Pipet, volumetric, 2.00-mL, Class A	each	14515-36
Pipet, volumetric, 3.00-mL, Class A	each	14515-03
Pipet Filler, safety bulb	each	14651-00

Appendix F
Laboratory Accreditation Certificates

LABORATORY ACCREDITATION BUREAU®

Certificate of Accreditation

ISO/IEC 17025:2005 Certificate Number L2224

Shealy Environmental Services, Inc.

106 Vantage Point Drive
West Columbia SC 29172

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

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

Accreditation valid through: November 18, 2015

R. Douglas Leonard, Jr., President, COO
Laboratory Accreditation Bureau
Presented the 28th of February 2013

*See the laboratory's Scope of Accreditation for details of accredited parameters
**Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

LABORATORY ACCREDITATION BUREAU

Certificate # L2224

Scope of Accreditation
For
Shealy Environmental Services, Inc.

106 Vantage Point Drive
West Columbia, SC 29172
Jami L. Savje
1-803-791-9700

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 Shealy Environmental Services, Inc. to perform the following tests:

Accreditation granted through: **November 18, 2015**

Testing – Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
GC	8151A	Dalapon
GC	8151A	Dicamba
GC	8151A	Dichloroprop
GC	8151A	MCPP
GC	8151A	MCPA
GC	8151A	2,4D
GC	8151A	Silvex(2,4,5 TP)
GC	8151A	2,4,5-T
GC	8151A	2,4DB
GC	8151A	Dinoseb
GC/MS	8270D	N-Nitrosodimethylamine
GC/MS	8270D	Pyridine
GC/MS	8270D	Benzaldhyde
GC/MS	8270D	Phenol
GC/MS	8270D	bis(2-Chloroethyl)ether
GC/MS	8270D	2-Chlorophenol
GC/MS	8270D	1,3-Dichlorobenzene
GC/MS	8270D	1,4-Dichlorobenzene
GC/MS	8270D	1,2-Dichlorobenzene
GC/MS	8270D	o-Cresol

Non-Potable Water

Technology	Method	Analyte
GC/MS	8270D	bis(2-Chloroisopropyl)ether
GC/MS	8270D	m+p-Cresol
GC/MS	8270D	n-Nitroso-di-n-propylamine
GC/MS	8270D	Acetophenone
GC/MS	8270D	Hexachloroethane
GC/MS	8270D	Nitrobenzene
GC/MS	8270D	Isophorone
GC/MS	8270D	2,4-Dimethylphenol
GC/MS	8270D	2-Nitrophenol
GC/MS	8270D	bis(2-Chloroethoxy)methane
GC/MS	8270D	Benzoic acid
GC/MS	8270D	2,4-Dichlorophenol
GC/MS	8270D	1,2,4-Trichlorobenzene
GC/MS	8270D	Naphthalene
GC/MS	8270D	4-Chloroaniline
GC/MS	8270D	Hexachlorobutadiene
GC/MS	8270D	4-Chloro-3-methylphenol
GC/MS	8270D	Caprolactam
GC/MS	8270D	2-Methylnaphthalene
GC/MS	8270D	Hexachlorocyclopentadiene
GC/MS	8270D	2,4,6-Trichlorophenol
GC/MS	8270D	2,4,5-Trichlorophenol
GC/MS	8270D	Biphenyl
GC/MS	8270D	2-Chloronaphthalene
GC/MS	8270D	2-Nitroaniline
GC/MS	8270D	Dimethylphthalate
GC/MS	8270D	2,6-Dinitrotoluene
GC/MS	8270D	Acenaphthylene
GC/MS	8270D	3-Nitroaniline
GC/MS	8270D	Acenaphthene
GC/MS	8270D	2,4-Dinitrophenol
GC/MS	8270D	4-Nitrophenol
GC/MS	8270D	2,4-Dinitrotoluene
GC/MS	8270D	Dibenzofuran
GC/MS	8270D	DEET
GC/MS	8270D	Diethylphthalate
GC/MS	8270D	4-Chlorophenylphenylether
GC/MS	8270D	Fluorene
GC/MS	8270D	4-Nitroaniline
GC/MS	8270D	4,6-Dinitro-2-methylphenol
GC/MS	8270D	n-Nitrosodiphenylamine

Non-Potable Water

Technology	Method	Analyte
GC/MS	8270D	Azobenzene
GC/MS	8270D	4-Bromophenylphenylether
GC/MS	8270D	Hexachlorobenzene
GC/MS	8270D	Atrazine
GC/MS	8270D	Pentachlorophenol
GC/MS	8270D	Phenanthrene
GC/MS	8270D	Anthracene
GC/MS	8270D	Carbazole
GC/MS	8270D	Di-n-butylphthalate
GC/MS	8270D	Fluoranthene
GC/MS	8270D	Benzidine
GC/MS	8270D	Pyrene
GC/MS	8270D	Butylbenzylphthalate
GC/MS	8270D	3,3'-Dimethylbenzidine
GC/MS	8270D	bis(2-Ethylhexyl)phthalate
GC/MS	8270D	3,3'-Dichlorobenzidine
GC/MS	8270D	Benzo(a)Anthracene
GC/MS	8270D	Chrysene
GC/MS	8270D	Di-n-octylphthalate
GC/MS	8270D	Benzo(b)fluoranthene
GC/MS	8270D	Benzo(k)fluoranthene
GC/MS	8270D	Benzo(a)pyrene
GC/MS	8270D	Indeno(1,2,3-c,d)pyrene
GC/MS	8270D	Dibenzo(a,h)anthracene
GC/MS	8270D	Benzo(g,h,i)perylene
GC/MS	8270D (SIM)	Acenaphthene
GC/MS	8270D (SIM)	Acenaphthylene
GC/MS	8270D (SIM)	Anthracene
GC/MS	8270D (SIM)	Benzo(a)anthracene
GC/MS	8270D (SIM)	Benzo(a)pyrene
GC/MS	8270D (SIM)	Benzo(b)fluoranthene
GC/MS	8270D (SIM)	Benzo(g,h,i)perylene
GC/MS	8270D (SIM)	Benzo(k)fluoranthene
GC/MS	8270D (SIM)	Chrysene
GC/MS	8270D (SIM)	Dibenz(a,h)anthracene
GC/MS	8270D (SIM)	Fluoranthene
GC/MS	8270D (SIM)	Fluorene
GC/MS	8270D (SIM)	Indeno(1,2,3-cd)pyrene
GC/MS	8270D (SIM)	1-Methylphenol
GC/MS	8270D (SIM)	2-Methylphenol
GC/MS	8270D (SIM)	Naphthalene

Non-Potable Water

Technology	Method	Analyte
GC/MS	8270D (SIM)	Pentachlorophenol
GC/MS	8270D (SIM)	Phenanthrene
GC/MS	8270D (SIM)	Pyrene
GC/MS	8260B	Dichlorodifluoromethane
GC/MS	8260B	Chloromethane
GC/MS	8260B	Vinyl chloride
GC/MS	8260B	Bromomethane
GC/MS	8260B	Chloroethane
GC/MS	8260B	Trichlorofluoromethane
GC/MS	8260B	Ethanol
GC/MS	8260B	Ethyl ether
GC/MS	8260B	Acrolein
GC/MS	8260B	1,1-Dichloroethene
GC/MS	8260B	Freon 113
GC/MS	8260B	Acetone
GC/MS	8260B	Methyl iodide
GC/MS	8260B	Carbon disulfide
GC/MS	8260B	Allyl chloride
GC/MS	8260B	Acetonitrile
GC/MS	8260B	Methyl Acetate
GC/MS	8260B	Methylene chloride
GC/MS	8260B	Tert-Butyl Alcohol
GC/MS	8260B	Acrylonitrile
GC/MS	8260B	trans-1,2-Dichloroethene
GC/MS	8260B	tert-Butyl methyl ether
GC/MS	8260B	Diisopropyl ether (IPE)
GC/MS	8260B	1,1-Dichloroethane
GC/MS	8260B	Vinyl acetate
GC/MS	8260B	Chloroprene
GC/MS	8260B	Ethyl-Tert-Butyl Ether
GC/MS	8260B	cis-1,2-Dichloroethene
GC/MS	8260B	2-Butanone (MEK)
GC/MS	8260B	2,2-Dichloropropane
GC/MS	8260B	Benzene
GC/MS	8260B	Tetrahydrofuran
GC/MS	8260B	Methacrylonitrile
GC/MS	8260B	Propionitrile
GC/MS	8260B	Bromochloromethane
GC/MS	8260B	Chloroform
GC/MS	8260B	Tert-Butyl Formate
GC/MS	8260B	1,1,1-Trichloroethane

Non-Potable Water

Technology	Method	Analyte
GC/MS	8260B	Carbon tetrachloride
GC/MS	8260B	Trichloroethene
GC/MS	8260B	Cyclohexane
GC/MS	8260B	1,1-Dichloropropene
GC/MS	8260B	Isobutyl alcohol
GC/MS	8260B	Tert-Amyl Alcohol
GC/MS	8260B	Methylcyclohexane
GC/MS	8260B	1,2-Dichloroethane
GC/MS	8260B	Tert-Amyl Methyl Ether
GC/MS	8260B	Methyl methacrylate
GC/MS	8260B	1,2-Dichloropropane
GC/MS	8260B	1,4-Dioxane
GC/MS	8260B	Bromodichloromethane
GC/MS	8260B	Dibromomethane
GC/MS	8260B	cis-1,3-Dichloropropene
GC/MS	8260B	Toluene
GC/MS	8260B	4-Methyl-2-pentanone
GC/MS	8260B	2-Chloroethylvinyl ether
GC/MS	8260B	trans-1,3-Dichloropropene
GC/MS	8260B	Ethyl methacrylate
GC/MS	8260B	1,1,2-Trichloroethane
GC/MS	8260B	Tetrachloroethene
GC/MS	8260B	1,3-Dichloropropane
GC/MS	8260B	2-Hexanone
GC/MS	8260B	Dibromochloromethane
GC/MS	8260B	1,2-Dibromoethane (EDB)
GC/MS	8260B	Ethyl-Tert-Butyl Alcohol
GC/MS	8260B	Chlorobenzene
GC/MS	8260B	1,1,1,2-Tetrachloroethane
GC/MS	8260B	Ethylbenzene
GC/MS	8260B	m+p-Xylenes
GC/MS	8260B	o-Xylene
GC/MS	8260B	Styrene
GC/MS	8260B	Bromoform
GC/MS	8260B	Isopropylbenzene
GC/MS	8260B	1,1,2,2-Tetrachloroethene
GC/MS	8260B	Bromobenzene
GC/MS	8260B	1,2,3-Trichloropropane
GC/MS	8260B	Cyclohexanone
GC/MS	8260B	trans-1,4-Dichloro-2-butene
GC/MS	8260B	n-Propylbenzene

Non-Potable Water

Technology	Method	Analyte
GC/MS	8260B	2-Chlorotoluene
GC/MS	8260B	1,3,5-Trimethylbenzene
GC/MS	8260B	4-Chlorotoluene
GC/MS	8260B	tert-Butylbenzene
GC/MS	8260B	1,2,4-Trimethylbenzene
GC/MS	8260B	sec-Butylbenzene
GC/MS	8260B	1,3-Dichlorobenzene
GC/MS	8260B	p-Isopropyltoluene
GC/MS	8260B	1,4-Dichlorobenzene
GC/MS	8260B	Benzyl chloride
GC/MS	8260B	n-Butylbenzene
GC/MS	8260B	1,2-Dichlorobenzene
GC/MS	8260B	1,2-Dibromo-3-chloropropane
GC/MS	8260B	1,2,4-Trichlorobenzene
GC/MS	8260B	Naphthalene
GC/MS	8260B	1,2,3-Trichlorobenzene
GC/MS	8260B (SIM)	1,4-Dioxane
GC	8081B	alpha-BHC
GC	8081B	gamma-BHC (Lindane)
GC	8081B	Heptachlor
GC	8081B	Aldrin
GC	8081B	beta-BHC
GC	8081B	delta-BHC
GC	8081B	Heptachlor Epoxide
GC	8081B	gamma-Chlordane
GC	8081B	alpha-Chlordane
GC	8081B	Endosulfan I
GC	8081B	4,4'-DDE
GC	8081B	Dieldrin
GC	8081B	Endrin
GC	8081B	4,4'-DDD
GC	8081B	Endosulfan II
GC	8081B	4,4'-DDT
GC	8081B	Endrin Aldehyde
GC	8081B	Endosulfan sulfate
GC	8081B	Methoxychlor
GC	8081B	Endrin Ketone
GC	8081B	Toxaphene
GC	8082A	Aroclor 1016
GC	8082A	Aroclor 1221
GC	8082A	Aroclor 1232

Non-Potable Water

Technology	Method	Analyte
GC	8082A	Aroclor 1242
GC	8082A	Aroclor 1248
GC	8082A	Aroclor 1254
GC	8082A	Aroclor 1260
GC	8082A	Aroclor 1262
GC	8082A	Aroclor 1268
HPLC	8330A	2-Amino-4,6-dinitrotoluene
HPLC	8330A	4-Amino-2,6-dinitrotoluene
HPLC	8330A	1,3-Dinitrobenzene
HPLC	8330A	2,4-Dinitrotoluene
HPLC	8330A	2,6-Dinitrotoluene
HPLC	8330A	HMX
HPLC	8330A	Nitrobenzene
HPLC	8330A	2-Nitrotoluene
HPLC	8330A	3-Nitrotoluene
HPLC	8330A	4-Nitrotoluene
HPLC	8330A	RDX
HPLC	8330A	Tetryl
HPLC	8330A	1,3,5-Trinitrobenzene
HPLC	8330A	2,4,6-Trinitrotoluene
GC	8015C	Diesel Range Organics
GC	8015C	Gasoline Range Organics
GC	RSK - 175	Methane, Ethane, Ethene
GC	8011	1,2-Dibromoethane (EDB)
GC	8011	1,2-Dibromo-3-chloropropane (DBCP)
ICP	6010 C	Aluminum
ICP	6010 C	Antimony
ICP	6010 C	Arsenic
ICP	6010 C	Barium
ICP	6010 C	Beryllium
ICP	6010 C	Cadmium
ICP	6010 C	Calcium
ICP	6010 C	Chromium
ICP	6010 C	Cobalt
ICP	6010 C	Copper
ICP	6010 C	Iron
ICP	6010 C	Lead
ICP	6010 C	Magnesium
ICP	6010 C	Manganese
ICP	6010 C	Nickel
ICP	6010 C	Potassium

Non-Potable Water

Technology	Method	Analyte
ICP	6010 C	Selenium
ICP	6010 C	Silver
ICP	6010 C	Sodium
ICP	6010 C	Thallium
ICP	6010 C	Vanadium
ICP	6010 C	Zinc
ICP/MS	6020A	Aluminum
ICP/MS	6020A	Antimony
ICP/MS	6020A	Arsenic
ICP/MS	6020A	Barium
ICP/MS	6020A	Beryllium
ICP/MS	6020A	Cadmium
ICP/MS	6020A	Calcium
ICP/MS	6020A	Chromium
ICP/MS	6020A	Cobalt
ICP/MS	6020A	Copper
ICP/MS	6020A	Iron
ICP/MS	6020A	Lead
ICP/MS	6020A	Magnesium
ICP/MS	6020A	Manganese
ICP/MS	6020A	Nickel
ICP/MS	6020A	Potassium
ICP/MS	6020A	Selenium
ICP/MS	6020A	Silver
ICP/MS	6020A	Sodium
ICP/MS	6020A	Thallium
ICP/MS	6020A	Vanadium
ICP/MS	6020A	Zinc
CVAA	1631E	Low Level Mercury
CVAA	7470A / 245.1	Mercury
Titration	SM 2320B	Alkalinity
Photometric	SM 2120E	Color-ADMI
Photometric	SM 2120B	Platinum Cobalt Color
Titration	SM 4500-S2 F	Sulfide
Wet Oxidation	9060A	TOC
Wet Oxidation	SM 5310C	TOC
Titration	SM 2340C	Total Hardness
Filtration	SM 2540C	Total Dissolved Solids (TDS)
Filtration	SM 2540D	Total Suspended Solids (TSS)
UV/VIS	SM 4500-CN E	Total Cyanide

Non-Potable Water

Technology	Method	Analyte
UV/VIS	9012B	Total Cyanide
IC	9056A	Fluoride
IC	9056A	Chloride
IC	9056A	Sulfate
IC	9056A	Bromide
IC	9056A	Nitrate
IC	9056A	Nitrite
IC	300.0	Fluoride
IC	300.0	Chloride
IC	300.0	Sulfate
IC	300.0	Bromide
IC	300.0	Nitrate
IC	300.0	Nitrite
UV/VIS	7196A	Hexavalent chromium
Pensky-Martens	1010A	Ignitability
Electrode	9040C	Corrosivity
Electrode	SM 4500-H B	Corrosivity
Titration	Sec. 7.3.3 SW-846	Reactive Cyanide
Photometric	Sec. 7.3.4 SW-846	Reactive Sulfide
UV/VIS	353.2	Nitrate
UV/VIS	353.2	Nitrite
UV/VIS	353.2	Nitrate-Nitrite
UV/VIS	365.1	Phosphorus/Ortho-Phosphorus
UV/VIS	350.1/SM 4500-NH3 B	Ammonia
UV/VIS	351.2	TKN
GC	MADEP-EPH-MOD	Extractable Petroleum Hydrocarbons (EPH) Modified
Preparation	**Method**	**Type**
Organic Preparation	3520C	Organic Prep. of Water by Continuous Liquid-Liquid
Organic Cleanup	3620B	Florisil Cleanup Procedure
Organic Cleanup	3660B	Sulfur Cleanup Procedure
Organic Cleanup	3665A	Sulfuric Acid Cleanup Procedure
Waste Dilution	3580A	Waste Dilution
Volatile Organic Preparation	5030B	Purge-and-Trap for Aqueous Samples
Volatile Organic Preparation	5035	Closed-System Purge-and-Trap and extraction for Volatile Organics in Soil and Waste Samples
Volatile Organic Preparation	3585	Waste Dilution for Volatile Organics
Inorganic Preparation	3005A	Preparation of Waters by Hotblock
Inorganic Preparation	1311	Toxicity Characteristic Leaching Procedure (TCLP)

Non-Potable Water

Technology	Method	Analyte
Inorganic Metals Preparation	3010A	Acid Digestion of Aqueous Samples and TCLP/SPLP Extracts for ICP analysis
Inorganic Metals Preparation	3030C	Acid Digestion of Aqueous Samples for ICP Spectroscopy

Solid and Chemical Waste

Technology	Method	Analyte
GC	8151A	Dalapon
GC	8151A	Dicamba
GC	8151A	Dichloroprop
GC	8151A	MCPP
GC	8151A	MCPA
GC	8151A	2,4D
GC	8151A	Silvex(2,4,5 TP)
GC	8151A	2,4,5-T
GC	8151A	2,4DB
GC	8151A	Dinoseb
GC/MS	8270D	N-Nitrosodimethylamine
GC/MS	8270D	Pyridine
GC/MS	8270D	Benzaldhyde
GC/MS	8270D	Phenol
GC/MS	8270D	bis(2-Chloroethyl)ether
GC/MS	8270D	2-Chlorophenol
GC/MS	8270D	1,3-Dichlorobenzene
GC/MS	8270D	1,4-Dichlorobenzene
GC/MS	8270D	1,2-Dichlorobenzene
GC/MS	8270D	o-Cresol
GC/MS	8270D	bis(2-Chloroisopropyl)ether
GC/MS	8270D	m+p-Cresol
GC/MS	8270D	n-Nitroso-di-n-propylamine
GC/MS	8270D	Acetophenone
GC/MS	8270D	Hexachloroethane
GC/MS	8270D	Nitrobenzene
GC/MS	8270D	Isophorone
GC/MS	8270D	2,4-Dimethylphenol
GC/MS	8270D	2-Nitrophenol
GC/MS	8270D	bis(2-Chloroethoxy)methane
GC/MS	8270D	Benzoic acid

Solid and Chemical Waste

Technology	Method	Analyte
GC/MS	8270D	2,4-Dichlorophenol
GC/MS	8270D	1,2,4-Trichlorobenzene
GC/MS	8270D	Naphthalene
GC/MS	8270D	4-Chloroaniline
GC/MS	8270D	Hexachlorobutadiene
GC/MS	8270D	4-Chloro-3-methylphenol
GC/MS	8270D	Caprolactam
GC/MS	8270D	2-Methylnaphthalene
GC/MS	8270D	Hexachlorocyclopentadiene
GC/MS	8270D	2,4,6-Trichlorophenol
GC/MS	8270D	2,4,5-Trichlorophenol
GC/MS	8270D	Biphenyl
GC/MS	8270D	2-Chloronaphthalene
GC/MS	8270D	2-Nitroaniline
GC/MS	8270D	Dimethylphthalate
GC/MS	8270D	2,6-Dinitrotoluene
GC/MS	8270D	Acenaphthylene
GC/MS	8270D	3-Nitroaniline
GC/MS	8270D	Acenaphthene
GC/MS	8270D	2,4-Dinitrophenol
GC/MS	8270D	4-Nitrophenol
GC/MS	8270D	2,4-Dinitrotoluene
GC/MS	8270D	Dibenzofuran
GC/MS	8270D	DEET
GC/MS	8270D	Diethylphthalate
GC/MS	8270D	4-Chlorophenylphenylether
GC/MS	8270D	Fluorene
GC/MS	8270D	4-Nitroaniline
GC/MS	8270D	4,6-Dinitro-2-methylphenol
GC/MS	8270D	n-Nitrosodiphenylamine
GC/MS	8270D	Azobenzene
GC/MS	8270D	4-Bromophenylphenylether
GC/MS	8270D	Hexachlorobenzene
GC/MS	8270D	Atrazine
GC/MS	8270D	Pentachlorophenol
GC/MS	8270D	Phenanthrene
GC/MS	8270D	Anthracene
GC/MS	8270D	Carbazole
GC/MS	8270D	Di-n-butylphthalate
GC/MS	8270D	Fluoranthene
GC/MS	8270D	Benzidine

Solid and Chemical Waste

Technology	Method	Analyte
GC/MS	8270D	Pyrene
GC/MS	8270D	Butylbenzylphthalate
GC/MS	8270D	3,3'-Dimethylbenzidine
GC/MS	8270D	bis(2-Ethylhexyl)phthalate
GC/MS	8270D	3,3'-Dichlorobenzidine
GC/MS	8270D	Benzo(a)Anthracene
GC/MS	8270D	Chrysene
GC/MS	8270D	Di-n-octylphthalate
GC/MS	8270D	Benzo(b)fluoranthene
GC/MS	8270D	Benzo(k)fluoranthene
GC/MS	8270D	Benzo(a)pyrene
GC/MS	8270D	Indeno(1,2,3-c,d)pyrene
GC/MS	8270D	Dibenzo(a,h)anthracene
GC/MS	8270D	Benzo(g,h,i)perylene
GC/MS	8270D (SIM)	Acenaphthene
GC/MS	8270D (SIM)	Acenaphthylene
GC/MS	8270D (SIM)	Anthracene
GC/MS	8270D (SIM)	Benzo(a)anthracene
GC/MS	8270D (SIM)	Benzo(a)pyrene
GC/MS	8270D (SIM)	Benzo(b)fluoranthene
GC/MS	8270D (SIM)	Benzo(g,h,i)perylene
GC/MS	8270D (SIM)	Benzo(k)fluoranthene
GC/MS	8270D (SIM)	Chrysene
GC/MS	8270D (SIM)	Dibenz(a,h)anthracene
GC/MS	8270D (SIM)	Fluoranthene
GC/MS	8270D (SIM)	Fluorene
GC/MS	8270D (SIM)	Indeno(1,2,3-cd)pyrene
GC/MS	8270D (SIM)	1-Methylphenol
GC/MS	8270D (SIM)	2-Methylphenol
GC/MS	8270D (SIM)	Naphthalene
GC/MS	8270D (SIM)	Pentachlorophenol
GC/MS	8270D (SIM)	Phenanthrene
GC/MS	8270D (SIM)	Pyrene
GC/MS	8260B	Dichlorodifluoromethane
GC/MS	8260B	Chloromethane
GC/MS	8260B	Vinyl chloride
GC/MS	8260B	Bromomethane
GC/MS	8260B	Chloroethane
GC/MS	8260B	Trichlorofluoromethane
GC/MS	8260B	Ethyl ether
GC/MS	8260B	Acrolein

Solid and Chemical Waste

Technology	Method	Analyte
GC/MS	8260B	1,1-Dichloroethene
GC/MS	8260B	Freon 113
GC/MS	8260B	Acetone
GC/MS	8260B	Methyl iodide
GC/MS	8260B	Carbon disulfide
GC/MS	8260B	Allyl chloride
GC/MS	8260B	Acetonitrile
GC/MS	8260B	Methyl Acetate
GC/MS	8260B	Methylene chloride
GC/MS	8260B	Acrylonitrile
GC/MS	8260B	trans-1,2-Dichloroethene
GC/MS	8260B	tert-Butyl methyl ether
GC/MS	8260B	Diisopropyl ether (IPE)
GC/MS	8260B	1,1-Dichloroethane
GC/MS	8260B	Vinyl acetate
GC/MS	8260B	Chloroprene
GC/MS	8260B	cis-1,2-Dichloroethene
GC/MS	8260B	2-Butanone (MEK)
GC/MS	8260B	2,2-Dichloropropane
GC/MS	8260B	Benzene
GC/MS	8260B	Tetrahydrofuran
GC/MS	8260B	Methacrylonitrile
GC/MS	8260B	Propionitrile
GC/MS	8260B	Bromochloromethane
GC/MS	8260B	Chloroform
GC/MS	8260B	1,1,1-Trichloroethane
GC/MS	8260B	Carbon tetrachloride
GC/MS	8260B	Trichloroethene
GC/MS	8260B	Cyclohexane
GC/MS	8260B	1,1-Dichloropropene
GC/MS	8260B	Isobutyl alcohol
GC/MS	8260B	Methylcyclohexane
GC/MS	8260B	1,2-Dichloroethane
GC/MS	8260B	Methyl methacrylate
GC/MS	8260B	1,2-Dichloropropane
GC/MS	8260B	1,4-Dioxane
GC/MS	8260B	Bromodichloromethane
GC/MS	8260B	Dibromomethane
GC/MS	8260B	cis-1,3-Dichloropropene
GC/MS	8260B	Toluene
GC/MS	8260B	4-Methyl-2-pentanone

Solid and Chemical Waste

Technology	Method	Analyte
GC/MS	8260B	2-Chloroethylvinyl ether
GC/MS	8260B	trans-1,3-Dichloropropene
GC/MS	8260B	Ethyl methacrylate
GC/MS	8260B	1,1,2-Trichloroethane
GC/MS	8260B	Tetrachloroethene
GC/MS	8260B	1,3-Dichloropropane
GC/MS	8260B	2-Hexanone
GC/MS	8260B	Dibromochloromethane
GC/MS	8260B	1,2-Dibromoethane (EDB)
GC/MS	8260B	Chlorobenzene
GC/MS	8260B	1,1,1,2-Tetrachloroethane
GC/MS	8260B	Ethylbenzene
GC/MS	8260B	m+p-Xylenes
GC/MS	8260B	o-Xylene
GC/MS	8260B	Styrene
GC/MS	8260B	Bromoform
GC/MS	8260B	Isopropylbenzene
GC/MS	8260B	1,1,2,2-Tetrachloroethene
GC/MS	8260B	Bromobenzene
GC/MS	8260B	1,2,3-Trichloropropane
GC/MS	8260B	Cyclohexanone
GC/MS	8260B	trans-1,4-Dichloro-2-butene
GC/MS	8260B	n-Propylbenzene
GC/MS	8260B	2-Chlorotoluene
GC/MS	8260B	1,3,5-Trimethylbenzene
GC/MS	8260B	4-Chlorotoluene
GC/MS	8260B	tert-Butylbenzene
GC/MS	8260B	1,2,4-Trimethylbenzene
GC/MS	8260B	sec-Butylbenzene
GC/MS	8260B	1,3-Dichlorobenzene
GC/MS	8260B	p-Isopropyltoluene
GC/MS	8260B	1,4-Dichlorobenzene
GC/MS	8260B	Benzyl chloride
GC/MS	8260B	n-Butylbenzene
GC/MS	8260B	1,2-Dichlorobenzene
GC/MS	8260B	1,2-Dibromo-3-chloropropane
GC/MS	8260B	1,2,4-Trichlorobenzene
GC/MS	8260B	Naphthalene
GC/MS	8260B	1,2,3-Trichlorobenzene
GC/MS	8260B (SIM)	1,4-Dioxane
GC	8081B	alpha-BHC

Solid and Chemical Waste

Technology	Method	Analyte
GC	8081B	gamma-BHC (Lindane)
GC	8081B	Heptachlor
GC	8081B	Aldrin
GC	8081B	beta-BHC
GC	8081B	delta-BHC
GC	8081B	Heptachlor Epoxide
GC	8081B	gamma-Chlordane
GC	8081B	alpha-Chlordane
GC	8081B	Endosulfan I
GC	8081B	4,4'-DDE
GC	8081B	Dieldrin
GC	8081B	Endrin
GC	8081B	4,4'-DDD
GC	8081B	Endosulfan II
GC	8081B	4,4'-DDT
GC	8081B	Endrin Aldehyde
GC	8081B	Endosulfan sulfate
GC	8081B	Methoxychlor
GC	8081B	Endrin Ketone
GC	8081B	Toxaphene
GC	8082A	Aroclor 1016
GC	8082A	Aroclor 1221
GC	8082A	Aroclor 1232
GC	8082A	Aroclor 1242
GC	8082A	Aroclor 1248
GC	8082A	Aroclor 1254
GC	8082A	Aroclor 1260
GC	8082A	Aroclor 1262
GC	8082A	Aroclor 1268
HPLC	8330A	2-Amino-4,6-dinitrotoluene
HPLC	8330A	4-Amino-2,6-dinitrotoluene
HPLC	8330A	1,3-Dinitrobenzene
HPLC	8330A	2,4-Dinitrotoluene
HPLC	8330A	2,6-Dinitrotoluene
HPLC	8330A	HMX
HPLC	8330A	Nitrobenzene
HPLC	8330A	2-Nitrotoluene
HPLC	8330A	3-Nitrotoluene
HPLC	8330A	4-Nitrotoluene
HPLC	8330A	RDX
HPLC	8330A	Tetryl

Solid and Chemical Waste

Technology	Method	Analyte
HPLC	8330A	1,3,5-Trinitrobenzene
HPLC	8330A	2,4,6-Trinitrotoluene
GC	8015C	Diesel Range Organics
GC	8015C	Gasoline Range Organics
ICP	6010 C	Aluminum
ICP	6010 C	Antimony
ICP	6010 C	Arsenic
ICP	6010 C	Barium
ICP	6010 C	Beryllium
ICP	6010 C	Cadmium
ICP	6010 C	Calcium
ICP	6010 C	Chromium
ICP	6010 C	Cobalt
ICP	6010 C	Copper
ICP	6010 C	Iron
ICP	6010 C	Lead
ICP	6010 C	Magnesium
ICP	6010 C	Manganese
ICP	6010 C	Nickel
ICP	6010 C	Potassium
ICP	6010 C	Selenium
ICP	6010 C	Silver
ICP	6010 C	Sodium
ICP	6010 C	Thallium
ICP	6010 C	Vanadium
ICP	6010 C	Zinc
ICP/MS	6020A	Aluminum
ICP/MS	6020A	Antimony
ICP/MS	6020A	Arsenic
ICP/MS	6020A	Barium
ICP/MS	6020A	Beryllium
ICP/MS	6020A	Cadmium
ICP/MS	6020A	Calcium
ICP/MS	6020A	Chromium
ICP/MS	6020A	Cobalt
ICP/MS	6020A	Copper
ICP/MS	6020A	Iron
ICP/MS	6020A	Lead
ICP/MS	6020A	Magnesium
ICP/MS	6020A	Manganese
ICP/MS	6020A	Nickel

Solid and Chemical Waste

Technology	Method	Analyte
ICP/MS	6020A	Potassium
ICP/MS	6020A	Selenium
ICP/MS	6020A	Silver
ICP/MS	6020A	Sodium
ICP/MS	6020A	Thallium
ICP/MS	6020A	Vanadium
ICP/MS	6020A	Zinc
CVAA	7471B	Mercury
Titration	Walkley-Black	TOC
UV/VIS	9012B	Total Cyanide
IC	9056A	Fluoride
IC	9056A	Sulfate
IC	9056A	Nitrate
IC	9056A	Nitrite
IC	300.0	Fluoride
IC	300.0	Chloride
IC	300.0	Sulfate
IC	300.0	Bromide
IC	300.0	Nitrate
IC	300.0	Nitrite
UV/VIS	7196A / 3060A	Hexavalent chromium
Pensky-Martens	1010A	Ignitability
Electrode	9045D	Corrosivity
Titration	Sec. 7.3.3 SW-846	Reactive Cyanide
Photometric	Sec. 7.3.4 SW-846	Reactive Sulfide
Filtration	9095B	Paint Filter Test
UV/VIS	365.1-MOD	Phosphorus
UV/VIS	353.2-MOD	Nitrate
UV/VIS	353.2-MOD	Nitrite
UV/VIS	353.2-MOD	Nitrate-Nitrite
UV/VIS	350.1/SM 4500-NH3 B-MOD	Ammonia
UV/VIS	351.2-MOD	TKN
GC	MADEP-EPH-MOD	Extractable Petroleum Hydrocarbons (EPH) Modified
Preparation	**Method**	**Type**
Organic Preparation	3550C	Preparation of Soil by Sonication
Organic Cleanup	3620B	Florisil Cleanup Procedure
Organic Cleanup	3660B	Sulfur Cleanup Procedure
Organic Cleanup	3665A	Sulfuric Acid Cleanup Procedure
Volatile Organic Preparation	5035	Closed-System Purge-and-Trap and extraction for Volatile Organics in Soil and Waste Samples

Solid and Chemical Waste		
Technology	**Method**	**Analyte**
Volatile Organic Preparation	3585	Waste Dilution for Volatile Organics
Waste Dilution	3580A	Waste Dilution
Inorganic Preparation	3050B	Preparation of Soils by Hotblock
Inorganic Preparation	1311	Toxicity Characteristic Leaching Procedure (TCLP)
Inorganic Preparation	1312	Synthetic Precipitation Leaching Procedure (SPLP)
Inorganic Metals Preparation	3010A	Acid Digestion of Aqueous Samples and TCLP/SPLP Extracts

Notes:

1) This laboratory offers commercial testing service.

Approved By: _____ Date: February 28, 2013

R. Douglas Leonard
Chief Technical Officer

Reissued: 2/28/13

State of Florida
Department of Health, Bureau of Public Health Laboratories

This is to certify that

E87653

SHEALY ENVIRONMENTAL SERVICES, INC. - 1
106 VANTAGE POINT DRIVE
WEST COLUMBIA, SC 29172

has complied with Florida Administrative Code 64E-1,
for the examination of environmental samples in the following categories

DRINKING WATER - MICROBIOLOGY, DRINKING WATER - PRIMARY INORGANIC CONTAMINANTS, DRINKING WATER - SECONDARY INORGANIC CONTAMINANTS, DRINKING WATER - SYNTHETIC ORGANIC CONTAMINANTS, NON-POTABLE WATER - EXTRACTABLE ORGANICS, NON-POTABLE WATER - GENERAL CHEMISTRY, NON-POTABLE WATER - METALS, NON-POTABLE WATER - MICROBIOLOGY, NON-POTABLE WATER - PESTICIDES-HERBICIDES-PCB'S, NON-POTABLE WATER - VOLATILE ORGANICS, SOLID AND CHEMICAL MATERIALS - EXTRACTABLE ORGANICS, SOLID AND CHEMICAL MATERIALS - GENERAL CHEMISTRY, SOLID AND CHEMICAL MATERIALS - METALS, SOLID AND CHEMICAL MATERIALS - PESTICIDES-HERBICIDES-PCB'S, SOLID AND CHEMICAL MATERIALS - VOLATILE ORGANICS

Continued certification is contingent upon successful on-going compliance with the NELAC Standards and FAC Rule 64E-1 regulations. Specific methods and analytes certified are cited on the Laboratory Scope of Accreditation for this laboratory and are on file at the Bureau of Public Health Laboratories, P. O. Box 210, Jacksonville, Florida 32231. Clients and customers are urged to verify with this agency the laboratory's certification status in Florida for particular methods and analytes.

Date Issued: September 18, 2013 Expiration Date: June 30, 2014

Victor Johnson

Victor Johnson, Director
Division of Emergency Preparedness and Community Support
DH Form 1697, 7/04
NON-TRANSFERABLE E87653-28-09/18/2013
Supersedes all previously issued certificates

Laboratory Scope of Accreditation

Attachment to Certificate #: E87653-28, expiration date June 30, 2014. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87653 **EPA Lab Code:** SC00162 (803) 791-9700

E87653
Shealy Environmental Services, Inc. - 1
106 Vantage Point Drive
West Columbia, SC 29172

Matrix: Drinking Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504.1	Synthetic Organic Contaminants	NELAP	7/3/2001
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 504.1	Synthetic Organic Contaminants	NELAP	7/3/2001
Alkalinity as CaCO3	SM 2320 B	Primary Inorganic Contaminants	NELAP	2/6/2003
Aluminum	EPA 200.7	Secondary Inorganic Contaminants	NELAP	10/17/2005
Aluminum	EPA 200.8	Secondary Inorganic Contaminants	NELAP	10/17/2005
Antimony	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/17/2005
Arsenic	EPA 200.7	Primary Inorganic Contaminants	NELAP	7/3/2001
Arsenic	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/17/2005
Barium	EPA 200.7	Primary Inorganic Contaminants	NELAP	7/3/2001
Barium	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/17/2005
Beryllium	EPA 200.7	Primary Inorganic Contaminants	NELAP	7/3/2001
Beryllium	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/17/2005
Cadmium	EPA 200.7	Primary Inorganic Contaminants	NELAP	7/3/2001
Cadmium	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/17/2005
Calcium	EPA 200.7	Primary Inorganic Contaminants	NELAP	10/17/2005
Chloride	EPA 300.0	Secondary Inorganic Contaminants	NELAP	3/25/2003
Chromium	EPA 200.7	Primary Inorganic Contaminants	NELAP	7/3/2001
Chromium	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/17/2005
Conductivity	SM 2510 B	Primary Inorganic Contaminants	NELAP	12/9/2011
Copper	EPA 200.7	Primary Inorganic Contaminants,Secondary Inorganic Contaminants	NELAP	7/3/2001
Copper	EPA 200.8	Primary Inorganic Contaminants,Secondary Inorganic Contaminants	NELAP	10/17/2005
Escherichia coli	SM 9223 B	Microbiology	NELAP	7/3/2001
Fluoride	EPA 300.0	Secondary Inorganic Contaminants,Primary Inorganic Contaminants	NELAP	12/9/2011
Iron	EPA 200.7	Secondary Inorganic Contaminants	NELAP	3/25/2003
Lead	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/17/2005
Magnesium	EPA 200.7	Primary Inorganic Contaminants	NELAP	10/17/2005
Manganese	EPA 200.7	Secondary Inorganic Contaminants	NELAP	7/3/2001
Manganese	EPA 200.8	Secondary Inorganic Contaminants	NELAP	10/17/2005
Mercury	EPA 245.1	Primary Inorganic Contaminants	NELAP	11/7/2002
Molybdenum	EPA 200.8	Secondary Inorganic Contaminants	NELAP	10/17/2005
Nickel	EPA 200.7	Primary Inorganic Contaminants	NELAP	7/3/2001
Nickel	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/17/2005
Nitrate as N	EPA 300.0	Primary Inorganic Contaminants	NELAP	3/25/2003

Laboratory Scope of Accreditation

Attachment to Certificate #: E87653-28, expiration date June 30, 2014. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87653 **EPA Lab Code:** SC00162 (803) 791-9700

E87653
Shealy Environmental Services, Inc. - 1
106 Vantage Point Drive
West Columbia, SC 29172

Matrix: Drinking Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Nitrate as N	EPA 353.2	Primary Inorganic Contaminants	NELAP	1/31/2012
Nitrite as N	EPA 300.0	Primary Inorganic Contaminants	NELAP	3/25/2003
Nitrite as N	EPA 353.2	Primary Inorganic Contaminants	NELAP	1/31/2003
pH	EPA 150.1	Primary Inorganic Contaminants,Secondary Inorganic Contaminants	NELAP	7/3/2001
Residue-filterable (TDS)	SM 2540 C	Secondary Inorganic Contaminants	NELAP	10/17/2005
Selenium	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/17/2005
Silver	EPA 200.7	Secondary Inorganic Contaminants	NELAP	1/31/2003
Silver	EPA 200.8	Secondary Inorganic Contaminants	NELAP	11/14/2011
Sodium	EPA 200.7	Primary Inorganic Contaminants	NELAP	10/17/2005
Sulfate	EPA 300.0	Secondary Inorganic Contaminants,Primary Inorganic Contaminants	NELAP	7/3/2001
Thallium	EPA 200.8	Primary Inorganic Contaminants	NELAP	10/17/2005
Total coliforms	SM 9223 B	Microbiology	NELAP	7/3/2001
Total cyanide	EPA 335.4	Primary Inorganic Contaminants	NELAP	10/17/2005
Total nitrate-nitrite	EPA 353.2	Primary Inorganic Contaminants	NELAP	10/17/2005
Total residual chlorine	SM 4500-Cl G	Primary Inorganic Contaminants	NELAP	10/17/2005
Turbidity	EPA 180.1	Secondary Inorganic Contaminants	NELAP	3/18/2008
Vanadium	EPA 200.8	Secondary Inorganic Contaminants	NELAP	10/17/2005
Zinc	EPA 200.7	Secondary Inorganic Contaminants	NELAP	7/3/2001

Laboratory Scope of Accreditation

Attachment to Certificate #: E87653-28, expiration date June 30, 2014. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87653 **EPA Lab Code:** SC00162 (803) 791-9700

E87653
Shealy Environmental Services, Inc. - 1
106 Vantage Point Drive
West Columbia, SC 29172

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,1,1,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1,1-Trichloroethane	EPA 624	Volatile Organics	NELAP	7/3/2001
1,1,1-Trichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1,2,2-Tetrachloroethane	EPA 624	Volatile Organics	NELAP	7/3/2001
1,1,2,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1,2-Trichloroethane	EPA 624	Volatile Organics	NELAP	7/3/2001
1,1,2-Trichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1-Dichloroethane	EPA 624	Volatile Organics	NELAP	7/3/2001
1,1-Dichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1-Dichloroethylene	EPA 624	Volatile Organics	NELAP	7/3/2001
1,1-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,1-Dichloropropene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,3-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	10/17/2005
1,2,3-Trichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,4-Trichlorobenzene	EPA 625	Extractable Organics	NELAP	7/3/2001
1,2,4-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2,4-Trichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,2,4-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8011	Volatile Organics	NELAP	7/1/2003
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8011	Volatile Organics	NELAP	7/1/2003
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	7/3/2001
1,2-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	7/3/2001
1,2-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,2-Dichloroethane	EPA 624	Volatile Organics	NELAP	7/3/2001
1,2-Dichloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Dichloropropane	EPA 624	Volatile Organics	NELAP	7/3/2001
1,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,2-Diphenylhydrazine	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,3,5-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,3-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	7/3/2001
1,3-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	7/3/2001
1,3-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,3-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003

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Shealy Environmental Services, Inc. - 1
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West Columbia, SC 29172

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,3-Dichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,4-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	7/3/2001
1,4-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	7/3/2001
1,4-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
1,4-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
1,4-Dioxane (1,4-Diethyleneoxide)	EPA 8260	Volatile Organics	NELAP	7/1/2003
2,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	7/1/2003
2,4,5-T	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	10/17/2005
2,4,5-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4,6-Trichlorophenol	EPA 625	Extractable Organics	NELAP	7/3/2001
2,4,6-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-D	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	10/17/2005
2,4-DB	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
2,4-Dichlorophenol	EPA 625	Extractable Organics	NELAP	7/3/2001
2,4-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dimethylphenol	EPA 625	Extractable Organics	NELAP	7/3/2001
2,4-Dimethylphenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dinitrophenol	EPA 625	Extractable Organics	NELAP	7/3/2001
2,4-Dinitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,4-Dinitrotoluene (2,4-DNT)	EPA 625	Extractable Organics	NELAP	7/3/2001
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,6-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2,6-Dinitrotoluene (2,6-DNT)	EPA 625	Extractable Organics	NELAP	7/3/2001
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Chloroethyl vinyl ether	EPA 624	Volatile Organics	NELAP	7/3/2001
2-Chloroethyl vinyl ether	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Chloronaphthalene	EPA 625	Extractable Organics	NELAP	7/3/2001
2-Chloronaphthalene	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Chlorophenol	EPA 625	Extractable Organics	NELAP	7/3/2001
2-Chlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	10/17/2005
2-Hexanone	EPA 8260	Volatile Organics	NELAP	7/1/2003
2-Methyl-4,6-dinitrophenol	EPA 625	Extractable Organics	NELAP	7/3/2001
2-Methyl-4,6-dinitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Methylnaphthalene	EPA 8270	Extractable Organics	NELAP	7/1/2003

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Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
2-Methylphenol (o-Cresol)	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
2-Nitrophenol	EPA 625	Extractable Organics	NELAP	7/3/2001
2-Nitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
3,3'-Dichlorobenzidine	EPA 625	Extractable Organics	NELAP	7/3/2001
3,3'-Dichlorobenzidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
3,3'-Dimethylbenzidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
3/4-Methylphenols (m/p-Cresols)	EPA 8270	Extractable Organics	NELAP	10/17/2005
3-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
4,4'-DDD	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
4,4'-DDD	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
4,4'-DDE	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
4,4'-DDE	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
4,4'-DDT	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
4,4'-DDT	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
4-Bromophenyl phenyl ether	EPA 625	Extractable Organics	NELAP	7/3/2001
4-Bromophenyl phenyl ether	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chloro-3-methylphenol	EPA 625	Extractable Organics	NELAP	7/3/2001
4-Chloro-3-methylphenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chloroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chlorophenyl phenylether	EPA 625	Extractable Organics	NELAP	7/3/2001
4-Chlorophenyl phenylether	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	10/17/2005
4-Methyl-2-pentanone (MIBK)	EPA 8260	Volatile Organics	NELAP	7/1/2003
4-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
4-Nitrophenol	EPA 625	Extractable Organics	NELAP	7/3/2001
4-Nitrophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acenaphthene	EPA 625	Extractable Organics	NELAP	7/3/2001
Acenaphthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acenaphthylene	EPA 625	Extractable Organics	NELAP	7/3/2001
Acenaphthylene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acetone	EPA 8260	Volatile Organics	NELAP	7/1/2003
Acetonitrile	EPA 8260	Volatile Organics	NELAP	7/1/2003
Acetophenone	EPA 8270	Extractable Organics	NELAP	7/1/2003
Acidity, as CaCO3	SM 2310 B	General Chemistry	NELAP	3/22/2012
Acrolein (Propenal)	EPA 8260	Volatile Organics	NELAP	7/1/2003

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Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Acrylonitrile	EPA 8260	Volatile Organics	NELAP	7/1/2003
Aldrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Aldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Alkalinity as CaCO3	SM 2320 B	General Chemistry	NELAP	12/31/2008
Allyl chloride (3-Chloropropene)	EPA 8260	Volatile Organics	NELAP	7/1/2003
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
alpha-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/24/2008
Aluminum	EPA 200.7	Metals	NELAP	7/3/2001
Aluminum	EPA 200.8	Metals	NELAP	10/17/2005
Aluminum	EPA 6010	Metals	NELAP	7/1/2003
Aluminum	EPA 6020	Metals	NELAP	10/17/2005
Amenable cyanide	EPA 9012	General Chemistry	NELAP	7/1/2003
Amenable cyanide	SM 4500-CN- G	General Chemistry	NELAP	12/31/2008
Ammonia as N	EPA 350.1	General Chemistry	NELAP	7/3/2001
Aniline	EPA 8270	Extractable Organics	NELAP	7/1/2003
Anthracene	EPA 625	Extractable Organics	NELAP	7/3/2001
Anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Antimony	EPA 200.7	Metals	NELAP	7/3/2001
Antimony	EPA 200.8	Metals	NELAP	10/17/2005
Antimony	EPA 6010	Metals	NELAP	7/1/2003
Antimony	EPA 6020	Metals	NELAP	10/17/2005
Aroclor-1016 (PCB-1016)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Aroclor-1016 (PCB-1016)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1221 (PCB-1221)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Aroclor-1221 (PCB-1221)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1232 (PCB-1232)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Aroclor-1232 (PCB-1232)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1242 (PCB-1242)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Aroclor-1242 (PCB-1242)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1248 (PCB-1248)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Aroclor-1248 (PCB-1248)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1254 (PCB-1254)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Aroclor-1254 (PCB-1254)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Aroclor-1260 (PCB-1260)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Aroclor-1260 (PCB-1260)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/1/2003

Laboratory Scope of Accreditation

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E87653
Shealy Environmental Services, Inc. - 1
106 Vantage Point Drive
West Columbia, SC 29172

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Aroclor-1262 (PCB-1262)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/22/2012
Aroclor-1268 (PCB-1268)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/22/2012
Arsenic	EPA 200.7	Metals	NELAP	7/3/2001
Arsenic	EPA 200.8	Metals	NELAP	10/17/2005
Arsenic	EPA 6010	Metals	NELAP	7/1/2003
Arsenic	EPA 6020	Metals	NELAP	10/17/2005
Barium	EPA 200.7	Metals	NELAP	1/17/2012
Barium	EPA 200.8	Metals	NELAP	10/17/2005
Barium	EPA 6010	Metals	NELAP	1/17/2012
Barium	EPA 6020	Metals	NELAP	10/17/2005
Benzene	EPA 624	Volatile Organics	NELAP	7/3/2001
Benzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Benzidine	EPA 625	Extractable Organics	NELAP	7/3/2001
Benzidine	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(a)anthracene	EPA 625	Extractable Organics	NELAP	7/3/2001
Benzo(a)anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(a)pyrene	EPA 625	Extractable Organics	NELAP	7/3/2001
Benzo(a)pyrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(b)fluoranthene	EPA 625	Extractable Organics	NELAP	7/3/2001
Benzo(b)fluoranthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(g,h,i)perylene	EPA 625	Extractable Organics	NELAP	7/3/2001
Benzo(g,h,i)perylene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzo(k)fluoranthene	EPA 625	Extractable Organics	NELAP	7/3/2001
Benzo(k)fluoranthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzoic acid	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzyl alcohol	EPA 8270	Extractable Organics	NELAP	7/1/2003
Benzyl chloride	EPA 8260	Volatile Organics	NELAP	7/1/2003
Beryllium	EPA 200.7	Metals	NELAP	7/3/2001
Beryllium	EPA 200.8	Metals	NELAP	10/17/2005
Beryllium	EPA 6010	Metals	NELAP	7/1/2003
Beryllium	EPA 6020	Metals	NELAP	10/17/2005
beta-BHC (beta-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Biochemical oxygen demand	SM 5210 B	General Chemistry	NELAP	12/31/2008
bis(2-Chloroethoxy)methane	EPA 625	Extractable Organics	NELAP	7/3/2001
bis(2-Chloroethoxy)methane	EPA 8270	Extractable Organics	NELAP	7/1/2003

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Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
bis(2-Chloroethyl) ether	EPA 625	Extractable Organics	NELAP	7/3/2001
bis(2-Chloroethyl) ether	EPA 8270	Extractable Organics	NELAP	7/1/2003
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 625	Extractable Organics	NELAP	7/3/2001
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 8270	Extractable Organics	NELAP	7/1/2003
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 625	Extractable Organics	NELAP	7/3/2001
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270	Extractable Organics	NELAP	7/1/2003
Boron	EPA 200.7	Metals	NELAP	7/3/2001
Boron	EPA 6010	Metals	NELAP	7/1/2003
Boron	EPA 6020	Metals	NELAP	10/17/2005
Bromide	EPA 300.0	General Chemistry	NELAP	7/3/2001
Bromide	EPA 9056	General Chemistry	NELAP	7/1/2003
Bromobenzene	EPA 8260	Volatile Organics	NELAP	10/17/2005
Bromochloromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Bromodichloromethane	EPA 624	Volatile Organics	NELAP	7/3/2001
Bromodichloromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Bromoform	EPA 624	Volatile Organics	NELAP	7/3/2001
Bromoform	EPA 8260	Volatile Organics	NELAP	7/1/2003
Butyl benzyl phthalate	EPA 625	Extractable Organics	NELAP	7/3/2001
Butyl benzyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Cadmium	EPA 200.7	Metals	NELAP	7/3/2001
Cadmium	EPA 200.8	Metals	NELAP	10/17/2005
Cadmium	EPA 6010	Metals	NELAP	7/1/2003
Cadmium	EPA 6020	Metals	NELAP	10/17/2005
Calcium	EPA 200.7	Metals	NELAP	7/3/2001
Calcium	EPA 6010	Metals	NELAP	7/1/2003
Calcium	EPA 6020	Metals	NELAP	10/17/2005
Caprolactam	EPA 8270	Extractable Organics	NELAP	3/22/2012
Carbazole	EPA 8270	Extractable Organics	NELAP	7/1/2003
Carbon disulfide	EPA 8260	Volatile Organics	NELAP	7/1/2003
Carbon tetrachloride	EPA 624	Volatile Organics	NELAP	7/3/2001
Carbon tetrachloride	EPA 8260	Volatile Organics	NELAP	7/1/2003
Carbonaceous BOD (CBOD)	SM 5210 B	General Chemistry	NELAP	7/3/2001
Chemical oxygen demand	SM 5220 D	General Chemistry	NELAP	12/31/2008
Chlorate	EPA 300.0	General Chemistry	NELAP	3/22/2012
Chlordane (tech.)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Chlordane (tech.)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	10/17/2005
Chloride	EPA 300.0	General Chemistry	NELAP	7/3/2001
Chloride	EPA 9056	General Chemistry	NELAP	10/17/2005
Chlorobenzene	EPA 624	Volatile Organics	NELAP	7/3/2001
Chlorobenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chloroethane	EPA 624	Volatile Organics	NELAP	7/3/2001
Chloroethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chloroform	EPA 624	Volatile Organics	NELAP	7/3/2001
Chloroform	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chloroprene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Chromium	EPA 200.7	Metals	NELAP	7/3/2001
Chromium	EPA 200.8	Metals	NELAP	10/17/2005
Chromium	EPA 6010	Metals	NELAP	7/1/2003
Chromium	EPA 6020	Metals	NELAP	10/17/2005
Chromium VI	EPA 7196	General Chemistry	NELAP	10/17/2005
Chromium VI	SM 3500-Cr D (18th/19th Ed.)/UV-VIS	General Chemistry	NELAP	2/11/2003
Chrysene	EPA 625	Extractable Organics	NELAP	7/3/2001
Chrysene	EPA 8270	Extractable Organics	NELAP	7/1/2003
cis-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
cis-1,3-Dichloropropene	EPA 624	Volatile Organics	NELAP	7/3/2001
cis-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Cobalt	EPA 200.7	Metals	NELAP	7/3/2001
Cobalt	EPA 200.8	Metals	NELAP	10/17/2005
Cobalt	EPA 6010	Metals	NELAP	7/1/2003
Cobalt	EPA 6020	Metals	NELAP	10/17/2005
Color	SM 2120 B	General Chemistry	NELAP	12/31/2008
Color	SM 2120 E	General Chemistry	NELAP	12/31/2008
Conductivity	EPA 120.1	General Chemistry	NELAP	7/3/2001
Conductivity	SM 2510 B	General Chemistry	NELAP	3/22/2012
Copper	EPA 200.7	Metals	NELAP	7/3/2001
Copper	EPA 200.8	Metals	NELAP	10/17/2005
Copper	EPA 6010	Metals	NELAP	7/1/2003
Copper	EPA 6020	Metals	NELAP	10/17/2005
Cyanide	EPA 335.4	General Chemistry	NELAP	12/31/2008
Cyanide	SM 4500-CN E	General Chemistry	NELAP	3/22/2012
Dalapon	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003

Laboratory Scope of Accreditation

Attachment to Certificate #: E87653-28, expiration date June 30, 2014. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87653 **EPA Lab Code:** SC00162 (803) 791-9700

E87653
Shealy Environmental Services, Inc. - 1
106 Vantage Point Drive
West Columbia, SC 29172

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
delta-BHC	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
delta-BHC	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dibenz(a,h)anthracene	EPA 625	Extractable Organics	NELAP	7/3/2001
Dibenz(a,h)anthracene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dibenzofuran	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dibromochloromethane	EPA 624	Volatile Organics	NELAP	7/3/2001
Dibromochloromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Dibromomethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Dicamba	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	10/17/2005
Dichlorodifluoromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Dichloroprop (Dichlorprop)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Dieldrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Dieldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Diesel range organics (DRO)	EPA 8015	Extractable Organics	NELAP	7/1/2003
Diesel range organics (DRO)	MADEP-EPH (MA-EPH)	Extractable Organics	NELAP	3/22/2012
Diethyl ether	EPA 8260	Volatile Organics	NELAP	7/1/2003
Diethyl phthalate	EPA 625	Extractable Organics	NELAP	7/3/2001
Diethyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dimethyl phthalate	EPA 625	Extractable Organics	NELAP	7/3/2001
Dimethyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Di-n-butyl phthalate	EPA 625	Extractable Organics	NELAP	7/3/2001
Di-n-butyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Di-n-octyl phthalate	EPA 625	Extractable Organics	NELAP	7/3/2001
Di-n-octyl phthalate	EPA 8270	Extractable Organics	NELAP	7/1/2003
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endosulfan I	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Endosulfan I	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endosulfan II	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Endosulfan II	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endosulfan sulfate	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Endosulfan sulfate	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Endrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endrin aldehyde	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Endrin aldehyde	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Endrin ketone	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003

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E87653
Shealy Environmental Services, Inc. - 1
106 Vantage Point Drive
West Columbia, SC 29172

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Ethyl methacrylate	EPA 8260	Volatile Organics	NELAP	7/1/2003
Ethylbenzene	EPA 624	Volatile Organics	NELAP	7/3/2001
Ethylbenzene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Fecal coliforms	COLILERT®-18 (Fecal Coliforms)	Microbiology	NELAP	3/22/2012
Fluoranthene	EPA 625	Extractable Organics	NELAP	7/3/2001
Fluoranthene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Fluorene	EPA 625	Extractable Organics	NELAP	7/3/2001
Fluorene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Fluoride	EPA 300.0	General Chemistry	NELAP	3/27/2003
Fluoride	EPA 9056	General Chemistry	NELAP	7/1/2003
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
gamma-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/24/2008
Gasoline range organics (GRO)	EPA 8015	Extractable Organics	NELAP	7/1/2003
Gasoline range organics (GRO)	MADEP-VPH (MA-VPH)	Volatile Organics	NELAP	3/22/2012
Hardness	SM 2340 C	General Chemistry	NELAP	12/31/2008
Heptachlor	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Heptachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Heptachlor epoxide	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Heptachlor epoxide	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Hexachlorobenzene	EPA 625	Extractable Organics	NELAP	7/3/2001
Hexachlorobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachlorobutadiene	EPA 625	Extractable Organics	NELAP	7/3/2001
Hexachlorobutadiene	EPA 8260	Volatile Organics	NELAP	3/22/2012
Hexachlorobutadiene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachlorocyclopentadiene	EPA 625	Extractable Organics	NELAP	7/3/2001
Hexachlorocyclopentadiene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Hexachloroethane	EPA 625	Extractable Organics	NELAP	7/3/2001
Hexachloroethane	EPA 8270	Extractable Organics	NELAP	7/1/2003
Ignitability	EPA 1010	General Chemistry	NELAP	7/1/2003
Indeno(1,2,3-cd)pyrene	EPA 625	Extractable Organics	NELAP	7/3/2001
Indeno(1,2,3-cd)pyrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Iodomethane (Methyl iodide)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Iron	EPA 200.7	Metals	NELAP	7/3/2001
Iron	EPA 6010	Metals	NELAP	7/1/2003

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Shealy Environmental Services, Inc. - 1
106 Vantage Point Drive
West Columbia, SC 29172

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Iron	EPA 6020	Metals	NELAP	10/17/2005
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Isophorone	EPA 625	Extractable Organics	NELAP	7/3/2001
Isophorone	EPA 8270	Extractable Organics	NELAP	7/1/2003
Isopropylbenzene	EPA 8260	Volatile Organics	NELAP	10/17/2005
Kjeldahl nitrogen - total	EPA 351.2	General Chemistry	NELAP	11/7/2002
Lead	EPA 200.7	Metals	NELAP	1/17/2012
Lead	EPA 200.8	Metals	NELAP	10/17/2005
Lead	EPA 6010	Metals	NELAP	1/17/2012
Lead	EPA 6020	Metals	NELAP	10/17/2005
Magnesium	EPA 200.7	Metals	NELAP	7/3/2001
Magnesium	EPA 6010	Metals	NELAP	7/1/2003
Magnesium	EPA 6020	Metals	NELAP	10/17/2005
Manganese	EPA 200.7	Metals	NELAP	7/3/2001
Manganese	EPA 200.8	Metals	NELAP	10/17/2005
Manganese	EPA 6010	Metals	NELAP	7/1/2003
Manganese	EPA 6020	Metals	NELAP	10/17/2005
MCPA	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
MCPP	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Mercury	EPA 1631	Metals	NELAP	10/17/2005
Mercury	EPA 245.1	Metals	NELAP	2/5/2003
Mercury	EPA 7470	Metals	NELAP	7/1/2003
Methacrylonitrile	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methoxychlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Methyl acetate	EPA 8260	Volatile Organics	NELAP	3/22/2012
Methyl bromide (Bromomethane)	EPA 624	Volatile Organics	NELAP	7/3/2001
Methyl bromide (Bromomethane)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methyl chloride (Chloromethane)	EPA 624	Volatile Organics	NELAP	7/3/2001
Methyl chloride (Chloromethane)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methyl methacrylate	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methyl tert-butyl ether (MTBE)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Methylcyclohexane	EPA 8260	Volatile Organics	NELAP	3/22/2012
Methylene chloride	EPA 624	Volatile Organics	NELAP	7/3/2001
Methylene chloride	EPA 8260	Volatile Organics	NELAP	7/1/2003
Molybdenum	EPA 200.7	Metals	NELAP	7/3/2001
Molybdenum	EPA 200.8	Metals	NELAP	10/17/2005

Laboratory Scope of Accreditation

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State Laboratory ID: E87653 **EPA Lab Code:** SC00162 **(803) 791-9700**

E87653
Shealy Environmental Services, Inc. - 1
106 Vantage Point Drive
West Columbia, SC 29172

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Molybdenum	EPA 6010	Metals	NELAP	7/1/2003
Molybdenum	EPA 6020	Metals	NELAP	10/17/2005
Naphthalene	EPA 625	Extractable Organics	NELAP	7/3/2001
Naphthalene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Naphthalene	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Butylbenzene	EPA 8260	Volatile Organics	NELAP	10/17/2005
Nickel	EPA 200.7	Metals	NELAP	7/3/2001
Nickel	EPA 200.8	Metals	NELAP	10/17/2005
Nickel	EPA 6010	Metals	NELAP	7/1/2003
Nickel	EPA 6020	Metals	NELAP	10/17/2005
Nitrate	EPA 9056	General Chemistry	NELAP	7/1/2003
Nitrate as N	EPA 300.0	General Chemistry	NELAP	3/27/2003
Nitrate as N	EPA 353.2	General Chemistry	NELAP	7/3/2001
Nitrate-nitrite	EPA 353.2	General Chemistry	NELAP	7/3/2001
Nitrite	EPA 9056	General Chemistry	NELAP	7/1/2003
Nitrite as N	EPA 300.0	General Chemistry	NELAP	3/27/2003
Nitrite as N	EPA 353.2	General Chemistry	NELAP	8/25/2008
Nitrobenzene	EPA 625	Extractable Organics	NELAP	7/3/2001
Nitrobenzene	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosodimethylamine	EPA 625	Extractable Organics	NELAP	7/3/2001
n-Nitrosodimethylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosodi-n-propylamine	EPA 625	Extractable Organics	NELAP	7/3/2001
n-Nitrosodi-n-propylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Nitrosodiphenylamine	EPA 625	Extractable Organics	NELAP	7/3/2001
n-Nitrosodiphenylamine	EPA 8270	Extractable Organics	NELAP	7/1/2003
n-Propylbenzene	EPA 8260	Volatile Organics	NELAP	10/17/2005
Oil & Grease	EPA 1664A	General Chemistry	NELAP	10/17/2005
Orthophosphate as P	EPA 365.1	General Chemistry	NELAP	3/22/2012
Pentachlorophenol	EPA 625	Extractable Organics	NELAP	7/3/2001
Pentachlorophenol	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
Pentachlorophenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
pH	EPA 9040	General Chemistry	NELAP	7/1/2003
pH	SM 4500-H+-B	General Chemistry	NELAP	12/31/2008
Phenanthrene	EPA 625	Extractable Organics	NELAP	7/3/2001
Phenanthrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Phenol	EPA 625	Extractable Organics	NELAP	7/3/2001

Laboratory Scope of Accreditation

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State Laboratory ID: E87653 **EPA Lab Code:** SC00162 (803) 791-9700

E87653
Shealy Environmental Services, Inc. - 1
106 Vantage Point Drive
West Columbia, SC 29172

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Phenol	EPA 8270	Extractable Organics	NELAP	7/1/2003
Phosphorus, total	EPA 365.1	General Chemistry	NELAP	3/22/2012
p-Isopropyltoluene	EPA 8260	Volatile Organics	NELAP	10/17/2005
Potassium	EPA 200.7	Metals	NELAP	10/17/2005
Potassium	EPA 6010	Metals	NELAP	7/1/2003
Potassium	EPA 6020	Metals	NELAP	10/17/2005
Propionitrile (Ethyl cyanide)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Pyrene	EPA 625	Extractable Organics	NELAP	7/3/2001
Pyrene	EPA 8270	Extractable Organics	NELAP	7/1/2003
Pyridine	EPA 8270	Extractable Organics	NELAP	7/1/2003
Residue-filterable (TDS)	SM 2540 C	General Chemistry	NELAP	12/31/2008
Residue-nonfilterable (TSS)	SM 2540 D	General Chemistry	NELAP	12/31/2008
Residue-total	SM 2540 B	General Chemistry	NELAP	12/31/2008
Salinity	SM 2520 B	General Chemistry	NELAP	10/17/2005
sec-Butylbenzene	EPA 8260	Volatile Organics	NELAP	10/17/2005
Selenium	EPA 200.7	Metals	NELAP	7/3/2001
Selenium	EPA 200.8	Metals	NELAP	10/17/2005
Selenium	EPA 6010	Metals	NELAP	7/1/2003
Selenium	EPA 6020	Metals	NELAP	10/17/2005
Silver	EPA 200.7	Metals	NELAP	7/3/2001
Silver	EPA 200.8	Metals	NELAP	10/17/2005
Silver	EPA 6010	Metals	NELAP	7/1/2003
Silver	EPA 6020	Metals	NELAP	10/17/2005
Silvex (2,4,5-TP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	10/17/2005
Sodium	EPA 200.7	Metals	NELAP	7/3/2001
Sodium	EPA 6010	Metals	NELAP	7/1/2003
Sodium	EPA 6020	Metals	NELAP	12/13/2011
Styrene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Sulfate	EPA 300.0	General Chemistry	NELAP	7/3/2001
Sulfate	EPA 9056	General Chemistry	NELAP	7/1/2003
Sulfide	SM 4500-S E (18th Ed.)/TITR	General Chemistry	NELAP	3/22/2012
Sulfite-SO3	SM 4500-SO3 B	General Chemistry	NELAP	12/31/2008
Surfactants - MBAS	SM 5540 C	General Chemistry	NELAP	3/22/2012
tert-Butylbenzene	EPA 8260	Volatile Organics	NELAP	10/17/2005
Tetrachloroethylene (Perchloroethylene)	EPA 624	Volatile Organics	NELAP	7/3/2001
Tetrachloroethylene (Perchloroethylene)	EPA 8260	Volatile Organics	NELAP	7/1/2003

Laboratory Scope of Accreditation

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State Laboratory ID: E87653 **EPA Lab Code:** SC00162 (803) 791-9700

E87653
Shealy Environmental Services, Inc. - 1
106 Vantage Point Drive
West Columbia, SC 29172

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Thallium	EPA 200.7	Metals	NELAP	7/3/2001
Thallium	EPA 200.8	Metals	NELAP	10/17/2005
Thallium	EPA 6010	Metals	NELAP	7/1/2003
Thallium	EPA 6020	Metals	NELAP	10/17/2005
Tin	EPA 200.7	Metals	NELAP	3/27/2003
Tin	EPA 6010	Metals	NELAP	7/1/2003
Tin	EPA 6020	Metals	NELAP	10/17/2005
Titanium	EPA 6010	Metals	NELAP	7/1/2003
Titanium	EPA 6020	Metals	NELAP	10/17/2005
Toluene	EPA 624	Volatile Organics	NELAP	7/3/2001
Toluene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Total cyanide	EPA 9012	General Chemistry	NELAP	7/1/2003
Total cyanide	LACHAT 10-204-00-1-X	General Chemistry	NELAP	3/22/2012
Total organic carbon	EPA 9060	General Chemistry	NELAP	7/1/2003
Total organic carbon	SM 5310 C	General Chemistry	NELAP	3/22/2012
Total Petroleum Hydrocarbons (TPH)	FL-PRO	Extractable Organics	NELAP	7/24/2008
Total phenolics	EPA 420.4	General Chemistry	NELAP	3/27/2003
Total phenolics	EPA 9065	General Chemistry	NELAP	3/22/2012
Total residual chlorine	SM 4500-Cl G	General Chemistry	NELAP	12/31/2008
Toxaphene (Chlorinated camphene)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Toxaphene (Chlorinated camphene)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/1/2003
trans-1,2-Dichloroethylene	EPA 624	Volatile Organics	NELAP	7/3/2001
trans-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	7/1/2003
trans-1,3-Dichloropropene	EPA 624	Volatile Organics	NELAP	7/3/2001
trans-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	7/1/2003
trans-1,4-Dichloro-2-butene	EPA 8260	Volatile Organics	NELAP	7/1/2003
Trichloroethene (Trichloroethylene)	EPA 624	Volatile Organics	NELAP	7/3/2001
Trichloroethene (Trichloroethylene)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Trichlorofluoromethane	EPA 624	Volatile Organics	NELAP	7/3/2001
Trichlorofluoromethane	EPA 8260	Volatile Organics	NELAP	7/1/2003
Turbidity	EPA 180.1	General Chemistry	NELAP	7/3/2001
Vanadium	EPA 200.7	Metals	NELAP	7/3/2001
Vanadium	EPA 200.8	Metals	NELAP	10/17/2005
Vanadium	EPA 6010	Metals	NELAP	7/1/2003
Vanadium	EPA 6020	Metals	NELAP	10/17/2005
Vinyl acetate	EPA 8260	Volatile Organics	NELAP	7/1/2003

Laboratory Scope of Accreditation

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State Laboratory ID: E87653 **EPA Lab Code:** SC00162 (803) 791-9700

E87653
Shealy Environmental Services, Inc. - 1
106 Vantage Point Drive
West Columbia, SC 29172

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Vinyl chloride	EPA 624	Volatile Organics	NELAP	7/3/2001
Vinyl chloride	EPA 8260	Volatile Organics	NELAP	7/1/2003
Xylene (total)	EPA 624	Volatile Organics	NELAP	10/17/2005
Xylene (total)	EPA 8260	Volatile Organics	NELAP	7/1/2003
Zinc	EPA 200.7	Metals	NELAP	7/3/2001
Zinc	EPA 200.8	Metals	NELAP	10/17/2005
Zinc	EPA 6010	Metals	NELAP	7/1/2003
Zinc	EPA 6020	Metals	NELAP	10/17/2005

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E87653
Shealy Environmental Services, Inc. - 1
106 Vantage Point Drive
West Columbia, SC 29172

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,1,1,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,1,1-Trichloroethane	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,1,2,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,1,2-Trichloroethane	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,1-Dichloroethane	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,1-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,1-Dichloropropene	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,2,3-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	10/17/2005
1,2,3-Trichloropropane	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,2,4-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,2,4-Trichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/3/2001
1,2,4-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,2-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,2-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/3/2001
1,2-Dichloroethane	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,2-Diphenylhydrazine	EPA 8270	Extractable Organics	NELAP	7/3/2001
1,3,5-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,3-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,3-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/3/2001
1,3-Dichloropropane	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,4-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	7/3/2001
1,4-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	7/3/2001
2,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	7/3/2001
2,4,5-T	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	10/17/2005
2,4,5-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	7/3/2001
2,4,6-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	7/3/2001
2,4-D	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	10/17/2005
2,4-DB	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
2,4-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	7/3/2001
2,4-Dimethylphenol	EPA 8270	Extractable Organics	NELAP	7/3/2001
2,4-Dinitrophenol	EPA 8270	Extractable Organics	NELAP	7/3/2001
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270	Extractable Organics	NELAP	7/3/2001
2,6-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	7/3/2001

Laboratory Scope of Accreditation

Attachment to Certificate #: E87653-28, expiration date June 30, 2014. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87653 **EPA Lab Code:** SC00162 (803) 791-9700

E87653
Shealy Environmental Services, Inc. - 1
106 Vantage Point Drive
West Columbia, SC 29172

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270	Extractable Organics	NELAP	7/3/2001
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260	Volatile Organics	NELAP	7/3/2001
2-Chloroethyl vinyl ether	EPA 8260	Volatile Organics	NELAP	7/3/2001
2-Chloronaphthalene	EPA 8270	Extractable Organics	NELAP	7/3/2001
2-Chlorophenol	EPA 8270	Extractable Organics	NELAP	7/3/2001
2-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	10/17/2005
2-Hexanone	EPA 8260	Volatile Organics	NELAP	7/3/2001
2-Methyl-4,6-dinitrophenol	EPA 8270	Extractable Organics	NELAP	7/3/2001
2-Methylnaphthalene	EPA 8270	Extractable Organics	NELAP	7/3/2001
2-Methylphenol (o-Cresol)	EPA 8270	Extractable Organics	NELAP	7/3/2001
2-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/3/2001
2-Nitrophenol	EPA 8270	Extractable Organics	NELAP	7/3/2001
3,3'-Dichlorobenzidine	EPA 8270	Extractable Organics	NELAP	7/3/2001
3,3'-Dimethylbenzidine	EPA 8270	Extractable Organics	NELAP	7/3/2001
3/4-Methylphenols (m/p-Cresols)	EPA 8270	Extractable Organics	NELAP	10/17/2005
3-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/3/2001
4,4'-DDD	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
4,4'-DDE	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
4,4'-DDT	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
4-Bromophenyl phenyl ether	EPA 8270	Extractable Organics	NELAP	7/3/2001
4-Chloro-3-methylphenol	EPA 8270	Extractable Organics	NELAP	7/3/2001
4-Chloroaniline	EPA 8270	Extractable Organics	NELAP	7/3/2001
4-Chlorophenyl phenylether	EPA 8270	Extractable Organics	NELAP	7/3/2001
4-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	10/17/2005
4-Methyl-2-pentanone (MIBK)	EPA 8260	Volatile Organics	NELAP	7/3/2001
4-Nitroaniline	EPA 8270	Extractable Organics	NELAP	7/3/2001
4-Nitrophenol	EPA 8270	Extractable Organics	NELAP	7/3/2001
Acenaphthene	EPA 8270	Extractable Organics	NELAP	7/3/2001
Acenaphthylene	EPA 8270	Extractable Organics	NELAP	7/3/2001
Acetone	EPA 8260	Volatile Organics	NELAP	7/3/2001
Acetonitrile	EPA 8260	Volatile Organics	NELAP	7/3/2001
Acetophenone	EPA 8270	Extractable Organics	NELAP	7/3/2001
Acrolein (Propenal)	EPA 8260	Volatile Organics	NELAP	7/3/2001
Acrylonitrile	EPA 8260	Volatile Organics	NELAP	7/3/2001
Aldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Allyl chloride (3-Chloropropene)	EPA 8260	Volatile Organics	NELAP	7/3/2001

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Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
alpha-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/24/2008
Aluminum	EPA 6010	Metals	NELAP	7/3/2001
Anthracene	EPA 8270	Extractable Organics	NELAP	7/3/2001
Antimony	EPA 6010	Metals	NELAP	7/3/2001
Aroclor-1016 (PCB-1016)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Aroclor-1221 (PCB-1221)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Aroclor-1232 (PCB-1232)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Aroclor-1242 (PCB-1242)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Aroclor-1248 (PCB-1248)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Aroclor-1254 (PCB-1254)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Aroclor-1260 (PCB-1260)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Aroclor-1262 (PCB-1262)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/22/2012
Aroclor-1268 (PCB-1268)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/22/2012
Arsenic	EPA 6010	Metals	NELAP	7/3/2001
Barium	EPA 6010	Metals	NELAP	7/3/2001
Benzene	EPA 8260	Volatile Organics	NELAP	7/3/2001
Benzidine	EPA 8270	Extractable Organics	NELAP	7/3/2001
Benzo(a)anthracene	EPA 8270	Extractable Organics	NELAP	7/3/2001
Benzo(a)pyrene	EPA 8270	Extractable Organics	NELAP	7/3/2001
Benzo(b)fluoranthene	EPA 8270	Extractable Organics	NELAP	7/3/2001
Benzo(g,h,i)perylene	EPA 8270	Extractable Organics	NELAP	7/3/2001
Benzo(k)fluoranthene	EPA 8270	Extractable Organics	NELAP	7/3/2001
Benzoic acid	EPA 8270	Extractable Organics	NELAP	7/3/2001
Benzyl alcohol	EPA 8270	Extractable Organics	NELAP	7/3/2001
Benzyl chloride	EPA 8260	Volatile Organics	NELAP	7/3/2001
Beryllium	EPA 6010	Metals	NELAP	7/3/2001
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
bis(2-Chloroethoxy)methane	EPA 8270	Extractable Organics	NELAP	7/3/2001
bis(2-Chloroethyl) ether	EPA 8270	Extractable Organics	NELAP	7/3/2001
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 8270	Extractable Organics	NELAP	7/3/2001
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270	Extractable Organics	NELAP	7/3/2001
Boron	EPA 6010	Metals	NELAP	7/3/2001
Bromobenzene	EPA 8260	Volatile Organics	NELAP	10/17/2005
Bromochloromethane	EPA 8260	Volatile Organics	NELAP	7/3/2001
Bromodichloromethane	EPA 8260	Volatile Organics	NELAP	7/3/2001

Laboratory Scope of Accreditation

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E87653
Shealy Environmental Services, Inc. - 1
106 Vantage Point Drive
West Columbia, SC 29172

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Bromoform	EPA 8260	Volatile Organics	NELAP	7/3/2001
Butyl benzyl phthalate	EPA 8270	Extractable Organics	NELAP	7/3/2001
Cadmium	EPA 6010	Metals	NELAP	7/3/2001
Calcium	EPA 6010	Metals	NELAP	7/3/2001
Caprolactam	EPA 8270	Extractable Organics	NELAP	3/22/2012
Carbazole	EPA 8270	Extractable Organics	NELAP	7/3/2001
Carbon disulfide	EPA 8260	Volatile Organics	NELAP	7/3/2001
Carbon tetrachloride	EPA 8260	Volatile Organics	NELAP	7/3/2001
Chlordane (tech.)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	2/7/2003
Chlorobenzene	EPA 8260	Volatile Organics	NELAP	7/3/2001
Chloroethane	EPA 8260	Volatile Organics	NELAP	7/3/2001
Chloroform	EPA 8260	Volatile Organics	NELAP	7/3/2001
Chloroprene	EPA 8260	Volatile Organics	NELAP	7/3/2001
Chromium	EPA 6010	Metals	NELAP	7/3/2001
Chromium VI	EPA 7196	General Chemistry	NELAP	10/17/2005
Chrysene	EPA 8270	Extractable Organics	NELAP	7/3/2001
cis-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	7/3/2001
cis-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	7/3/2001
Cobalt	EPA 6010	Metals	NELAP	7/3/2001
Copper	EPA 6010	Metals	NELAP	7/3/2001
Dalapon	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
delta-BHC	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Dibenz(a,h)anthracene	EPA 8270	Extractable Organics	NELAP	7/3/2001
Dibenzofuran	EPA 8270	Extractable Organics	NELAP	7/3/2001
Dibromochloromethane	EPA 8260	Volatile Organics	NELAP	7/3/2001
Dibromomethane	EPA 8260	Volatile Organics	NELAP	7/3/2001
Dicamba	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	10/17/2005
Dichlorodifluoromethane	EPA 8260	Volatile Organics	NELAP	7/3/2001
Dichloroprop (Dichlorprop)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Dieldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Diesel range organics (DRO)	EPA 8015	Extractable Organics	NELAP	7/3/2001
Diethyl ether	EPA 8260	Volatile Organics	NELAP	7/3/2001
Diethyl phthalate	EPA 8270	Extractable Organics	NELAP	7/3/2001
Dimethyl phthalate	EPA 8270	Extractable Organics	NELAP	7/3/2001
Di-n-butyl phthalate	EPA 8270	Extractable Organics	NELAP	7/3/2001
Di-n-octyl phthalate	EPA 8270	Extractable Organics	NELAP	7/3/2001

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Shealy Environmental Services, Inc. - 1
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Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Endosulfan I	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Endosulfan II	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Endosulfan sulfate	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Endrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Endrin aldehyde	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Endrin ketone	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Ethyl methacrylate	EPA 8260	Volatile Organics	NELAP	7/3/2001
Ethylbenzene	EPA 8260	Volatile Organics	NELAP	7/3/2001
Fluoranthene	EPA 8270	Extractable Organics	NELAP	7/3/2001
Fluorene	EPA 8270	Extractable Organics	NELAP	7/3/2001
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
gamma-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/24/2008
Gasoline range organics (GRO)	EPA 8015	Extractable Organics	NELAP	7/3/2001
Gasoline range organics (GRO)	MADEP-VPH (MA-VPH)	Volatile Organics	NELAP	3/22/2012
Heptachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Heptachlor epoxide	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Hexachlorobenzene	EPA 8270	Extractable Organics	NELAP	7/3/2001
Hexachlorobutadiene	EPA 8260	Volatile Organics	NELAP	3/22/2012
Hexachlorobutadiene	EPA 8270	Extractable Organics	NELAP	7/3/2001
Hexachlorocyclopentadiene	EPA 8270	Extractable Organics	NELAP	7/3/2001
Hexachloroethane	EPA 8270	Extractable Organics	NELAP	7/3/2001
Ignitability	EPA 1010	General Chemistry	NELAP	7/3/2001
Indeno(1,2,3-cd)pyrene	EPA 8270	Extractable Organics	NELAP	7/3/2001
Iodomethane (Methyl iodide)	EPA 8260	Volatile Organics	NELAP	7/3/2001
Iron	EPA 6010	Metals	NELAP	7/3/2001
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260	Volatile Organics	NELAP	7/3/2001
Isophorone	EPA 8270	Extractable Organics	NELAP	7/3/2001
Isopropylbenzene	EPA 8260	Volatile Organics	NELAP	10/17/2005
Lead	EPA 6010	Metals	NELAP	7/3/2001
Magnesium	EPA 6010	Metals	NELAP	7/3/2001
Manganese	EPA 6010	Metals	NELAP	7/3/2001
MCPA	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
MCPP	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Mercury	EPA 7471	Metals,General Chemistry	NELAP	7/3/2001
Methacrylonitrile	EPA 8260	Volatile Organics	NELAP	7/3/2001

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E87653
Shealy Environmental Services, Inc. - 1
106 Vantage Point Drive
West Columbia, SC 29172

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Methoxychlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Methyl acetate	EPA 8260	Volatile Organics	NELAP	3/22/2012
Methyl bromide (Bromomethane)	EPA 8260	Volatile Organics	NELAP	7/3/2001
Methyl chloride (Chloromethane)	EPA 8260	Volatile Organics	NELAP	7/3/2001
Methyl methacrylate	EPA 8260	Volatile Organics	NELAP	7/3/2001
Methyl tert-butyl ether (MTBE)	EPA 8260	Volatile Organics	NELAP	7/3/2001
Methylcyclohexane	EPA 8260	Volatile Organics	NELAP	3/22/2012
Methylene chloride	EPA 8260	Volatile Organics	NELAP	7/3/2001
Molybdenum	EPA 6010	Metals	NELAP	7/3/2001
Naphthalene	EPA 8260	Volatile Organics	NELAP	7/3/2001
Naphthalene	EPA 8270	Extractable Organics	NELAP	7/3/2001
n-Butylbenzene	EPA 8260	Volatile Organics	NELAP	10/17/2005
Nickel	EPA 6010	Metals	NELAP	7/3/2001
Nitrobenzene	EPA 8270	Extractable Organics	NELAP	7/3/2001
n-Nitrosodimethylamine	EPA 8270	Extractable Organics	NELAP	7/3/2001
n-Nitrosodi-n-propylamine	EPA 8270	Extractable Organics	NELAP	7/3/2001
n-Nitrosodiphenylamine	EPA 8270	Extractable Organics	NELAP	7/3/2001
n-Propylbenzene	EPA 8260	Volatile Organics	NELAP	10/17/2005
Oil & Grease	EPA 9071	General Chemistry	NELAP	7/3/2001
Paint Filter Liquids Test	EPA 9095	General Chemistry	NELAP	7/3/2001
p-Dioxane	EPA 8260	Volatile Organics	NELAP	7/3/2001
Pentachlorophenol	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Pentachlorophenol	EPA 8270	Extractable Organics	NELAP	7/3/2001
pH	EPA 9045	General Chemistry	NELAP	7/3/2001
Phenanthrene	EPA 8270	Extractable Organics	NELAP	7/3/2001
Phenol	EPA 8270	Extractable Organics	NELAP	7/3/2001
p-Isopropyltoluene	EPA 8260	Volatile Organics	NELAP	10/17/2005
Potassium	EPA 6010	Metals	NELAP	7/3/2001
Propionitrile (Ethyl cyanide)	EPA 8260	Volatile Organics	NELAP	7/3/2001
Pyrene	EPA 8270	Extractable Organics	NELAP	7/3/2001
Pyridine	EPA 8270	Extractable Organics	NELAP	7/3/2001
Reactive cyanide	Sec. 7.3 SW-846	General Chemistry	NELAP	7/3/2001
Reactive sulfide	Sec. 7.3 SW-846	General Chemistry	NELAP	7/3/2001
sec-Butylbenzene	EPA 8260	Volatile Organics	NELAP	10/17/2005
Selenium	EPA 6010	Metals	NELAP	7/3/2001
Silver	EPA 6010	Metals	NELAP	7/3/2001

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Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Silvex (2,4,5-TP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	10/17/2005
Sodium	EPA 6010	Metals	NELAP	7/3/2001
Styrene	EPA 8260	Volatile Organics	NELAP	7/3/2001
Synthetic Precipitation Leaching Procedure	EPA 1312	General Chemistry	NELAP	10/17/2005
tert-Butylbenzene	EPA 8260	Volatile Organics	NELAP	10/17/2005
Tetrachloroethylene (Perchloroethylene)	EPA 8260	Volatile Organics	NELAP	7/3/2001
Thallium	EPA 6010	Metals	NELAP	7/3/2001
Tin	EPA 6010	Metals	NELAP	7/3/2001
Titanium	EPA 6010	Metals	NELAP	7/3/2001
Toluene	EPA 8260	Volatile Organics	NELAP	7/3/2001
Total cyanide	EPA 9012	General Chemistry	NELAP	7/3/2001
Total Petroleum Hydrocarbons (TPH)	FL-PRO	Extractable Organics	NELAP	7/24/2008
Toxaphene (Chlorinated camphene)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	7/3/2001
Toxicity Characteristic Leaching Procedure	EPA 1311	General Chemistry	NELAP	7/3/2001
trans-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	7/3/2001
trans-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	7/3/2001
trans-1,4-Dichloro-2-butene	EPA 8260	Volatile Organics	NELAP	7/3/2001
Trichloroethene (Trichloroethylene)	EPA 8260	Volatile Organics	NELAP	7/3/2001
Trichlorofluoromethane	EPA 8260	Volatile Organics	NELAP	7/3/2001
Vanadium	EPA 6010	Metals	NELAP	7/3/2001
Vinyl acetate	EPA 8260	Volatile Organics	NELAP	7/3/2001
Vinyl chloride	EPA 8260	Volatile Organics	NELAP	7/3/2001
Xylene (total)	EPA 8260	Volatile Organics	NELAP	7/3/2001
Zinc	EPA 6010	Metals	NELAP	7/3/2001

PERRY JOHNSON LABORATORY ACCREDITATION, INC.

Certificate of Accreditation

Perry Johnson Laboratory Accreditation, Inc. has assessed the Laboratory of:

Columbia Analytical Services, Inc.

1317 South 13th Avenue, Kelso, WA 98626

(Hereinafter called the Organization) and hereby declares that Organization has met the requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the DoD Quality Systems Manual for Environmental Laboratories Version 4.2 4/22/2009 and is accredited is accordance with the:

United States Department of Defense
Environmental Laboratory Accreditation Program
(DoD-ELAP)

This accreditation demonstrates technical competence for the defined scope:

Environmental Testing

(As detailed in the supplement)

Accreditation claims for such testing and/or calibration services shall only be made from addresses referenced within this certificate. This Accreditation is granted subject to the system rules governing the Accreditation referred to above, and the Organization hereby covenants with the Accreditation body's duty to observe and comply with the said rules.

For PJLA:

Initial Accreditation Date:	*Issue Date:*	*Accreditation No.:*	*Certificate No.:*
July 19, 2011	March 1, 2012	65188	L12-28

Tracy Szerszen
President/Operations Manager

Perry Johnson Laboratory
Accreditation, Inc. (PJLA)
755 W. Big Beaver, Suite 1325
Troy, Michigan 48084

The validity of this certificate is maintained through ongoing assessments based on a continuous accreditation cycle. The validity of this certificate should be confirmed through the PJLA website: www.pjlabs.com

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Columbia Analytical Services, Inc.

1317 South 13th Avenue, Kelso, WA 98626

Julie Gish Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard / Method	Technology	Analyte
Aqueous	EPA 1631E	CVAFS	Mercury (Low level)
Aqueous	EPA 1664A	Gravimetry	Hexane Extractable Material (HEM)
Aqueous	EPA 1664A	Gravimetry	Total Petroleum Hydrocarbons (TPH)
Aqueous	EPA 180.1	Nephelometer	Turbidity
Aqueous	EPA 2340B	Calculation by 6010	Hardness as $CaCO_3$)
Aqueous	EPA 245.1	CVAA	Mercury
Aqueous	EPA 300.0	IC	Bromide
Aqueous	EPA 300.0	IC	Chloride
Aqueous	EPA 300.0	IC	Fluoride
Aqueous	EPA 300.0	IC	Nitrate + Nitrite as N
Aqueous	EPA 300.0	IC	Nitrate as N
Aqueous	EPA 300.0	IC	Nitrite as N
Aqueous	EPA 300.0	IC	Sulfate
Aqueous	EPA 353.2	Automated Colorimetry	Nitrate + Nitrite as N
Aqueous	EPA 7196A	Colorimetry	Chromium VI
Aqueous	EPA 7470A	CVAA	Mercury
Aqueous	EPA 8260C SIM	GC-MS	1,1,2,2-Tetrachloroethane
Aqueous	EPA 8260C SIM	GC-MS	1,1,2-Trichloroethane
Aqueous	EPA 8260C SIM	GC-MS	1,1-Dichloroethene
Aqueous	EPA 8260C SIM	GC-MS	1,2-Dibromoethane (EDB)
Aqueous	EPA 8260C SIM	GC-MS	1,2-Dichloroethane
Aqueous	EPA 8260C SIM	GC-MS	1,3 Butadine
Aqueous	EPA 8260C SIM	GC-MS	1,4-Dichlorobenzene
Aqueous	EPA 8260C SIM	GC-MS	Bromodichloromethane
Aqueous	EPA 8260C SIM	GC-MS	Carbon Tetrachloride
Aqueous	EPA 8260C SIM	GC-MS	Chlorodibromomethane
Aqueous	EPA 8260C SIM	GC-MS	Chloroform
Aqueous	EPA 8260C SIM	GC-MS	Chloromethane
Aqueous	EPA 8260C SIM	GC-MS	cis-1,2-Dichloroethene
Aqueous	EPA 8260C SIM	GC-MS	Dichloromethane (Methylene Chloride)
Aqueous	EPA 8260C SIM	GC-MS	Tetrachloroethene
Aqueous	EPA 8260C SIM	GC-MS	trans-1,2-Dichloroethene
Aqueous	EPA 8260C SIM	GC-MS	Trichloroethene

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ISO/IEC 17025:2005 and DoD-ELAP

Columbia Analytical Services, Inc.

1317 South 13th Avenue, Kelso, WA 98626
Julie Gish Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard / Method	Technology	Analyte
Aqueous	EPA 8260C SIM	GC-MS	Vinyl chloride
Aqueous	EPA 9020B	Microcoulometric-titration detector	Total Organic Halides (TOX)
Aqueous	EPA 9040C	pH Meter	pH
Aqueous	EPA 9060A	TOC Meter	Total Organic Carbons (TOC)
Aqueous	SM 2130B	Nephelometer	Turbidity
Aqueous	SM 4500 CN- G	Colorimetry	Cyanide, Amenable
Aqueous	SM 4500 P-E	Colorimetry	ortho-phosphorous
Aqueous	SM 4500 S2 D	Distillation Unit	Sulfide
Aqueous	SM2320B	Titrimetry	Total Alkalinity (as $CaCO_3$)
Aqueous	SM2510B	Conductivity Meter	Specific Conductance
Aqueous	SM2540B	Balance	Solids, Total
Aqueous	SM2540C	Balance	Solids, Total Dissolved
Aqueous	SM2540D	Balance	Solids, Total Suspended
Aqueous	SM4500CN E	Colorimetry	Total Cyanide
Aqueous	SM4500CN-G	Colorimetry	Cyanide, Amenable
Aqueous	SM4500NH3 G	Colorimetry	Ammonia
Aqueous	SM5220C	Titrimetry	Chemical Oxygen Demand (COD)
Aqueous	SM5310C	TOC Meter	Total Organic Carbons (TOC)
Aqueous	SOP-LCP-PFC	HPLC/MS/MS	Perfluor-n butanoic acid (PFBA)
Aqueous	SOP-LCP-PFC	HPLC/MS/MS	Perfluor-n octanesulfonate (PFOS)
Aqueous	SOP-LCP-PFC	HPLC/MS/MS	Perfluor-n octanoic acid (PFOA)
Aqueous/Drinking Water	EPA 200.9	GFAA	Antimony
Aqueous/Drinking Water	EPA 200.9	GFAA	Selenium
Aqueous/Drinking Water	EPA 200.9	GFAA	Thallium
Aqueous/Drinking Water	EPA 200.9	GFAA	Arsenic
Aqueous/Drinking Water	EPA 200.9	GFAA	Lead
Aqueous/Solid	ASTM D 1426-93B	ISE	Nitrogen, Total Kjeldahl (TKN)
Aqueous/Solid	EPA 1630	CVAFS	Methyl Mercury
Aqueous/Solid	EPA 1020A	Closed Cup Flashpoint	Ignitability
Aqueous/Solid	EPA 314.0	IC	Perchlorate
Aqueous/Solid	EPA 350.1	Colorimetry	Ammonia
Aqueous/Solid	EPA 365.3	Colorimetry	Total Phosphorus
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Aluminum

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Matrix	Standard / Method	Technology	Analyte
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Antimony
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Arsenic
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Barium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Beryllium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Boron
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Cadmium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Calcium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Chromium, total
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Cobalt
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Copper
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Iron
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Lead
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Magnesium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Manganese
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Molybdenum
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Nickel
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Potassium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Selenium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Silver
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Sodium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Strontium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Thallium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Tin
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Titanium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Vanadium
Aqueous/Solid	EPA 6010B, C/200.7	ICP	Zinc
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Aluminum
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Antimony
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Arsenic
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Barium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Beryllium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Boron
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Cadmium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Chromium, total

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Matrix	Standard / Method	Technology	Analyte
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Cobalt
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Copper
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Iron
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Lead
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Manganese
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Molybdenum
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Nickel
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Selenium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Silver
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Strontium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Thallium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Tin
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Titanium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Vanadium
Aqueous/Solid	EPA 6020, A/200.8	ICP-MS	Zinc
Aqueous/Solid	EPA 7010	GFAA	Antimony
Aqueous/Solid	EPA 7010	GFAA	Arsenic
Aqueous/Solid	EPA 7010	GFAA	Chromium, total
Aqueous/Solid	EPA 7010	GFAA	Lead
Aqueous/Solid	EPA 7010	GFAA	Selenium
Aqueous/Solid	EPA 7010	GFAA	Thallium
Aqueous/Solid	EPA 7742	AA, Borohydride Reduction; GFAA	Selenium
Aqueous/Solid	EPA 8015C/AK103-RRO	GC-FID	Residual Range Organics (RRO)
Aqueous/Solid	EPA 8015C; AK101-GRO; NWTPH-Gx	GC-FID	Gasoline Range Organics (GRO)
Aqueous/Solid	EPA 8015C; AK102-DRO; NWTPH-Dx	GC-FID	Diesel Range Organics (DRO)
Aqueous/Solid	EPA 8021B	GC-FID	Benzene
Aqueous/Solid	EPA 8021B	GC-FID	Ethyl Benzene
Aqueous/Solid	EPA 8021B	GC-FID	Toluene
Aqueous/Solid	EPA 8021B	GC-FID	Xylene, total
Aqueous/Solid	EPA 8081A, B	GC-ECD	Aldrin
Aqueous/Solid	EPA 8081A, B	GC-ECD	Alpha-BHC

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Matrix	Standard / Method	Technology	Analyte
Aqueous/Solid	EPA 8081A, B	GC-ECD	DDD (4,4)
Aqueous/Solid	EPA 8081A, B	GC-ECD	DDE (4,4)
Aqueous/Solid	EPA 8081A, B	GC-ECD	DDT (4,4)
Aqueous/Solid	EPA 8081A, B	GC-ECD	delta-BHC
Aqueous/Solid	EPA 8081A, B	GC-ECD	Dieldrin
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endosulfan I
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endosulfan II
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endosulfan sulfate
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endrin
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endrin aldehyde
Aqueous/Solid	EPA 8081A, B	GC-ECD	Endrin ketone
Aqueous/Solid	EPA 8081A, B	GC-ECD	gamma-BHC
Aqueous/Solid	EPA 8081A, B	GC-ECD	gamma-Chlordane
Aqueous/Solid	EPA 8081A, B	GC-ECD	Heptachlor
Aqueous/Solid	EPA 8081A, B	GC-ECD	Heptachlor Epoxide (beta)
Aqueous/Solid	EPA 8081A, B	GC-ECD	Methoxychlor
Aqueous/Solid	EPA 8081A, B	GC-ECD	Toxaphene (total)
Aqueous/Solid	EPA 8081B	GC-ECD	2,4-DDD
Aqueous/Solid	EPA 8081B	GC-ECD	2,4-DDE
Aqueous/Solid	EPA 8081B	GC-ECD	2,4-DDT
Aqueous/Solid	EPA 8081B	GC-ECD	Chlorpyrifos
Aqueous/Solid	EPA 8081B	GC-ECD	cis-Nonachlor
Aqueous/Solid	EPA 8081B	GC-ECD	Hexachlorobenzene
Aqueous/Solid	EPA 8081B	GC-ECD	Hexachlorobutadiene
Aqueous/Solid	EPA 8081B	GC-ECD	Hexachloroethane
Aqueous/Solid	EPA 8081B	GC-ECD	Isodrin
Aqueous/Solid	EPA 8081B	GC-ECD	Mirex
Aqueous/Solid	EPA 8081B	GC-ECD	Oxychlordane
Aqueous/Solid	EPA 8081B	GC-ECD	trans-Nonachlor
Aqueous/Solid	EPA 8082, A	GC-ECD	2,2,3,3,4,4,5,5,6-Nonachlorobiphenyl (PCB 206)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,2,3,3,4,4,5,6-Octachlorobiphenyl (PCB 195)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,2,3,3,4,4,5-Heptachlorobiphenyl (PCB 170)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,2,3,3,4,4-Hexachlorobiphenyl (PCB 128)

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Matrix	Standard / Method	Technology	Analyte
Aqueous/Solid	EPA 8082, A	GC-ECD	2,2,3,4,4,5,5-Heptachlorobiphenyl (PCB180)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,2,3,4,4,5,6-Heptachlorobiphenyl (PCB 183)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,2,3,4,4,5-Hexachlorobiphenyl (PCB 138)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,2,3,4,4,6,6-Heptachlorobiphenyl (PCB 184)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,2,3,4,5,5,6-Heptachlorobiphenyl (PCB 187)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,2,3,4,5-Pentachlorobiphenyl (PCB87)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,2,3,4,5-Pentachlorobiphenyl (PCB90)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,2,3,5-Tetrachlorobiphenyl (PCB44)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,2,4,4,5,5-Hexachlorobiphenyl (PCB153)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,2,4,5,5-Pentachlorobiphenyl (PCB 101)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,2,5,5-Tetrachlorbiphenyl (PCB 53)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,2,5-Trichlorobiphenyl (PCB18)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,3,3,4,4,5,5-Heptachlorobiphenyl (PCB 189)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,3,3,4,4,5-Hexachlorobiphenyl (PCB 156)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,3,3,4,4,5-Hexachlorobiphenyl (PCB 157)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,3,3,4,4,6-Hexachlorobiphenyl (PCB 158)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,3,3,4,4-Pentachlorobiphenyl (PCB 105)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,3,4,4,5,5 Hexachlorobiphenyl (PCB 167)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,3,4,4,5,6-Hexachlorobiphenyl (PCB 168)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,3,4,4,5-Pentachlorobiphenyl (PCB 114)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,3,4,4,5-Pentachlorobiphenyl (PCB 118)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,3,4,4,5-Pentachlorobiphenyl (PCB 123)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,3,4,4-Tetrachlorobiphenyl (PCB60)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,3,4,4-Tetrachlorobiphenyl (PCB66)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,4,4-Trichlorobiphenyl (PCB 28)
Aqueous/Solid	EPA 8082, A	GC-ECD	2,4-Dichlorobiphenyl (PCB8)
Aqueous/Solid	EPA 8082, A	GC-ECD	3,3,4,4,5,5-Hexachlorobiphenyl (PCB 169)
Aqueous/Solid	EPA 8082, A	GC-ECD	3,3,4,4,5-Pentachlorobiphenyl (PCB 126)
Aqueous/Solid	EPA 8082, A	GC-ECD	3,3,4,4-Tetrachlorobiphenyl (PCB 77)
Aqueous/Solid	EPA 8082, A	GC-ECD	3,4,4,5-Tetrachlorobiphenyl (PCB 81)
Aqueous/Solid	EPA 8082, A	GC-ECD	Aroclor 1016
Aqueous/Solid	EPA 8082, A	GC-ECD	Aroclor 1221
Aqueous/Solid	EPA 8082, A	GC-ECD	Aroclor 1232

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Matrix	Standard / Method	Technology	Analyte
Aqueous/Solid	EPA 8082, A	GC-ECD	Aroclor 1242
Aqueous/Solid	EPA 8082, A	GC-ECD	Aroclor 1248
Aqueous/Solid	EPA 8082, A	GC-ECD	Aroclor 1254
Aqueous/Solid	EPA 8082, A	GC-ECD	Aroclor 1260
Aqueous/Solid	EPA 8082, A	GC-ECD	Aroclor 1262
Aqueous/Solid	EPA 8082, A	GC-ECD	Aroclor 1268
Aqueous/Solid	EPA 8082, A	GC-ECD	Decachlorobiphenyl (PC B209)
Aqueous/Solid	EPA 8151A	GC-ECD	2,4,5-T
Aqueous/Solid	EPA 8151A	GC-ECD	2,4,5-TP (Silvex)
Aqueous/Solid	EPA 8151A	GC-ECD	2,4-D
Aqueous/Solid	EPA 8151A	GC-ECD	2,4-DB
Aqueous/Solid	EPA 8151A	GC-ECD	Dalapon
Aqueous/Solid	EPA 8151A	GC-ECD	Dicamba
Aqueous/Solid	EPA 8151A	GC-ECD	Dichloroprop
Aqueous/Solid	EPA 8151A	GC-ECD	Dinoseb
Aqueous/Solid	EPA 8151A	GC-ECD	MCPA
Aqueous/Solid	EPA 8151A	GC-ECD	MCPP
Aqueous/Solid	EPA 8260B, C	GC-MS	1-phenylpropane
Aqueous/Solid	EPA 8260B, C	GC-MS	Benzene
Aqueous/Solid	EPA 8260B, C	GC-MS	DIPE
Aqueous/Solid	EPA 8260B, C	GC-MS	ETBE
Aqueous/Solid	EPA 8260B, C	GC-MS	Ethyl Benzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Freon 11
Aqueous/Solid	EPA 8260B, C	GC-MS	Freon 113
Aqueous/Solid	EPA 8260B, C	GC-MS	MTBE
Aqueous/Solid	EPA 8260B, C	GC-MS	TAME
Aqueous/Solid	EPA 8260B, C	GC-MS	tert-Butyl alcohol
Aqueous/Solid	EPA 8260B, C	GC-MS	Toluene
Aqueous/Solid	EPA 8260B, C	GC-MS	Xylene, total
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1,1,2-Tetrachloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1,1-Trichloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1,2,2-Tetrachloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,1,2-Trichloroethane

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Aqueous/Solid	EPA 8260B, C	GC-MS	1,1-Dichloroethane
Aqueous/Solid	EPA 8260B,C	GC-MS	1,1-Dichloroethene
Aqueous/Solid	EPA 8260B,C	GC-MS	1,1-Dichloropropene
Aqueous/Solid	EPA 8260B,C	GC-MS	1,2,3-Trichlorobenzene
Aqueous/Solid	EPA 8260B,C	GC-MS	1,2,3-Trichloropropane
Aqueous/Solid	EPA 8260B,C	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solid	EPA 8260B,C	GC-MS	1,2,4-Trimethylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2-Dibromoethane (EDB)
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2-Dichlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2-Dichloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,2-Dichloropropane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,3,5-Trimethylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,3-Dichlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	1,3-Dichloropropane
Aqueous/Solid	EPA 8260B, C	GC-MS	1,4-Dichlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	2,2-Dichloropropane
Aqueous/Solid	EPA 8260B, C	GC-MS	2-Butanone (MEK)
Aqueous/Solid	EPA 8260B, C	GC-MS	2-Chloroethylvinlether
Aqueous/Solid	EPA 8260B, C	GC-MS	2-Chlorotoluene
Aqueous/Solid	EPA 8260B, C	GC-MS	2-Hexanone
Aqueous/Solid	EPA 8260B, C	GC-MS	4-Chlorotoluene
Aqueous/Solid	EPA 8260B, C	GC-MS	4-Isopropyltoluene
Aqueous/Solid	EPA 8260B, C	GC-MS	4-Methyl-2-pentanone (MIBK)
Aqueous/Solid	EPA 8260B, C	GC-MS	Acetone
Aqueous/Solid	EPA 8260B, C	GC-MS	Acetonitrile
Aqueous/Solid	EPA 8260B, C	GC-MS	Acrolein
Aqueous/Solid	EPA 8260B, C	GC-MS	Acrylonitrile
Aqueous/Solid	EPA 8260B, C	GC-MS	Benzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromochloromethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromodichloromethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromoform
Aqueous/Solid	EPA 8260B, C	GC-MS	Bromomethane

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Matrix	Standard / Method	Technology	Analyte
Aqueous/Solid	EPA 8260B, C	GC-MS	Carbon disulfide
Aqueous/Solid	EPA 8260B, C	GC-MS	Carbon Tetrachloride
Aqueous/Solid	EPA 8260B, C	GC-MS	Chlorobenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Chlorodibromomethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Chloroethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Chloroform
Aqueous/Solid	EPA 8260B, C	GC-MS	Chloromethane
Aqueous/Solid	EPA 8260B, C	GC-MS	cis-1,2-Dichloroethene
Aqueous/Solid	EPA 8260B, C	GC-MS	cis-1,3-Dichloropropene
Aqueous/Solid	EPA 8260B, C	GC-MS	Dibromomethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Dichlorodifluoromethane
Aqueous/Solid	EPA 8260B, C	GC-MS	Dichloromethane (Methylene Chloride)
Aqueous/Solid	EPA 8260B, C	GC-MS	Di-isopropylether (DIPE)
Aqueous/Solid	EPA 8260B, C	GC-MS	Ethylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Hexachlorobutadiene
Aqueous/Solid	EPA 8260B, C	GC-MS	Isopropylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Methyl-tert-butylether (MTBE)
Aqueous/Solid	EPA 8260B, C	GC-MS	Naphthalene
Aqueous/Solid	EPA 8260B, C	GC-MS	n-Butylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	n-Propylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	sec-Butylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Styrene
Aqueous/Solid	EPA 8260B, C	GC-MS	tert-amylmethylether (TAME)
Aqueous/Solid	EPA 8260B, C	GC-MS	tert-butylbenzene
Aqueous/Solid	EPA 8260B, C	GC-MS	Tetrachloroethene
Aqueous/Solid	EPA 8260B, C	GC-MS	Toluene
Aqueous/Solid	EPA 8260B, C	GC-MS	trans-1,2-Dichloroethene
Aqueous/Solid	EPA 8260B, C	GC-MS	trans-1,3-Dichloropropene
Aqueous/Solid	EPA 8260B, C	GC-MS	Trichloroethene
Aqueous/Solid	EPA 8260B, C	GC-MS	Trichlorofluoromethane (Freon 11)
Aqueous/Solid	EPA 8260B, C	GC-MS	Vinyl acetate
Aqueous/Solid	EPA 8260B, C	GC-MS	Vinyl chloride
Aqueous/solid	EPA 8260B, C	GC-MS	Xylenes, total

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Columbia Analytical Services, Inc.

1317 South 13th Avenue, Kelso, WA 98626

Julie Gish Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard / Method	Technology	Analyte
Aqueous/Solid	EPA 8270C, D	GC-MS	1,2,4-Trichlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	1,2-Dichlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	1,3-Dichlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	1,4-Dichlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4,5-Trichlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4,6-Trichlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4-Dichlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4-Dimethylphenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4-Dinitrophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,4-Dinitrotoluene
Aqueous/Solid	EPA 8270C, D	GC-MS	2,6-Dichlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2,6-Dinitrotoluene
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Chloronaphthalene
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Chlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Methyl-4,6-Dinitrophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Methylnaphthalene
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Methylphenol
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Nitroaniline
Aqueous/Solid	EPA 8270C, D	GC-MS	2-Nitrophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	3,3-Dichlorobenzidine
Aqueous/Solid	EPA 8270C, D	GC-MS	3-Nitroaniline
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Bromophenyl-phenylether
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Chloro-3-methylphenol
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Chloroaniline
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Chlorophenyl-phenylether
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Methylphenol (and/or 3-Methylphenol)
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Nitroaniline
Aqueous/Solid	EPA 8270C, D	GC-MS	4-Nitrophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	Acenaphthene
Aqueous/Solid	EPA 8270C, D	GC-MS	Acenaphthylene
Aqueous/Solid	EPA 8270C, D	GC-MS	Aniline
Aqueous/Solid	EPA 8270C, D	GC-MS	Anthracene
Aqueous/Solid	EPA 8270C, D	GC-MS	Azinphos-methyl (Guthion)

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Columbia Analytical Services, Inc.

1317 South 13th Avenue, Kelso, WA 98626

Julie Gish Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard / Method	Technology	Analyte
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzidine
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(a)anthracene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(a)pyrene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(b)fluoranthene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzo(k)fluoranthene
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzoic acid
Aqueous/Solid	EPA 8270C, D	GC-MS	Benzyl alcohol
Aqueous/Solid	EPA 8270C, D	GC-MS	bis(2-Chloroethoxy)methane
Aqueous/Solid	EPA 8270C, D	GC-MS	bis(2-Chloroethyl)ether
Aqueous/Solid	EPA 8270C, D	GC-MS	bis(2-Chloroisopropyl)ether
Aqueous/Solid	EPA 8270C, D	GC-MS	bis(2-ethylhexy)phthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	Butyl benzyl phthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	Carbazole
Aqueous/Solid	EPA 8270C, D	GC-MS	Chlorpyrifos
Aqueous/Solid	EPA 8270C, D	GC-MS	Chrysene
Aqueous/Solid	EPA 8270C, D	GC-MS	Demeton O & S
Aqueous/Solid	EPA 8270C, D	GC-MS	Diazinon
Aqueous/Solid	EPA 8270C, D	GC-MS	Dibenzo(a,h)anthracene
Aqueous/Solid	EPA 8270C, D	GC-MS	Dibenzofuran
Aqueous/Solid	EPA 8270C, D	GC-MS	Dichlorvos
Aqueous/Solid	EPA 8270C, D	GC-MS	Diethyl phthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	dimethoate
Aqueous/Solid	EPA 8270C, D	GC-MS	Dimethylphthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	di-n-butylphthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	Di-n-octylphthalate
Aqueous/Solid	EPA 8270C, D	GC-MS	Disulfoton
Aqueous/Solid	EPA 8270C, D	GC-MS	Ethoprop
Aqueous/Solid	EPA 8270C, D	GC-MS	Fluoranthene
Aqueous/Solid	EPA 8270C, D	GC-MS	Fluorene
Aqueous/Solid	EPA 8270C, D	GC-MS	Hexachlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	Hexachlorobutadiene
Aqueous/Solid	EPA 8270C, D	GC-MS	Hexachlorocyclopentadiene

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Columbia Analytical Services, Inc.

1317 South 13th Avenue, Kelso, WA 98626
Julie Gish Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard / Method	Technology	Analyte
Aqueous/Solid	EPA 8270C, D	GC-MS	Hexachloroethane
Aqueous/Solid	EPA 8270C, D	GC-MS	Indeno(1,2,3, cd)pyrene
Aqueous/Solid	EPA 8270C, D	GC-MS	Isophorone
Aqueous/Solid	EPA 8270C, D	GC-MS	Naphthalene
Aqueous/Solid	EPA 8270C, D	GC-MS	Nitrobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	N-Nitrosodiethylamine
Aqueous/Solid	EPA 8270C, D	GC-MS	N-Nitrosodimethylamine
Aqueous/Solid	EPA 8270C, D	GC-MS	N-Nitroso-di-n-propylamine
Aqueous/Solid	EPA 8270C, ~~D~~	GC-MS	N-Nitrosodiphenylamine
Aqueous/Solid	EPA 8270C, D	GC-MS	o-Toluidine
Aqueous/Solid	EPA 8270C, D	GC-MS	Parathion, ethyl
Aqueous/Solid	EPA 8270C, D	GC-MS	Parathion, methyl
Aqueous/Solid	EPA 8270C, D	GC-MS	Pentachlorobenzene
Aqueous/Solid	EPA 8270C, D	GC-MS	Pentachlorophenol
Aqueous/Solid	EPA 8270C, D	GC-MS	Phenanthrene
Aqueous/Solid	EPA 8270C, D	GC-MS	Phenol
Aqueous/Solid	EPA 8270C, D	GC-MS	Phorate
Aqueous/Solid	EPA 8270C, D	GC-MS	Pyrene
Aqueous/Solid	EPA 8270C, D	GC-MS	Pyridine
Aqueous/Solid	EPA 8270C, D	GC-MS	Ronnel
Aqueous/Solid	EPA 8270C, D	GC-MS	Stirophos
Aqueous/Solid	EPA 8270C, D	GC-MS	Sulfotepp
Aqueous/Solid	EPA 8270C, D	GC-MS	2,3,4,6-Tetrachlorophenol
Aqueous/Solid	EPA 8270C,D	GC-MS	1,2,4,5-Tetrachlorobenzene
Aqueous/Solid	EPA 8270SIM	GC-MS	2-Methylnaphthalene
Aqueous/Solid	EPA 8270SIM	GC-MS	Acenaphthene
Aqueous/Solid	EPA 8270SIM	GC-MS	Acenaphthylene
Aqueous/Solid	EPA 8270SIM	GC-MS	Anthracene
Aqueous/Solid	EPA 8270SIM	GC-MS	Benzo(a)anthracene
Aqueous/Solid	EPA 8270SIM	GC-MS	Benzo(a)pyrene
Aqueous/Solid	EPA 8270SIM	GC-MS	Benzo(b)fluoranthene
Aqueous/Solid	EPA 8270SIM	GC-MS	Benzo(g,h,i)perylene
Aqueous/Solid	EPA 8270SIM	GC-MS	Benzo(k)fluoranthene

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Columbia Analytical Services, Inc.

1317 South 13th Avenue, Kelso, WA 98626

Julie Gish Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard / Method	Technology	Analyte
Aqueous/Solid	EPA 8270SIM	GC-MS	Chrysene
Aqueous/Solid	EPA 8270SIM	GC-MS	Dibenzo(a,h)anthracene
Aqueous/Solid	EPA 8270SIM	GC-MS	Fluoranthene
Aqueous/Solid	EPA 8270SIM	GC-MS	Fluorene
Aqueous/Solid	EPA 8270SIM	GC-MS	Indeno(1,2,3, cd)pyrene
Aqueous/Solid	EPA 8270SIM	GC-MS	Naphthalene
Aqueous/Solid	EPA 8270SIM	GC-MS	p-Dioxane
Aqueous/Solid	EPA 8270SIM	GC-MS	Phenanthrene
Aqueous/Solid	EPA 8270SIM	GC-MS	Pyrene
Aqueous/Solid	EPA 8330B	HPLC	1,3,5-Trinitrobenzene
Aqueous/Solid	EPA 8330B	HPLC	1,3-Dinitrobenzene
Aqueous/Solid	EPA 8330B	HPLC	2,4,6-Trinitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	2,4-Dinitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	2,6-Dinitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	2-Amino-4,6-dinitrtoluene
Aqueous/Solid	EPA 8330B	HPLC	2-Nitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	3,5-Dinitroaniline
Aqueous/Solid	EPA 8330B	HPLC	3-Nitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	4-Amino-2,6-dinitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	4-Nitrotoluene
Aqueous/Solid	EPA 8330B	HPLC	HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)
Aqueous/Solid	EPA 8330B	HPLC	Nitrobenzene
Aqueous/Solid	EPA 8330B	HPLC	Nitroglycerin
Aqueous/Solid	EPA 8330B	HPLC	Pentachloronitrobenzene
Aqueous/Solid	EPA 8330B	HPLC	Pentaerythritoltetranitrate
Aqueous/Solid	EPA 8330B	HPLC	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)
Aqueous/Solid	EPA 8330B	HPLC	Tetryl (methyl-2,4,6-trinitrophenylnitramine)
Aqueous/Solid	EPA 9012B,	Colorimetry	Total Cyanide
Aqueous/Solid	EPA 9030B	Distillation Unit	Sulfide
Aqueous/Solid	EPA 9056A	IC	Bromide
Aqueous/Solid	EPA 9056A	IC	Chloride
Aqueous/Solid	EPA 9056A	IC	Fluoride

Certificate of Accreditation: Supplement

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Columbia Analytical Services, Inc.

1317 South 13th Avenue, Kelso, WA 98626

Julie Gish Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard / Method	Technology	Analyte
Aqueous/Solid	EPA 9056A	IC	Sulfate
Aqueous/Solid	EPA 9065	Spectrophotometer	Total Phenolics
Aqueous/Solid	LCP-NITG	HPLC/UV	Nitroguanidine
Aqueous/Solid	SM4500 NH3 G	Colorimetry	Ammonia
Aqueous/Solid	SOC-OTTO	GC-ECD	Otto Fuel
Aqueous/Solid	SOC-Butyl	GC-FPD	Di-n-butyltin
Aqueous/Solid	SOC-Butyl	GC-FPD	n-Butyltin
Aqueous/Solid	SOC-Butyl	GC-FPD	Tetra-n-butyltin
Aqueous/Solid	SOC-Butyl	GC-FPD	Tri-n-butyltin
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Aldrin
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Alpha-BHC
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	beta-BHC
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	DDD (4,4)
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	DDE (4,4)
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	DDT (4,4)
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	delta-BHC
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Dieldrin
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Endosulfan I
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Endosulfan II
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Endosulfan sulfate
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Endrin
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Endrin aldehyde
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Endrin ketone
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	gamma-BHC
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Heptachlor
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Heptachlor Epoxide (beta)
Aqueous/Solid	SOC-PESTMS2	GC/MS/MS/MS	Methoxychlor
Drinking Water	EPA 504	GC-ECD	1,2-Dibromo-3-chloropropane (DBCP)
Drinking Water	EPA 504	GC-ECD	1,2-Dibromoethane (EDB)
Drinking Water	EPA 524.2	GC-MS	1,1,1,2-Tetrachloroethane
Drinking Water	EPA 524.2	GC-MS	1,1,1-Trichloroethane
Drinking Water	EPA 524.2	GC-MS	1,1,2,2-Tetrachloroethane
Drinking Water	EPA 524.2	GC-MS	1,1-Dichloroethane
Drinking Water	EPA 524.2	GC-MS	1,1-Dichloroethene

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Columbia Analytical Services, Inc.

1317 South 13th Avenue, Kelso, WA 98626

Julie Gish Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard / Method	Technology	Analyte
Drinking Water	EPA 524.2	GC-MS	1,1-Dichloropropene
Drinking Water	EPA 524.2	GC-MS	1,2,3-Trichlorobenzene
Drinking Water	EPA 524.2	GC-MS	1,2,3-Trichloropropane
Drinking Water	EPA 524.2	GC-MS	1,2,4-Trichlorobenzene
Drinking Water	EPA 524.2	GC-MS	1,2,4-Trimethylbenzene
Drinking Water	EPA 524.2	GC-MS	1,2-Dibromoethane (EDB)
Drinking Water	EPA 524.2	GC-MS	1,2-Dichlorobenzene
Drinking Water	EPA 524.2	GC-MS	1,2-Dichloroethane
Drinking Water	EPA 524.2	GC-MS	1,2-Dichloropropane
Drinking Water	EPA 524.2	GC-MS	1,3,5-Trimethylbenzene
Drinking Water	EPA 524.2	GC-MS	1,3-Dichlorobenzene
Drinking Water	EPA 524.2	GC-MS	1,3-Dichloropropane
Drinking Water	EPA 524.2	GC-MS	1,4-Dichlorobenzene
Drinking Water	EPA 524.2	GC-MS	2,2-Dichloropropane
Drinking Water	EPA 524.2	GC-MS	2-Chlorotoluene
Drinking Water	EPA 524.2	GC-MS	4-Chlorotoluene
Drinking Water	EPA 524.2	GC-MS	4-Isopropyltoluene
Drinking Water	EPA 524.2	GC-MS	Benzene
Drinking Water	EPA 524.2	GC-MS	Bromobenzene
Drinking Water	EPA 524.2	GC-MS	Bromochloromethane
Drinking Water	EPA 524.2	GC-MS	Bromodichloromethane
Drinking Water	EPA 524.2	GC-MS	Bromoform
Drinking Water	EPA 524.2	GC-MS	Bromomethane
Drinking Water	EPA 524.2	GC-MS	Carbon Tetrachloride
Drinking Water	EPA 524.2	GC-MS	Chlorobenzene
Drinking Water	EPA 524.2	GC-MS	Chlorodibromomethane
Drinking Water	EPA 524.2	GC-MS	Chloroethane
Drinking Water	EPA 524.2	GC-MS	Chloroform
Drinking Water	EPA 524.2	GC-MS	Chloromethane
Drinking Water	EPA 524.2	GC-MS	cis-1,2-Dichloroethene
Drinking Water	EPA 524.2	GC-MS	cis-1,3-Dichloropropene
Drinking Water	EPA 524.2	GC-MS	Dibromomethane
Drinking Water	EPA 524.2	GC-MS	Dichlorodifluoromethane
Drinking Water	EPA 524.2	GC-MS	Dichloromethane (Methylene Chloride)

Certificate of Accreditation: Supplement

ISO/IEC 17025:2005 and DoD-ELAP

Columbia Analytical Services, Inc.

1317 South 13th Avenue, Kelso, WA 98626

Julie Gish Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard / Method	Technology	Analyte
Drinking Water	EPA 524.2	GC-MS	Ethylbenzene
Drinking Water	EPA 524.2	GC-MS	Hexachlorobutadiene
Drinking Water	EPA 524.2	GC-MS	Isopropylbenzene
Drinking Water	EPA 524.2	GC-MS	m+p-Xylene
Drinking Water	EPA 524.2	GC-MS	Naphthalene
Drinking Water	EPA 524.2	GC-MS	n-Butylbenzene
Drinking Water	EPA 524.2	GC-MS	n-Propylbenzene
Drinking Water	EPA 524.2	GC-MS	o-Xylene
Drinking Water	EPA 524.2	GC-MS	sec-Butylbenzene
Drinking Water	EPA 524.2	GC-MS	Styrene
Drinking Water	EPA 524.2	GC-MS	tert-butylbenzene
Drinking Water	EPA 524.2	GC-MS	Tetrachloroethene
Drinking Water	EPA 524.2	GC-MS	Toluene
Drinking Water	EPA 524.2	GC-MS	trans-1,2-Dichloroethene
Drinking Water	EPA 524.2	GC-MS	trans-1,3-Dichloropropene
Drinking Water	EPA 524.2	GC-MS	Trichlorofluoromethane (Freon 11)
Drinking Water	EPA 524.2	GC-MS	Vinyl chloride
Drinking Water	EPA 524.2	GC-MS	Xylenes, total
Solid	ASTMD4129-92M, Lloyd Kahn	TOC Meter	Total Organic Carbons (TOC)
Solid	EPA 160.3M	Gravimetry	Solids, Total
Solid	EPA 7471A, B	CVAA	Mercury
Solid	EPA 9045D	pH Meter	pH
Solid	EPA 9056A	IC	Nitrate as N
Solid	EPA 9056A	IC	Nitrite as N
Solid	EPA 9071B	Gravimetry	Hexane Extractable Material (HEM)
Solid	GEN-AVS	Colorimetry	Acid Volatile Sulfides
Solid	GEN-NCEL	Colorimetry	Nitrocellulose
Solid	LCP-LCMS4	HPLC/MS/MS	1,3,5-Trinitrobenzene
Solid	LCP-LCMS4	HPLC/MS/MS	1,3-Dinitrobenzene
Solid	LCP-LCMS4	HPLC/MS/MS	2,4,6-Trinitrotoluene
Solid	LCP-LCMS4	HPLC/MS/MS	2,4-Dinitrotoluene
Solid	LCP-LCMS4	HPLC/MS/MS	2,6-Dinitrotoluene
Solid	LCP-LCMS4	HPLC/MS/MS	2-Amino-4,6-dinitrotoluene
Solid	LCP-LCMS4	HPLC/MS/MS	3,5-Dinitroaniline

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Columbia Analytical Services, Inc.

1317 South 13th Avenue, Kelso, WA 98626
Julie Gish Phone: 360-577-7222

Accreditation is granted to the facility to perform the following testing:

Matrix	Standard / Method	Technology	Analyte
Solid	LCP-LCMS4	HPLC/MS/MS	4-Amino-2,6-dinitrotoluene
Solid	LCP-LCMS4	HPLC/MS/MS	HMX (Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine)
Solid	LCP-LCMS4	HPLC/MS/MS	Pentaerythritoltetranitrate
Solid	LCP-LCMS4	HPLC/MS/MS	RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)
Solid	LCP-LCMS4	HPLC/MS/MS	Tetryl (methyl-2,4,6-trinitrophenylnitramine)
Solid	LCP-Nitro	HPLC/MS/MS	2,4-Dinitrophenol
Solid	LCP-Nitro	HPLC/MS/MS	Picramic Acid
Solid	LCP-Nitro	HPLC/MS/MS	Picric Acid
Solid	PSEP	Gravimetry	Particle Size

Matrix	Standard / Method	Technology	Analyte
Aqueous	EPA 1640	Reductive Metals Precipitation	Prep Method
Aqueous	EPA 3010A	Acid Digestion	Metals Digestion
Aqueous	EPA 3020A	Acid Digestion	Metals Digestion
Aqueous	EPA 3520C	Continuous Liquid-Liquid Extraction	Extractable Prep
Aqueous	EPA 3535A	Solid Phase Extraction	Prep Method
Aqueous	EPA 5030B	Purge and Trap for Volatiles	Volatile Prep
Aqueous	SOP-MET-DIG	Acid Digestion	Metals Digestion
Aqueous/Solids	EPA 1311	TCLP Extraction	Physical Extraction
Aqueous/Solids	EPA 3620C	Florisil clean up	Extractable Cleanup
Aqueous/Solids	EPA 3630C	Silica gel clean up	Extractable Prep
Aqueous/Solids	EPA 3640A	Gel-Permeation Clean-up	Extractable Cleanup
Aqueous/Solids	EPA 3660	Sulfur Clean-up	Extractable Prep
Aqueous/Solids	EPA 3665A	Acid clean up	Extractable Cleanup
Aqueous/Solids	ASTM D3590-89	Digestion	TKN
Solid	EPA 3050B	Acid Digestion	Metals Digestion
Solid	EPA 3060	Alkaline Digestion for Cr(VI)	Alkaline Digestion for Cr(VI) only
Solid	EPA 3541	Automated Soxhlet Extraction	Extractable Prep
Solid	EPA 3550B	Ultrasonic Extraction	Extractable Prep
Solid	EPA 5035A	Purge and Trap for Volatiles	Voc Organics
Solid	EPA 5050	Bomb Digestion	Prep Method
Solids	EPA 9013	Midi-Distillation	Cyanides

State of Florida
Department of Health, Bureau of Public Health Laboratories

This is to certify that

E87412

ALS ENVIRONMENTAL, KELSO
1317 SOUTH 13TH AVENUE
KELSO, WA 98626

has complied with Florida Administrative Code 64E-1,
for the examination of environmental samples in the following categories

DRINKING WATER - GROUP I UNREGULATED CONTAMINANTS, DRINKING WATER - GROUP II UNREGULATED CONTAMINANTS, DRINKING WATER - GROUP III UNREGULATED CONTAMINANTS, DRINKING WATER - OTHER REGULATED CONTAMINANTS, DRINKING WATER - PRIMARY INORGANIC CONTAMINANTS, DRINKING WATER - SECONDARY INORGANIC CONTAMINANTS, DRINKING WATER - SYNTHETIC ORGANIC CONTAMINANTS, NON-POTABLE WATER - EXTRACTABLE ORGANICS, NON-POTABLE WATER - GENERAL CHEMISTRY, NON-POTABLE WATER - METALS, NON-POTABLE WATER - PESTICIDES-HERBICIDES-PCB'S, NON-POTABLE WATER - VOLATILE ORGANICS, SOLID AND CHEMICAL MATERIALS - EXTRACTABLE ORGANICS, SOLID AND CHEMICAL MATERIALS - GENERAL CHEMISTRY, SOLID AND CHEMICAL MATERIALS - METALS, SOLID AND CHEMICAL MATERIALS - PESTICIDES-HERBICIDES-PCB'S, SOLID AND CHEMICAL MATERIALS - VOLATILE ORGANICS, BIOLOGICAL TISSUE - EXTRACTABLE ORGANICS, BIOLOGICAL TISSUE - METALS, BIOLOGICAL TISSUE - PESTICIDES-HERBICIDES-PCB'S

Continued certification is contingent upon successful on-going compliance with the NELAC Standards and FAC Rule 64E-1 regulations. Specific methods and analytes certified are cited on the Laboratory Scope of Accreditation for this laboratory and are on file at the Bureau of Public Health Laboratories, P. O. Box 210, Jacksonville, Florida 32231. Clients and customers are urged to verify with this agency the laboratory's certification status in Florida for particular methods and analytes.

Date Issued: July 01, 2013 Expiration Date: June 30, 2014

Victor Johnson, Director
Division of Emergency Preparedness and Community Support
DH Form 1697, 7/04
NON-TRANSFERABLE E87412-26-07/01/2013
Supersedes all previously issued certificates

Laboratory Scope of Accreditation

Attachment to Certificate #: E87412-26, expiration date June 30, 2014. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87412 **EPA Lab Code:** WA01276 (360) 577-7222

E87412
ALS Environmental, Kelso
1317 South 13th Avenue
Kelso, WA 98626

Matrix: Drinking Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,1,1,2-Tetrachloroethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
1,1,1-Trichloroethane	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
1,1,2,2-Tetrachloroethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
1,1,2-Trichloroethane	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
1,1-Dichloroethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
1,1-Dichloroethylene	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
1,1-Dichloropropene	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
1,2,3-Trichlorobenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
1,2,3-Trichloropropane	EPA 504.1	Group II Unregulated Contaminants	NELAP	3/7/2012
1,2,3-Trichloropropane	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
1,2,4-Trichlorobenzene	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
1,2,4-Trimethylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504.1	Synthetic Organic Contaminants	NELAP	3/7/2012
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 504.1	Synthetic Organic Contaminants	NELAP	3/7/2012
1,2-Dichlorobenzene	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
1,2-Dichloroethane	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
1,2-Dichloropropane	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
1,3,5-Trimethylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
1,3-Dichlorobenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
1,3-Dichloropropane	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
1,4-Dichlorobenzene	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
2,2-Dichloropropane	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
2,4,5-T	EPA 515.4	Synthetic Organic Contaminants	NELAP	3/7/2012
2,4-D	EPA 515.4	Synthetic Organic Contaminants	NELAP	3/7/2012
2,4-Dinitrotoluene (2,4-DNT)	EPA 525.2	Group III Unregulated Contaminants	NELAP	3/7/2012
2,6-Dinitrotoluene (2,6-DNT)	EPA 525.2	Group III Unregulated Contaminants	NELAP	3/7/2012
2-Chlorotoluene	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
4,4'-DDD	EPA 508.1	Group I Unregulated Contaminants	NELAP	3/7/2012
4,4'-DDE	EPA 508.1	Group I Unregulated Contaminants	NELAP	3/7/2012
4,4'-DDT	EPA 508.1	Group I Unregulated Contaminants	NELAP	3/7/2012
4-Chlorotoluene	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
4-Isopropyltoluene	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
Acetochlor	EPA 525.2	Group I Unregulated Contaminants	NELAP	3/7/2012
Acifluorfen	EPA 515.4	Synthetic Organic Contaminants	NELAP	3/7/2012
Alachlor	EPA 525.2	Synthetic Organic Contaminants	NELAP	3/7/2012
Aldrin	EPA 508.1	Group I Unregulated Contaminants	NELAP	3/7/2012

Laboratory Scope of Accreditation

Attachment to Certificate #: E87412-26, expiration date June 30, 2014. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87412 **EPA Lab Code:** WA01276 **(360) 577-7222**

E87412
ALS Environmental, Kelso
1317 South 13th Avenue
Kelso, WA 98626

Matrix: Drinking Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Alkalinity as CaCO3	SM 2320 B	Primary Inorganic Contaminants	NELAP	3/7/2012
Aluminum	EPA 200.7	Secondary Inorganic Contaminants	NELAP	3/7/2012
Aluminum	EPA 200.8	Secondary Inorganic Contaminants	NELAP	3/7/2012
Antimony	EPA 200.8	Primary Inorganic Contaminants	NELAP	3/7/2012
Antimony	EPA 200.9	Primary Inorganic Contaminants	NELAP	3/7/2012
Arsenic	EPA 200.8	Primary Inorganic Contaminants	NELAP	3/7/2012
Arsenic	EPA 200.9	Primary Inorganic Contaminants	NELAP	3/7/2012
Atrazine	EPA 525.2	Synthetic Organic Contaminants	NELAP	3/7/2012
Barium	EPA 200.7	Primary Inorganic Contaminants	NELAP	3/7/2012
Barium	EPA 200.8	Primary Inorganic Contaminants	NELAP	3/7/2012
Benzene	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
Benzo(a)pyrene	EPA 525.2	Synthetic Organic Contaminants	NELAP	3/7/2012
Beryllium	EPA 200.7	Primary Inorganic Contaminants	NELAP	3/7/2012
Beryllium	EPA 200.8	Primary Inorganic Contaminants	NELAP	3/7/2012
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 525.2	Synthetic Organic Contaminants	NELAP	3/7/2012
Boron	EPA 200.7	Primary Inorganic Contaminants	NELAP	3/7/2012
Bromate	EPA 300.1	Primary Inorganic Contaminants	NELAP	3/7/2012
Bromide	EPA 300.1	Primary Inorganic Contaminants	NELAP	3/7/2012
Bromoacetic acid	EPA 552.2	Group I Unregulated Contaminants	NELAP	3/7/2012
Bromobenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
Bromochloroacetic acid	EPA 552.2	Group I Unregulated Contaminants	NELAP	3/7/2012
Bromochloromethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
Bromodichloromethane	EPA 524.2	Other Regulated Contaminants,Group II Unregulated Contaminants	NELAP	3/7/2012
Bromoform	EPA 524.2	Other Regulated Contaminants,Group II Unregulated Contaminants	NELAP	3/7/2012
Butachlor	EPA 525.2	Group I Unregulated Contaminants	NELAP	3/7/2012
Butyl benzyl phthalate	EPA 525.2	Group III Unregulated Contaminants	NELAP	3/7/2012
Cadmium	EPA 200.7	Primary Inorganic Contaminants	NELAP	3/7/2012
Cadmium	EPA 200.8	Primary Inorganic Contaminants	NELAP	3/7/2012
Calcium	EPA 200.7	Primary Inorganic Contaminants	NELAP	3/7/2012
Carbon tetrachloride	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
Chlorate	EPA 300.1	Secondary Inorganic Contaminants	NELAP	3/7/2012
Chlordane (tech.)	EPA 508.1	Synthetic Organic Contaminants	NELAP	3/7/2012
Chloride	EPA 300.0	Secondary Inorganic Contaminants	NELAP	3/7/2012
Chlorite	EPA 300.1	Primary Inorganic Contaminants	NELAP	3/7/2012

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Matrix: Drinking Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Chloroacetic acid	EPA 552.2	Group I Unregulated Contaminants	NELAP	3/7/2012
Chlorobenzene	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
Chloroethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
Chloroform	EPA 524.2	Other Regulated Contaminants,Group II Unregulated Contaminants	NELAP	3/7/2012
Chromium	EPA 200.7	Primary Inorganic Contaminants	NELAP	3/7/2012
Chromium	EPA 200.8	Primary Inorganic Contaminants	NELAP	3/7/2012
cis-1,2-Dichloroethylene	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
cis-1,3-Dichloropropene	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
Color	SM 2120 B	Secondary Inorganic Contaminants	NELAP	3/7/2012
Conductivity	SM 2510 B	Primary Inorganic Contaminants	NELAP	3/7/2012
Copper	EPA 200.7	Primary Inorganic Contaminants,Secondary Inorganic Contaminants	NELAP	3/7/2012
Copper	EPA 200.8	Primary Inorganic Contaminants,Secondary Inorganic Contaminants	NELAP	3/7/2012
Copper	EPA 200.9	Primary Inorganic Contaminants	NELAP	3/7/2012
Cyanide	EPA 335.4	Primary Inorganic Contaminants	NELAP	3/7/2012
Dacthal (DCPA)	EPA 525.2	Synthetic Organic Contaminants	NELAP	3/7/2012
Dalapon	EPA 515.4	Synthetic Organic Contaminants	NELAP	3/7/2012
DCPA di acid degradate	EPA 515.4	Group I Unregulated Contaminants	NELAP	3/7/2012
Di(2-ethylhexyl)adipate	EPA 525.2	Synthetic Organic Contaminants	NELAP	3/7/2012
Dibromoacetic acid	EPA 552.2	Group I Unregulated Contaminants	NELAP	3/7/2012
Dibromochloromethane	EPA 524.2	Other Regulated Contaminants,Group II Unregulated Contaminants	NELAP	3/7/2012
Dibromomethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
Dicamba	EPA 515.4	Synthetic Organic Contaminants	NELAP	3/7/2012
Dichloroacetic acid	EPA 552.2	Group I Unregulated Contaminants	NELAP	3/7/2012
Dichlorodifluoromethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
Dichloromethane (DCM, Methylene chloride)	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
Dieldrin	EPA 508.1	Group I Unregulated Contaminants	NELAP	3/7/2012
Diethyl phthalate	EPA 525.2	Group III Unregulated Contaminants	NELAP	3/7/2012
Dimethyl phthalate	EPA 525.2	Group III Unregulated Contaminants	NELAP	3/7/2012
Di-n-butyl phthalate	EPA 525.2	Group III Unregulated Contaminants	NELAP	3/7/2012
Di-n-octyl phthalate	EPA 525.2	Synthetic Organic Contaminants	NELAP	3/7/2012
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 515.4	Synthetic Organic Contaminants	NELAP	3/7/2012
Diquat	EPA 549.2	Synthetic Organic Contaminants	NELAP	3/7/2012

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ALS Environmental, Kelso
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Kelso, WA 98626

Matrix: Drinking Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Endothall	EPA 548.1	Synthetic Organic Contaminants	NELAP	3/7/2012
Endrin	EPA 508.1	Synthetic Organic Contaminants	NELAP	3/7/2012
EPTC (Eptam, s-ethyl-dipropyl thio carbamate)	EPA 525.2	Group I Unregulated Contaminants	NELAP	3/7/2012
Ethylbenzene	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
Fluoride	EPA 300.0	Primary Inorganic Contaminants,Secondary Inorganic Contaminants	NELAP	3/7/2012
Fluoride	SM 4500 F-C	Secondary Inorganic Contaminants,Primary Inorganic Contaminants	NELAP	3/7/2012
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 508.1	Synthetic Organic Contaminants	NELAP	3/7/2012
Hardness	SM 2340 B	Secondary Inorganic Contaminants	NELAP	3/7/2012
Heptachlor	EPA 508.1	Synthetic Organic Contaminants	NELAP	3/7/2012
Heptachlor epoxide	EPA 508.1	Synthetic Organic Contaminants	NELAP	3/7/2012
Hexachlorobenzene	EPA 525.2	Synthetic Organic Contaminants	NELAP	3/7/2012
Hexachlorobutadiene	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
Hexachlorocyclopentadiene	EPA 525.2	Synthetic Organic Contaminants	NELAP	3/7/2012
Iron	EPA 200.7	Secondary Inorganic Contaminants	NELAP	3/7/2012
Isophorone	EPA 525.2	Group III Unregulated Contaminants	NELAP	3/7/2012
Isopropylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
Lead	EPA 200.8	Primary Inorganic Contaminants	NELAP	3/7/2012
Lead	EPA 200.9	Primary Inorganic Contaminants	NELAP	3/7/2012
Magnesium	EPA 200.7	Primary Inorganic Contaminants	NELAP	3/7/2012
Manganese	EPA 200.7	Secondary Inorganic Contaminants	NELAP	3/7/2012
Manganese	EPA 200.8	Secondary Inorganic Contaminants	NELAP	3/7/2012
Mercury	EPA 245.1	Primary Inorganic Contaminants	NELAP	3/7/2012
Methoxychlor	EPA 508.1	Synthetic Organic Contaminants	NELAP	3/7/2012
Methyl bromide (Bromomethane)	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
Methyl chloride (Chloromethane)	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
Methyl tert-butyl ether (MTBE)	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
Metolachlor	EPA 525.2	Group I Unregulated Contaminants	NELAP	3/7/2012
Metribuzin	EPA 525.2	Group I Unregulated Contaminants	NELAP	3/7/2012
Molinate	EPA 525.2	Group I Unregulated Contaminants	NELAP	3/7/2012
Molybdenum	EPA 200.7	Primary Inorganic Contaminants	NELAP	3/7/2012
Naphthalene	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
n-Butylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
Nickel	EPA 200.7	Primary Inorganic Contaminants	NELAP	3/7/2012

Laboratory Scope of Accreditation

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State Laboratory ID: E87412 **EPA Lab Code:** WA01276 **(360) 577-7222**

E87412
ALS Environmental, Kelso
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Kelso, WA 98626

Matrix: Drinking Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Nickel	EPA 200.8	Primary Inorganic Contaminants	NELAP	3/7/2012
Nitrate	EPA 300.0	Primary Inorganic Contaminants	NELAP	3/7/2012
Nitrate	EPA 353.2	Primary Inorganic Contaminants	NELAP	3/7/2012
Nitrite	EPA 300.0	Primary Inorganic Contaminants	NELAP	3/7/2012
Nitrite	EPA 353.2	Primary Inorganic Contaminants	NELAP	3/7/2012
n-Propylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
Orthophosphate as P	SM 4500-P E	Primary Inorganic Contaminants	NELAP	3/7/2012
Paraquat	EPA 549.2	Synthetic Organic Contaminants	NELAP	3/7/2012
PCBs	EPA 508.1	Synthetic Organic Contaminants	NELAP	3/7/2012
Pentachlorophenol	EPA 515.4	Synthetic Organic Contaminants	NELAP	3/7/2012
Perchlorate	EPA 314.0	Primary Inorganic Contaminants	NELAP	3/7/2012
pH	SM 4500-H+-B	Primary Inorganic Contaminants	NELAP	3/7/2012
Picloram	EPA 515.4	Synthetic Organic Contaminants	NELAP	3/7/2012
Potassium	EPA 200.7	Primary Inorganic Contaminants	NELAP	3/7/2012
Propachlor (Ramrod)	EPA 525.2	Group I Unregulated Contaminants	NELAP	3/7/2012
sec-Butylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
Selenium	EPA 200.8	Primary Inorganic Contaminants	NELAP	3/7/2012
Selenium	EPA 200.9	Primary Inorganic Contaminants	NELAP	3/7/2012
Silica as SiO2	EPA 200.7	Primary Inorganic Contaminants	NELAP	3/7/2012
Silver	EPA 200.7	Secondary Inorganic Contaminants	NELAP	3/7/2012
Silver	EPA 200.8	Secondary Inorganic Contaminants	NELAP	3/7/2012
Silvex (2,4,5-TP)	EPA 515.4	Synthetic Organic Contaminants	NELAP	3/7/2012
Simazine	EPA 525.2	Synthetic Organic Contaminants	NELAP	3/7/2012
Sodium	EPA 200.7	Primary Inorganic Contaminants	NELAP	3/7/2012
Styrene	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
Sulfate	EPA 300.0	Secondary Inorganic Contaminants,Primary Inorganic Contaminants	NELAP	3/7/2012
Terbacil	EPA 525.2	Group I Unregulated Contaminants	NELAP	3/7/2012
tert-Butylbenzene	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
Tetrachloroethylene (Perchloroethylene)	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
Thallium	EPA 200.8	Primary Inorganic Contaminants	NELAP	3/7/2012
Thallium	EPA 200.9	Primary Inorganic Contaminants	NELAP	3/7/2012
Toluene	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
Total dissolved solids	SM 2540 C	Secondary Inorganic Contaminants	NELAP	3/7/2012
Total haloacetic acids (HAA5)	EPA 552.2	Synthetic Organic Contaminants	NELAP	3/7/2012
Total nitrate-nitrite	EPA 300.0	Primary Inorganic Contaminants	NELAP	3/7/2012

Laboratory Scope of Accreditation

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Matrix: Drinking Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Total nitrate-nitrite	EPA 353.2	Primary Inorganic Contaminants	NELAP	3/7/2012
Total organic carbon	SM 5310 C	Primary Inorganic Contaminants	NELAP	3/7/2012
Total trihalomethanes	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
Toxaphene (Chlorinated camphene)	EPA 508.1	Synthetic Organic Contaminants	NELAP	3/7/2012
trans-1,2-Dichloroethylene	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
trans-1,3-Dichloropropene	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
Trichloroacetic acid	EPA 552.2	Group I Unregulated Contaminants	NELAP	3/7/2012
Trichloroethene (Trichloroethylene)	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
Trichlorofluoromethane	EPA 524.2	Group II Unregulated Contaminants	NELAP	3/7/2012
Turbidity	EPA 180.1	Secondary Inorganic Contaminants	NELAP	3/7/2012
Vanadium	EPA 200.7	Primary Inorganic Contaminants	NELAP	3/7/2012
Vinyl chloride	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
Xylene (total)	EPA 524.2	Other Regulated Contaminants	NELAP	3/7/2012
Zinc	EPA 200.7	Secondary Inorganic Contaminants	NELAP	3/7/2012

Laboratory Scope of Accreditation

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State Laboratory ID: E87412 **EPA Lab Code:** WA01276 **(360) 577-7222**

E87412
ALS Environmental, Kelso
1317 South 13th Avenue
Kelso, WA 98626

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,1,1,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,1,1-Trichloroethane	EPA 624	Volatile Organics	NELAP	3/7/2012
1,1,1-Trichloroethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,1,2,2-Tetrachloroethane	EPA 624	Volatile Organics	NELAP	3/7/2012
1,1,2,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,1,2-Trichloroethane	EPA 624	Volatile Organics	NELAP	3/7/2012
1,1,2-Trichloroethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,1-Dichloroethane	EPA 624	Volatile Organics	NELAP	3/7/2012
1,1-Dichloroethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,1-Dichloroethylene	EPA 624	Volatile Organics	NELAP	3/7/2012
1,1-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,1-Dichloropropene	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,2,3-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,2,4,5-Tetrachlorobenzene	EPA 8270	Extractable Organics	NELAP	3/7/2012
1,2,4-Trichlorobenzene	EPA 625	Extractable Organics	NELAP	3/7/2012
1,2,4-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,2,4-Trichlorobenzene	EPA 8270	Extractable Organics	NELAP	3/7/2012
1,2,4-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,2-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	3/7/2012
1,2-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	3/7/2012
1,2-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,2-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	3/7/2012
1,2-Dichloroethane	EPA 624	Volatile Organics	NELAP	3/7/2012
1,2-Dichloroethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,2-Dichloropropane	EPA 624	Volatile Organics	NELAP	3/7/2012
1,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,2-Diphenylhydrazine	EPA 8270	Extractable Organics	NELAP	3/7/2012
1,3,5-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270	Extractable Organics	NELAP	3/7/2012
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330	Extractable Organics	NELAP	3/7/2012
1,3-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	3/7/2012
1,3-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	3/7/2012
1,3-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,3-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	3/7/2012

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Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,3-Dichloropropane	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,3-Dinitrobenzene (1,3-DNB)	EPA 8330	Extractable Organics	NELAP	3/7/2012
1,4-Dichlorobenzene	EPA 624	Volatile Organics	NELAP	3/7/2012
1,4-Dichlorobenzene	EPA 625	Extractable Organics	NELAP	3/7/2012
1,4-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,4-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	3/7/2012
1,4-Dioxane (1,4-Diethyleneoxide)	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,4-Naphthoquinone	EPA 8270	Extractable Organics	NELAP	3/7/2012
1,4-Phenylenediamine	EPA 8270	Extractable Organics	NELAP	3/7/2012
17a-Estradiol	EPA 1694	Extractable Organics	NELAP	3/7/2012
17a-Ethynyl Estradiol	EPA 1694	Extractable Organics	NELAP	3/7/2012
17B-Estradiol	EPA 1694	Extractable Organics	NELAP	3/7/2012
1-Chlorohexane	EPA 8260	Volatile Organics	NELAP	3/7/2012
1-Chloronaphthalene	EPA 8270	Extractable Organics	NELAP	3/7/2012
1-Naphthylamine	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ 206)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ 194)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ 195)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,3',4,4'-Hexachlorobiphenyl (BZ 128)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ 180)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ 183)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,4,4',5'-Hexachlorobiphenyl (BZ 138)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,4,5,5'-Hexachlorobiphenyl (BZ 141)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,4,5'-Pentachlorobiphenyl (BZ 87)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,5,5',6-Hexachlorobiphenyl (BZ 151)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,5'-Tetrachlorobiphenyl (BZ 44)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',4,4',5,5'-Hexachlorobiphenyl (BZ 153)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',4,5,5'-Pentachlorobiphenyl (BZ 101)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',4,5'-Tetrachlorobiphenyl (BZ 49)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',5,5'-Tetrachlorobiphenyl (BZ 52)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',5-Trichlorobiphenyl (BZ 18)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	3/7/2012
2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ 189)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3,3',4,4',5-Hexachlorobiphenyl (BZ 156)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012

Laboratory Scope of Accreditation

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State Laboratory ID: E87412 **EPA Lab Code:** WA01276 (360) 577-7222

E87412
ALS Environmental, Kelso
1317 South 13th Avenue
Kelso, WA 98626

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,3,3',4',6-Pentachlorobiphenyl (BZ 110)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3',4,4',5,5'-Hexachlorobiphenyl (BZ 167)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3,4,4',5-Pentachlorobiphenyl (BZ 114)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3',4,4',5-Pentachlorobiphenyl (BZ 118)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3',4,4',5'-Pentachlorobiphenyl (BZ 123)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3',4,4'-Tetrachlorobiphenyl (BZ 66)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3,4,6-Tetrachlorophenol	EPA 1653	Extractable Organics	NELAP	3/7/2012
2,3,4,6-Tetrachlorophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,3-Dichlorobiphenyl (BZ 5)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4,5-T	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4',5-Trichlorobiphenyl (BZ 31)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4,5-Trichlorophenol	EPA 1653	Extractable Organics	NELAP	3/7/2012
2,4,5-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,4,6-Trichlorophenol	EPA 1653	Extractable Organics	NELAP	3/7/2012
2,4,6-Trichlorophenol	EPA 625	Extractable Organics	NELAP	3/7/2012
2,4,6-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330	Extractable Organics	NELAP	3/7/2012
2,4-D	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4-DB	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4'-DDD	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4'-DDE	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4'-DDT	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4'-Dichlorobiphenyl (BZ 8)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4-Dichlorophenol	EPA 625	Extractable Organics	NELAP	3/7/2012
2,4-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,4-Dimethylphenol	EPA 625	Extractable Organics	NELAP	3/7/2012
2,4-Dimethylphenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,4-Dinitrophenol	EPA 625	Extractable Organics	NELAP	3/7/2012
2,4-Dinitrophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,4-Dinitrotoluene (2,4-DNT)	EPA 625	Extractable Organics	NELAP	3/7/2012
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,4-Dinitrotoluene (2,4-DNT)	EPA 8330	Extractable Organics	NELAP	3/7/2012
2,6-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,6-Dinitrotoluene (2,6-DNT)	EPA 625	Extractable Organics	NELAP	3/7/2012
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270	Extractable Organics	NELAP	3/7/2012

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E87412
ALS Environmental, Kelso
1317 South 13th Avenue
Kelso, WA 98626

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,6-Dinitrotoluene (2,6-DNT)	EPA 8330	Extractable Organics	NELAP	3/7/2012
2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330	Extractable Organics	NELAP	3/7/2012
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260	Volatile Organics	NELAP	3/7/2012
2-Chlorobiphenyl (BZ 1)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2-Chloroethyl vinyl ether	EPA 624	Volatile Organics	NELAP	3/7/2012
2-Chloroethyl vinyl ether	EPA 8260	Volatile Organics	NELAP	3/7/2012
2-Chloronaphthalene	EPA 625	Extractable Organics	NELAP	3/7/2012
2-Chloronaphthalene	EPA 8270	Extractable Organics	NELAP	3/7/2012
2-Chlorophenol	EPA 625	Extractable Organics	NELAP	3/7/2012
2-Chlorophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	3/7/2012
2-Hexanone	EPA 8260	Volatile Organics	NELAP	3/7/2012
2-Methyl-4,6-dinitrophenol	EPA 625	Extractable Organics	NELAP	3/7/2012
2-Methyl-4,6-dinitrophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2-Methylnaphthalene	EPA 8270	Extractable Organics	NELAP	3/7/2012
2-Methylphenol (o-Cresol)	EPA 8270	Extractable Organics	NELAP	3/7/2012
2-Naphthylamine	EPA 8270	Extractable Organics	NELAP	3/7/2012
2-Nitroaniline	EPA 8270	Extractable Organics	NELAP	3/7/2012
2-Nitrophenol	EPA 625	Extractable Organics	NELAP	3/7/2012
2-Nitrophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	3/7/2012
2-Picoline (2-Methylpyridine)	EPA 8270	Extractable Organics	NELAP	3/7/2012
3,3',4,4',5,5'-Hexachlorobiphenyl (BZ 169)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
3,3',4,4',5-Pentachlorobiphenyl (BZ 126)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
3,3',4,4'-Tetrachlorobiphenyl (BZ 77)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
3,3'-Dichlorobenzidine	EPA 625	Extractable Organics	NELAP	3/7/2012
3,3'-Dichlorobenzidine	EPA 8270	Extractable Organics	NELAP	3/7/2012
3,3'-Dimethylbenzidine	EPA 8270	Extractable Organics	NELAP	3/7/2012
3,4,4',5-Tetrachlorobiphenyl (BZ 81)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
3,4,5-Trichlorocatechol	EPA 1653	Extractable Organics	NELAP	3/7/2012
3,4,5-Trichloroguaiacol	EPA 1653	Extractable Organics	NELAP	3/7/2012
3,4,6-Trichlorocatechol	EPA 1653	Extractable Organics	NELAP	3/7/2012
3,4,6-Trichloroguaiacol	EPA 1653	Extractable Organics	NELAP	3/7/2012
3,5-Dinitroaniline	EPA 8330	Extractable Organics	NELAP	3/7/2012
3-Methylcholanthrene	EPA 8270	Extractable Organics	NELAP	3/7/2012
3-Methylphenol (m-Cresol)	EPA 8270	Extractable Organics	NELAP	3/7/2012

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Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
3-Nitroaniline	EPA 8270	Extractable Organics	NELAP	3/7/2012
3-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	3/7/2012
4,4'-DDD	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
4,4'-DDD	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
4,4'-DDD	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
4,4'-DDE	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
4,4'-DDE	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
4,4'-DDE	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
4,4'-DDT	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
4,4'-DDT	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
4,4'-DDT	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
4,5,6-Trichloroguaiacol	EPA 1653	Extractable Organics	NELAP	3/7/2012
4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330	Extractable Organics	NELAP	3/7/2012
4-Aminobiphenyl	EPA 8270	Extractable Organics	NELAP	3/7/2012
4-Bromophenyl phenyl ether	EPA 625	Extractable Organics	NELAP	3/7/2012
4-Chloro-3-methylphenol	EPA 625	Extractable Organics	NELAP	3/7/2012
4-Chloro-3-methylphenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
4-Chloroaniline	EPA 8270	Extractable Organics	NELAP	3/7/2012
4-Chlorophenyl phenylether	EPA 625	Extractable Organics	NELAP	3/7/2012
4-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	3/7/2012
4-Methyl-2-pentanone (MIBK)	EPA 8260	Volatile Organics	NELAP	3/7/2012
4-Methylphenol (p-Cresol)	EPA 8270	Extractable Organics	NELAP	3/7/2012
4-Nitroaniline	EPA 8270	Extractable Organics	NELAP	3/7/2012
4-Nitrophenol	EPA 625	Extractable Organics	NELAP	3/7/2012
4-Nitrophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
4-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	3/7/2012
5,5-Diphenylhydantoin (Phenytoin, Dilantin)	EPA 1694	Extractable Organics	NELAP	3/7/2012
a,a-Dimethylphenethylamine	EPA 8270	Extractable Organics	NELAP	3/7/2012
Acenaphthene	EPA 625	Extractable Organics	NELAP	3/7/2012
Acenaphthene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Acenaphthylene	EPA 625	Extractable Organics	NELAP	3/7/2012
Acenaphthylene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Acetaminophen	EPA 1694	Extractable Organics	NELAP	3/7/2012
Acetone	EPA 8260	Volatile Organics	NELAP	3/7/2012
Acetonitrile	EPA 8260	Volatile Organics	NELAP	3/7/2012

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Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Acetophenone	EPA 8270	Extractable Organics	NELAP	3/7/2012
Acidity, as CaCO3	SM 2310 B	General Chemistry	NELAP	3/7/2012
Acrolein (Propenal)	EPA 624	Volatile Organics	NELAP	3/7/2012
Acrolein (Propenal)	EPA 8260	Volatile Organics	NELAP	3/7/2012
Acrylonitrile	EPA 624	Volatile Organics	NELAP	3/7/2012
Acrylonitrile	EPA 8260	Volatile Organics	NELAP	3/7/2012
Adsorbable organic halogens (AOX)	EPA 1650	General Chemistry	NELAP	3/7/2012
Aldrin	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aldrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Alkalinity as CaCO3	SM 2320 B	General Chemistry	NELAP	3/7/2012
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
alpha-Chlordane	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
alpha-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aluminum	EPA 200.7	Metals	NELAP	3/7/2012
Aluminum	EPA 200.8	Metals	NELAP	3/7/2012
Aluminum	EPA 6010	Metals	NELAP	3/7/2012
Aluminum	EPA 6020	Metals	NELAP	3/7/2012
Amenable cyanide	SM 4500-CN- G	General Chemistry	NELAP	3/7/2012
Ammonia as N	ASTM D1426-98B	General Chemistry	NELAP	3/7/2012
Ammonia as N	SM 4500-NH3 E (19th, 20th, 21st Ed.)/ISE	General Chemistry	NELAP	3/7/2012
Ammonia as N	SM 4500-NH3 G	General Chemistry	NELAP	3/7/2012
Androstenedione	EPA 1694	Extractable Organics	NELAP	3/7/2012
Aniline	EPA 8270	Extractable Organics	NELAP	3/7/2012
Anthracene	EPA 625	Extractable Organics	NELAP	3/7/2012
Anthracene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Antimony	EPA 200.7	Metals	NELAP	3/7/2012
Antimony	EPA 200.8	Metals	NELAP	3/7/2012
Antimony	EPA 200.9	Metals	NELAP	3/7/2012
Antimony	EPA 6010	Metals	NELAP	3/7/2012
Antimony	EPA 6020	Metals	NELAP	3/7/2012
Aramite	EPA 8270	Extractable Organics	NELAP	3/7/2012
Aroclor-1016 (PCB-1016)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1016 (PCB-1016)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Aroclor-1221 (PCB-1221)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1221 (PCB-1221)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1232 (PCB-1232)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1232 (PCB-1232)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1242 (PCB-1242)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1242 (PCB-1242)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1248 (PCB-1248)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1248 (PCB-1248)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1254 (PCB-1254)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1254 (PCB-1254)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1260 (PCB-1260)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1260 (PCB-1260)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Arsenic	EPA 200.7	Metals	NELAP	3/7/2012
Arsenic	EPA 200.8	Metals	NELAP	3/7/2012
Arsenic	EPA 200.9	Metals	NELAP	3/7/2012
Arsenic	EPA 6010	Metals	NELAP	3/7/2012
Arsenic	EPA 6020	Metals	NELAP	3/7/2012
Arsenic	EPA 7062	Metals	NELAP	3/7/2012
Atrazine	EPA 1694	Extractable Organics	NELAP	3/7/2012
Azinphos-methyl (Guthion)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Barium	EPA 200.7	Metals	NELAP	3/7/2012
Barium	EPA 200.8	Metals	NELAP	3/7/2012
Barium	EPA 6010	Metals	NELAP	3/7/2012
Barium	EPA 6020	Metals	NELAP	3/7/2012
Benzene	EPA 624	Volatile Organics	NELAP	3/7/2012
Benzene	EPA 8021	Volatile Organics	NELAP	3/7/2012
Benzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Benzidine	EPA 625	Extractable Organics	NELAP	3/7/2012
Benzo(a)anthracene	EPA 625	Extractable Organics	NELAP	3/7/2012
Benzo(a)anthracene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Benzo(a)pyrene	EPA 625	Extractable Organics	NELAP	3/7/2012
Benzo(a)pyrene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Benzo(b)fluoranthene	EPA 625	Extractable Organics	NELAP	3/7/2012
Benzo(b)fluoranthene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Benzo(g,h,i)perylene	EPA 625	Extractable Organics	NELAP	3/7/2012
Benzo(g,h,i)perylene	EPA 8270	Extractable Organics	NELAP	3/7/2012

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Benzo(j)fluoranthene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Benzo(k)fluoranthene	EPA 625	Extractable Organics	NELAP	3/7/2012
Benzo(k)fluoranthene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Benzoic acid	EPA 8270	Extractable Organics	NELAP	3/7/2012
Benzyl alcohol	EPA 8270	Extractable Organics	NELAP	3/7/2012
Beryllium	EPA 200.7	Metals	NELAP	3/7/2012
Beryllium	EPA 200.8	Metals	NELAP	3/7/2012
Beryllium	EPA 6010	Metals	NELAP	3/7/2012
Beryllium	EPA 6020	Metals	NELAP	3/7/2012
beta-BHC (beta-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
bis(2-Chloroethoxy)methane	EPA 625	Extractable Organics	NELAP	3/7/2012
bis(2-Chloroethoxy)methane	EPA 8270	Extractable Organics	NELAP	3/7/2012
bis(2-Chloroethyl) ether	EPA 625	Extractable Organics	NELAP	3/7/2012
bis(2-Chloroethyl) ether	EPA 8270	Extractable Organics	NELAP	3/7/2012
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 625	Extractable Organics	NELAP	3/7/2012
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 8270	Extractable Organics	NELAP	3/7/2012
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 625	Extractable Organics	NELAP	3/7/2012
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270	Extractable Organics	NELAP	3/7/2012
Bisphenol A	EPA 1694	Extractable Organics	NELAP	3/7/2012
Bolstar (Sulprofos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Boron	EPA 200.7	Metals	NELAP	3/7/2012
Boron	EPA 6010	Metals	NELAP	3/7/2012
Bromide	EPA 300.0	General Chemistry	NELAP	3/7/2012
Bromobenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Bromochloromethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
Bromodichloromethane	EPA 624	Volatile Organics	NELAP	3/7/2012
Bromodichloromethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
Bromoform	EPA 624	Volatile Organics	NELAP	3/7/2012
Bromoform	EPA 8260	Volatile Organics	NELAP	3/7/2012
Butyl benzyl phthalate	EPA 625	Extractable Organics	NELAP	3/7/2012
Butyl benzyl phthalate	EPA 8270	Extractable Organics	NELAP	3/7/2012
Butyltin trichloride	CASW SOC-Butyl/GC-FPD	Extractable Organics	NELAP	3/7/2012
Cadmium	EPA 200.7	Metals	NELAP	3/7/2012
Cadmium	EPA 200.8	Metals	NELAP	3/7/2012

Laboratory Scope of Accreditation

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State Laboratory ID: E87412 **EPA Lab Code:** WA01276 (360) 577-7222

E87412
ALS Environmental, Kelso
1317 South 13th Avenue
Kelso, WA 98626

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Cadmium	EPA 6010	Metals	NELAP	3/7/2012
Cadmium	EPA 6020	Metals	NELAP	3/7/2012
Caffeine	EPA 1694	Extractable Organics	NELAP	3/7/2012
Calcium	EPA 200.7	Metals	NELAP	3/7/2012
Calcium	EPA 6010	Metals	NELAP	3/7/2012
Caprolactam	EPA 8270	Extractable Organics	NELAP	3/7/2012
Carbamazepine	EPA 1694	Extractable Organics	NELAP	3/7/2012
Carbazole	EPA 8270	Extractable Organics	NELAP	3/7/2012
Carbon disulfide	EPA 8260	Volatile Organics	NELAP	3/7/2012
Carbon tetrachloride	EPA 624	Volatile Organics	NELAP	3/7/2012
Carbon tetrachloride	EPA 8260	Volatile Organics	NELAP	3/7/2012
Chemical oxygen demand	SM 5220 C	General Chemistry	NELAP	3/7/2012
Chlordane (tech.)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Chlordane (tech.)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Chloride	EPA 300.0	General Chemistry	NELAP	3/7/2012
Chloride	SM 4500-Cl^- C	General Chemistry	NELAP	3/7/2012
Chlorine	SM 4500-Cl F	General Chemistry	NELAP	3/7/2012
Chlorobenzene	EPA 624	Volatile Organics	NELAP	3/7/2012
Chlorobenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Chlorobenzilate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Chloroethane	EPA 624	Volatile Organics	NELAP	3/7/2012
Chloroform	EPA 624	Volatile Organics	NELAP	3/7/2012
Chloroform	EPA 8260	Volatile Organics	NELAP	3/7/2012
Chloroprene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Chlorpyrifos	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Chlorpyrifos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Chromium	EPA 200.7	Metals	NELAP	3/7/2012
Chromium	EPA 200.8	Metals	NELAP	3/7/2012
Chromium	EPA 6010	Metals	NELAP	3/7/2012
Chromium	EPA 6020	Metals	NELAP	3/7/2012
Chromium VI	EPA 7195	Metals	NELAP	3/7/2012
Chromium VI	EPA 7196	General Chemistry	NELAP	3/7/2012
Chrysene	EPA 625	Extractable Organics	NELAP	3/7/2012
Chrysene	EPA 8270	Extractable Organics	NELAP	3/7/2012
cis-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	3/7/2012
cis-1,3-Dichloropropene	EPA 624	Volatile Organics	NELAP	3/7/2012

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Analyte	Method/Tech	Category	Certification Type	Effective Date
cis-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	3/7/2012
cis-Nonachlor	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Cobalt	EPA 200.8	Metals	NELAP	3/7/2012
Cobalt	EPA 6010	Metals	NELAP	3/7/2012
Cobalt	EPA 6020	Metals	NELAP	3/7/2012
Color	SM 2120 B	General Chemistry	NELAP	3/7/2012
Copper	EPA 200.7	Metals	NELAP	3/7/2012
Copper	EPA 200.8	Metals	NELAP	3/7/2012
Copper	EPA 200.9	Metals	NELAP	3/7/2012
Copper	EPA 6010	Metals	NELAP	3/7/2012
Copper	EPA 6020	Metals	NELAP	3/7/2012
Coumaphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Dalapon	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Decachlorobiphenyl (BZ 209)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
DEET	EPA 1694	Extractable Organics	NELAP	3/7/2012
delta-BHC	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
delta-BHC	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
delta-BHC	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Demeton-o	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Demeton-s	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Diallate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Diazepam	EPA 1694	Extractable Organics	NELAP	3/7/2012
Diazinon	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Dibenz(a,h)anthracene	EPA 625	Extractable Organics	NELAP	3/7/2012
Dibenz(a,h)anthracene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Dibenzofuran	EPA 8270	Extractable Organics	NELAP	3/7/2012
Dibromochloromethane	EPA 624	Volatile Organics	NELAP	3/7/2012
Dibromochloromethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
Dibromomethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
Dibutyltin dichloride	CASW SOC-Butyl/GC-FPD	Extractable Organics	NELAP	3/7/2012
Dicamba	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Dichlorodifluoromethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
Dichloroprop (Dichlorprop)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Dichlorovos (DDVP, Dichlorvos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Diclofenac	EPA 1694	Extractable Organics	NELAP	3/7/2012

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Dieldrin	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Dieldrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Dieldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Diesel range organics (DRO)	EPA 8015	Extractable Organics	NELAP	3/7/2012
Diethyl ether	EPA 8260	Volatile Organics	NELAP	3/7/2012
Diethyl phthalate	EPA 625	Extractable Organics	NELAP	3/7/2012
Diethyl phthalate	EPA 8270	Extractable Organics	NELAP	3/7/2012
Diethylstilbestrol	EPA 1694	Extractable Organics	NELAP	3/7/2012
Dimethoate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Dimethyl phthalate	EPA 625	Extractable Organics	NELAP	3/7/2012
Dimethyl phthalate	EPA 8270	Extractable Organics	NELAP	3/7/2012
Di-n-butyl phthalate	EPA 625	Extractable Organics	NELAP	3/7/2012
Di-n-butyl phthalate	EPA 8270	Extractable Organics	NELAP	3/7/2012
Di-n-octyl phthalate	EPA 625	Extractable Organics	NELAP	3/7/2012
Di-n-octyl phthalate	EPA 8270	Extractable Organics	NELAP	3/7/2012
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Disulfoton	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endosulfan I	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endosulfan I	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endosulfan I	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endosulfan II	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endosulfan II	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endosulfan II	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endosulfan sulfate	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endosulfan sulfate	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endosulfan sulfate	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endrin	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endrin	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endrin aldehyde	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endrin aldehyde	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endrin aldehyde	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endrin ketone	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Endrin ketone	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Estriol	EPA 1694	Extractable Organics	NELAP	3/7/2012
Estrone	EPA 1694	Extractable Organics	NELAP	3/7/2012
Ethoprop	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Ethyl acetate	EPA 8260	Volatile Organics	NELAP	3/7/2012
Ethyl methacrylate	EPA 8260	Volatile Organics	NELAP	3/7/2012
Ethylbenzene	EPA 624	Volatile Organics	NELAP	3/7/2012
Ethylbenzene	EPA 8021	Volatile Organics	NELAP	3/7/2012
Ethylbenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Ethylene glycol	EPA 8015	Volatile Organics	NELAP	3/7/2012
Fensulfothion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Fenthion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Fluoranthene	EPA 625	Extractable Organics	NELAP	3/7/2012
Fluoranthene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Fluorene	EPA 625	Extractable Organics	NELAP	3/7/2012
Fluorene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Fluoride	EPA 300.0	General Chemistry	NELAP	3/7/2012
Fluoride	SM 4500 F-C	General Chemistry	NELAP	3/7/2012
Fluoxetine	EPA 1694	Extractable Organics	NELAP	3/7/2012
Formaldehyde	EPA 8315	Extractable Organics	NELAP	3/7/2012
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
gamma-Chlordane	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
gamma-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Gasoline range organics (GRO)	EPA 8015	Volatile Organics	NELAP	3/7/2012
Gemfibrozil	EPA 1694	Extractable Organics	NELAP	3/7/2012
Hardness	SM 2340 B	General Chemistry	NELAP	3/7/2012
Hardness (calc.)	EPA 200.7	Metals	NELAP	3/7/2012
Heptachlor	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Heptachlor	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Heptachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Heptachlor epoxide	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Heptachlor epoxide	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Heptachlor epoxide	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012

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Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Hexachlorobenzene	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Hexachlorobenzene	EPA 625	Extractable Organics	NELAP	3/7/2012
Hexachlorobenzene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Hexachlorobutadiene	EPA 625	Extractable Organics	NELAP	3/7/2012
Hexachlorobutadiene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Hexachlorobutadiene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Hexachlorocyclopentadiene	EPA 625	Extractable Organics	NELAP	3/7/2012
Hexachlorocyclopentadiene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Hexachloroethane	EPA 625	Extractable Organics	NELAP	3/7/2012
Hexachloroethane	EPA 8270	Extractable Organics	NELAP	3/7/2012
Hexachlorophene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Hydrocodone	EPA 1694	Extractable Organics	NELAP	3/7/2012
Ibuprofen	EPA 1694	Extractable Organics	NELAP	3/7/2012
Ignitability	EPA 1020	General Chemistry	NELAP	3/7/2012
Indeno(1,2,3-cd)pyrene	EPA 625	Extractable Organics	NELAP	3/7/2012
Indeno(1,2,3-cd)pyrene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Iodomethane (Methyl iodide)	EPA 8260	Volatile Organics	NELAP	3/7/2012
Iopromide	EPA 1694	Extractable Organics	NELAP	3/7/2012
Iron	EPA 200.7	Metals	NELAP	3/7/2012
Iron	EPA 6010	Metals	NELAP	3/7/2012
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260	Volatile Organics	NELAP	3/7/2012
Isodrin	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Isodrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Isophorone	EPA 625	Extractable Organics	NELAP	3/7/2012
Isophorone	EPA 8270	Extractable Organics	NELAP	3/7/2012
Isopropylbenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Kepone	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Kjeldahl nitrogen - total	ASTM D3590-89B	General Chemistry	NELAP	3/7/2012
Lead	EPA 200.7	Metals	NELAP	3/7/2012
Lead	EPA 200.8	Metals	NELAP	3/7/2012
Lead	EPA 200.9	Metals	NELAP	3/7/2012
Lead	EPA 6010	Metals	NELAP	3/7/2012
Lead	EPA 6020	Metals	NELAP	3/7/2012
Magnesium	EPA 200.7	Metals	NELAP	3/7/2012
Magnesium	EPA 6010	Metals	NELAP	3/7/2012

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Malathion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Manganese	EPA 200.7	Metals	NELAP	3/7/2012
Manganese	EPA 200.8	Metals	NELAP	3/7/2012
Manganese	EPA 6010	Metals	NELAP	3/7/2012
Manganese	EPA 6020	Metals	NELAP	3/7/2012
MCPA	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
MCPP	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Meprobamate	EPA 1694	Extractable Organics	NELAP	3/7/2012
Mercury	EPA 1631	Metals	NELAP	3/7/2012
Mercury	EPA 245.1	Metals	NELAP	3/7/2012
Mercury	EPA 7470	Metals	NELAP	3/7/2012
Merphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Methacrylonitrile	EPA 8260	Volatile Organics	NELAP	3/7/2012
Methadone	EPA 1694	Extractable Organics	NELAP	3/7/2012
Methanol	NCASI 99.01	Volatile Organics	NELAP	3/7/2012
Methanol	NCASI DI/MEOH-94.03	Volatile Organics	NELAP	3/7/2012
Methapyrilene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Methoxychlor	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Methoxychlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Methyl bromide (Bromomethane)	EPA 624	Volatile Organics	NELAP	3/7/2012
Methyl bromide (Bromomethane)	EPA 8260	Volatile Organics	NELAP	3/7/2012
Methyl chloride (Chloromethane)	EPA 624	Volatile Organics	NELAP	3/7/2012
Methyl chloride (Chloromethane)	EPA 8260	Volatile Organics	NELAP	3/7/2012
Methyl mercury	EPA 1630	Metals	NELAP	3/7/2012
Methyl parathion (Parathion, methyl)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Methyl parathion (Parathion, methyl)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Methyl tert-butyl ether (MTBE)	EPA 8260	Volatile Organics	NELAP	3/7/2012
Methylene chloride	EPA 624	Volatile Organics	NELAP	3/7/2012
Methylene chloride	EPA 8260	Volatile Organics	NELAP	3/7/2012
Mevinphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Mirex	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Mirex	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Molybdenum	EPA 200.7	Metals	NELAP	3/7/2012
Molybdenum	EPA 200.8	Metals	NELAP	3/7/2012
Molybdenum	EPA 6010	Metals	NELAP	3/7/2012

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Molybdenum	EPA 6020	Metals	NELAP	3/7/2012
Naphthalene	EPA 625	Extractable Organics	NELAP	3/7/2012
Naphthalene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Naphthalene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Naproxen	EPA 1694	Extractable Organics	NELAP	3/7/2012
n-Butylbenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Nickel	EPA 200.7	Metals	NELAP	3/7/2012
Nickel	EPA 200.8	Metals	NELAP	3/7/2012
Nickel	EPA 6010	Metals	NELAP	3/7/2012
Nickel	EPA 6020	Metals	NELAP	3/7/2012
Nitrate as N	EPA 300.0	General Chemistry	NELAP	3/7/2012
Nitrate as N	EPA 353.2	General Chemistry	NELAP	3/7/2012
Nitrate-nitrite	EPA 353.2	General Chemistry	NELAP	3/7/2012
Nitrite as N	EPA 300.0	General Chemistry	NELAP	3/7/2012
Nitrite as N	EPA 353.2	General Chemistry	NELAP	3/7/2012
Nitrobenzene	EPA 625	Extractable Organics	NELAP	3/7/2012
Nitrobenzene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Nitrobenzene	EPA 8330	Extractable Organics	NELAP	3/7/2012
Nitroglycerin	EPA 8330	Extractable Organics	NELAP	3/7/2012
n-Nitrosodiethylamine	EPA 8270	Extractable Organics	NELAP	3/7/2012
n-Nitrosodimethylamine	EPA 625	Extractable Organics	NELAP	3/7/2012
n-Nitrosodimethylamine	EPA 8270	Extractable Organics	NELAP	3/7/2012
n-Nitrosodi-n-propylamine	EPA 625	Extractable Organics	NELAP	3/7/2012
n-Nitrosodiphenylamine	EPA 625	Extractable Organics	NELAP	3/7/2012
n-Nitrosodiphenylamine	EPA 8270	Extractable Organics	NELAP	3/7/2012
n-Nitrosomorpholine	EPA 8270	Extractable Organics	NELAP	3/7/2012
n-Nitrosopiperidine	EPA 8270	Extractable Organics	NELAP	3/7/2012
n-Nitrosopyrrolidine	EPA 8270	Extractable Organics	NELAP	3/7/2012
n-Propylbenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330	Extractable Organics	NELAP	3/7/2012
Oil & Grease	EPA 1664A	General Chemistry	NELAP	3/7/2012
Orthophosphate as P	EPA 365.3	General Chemistry	NELAP	3/7/2012
Oxybenzone	EPA 1694	Extractable Organics	NELAP	3/7/2012
Oxygen, dissolved	SM 4500-O G	General Chemistry	NELAP	3/7/2012
Parathion, ethyl	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Parathion, ethyl	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/7/2012

Laboratory Scope of Accreditation

Attachment to Certificate #: E87412-26, expiration date June 30, 2014. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87412 **EPA Lab Code: WA01276** **(360) 577-7222**

E87412
ALS Environmental, Kelso
1317 South 13th Avenue
Kelso, WA 98626

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Pentachloronitrobenzene (Quintozene)	EPA 8270	Extractable Organics	NELAP	3/7/2012
Pentachlorophenol	EPA 1653	Extractable Organics	NELAP	3/7/2012
Pentachlorophenol	EPA 625	Extractable Organics	NELAP	3/7/2012
Pentachlorophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
Pentaerythritoltetranitrate (PETN)	EPA 8330	Extractable Organics	NELAP	3/7/2012
Pentoxifylline	EPA 1694	Extractable Organics	NELAP	3/7/2012
Perchlorate	EPA 314.0	General Chemistry	NELAP	3/7/2012
pH	EPA 9040	General Chemistry	NELAP	3/7/2012
pH	SM 4500-H+-B	General Chemistry	NELAP	3/7/2012
Phenanthrene	EPA 625	Extractable Organics	NELAP	3/7/2012
Phenanthrene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Phenol	EPA 625	Extractable Organics	NELAP	3/7/2012
Phenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
Phorate	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Phosphorus, total	EPA 365.3	General Chemistry	NELAP	3/7/2012
p-Isopropyltoluene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Potassium	EPA 200.7	Metals	NELAP	3/7/2012
Potassium	EPA 6010	Metals	NELAP	3/7/2012
Progesterone	EPA 1694	Extractable Organics	NELAP	3/7/2012
Pronamide (Kerb)	EPA 8270	Extractable Organics	NELAP	3/7/2012
Pyrene	EPA 625	Extractable Organics	NELAP	3/7/2012
Pyrene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Pyridine	EPA 8270	Extractable Organics	NELAP	3/7/2012
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330	Extractable Organics	NELAP	3/7/2012
Residual free chlorine	EPA 330.4	General Chemistry	NELAP	3/7/2012
Residue-filterable (TDS)	SM 2540 C	General Chemistry	NELAP	3/7/2012
Residue-nonfilterable (TSS)	SM 2540 D	General Chemistry	NELAP	3/7/2012
Residue-settleable	SM 2540 F	General Chemistry	NELAP	3/7/2012
Residue-total	SM 2540 B	General Chemistry	NELAP	3/7/2012
Residue-volatile	EPA 160.4	General Chemistry	NELAP	3/7/2012
Ronnel	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Safrole	EPA 8270	Extractable Organics	NELAP	3/7/2012
Salicylic acid	EPA 1694	Extractable Organics	NELAP	3/7/2012
sec-Butylbenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Selenium	EPA 200.7	Metals	NELAP	3/7/2012
Selenium	EPA 200.8	Metals	NELAP	3/7/2012

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E87412
ALS Environmental, Kelso
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Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Selenium	EPA 200.9	Metals	NELAP	3/7/2012
Selenium	EPA 6010	Metals	NELAP	3/7/2012
Selenium	EPA 6020	Metals	NELAP	3/7/2012
Selenium	EPA 7742	Metals	NELAP	3/7/2012
Silica as SiO2	EPA 200.7	Metals	NELAP	3/7/2012
Silver	EPA 200.7	Metals	NELAP	3/7/2012
Silver	EPA 200.8	Metals	NELAP	3/7/2012
Silver	EPA 6010	Metals	NELAP	3/7/2012
Silver	EPA 6020	Metals	NELAP	3/7/2012
Silvex (2,4,5-TP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Sodium	EPA 200.7	Metals	NELAP	3/7/2012
Sodium	EPA 6010	Metals	NELAP	3/7/2012
Stirofos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Strontium	EPA 200.7	Metals	NELAP	3/7/2012
Styrene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Sulfamethoxazole	EPA 1694	Extractable Organics	NELAP	3/7/2012
Sulfate	EPA 300.0	General Chemistry	NELAP	3/7/2012
Sulfide	SM 4500-S D/UV-VIS	General Chemistry	NELAP	3/7/2012
Sulfide	SM 4500-S F (19th/20th/21st Ed.)/TITR	General Chemistry	NELAP	3/7/2012
Sulfite-SO3	SM 4500-SO3 B	General Chemistry	NELAP	3/7/2012
Surfactants - MBAS	SM 5540 C	General Chemistry	NELAP	3/7/2012
Tannin & Lignin	SM 5550 B	General Chemistry	NELAP	3/7/2012
tert-Butylbenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Testosterone	EPA 1694	Extractable Organics	NELAP	3/7/2012
Tetrabutyltin	CASW SOC-Butyl/GC-FPD	Extractable Organics	NELAP	3/7/2012
Tetrachlorocatechol	EPA 1653	Extractable Organics	NELAP	3/7/2012
Tetrachloroethylene (Perchloroethylene)	EPA 624	Volatile Organics	NELAP	3/7/2012
Tetrachloroethylene (Perchloroethylene)	EPA 8260	Volatile Organics	NELAP	3/7/2012
Tetrachloroguaiacol	EPA 1653	Extractable Organics	NELAP	3/7/2012
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	EPA 8330	Extractable Organics	NELAP	3/7/2012
Thallium	EPA 200.8	Metals	NELAP	3/7/2012
Thallium	EPA 200.9	Metals	NELAP	3/7/2012
Thallium	EPA 6010	Metals	NELAP	3/7/2012
Thallium	EPA 6020	Metals	NELAP	3/7/2012
Tin	EPA 200.7	Metals	NELAP	3/7/2012
Tin	EPA 6010	Metals	NELAP	3/7/2012

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E87412
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Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Titanium	EPA 200.7	Metals	NELAP	3/7/2012
Titanium	EPA 6010	Metals	NELAP	3/7/2012
Tokuthion (Prothiophos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Toluene	EPA 624	Volatile Organics	NELAP	3/7/2012
Toluene	EPA 8021	Volatile Organics	NELAP	3/7/2012
Total cyanide	EPA 335.4	General Chemistry	NELAP	3/7/2012
Total cyanide	EPA 9012	General Chemistry	NELAP	3/7/2012
Total cyanide	SM 4500CN-E	General Chemistry	NELAP	3/7/2012
Total nitrate-nitrite	EPA 300.0	General Chemistry	NELAP	3/7/2012
Total organic carbon	EPA 9060	General Chemistry	NELAP	3/7/2012
Total organic carbon	SM 5310 C	General Chemistry	NELAP	3/7/2012
Total organic halides (TOX)	EPA 9020	General Chemistry	NELAP	3/7/2012
Total phenolics	EPA 420.1	General Chemistry	NELAP	3/7/2012
Total residual chlorine	SM 4500-Cl F	General Chemistry	NELAP	3/7/2012
Toxaphene (Chlorinated camphene)	EPA 608	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Toxaphene (Chlorinated camphene)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
trans-1,2-Dichloroethylene	EPA 624	Volatile Organics	NELAP	3/7/2012
trans-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	3/7/2012
trans-1,3-Dichloropropene	EPA 624	Volatile Organics	NELAP	3/7/2012
trans-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	3/7/2012
trans-1,4-Dichloro-2-butene	EPA 8260	Volatile Organics	NELAP	3/7/2012
trans-Nonachlor	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
trans-Nonachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Tributyltin chloride	CASW SOC-Butyl/GC-FPD	Extractable Organics	NELAP	3/7/2012
Trichloroethene (Trichloroethylene)	EPA 624	Volatile Organics	NELAP	3/7/2012
Trichloroethene (Trichloroethylene)	EPA 8260	Volatile Organics	NELAP	3/7/2012
Trichlorofluoromethane	EPA 624	Volatile Organics	NELAP	3/7/2012
Trichlorofluoromethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
Trichloronate	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Trichlorosyringol	EPA 1653	Extractable Organics	NELAP	3/7/2012
Triclosan	EPA 1694	Extractable Organics	NELAP	3/7/2012
Trimethoprim	EPA 1694	Extractable Organics	NELAP	3/7/2012
Turbidity	EPA 180.1	General Chemistry	NELAP	3/7/2012
Uranium	EPA 200.8	Metals	NELAP	3/7/2012
Vanadium	EPA 200.7	Metals	NELAP	3/7/2012
Vanadium	EPA 200.8	Metals	NELAP	3/7/2012

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Kelso, WA 98626

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Vanadium	EPA 6010	Metals	NELAP	3/7/2012
Vanadium	EPA 6020	Metals	NELAP	3/7/2012
Vinyl acetate	EPA 8260	Volatile Organics	NELAP	3/7/2012
Vinyl chloride	EPA 624	Volatile Organics	NELAP	3/7/2012
Vinyl chloride	EPA 8260	Volatile Organics	NELAP	3/7/2012
Xylene (total)	EPA 624	Volatile Organics	NELAP	3/7/2012
Xylene (total)	EPA 8021	Volatile Organics	NELAP	3/7/2012
Xylene (total)	EPA 8260	Volatile Organics	NELAP	3/7/2012
Zinc	EPA 200.7	Metals	NELAP	3/7/2012
Zinc	EPA 200.8	Metals	NELAP	3/7/2012
Zinc	EPA 6010	Metals	NELAP	3/7/2012
Zinc	EPA 6020	Metals	NELAP	3/7/2012

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E87412
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Kelso, WA 98626

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,1,1,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,1,1-Trichloroethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,1,2,2-Tetrachloroethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,1,2-Trichloroethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,1-Dichloroethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,1-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,1-Dichloropropene	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,2,3-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,2,4,5-Tetrachlorobenzene	EPA 8270	Extractable Organics	NELAP	3/7/2012
1,2,4-Trichlorobenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,2,4-Trichlorobenzene	EPA 8270	Extractable Organics	NELAP	3/7/2012
1,2,4-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,2-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,2-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	3/7/2012
1,2-Dichloroethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,2-Diphenylhydrazine	EPA 8270	Extractable Organics	NELAP	3/7/2012
1,3,5-Trimethylbenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270	Extractable Organics	NELAP	3/7/2012
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330	Extractable Organics	NELAP	3/7/2012
1,3-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,3-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	3/7/2012
1,3-Dichloropropane	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,3-Dinitrobenzene (1,3-DNB)	EPA 8330	Extractable Organics	NELAP	3/7/2012
1,4-Dichlorobenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
1,4-Dichlorobenzene	EPA 8270	Extractable Organics	NELAP	3/7/2012
1,4-Dioxane (1,4-Diethyleneoxide)	EPA 8260	Volatile Organics	NELAP	3/7/2012
1-Chlorohexane	EPA 8260	Volatile Organics	NELAP	3/7/2012
1-Chloronaphthalene	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ 206)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ 194)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ 195)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,3',4,4'-Hexachlorobiphenyl (BZ 128)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012

Laboratory Scope of Accreditation

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E87412
ALS Environmental, Kelso
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Kelso, WA 98626

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ 180)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ 183)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,4,4',5'-Hexachlorobiphenyl (BZ 138)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,4,5,5'-Hexachlorobiphenyl (BZ 141)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,4,5'-Pentachlorobiphenyl (BZ 87)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,5,5',6-Hexachlorobiphenyl (BZ 151)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,5'-Tetrachlorobiphenyl (BZ 44)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',4,4',5,5'-Hexachlorobiphenyl (BZ 153)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',4,5,5'-Pentachlorobiphenyl (BZ 101)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',4,5'-Tetrachlorobiphenyl (BZ 49)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',5,5'-Tetrachlorobiphenyl (BZ 52)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',5-Trichlorobiphenyl (BZ 18)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2-Dichloropropane	EPA 8260	Volatile Organics	NELAP	3/7/2012
2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ 189)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3,3',4,4',5-Hexachlorobiphenyl (BZ 156)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3,3',4',6-Pentachlorobiphenyl (BZ 110)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3',4,4',5,5'-Hexachlorobiphenyl (BZ 167)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3,4,4',5-Pentachlorobiphenyl (BZ 114)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3',4,4',5-Pentachlorobiphenyl (BZ 118)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3',4,4',5'-Pentachlorobiphenyl (BZ 123)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3',4,4'-Tetrachlorobiphenyl (BZ 66)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3,4,6-Tetrachlorophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,3-Dichlorobiphenyl (BZ 5)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4,5-T	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4',5-Trichlorobiphenyl (BZ 31)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4,5-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,4,6-Trichlorophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330	Extractable Organics	NELAP	3/7/2012
2,4-D	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4-DB	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4'-DDD	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4'-DDE	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4'-DDT	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4'-Dichlorobiphenyl (BZ 8)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012

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Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
2,4-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,4-Dimethylphenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,4-Dinitrophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,4-Dinitrotoluene (2,4-DNT)	EPA 8330	Extractable Organics	NELAP	3/7/2012
2,6-Dichlorophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270	Extractable Organics	NELAP	3/7/2012
2,6-Dinitrotoluene (2,6-DNT)	EPA 8330	Extractable Organics	NELAP	3/7/2012
2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330	Extractable Organics	NELAP	3/7/2012
2-Butanone (Methyl ethyl ketone, MEK)	EPA 8260	Volatile Organics	NELAP	3/7/2012
2-Chlorobiphenyl (BZ 1)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2-Chloroethyl vinyl ether	EPA 8260	Volatile Organics	NELAP	3/7/2012
2-Chloronaphthalene	EPA 8270	Extractable Organics	NELAP	3/7/2012
2-Chlorophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	3/7/2012
2-Hexanone	EPA 8260	Volatile Organics	NELAP	3/7/2012
2-Methyl-4,6-dinitrophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2-Methylnaphthalene	EPA 8270	Extractable Organics	NELAP	3/7/2012
2-Methylphenol (o-Cresol)	EPA 8270	Extractable Organics	NELAP	3/7/2012
2-Nitroaniline	EPA 8270	Extractable Organics	NELAP	3/7/2012
2-Nitrophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
2-Nitropropane	EPA 8260	Volatile Organics	NELAP	3/7/2012
2-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	3/7/2012
2-Picoline (2-Methylpyridine)	EPA 8270	Extractable Organics	NELAP	3/7/2012
3,3',4,4',5,5'-Hexachlorobiphenyl (BZ 169)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
3,3',4,4',5-Pentachlorobiphenyl (BZ 126)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
3,3',4,4'-Tetrachlorobiphenyl (BZ 77)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
3,3'-Dichlorobenzidine	EPA 8270	Extractable Organics	NELAP	3/7/2012
3,4,4',5-Tetrachlorobiphenyl (BZ 81)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
3,5-Dinitroaniline	EPA 8330	Extractable Organics	NELAP	3/7/2012
3-Methylphenol (m-Cresol)	EPA 8270	Extractable Organics	NELAP	3/7/2012
3-Nitroaniline	EPA 8270	Extractable Organics	NELAP	3/7/2012
3-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	3/7/2012
4,4'-DDD	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
4,4'-DDD	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012

Laboratory Scope of Accreditation

Attachment to Certificate #: E87412-26, expiration date June 30, 2014. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87412 **EPA Lab Code:** WA01276 (360) 577-7222

E87412
ALS Environmental, Kelso
1317 South 13th Avenue
Kelso, WA 98626

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
4,4'-DDE	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
4,4'-DDE	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
4,4'-DDT	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
4,4'-DDT	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
4,4'-Methylenebis(2-chloroaniline)	EPA 8270	Extractable Organics	NELAP	3/7/2012
4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330	Extractable Organics	NELAP	3/7/2012
4-Chloro-3-methylphenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
4-Chloroaniline	EPA 8270	Extractable Organics	NELAP	3/7/2012
4-Chlorotoluene	EPA 8260	Volatile Organics	NELAP	3/7/2012
4-Methyl-2-pentanone (MIBK)	EPA 8260	Volatile Organics	NELAP	3/7/2012
4-Methylphenol (p-Cresol)	EPA 8270	Extractable Organics	NELAP	3/7/2012
4-Nitroaniline	EPA 8270	Extractable Organics	NELAP	3/7/2012
4-Nitrophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
4-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	3/7/2012
Acenaphthene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Acenaphthylene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Acetone	EPA 8260	Volatile Organics	NELAP	3/7/2012
Acetonitrile	EPA 8260	Volatile Organics	NELAP	3/7/2012
Acetophenone	EPA 8270	Extractable Organics	NELAP	3/7/2012
Acrolein (Propenal)	EPA 8260	Volatile Organics	NELAP	3/7/2012
Acrylonitrile	EPA 8260	Volatile Organics	NELAP	3/7/2012
Alachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aldrin	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
alpha-Chlordane	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
alpha-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aluminum	EPA 6010	Metals	NELAP	3/7/2012
Aluminum	EPA 6020	Metals	NELAP	3/7/2012
Amenable cyanide	EPA 9012	General Chemistry	NELAP	3/7/2012
Ammonia as N	EPA 350.1	General Chemistry	NELAP	3/7/2012
Aniline	EPA 8270	Extractable Organics	NELAP	3/7/2012
Anthracene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Antimony	EPA 6010	Metals	NELAP	3/7/2012

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Antimony	EPA 6020	Metals	NELAP	3/7/2012
Aramite	EPA 8270	Extractable Organics	NELAP	3/7/2012
Aroclor-1016 (PCB-1016)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1221 (PCB-1221)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1232 (PCB-1232)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1242 (PCB-1242)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1248 (PCB-1248)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1254 (PCB-1254)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1260 (PCB-1260)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Arsenic	EPA 6010	Metals	NELAP	3/7/2012
Arsenic	EPA 6020	Metals	NELAP	3/7/2012
Arsenic	EPA 7010	Metals	NELAP	3/7/2012
Arsenic	EPA 7062	Metals	NELAP	3/7/2012
Azinphos-methyl (Guthion)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Barium	EPA 6010	Metals	NELAP	3/7/2012
Barium	EPA 6020	Metals	NELAP	3/7/2012
Benzene	EPA 8021	Volatile Organics	NELAP	3/7/2012
Benzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Benzo(a)anthracene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Benzo(a)pyrene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Benzo(b)fluoranthene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Benzo(g,h,i)perylene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Benzo(j)fluoranthene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Benzo(k)fluoranthene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Benzoic acid	EPA 8270	Extractable Organics	NELAP	3/7/2012
Benzyl alcohol	EPA 8270	Extractable Organics	NELAP	3/7/2012
Beryllium	EPA 6010	Metals	NELAP	3/7/2012
Beryllium	EPA 6020	Metals	NELAP	3/7/2012
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
bis(2-Chloroethoxy)methane	EPA 8270	Extractable Organics	NELAP	3/7/2012
bis(2-Chloroethyl) ether	EPA 8270	Extractable Organics	NELAP	3/7/2012
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 8270	Extractable Organics	NELAP	3/7/2012
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270	Extractable Organics	NELAP	3/7/2012
Bolstar (Sulprofos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Boron	EPA 6010	Metals	NELAP	3/7/2012
Bromobenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Bromochloromethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
Bromodichloromethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
Bromoform	EPA 8260	Volatile Organics	NELAP	3/7/2012
Butyl benzyl phthalate	EPA 8270	Extractable Organics	NELAP	3/7/2012
Butyltin trichloride	CASW SOC-Butyl/GC-FPD	Extractable Organics	NELAP	3/7/2012
Cadmium	EPA 6010	Metals	NELAP	3/7/2012
Cadmium	EPA 6020	Metals	NELAP	3/7/2012
Calcium	EPA 6010	Metals	NELAP	3/7/2012
Caprolactam	EPA 8270	Extractable Organics	NELAP	3/7/2012
Carbazole	EPA 8270	Extractable Organics	NELAP	3/7/2012
Carbon disulfide	EPA 8260	Volatile Organics	NELAP	3/7/2012
Carbon tetrachloride	EPA 8260	Volatile Organics	NELAP	3/7/2012
Chlordane (tech.)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Chloride	EPA 300.0	General Chemistry	NELAP	3/7/2012
Chloride	EPA 9056	General Chemistry	NELAP	3/7/2012
Chlorobenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Chloroform	EPA 8260	Volatile Organics	NELAP	3/7/2012
Chloroprene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Chlorpyrifos	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Chlorpyrifos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Chromium	EPA 6010	Metals	NELAP	3/7/2012
Chromium	EPA 6020	Metals	NELAP	3/7/2012
Chromium VI	EPA 7196	General Chemistry	NELAP	3/7/2012
Chrysene	EPA 8270	Extractable Organics	NELAP	3/7/2012
cis-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	3/7/2012
cis-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	3/7/2012
cis-Nonachlor	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Cobalt	EPA 6010	Metals	NELAP	3/7/2012
Cobalt	EPA 6020	Metals	NELAP	3/7/2012
Copper	EPA 6010	Metals	NELAP	3/7/2012
Copper	EPA 6020	Metals	NELAP	3/7/2012
Corrosivity toward steel	EPA 1110	General Chemistry	NELAP	3/7/2012
Coumaphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Dalapon	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Decachlorobiphenyl (BZ 209)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012

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Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
delta-BHC	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
delta-BHC	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Demeton-o	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Demeton-s	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Diallate	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Diazinon	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Dibenz(a,h)anthracene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Dibenzofuran	EPA 8270	Extractable Organics	NELAP	3/7/2012
Dibromochloromethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
Dibromomethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
Dibutyltin dichloride	CASW SOC-Butyl/GC-FPD	Extractable Organics	NELAP	3/7/2012
Dicamba	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Dichlorodifluoromethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
Dichloroprop (Dichlorprop)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Dichlorovos (DDVP, Dichlorvos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Dieldrin	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Dieldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Diesel range organics (DRO)	EPA 8015	Extractable Organics	NELAP	3/7/2012
Diethyl ether	EPA 8260	Volatile Organics	NELAP	3/7/2012
Diethyl phthalate	EPA 8270	Extractable Organics	NELAP	3/7/2012
Dimethyl phthalate	EPA 8270	Extractable Organics	NELAP	3/7/2012
Di-n-butyl phthalate	EPA 8270	Extractable Organics	NELAP	3/7/2012
Di-n-octyl phthalate	EPA 8270	Extractable Organics	NELAP	3/7/2012
Dinoseb (2-sec-butyl-4,6-dinitrophenol, DNBP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Disulfoton	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endosulfan I	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endosulfan I	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endosulfan II	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endosulfan II	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endosulfan sulfate	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endosulfan sulfate	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endrin	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Endrin aldehyde	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endrin aldehyde	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endrin ketone	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endrin ketone	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Ethoprop	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Ethyl acetate	EPA 8260	Volatile Organics	NELAP	3/7/2012
Ethyl methacrylate	EPA 8260	Volatile Organics	NELAP	3/7/2012
Ethylbenzene	EPA 8021	Volatile Organics	NELAP	3/7/2012
Ethylbenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Ethylene glycol	EPA 8015	Volatile Organics	NELAP	3/7/2012
Extractable cyanide	EPA 9010/9013	General Chemistry	NELAP	3/7/2012
Fensulfothion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Fenthion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Fluoranthene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Fluorene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Fluoride	EPA 300.0	General Chemistry	NELAP	3/7/2012
Fluoride	EPA 9056	General Chemistry	NELAP	3/7/2012
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
gamma-Chlordane	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
gamma-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Gasoline range organics (GRO)	EPA 8015	Extractable Organics	NELAP	3/7/2012
Heptachlor	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Heptachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Heptachlor epoxide	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Heptachlor epoxide	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Hexachlorobenzene	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Hexachlorobenzene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Hexachlorobutadiene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Hexachlorobutadiene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Hexachlorocyclopentadiene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Hexachloroethane	EPA 8270	Extractable Organics	NELAP	3/7/2012
Hexachlorophene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Ignitability	EPA 1020	General Chemistry	NELAP	3/7/2012

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Analyte	Method/Tech	Category	Certification Type	Effective Date
Indeno(1,2,3-cd)pyrene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Iodomethane (Methyl iodide)	EPA 8260	Volatile Organics	NELAP	3/7/2012
Iron	EPA 6010	Metals	NELAP	3/7/2012
Isobutyl alcohol (2-Methyl-1-propanol)	EPA 8260	Volatile Organics	NELAP	3/7/2012
Isodrin	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Isodrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Isodrin	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Isophorone	EPA 8270	Extractable Organics	NELAP	3/7/2012
Isopropylbenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Kepone	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Lead	EPA 6010	Metals	NELAP	3/7/2012
Lead	EPA 6020	Metals	NELAP	3/7/2012
Lead	EPA 7010	Metals	NELAP	3/7/2012
Magnesium	EPA 6010	Metals	NELAP	3/7/2012
Malathion	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Manganese	EPA 6010	Metals	NELAP	3/7/2012
Manganese	EPA 6020	Metals	NELAP	3/7/2012
MCPA	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
MCPP	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Mercury	EPA 1631	Metals	NELAP	3/7/2012
Mercury	EPA 7471	Metals	NELAP	3/7/2012
Merphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Methacrylonitrile	EPA 8260	Volatile Organics	NELAP	3/7/2012
Methapyrilene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Methoxychlor	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Methoxychlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Methyl bromide (Bromomethane)	EPA 8260	Volatile Organics	NELAP	3/7/2012
Methyl chloride (Chloromethane)	EPA 8260	Volatile Organics	NELAP	3/7/2012
Methyl mercury	EPA 1630	Metals	NELAP	3/7/2012
Methyl parathion (Parathion, methyl)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Methyl parathion (Parathion, methyl)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Methyl tert-butyl ether (MTBE)	EPA 8260	Volatile Organics	NELAP	3/7/2012
Methylene chloride	EPA 8260	Volatile Organics	NELAP	3/7/2012
Mevinphos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Mirex	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012

Laboratory Scope of Accreditation

Attachment to Certificate #: E87412-26, expiration date June 30, 2014. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E87412 **EPA Lab Code:** WA01276 (360) 577-7222

E87412
ALS Environmental, Kelso
1317 South 13th Avenue
Kelso, WA 98626

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Mirex	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Molybdenum	EPA 6010	Metals	NELAP	3/7/2012
Molybdenum	EPA 6020	Metals	NELAP	3/7/2012
Naphthalene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Naphthalene	EPA 8270	Extractable Organics	NELAP	3/7/2012
n-Butylbenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Nickel	EPA 6010	Metals	NELAP	3/7/2012
Nickel	EPA 6020	Metals	NELAP	3/7/2012
Nitrate	EPA 9056	General Chemistry	NELAP	3/7/2012
Nitrate as N	EPA 353.2	General Chemistry	NELAP	3/7/2012
Nitrite	EPA 9056	General Chemistry	NELAP	3/7/2012
Nitrite as N	EPA 353.2	General Chemistry	NELAP	3/7/2012
Nitrobenzene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Nitrobenzene	EPA 8330	Extractable Organics	NELAP	3/7/2012
Nitroglycerin	EPA 8330	Extractable Organics	NELAP	3/7/2012
n-Nitrosodiethylamine	EPA 8270	Extractable Organics	NELAP	3/7/2012
n-Nitrosodimethylamine	EPA 8270	Extractable Organics	NELAP	3/7/2012
n-Nitrosodiphenylamine	EPA 8270	Extractable Organics	NELAP	3/7/2012
n-Nitrosomorpholine	EPA 8270	Extractable Organics	NELAP	3/7/2012
n-Nitrosopiperidine	EPA 8270	Extractable Organics	NELAP	3/7/2012
n-Nitrosopyrrolidine	EPA 8270	Extractable Organics	NELAP	3/7/2012
n-Propylbenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330	Extractable Organics	NELAP	3/7/2012
Oil & Grease	EPA 1664A	General Chemistry	NELAP	3/7/2012
Oil & Grease	EPA 9071	General Chemistry	NELAP	3/7/2012
Orthophosphate as P	EPA 365.3	General Chemistry	NELAP	3/7/2012
Parathion, ethyl	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Parathion, ethyl	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Pentachlorobenzene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Pentachloronitrobenzene (Quintozene)	EPA 8270	Extractable Organics	NELAP	3/7/2012
Pentachlorophenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
Pentaerythritoltetranitrate (PETN)	EPA 8330	Extractable Organics	NELAP	3/7/2012
Perchlorate	EPA 314.0	General Chemistry	NELAP	3/7/2012
Phenanthrene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Phenol	EPA 8270	Extractable Organics	NELAP	3/7/2012
Phorate	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012

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Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Phosphorus, total	EPA 365.3	General Chemistry	NELAP	3/7/2012
p-Isopropyltoluene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Potassium	EPA 6010	Metals	NELAP	3/7/2012
Pronamide (Kerb)	EPA 8270	Extractable Organics	NELAP	3/7/2012
Pyrene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Pyridine	EPA 8270	Extractable Organics	NELAP	3/7/2012
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330	Extractable Organics	NELAP	3/7/2012
Residue-total	EPA 160.3	General Chemistry	NELAP	3/7/2012
Ronnel	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Safrole	EPA 8270	Extractable Organics	NELAP	3/7/2012
sec-Butylbenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Selenium	EPA 6010	Metals	NELAP	3/7/2012
Selenium	EPA 6020	Metals	NELAP	3/7/2012
Selenium	EPA 7010	Metals	NELAP	3/7/2012
Selenium	EPA 7742	Metals	NELAP	3/7/2012
Silver	EPA 6010	Metals	NELAP	3/7/2012
Silver	EPA 6020	Metals	NELAP	3/7/2012
Silvex (2,4,5-TP)	EPA 8151	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Sodium	EPA 6010	Metals	NELAP	3/7/2012
Stirofos	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Strontium	EPA 6010	Metals	NELAP	3/7/2012
Strontium	EPA 6020	Metals	NELAP	3/7/2012
Styrene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Sulfate	EPA 300.0	General Chemistry	NELAP	3/7/2012
Sulfate	EPA 9056	General Chemistry	NELAP	3/7/2012
Sulfide	EPA 9030/9034	General Chemistry	NELAP	3/7/2012
Synthetic Precipitation Leaching Procedure	EPA 1312	General Chemistry	NELAP	3/7/2012
tert-Butylbenzene	EPA 8260	Volatile Organics	NELAP	3/7/2012
Tetrabutyltin	CASW SOC-Butyl/GC-FPD	Extractable Organics	NELAP	3/7/2012
Tetrachloroethylene (Perchloroethylene)	EPA 8260	Volatile Organics	NELAP	3/7/2012
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	EPA 8330	Extractable Organics	NELAP	3/7/2012
Thallium	EPA 6010	Metals	NELAP	3/7/2012
Thallium	EPA 6020	Metals	NELAP	3/7/2012
Thallium	EPA 7010	Metals	NELAP	3/7/2012
Thionazin (Zinophos)	EPA 8270	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Tin	EPA 6010	Metals	NELAP	3/7/2012

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Kelso, WA 98626

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Titanium	EPA 6010	Metals	NELAP	3/7/2012
Tokuthion (Prothiophos)	EPA 8141	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Toluene	EPA 8021	Volatile Organics	NELAP	3/7/2012
Total cyanide	EPA 9012	General Chemistry	NELAP	3/7/2012
Total nitrate-nitrite	EPA 353.2	General Chemistry	NELAP	3/7/2012
Total organic carbon	ASTM D4129-05	General Chemistry	NELAP	3/7/2012
Total organic halides (TOX)	EPA 9020	General Chemistry	NELAP	3/7/2012
Toxaphene (Chlorinated camphene)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Toxicity Characteristic Leaching Procedure	EPA 1311	General Chemistry	NELAP	3/7/2012
trans-1,2-Dichloroethylene	EPA 8260	Volatile Organics	NELAP	3/7/2012
trans-1,3-Dichloropropene	EPA 8260	Volatile Organics	NELAP	3/7/2012
trans-1,4-Dichloro-2-butene	EPA 8260	Volatile Organics	NELAP	3/7/2012
trans-Nonachlor	CASW PestMS2/GC-MS-MS	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
trans-Nonachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Tributyltin chloride	CASW SOC-Butyl/GC-FPD	Extractable Organics	NELAP	3/7/2012
Trichloroethene (Trichloroethylene)	EPA 8260	Volatile Organics	NELAP	3/7/2012
Trichlorofluoromethane	EPA 8260	Volatile Organics	NELAP	3/7/2012
Vanadium	EPA 6010	Metals	NELAP	3/7/2012
Vanadium	EPA 6020	Metals	NELAP	3/7/2012
Vinyl acetate	EPA 8260	Volatile Organics	NELAP	3/7/2012
Vinyl chloride	EPA 8260	Volatile Organics	NELAP	3/7/2012
Xylene (total)	EPA 8021	Volatile Organics	NELAP	3/7/2012
Xylene (total)	EPA 8260	Volatile Organics	NELAP	3/7/2012
Zinc	EPA 6010	Metals	NELAP	3/7/2012
Zinc	EPA 6020	Metals	NELAP	3/7/2012

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State Laboratory ID: E87412 **EPA Lab Code: WA01276** **(360) 577-7222**

E87412
ALS Environmental, Kelso
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Kelso, WA 98626

Matrix: Biological Tissue

Analyte	Method/Tech	Category	Certification Type	Effective Date
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8330	Extractable Organics	NELAP	3/7/2012
1,3-Dinitrobenzene (1,3-DNB)	EPA 8330	Extractable Organics	NELAP	3/7/2012
2,2',3,3',4,4',5,5',6-Nonachlorobiphenyl (BZ 206)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,3',4,4',5,5'-Octachlorobiphenyl (BZ 194)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,3',4,4',5,6-Octachlorobiphenyl (BZ 195)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,3',4,4',5-Heptachlorobiphenyl (BZ 170)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,3',4,4'-Hexachlorobiphenyl (BZ 128)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,4,4',5,5'-Heptachlorobiphenyl (BZ 180)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,4,4',5',6-Heptachlorobiphenyl (BZ 183)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,4,4',5'-Hexachlorobiphenyl (BZ 138)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,4',5,5',6-Heptachlorobiphenyl (BZ 187)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,4,5,5'-Hexachlorobiphenyl (BZ 141)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,4,5'-Pentachlorobiphenyl (BZ 87)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,5,5',6-Hexachlorobiphenyl (BZ 151)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',3,5'-Tetrachlorobiphenyl (BZ 44)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',4,4',5,5'-Hexachlorobiphenyl (BZ 153)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',4,5,5'-Pentachlorobiphenyl (BZ 101)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',4,5'-Tetrachlorobiphenyl (BZ 49)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',5,5'-Tetrachlorobiphenyl (BZ 52)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,2',5-Trichlorobiphenyl (BZ 18)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3,3',4,4',5,5'-Heptachlorobiphenyl (BZ 189)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3,3',4,4',5-Hexachlorobiphenyl (BZ 156)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3,3',4',6-Pentachlorobiphenyl (BZ 110)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3',4,4',5,5'-Hexachlorobiphenyl (BZ 167)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3,4,4',5-Pentachlorobiphenyl (BZ 114)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3',4,4',5-Pentachlorobiphenyl (BZ 118)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3',4,4',5'-Pentachlorobiphenyl (BZ 123)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3',4,4'-Tetrachlorobiphenyl (BZ 66)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,3-Dichlorobiphenyl (BZ 5)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4',5-Trichlorobiphenyl (BZ 31)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2,4,6-Trinitrotoluene (2,4,6-TNT)	EPA 8330	Extractable Organics	NELAP	3/7/2012
2,4-Dinitrotoluene (2,4-DNT)	EPA 8330	Extractable Organics	NELAP	3/7/2012
2,6-Dinitrotoluene (2,6-DNT)	EPA 8330	Extractable Organics	NELAP	3/7/2012
2-Amino-4,6-dinitrotoluene (2-am-dnt)	EPA 8330	Extractable Organics	NELAP	3/7/2012
2-Chlorobiphenyl (BZ 1)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
2-Methylnaphthalene	EPA 8270	Extractable Organics	NELAP	3/7/2012

Laboratory Scope of Accreditation

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State Laboratory ID: E87412 **EPA Lab Code:** WA01276 **(360) 577-7222**

E87412
ALS Environmental, Kelso
1317 South 13th Avenue
Kelso, WA 98626

Matrix: Biological Tissue

Analyte	Method/Tech	Category	Certification Type	Effective Date
2-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	3/7/2012
3,4,4',5-Tetrachlorobiphenyl (BZ 81)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
3,5-Dinitroaniline	EPA 8330	Extractable Organics	NELAP	3/7/2012
3-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	3/7/2012
4,4'-DDD	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
4,4'-DDE	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
4,4'-DDT	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
4-Amino-2,6-dinitrotoluene (4-am-dnt)	EPA 8330	Extractable Organics	NELAP	3/7/2012
4-Nitrotoluene	EPA 8330	Extractable Organics	NELAP	3/7/2012
Acenaphthene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Acenaphthylene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Alachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
alpha-BHC (alpha-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
alpha-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aluminum	EPA 6010	Metals	NELAP	3/7/2012
Aluminum	EPA 6020	Metals	NELAP	3/7/2012
Anthracene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Antimony	EPA 6010	Metals	NELAP	3/7/2012
Antimony	EPA 6020	Metals	NELAP	3/7/2012
Aroclor-1016 (PCB-1016)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1221 (PCB-1221)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1232 (PCB-1232)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1242 (PCB-1242)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1248 (PCB-1248)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1254 (PCB-1254)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Aroclor-1260 (PCB-1260)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Arsenic	EPA 6010	Metals	NELAP	3/7/2012
Arsenic	EPA 6020	Metals	NELAP	3/7/2012
Barium	EPA 6010	Metals	NELAP	3/7/2012
Barium	EPA 6020	Metals	NELAP	3/7/2012
Benzo(a)anthracene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Benzo(a)pyrene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Benzo(b)fluoranthene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Benzo(g,h,i)perylene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Benzo(j)fluoranthene	EPA 8270	Extractable Organics	NELAP	3/7/2012

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Matrix: Biological Tissue

Analyte	Method/Tech	Category	Certification Type	Effective Date
Benzo(k)fluoranthene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Beryllium	EPA 6010	Metals	NELAP	3/7/2012
Beryllium	EPA 6020	Metals	NELAP	3/7/2012
beta-BHC (beta-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Boron	EPA 6010	Metals	NELAP	3/7/2012
Butyltin trichloride	CASW SOC-Butyl/GC-FPD	Extractable Organics	NELAP	3/7/2012
Cadmium	EPA 6010	Metals	NELAP	3/7/2012
Cadmium	EPA 6020	Metals	NELAP	3/7/2012
Chlordane (tech.)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Chromium	EPA 6010	Metals	NELAP	3/7/2012
Chromium	EPA 6020	Metals	NELAP	3/7/2012
Chromium VI	EPA 7196	Metals	NELAP	3/7/2012
Chrysene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Cobalt	EPA 6010	Metals	NELAP	3/7/2012
Cobalt	EPA 6020	Metals	NELAP	3/7/2012
Copper	EPA 6010	Metals	NELAP	3/7/2012
Copper	EPA 6020	Metals	NELAP	3/7/2012
Decachlorobiphenyl (BZ 209)	EPA 8082	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
delta-BHC	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Dibenz(a,h)anthracene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Dibutyltin dichloride	CASW SOC-Butyl/GC-FPD	Extractable Organics	NELAP	3/7/2012
Dieldrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endosulfan I	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endosulfan II	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endosulfan sulfate	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endrin aldehyde	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Endrin ketone	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Fluoranthene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Fluorene	EPA 8270	Extractable Organics	NELAP	3/7/2012
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
gamma-Chlordane	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Heptachlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Heptachlor epoxide	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Indeno(1,2,3-cd)pyrene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Iron	EPA 6010	Metals	NELAP	3/7/2012

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Matrix: Biological Tissue

Analyte	Method/Tech	Category	Certification Type	Effective Date
Isodrin	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Lead	EPA 6010	Metals	NELAP	3/7/2012
Lead	EPA 6020	Metals	NELAP	3/7/2012
Manganese	EPA 6010	Metals	NELAP	3/7/2012
Manganese	EPA 6020	Metals	NELAP	3/7/2012
Mercury	EPA 1631	Metals	NELAP	3/7/2012
Mercury	EPA 7471	Metals	NELAP	3/7/2012
Methoxychlor	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Mirex	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Molybdenum	EPA 6010	Metals	NELAP	3/7/2012
Molybdenum	EPA 6020	Metals	NELAP	3/7/2012
Naphthalene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Nickel	EPA 6010	Metals	NELAP	3/7/2012
Nickel	EPA 6020	Metals	NELAP	3/7/2012
Nitrobenzene	EPA 8330	Extractable Organics	NELAP	3/7/2012
Nitroglycerin	EPA 8330	Extractable Organics	NELAP	3/7/2012
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330	Extractable Organics	NELAP	3/7/2012
Pentaerythritoltetranitrate (PETN)	EPA 8330	Extractable Organics	NELAP	3/7/2012
Phenanthrene	EPA 8270	Extractable Organics	NELAP	3/7/2012
Pyrene	EPA 8270	Extractable Organics	NELAP	3/7/2012
RDX (hexahydro-1,3,5-trinitro-1,3,5-triazine)	EPA 8330	Extractable Organics	NELAP	3/7/2012
Selenium	EPA 6010	Metals	NELAP	3/7/2012
Selenium	EPA 6020	Metals	NELAP	3/7/2012
Selenium	EPA 7742	Metals	NELAP	3/7/2012
Silver	EPA 6010	Metals	NELAP	3/7/2012
Silver	EPA 6020	Metals	NELAP	3/7/2012
Tetrabutyltin	CASW SOC-Butyl/GC-FPD	Extractable Organics	NELAP	3/7/2012
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	EPA 8330	Extractable Organics	NELAP	3/7/2012
Thallium	EPA 6020	Metals	NELAP	3/7/2012
Tin	EPA 6010	Metals	NELAP	3/7/2012
Toxaphene (Chlorinated camphene)	EPA 8081	Pesticides-Herbicides-PCB's	NELAP	3/7/2012
Tributyltin chloride	CASW SOC-Butyl/GC-FPD	Extractable Organics	NELAP	3/7/2012
Vanadium	EPA 6010	Metals	NELAP	3/7/2012
Vanadium	EPA 6020	Metals	NELAP	3/7/2012
Zinc	EPA 6010	Metals	NELAP	3/7/2012
Zinc	EPA 6020	Metals	NELAP	3/7/2012

State of Florida

Department of Health, Bureau of Public Health Laboratories

This is to certify that

E82295

HYDROSPHERE RESEARCH ENVIRONMENTAL SERVICES, INC.
11842 RESEARCH CIRCLE
ALACHUA, FL 32615

has complied with Florida Administrative Code 64E-1,
for the examination of environmental samples in the following categories

NON-POTABLE WATER - TOXICITY, SOLID AND CHEMICAL MATERIALS - TOXICITY

Continued certification is contingent upon successful on-going compliance with the NELAC Standards and FAC Rule 64E-1 regulations. Specific methods and analytes certified are cited on the Laboratory Scope of Accreditation for this laboratory and are on file at the Bureau of Public Health Laboratories, P. O. Box 210, Jacksonville, Florida 32231. Clients and customers are urged to verify with this agency the laboratory's certification status in Florida for particular methods and analytes.

Date Issued: July 01, 2013 Expiration Date: June 30, 2014

Victor Johnson, Director
Division of Emergency Preparedness and Community Support
DH Form 1697, 7/04
NON-TRANSFERABLE E82295-14-07/01/2013
Supersedes all previously issued certificates

Laboratory Scope of Accreditation

Attachment to Certificate #: E82295-14, expiration date June 30, 2014. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E82295 **EPA Lab Code:** FL01105 (386) 462-7889

E82295
Hydrosphere Research Environmental Services, Inc.
11842 Research Circle
Alachua, FL 32615

Matrix: Non-Potable Water

Analyte	Method/Tech	Category	Certification Type	Effective Date
Arbacia punctulata	EPA 821-R-02-014 (SW chronic)(1008.0)	Toxicity	NELAP	11/28/2006
Ceriodaphnia dubia	EPA 821-R-02-012 (FW acute)(2002.0)	Toxicity	NELAP	8/12/2004
Ceriodaphnia dubia	EPA 821-R-02-013 (FW chronic)(1002.0)	Toxicity	NELAP	8/12/2004
Cyprinella leedsi	EPA 821-R-02-012 (FW acute)(2000.0)	Toxicity	NELAP	8/12/2004
Daphnia magna	EPA 821-R-02-012 (FW acute)(2021.0)	Toxicity	NELAP	3/27/2013
Daphnia pulex	EPA 821-R-02-012 (FW acute)(2021.0)	Toxicity	NELAP	11/9/2006
Menidia beryllina	EPA 821-R-02-012 (SW acute)(2006.0)	Toxicity	NELAP	8/12/2004
Menidia beryllina	EPA 821-R-02-014 (SW chronic)(1006.0)	Toxicity	NELAP	8/12/2004
Mysidopsis bahia	EPA 821-R-02-012 (SW acute)(2007.0)	Toxicity	NELAP	8/12/2004
Mysidopsis bahia	EPA 821-R-02-014 (SW chronic)(1007.0)	Toxicity	NELAP	8/12/2004
Pimephales promelas	EPA 821-R-02-012 (FW acute)(2000.0)	Toxicity	NELAP	8/12/2004
Pimephales promelas	EPA 821-R-02-013 (FW chronic)(1000.0)	Toxicity	NELAP	8/12/2004
Selenastrum capricornutum	EPA 821-R-02-013 (FW chronic)(1003.0)	Toxicity	NELAP	8/12/2004

Laboratory Scope of Accreditation

Attachment to Certificate #: E82295-14, expiration date June 30, 2014. This listing of accredited analytes should be used only when associated with a valid certificate.

State Laboratory ID: E82295 **EPA Lab Code:** FL01105 (386) 462-7889

E82295
Hydrosphere Research Environmental Services, Inc.
11842 Research Circle
Alachua, FL 32615

Matrix: Solid and Chemical Materials

Analyte	Method/Tech	Category	Certification Type	Effective Date
Ampelisca abdita	EPA/600/R-94/025	Toxicity	NELAP	1/22/2007
Chironomus tentans	EPA/600/R-94/024	Toxicity	NELAP	1/22/2007
Hyalella azteca	EPA/600/R-94/024	Toxicity	NELAP	1/22/2007
Leptochirus plumulosus	EPA/600/R-94/025	Toxicity	NELAP	1/22/2007

Appendix G
Toxicity Laboratory Standard Operating Procedures

Standard Operating Procedure

Procedure: Conducting 28-day Chronic Toxicity Tests on Marine and Estuarine Sediments with the amphipod *Leptocheirus plumulosus*
Number: TST-017
Page: 1 of 16
Date: 6/9/2013
Revision No: Original

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1.0 Introduction/Objective

1.1. The objective of a sediment test is to determine whether chemicals in sediment are harmful to benthic organisms. The tests can be used to measure interactive toxic effects of complex chemical mixtures in sediment.

1.2. Definitions of certain terms…

A. **Control Sediment:** Control sediment is a negative control against which comparisons (typically statistical) are made. The negative control can be an artificially prepared sediment or clean naturally occurring sediment collected from an area that has healthy aquatic communities associated with it. As of SOP version 0, there are no approved artificial control sediments.

B. **Reference Sediment:** These can also serve as negative control groups that can be used for comparisons. They are sediments that are collected near the study or test site. The intent is that the reference sediment is outside of the area of concern but near it, so as to have similar physical characteristic but be free of contamination.

C. **Test Sediment:** The test sediment is the material being evaluated against the control sediment and/or the reference sediment.

D. **Overlay Waters:** This water that covers the exposure sediments during testing. Overlay water are either laboratory prepared synthetic seawaters or natural waters. Natural waters are typically from a receiving water body such as an estuary or marine water body.

E. **Job Folder:** Folder containing instructions and bench sheets to conduct study. Chain-of-Custodies and test related paperwork are kept in this folder.

F. **Laboratory:** Unless stated otherwise, references in this SOP to "the laboratory" mean Hydrosphere Research, 11842 Research Circle, Alachua, FL 32615.

G. **Exposure Vessel:** This is the container, typically a glass beaker or jar, which holds the sediments, overlying waters and the amphipods. Several exposure vessels containing the same test materials (sediment, water, amphipods) are referred to as "replicates".

H. **Sediment Settling Container:** The Sediment Rinse Station consists of a sink that contains the appropriate sieve and a series of Sediment Settling Containers which are 5 gallon buckets, one draining into the other, to capture the sediment and overflow rinse water. A large plastic container under the buckets provides secondary containment. The Rinse Station is located in the Utility 3 area near the back gate. Some sediment will fall into the sink during sediment washing, and it will settle on the bottom of one or more of the 5 gallon buckets. After all sediments have been washed, the sediment on the bottom of the buckets must be retrieved and placed in a sample container for return to the client.

2.0 Apparatus/Equipment/Laboratory Books

2.1. Laboratory Books

~ a complete list and location of lab books are in the front of each Laboratory Book ~

A. SOP, "Creating a Job Folder", PRO-013

B. Pen, water-proof, black ink
   1. To be used for making all records in laboratory books, logbooks and bench sheets.

C. Logbook, "Chemical & Solutions Logbook", LGB-002
   1. The chemical portion of the logbook is an electronic data base (Application: Filemaker) on the laboratory server (F:\databases\Chemical Log.fp5)
   2. New records are created here. File is printed periodically and placed in the logbook.

D. SOP, "Sample Receiving", PRO-009

E. Logbook, "Test Organism Receipt and Acclimation", LGB-015

F. SOP, "Test Organism Receipt and Acclimation", PRO-010

G. SOP, "Determination of Mass using the Sartorius Analytical Balance, Type R200D", MTR-001

H. SOP, "Randomization", PRO-036

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2.2. Sampling Kit

A. Plastic Cooler, 48-quart minimum (1) (Brand: Coleman, Rubbermaid, Igloo)
B. Nalgene® Polyethylene Wide Mouth Bottles (4) (U.S. Plastic, Lima, OH ~ Stock 68082)
C. Ziplock Bag, 5" x 10" (1)
D. Clear Shipping Tape (roll)
E. Chain-of-Custody (COC) Form (1)
F. COC Seal (2)
G. Sample Bottle Labels, weather-proof (4)
H. Nylon Reinforced Tape (roll)
I. Hydrosphere Return Address Label(1)
J. FedEx Ground Shipping Label (1)
K. Shipping Label Sleeve (1)

2.3. Environmentally Controlled Water Bath

A. Fluorescent Lighting
    1. **Note:** Photoperiod is 16L;8D
B. Water Pump with plumbing
C. Heater, 300-watt
D. Aeration Manifold, Valved
E. Source of low pressure aeration, oil-free

2.4. Thermometer, calibrated
2.5. Sharpie Permanent Marker, Black or Colored
    A. To be used for marking all sample containers and labware.
2.6. Coldroom, maintained at 0 to 6°C
2.7. Stainless Steel Beater
2.8. Drill with ½"chuck
2.9. Bucket, 5-gallon HDPE with Lid (3)

2.10. Nitex or Stainless Steel Sieves

A. ¼", 2-mm, 1000-µm, 800-µm, 600-µm, 450-µm screens

2.11. Silicone Tubing, 3/8" (~6')
2.12. Aquaculture Basin, 15-L (1 or more)
2.13. Airline Tubing (10')
2.14. Pipettes, 1-mL, for aeration (1 or more)
2.15. Sediment Rinse Container

2.16. Job Folder

A. Bench Sheets
    1. "Sample Data"
    2. "Survivorship"
    3. "Dissolved Oxygen"
    4. "pH"
    5. "Temperature"
    6. "Salinity"
    7. "Feedings & Renewals"
    8. "Growth"
    9. "Growth Rate"

10. "Reproduction"

2.17. Beaker or glass jar, 1,000-mL (7 per sample, 5-reps for test exposure and 2 dummy vessels for pore-water ammonia)
2.18. Stainless Steel Spoon (1 or more)
2.19. Ziploc Bag, 1-gallon, double zipper (1 or more)
2.20. Scissor (1)
2.21. Dissolved Oxygen Meter, calibrated (1) — YSI, Model 58
2.22. pH Meter, calibrated (1)
2.23. Salinity Meter, calibrated (1)
2.24. Colorimeter (1) — HACH, DR890
2.25. Test Strips (1 or more) — HACH
2.26. Water Baffling Assembly
2.27. Light Table
2.28. Weigh Boats, Plastic, 100-mL
2.29. Transfer Pipette
2.30. Sediment Settling Assembly
2.31. Table, Folding, Water-proof
2.32. Light Box
2.33. Pyrex Casserole Dish, 4-L
2.34. Forceps
2.35. Vinyl Hose with Spray Nozzle
2.36. Centrifuge Tubes, 15-mL
2.37. Centrifuge, Bucket with test tube inserts.
2.38. Blender
2.39. Jars, 32 ounce with lids

3.0 Organisms/Reagents/Solutions

3.1. Amphipod, *Leptocheirus plumulosus* neonates that are < 48 hour old. These animals are typically those that are sieved through a 600-µm sieve and retained on a 250-µm sieve.
   A. **Source:** In-House Cultures
   B. **Source:** Aquatic Research Organisms, Hampton, NH, 603-926-1650
   C. **Source:** Aquatic Biosystems, Ft. Collins, CO, 970-484-5091

3.2. Control Sediment, Saltwater
   A. **Source:** Control Sediments are either material acquired from the vendor supplying the test organisms or material collected from a clean reference site that has been determined to be suitable for testing. In both cases the control materials are natural occurring sediments.

3.3. Synthetic Saltwater (SSW)
   A. Typically this would be synthetic seawater (SSW) made from ultra-pure water (18.2 MOhm) and Tropic Marin™ sea salts prepared according to the EPA's "Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms", Fifth Edition, October 2002, EPA-821-R-02-012.
   B. Acclimation and control waters are prepared at **either 5‰ or 20‰** and allowed to equilibrate overnight under aeration before use.
      1. The tests overlay water salinity with either be 5‰ or 20‰ depending on the sediment sample's pore water salinity. If the salinity of the pore water is 1 to 10‰, then the overlay water will be 10‰. If the salinity of the pore water is >10 to 35‰, then the overlay water salinity will be 20‰.

3.4. Reagent Grade Water · Type I

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3.5. Tropicmarin Synthetic Seasalts
3.6. Aquatox Flake Fish Feed
3.7. Staining Solution
   A. Prepare by adding 45 mgs Rose Bengal to 1 gallon of denatured alcohol.

4.0 Personal Protection Equipment

4.1. No hazardous chemicals are used for the procedure, therefore; only standard laboratory safety procedures are practiced.

5.0 Procedure **Test Day**

5.1. Schedule Test Event and Shipment of Sampling Kit **~ 2-weeks**

A. Create a Job Folder according to the SOP.
   1. Place Job folder in relevant tray on the Sample Receipt Counter in the Lab Testing Bay.

B. Sample Volume
   1. 5-replicates x 175-mLs is 875-mLs, however… sediment sample can vary greatly and the study may need to be repeated if it is unacceptable. The sample containers provided are 1-gallon (~3.78-L). Based on these elements the requested **sample volume should be 1-gallon**.

C. Sample Kit Shipment
   1. Determine how many sampling kits will be required. Each kit can hold 4, 1-gallon Nalgene® (or equivalent) sampling bottles and sufficient ice to preserve samples for a 24-hour period.
   2. Prepare sampling kits by including the following:
      a. Cooler containing…
         1) 4, clean 1-gallon Nalgene® bottles (each cooler can hold maximum of 4 bottles)
         2) Ziploc Bag. The Ziploc bag gets taped to the inside lid of the cooler but first place the following inside the Ziploc bag…
            a) Chain-of-Custody
            b) COC Seal
            c) Sample Bottle Labels
            d) Hydrosphere Return Address Label
      b. Chain-of-Custody Seal
         1) Sign & date the COC seal with water-proof black pen. Apply across the seam that's between the lid and body of the cooler.
         2) Tape the cooler closed with nylon reinforced tape. You must tape over the signed COC Seal with the tape. The tape is clear so the signed COC seal is visible.
      c. Apply the shipping sleeve containing the FedEx shipping label to the top of the cooler.
   3. Place cooler to the left of the front door to await pickup.
   4. Sign off on the Job Folder, "Shipped by" and "Shipped Date".
   5. Return Job Folder to relevant tray.

5.2. Determine where in the Laboratory the Bioassay will be Conducted **~ 2-weeks**

A. Determine which environmentally controlled water baths will accommodate the exposure vessels and will be able to meet the test conditions. The baths must have a pump and heater for temperature control, a source of clean, oil-free air, approximately 50 to 100 foot-candles illumination (ambient laboratory) and a 16-hour light/8-hour dark photoperiod.
B. Adjust photoperiod if necessary.

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C. Adjust temperature of water bath to between 25 and 26°C. Exposure vessels typically run slightly less than bath temperature. Check water pump and verify that water is circulating. On subsequent days verify water bath temperature adjustments by checking the laboratories logbook which records the temperatures of all active baths and environmental chambers daily.

5.3. The Acquisition of *Leptocheirus plumulosus* for use in Bioassay ~ 2-weeks

A. Locate source of *Leptocheirus plumulosus*
B. Determine the number of amphipods required for the bioassay. The method recommends 5-replicate vessels with 20-organisms per replicate or a total of 100-amphipods per sediment sample or treatments.

C. Organisms Ordered from Outside Source
1. Order 20% more than is required for the test. Mortalities may occur in shipping.
2. Have test organisms shipped priority overnight service.
3. Order amphipods so they arrive **one day** before the test is to be initiated. This give them time to sort themselves out (injuries during shipment may not be apparent upon arrival).

D. Organisms Cultured In-House
1. Two Days prior to Testing
   a. Sieve cultures through a 600-µm sieve and then through a 250-µm sieve. Those retained on a 250-µm sieve are organisms that are < 48 hours old.

E. **NOTE:** Determine the tests overlay water salinity and request LP at either 5‰ or 20‰!!!

5.4. The Acquisition and Processing of Control Sediment ~ 1-week

A. Determine what the negative control(s) shall be. They may be artificial prepared or naturally occurring. They should have a high likelihood of performing adequately, as in, meeting minimal test method quality control standards.
B. Acquire control sediment approximately 1 to 2 weeks ahead of scheduled test date.
C. Control sediments may be collected by the laboratory, a contracted vendor or may be a reference site located near the test site. Refer to the Job Folder for the specific control sediments required for each test event.
D. The control sediment is to be collected in clean plastic (preferably HDPE) containers. These containers are then packed in a cooler with ice and shipped via an overnight courier to this laboratory.

E. Receipt and Processing of Control Sediment
1. **Upon arrival of control sediment…**
   a. Acquire the shipper's air bill.
   b. Inspect the packaging; ensure that the contents are intact.
   c. Note the condition of a chain-of-custody seal, if present.
   d. Open shipping container and find the paperwork describing the contents (chain-of-custody, shipping slip, etc…).
   e. Record the following on the paperwork:
      1) Temperature of the sediment.
      2) Date Received and Initial.
   f. Record the following on the sediment container:
      1) Make a record in the "Chemical & Solutions" Logbook and generate a Chemical Log number. Record this on the sediment container.
      2) Assign a 6-month expiration date and record on container.

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g. Refrigerate sediment in coldroom.

2. Processing of Control Sediment

a. Remove control sediment from coldroom.
b. Warm sediment to room temperature.
c. Open sediment sample container. Do **not** pour off overlying water. During shipping and storage the sediment settles exposing some of the interstitial water. The overlying water will be mixed back into sample in the following step.
d. Homogenized the sediment by mixing with a stainless steel beater attached to a drill. This may be done in the original container (if large enough) or in another appropriate container; typically a 5-gallon HDPE Bucket.
e. The control sediment is sieved through a series of ~12" diameter Nitex® or stainless steel sieves to reduce the particle size to less than 240-µm.
   1) Wash sediment using synthetic saltwater.
   2) ***NOTE:*** *Adjust salinity of pore water to either 5‰ or 20‰ as determined by the client's sample.*
   3) Sieve through ¼", 1000-µm, 800-µm, 600-µm, 450-µm, 240-µm screens.
f. Store sediments in a labeled 5-gallon bucket and store in coldroom. Allow washed sediment to settle for ≥2-days then draw off the overlay water with a 3/8" silicone tube.

5.5. The Receipt of Sediment — < 8-weeks (Sediments), < 2-weeks (Water)

A. Unless otherwise noted on the Job Folder, Sediments have an 8-week holding time and Receiving Waters have a 2-week holding time. Laboratory prepared synthetic waters have a 2-week holding time.
B. Receipt of Test Sediment
   1. The receiving of the test sediment samples shall be conducted as given in the Sample Receiving SOP.
   2. Points Emphasized from item 1 above.
      a. Record **Sample ID** on each container.
      b. Record **Expiration Date** (8-weeks) on each container.
   3. Refrigerate sediment samples in cold room until use in testing.
      a. Record the condition of the COC seal.
      b. Scan and email completed COC to client.
   4. ***NOTE:*** *Determine salinity of pore water !!!*

5.6. Receipt of Amphipods — Day -1

A. Acquire the shipper's air bill.
B. Inspect the packaging; ensure that the contents are intact.
C. Open container and find shipping slip.
D. Make record in the "Test Organism Receipt and Acclimation" Logbook.
   1. Follow instructions in SOP, "Test Organism Receipt and Acclimation".
   2. Check Salinity and Temperature.
E. Fill 15-L aquaculture basin with 10-L SSW at either 5‰ or 20‰. Transfer amphipods to basin (~500 per basin).
F. Place in appropriate bath at 25°C and place on light air.
G. Water change amphipod basins at least daily.

5.7. Other Pre-Test Preparations — Day -2

A. Job Order and Data/Bench Sheets

1. Locate Job Folder. Check for completeness.

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2. Review information/instructions on Job Folder and Bench Sheets. Report any discrepancies to the laboratory manager.
3. Record Job Number on all bench sheets.
4. **Remember:** Corrections are made by drawing a single line through the error, initial and date correction, record correct data next to correction or, if note enough room, footnote and record correct data in "Notes and Comments" section at the bottom of the bench sheet.

B. Apparatus and Equipment Review

1. Review the list in Section 2.0. Verify that all are present, clean and in acceptable working order.
2. **Exposure Vessels, 1,000-mL Beakers**
   a. The bioassay is conducted in 1,000-mL beakers or glass jars. Each sediment sample will be divided into 5 identical exposure vessels or replicates. Label each exposure vessel with Sample Type and Replicate designation (The 5-replicates are designated alphabetically "A" through "E").

5.8. Preparing Sediments for use in Bioassay — Day -1

A. **Control Sediment**

1. Retrieve sediment sample from cold room.
2. Warm sediment sample to room temperature.
3. ***Note:*** *Sediment should have already been processed per section 5.3 above.*
4. Open sediment sample container. Do **not** pour off overlying water. The overlying water will be mixed back into sample.
5. Homogenize the processed sediment (settling is likely to have occurred during storage in cold room) by mixing with stainless steel beater attached to a drill.
6. Pour or scoop sediment into a 1-gallon double Ziploc bag. Cut off a corner of the bag and squeeze sediment into appropriate exposure vessel. Fill to the 175-mL mark. Repeat for remaining replicates.
7. Place exposure vessels into testing water bath. Randomize locations per Template. Record Template number.
8. Return unused portion to original container and refrigerate sediment in cold room.

B. **Test Sediment**

1. Retrieve sediment sample from cold room.
2. Warm sediment sample to room temperature.
3. Open sediment sample container. Do not pour off overlying water. During shipping and storage the sediment settles exposing some of the interstitial water. The overlying water will be mixed back into sample in the following steps.
4. Homogenized the sediment by mixing with a stainless steel beater attached to a drill. This may be done in the original container (if large enough) or in another appropriate container (HDPE Bucket).
5. If needed, the test sediment is press sieved through a series for Nitex® or stainless steel sieves to reduce the particle size. The method discourages sieving sediment samples. However, large particulate matter will make retrieving test organisms at the end of the study extremely difficult. Test organisms will likely be lost during test take down if large debris is not removed from the sediment sample during test setup. Sieving down to 1 to 2-mm is recommended.
6. Scoop sediment into appropriate exposure vessel using a stainless steel spoon. If sediment is fluid enough then it may be easier to "squeeze" it in. Pour or scoop sediment into a 1-gallon double Ziploc bag. Cut off a corner of the bag and squeeze sediment into appropriate exposure vessel. Fill to the 175-mL mark. Repeat for remaining replicates.
7. Place exposure vessels into testing water bath at 25 ± 1°C. Randomize locations per Template. Record Template number.

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8. Pore Water Quality

a. Transfer 10-mLs of sediment to each of 2, 15-mL centrifuge tubes for each sample.
b. Centrifuge samples for 30-minutes at ½ speed.
c. Measure Salinity and Ammonia of supernatant.
d. **Make a record on the "Pore Water Ammonia & Salinity" bench sheets.**
e. **Note:** Salinity tolerance for *L. plumulosus* is 0 to 34‰.

9. Return unused portion to original container and refrigerate sediment in cold room.

C. The Exposure Vessel and associated sediments are now ready to have overlay water added to them.

5.9. Preparing Overlay Waters for use in Bioassay — Day -1

A. Overlay water can either be laboratory prepare synthetic saltwater (SSW) or receiving water. Receiving waters are typically taken from upstream of the test sediment sample or a nearby body of water. In either case the receiving water is to be taken from a "clean" location. Refer to Job Order to determine what overlay water is to be used.

B. **Preparation of SSW**

1. SSW is prepared according to the EPA reference method listed in section 9.

C. **Preparation of Receiving Water**

1. Retrieve water from cold room (unless it has just arrived and is still in cooler).
2. Warm water sample up to room temperature (~25°C).
3. **Make a record on the "Sample Data" bench sheet.**
   a. Record sample ID.
   b. Measure initial water quality and record.
      1) Measurements taken are dissolved oxygen (DO), pH, salinity, total ammonia (TAN), alkalinity, hardness, total residual chlorine (TRC).
      2) Adjust salinity to 5 or 20‰ if necessary. Do so either by diluting with Reagent Grade Water · Type I or salting the water with Tropic Marin Sea Salts.
      3) Adjust DO if supersaturated by light aeration. Receiving waters should not have an oxygen demand. If DO is <4.0-mg/L, do not use and contact the laboratory manager immediately.
   c. Record the receiving waters expiration date. This is 2-weeks unless otherwise noted on the Job Folder.

D. **Addition of Overlay Water to Exposure Vessel**

1. Place Water Baffling Assembly in an exposure vessel.
   a. This device is designed to allow the addition of water with minimally disturbing the sediment in the exposure vessel.
2. Pour water to exposure vessels. Fill to 900-mLs (overlay volume is 725-mLs).

E. The exposure vessels will now be allowed to settle overnight. Test initiation (Day 0) will be tomorrow.

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5.10. Initiation of Bioassay — Day 0

A. There are several steps required to initiate the bioassay. The overlay water in the exposure vessels must be partially replenished. Water quality must be checked and recorded. Water quality must also be acceptable in order to support the unstressed survival of the amphipods for the duration of the bioassay. Amphipods are introduced to the exposure vessels once these parameters are deemed to be acceptable.

B. **Prepare Water for Renewal of Overlay Water**

1. If Overlay is **SSW**, skip ahead to C.
2. If Overlay is **Receiving Water**…
3. Retrieve water from cold room (unless it has just arrived and is still in cooler).
4. Warm water sample up to room temperature (~25°C).
5. **Make a record on the "Sample Data" bench sheet.**
   a. Record sample ID.
   b. Measure initial water quality and record.
      1) Measure dissolved oxygen (DO), pH and salinity. These are measured with each days use.
      2) Measure total ammonia (TAN), alkalinity, hardness, total residual chlorine (TRC). These are only measured with the samples first use.
      3) Adjust DO if supersaturated by light aeration. Receiving waters should not have an oxygen demand. If DO is <4.0-mg/L, do not use and contact the laboratory manager immediately.
   c. Record the receiving waters expiration date (from the sample container).

C. Measure Water Quality

1. Retrieve one of the sediment sample sets from the water bath (a "set" is all of the replicates, "A" through "E" of a given sediment sample) and place them on a light table.
   a. Take measurements directly in each exposure vessel.
   b. **Make a record on the "Temperature" bench sheets.**
      1) Measure and record Temperature from one replicate.
      2) This is done daily for the duration of the test.
   c. **Make a record on the "Dissolved Oxygen", "pH" and "Salinity" bench sheets.**
      1) Measure and record Dissolved Oxygen, pH and Salinity from ALL replicates.
      2) This is done on day 0 and day 28.
2. ***Important*** Be certain that all water quality parameters are within prescribed method specifications. If not, contact the laboratory manager.

D. Renewal of the Overlay Water

1. Place Water Baffling Assembly (WBA), in an exposure vessel.
2. Siphon overlay water out of exposure vessel into a 5-gallon bucket on the floor.
3. Repeat for remaining test replicates on the table.
4. With the WBA still in one of the exposure vessel, carefully fill the exposure vessel with fresh overlay water. Fill to top (but not to overflowing!) of exposure vessel.
5. Carefully remove the WBA and move it to the next exposure vessel.
6. Check overlay volume. If necessary adjust 900-mLs (overlay volume is 725-mLs).
7. Repeat steps 4 and 5 for remaining exposure vessels.
8. Return the exposure vessels to the water bath.
9. **Make a record on the "Renewals and Feedings" bench sheet**
   a. Record the overlays ID# on the bench sheet.

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E. Repeat C and D above for remaining Sediment Sample Exposure Vessels.

F. Addition of Amphipods to Exposure Vessels

1. Retrieve basin containing amphipods from water bath and place on a counter or light table.
2. Siphon off most of the water in the basin. This will make it easier to count out the amphipods.
3. Set out weigh boats on the table. Using a transfer pipette add some of the SSW from the basin into each weigh boat. Then carefully count out 20-amphipods into each boat.
4. Bring out 5 randomly selected exposure vessels from the testing water bath.
5. Gently wash amphipods from the weigh boat into the exposure vessel.
6. Be certain that all amphipods break through the surface tension of the overlay water. Any floating amphipods are gently nudged into the water by using the transfer pipette and dropping overlay water onto the floating amphipod.
7. Once all vessels have had 20-amphipods added to them they are returned to the testing water bath.
8. Repeat steps 3 through 7 above for remaining sediment sample test vessels.
9. **Make a record on the "Survivorship" bench sheet**
   a. Record the initiation of the test.
10. 20-minutes after addition of amphipods to test vessels check to ensure all animals have burrowed into sediment. Replace any animals that have not burrowed. Do not replace amphipods that are attempting to burrow but are immediately emerging as this is likely an avoidance response. Record the number of animals replaced.
11. Prepare 3 sets of 20 neonates for initial weight of the growth rate endpoint. Rinse with deionized water and dry overnight at 70°C.

G. Feeding Exposure Vessels

1. None

H. Aeration

1. Place all test vessels on light aeration.
2. The test is aerated continuously for the duration of the 28-days.

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5.11. Observations and Water Quality during the test… Days 1 through 27

A. Measure Water Quality on Renewal Days… Monday, Wednesdays and Fridays

1. Retrieve one of the sediment sample sets from the water bath (a "set" is all of the replicates, "A" through "E" of a given sediment sample) and place them on a light table.
   a. Take measurements directly in each exposure vessel.
   b. **Make a record on the "Temperature", "Dissolved Oxygen", "pH" and "Salinity" bench sheets.**
      1) Measure and record Temperature, Dissolved Oxygen, pH and Salinity from ONE replicate.
2. ***Important*** Be certain that all water quality parameters are within prescribed method specifications. If not, contact the laboratory manager.

B. Observations on Renewal Days… Monday, Wednesdays and Fridays

1. Record observations of amphipod activity and condition of sediment and water in all test chambers.

C. Renewal of the Overlay Water Monday, Wednesdays and Fridays

1. Place Water Baffling Assembly (WBA), in an exposure vessel.
2. Siphon overlay water out of exposure vessel into a 5-gallon bucket on the floor.
3. Repeat for remaining test replicates on the table.
4. With the WBA still in one of the exposure vessel, carefully fill the exposure vessel with fresh overlay water. Fill to top (but not to overflowing!) of exposure vessel.
5. Carefully remove the WBA and move it to the next exposure vessel.
6. Check overlay volume. If necessary adjust 900-mLs (overlay volume is 725-mLs).
7. Repeat steps 4 and 5 for remaining exposure vessels.
8. Return the exposure vessels to the water bath.
9. **Make a record on the "Renewals and Feedings" bench sheet**
   a. Record the overlays ID# on the bench sheet.
   b. Repeat C and D above for remaining Sediment Sample Exposure Vessels.
      1) This is done on a Monday, Wednesday, Friday schedule.

D. Feeding Exposure Vessels on Renewal Days… Monday, Wednesdays and Fridays

1. Prepare a stock of Aquatox Flake Fish Feed by blending 40-grams in 1L of RGW·I for 5-minutes.
2. Assign a 2-week expiration date and refrigerate at 4°C.
3. On days 0 to 13, feed ½ mL to each replicate after renewal.
4. On days 14 to 28, feed 1 mL to each replicate after renewal.
5. Record feeding.

E. Measure Water Quality on Non-Renewal Days…

1. Retrieve one of the replicate sediment exposure vessels from each sample and place them on a light table.
   a. Take measurements directly in each exposure vessel.
   b. **Make a record on the "Temperature" bench sheets.**
      1) Measure and record Temperature from ONE replicate.

F. Aeration

1. Check aeration of test vessels. Adjust aeration were needed.
2. If any test vessels have lost aeration, make a record of which vessels lost aeration. Restore aeration to those vessels immediately.

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5.12. Termination of Bioassay — Day 28

A. Termination of the bioassay occurs on the 28th day. Final water quality is taken. The sediments are washed through a 600-µm sieve in order to collect and count the adult amphipods. The sediments are then washed through a 250-µm sieve in order to collect and count the amphipods offspring.

B. On the day before the test is to be terminated, prepare aluminum weigh pans per SOP number MTR-001.

C. Setup a Sediment Take Down Work Station

1. **Set up Work Station outside.**
   a. Sediment Rinse Station
   b. Water Proof Table
   c. Light Box
   d. 600-µm sieve
   e. 240-µm sieve
   f. Pyrex Casserole Dish
   g. Forceps
   h. Deionized Water Hose
   i. Spray Attachment for DI water

D. Measure Water Quality

1. Retrieve one of the sediment sample sets from the water bath (a "set" is all of the replicates, "A" through "E" of a given sediment sample) and place them on a light table.
   a. Take measurements directly in each exposure vessel.
   b. **Make a record on the "Temperature" bench sheets.**
      1) Measure and record Temperature from one replicate.
   c. **Make a record on the "Dissolved Oxygen", "pH" and "Salinity" bench sheets.**
      1) Measure and record Dissolved Oxygen, pH and Salinity from ALL replicates.
   d. **Make a record on the "Pore Water Ammonia" bench sheets.**
      1) Measure and record Ammonia, pH and Temperature from one replicate.

E. Separation of Amphipods from Sediment

1. Work with one set and then one **exposure vessel at a time**.
   a. Transport one set of exposure vessels and tared weigh pans outside to the Sediment Settlement Container.
   b. Pore contents of exposure vessel into 240-µm sieve. Flushing the vessel with DI water will likely be necessary.
   c. Rinse sediment through the sieve.
   d. Locate and count the adult amphipods.
   e. **Make a record on the "Survivorship" bench sheet.**
   f. Using forceps, transfer adult amphipods to the appropriate weigh pan.
   g. Transfer remaining sediment into a 32 ounce jar.
   h. Add about 250 mLs of Staining Solution and seal. Place jars in a safe place for later scoring of offspring.
   i. Repeat a. through e. for the remaining exposure vessels in this set.
   j. Place weigh pans in oven at 70°C to dry overnight.

F. Repeat C and D above for remaining sediment sets.

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G. Transport empty labware and exposure vessels to the dirty lab ware counter.

H. Remove the water from the sediment settling container, and use a scoop to remove and transfer the "composited" sediment remaining in the container to a sample container for return to the client.

I. Final Dry Weights

1. After pans have dried overnight, transfer to a desiccator for 20 minutes.
2. Determine final dry weights using the SOP number MTR-001.

J. Counting Offspring

1. Within 2 weeks, count offspring and record.

6.0 Quick Summary

6.1. No summary currently prepared.

7.0 Acceptability of Data

7.1. Minimum mean **control survival 80%** in the control sediment with **no single control having ≤60% survival.**

8.0 General References

8.1. Method for Assessing the Chronic Toxicity of Marine and Estuarine Sediment-associated Contaminants with the Amphipod *Leptocheirus plumulosus*. (EPA 600/R-01/020, March 2001)

8.2. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition, (EPA-821-R-02-012, October 2002)

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9.0 Signatures

9.1. Signature, Title of the Approving Authority and Implementation Date.

A. _____ _____ ___/___/___.

9.2. Each person conducting the SOP should read the following statement. Print and sign if you agree.

"I have read and understand this Standard Operating Procedures as it relates to my job responsibilities. I further understand that the Standard Operating Procedures are an integral part of Hydrosphere Research's operations. I agree to follow all procedures outlined in the Standard Operating Procedures."

9.3. Printed **Name**, **Signature**, **Date and Training ETW** of persons conducting this procedure:

A. _____ _____ ___/___/___ _____·ETW

B. _____ _____ ___/___/___ _____·ETW

C. _____ _____ ___/___/___ _____·ETW

D. _____ _____ ___/___/___ _____·ETW

E. _____ _____ ___/___/___ _____·ETW

F. _____ _____ ___/___/___ _____·ETW

G. _____ _____ ___/___/___ _____·ETW

H. _____ _____ ___/___/___ _____·ETW

I. _____ _____ ___/___/___ _____·ETW

J. _____ _____ ___/___/___ _____·ETW

K. _____ _____ ___/___/___ _____·ETW

L. _____ _____ ___/___/___ _____·ETW

9.4. Annual Review (signature and date)

A. _____ ___/___/___.

B. _____ ___/___/___.

C. _____ ___/___/___.

D. _____ ___/___/___.

E. _____ ___/___/___.

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10.0 SOP Postings and Revisions

10.1. Postings

A. Laboratory Posted Location(s) of SOP's.

1. _____

2. _____

3. _____

10.2. Revision Checklist

- ☐ Retrieve and Dispose of Posted Copies. Initial _____
- ☐ Create New Revised SOP Initial _____
- ☐ Train Personnel on "new" SOP Initial _____
- ☐ File Electronic Version of Retired SOP Initial _____
- ☐ File Paper Version of Retired SOP Initial _____

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11.0 Examples of Relevant Datasheets or Documents

11.1.

A. None currently prepared for this document.

Standard Operating Procedure

Procedure: Conducting Test Method 100.4, 42-day Survival, Growth & Reproduction Test for Sediments with the amphipod *Hyalella azteca*
Number: TST-013
Page: 1 of 20
Date: 6/9/2013
Revision No: 0 (original)

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1.0 Introduction/Objective

1.1. The objective of a sediment test is to determine whether chemicals in sediment are harmful to or are bioaccumulated by benthic organisms. The tests can be used to measure interactive toxic effects of complex chemical mixtures in sediment.

1.2. Definitions of certain terms…

A. **Control Sediment:** Control sediment is a negative control against which comparisons (typically statistical) are made. The negative control can be an artificially prepared sediment or clean naturally occurring sediment collected from an area that has health aquatic communities associated with it. As of SOP version 4, there are no approved artificial control sediments.

B. **Reference Sediment:** These can also serve as negative control groups that can be used for comparisons. They are sediments that are collected near the study or test site. The intent is that the reference sediment is outside of the area of concern but near it, so as to have similar physical characteristic but be free of contamination.

C. **Test Sediment:** The test sediment is the material being evaluated against the control sediment and/or the reference sediment.

D. **Job Folder:** Folder containing instructions and bench sheets to conduct study. Chain-of-Custodies and test related paperwork are kept in this folder.

E. **Laboratory:** Unless stated otherwise, references in this SOP to "the laboratory" mean Hydrosphere Research, 11842 Research Circle, Alachua, FL 32615.

F. **Exposure Vessel:** This is the container, which holds the sediments, overlying waters and amphipods. Several exposure vessels containing the same test materials (sediment, water, amphipods) are referred to as "replicates".

G. **Sediment Settling Container:** The Sediment Rinse Station consists of a sink that contains the appropriate sieve and a series of Sediment Settling Containers which are 5 gallon buckets, one draining into the other, to capture the sediment and overflow rinse water. A large plastic container under the buckets provides secondary containment. The Rinse Station is located in the Utility 3 area near the back gate. Some sediment will fall into the sink during sediment washing, and it will settle on the bottom of one or more of the 5 gallon buckets. After all sediments have been washed, the sediment on the bottom of the buckets must be retrieved and placed in a sample container for return to the client.

2.0 Apparatus/Equipment/Laboratory Books

2.1. Laboratory Books

~ a complete list and location of lab books are in the front of each Laboratory Book ~

A. SOP, "Creating a Job Folder", PRO-013

B. Pen, water-proof, black ink
   1. To be used for making all records in laboratory books, logbooks and bench sheets.

C. Logbook, "Chemical & Solutions Logbook", LGB-002
   1. The chemical portion of the logbook is an electronic data base (Application: Filemaker) on the laboratory server (F:\databases\Chemical Log.fp7)
   2. New records are created here. File is printed periodically and placed in the logbook.

D. SOP, "Sample Receiving", PRO-009

E. Logbook, "Test Organism Receipt and Acclimation", LGB-015

F. SOP, "Test Organism Receipt and Acclimation", PRO-010

G. SOP, "Determination of Mass using the Sartorius Analytical Balance, Type R200D", MTR-001

H. SOP, "Randomization", PRO-036

2.2. Sampling Kit

A. Plastic Cooler, 48-quart minimum (1) (Brand: Coleman, Rubbermaid, Igloo)

B. Nalgene® Polyethylene Wide Mouth Bottles (4) (U.S. Plastic, Lima, OH ~ Stock 68082)

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C. Ziplock Bag, 5" x 10" (1)
D. Clear Shipping Tape (roll)
E. Chain-of-Custody (COC) Form (1)
F. COC Seal (2)
G. Sample Bottle Labels, weather-proof (4)
H. Nylon Reinforced Tape (roll)
I. Hydrosphere Return Address Label(1)
J. FedEx Ground Shipping Label (1)
K. Shipping Label Sleeve (1)

2.3. Environmentally Controlled Water Bath

A. Fluorescent Lighting
B. Light Timer
C. Water Pump with plumbing
D. Heater, 300-watt
E. Aeration Manifold, Valved
F. Source of low pressure aeration, oil-free

2.4. Thermometer, calibrated
2.5. Sharpie Permanent Marker, Black or Colored
A. To be used for marking all sample containers and labware.
2.6. Coldroom, maintained at 0 to 6°C
2.7. Stainless Steel Beater
2.8. Drill with ½"chuck
2.9. Bucket, 5-gallon HDPE with Lid (3)

2.10. Nitex or Stainless Steel Sieves

A. ¼", 1000-µm, 800-µm, 600-µm, 425-µm, 240-µm screens

2.11. Silicone Tubing, 3/8" (~6')
2.12. Aquaculture Basin, 15-L (1 or more)
2.13. Airline Tubing (10')
2.14. Pipettes, 1-mL, for aeration (1 or more)
2.15. Sediment Rinse Container

2.16. Job Folder

A. Bench Sheets for EPA Method "100.4"

1. Sample Data
2. Survivorship
3. Water Quality
4. Overlay Water and Feedings
5. Growth
6. Reproduction

2.17. Glass Jar, 240-µm screen modified, 300-mL (12, per sample)
2.18. Stainless Steel Spoon (1 or more)
2.19. Ziploc Bag, 1-gallon, double zipper (1 or more)

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2.20. Scissor (1)
2.21. Dissolved Oxygen Meter, calibrated (1) YSI, Model 58
2.22. pH Meter, calibrated (1)
2.23. Conductance Meter, calibrated (1)
2.24. Colorimeter (1) HACH, DR890
2.25. Test Strips (1 or more) HACH
2.26. Head Box Assembly
   A. This is an acrylic box fitted with…
   B. 60-cc syringes and…
   C. Stainless steel blunted needles.
2.27. Light Table
2.28. Weigh Boats, Plastic, 100-mL
2.29. Transfer Pipette
2.30. Aluminum Weigh Pans
2.31. Sediment Settling Trash Can Assembly
2.32. Table, Folding, Water-proof
2.33. Light Box
2.34. Pyrex Casserole Dish, 4-L
2.35. Forceps
2.36. Vinyl Hose with Spray Nozzle

3.0 Organisms/Reagents/Solutions

3.1. Amphipod, *Hyalella azteca*. 7 to 8-days old
   A. **Source:** In-house cultures or…
   B. **Source:** Aquatic Research Organisms, Hampton, NH, 603-926-1650
   C. **Source:** Aquatic Indicators, St. Augustine, FL, 904-829-2780

3.2. Control Sediment, Freshwater
   A. **Source:** Local, Alachua County, Florida
   B. **Source:** Aquatic Research Organisms, Hampton, NH, 603-926-1650

3.3. Freshwater
   A. Aquaculture Water

3.4. Deionized Water
   A. Reagent Grade Water · Type I

4.0 Personal Protection Equipment

4.1. No hazardous chemicals are used for the procedure, therefore; only standard laboratory safety procedures are practiced.

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5.0 Procedure **Test Day**

5.1. Schedule Test Event and Shipment of Sampling Kit **~ 2-weeks**

A. Create a Job Folder according to the SOP.
   1. Place Job folder in relevant tray on the Sample Receipt Counter in the Lab Testing Bay.

B. Sample Volume
   1. 12-replicates x 100-mLs is 1,200-mLs, however… sediment sample can vary greatly and the study may need to be repeated if it is unacceptable. The sample containers provided are 1-gallon (~3.78-L). Based on these elements the requested **sample volume should be 1-gallon**.

C. Sample Kit Shipment
   1. Determine how many sampling kits will be required. Each kit can hold 4, 1-gallon Nalgene® (or equivalent) sampling bottles and sufficient ice to preserve samples for a 24-hour period.
   2. Prepare sampling kits by including the following:
      a. Cooler containing…
         1) Clean 1-gallon Nalgene® bottles (each cooler can hold maximum of 4 bottles)
         2) Ziploc Bag. The Ziploc bag gets taped to the inside lid of the cooler but first place the following inside the Ziploc bag…
            a) Chain-of-Custody
            b) COC Seal
            c) Sample Bottle Labels
            d) Hydrosphere Return Address Label
      b. Chain-of-Custody Seal
         1) Sign & date the COC seal with water-proof black pen. Apply across the seam that's between the lid and body of the cooler.
         2) Tape the cooler closed with nylon reinforced tape. You must tape over the signed COC Seal with the tape. The tape is clear so the signed COC seal is visible.
      c. Apply the shipping sleeve containing the FedEx shipping label to the top of the cooler.
   3. Place cooler to the left of the front door to await pickup.
   4. Sign off on the Job Folder, "Shipped by" and "Shipped Date".
   5. Return Job Folder to relevant tray.

6. Client: TVA
   a. TVA provides sample kits.

5.2. Determine where in the Laboratory the Bioassay will be Conducted **~ 2-weeks**

A. Determine which environmentally controlled water baths will accommodate the exposure vessels and will be able to meet the test conditions. The baths must have a pump and heater for temperature control, a source of clean, oil-free air, approximately 50 to 100 foot-candles illumination (ambient laboratory) and a 16-hour light/8-hour dark photoperiod.
B. Adjust photoperiod if necessary.
C. Adjust temperature of water bath to between 23 and 24°C. Exposure vessels typically run slightly less than bath temperature. Check water pump and verify that water is circulating. On subsequent days verify water bath temperature adjustments by checking the laboratories logbook which records the temperatures of all active baths and environmental chambers daily.

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5.3. The Acquisition of *Hyalella azteca* for use in Bioassay ~ 2-weeks

A. Locate source of *H. azteca*.
B. Determine the number of amphipods required for the bioassay. The method recommends 12-replicate vessels with 10-organisms per replicate or a total of 120-amphipods per sediment sample or treatments.
C. Order 20% more than is required for the test. Mortalities may occur in shipping.
D. Have test organisms shipped priority overnight service.
E. Order amphipods so that they are as old as possible and so they arrive 2 to 3-days before the test is to be initiated. This give them time to sort themselves out (injuries during shipment may not be apparent upon arrival).

5.4. The Acquisition and Processing of Control Sediment ~ 1-week

A. Determine what the negative control(s) shall be. They may be artificial prepared or naturally occurring. They should have a high likelihood of performing adequately, as in, meeting minimal test method quality control standards.
B. Acquire control sediment approximately 1 to 2 weeks ahead of scheduled test date.
C. Control sediments may be collected by the laboratory, a contracted vendor or may be a reference site located near the test site. Refer to the Job Folder for the specific control sediments required for each test event.
D. The control sediment is to be collected in clean plastic (preferably HDPE) containers. These containers are then packed in a cooler with ice and shipped via an overnight courier to this laboratory.

E. Receipt and Processing of Control Sediment

1. Upon arrival of control sediment…
   a. Acquire the shipper's air bill.
   b. Inspect the packaging; ensure that the contents are intact.
   c. Note the condition of a chain-of-custody seal, if present.
   d. Open shipping container and find the paperwork describing the contents (chain-of-custody, shipping slip, etc…).
   e. Record the following on the paperwork:
      1) Temperature of the sediment.
      2) Date Received and Initial.
   f. Record the following on the sediment container:
      1) Make a record in the "Chemical & Solutions" Logbook and generate a Chemical Log number. Record this on the sediment container.
      2) Assign an 8-week expiration date and record on container.
      3) Client: TVA
         a) Record the condition of the COC seal.
         b) Scan and email completed COC to client.
   g. Refrigerate sediment in coldroom.

2. Processing of Control Sediment
   a. Remove control sediment from coldroom.
   b. Warm sediment to room temperature.
   c. Open sediment sample container. Do **not** pour off overlying water. During shipping and storage the sediment settles exposing some of the interstitial water. The overlying water will be mixed back into sample in the following step.

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d. Homogenized the sediment by mixing with a stainless steel beater attached to a drill. This may be done in the original container (if large enough) or in another appropriate container; typically a 5-gallon HDPE Bucket.
e. The control sediment is sieved through a series of ~12" diameter Nitex® or stainless steel sieves to reduce the particle size to less than 450-µm.
   1) Wash sediment using synthetic freshwater.
   2) Sieve through ¼", 1000-µm, 800-µm, 600-µm, 450-µm screens.
f. Store sediments in a labeled 5-gallon bucket and store in coldroom. Allow washed sediment to settle for ≥2-days then draw off the overlay water with a 3/8" silicone tube.

5.5. The Receipt of Sediment and Overlay Water Samples — < 8-weeks (Sediments), < 2-weeks (Water)

A. Unless otherwise noted on the Job Folder, Sediments have an 8-week holding time and Receiving Waters have a 2-week holding time. Laboratory prepared synthetic waters have a 2-week holding time.

B. Receipt of Test Sediment

1. The receiving of the test sediment samples shall be conducted as given in the Sample Receiving SOP.
2. Points Emphasized from item 1 above.
   a. Record **Sample ID** on each container.
   b. Record **Expiration Date** (8-weeks) on each container.
3. Refrigerate sediment samples in cold room until use in testing.
4. **Client: TVA**
   a. Record the condition of the COC seal.
   b. Scan and email completed COC to client.

C. **Receipt of Receiving Water**

1. The receiving of receiving water samples shall be conducted as given in the Sample Receiving SOP.
2. Points Emphasized from item 1 above.
   a. Record **Sample ID** on each container.
   b. Record **Expiration Date** (2-weeks) on each container.
3. Refrigerate water samples in cold room until use in testing.
4. **Client: TVA**
   a. Record the condition of the COC seal.
   b. Scan and email completed COC to client.

5.6. Receipt of Amphipods — Day -3

A. Acquire the shipper's air bill.
B. Inspect the packaging; ensure that the contents are intact.
C. Open container and find shipping slip.
D. Make record in the "Test Organism Receipt and Acclimation" Logbook.
   1. Follow instructions in SOP, "Test Organism Receipt and Acclimation".
E. Fill 15-L aquaculture basin with 10-L SYNTHETIC FRESHWATER. Transfer amphipods to basin (~500 per basin).
F. Place in appropriate bath at 23°C and place on light air.
G. Water change amphipod basins at least daily over the next few days.

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5.7. Other Pre-Test Preparations — Day -2

A. Job Order and Data/Bench Sheets

1. Locate Job Folder. Check for completeness.
2. Review information/instructions on Job Folder and Bench Sheets. Report any discrepancies to the laboratory manager.
3. Record Job Number on all bench sheets.
4. **Remember:** Corrections are made by drawing a single line through the error, initial and date correction, record correct data next to correction or, if note enough room, footnote and record correct data in "Notes and Comments" section at the bottom of the bench sheet.

B. Apparatus and Equipment Review

1. Review the list in Section 2.0. Verify that all are present, clean and in acceptable working order.
2. **Exposure Vessels, 300-mL Jars**
   a. The bioassay is conducted in 300-mL glass jars. Each sediment sample will be divided into 12 identical exposure vessels or replicates. Label each exposure vessel with Sample Type and Replicate designation (The 12-replicates are designated alphabetically "A" through "L").

5.8. Preparing Sediments for use in Bioassay — Day -1

A. Control Sediment

1. Retrieve sediment sample from cold room.
2. Warm sediment sample to room temperature.
3. ***Note:*** *Sediment should have already been processed per section 5.3 above.*
4. Open sediment sample container. Do **not** pour off overlying water. The overlying water will be mixed back into sample.
5. Homogenize the processed sediment (settling is likely to have occurred during storage in cold room) by mixing with stainless steel beater attached to a drill.
6. Pour or scoop sediment into a 1-gallon double Ziploc bag. Cut off a corner of the bag and squeeze sediment into appropriate exposure vessel. Fill to the 100-mL mark. Repeat for remaining replicates.
7. Place exposure vessels into testing water bath. Randomize locations. Record Template number.
8. Return unused portion to original container and refrigerate sediment in cold room.

B. Test Sediment

1. Retrieve sediment sample from cold room.
2. Warm sediment sample to room temperature.
3. Open sediment sample container. Do not pour off overlying water. During shipping and storage the sediment settles exposing some of the interstitial water. The overlying water will be mixed back into sample in the following steps.
4. Homogenized the sediment by mixing with a stainless steel beater attached to a drill. This may be done in the original container (if large enough) or in another appropriate container (HDPE Bucket).
5. If needed, the test sediment is press sieved through a series for Nitex® or stainless steel sieves to reduce the particle size. The method discourages sieving sediment samples. However, large particulate matter will make retrieving test organisms at the end of the study extremely difficult. Test organisms may be lost during test take down if large debris is not removed from the sediment sample during test setup.

a. Client: TVA

1) Ash samples do not typically need to be sieved.

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6. Scoop sediment into appropriate exposure vessel using a stainless steel spoon. If sediment is fluid enough then it may be easier to "squeeze" it in. Pour or scoop sediment into a 1-gallon double Ziploc bag. Cut off a corner of the bag and squeeze sediment into appropriate exposure vessel. Fill to the 100-mL mark. Repeat for remaining replicates.
7. Place exposure vessels into testing water bath. Randomize locations. Record Template number.
8. **Pore Water Quality**
   a. Transfer 10-mLs of sediment to each of 2, 15-mL centrifuge tubes for each sample.
   b. Centrifuge samples for 30-minutes at ½ speed.
   c. Measure Salinity and Ammonia of supernatant.
   d. **Make a record on the "Pore Water Ammonia & Salinity" bench sheets.**
9. Return unused portion to original container and refrigerate sediment in cold room.

C. The Exposure Vessel and associated sediments are now ready to have overlay water added to them.

5.9. Preparing Overlay Waters for use in Bioassay — Day -1

A. Overlay water can either be laboratory prepare synthetic freshwater or receiving water. Receiving waters are typically taken from upstream of the test sediment sample or a nearby body of water. In either case the receiving water is to be taken from a "clean" location. Refer to Job Order to determine what overlay water is to be used.

B. **Preparation of Synthetic Freshwater**
1. Synthetic Freshwater is prepared according to the EPA reference method listed in section 9.

C. **Preparation of Receiving Water**
1. Retrieve water from cold room (unless it has just arrived and is still in cooler).
2. Warm water sample up to room temperature (~23°C).
3. **Make a record on the "Sample Data" bench sheet.**
   a. Record sample ID.
   b. Measure initial water quality and record.
      1) Measurements taken are dissolved oxygen (DO), pH, conductance, total ammonia (TAN), alkalinity, hardness, total residual chlorine (TRC).
      2) Adjust DO if supersaturated by light aeration. Receiving waters should not have an oxygen demand. If DO is <4.0-mg/L, do not use and contact the laboratory manager immediately.
   c. Record the receiving waters expiration date. This is 2-weeks unless otherwise noted on the Job Folder.

D. **Addition of Overlay Water to Exposure Vessel**
1. Assemble Head Box Assembly (HBA)
   a. Some syringes may not be used. Fit those with syringe plungers so that the syringe will not fill with water.
2. Wet screens of exposure vessels. This will prevent the exposure vessels from overflowing. Dry screens can prevent water from draining out of the exposure vessels due to surface tension.
3. Place the HBA over exposure vessels.
4. Calculate total volume of overlay water required to fill all of the exposure vessels present under HBA.
5. For the initial filling of the test vessels add ~20% to the above volume.
6. Fill HBA with overlay water.

E. The exposure vessels will now be allowed to settle overnight. Test initiation (Day 0) will be tomorrow.

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5.10. Initiation of Bioassay — Day 0

A. There are several steps required to initiate the bioassay. The overlay water in the exposure vessels must be partially replenished. Water quality must be checked and recorded. Water quality must also be acceptable in order to support the unstressed survival of the amphipods for the duration of the bioassay. Amphipods are introduced to the exposure vessels once these parameters are deemed to be acceptable.

B. **Prepare Water for Renewal of Overlay Water**

1. If Overlay is **Synthetic Freshwater**, skip ahead to C.
2. If Overlay is **Receiving Water**…
3. Retrieve water from cold room (unless it has just arrived and is still in cooler).
4. Warm water sample up to room temperature (~23°C).
5. **Make a record on the "Sample Data" bench sheet.**
   a. Record sample ID.
   b. Measure initial water quality and record.
      1) Measure dissolved oxygen (DO), pH and conductance. These are measured with each days use.
      2) Measure total ammonia (TAN), alkalinity, hardness, total residual chlorine (TRC). These are only measured with the samples first use.
      3) Adjust DO if supersaturated by light aeration. Receiving waters should not have an oxygen demand. If DO is <4.0-mg/L, do not use and contact the laboratory manager immediately.
   c. Record the receiving waters expiration date (from the sample container).

C. **Measure Water Quality**

1. Retrieve one of the sediment sample sets from the water bath (a "set" is all of the replicates, "A" through "L" of a given sediment sample) and place them on a light table.
   a. Take measurements directly in each exposure vessel.
   b. **Make a record on the "Temperature" and "Dissolved Oxygen" bench sheets.**
      1) Measure and record Temperature and DO from one replicate.
      2) This is done daily for the duration of the test.
   c. **Make a record on the "pH", "Conductance", "Hardness", "Alkalinity" and "Ammonia" bench sheets.**
      1) Measure and record pH, Conductance, Hardness, Alkalinity and Ammonia from one replicate.
      2) This is done on day 0, day 28 and day 42.
2. ***Important*** Be certain that all water quality parameters are within prescribed method specifications. If not, contact the laboratory manager.

D. **Renewal of the Overlay Water**

1. Assemble Head Box Assembly (HBA)
   a. Some syringes may not be used. Fit those with syringe plungers so that the syringe will not fill with water.
2. Wet screens of exposure vessels. This will prevent the exposure vessels from overflowing. Dry screens can prevent water from draining out of the exposure vessels due to surface tension.
3. Place the HBA over exposure vessels.
4. Calculate total volume of overlay water required to fill all of the exposure vessels present under HBA.
5. Fill HBA with overlay water.
6. Repeat above process for remaining exposure vessels.

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7. **Make a record on the "Renewals and Feedings" bench sheet**
   a. Record the overlays ID# on the bench sheet.

E. Addition of Amphipods to Exposure Vessels

1. Retrieve basin containing amphipods from water bath and place on a counter or light table.
2. Siphon off most of the water in the basin. This will make it easier to count out the amphipods.
3. Set out weigh boats on the table. Using a transfer pipette add some of the synthetic freshwater from the basin into each weigh boat. Then carefully count out 10-amphipods into each boat.
4. Bring out 8 randomly selected exposure vessels from the testing water bath.
5. Gently wash amphipods from the weigh boat into the exposure vessel.
6. Be certain that all amphipods break through the surface tension of the overlay water. Any floating amphipods are gently nudged into the water by using the transfer pipette and dropping overlay water onto the floating amphipod.
7. Once all vessels have had 10-amphipods added to them they are returned to the testing water bath.
8. Repeat steps 3 through 7 above for remaining sediment sample test vessels.
9. **Make a record on the "Survivorship" bench sheet**
   a. Record the initiation of the test.

F. Initial Amphipod Weights

1. Archive 80-amphipods for dry weight determination.
2. Number aluminum weigh pans. One pan per 20-amphipods.
3. Determine weight according to the SOP, "Determination of Mass using the Sartorius Analytical Balance, Type R200D".
4. **Make a record on the "Growth" bench sheet.**
   a. Record pan number, tare weights, total weight, number of specimens per pan, final dry weight, date final dry weight.

G. Feeding Exposure Vessels

1. Test Vessels are fed 1-mL of F-CD. F-CD is a feed used for *Ceriodaphnia* cultures.
2. **Make a record on the "Renewals & Feedings" bench sheet**
   a. Record the Feed ID#.

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5.11. Daily Renewal, Observations and Water Quality… ~ Mornings ~ Days 1 through 28

A. On renewal days prepare fresh water for replenishing overlay water in the morning and evening. Make observations on mortalities, remove mortalities and record on bench sheets. Record water quality on bench sheets.

B. **Prepare Water for Renewal of Overlay Water**

1. If Overlay is **Synthetic Freshwater**, skip ahead to C.
2. If Overlay is **Receiving Water**…
3. Retrieve water from cold room (unless it has just arrived and is still in cooler).
   a. Retrieve enough for morning and evening renewals.
4. Warm water sample up to room temperature (~23°C).
5. Place water sample in bath at 23°C.
6. **Make a record on the "Sample Data" bench sheet.**
   a. Record sample ID.
   b. Measure initial water quality and record.
      1) Measure dissolved oxygen (DO), pH and conductance. These are measured with each days use.
      2) Measure total ammonia (TAN), alkalinity, hardness, total residual chlorine (TRC). These are only measured with the samples first use.
      3) Adjust DO if supersaturated by light aeration. Receiving waters should not have an oxygen demand. If DO is <4.0-mg/L, do not use and contact the laboratory manager immediately.
   c. Record the receiving waters expiration date (from the sample container).

C. Measure Water Quality of the Exposure Vessels

1. Retrieve one of the sediment sample sets from the water bath (a "set" is all of the replicates, "A" through "H" of a given sediment sample) and place them on a light table.
   a. Take measurements directly in each exposure vessel.
   b. **Make a record on the "Temperature" and "Dissolved Oxygen" bench sheets.**
      1) Measure and record Temperature and DO from one replicate.
      2) This is done daily for the duration of the test.
2. ***Important*** Be certain that all water quality parameters are within prescribed method specifications. If not, contact the laboratory manager.

D. **Renewal of the Overlay Water**

1. Assemble Head Box Assembly (HBA)
   a. Some syringes may not be used. Fit those with syringe plungers so that the syringe will not fill with water.
2. Wet screens of exposure vessels. This will prevent the exposure vessels from overflowing. Dry screens can prevent water from draining out of the exposure vessels due to surface tension.
3. Place the HBA over exposure vessels.
4. Calculate total volume of overlay water required to fill all of the exposure vessels present under HBA.
5. Fill HBA with overlay water.
6. Repeat above process for remaining exposure vessels.
7. **Make a record on the "Renewals and Feedings" bench sheet**
   a. Record the overlays ID# on the bench sheet.

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5.12. Daily Renewal, Observations and Water Quality… ~ Evenings ~ Days 1 through 28

A. Renewal of the Overlay Water

1. Assemble Head Box Assembly (HBA)
   a. Some syringes may not be used. Fit those with syringe plungers so that they will not fill with water.
2. Wet screens of exposure vessels. This will prevent the exposure vessels from overflowing. Dry screens can prevent water from draining out of the exposure vessels due to surface tension.
3. Place the HBA over exposure vessels.
4. Calculate total volume of overlay water required to fill all of the exposure vessels present under HBA.
5. Fill HBA with overlay water.
6. Repeat above process for remaining exposure vessels.
7. **Make a record on the "Renewals and Feedings" bench sheet**
   a. Record the overlays ID# on the bench sheet.

B. Feeding Exposure Vessels

1. Test Vessels are fed 1-mL of F-CD after evening renewal. F-CD is a feed used for *Ceriodaphnia* cultures.
2. **Make a record on the "Renewals & Feedings" bench sheet**
   a. Record the Feed ID#.

5.13. Dry Weight Determination and Transfer of Adults to Water Only Vessels Day 28

A. The sediments are washed through a 425-µm sieve in order to collect the amphipods. The amphipods in four of the 12 replicates are counted, placed on tared weigh pans, dried & final dry weights are determined. The amphipods in the other 8 replicates are counted and transferred into water only test vessels for further evaluations.

B. Setup a Sediment Take Down Work Station

1. Set up Work Station outside.
   a. Sediment sample settling assembly with Eggcrate
   b. Water Proof Table
   c. Light Box
   d. 425-µm sieve
   e. Pyrex Casserole Dish
   f. Forceps
   g. Wide-bore Transfer Pipettes
      1) Cut 5-mL glass pipettes to about 3 inches. Fire polish ends.
      2) Cut plastic 3.5 mL transfer pipette at about the 2.5 mL mark.
      3) Slide plastic bulb end onto cut glass pipette.
   h. Deionized Water Hose
   i. Spray Attachment for DI water

C. Tare Aluminum Weigh Pans

1. Number aluminum weigh pans. One pan per exposure vessel.
2. Tare pans according to the SOP "Determination of Mass using the Sartorius Analytical Balance, Type R200D" (procedure number MTR-001).
3. **Make a record on the "Growth" bench sheet.**
   a. Record pan number and tare weights.

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D. Measure Water Quality

1. Retrieve one of the sediment sample sets from the water bath (a "set" is all of the replicates, "A" through "L" of a given sediment sample) and place them on a light table.
   a. Take measurements directly in each exposure vessel.
   b. **Make a record on the "Temperature" and "Dissolved Oxygen" bench sheets.**
      1) Measure and record Temperature and DO from one replicate.
      2) This is done daily for the duration of the test.
   c. **Make a record on the "pH", "Conductance", "Hardness", "Alkalinity" and "Ammonia" bench sheets.**
      1) Measure and record pH, Conductance, Hardness, Alkalinity and Ammonia from one replicate.
      2) This is done on day 0, day 28 and day 42.

E. Separation of Amphipods from Sediment

1. Work with one set and then one **exposure vessel at a time**.
   a. Transport one set of exposure vessels and tared weigh pans outside to the Sediment Settlement Container.
2. For the **8 test vessels** whose amphipods are to be transferred to the **water only test vessels**…
   a. Pore contents of exposure vessel into 425-µm sieve.
   b. Carefully wash the sediment with aquaculture water to remove fine material while minimizing possible injury to the amphipods.
   c. Wash the contents of the sieve into a casserole dish.
   d. Using a wide-bore transfer pipette, transfer all of the amphipods from the dish to the appropriately marked water-only test vessel.
   e. **Make a record on the "Survivorship" bench sheet.**
   f. Record number of living Amphipods recovered.
   g. Repeat a. through f. for the remaining 7 exposure vessels in this set.

3. For the **4 test** vessels whose amphipods are to be transferred to the **tared weigh pans**…
   a. Pore contents of exposure vessel into 425-µm sieve.
   b. Flushing the vessel with the deionized water.
   c. Rinse sediment through the sieve.
   d. Transfer the contents of the sieve to a casserole dish.
   e. Using forceps or transfer pipette remove all of the amphipods from the dish and transfer to the appropriate weigh pan.
   f. **Make a record on the "Survivorship" bench sheet.**
   g. Record number of living Amphipods recovered.
   h. **Make a record on the "Growth" bench sheet.**
      1) Record number of specimens transferred to the weigh pan.
   i. Repeat a. through h. for the remaining exposure vessels in this set.

F. Repeat 5.13.D and 5.13.E for remaining sediment sets.
G. Transport empty labware and exposure vessels to the dirty labware counter.
H. Remove the water from the sediment settling container, and use a scoop to remove and transfer the "composited" sediment remaining in the container to a sample container for return to the client.

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I. Final Dry Weight Determination

1. Determine final dry weights according to the SOP "Determination of Mass using the Sartorius Analytical Balance, Type R200D" (procedure number MTR-001).
2. **Make a record on the "Growth" bench sheet.**
   a. Record total weights and calculate final dry weights.

5.14. Daily Renewal, Observations and Water Quality… ~ Mornings ~ Days 29 through 42

A. On renewal days prepare fresh water for replenishing overlay water in the morning and evening. Make observations on mortalities, remove mortalities and record on bench sheets. Record water quality on bench sheets.

B. **Prepare Water for Renewal of Overlay Water**

1. If Overlay is **Synthetic Freshwater**, skip ahead to C.
2. If Overlay is **Receiving Water**…
3. Retrieve water from cold room (unless it has just arrived and is still in cooler).
   a. Retrieve enough for morning and evening renewals.
4. Warm water sample up to room temperature (~23°C).
5. Place water sample in bath at 23°C.
6. **Make a record on the "Sample Data" bench sheet.**
   a. Record sample ID.
   b. Measure initial water quality and record.
      1) Measure dissolved oxygen (DO), pH and conductance. These are measured with each days use.
      2) Measure total ammonia (TAN), alkalinity, hardness, total residual chlorine (TRC). These are only measured with the samples first use.
      3) Adjust DO if supersaturated by light aeration. Receiving waters should not have an oxygen demand. If DO is <4.0-mg/L, do not use and contact the laboratory manager immediately.
   c. Record the receiving waters expiration date (from the sample container).

C. Measure Water Quality of the Exposure Vessels

1. Retrieve one of the sediment sample sets from the water bath (a "set" is all of the replicates, "A" through "H" of a given sediment sample) and place them on a light table.
   a. Take measurements directly in each exposure vessel.
   b. **Make a record on the "Temperature" and "Dissolved Oxygen" bench sheets.**
      1) Measure and record Temperature and DO from one replicate.
      2) This is done daily for the duration of the test.
2. ***Important*** Be certain that all water quality parameters are within prescribed method specifications. If not, contact the laboratory manager.

D. **Renewal of the Overlay Water**

1. Assemble Head Box Assembly (HBA)
   a. Some syringes may not be used. Fit those with syringe plungers so that the syringe will not fill with water.
2. Wet screens of exposure vessels. This will prevent the exposure vessels from overflowing. Dry screens can prevent water from draining out of the exposure vessels due to surface tension.
3. Place the HBA over exposure vessels.
4. Calculate total volume of overlay water required to fill all of the exposure vessels present under HBA.

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5. Fill HBA with overlay water.
6. Repeat above process for remaining exposure vessels.
7. **Make a record on the "Renewals and Feedings" bench sheet**
   a. Record the overlays ID# on the bench sheet.

5.15. Daily Renewal, Observations and Water Quality… ~ Evenings ~ Days 29 through 42

A. Renewal of the Overlay Water

1. Assemble Head Box Assembly (HBA)
   a. Some syringes may not be used. Fit those with syringe plungers so that the syringe will not fill with water.
2. Wet screens of exposure vessels. This will prevent the exposure vessels from overflowing. Dry screens can prevent water from draining out of the exposure vessels due to surface tension.
3. Place the HBA over exposure vessels.
4. Calculate total volume of overlay water required to fill all of the exposure vessels present under HBA.
5. Fill HBA with overlay water.
6. Repeat above process for remaining exposure vessels.
7. **Make a record on the "Renewals and Feedings" bench sheet**
   a. Record the overlays ID# on the bench sheet.

B. Feeding Exposure Vessels

1. Test Vessels are fed 1-mL of F-CD after evening renewal. F-CD is a feed used for *Ceriodaphnia* cultures.
2. **Make a record on the "Renewals & Feedings" bench sheet**
   a. Record the Feed ID#.

5.16. Record Offspring Production Days 35 and 42

A. Remove Offspring from Test Vessels and Record

1. Retrieve one of the sediment sample sets from the water bath (a "set" is all of the replicates, "A" through "H" of a given sediment sample) and place them on a light table.
2. Transfer contents of vessel to a culture dish.
3. Replenish volume in test vessel with fresh water.
4. Transfer Adults back into test vessel.
5. Count offspring and record. Discard offspring.

5.17. Termination of Test Days 42

A. Tare Aluminum Weigh Pans

1. Number aluminum weigh pans. One pan per exposure vessel.
2. Tare pans according to the SOP "Determination of Mass using the Sartorius Analytical Balance, Type R200D" (procedure number MTR-001).
3. **Make a record on the "Growth" bench sheet.**
   a. Record pan number and tare weights.

B. Measure Water Quality

1. Retrieve one of the sediment sample sets from the water bath (a "set" is all of the replicates, "A" through "H" of a given sediment sample) and place them on a light table.

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a. Take measurements directly in each exposure vessel.
b. **Make a record on the "Temperature" and "Dissolved Oxygen" bench sheets.**
   1) Measure and record Temperature and DO from one replicate.
   2) This is done daily for the duration of the test.
c. **Make a record on the "pH", "Conductance", "Hardness", "Alkalinity" and "Ammonia" bench sheets.**
   1) Measure and record pH, Conductance, Hardness, Alkalinity and Ammonia from one replicate.
   2) This is done on day 0, day 28 and 42.

C. Remove Offspring from Test Vessels and Record

1. Transfer contents of vessel to a culture dish.
2. Count offspring and record. Discard offspring.

D. Determine Sex of Adults and Final Dry Weights

1. Determine the sex of the surviving amphipods and record.
2. Using forceps or transfer pipette remove all of the amphipods from the dish and transfer to the appropriate weigh pan.
3. **Make a record on the "Survivorship" bench sheet.**
4. Record number of living Amphipods recovered and their sex.
5. **Make a record on the "Growth" bench sheet.**
   a. Record number of specimens transferred to the weigh pan.

E. Repeat 5.17.B and 5.17.D for remaining sets.

F. Final Dry Weight Determination

1. Determine final dry weights according to the SOP "Determination of Mass using the Sartorius Analytical Balance, Type R200D" (procedure number MTR-001).
2. **Make a record on the "Growth" bench sheet.**
   a. Record total weights and calculate final dry weights.

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6.0 Quick Summary

6.1. No summary currently prepared.

7.0 Acceptability of Data

7.1. Minimum mean **control survival 80% at 28 days**.

8.0 General References

8.1. Methods for Measuring the Toxicity and Bioaccumulation of Sediment-associated Contaminants with Freshwater Invertebrates, Second Edition (EPA 600/R-99/064, March 2000)

8.2. Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, Fifth Edition, (EPA-821-R-02-012, October 2002)

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9.0 Signatures

9.1. Signature, Title of the Approving Authority and Implementation Date.

A. _____ _____ ___/___/___.

9.2. Each person conducting the SOP should read the following statement. Print and sign if you agree.

"I have read and understand this Standard Operating Procedures as it relates to my job responsibilities. I further understand that the Standard Operating Procedures are an integral part of Hydrosphere Research's operations. I agree to follow all procedures outlined in the Standard Operating Procedures."

9.3. Printed **Name**, **Signature**, **Date and Training ETW** of persons conducting this procedure:

A. _____ _____ ___/___/___ _____·ETW

B. _____ _____ ___/___/___ _____·ETW

C. _____ _____ ___/___/___ _____·ETW

D. _____ _____ ___/___/___ _____·ETW

E. _____ _____ ___/___/___ _____·ETW

F. _____ _____ ___/___/___ _____·ETW

G. _____ _____ ___/___/___ _____·ETW

H. _____ _____ ___/___/___ _____·ETW

I. _____ _____ ___/___/___ _____·ETW

J. _____ _____ ___/___/___ _____·ETW

K. _____ _____ ___/___/___ _____·ETW

L. _____ _____ ___/___/___ _____·ETW

9.4. Annual Review (signature and date)

A. _____ ___/___/___.

B. _____ ___/___/___.

C. _____ ___/___/___.

D. _____ ___/___/___.

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E. _____ ___/___/___.

10.0 SOP Postings and Revisions

10.1. Postings

A. Laboratory Posted Location(s) of SOP's.

1. _____
2. _____
3. _____

10.2. Revision Checklist

- ☐ Retrieve and Dispose of Posted Copies. Initial _____
- ☐ Create New Revised SOP Initial _____
- ☐ Train Personnel on "new" SOP Initial _____
- ☐ File Electronic Version of Retired SOP Initial _____
- ☐ File Paper Version of Retired SOP Initial _____

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11.0 Examples of Relevant Datasheets or Documents

11.1. None are currently included.

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1.0 Introduction/Objective

1.1. The objective of this procedure is to conduct chronic toxicity tests for use in the National Pollutant Discharge Elimination System (NPDES) Permits Program to identify effluents and receiving waters containing toxic materials in chronically toxic concentrations. [8.1-section 1.1]
1.2. The data are used for NPDES permits development and to determine compliance with permit toxicity limits. [8.1-section 1.2]
1.3. This SOP describes the procedures used to estimate the chronic toxicity of effluents and receiving waters (saltwater aqueous samples) to the mysid shrimp, *Mysidopsis bahia*, using shrimp in a 7-day chronic static renewal exposure.

2.0 Apparatus/Equipment/SOP

2.1. Job Folder

A. Benchsheets (specific examples given in section 11)
   1. Generic benchseets can be found on the server at F:\Benchsheets, Logs & Forms
   2. Client specific benchsheets can be found on the server at F:\Clients\AAA-AA\Bench

2.2. Laboratory Books, Book ID Number

A. Procedure: Standard Operating (SOP)	PRC-001
B. Logbook: Test Organism Receipt and Acclimation	LGB-015
1. Test Organism Acclimation Log page	11.1.B
C. Logbook: Meter & Equipment Calibration – Volume 1	LGB-009
D. Logbook: Total Residual Chlorine	LGB-016

2.3. Standard Operating Procedures (SOP's), SOP ID Number

A. *Artemia* Hatching and Feeding	PRO-002
B. Sample Kit Preparation	PRO-008
C. Test Organism Receipt & Acclimation	PRO-010
D. Thermometer, IR	MTR-011
E. Sample Receiving	PRO-009
F. Dissolved Oxygen Meter	MTR-004
G. pH Meter,	MTR-007, 015, 017
H. Conductance Meter	MTR-016
I. Total Residual Chlorine	MTR-010
J. Hardness and Alkalinity	MTR-014
K. Randomization	PRO-036

2.4. Equipment

A. Environmental Chamber (waterbath)
   1. Photoperiod set at 16h light and 8h dark
   2. Set temperature at 26±1 °C (as measured in a test dummy vessel)
B. Work Station
   1. Light Table
   2. Dissolved Oxygen Meter (calibrated)
   3. pH Meter (calibrated)
   4. Conductance Meter (calibrated)
   5. Refractometer (calibrated)

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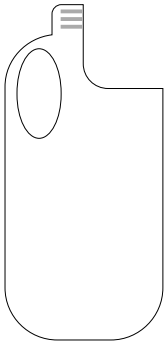
6. DI water wash bottle
7. Siphon Hose
   a. Glass tube, 3/8”
      1) Fitted with a length of silicone tubing, 3/8”
8. 5-gallon bucket for waste water

C. Coldroom or refrigerator maintained at 0 to 4°C
D. Plastic Bin, 10-L
E. Solo Cup, Plastic, 16-ounce (DM16)
F. Sharpie Permanent Marker
G. Graduated Cylinder, 100-mL
H. Graduated Cylinder, 1-L
I. Graduated Cylinder, 2-L
J. Container for Dilution Preparation
   1. Strong scissors
   2. ½ - gallon plastic bottles cut like so……



K. Glass Stirring Rod
L. Stir Bar
M. Magnetic Stirring Plate
N. Thermometer
O. Weigh Boats, 100-mL
P. 10-mL glass pipette
   1. fitted with a length (~2’) of airline tubing
Q. Transfer Pipette
R. Weigh Pans
   1. Aluminum Foil Weigh Pans
      a. Standard Aluminum Foil (NOT heavy duty!!!)
      b. Guillotine Paper Trimmer
      c. Scoring Board, ½ inch squares (made at Hydrosphere from tile board and table saw)
      d. Wooden press and dowel.
   2. 20-mL Aluminum Crinkle Dishes with Tabs (VWR Cat. No. 25433-052)
   3. Aluminum Cake Pans (local)
S. 240-µm sieve
T. forceps

3.0 Organisms/Reagents/Solutions

3.1. Mysid Shrimp, *Mysidopsis bahia.* 7-day old.
   A. **Source:** In-house cultures
   B. **Source:** Indicators, St. Augustine FL (904-829-2780)
   C. **Source:** Aquatic Biosystems, Ft. Collins, CO (970-484-5091)
3.2. Synthetic Saltwater (SSW) at test salinity
3.3. Reagent Grade Water, Type I (minimum resistivity of 0.06 µS/cm)
3.4. Deionized Water or Reagent Grade Water, Type III (minimum resistivity of 1 µS/cm)
3.5. *Artemia* Nauplii, <24-hour old.
3.6. Tropic Marin Synthetic Seasalts.

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4.0 Personal Protection Equipment

4.1. No hazardous chemicals are used for the method, therefore; only standard laboratory safety procedures are practiced.

5.0 Procedure — Test Day

5.1. Components of Chronic Toxicity Tests

A. Duration
   1. Tests are conducted for 7-days.

B. Water Flow
   1. Static: test organisms are exposed to one volume of solution in a test vessel.
   2. Flow-through: test organisms are exposed to multiple volumes of solution in a test vessel. The solution may be pumped through the test vessel in a continuous flow or dumped into the vessel in cycles. (Note: this SOP does not give guidance for this test type)

C. Solutions Renewal
   1. Daily Renewal

D. Test Concentrations
   1. Screening: test is conducted with one test concentration, typically 100% and a control (job order may require some other single test concentration such as 33%)
   2. Definitive: this is a test conducted with a series of dilutions of the sample. A typical series is a 0.5-dilution such as 100%, 50%, 25%, 12.5%, 6.25% and a control. But other dilutions might be substituted per the job order.

E. The following are two (and there are more) Laboratory Abbreviations used to indicate the above components as used in the Job Order & other places:
   1. 7CSRD is a 7-day Acute, Static, Daily Renewal, Definitive toxicity test
   2. 7CSNS is a 7-day Acute, Static, Daily Renewal, Screening toxicity test

5.2. Review Job Folders — Daily

A. Job Folders are located in the Testing Bay, south wall counter, in the stacking trays.
B. When a client calls in to schedule a test event, a Job Folder is created.
C. Review all Job Folders in trays daily. The trays are identified, from top to bottom, as follows:
   1. Kits to be shipped (Job Folders)
   2. NO test date (Job Folders)
   3. Greater than two weeks (Job Folders)
   4. Next Week (Job Folders)
   5. This Week (Job Folders)
   6. Currently Test (Job Folders)
   7. Sample Receiving (Logbook)
   8. Chain-of-Custody (Logbook)

D. Perform tasks needed and return Job Folder to appropriate section of the stack.
   1. Pay particular attention to the "Notes" section. This will contain any special tasks.
   2. *If there are any questions, immediately contact the Lab Manager or Director.*

5.3. Sample Kits — ~ 2-weeks before test

A. The Job Folder has a "Ship Kits by" section.
B. Send sample kits at least 2-weeks ahead of scheduled test date.
C. Follow the instructions in the SOP: Sample Kit Preparation, PRO-008.

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5.4. Selection and Acclimation of Mysid Shrimp **Days -7 to 0**

A. Calculate the number of shrimp needed for the test.
   1. shrimp/replicates x replicates/dilution x dilutions/sample x samples/test = shrimp/test
   2. example: 5 x 8 x 6 x 1 = 240 shrimp for a one sample definitive test

B. Determine the sample's salinity. This test method can be conducted with samples having salinities 20 to 30‰. In-house shrimp are cultured at 20‰.

C. In-House Mysid Cultures

1. Coordinate with the aquaculture manager about a week in advance and select a batch of mysid shrimp that will be 7-days old on the day the test is to be initiated.
2. Make a record of the batch in the logbook LGB-015, Test Organism Receipt and Acclimation on the Test Organism Receipt Log.
3. Making a record of the acclimation process in the logbook LGB-015, Test Organism Receipt and Acclimation on a Test Organism Acclimation Log page for mysid shrimp. Make daily records of the activities outline in the log.
4. Label bin with batch identification information.
5. Shrimp are cultured at room temperature so once a batch of shrimp has been designated for a test, move the bin to a bath at 25°C for the duration of the acclimation period.

D. Purchased Mysids form Vendor

1. Call a vendor and order mysids a week or more in advance. Section 3.1 above lists vendors.
2. Arrange to have shrimp shipped a few days in advance of the test initiation date in order to acclimate the shrimp to the lab environment and to adjust salinity if needed.
3. Log in mysids from vendor using SOP PRO-010. Make a record of the batch in the logbook LGB-015, Test Organism Receipt and Acclimation on the Test Organism Receipt Log.
4. Making a record of the acclimation process in the logbook LGB-015, Test Organism Receipt and Acclimation on a Test Organism Acclimation Log page for mysid shrimp. Make daily records of the activities outline in the log.
5. Label bin with batch identification information.
6. Move the bin to a bath at 25°C for the duration of the acclimation period.

E. Salinity adjustments

1. Adjust salinity by no more than 3‰ per water change following the SOP PRO-010. Adjust salinity no more than twice daily, in the morning and in the evening making certain that adjustments are no closer than 6 hours apart.
2. It should be noted that section 6.5.1 of the document listed in 8.1 below states "Test organisms should not be subjected to changes of more than 3°C in water temperature or 3‰ in salinity in any 12 h period." 6 hours is adequate using the procedure outlined in PRO-010.
3. Adjustments that span the entire range from 20 to 30‰ will take 2 days to complete.
   a. Example: 20↑23‰ Mon AM, 23↑26‰ Mon PM, 26↑29‰ Tue AM, 29‰→test

F. Once shrimp have been acclimated they are ready to be loaded into the test.

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5.5. Prepare Labware and Benchsheets for use in testing — Day -1

A. Test Vessels

1. The test vessels are …
   a. 16-ounce, ≈ 500-mL; plastic Solo cups.
   b. These are located in a labeled cabinet drawer on the east wall of the Testing Bay (or there are cases on the loft on the south side of the Testing Bay).
2. Use a permanent marker (sharpie) and label cups. Be sure to include the following:
   a. Job Number (ie: AAA-AA 07001)
   b. Sample Designation (ie: A, B, C, etc…)
   c. Test Dilution (ie: 0, 6.25%, 12.5%, etc…)
   d. Use green for the "Control". Use Black or Blue for the Sample, Use Red for SRT's.
   e. Mark cups at 200-mLs.

B. Labware

1. ½ - gallon plastic sample bottles with tops cup off (handles left on).
   a. Label bottles with Job Number and dilution designation using a sharpie pen.
2. Graduated Cylinders, 100-mL, 1-L, 2-L.
   a. Label Cylinder with Job Number.

C. **Prepare Benchsheets**

1. Obtain benchsheets from Job Folder and fill in pretest data (ie: job number, dates)
2. Benchsheets and their loction on the server are given in section 11 below.

5.6. Calibration of Meters and Standardizing Methods — Day 0

A. The following are Meters or Analytical Methods and their SOP's required for this procedure:

1.	Dissolved Oxygen Meter	MTR-004
2.	pH Meter	MTR-007, 015, 017
3.	Conductance Meter	MTR-016
4.	Refractometer	(to be written)
5.	Total Residual Chlorine	MTR-010
6.	Hardness & Alkalinity	MTR-014

B. Each of the above must be calibrated before each day's use. Calibrate using the above SOP's and record in the following Laboratory Books:

1. Meter & Equipment Calibration – Volume 1, LGB-009.
   a. For dissolved oxygen, pH, conductance and salinity.
2. Total Residual Chlorine, LGB-016

5.7. Initiating Test — Day 0

A. Prepare Sample for use in Test

1. Obtain sample for use in test. On the day of test initiation there are two possible sample locations:
   a. The samples have been stored in the coldroom.
   b. The samples are arriving that day.
   c. In either case, be sure that the samples have already been processed according to the SOP: Sample Receiving, PRO-009.
2. How much sample is required?
   a. Check the Job Order for the test details.

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b. Use the charts on the corkboard to the left of the coldroom over the sample receiving counter to determine how many bottles will be required.

3. Double-check sample holding times.
4. Warm the sample to 25°C in the sink on the east wall of the Testing Bay.
5. Place warmed sample in a bath at 25°C until needed.

B. Measure the Initial Sample Water Quality

1. This includes Dissolved Oxygen, pH, Conductance, Salinity, Total Residual Chlorine, Alkalinity and Hardness.
2. Record on the "Sample Data" benchsheet.
3. Be very conscious of the samples water quality. Some of the following are excerpts from the Meter SOP's.

a. Dissolved Oxygen can be too high and too low

1) **Case 1:** When a sample first arrives at the lab on ice or is pulled from the cold room there is the possibility that oxygen could have diffused into the sample during storage since oxygen is more soluble in water at cooler temperatures. When the samples are warmed up to testing temperature a condition called super-saturation will occur were there is more oxygen in the sample than normal. This is typically not a problem for most species. However, some water fleas can float as a result of oxygen bubbles forming under their carapaces casing mortality. To correct this the sample is aerated at ~500-mLs per minute, checking the sample's DO at 5-minute intervals until it is below 100% (Section 9.1.7 and 9.1.8, page 41 of reference 8.1 below).
2) **Case 2:** When a sample first arrives at the lab or is pulled from the cold room, the DO may be near or below 4.0-mg/L. This can be caused by chemical or biological oxygen demand in the sample. To correct this, the sample is aerated at ~500-mLs per minute, checking the sample's DO at 5-minute intervals until it is above 4.0-mg/L. **Caution:** Watch the samples DO in the test for a few hours to be sure that the DO level does not drop (Section 9.1.7 and 9.1.8, page 41 of reference 8.1 below).
3) **Case 3:** Samples that are already in a test are aerated if the DO levels are ***approaching*** 4.0-mg/L. The sample may arrive with a DO in the acceptable range and then have the DO fall off in the test. If the DO is already below 4.0-mg/L then the test may be rendered invalid. In the former situation all test vessels associated with that sample, including the control, are aerated at ~100-bubbles per minute using a 1-mL pipette (Section 9.14.2, page 50 of reference 8.1 below).

b. Watch out for pH values above 9 and below 6

1) "Mortality due to pH alone may occur if the pH of the sample falls outside the range of 6.0-9.0. Thus, the presence of other forms of toxicity (metals and organics) in the sample may be masked by the toxic effects of low or high pH. The question about the presence of other toxicants can be answered only by performing two parallel tests, one with an adjusted pH, and one without an adjusted pH. Freshwater samples are adjusted to pH 7.0, and marine samples are adjusted to pH 8.0, by adding 1N NaOH or 1N HCl dropwise, as required, being careful to avoid over adjustment." (Reference 8.1, section 9.1.9, page 41)

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c. Watch out for High Conductance samples
   1) Samples above a conductivity of 2,000-µmho/cm at 25°C may require using estuarine test species such as *Mysidopsis bahia* or *Menidia beryllina*. Check the Job Order, the clients permit or with the lab manager.

4. Measure the samples Total Residual Chlorine (TRC) and record on the "Sample Data" benchsheet.
   a. Samples with TRC >1-ppm should be split into two samples, an unaltered sample and a dechlorinated sample, and tested separately. In addition a "dechlorinated" control must be conducted. Only a 100% dechlorinated sample need be conducted.

5. Measure the samples Hardness and Alkalinity using the test strips and record on the Sample Data Sheet.

C. Adjustments to Sample Salinity
1. Check the Job Order for a target salinity.
2. Adjust sample salinity using Tropic Marin Synthetic Seasalts.
3. The mass of salts needed are calculated as follows:
   a. To add 0 to 10‰ to a sample…
      1) Desired salinity (‰) x Sample Volume (L) x 1.1 = Mass of Seasalts (grams)
   b. To add 11 to 20‰ to a sample…
      1) Desired salinity (‰) x Sample Volume (L) x 1.2 = Mass of Seasalts (grams)
   c. To add 21 to 30‰ to a sample…
      1) Desired salinity (‰) x Sample Volume (L) x 1.3 = Mass of Seasalts (grams)
4. Mix the sample thoroughly using a glass stirring rod or a magnetic stir plate.
5. Check salinity. Make further adjustments if necessary.

D. Prepare Solutions of Sample
1. Prepared samples are distributed into bottles or vessels as dilutions of that sample or simply as 100% sample can be referred to as Solutions.
2. For Definitive Tests do the following:
   a. Prepare 1,600-mLs of each test solution.
      1) Measure the appropriate volume of sample into a 2-L graduated cylinder.
      2) Top off the graduated cylinder with SSW.
      3) Transfer contents of cylinder to marked bottle.
   b. Repeat for each test solution.
   c. Add 1,600-mLs of SSW to bottle marked "Control".
3. For Screening Tests do the following:
   a. Prepare 1,600-mLs of the test solution.
      1) Test concentration other than 100%.
         a) Measure the appropriate volume of sample into a 2-L graduated cylinder.
         b) Top off the graduated cylinder with SSW.
         c) Transfer contents of cylinder to marked bottle.
      2) Test concentration is 100%.
         a) Measure 1,600-mLs of sample directly into marked bottle.
   b. Add 1,600-mLs of SSW to bottle marked "Control".
4. Measure the water quality (dissolved oxygen, pH and salinity) of each test solution and record on "Water Quality" benchsheet in the 0-hour column. Temperature is not recorded at 0-hours.
5. Pour 200-mLs of the prepared test solutions into the appropriate cup.

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a. Each test solution is to be distributed 8 test replicate vessels.
6. Rinse bottles and graduated cylinders with deionized water and place upside-down on a paper towel (on counter or cart) subsequent daily.
7. Place Test vessels in bath at 26°C.

E. Adding Organisms to Test Vessels
1. Check temperature of test solutions. If the temperature is 26±1°C then the test is ready to have *M. bahia* added to it.
2. Retrieve the test vessels and the larvae from the bath and place them on a light table.
3. **Important:** do not leave the test solution or bin of larvae unattended. Load the test immediately. Some light tables generate heat and the solutions can get overheated if left unattended.
4. Distribute weigh boats (one for each test vessel) onto light table.
5. Transfer 5-shrimp to each weigh boat by mouth pipetting using a 10-mL pipette fitted with a length of airline tubing. Minimize the amount of culture water you are adding to the weigh boat. There should be just enough for the shrimp to swim around.
6. Wash the shrimp from the boats into the test vessels.
7. Return test vessels to bath at 26°C.
   a. Randomize Cups using SOP PRO-036.
8. Record technician's initials and time of test initiation (the time test was completely stocked with shrimp).
9. Record Randomization Template number.

5.8. Standard Reference Toxicant (SRT) Tests

A. SRT's shall be conducted concurrently or no greater than 30-days before the date of "routine" test. (FDEP permits)
B. Check the status of the SRT for this method.
C. If this species does not have a SRT that was initiated within the prior 30-day period then one needs to be conducted concurrently with the current test event.

5.9. Feeding Test — Day 0 to Day 7

1. Feed test vessels daily 1drop of a <24-hour old *Artemia* concentrated slurry in the morning and again in the evening. (see PRO-002 for preparation procedures for feeding a mysid chronic test).

5.10. Monitoring Test — Day 1 to Day 7

A. Prepare Solutions of Sample
1. Obtain sample for use in test from the Coldroom.
2. How much sample is required?
   a. Check the Job Order for the test details.
   b. Use the charts on the corkboard to the left of the coldroom over the sample receiving counter to determine how many bottles will be required.
3. Warm the sample to 26°C in the sink on the east wall of the Testing Bay.
4. Place warmed sample in a bath at 26°C until needed.

B. Measure the Initial Sample Water Quality
1. This includes Dissolved Oxygen, pH, Conductance and Salinity.
2. Record on the "Sample Data" benchsheet.
3. Make any necessary adjustments to the sample.

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C. Adjustments to Sample Salinity

1. Check the Job Order for a target salinity.
2. Adjust sample salinity using Tropic Marin Synthetic Seasalts.
3. The mass of salts needed are calculated as follows:
   a. To add 0 to 10‰ to a sample…
      1) Desired salinity (‰) x Sample Volume (L) x 1.1 = Mass of Seasalts (grams)
   b. To add 11 to 20‰ to a sample…
      1) Desired salinity (‰) x Sample Volume (L) x 1.2 = Mass of Seasalts (grams)
   c. To add 21 to 30‰ to a sample…
      1) Desired salinity (‰) x Sample Volume (L) x 1.3 = Mass of Seasalts (grams)
4. Mix the sample thoroughly using a glass stirring rod or a magnetic stir plate.
5. Check salinity. Make further adjustments if necessary.

D. Prepare Solutions of Sample

1. Prepared samples are distributed into bottles or vessels as dilutions of that sample or simply as 100% sample can be referred to as Solutions.
2. For Definitive Tests do the following:
   a. Prepare 1,600-mLs of each test solution.
      1) Measure the appropriate volume of sample into a 2-L graduated cylinder.
      2) Top off the graduated cylinder with SSW.
      3) Transfer contents of cylinder to marked bottle.
   b. Repeat for each test solution.
   c. Add 1,600-mLs of SSW to bottle marked “Control”.
3. For Screening Tests do the following:
   a. Prepare 1,600-mLs of the test solution.
      1) Test concentration other than 100%.
         a) Measure the appropriate volume of sample into a 2-L graduated cylinder.
         b) Top off the graduated cylinder with SSW.
         c) Transfer contents of cylinder to marked bottle.
      2) Test concentration is 100%.
         a) Measure 1,600-mLs of sample directly into marked bottle.
   b. Add 1,600-mLs of SSW to bottle marked “Control”.
4. Measure the water quality of each test solution and record on benchsheets in the “new” blocks on the appropriate day.
5. Place bottles in bath at 26°C.
6. Check temperature of test solutions. If the temperature is 26±1°C then the test is ready to be renewed.

E. Renew of Test Solutions

1. Retrieve the Test Vessel from bath and place on light table.
2. All measurements are to be taken directly from the Test Vessel.
3. Counts, measurements and the meter’s ID number are recorded on the benchsheet.
4. Measure test solution temperatures immediately before they have a chance to cool.
5. Count the number of surviving shrimp.
6. Measure DO, pH and salinity of the “old” solutions in the Test Vessel using calibrated meters.
7. Use a transfer pipette to remove any uneaten *Artemia* or debris from the bottom of the test vessel.
8. Using a siphon hose carefully draw down the test solution in each of the test vessels. Use the clamp on the hose to control the draining rate.

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9. Recount the number of shrimp present.
10. If any are lost or injured, make a record on the benchsheet by footnoting it in the "Notes & Comments" section.
11. Retrieve the bottles containing the test solutions which are in the bath at 26°C.
12. Carefully pour the appropriate test solution into each test vessel up to the 200-mL mark.
13. Initial and record the time these observations and measurements were taken.
14. Return Test Vessel to bath at 26°C.
15. Rinse bottles and graduated cylinders with deionized water and place upside-down on a paper towel (on counter or cart) subsequent daily.

5.11. Tare Aluminum Weigh Pans **Day 6 or the morning of day 7**

A. Make aluminum foil weigh pans
   1. Lay a section of aluminum foil over scoring board and rub foil with hand to mark the foil.
   2. Use paper trimmer, cut foil into ½" squares.
   3. Center foil square on wooden press and use dowel to form a pan.
   4. Foil pans should weigh no more than ~0.01 grams.
   5. Number pans using a sharpie pen.
   6. Label crinkle dishes with the sample dilution and place the foil pans inside the crinkle dish.
   7. Place the crinkle dish in an aluminum cake pan.

B. Tare pans according to the SOP "Determination of Mass using the Sartorius Analytical Balance, Type R200D" (procedure number MTR-001).

C. Make a record on the bench sheet.
   1. Record pan number and tare weights.

5.12. Terminating Test on Day 7 **Day 7**

A. Retrieve the test vessel from bath and place them on a light table.
B. All measurements are to be taken directly from the Test Vessel.
C. Counts, measurements and the meter's ID number are recorded on the benchsheet.
D. Measure test solution temperature immediately before it has a chance to cool.
E. Count the number of surviving shrimp.
   1. Pour shrimp into a small sieve (240-µm). Rinses specimens with DI water. Transfer specimens to marked aluminum foil weigh pans using forceps.
F. Measure DO, pH and salinity using calibrated meters.
G. Initial and record the time these observations and measurements were taken.
H. Record test termination date.

5.13. Final Dry Weight Determination **Day 8**

1. Determine final dry weights according to the SOP "Determination of Mass using the Sartorius Analytical Balance, Type R200D" (procedure number MTR-001).
2. Make a record on the "Growth" bench sheet.

B. Record total weights and calculate final dry weights.

5.14. Place completed benchsheets in the Job Folder

A. The completed Folder goes in the tray marked "Fax Test Results" which is on the wall next to the reception desk.

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6.0 Quick Summary

6.1. No summary currently prepared.

7.0 Acceptability of Data

7.1. 80% or greater survival in the controls. Growth in the controls of ≥0.20-mg/surviving shrimp.

8.0 General References

8.1. Methods for Measuring the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms, Third Edition, October 2002, EPA-821-R-02-014
8.2. Handbook for Analytical Quality Control in Water and Wastewater Laboratories, March 1979, EPA-600/4-79-019

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9.0 Signatures

9.1. Signature, Title of the Approving Authority and Implementation Date.

A. _____ _____ ___/___/___.

9.2. Each person conducting the SOP should read the following statement. Print and sign if you agree.

"I have read and understand this Standard Operating Procedures as it relates to my job responsibilities. I further understand that the Standard Operating Procedures are an integral part of Hydrosphere Research's operations. I agree to follow all procedures outlined in the Standard Operating Procedures."

9.3. Printed **Name**, **Signature**, **Date and Training ETW** of persons conducting this procedure:

A. _____ _____ ___/___/___ _____·ETW

B. _____ _____ ___/___/___ _____·ETW

C. _____ _____ ___/___/___ _____·ETW

D. _____ _____ ___/___/___ _____·ETW

E. _____ _____ ___/___/___ _____·ETW

F. _____ _____ ___/___/___ _____·ETW

G. _____ _____ ___/___/___ _____·ETW

H. _____ _____ ___/___/___ _____·ETW

I. _____ _____ ___/___/___ _____·ETW

J. _____ _____ ___/___/___ _____·ETW

K. _____ _____ ___/___/___ _____·ETW

L. _____ _____ ___/___/___ _____·ETW

9.4. Annual Review (signature and date)

A. _____ ___/___/___.

B. _____ ___/___/___.

C. _____ ___/___/___.

D. _____ ___/___/___.

E. _____ ___/___/___.

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10.0 SOP Postings and Revisions

10.1. Postings

A. Laboratory Posted Location(s) of SOP's.

1. _____

2. _____

3. _____

10.2. Revision Checklist

- ☐ Retrieve and Dispose of Posted Copies. Initial _____
- ☐ Create New Revised SOP Initial _____
- ☐ Train Personnel on "new" SOP Initial _____
- ☐ File Electronic Version of Retired SOP Initial _____
- ☐ File Paper Version of Retired SOP Initial _____

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11.0 Examples of Relevant Datasheets or Documents

11.1. Logbook Page

A. Test Organism Acclimation Log
B. File location is F:\Benchsheets, Logs & Forms\Logs \LGB-015, Test Organism R-A Logbook\LGB-015.TOA.MS.xlsx

HYDROSPHERE research

Test Organism Acclimation

Client: | Species: *Mysidopsis bahia*
Test Date: | Code: MS | ID #:
Expected Salinity (‰): | # Needed: | Age at Test Initiation: | Test Salinity Range: ‰

Acclimate the Shrimp to…

30‰

Actual Salinity Adjustments							
Date	Day of Week	AM/PM	Salinity Adjustment (‰)	Salinity Change	Feeding (✓)	Initials	Time
/ /				arrival	☐		
/ /			↓↑		☐		
/ /			↓↑		☐		
/ /			↓↑		☐		
/ /			↓↑		☐		
/ /			↓↑		☐		
/ /			↓↑		☐		
/ /			↓↑		☐		

Notes & Comments

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11.2. Bench Sheet Page

A. Sample Data
B. File location is F:\Benchsheets, Logs & Forms\ Sample.Data.v3.xlsx

HYDROSPHERE research

Client:
Code: Job:

Sample Data

Sample Info				Dissolved Oxygen (D.O.)						Total Residual Chlorine ②			Ammonia				Conductivity			Salinity				Alkalinity/Hardness		
#	Date M/D/Y	Day	Letter Code	Description	D.O. (mg/L)	D.O. (%)	Aeration ① (min.)	Post Aeration D.O. (mg/L)	Meter #	Initials	TRC (mg/L)	Meter #	Initials	T-NH$_3$ (mg/L)	pH	Meter #	Initials	Conductivity (mS/cm)	Meter #	Initials	Salinity (ppt)	Adjusted (ppt)	Meter #	Initials	Alkalinity (mgCaCO$_3$/L)	Hardness (mgCaCO$_3$/L)	Initials
1	/ /																										
2	/ /																										
3	/ /																										
4	/ /																										
5	/ /																										
6	/ /																										
7	/ /																										
8	/ /																										
9	/ /																										
10	/ /																										
11	/ /																										
12	/ /																										
13	/ /																										
14	/ /																										
15	/ /																										
16	/ /																										

Notes & Comments
① Aeration rate is 500-mL/s/min (EPA-821-R-02-012, Section 9.1.8, page 41).
② If sample is to be dechlorinated then use 1-mL Effluent Dechlorinator (8-g/L NaThio) per 1-L Effluent Sample per 1-ppm TRC (EPA-821-R-02-012, Section 9.1.6, pg 41).

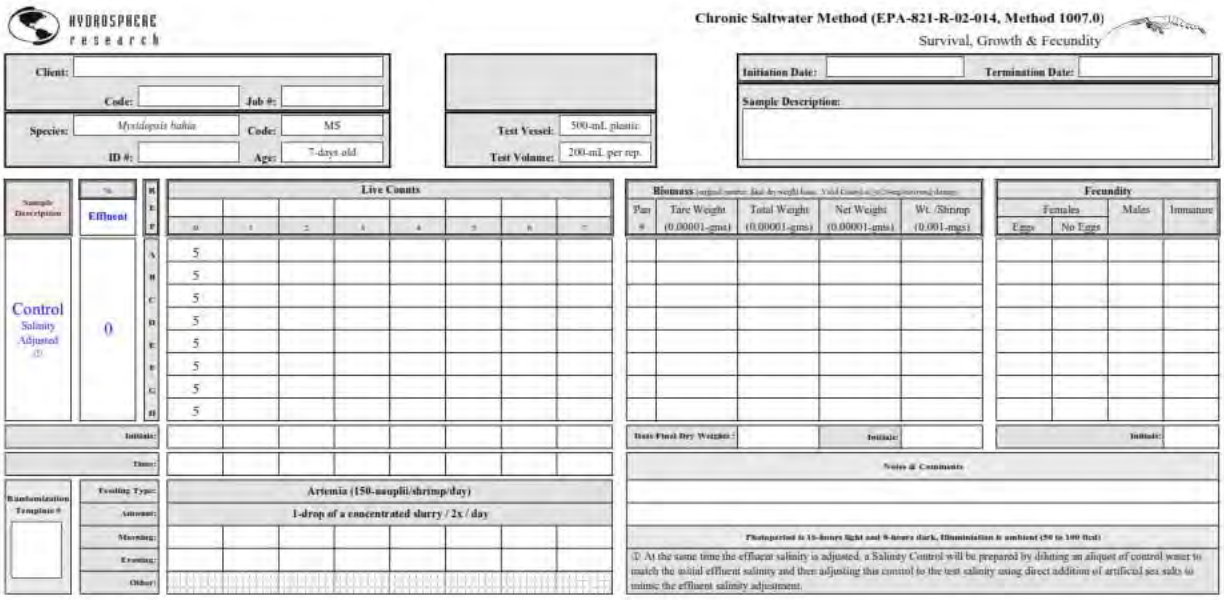
Dilution Waters		Alkalinity/Hardness		
Code	ID #	Alkalinity (mgCaCO$_3$/L)	Hardness (mgCaCO$_3$/L)	Initials

Version 3 (12040-DCF) F:\Benchsheets, Logs & Forms\Sample.Data.v3.xlsx

DO NOT USE THIS SOP IN PRINTED FORM WITHOUT FIRST CHECKING IT AS THE LATEST VERSION

11.3. Bench Sheet Page

A. Survival, Growth & Fecundity
B. File location is F:\Benchsheets, Logs & Forms\2) CHRONIC\ MS.07.CSRD.Surv1.EPA1007.v1.xlsx



HYDROSPHERE research

Chronic Saltwater Method (EPA-821-R-02-014, Method 1007.0)
Survival, Growth & Fecundity

Client: | Code: | Job #:
Species: *Mysidopsis bahia* | Code: MS | ID #: | Age: 7-days old
Test Vessel: 500-mL plastic | Test Volume: 200-mL per rep.
Initiation Date: | Termination Date:
Sample Description:

Sample Description	% Effluent	Rep	Live Counts A	B	C	D	E	F	G	H	Biomass Pan #	Tare Weight (0.00001-gms)	Total Weight (0.00001-gms)	Net Weight (0.00001-gms)	Wt. /Shrimp (0.001-mgs)	Fecundity Females: Eggs	Females: No Eggs	Males	Immature
Control Salinity Adjusted ①	0	A	5																
		B	5																
		C	5																
		D	5																
		E	5																
		F	5																
		G	5																
		H	5																
Initials:											Dish Final Dry Weights:		Initials:			Initials:			
Time:																			

Randomization Template #:
Feeding Type: Artemia (150-nauplii/shrimp/day)
Amount: 1-drop of a concentrated slurry / 2x / day
Morning:
Evening:
Other:

Notes & Comments

Photoperiod is 16-hours light and 8-hours dark, Illumination is ambient (50 to 100 fcd)

① At the same time the effluent salinity is adjusted, a Salinity Control will be prepared by diluting an aliquot of control water to match the initial effluent salinity and then adjusting this control to the test salinity using direct addition of artificial sea salts to mimic the effluent salinity adjustment.

Version 1 | (2013 DCF)

F:\Benchsheets, Logs & Forms\2) CHRONIC\ MS.07.CSRD.Surv1.EPA1007.v1.xlsx

DO NOT USE THIS SOP IN PRINTED FORM WITHOUT FIRST CHECKING IT AS THE LATEST VERSION

11.4. Bench Sheet Page

A. Survival, Growth & Fecundity

B. File location is F:\Benchsheets, Logs & Forms\2) CHRONIC\ MS.07.CSRD.Surv1.EPA1007.v1.xlsx

HYDROSPHERE research

Chronic Saltwater Method (EPA-821-R-02-014, Method 1007.0)
Survival, Growth & Fecundity

Client: | Code: | Job #:
Species: *Mysidopsis bahia* | Code: MS | ID #: | Age: 7-days old
Test Vessel: 500-mL plastic | Test Volume: 200-mL per rep
Initiation Date: | Termination Date:
Sample Description:

Sample Description	% Effluent	Rep	Live Counts (Day 0)	Live Counts (Day 1)	Live Counts (Day 2)	Live Counts (Day 3)	Live Counts (Day 4)	Live Counts (Day 5)	Live Counts (Day 6)	Live Counts (Day 7)	Biomass Pan #	Tare Weight (0.00001-gms)	Total Weight (0.00001-gms)	Net Weight (0.00001-gms)	Wt. /Shrimp (0.001-mgs)	Fecundity Females Eggs	Fecundity Females No Eggs	Fecundity Males	Fecundity Immature
Control	0	A	5																
		B	5																
		C	5																
		D	5																
		E	5																
		F	5																
		G	5																
		H	5																
Effluent	6.25	A	5																
		B	5																
		C	5																
		D	5																
		E	5																
		F	5																
		G	5																
		H	5																
	12.5	A	5																
		B	5																
		C	5																
		D	5																
		E	5																
		F	5																
		G	5																
		H	5																
Initials:											Date Final Dry Weights:		Initials:			Initials:			
Time:											Notes & Comments								
Bombesination Template #		Feeding Type:	Artemia (150-nauplii/shrimp/day)																
		Amount:	1-drop of a concentrated slurry / 2x / day																
		Morning:																	
		Evening:																	
		Other:									Photoperiod is 16-hours light and 8-hours dark. Illumination is ambient (50 to 100 lux)								

DO NOT USE THIS SOP IN PRINTED FORM WITHOUT FIRST CHECKING IT AS THE LATEST VERSION

11.5. Bench Sheet Page

A. Water Quality I
B. File location is F:\Benchsheets, Logs & Forms\2) CHRONIC\MS.07.CSRD.WQ1.EPA1007.v1.xlsx

HYDROSPHERE research

Chronic Saltwater Method (EPA-821-R-02-014, Method 1007.0)
Water Quality I

Client: | Code: | Job #: | Species: *Mysidopsis bahia* | ID#:
Initiation Date: | Termination Date: | Sample Description:

Sample Description	% Effluent	pH (new / old, Day 0–7)	Dissolved Oxygen (mg/L) (new / old, Day 0–7)
Control Salinity Adjusted	0		
Control	0		
Effluent	6.25		
Effluent	12.5		
Effluent	25		
Effluent	50		
Effluent	100		
Meter ID:			
Day:		0 1 2 3 4 5 6 7	Notes & Comments
Control ID:			
Dilution ID:			
Effluent ID:			
Initials:			
Time:			

Version 1 (12033-DCF) F:\Benchsheets: Logs & Forms\2) CHRONIC\MS.07.CSRD.WQ1.EPA1007.v1.xlsx

DO NOT USE THIS SOP IN PRINTED FORM WITHOUT FIRST CHECKING IT AS THE LATEST VERSION

11.6. Bench Sheet Page

A. Water Quality II
B. File location is F:\Benchsheets, Logs & Forms\2) CHRONIC\MS.07.CSRD.WQ21.EPA1007.v1.xlsx

HYDROSPHERE research

Chronic Saltwater Method (EPA-821-R-02-014, Method 1007.0)
Water Quality II

Client: | Code: | Job #: | Species: *Mysidopsis bahia* | ID #:
Initiation Date: | Termination Date:
Sample Description:

Sample Description	‰ Effluent	Salinity (‰) new	old	new	old	new	old	new	old	new	old	new	old	new	old	Temperature (°C) Measured at the end of each 24-h exposure period 0	1	2	3	4	5	6	7
		0	1	2	3	4	5	6	7														
Control Salinity Adjusted	0																						
Control	0																						
Effluent	6.25																						
	12.5																						
	25																						
	50																						
	100																						
Meter ID:																							

Day:	0	1	2	3	4	5	6	7	Notes & Comments
Control ID:									
Dilution ID:									
Effluent ID:									
Initials:									
Time:									

Version 2.1 (13006-DCF) F:\Benchsheets, Logs & Forms\2) CHRONIC\MS.07.CSRD.WQ2.EPA1007.v2.xlsx

STEPS	COMMENTS
Materials	
Daily	
1. One-oz, plastic, disposable test cups	10 cups per concentration plus 10 for controls needed for each sample tested.
2. Foam board to hold cups	One board per sample or facility tested.
3. Aged Moderately Hard Reconstituted Freshwater (AMHR)	Prepared per EPA Method.
4. Ranin Repeater Pipette	For dispensing aliquots of diluent, test dilutions, and food.
5. 10-mL and 20-mL borosilicate glass pipettes	One tip per sample tested, plus one for the AMHW.
6. Ranin tips, 10-mL	For daily feeding with YCT and algal suspension.
7. YCT and algal suspension combined 1:1 for daily feeding	YCT prepared per EPA Method. *Selenastrum capricornutum* prepared per EPA Method.
8. 250-mL graduated cylinders	One per sample for measuring test concentrations and one for the diluent.
9. 500-mL beaker (or larger)	For mixing sample concentrations before dispensing.
10. 250-mL beakers	For dispensing dilutions.
11. Transfer Pipet	Used to transfer neonates from culture cups to test cups (day 1), and adults from old test cups to new test cups (days 2–7).
12. Dissecting microscope	Use low magnification (e.g., 5x) to view entire cup at once.
13. Meters and apparatus to measure alkalinity, hardness, TRC, pH, DO, temperature, and conductivity	Calibrate per SOP's.
Day 1	
1. Daily materials	
2. *C. dubia* neonates (< 24 hours old)	
3. Sample collected at hour 0, warmed to 20-25 °C prior to use	Samples collected at 0, 48, and 96 hr are used upon receipt and the remainder stored for solution renewal the following day. For a valid test: a) the sample should be held at 4°C prior to test initiation and between renewal, and b) sample holding time should not exceed 36 hours from time of collection until initial use of sample.
4. Measure total residual chlorine (TRC), alkalinity, and hardness	Calibrate per SOP.
Day 2	
1. Daily materials	
2. Sample collected at hour 0, warmed to 20-25 °C prior to use	

Day 3

1.	Daily materials	
2.	Sample collected at hour 48, warmed to 20-25 °C prior to use	Solution is renewed from the NEW sample which was collected at 48 hours.
3.	Measure TRC, alkalinity, and hardness	Calibrate per SOP.

Day 4

1.	Daily materials	
2.	Sample collected at hour 48, warmed to 20-25 °C prior to use	

Day 5

1.	Daily materials	
2.	Sample collected at hour 96, warmed to 20-25 °C prior to use	Solution is renewed from the NEW sample which was collected at 96 hours.
3.	Measure TRC, alkalinity, and hardness	Calibrate per SOP.

Day 6

1.	Daily materials	
2.	Sample collected at hour 96, warmed to 20-25 °C prior to use	

Day 7 (if test finished)

1.	Dissecting microscope	Use low magnification (e.g., 5x) to view entire cup at once.
2.	Meters to measure pH, DO, temperature, and conductivity	Calibrate per SOP's.

Day 7 (if test continued)

1.	Daily materials	
2.	Sample collected at hour 96, warmed to 20-25 °C prior to use	

Day 8 (if necessary)

1.	Dissecting microscope	Use low magnification (e.g., 5x) to view entire cup at once.
2.	Meters to measure pH, DO, temperature, and conductivity	Calibrate per SOP's.

Documentation

1. Use only black, waterproof pen for all log book and bench sheet entries.
2. Log sample receipt, temperature, and condition into *Sample Receiving Use & Disposal Log.*
3. Fill in information requested at top of bench sheets as completely as possible, including daily calibrations, prior to test initiation.

Include full name of facility, date and time collected, field TRC, sample and job numbers, and chamber numbers. Some of this information will only be available after the log-in folder comes down from Chemistry.

4. To make any corrections to bench sheet entries, place a single line through the incorrect entry, write the corrected entry as near its appropriate space as possible, and initial the correction.

Write an explanation of the error below the corrected entry, initial, and date.

5. Two different bench sheets are used: one for the survival and reproduction data and one for the physical-chemical parameters of the sample.

The bench sheets are entitled: *C. dubia Chronic Bioassay Bench Sheet-Reproduction* and *C. dubia Chronic Bioassay Bench Sheet-Chemistry*.

6. Perform QA standard reference toxicant (SRT) tests monthly or concurrently as permits require. Use this SOP, substituting toxicant for sample where appropriate.

Dilution volumes for *C.dubia* SRT test using KCl Stock solution of 100g KCl per liter.

Concentration	Toxicant Vol.	Total Vol.
Control	0 mL	200 mL
62.5 mg/L	0.125 mL	200 mL
125 mg/L	0.25 mL	200 mL
250 mg/L	0.5 mL	200 mL
500 mg/L	1 mL	200 mL
1,000 mg/L	2 mL	200 mL

Methods

Daily

1. Place new, one-ounce test cups in large, foam board. Label the board beside each column of cups to identify the test concentration and facility sampled.

Place tape across the front of the board and use a waterproof marker to designate columns. Ten cups for each set of control replicates are needed for each sample tested, plus ten cups per concentration for each sample tested.

2. Measure TRC in sample on days 1, 3, and 5 only. Check field data sheet supplied by sampler for field TRC and atypical field measurements.

Measure TRC per SOP. If TRC > 0.1 mg/L and non-chlorine toxicity is to be measured, dechlorinate a portion of the sample by the sodium thiosulfate method per SOP.

3. Calibrate meters and record calibration readings on *C. dubia Chronic Bioassay Bench Sheet—Reproduction* bench sheet.

Calibrate meters per SOP's. Record calibration readings in *Calibration Log Book* (during the first use each week) and on bench sheet (daily during test).

4. Place 20-mL of diluent into each of the control replicate cups.

5. Place the desired volume of diluent and sample into separate 250-mL graduated cylinders. Pour contents of both cylinders into a flask (500-mL) and swirled to yield a uniformly-mixed test solution of 200 mL total. Dispense solution into 250-mL beakers before mixing next test concentration. Mix from lowest concentration in a dilution series to the highest.

Ten cups per concentration in a dilution series for each sample tested. Dilution series based on previous knowledge of toxicity level. Sample volumes when mixing a 240 mL solution for *chronic definitive* toxicity test (choose 5 concentrations plus the control):

Concentration	Diluent	Sample	Total Volume
Control	200 mL	0 mL	200 mL
l0 %	180 mL	20 mL	200 mL
25 %	150 mL	50 mL	200 mL
50 %	100 mL	100 mL	200 mL
75 %	50 mL	150 mL	200 mL
l00 %	0 mL	200 mL	200 mL

Ten cups x 20 mL/cup = 200 mL.

6. Measure pH, DO, and conductivity of the solutions in all beakers. Measure the temperature in the test bath. Record readings. Record any comments pertaining to the condition or appearance of the sample.

Conductivity readings shall be rounded to the nearest 5 µmhos. Readings for pH, DO, and temperature shall be read to one decimal place. Take measurements from lowest to highest concentration.

Record all readings in appropriate columns on *Chronic Bioassay Bench Sheet*.

7. Feed 2.68-mls of combined 1:1 YCT and algal suspension per 250-mL beaker. Mix.

Measurements made per SOP.

8. Dispense 20-mL aliquots of each mixed solution into each of the appropriate replicate cups on the board.

9. Measure alkalinity and hardness of the sample only on days 1, 3, and 5.

10. Fill another large foam board with new cups.

Store board in a safe place, covered.

11. For chronic SRT tests, repeat daily methods 1–8 and 10–11 above.

After the adults have been transferred to the day's new cups, pH and D.O. are measured in one cup from each concentration; temperature and conductivity are not measured in any cups.

Day 1

1. Daily methods #1–11.

2. With transfer pipet, RANDOMLY load ONE *C. dubia* neonate into each of the ten replicate cups of the controls and of each test concentration.

3. Verify the count under the lowest power of a dissecting scope. Place the board of cups into a waterbath and cover board with clear plexiglass. Record counts.

Day 2

(1 *C. dubia* per replicate) x (10 replicates per test concentration) = 10 *C. dubia* per concentration tested.

Use a random loading pattern similar to that shown in the EPA chronic manual.

1. Daily methods #1–11 (skip #2 and 9).

Water bath should maintain 25±1 °C and 16h:8h light:dark.

Record counts on *C. dubia Chronic Bioassay Bench Sheet-Reproduction*.

2. Retrieve remainder of hour-0 sample from refrigerator and warm to 20–25°C.

3. Retrieve previous day's board of cups. In every cup, verify count of surviving animals under lowest power of dissecting scope. Record counts.

Important Note: If test was not completely loaded on day 1 then the test has to be reinitiated with the second sample. Contact the client and arrange to have an additional (4th) sample sent. Be sure to have a sample kit sent. (rev3)

4. With Transfer pipet, transfer the ONE *C. dubia* adult from previous board into the corresponding test cup on the new board. Verify count under lowest power of dissecting scope. Place board of cups into water bath and cover board with clear plexiglass.

Day 3

Record survival counts on *C. dubia Chronic Bioassay Bench Sheet - Reproduction*.

1. Daily methods #1–11.

Transfers MUST be performed prior to measuring physical parameters in cups from the previous day.

2. Use new sample which was collected 48 hr after original sample. Warm sample to 20–25°C.

3. Retrieve previous day's board of cups. In every cup, verify count of surviving animals under lowest power of dissecting scope. Record counts.

4. With Transfer pipet, transfer the ONE *C. dubia* adult from previous board into the corresponding test cup on the new board. Verify count under lowest power of dissecting scope. Place board of cups in water bath and cover board with clear plexiglass.

Day 4

Record survival counts on *C. dubia Chronic Bioassay Bench Sheet - Reproduction*.

Transfers MUST be performed prior to measuring physical parameters in cups from the previous day.

1. Daily methods #1–11. (skip #2 and 9).

2. Use new sample which was collected 48 hr after the original sample. Warm sample to 20-25°C.

3. Retrieve previous day's board of cups. In every cup, verify count of surviving animals under lowest power of dissecting scope. Record counts.

4. With Transfer pipet, transfer the ONE *C. dubia* adult from previous board into the corresponding test cup on the new board. Verify count under lowest power of dissecting scope. Place board of cups into water bath and cover board with clear plexiglass.

5. Record the number of young produced in each cup in the appropriate columns on the bench sheet.

Record survival counts on *C. dubia Chronic Bioassay Bench Sheet - Reproduction*.

Transfers MUST be performed prior to measuring physical parameters in cups from the previous day.

Day 5

1. Daily methods #1–11.

Young will typically be present on days 4–8. If young appear earlier than day 4, then the age of the neonates was not accurate or the temperature regime was incorrect and the validity of the test results is in question. Record counts on *C. dubia Chronic Bioassay Bench Sheet - Reproduction*.

2. Use new sample which was collected 96 hr after the original sample. Warm sample to 20-25°C.

3. Retrieve previous day's board of cups. In every cup, verify count of surviving animals under lowest power of dissecting scope. Record counts.

4. With Transfer pipet, transfer the ONE *C. dubia* adult from previous board into the corresponding test cup on the new board. Verify count under lowest power of dissecting scope. Place board of cups into water bath and cover board with clear plexiglass.

5. Record the number of young produced in each cup in the appropriate columns on the bench sheet.

Record survival counts on *C. dubia Chronic Bioassay Bench Sheet - Reproduction*.

Transfers MUST be performed prior to measuring physical parameters in cups from the previous day.

Day 6

1. Daily methods #1–11. (skip #2 and 9).

Record counts on *C. dubia Chronic Bioassay Bench Sheet - Reproduction*.

2. Use new sample which was collected 96 hr after the original sample. Warm sample to 20-25°C.

3. Retrieve previous day's board of cups. In every cup, verify count of surviving animals under lowest power of dissecting scope. Record counts.

4. With Transfer pipet, transfer the ONE *C. dubia* adult from previous board into the corresponding test cup on the new board. Verify count under lowest power of dissecting scope. Place board of cups into water bath and cover board with clear plexiglass.

5. Record the number of young produced in each cup in the appropriate columns on the bench sheet.

Record survival counts on *C. dubia Chronic Bioassay Bench Sheet - Reproduction*.

Day 7

Transfers MUST be performed prior to measuring physical parameters in cups from the previous day.

1. If 60% or more of the surviving females in the controls have produced their third brood, proceed with test termination as described in the next section.
2. If less than 60% of the surviving females in the controls have produced their third brood, follow daily methods from #1–11 (skip #2 and 9).
3. Use new sample which was collected 96 hr after the original sample. Warm sample to 20-25°C.
4. Retrieve previous day's board of cups. In every cup, verify count of surviving animals under lowest power of dissecting scope. Record counts.
5. With Transfer pipet, transfer the ONE *C. dubia* adult from previous board into the corresponding test cup on the new board. Verify count under lowest power of dissecting scope. Place board of cups into water bath and cover board with clear plexiglass.
6. Record the number of young produced in each cup in the appropriate columns on the bench sheet.

Record counts on *C. dubia Chronic Bioassay Bench Sheet - Reproduction*.

The test may continue until day 8 to obtain the required number of third broods.

Record survival counts on *C. dubia Chronic Bioassay Bench Sheet - Reproduction*.

Day 8 (if necessary)

Transfers MUST be performed prior to measuring physical parameters in cups from the previous day.

1. Proceed with test termination described below.

Record counts on *C. dubia Chronic Bioassay Bench Sheet - Reproduction*.

Test Termination

1. On day 7 or 8, count number of young produced. Measure pH and D.O. of the solutions in all cups. Record all counts and readings in appropriate columns on bench sheets. Record any comments pertaining to the condition of the test animals. Record test termination date and time.

Special Note: for TVA studies, the test is terminated ±1 hour of test initiation on the day that the reproduction requirements are met. (rev3)

2. Pour contents of all test cups into sink and flush drain with water. Dispose of cups in trash can. Store board.

3. Enter test results into statistical program to obtain the NOEC and LOEC.

Adults and young MUST be counted prior to measuring physical parameters in cups from the previous day but they don't need to be removed to take the measurements**.** Counting should be done under a dissecting scope. Because of the rapid rate of development of *C. dubia*, at test termination all observations on numbers of offspring should be completed within two hours. An extension of more than a few hours in the test period would be a significant part of the brood production cycle of the animals, and could result in additional broods.

DO NOT USE THIS SOP IN PRINTED FORM WITHOUT FIRST CHECKING IT AS THE LATEST VERSION

1.0 Signatures

1.1. Signature, Title of the Approving Authority and Implementation Date.

A. _____ _____ ___/___/___

1.2. Each person conducting the SOP should read the following statement. Print and sign if you agree.

"I have read and understand this Standard Operating Procedures as it relates to my job responsibilities. I further understand that the Standard Operating Procedures are an integral part of Hydrosphere Research's operations. I agree to follow all procedures outlined in the Standard Operating Procedures."

1.3. Printed **Name**, **Signature**, **Date and Training ETW** of persons conducting this procedure:

A. _____ _____ ___/___/___ _____·ETW

B. _____ _____ ___/___/___ _____·ETW

C. _____ _____ ___/___/___ _____·ETW

D. _____ _____ ___/___/___ _____·ETW

E. _____ _____ ___/___/___ _____·ETW

F. _____ _____ ___/___/___ _____·ETW

G. _____ _____ ___/___/___ _____·ETW

H. _____ _____ ___/___/___ _____·ETW

I. _____ _____ ___/___/___ _____·ETW

J. _____ _____ ___/___/___ _____·ETW

K. _____ _____ ___/___/___ _____·ETW

L. _____ _____ ___/___/___ _____·ETW

1.4. Annual Review (signature and date)

A. _____ ___/___/___

B. _____ ___/___/___

C. _____ ___/___/___

D. _____ ___/___/___

E. _____ ___/___/___

2.0 SOP Postings and Revisions

2.1. Postings

A. Laboratory Posted Location(s) of SOP's.

1. _____
2. _____
3. _____

2.2. Revision Checklist

- ☐ Retrieve and Dispose of Posted Copies. Initial _____
- ☐ Create New Revised SOP Initial _____
- ☐ Train Personnel on "new" SOP Initial _____
- ☐ File Electronic Version of Retired SOP Initial _____
- ☐ File Paper Version of Retired SOP Initial _____

3.0 Examples of Relevant Datasheets or Documents

3.1.

A. None currently prepared for this document.

Appendix H
DoD Quality Systems Manual and Laboratory Control Limits

Appendix G – SW-846 LCS Control Limits

DoD conducted a study to establish control limits for laboratory control samples (LCS) using data collected from DoD-approved environmental laboratories. LCS recoveries for all the analytes on the target analyte lists were pooled, and statistical analyses (such as outlier tests and analysis of variance) were performed on the data before generating the final LCS control limits (LCS-CLs). A complete description of the methodology and findings for Method 8270 can be found in the Laboratory Control Sample Pilot Study (DoD, 2000).

Environmental testing laboratories that perform work for DoD must utilize the DoD-specified LCS-CLs when assessing batch acceptance whenever they are available. This appendix presents the control limits generated by the LCS study and the methodology for applying the limits to LCS data. All analytes spiked in the LCS shall meet the DoD-generated LCS control limits. As described in Section D.1.1.2.1.e of NELAC Appendix D, a number of sporadic marginal exceedances are allowed. Depending on the length of the list of analytes, a specified small number of analytes may exceed the generated control limit. Upper and lower marginal exceedance (ME) limits, calculated at 4 standard deviations around the mean, are established to mark the boundaries of marginal exceedances. If more analytes exceed the LCS-CLs than are allowed, or if any one analyte exceeds the ME limits, then the LCS has failed.

DoD LCS Control Limits Policy

- The laboratory shall use project-specific control limits based on data quality objectives (DQOs), if available. If not, DoD-generated LCS-CLs shall be used, if available. Otherwise, the laboratory's own in-house control limits shall be used.
- The LCS-CLs are based on the promulgated versions of SW-846 methods at the time of the study (2000). They should be used as a benchmark to evaluate acceptability even as methods are updated or alternative methods for the same class of compounds become available.
- The fact that the LCS-CLs are based on certain SW-846 methods should not limit the use of alternative analytical methods, if appropriate. If an alternative method is used, however, it should be capable of producing LCS recoveries that are at least as good as the DoD-generated LCS-CLs, unless project-specific DQOs allow less stringent criteria.
- The LCS study shows that preparatory methods may have a significant influence on a laboratory's ability to achieve certain LCS-CLs. If a laboratory is unable to achieve the LCS-CLs presented in this appendix, it should investigate the use of alternative preparatory methods as a means to improve precision and accuracy.

G.1 Generated LCS Control Limits

As mentioned above, DoD compiled LCS data from multiple laboratories, performing statistical analyses on the data sets before generating control limits. The control limits were set at 3 standard deviations around the mean for all methods except 8151 (see below for further explanation). Limits were then rounded to the nearest 5 for ease of use. The ME limits were set at 4 standard deviations around the mean. The lower ME limit was then raised to 10% for those analytes in which 4 standard deviations falls below that level. Tables G -4 through G -19 at the end of this appendix present the mean or median, standard deviation, lower control limit, upper control limit, lower ME limit, and upper ME limit, as applicable, for each analyte in Methods 8260, 8270, 8151, 8310, 8330, 8081, 8082, 6010, and 7470/7471, for the water and solid matrices. The lower and upper ME limits are not presented for Methods 8151, 8082, and 7470/7471, since those methods have fewer than 11 analytes and are not capable of utilizing the sporadic marginal exceedance allowance. The analytes for Method 8270 are grouped by compound class.

The control limits for explosives Method 8330 in the water matrix were generated using data that were extracted with solid phase extraction (SPE) using acetonitrile only. Analysis of the data received from the LCS study showed that the extraction method produced recoveries with higher means and lower

standard deviations than the salting out extraction method. This results in significantly narrower control limits. Since SPE/acetonitrile is less expensive, cumbersome, and time and labor intensive, the LCS control limits for Method 8330 in water were set with data using only that method. A limited amount of data were received that used SPE/acetonitrile, therefore, no outliers were removed during the statistical analysis. This ensures that a representative data set was used to generate the control limits (see Table G -12).

Note: Laboratories may use any extraction method they feel is appropriate; however, the LCS recoveries must fall within the LCS-CLs presented in Table G-12.

Control limits for chlorinated herbicides Method 8151 were generated using a non-parametric statistical approach. This is a different approach than for the other methods in the LCS study due to the large amount of intralaboratory variability in recoveries for all analytes in the method. The control limits for Method 8151, both solid and water matrices, were set at the 5th and 95th percentile of all data received in the study (no outliers were removed). Tables G -8 and G -9 present the median, lower control limit, and upper control limit for each analyte. LCS failure is assessed and corrective action applied the same way for all methods with control limits in this appendix (see Sections G.3 and G.4).

Note: These data represent the current capability of the SW-846 analytical and preparatory methods. Use of alternative preparatory procedures and/or improvements through PBMS is encouraged. Project-specific control limits can supersede these DoD limits.

If limits are not available for a project-specific analyte, the laboratory shall discuss with the client appropriate limits considering the project-specific DQOs.

Control limits for metals Method 6010, and mercury Method 7470/7471 were set at 80 - 120% even though generated limits were within these numbers. This reflects the allowable uncertainty in the calibration of the instrument. In one case the generated limit (silver in solid) was outside 80 - 120%, and therefore the generated limit was used.

G.2 Marginal Exceedance

As described in Section D.1.1.2.1.e of NELAC Appendix D, a number of sporadic marginal exceedances of the LCS-CLs will be allowed. The number of exceedances is based on the total number of analytes spiked in the LCS. As the number of analytes in the LCS increases, more marginal exceedances are allowed. Table G-1 presents the allowable number of marginal exceedances for a given number of analytes in the LCS (as presented in NELAC Appendix D).

Table G-1. Number of Marginal Exceedances

Number of Analytes in LCS	Allowable Number of Marginal Exceedances of LCS-CLs
> 90	5
71 - 90	4
51 - 70	3
31 - 50	2
11 - 30	1
< 11	0

A *marginal* exceedance is defined as beyond the LCS-CL but still within the marginal exceedance limits (set at 4 standard deviations around the mean). This outside boundary prevents a grossly out-of-control LCS from passing.

NELAC requires that the marginal exceedances be sporadic, i.e., random. As defined by DoD, if the same analyte exceeds the LCS-CLs repeatedly (e.g., two out of three consecutive LCS), that is an indication that the problem is systematic and something is wrong with the measurement system. The source of error should be located and the appropriate corrective action taken. Laboratories must monitor the application of the sporadic marginal exceedance allowance to the LCS results through QA

channels to ensure random behavior. Effective implementation of the marginal exceedance allowance requires cooperation from the laboratory. If the laboratory fails to implement the policy properly, the privilege of using the marginal exceedance option will be revoked. Oversight and appropriate corrective action will be a focus of DoD laboratory assessments in the future.

G.3 LCS Failure

Each LCS must be evaluated against the appropriate control limits and ME limits before being accepted. The laboratory shall use project-specific control limits, if available. If not, DoD generated LCS-CLs shall be used, if available (see Tables G-4 through G-19). Otherwise, the laboratory's own in-house control limits shall be used. First, the recoveries for the analytes spiked in the LCS should be compared with the LCS control limits. If a recovery is less than the lower control limit or greater than the upper control limit, that is an exceedance. The laboratory should note which analytes exceeded the control limits and make a comparison to the list of project-specific analytes of concern. **If a project-specific analyte of concern exceeds its LCS-CLs, the LCS has failed.** Next, the laboratory should add up the total number of exceedances for the LCS. Based on the number of analytes spiked in the LCS, the total number of exceedances should be compared with the allowable number from Table G-1. (The allowable number of marginal exceedances depends on the total number of analytes spiked in the LCS, even if DoD-generated control limits are not available for all analytes.) **If a LCS has more than the allowable number of marginal exceedances, the LCS has failed.** Finally, the recoveries for those analytes that exceeded the LCS-CLs should be compared with the ME limits from Tables G-4 to G-7, G-10 to G-15, or G-18 to G-19. **If a single analyte exceeds its marginal exceedance limit, the LCS has failed.** (This applies only to methods with greater than 10 analytes.)

In summary, failure of the LCS can occur several ways:

- Exceedance of a LCS-CL by any project-specific analyte of concern
- Marginal exceedance of the LCS-CLs by more than the allowable number of analytes
- Exceedance of the ME limits by one or more analytes

Once a LCS has failed, corrective action is required, see section D.4.

G.4 Corrective Action

If a sample fails based on any of the criteria in section G.3, corrective action is required. The corrective action requirement applies to all analytes that exceeded the LCS-CLs, even if one specific analyte's exceedance was not the trigger of LCS failure (see example below). **All exceedances of the LCS-CLs, marginal or otherwise, are subject to corrective action.**

Example of Applying Corrective Action

- In a single LCS, anthracene has a recovery of 30%.
- The lower ME limit for anthracene is 45, therefore the LCS has failed.
- In the same LCS three other analytes exceeded their LCS-CLs but were within their ME limits.
- The LCS was spiked with 74 analytes; therefore, according to Table G-1, four marginal exceedances are allowed.
- The four total exceedances (anthracene plus the three other analytes) are within the allowable number for that analyte list size.

Corrective action is triggered for the LCS because the anthracene recovery exceeded its ME limit, but it is required for all four analytes that exceeded the LCS-CLs.

If a LCS fails, an attempt must be made to determine the source of error and find a solution. All the findings and corrective action should be documented. DoD requires that the analytes subject to corrective action in the LCS and all the samples in the batch be reprepped and reanalyzed or the batch rerun with a new LCS. The corrective action applied shall be based on professional judgment in the review of other QC measures (i.e., surrogates). If an analyte falls outside the LCS-CLs a second time or

if there is not sufficient sample material available to be reanalyzed, then all the results in the associated batch for that analyte must be flagged with a Q (see DoD Gray Box 47). The recoveries of those analytes subject to corrective action must be documented in the case narrative, whether flagging is needed or not.

G.5 Poor Performing Analytes

On the basis of results from the LCS study, DoD identified certain compounds that do not perform well with specific methods. These compounds produce low mean recoveries and high standard deviations, resulting in wide LCS control limits with particularly low lower control limits (sometimes negative values). The performance of these compounds reflects routine implementation of the method in many laboratories. DoD has defined a poor performing analyte as having a lower control limit of 10% or less. DoD does not feel it is appropriate to control batch acceptance on these compounds because there is a high level of uncertainty in their recovery. The data may be used; however, routine performance of the method on these compounds can result in being able to identify only a small percentage of the analyte.

The laboratory should include all target analytes in the calibration standard, including the poor performing analytes. If one of the poor performing analytes identified below is a project-specific analyte of concern *or* if it is detected in the project samples, the laboratory should contact the client (DoD), who will then work with the laboratory on an appropriate course of action. Ideally DoD and the laboratory would use an alternative method to test for the analyte (one that is known to produce higher recoveries) or else modify the original method to optimize conditions for the poor performing analyte.

Poor performing analytes were only identified in SW-846 Methods 8270, 8151, and 8330. These analytes, along with the mean, standard deviation, lower control limit, upper control limit, lower ME limit, and upper ME limit (as generated by the LCS study) are presented in Table G-2.

Table G-2. Poor Performing Analytes[1]

Analyte	Mean/ Median	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
8270 Water:						
4-Nitrophenol	54	23	0	125	0	145
Benzoic acid	54	24	0	125	0	150
Phenol	55	19	0	115	0	135
Phenol-d_5/d_6 (surrogate)	62	18	10	115	0	135
8270 Solid:						
3,3'Dichlorobenzidine	68	19	10	130	0	145
4-Chloroaniline	51	14	10	100	0	110
Benzoic acid	55	18	0	110	0	130
8151 Solid:						
Dinoseb	72		5	130		
8330 and 8330A Solid:						
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)	80	23	10	150	0	172

Note: Lower limits calculated as negative values were raised to zero.

The LCS control limits generated by the study for the poor performing analytes are provided as a benchmark against which laboratories can measure the effectiveness of alternative methods or modifications to the current methods. Batch acceptance should not be evaluated using these limits. When choosing alternative or modified methods, laboratories should strive to raise the mean recoveries and lower the standard deviations in comparison with the performance of the analytes

[1]Control limits for Method 8151 were generated using non-parametric statistics; therefore, the median is presented without standard deviation (see section G.1 for further explanation). ME limits are not used for Method 8151 since the target analyte list has fewer than 11 analytes.

presented in Table G-2. The lower control limit generated for alternative or modified methods must be greater than 10% to be considered acceptable.

G.6 Surrogates

The surrogate compounds for each method are added to all samples, standards, and blanks to assess the ability of the method to recover specific non-target analytes from a given matrix and to monitor sample-specific recovery. Control limits for these compounds were calculated in the same study as the other analytes on the target analyte lists. Below are the limits for some of the surrogates of Methods 8260, 8270, 8081, and 8082, based on 3 standard deviations around the mean (Table G-3). Sufficient data were not received for those analytes during the LCS study to perform statistically significant analyses. No ME limits are presented as marginal exceedances are not acceptable for surrogate spikes.

Note: DoD prefers the use of those surrogates not identified as poor performing analytes in Table G-2 above.

Table G-3. Surrogates

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
8260 Water:				
1,2-Dichloroethane-d_4	95	8	70	120
4-Bromofluorobenzene	98	7	75	120
Dibromofluoromethane	100	5	85	115
Toluene-d_8	102	6	85	120
8260 Solid:				
4-Bromofluorobenzene	101	6	85	120
Toluene-d_8	100	5	85	115
8270 Water:				
2-Fluorobiphenyl	79	10	50	110
Terphenyl-d_{14}	92	14	50	135
2,4,6-Tribromophenol	82	13	40	125
2-Fluorophenol	63	14	20	110
Nitrobenzene-d_5	76	11	40	110
8270 Solid:				
2-Fluorobiphenyl	72	10	45	105
Terphenyl-d_{14}	78	15	30	125
2,4,6-Tribromophenol	80	15	35	125
2-Fluorophenol	70	11	35	105
Phenol-d_5/d_6	71	10	40	100
Nitrobenzene-d_5	69	10	35	100
8081 Water:				
Decachlorobiphenyl	83	17	30	135
TCMX	81	19	25	140
8081 Solid:				
Decachlorobiphenyl	94	13	55	130
TCMX	97	9	70	125
8082 Water:				
Decachlorobiphenyl	88	15	40	135
8082 Solid:				
Decachlorobiphenyl	91	11	60	125

G.7 In-House LCS Control Limits

The acceptability of LCS results within any preparatory batch shall be based on project-specified limits or the following DoD-specified LCS control limits, if project-specific limits are not available. If DoD limits are not available, the laboratory must use its in-house limits for batch acceptance.

DoD strongly believes that it is important for laboratories to maintain their own in-house LCS limits. These in-house limits must be consistent with (i.e., within) the DoD limits (project-specific, if available; otherwise the following LCS-CLs). The laboratory in-house limits shall be calculated from the laboratory's historical LCS data in accordance with a documented procedure (e.g., SOP) that is consistent with good laboratory practice. That document must describe the process for establishing and maintaining LCS limits and the use of control charts.

The laboratory in-house limits are to be used for several purposes:

- Laboratories are expected to utilize their in-house limits as part of their quality control system, and to evaluate trends and monitor and improve performance.
- When a laboratory's in-house limits are outside the DoD control limits (upper and/or lower), they must report their in-house limits in the laboratory report (see Appendix E) even if the LCS associated with the batch fell within the DoD limits. Using this information, DoD will be able to determine how laboratory performance affects the quality of the environmental data.
- DoD may review the laboratory in-house limits and associated trends, as reflected in control charts, to determine whether the laboratory's overall performance is acceptable. If deemed unacceptable, this can allow DoD to decide not to use the laboratory again until substantial improvement has occurred.

Table G-4. LCS Control Limits for Volatile Organic Compounds SW-846 Method 8260 Water Matrix[2]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
1,1,1,2-Tetrachloroethane	105	8	80	130	75	135
1,1,1-Trichloroethane	100	11	65	130	55	145
1,1,2,2-Tetrachloroethane	96	11	65	130	55	140
1,1,2-Trichloroethane	100	8	75	125	65	135
1,1-Dichloroethane	101	11	70	135	60	145
1,1-Dichloroethene	99	10	70	130	55	140
1,1-Dichloropropene	102	10	75	130	65	140
1,2,3-Trichlorobenzene	99	14	55	140	45	155
1,2,3-Trichloropropane	98	9	75	125	65	130
1,2,4-Trichlorobenzene	100	11	65	135	55	145
1,2,4-Trimethylbenzene	103	10	75	130	65	140
1,2-Dibromo-3-chloropropane	91	14	50	130	35	145
1,2-Dibromoethane	100	7	80	120	75	125
1,2-Dichlorobenzene	96	9	70	120	60	130
1,2-Dichloroethane	100	10	70	130	60	140
1,2-Dichloropropane	100	8	75	125	65	135
1,3,5-Trimethylbenzene	102	10	75	130	65	140
1,3-Dichlorobenzene	100	8	75	125	65	130
1,3-Dichloropropane	100	9	75	125	65	135
1,4-Dichlorobenzene	99	8	75	125	65	130
2,2-Dichloropropane	103	11	70	135	60	150
2-Butanone	91	20	30	150	10	170

[2] A number of sporadic marginal exceedances of the control limits are allowed, depending on the number of analytes spiked in the LCS. Refer to section G.2 and Table G-1 for guidance on the appropriate application of control and ME limits. LCS control limits are not available for Total Xylene. Xylene may be reported on a project-specific basis as a total number; however, for the purposes of the DoD QSM, it will be analyzed and reported as m,p-Xylene and o-Xylene. Additional limits for poor performing compounds can be found in section G.5 and for surrogate compounds in section G.6.

Table G-4. LCS Control Limits for Volatile Organic Compounds SW-846 Method 8260 Water Matrix[2] (continued)

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
2-Chlorotoluene	100	9	75	125	65	135
2-Hexanone	92	12	55	130	45	140
4-Chlorotoluene	101	9	75	130	65	135
4-Methyl-2-pentanone	96	13	60	135	45	145
Acetone	91	17	40	140	20	160
Benzene	102	7	80	120	75	130
Bromobenzene	100	8	75	125	70	130
Bromochloromethane	97	11	65	130	55	140
Bromodichloromethane	98	8	75	120	70	130
Bromoform	99	10	70	130	60	140
Bromomethane	88	19	30	145	10	165
Carbon disulfide	100	21	35	160	15	185
Carbon tetrachloride	102	12	65	140	55	150
Chlorobenzene	102	7	80	120	75	130
Chlorodibromomethane	96	13	60	135	45	145
Chloroethane	99	12	60	135	50	145
Chloroform	100	12	65	135	50	150
Chloromethane	83	15	40	125	25	140
cis-1,2-Dichloroethene	99	9	70	125	60	135
cis-1,3-Dichloropropene	100	10	70	130	60	140
Dibromomethane	101	8	75	125	65	135
Dichlorodifluoromethane	93	21	30	155	10	175
Ethylbenzene	100	9	75	125	65	135
Hexachlorobutadiene	97	15	50	140	35	160
Isopropylbenzene	101	9	75	125	65	135
m,p-Xylene	102	9	75	130	65	135
Methyl tert-butyl ether	94	10	65	125	55	135
Methylene chloride	96	14	55	140	40	155
Naphthalene	96	14	55	140	40	150
n-Butylbenzene	103	11	70	135	55	150
n-Propylbenzene	101	9	70	130	65	140
o-Xylene	100	7	80	120	75	130
p-Isopropyltoluene	102	10	75	130	65	140
sec-Butylbenzene	100	9	70	125	65	135
Styrene	100	11	65	135	55	145
tert-Butylbenzene	99	10	70	130	60	140
Tetrachloroethene	96	18	45	150	25	165
Toluene	100	7	75	120	70	130
trans-1,2-Dichloroethene	99	13	60	140	45	150
trans-1,3-Dichloropropene	98	15	55	140	40	155
Trichloroethene	99	9	70	125	60	135
Trichlorofluoromethane	103	15	60	145	45	160
Vinyl chloride	99	16	50	145	35	165

Table G-5. LCS Control Limits for Volatile Organic Compounds SW-846 Method 8260 Solid Matrix[3]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
1,1,1,2-Tetrachloroethane	100	9	75	125	65	135
1,1,1-Trichloroethane	101	11	70	135	55	145
1,1,2,2-Tetrachloroethane	93	13	55	130	40	145
1,1,2-Trichloroethane	95	11	60	125	50	140
1,1-Dichloroethane	99	9	75	125	65	135
1,1-Dichloroethene	100	12	65	135	55	150
1,1-Dichloropropene	102	11	70	135	60	145
1,2,3-Trichlorobenzene	97	12	60	135	50	145
1,2,3-Trichloropropane	97	11	65	130	50	140
1,2,4-Trichlorobenzene	98	11	65	130	55	140
1,2,4-Trimethylbenzene	100	12	65	135	55	145
1,2-Dibromo-3-chloropropane	87	16	40	135	25	150
1,2-Dibromoethane	97	9	70	125	60	135
1,2-Dichlorobenzene	97	7	75	120	65	125
1,2-Dichloroethane	104	11	70	135	60	145
1,2-Dichloropropane	95	8	70	120	65	125
1,3,5-Trimethylbenzene	99	11	65	135	55	145
1,3-Dichlorobenzene	98	9	70	125	65	135
1,3-Dichloropropane	100	8	75	125	70	130
1,4-Dichlorobenzene	98	9	70	125	65	135
2,2-Dichloropropane	101	11	65	135	55	145
2-Butanone	94	22	30	160	10	180
2-Chlorotoluene	98	10	70	130	60	140
2-Hexanone	97	16	45	145	30	160
4-Chlorotoluene	100	9	75	125	65	135
4-Methyl-2-pentanone	97	17	45	145	30	165
Acetone	88	23	20	160	10	180
Benzene	99	9	75	125	65	135
Bromobenzene[4]	93	9	65	120	55	130
Bromochloromethane	99	9	70	125	60	135
Bromodichloromethane	100	9	70	130	60	135
Bromoform	96	13	55	135	45	150
Bromomethane	95	21	30	160	10	180
Carbon disulfide	103	19	45	160	30	180
Carbon tetrachloride	100	11	65	135	55	145
Chlorobenzene	99	8	75	125	65	130
Chlorodibromomethane	98	11	65	130	55	140
Chloroethane	98	20	40	155	20	175

[3] A number of sporadic marginal exceedances of the control limits are allowed, depending on the number of analytes spiked in the LCS. Refer to section G.2 and Table G-1 for guidance on the appropriate application of control and ME limits. LCS control limits are not available for Methyl tert-butyl ether and Total Xylene. Sufficient data to perform statistically significant analyses were not received for MTBE during the LCS study. Xylene may be reported on a project-specific basis as a total number; however, for the purposes of the DoD QSM, it will be analyzed and reported as m,p-Xylene and o-Xylene. Additional limits for poor performing compounds can be found in section G.5 and for surrogate compounds in section G.6.

[4] Provisional limits – outlier analyses during the LCS study resulted in LCS-CLs generated with data from fewer than four laboratories. Limits may be adjusted in the future as additional data become available.

Table G-5. LCS Control Limits for Volatile Organic Compounds SW-846 Method 8260 Solid Matrix[3] (continued)

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
Chloroform	98	9	70	125	65	135
Chloromethane	90	13	50	130	40	140
cis-1,2-Dichloroethene	96	10	65	125	55	135
cis-1,3-Dichloropropene	99	9	70	125	65	135
Dibromomethane	100	9	75	130	65	135
Dichlorodifluoromethane[4]	85	17	35	135	15	155
Ethylbenzene	101	9	75	125	65	135
Hexachlorobutadiene	98	15	55	140	40	155
Isopropylbenzene	103	9	75	130	70	140
m,p-Xylene	102	8	80	125	70	135
Methylene chloride	97	14	55	140	40	155
Naphthalene	84	14	40	125	25	140
n-Butylbenzene	101	12	65	140	50	150
n-Propylbenzene	99	12	65	135	50	145
o-Xylene	101	8	75	125	70	135
p-Isopropyltoluene	104	10	75	135	65	140
sec-Butylbenzene	97	11	65	130	50	145
Styrene	101	9	75	125	65	135
tert-Butylbenzene	99	11	65	130	55	145
Tetrachloroethene	103	12	65	140	55	150
Toluene	99	9	70	125	60	135
trans-1,2-Dichloroethene	100	11	65	135	55	145
trans-1,3-Dichloropropene	96	10	65	125	55	140
Trichloroethene	101	8	75	125	70	130
Trichlorofluoromethane	106	27	25	185	10	215
Vinyl chloride	92	11	60	125	45	140

Table G-6. LCS Control Limits for Semivolatile Organic Compounds SW-846 Method 8270 Water Matrix[5]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
Polynuclear Aromatics						
2-Methylnaphthalene	75.0	9.5	45	105	35	115
Acenaphthene	77.6	10.1	45	110	35	120
Acenaphthylene	78.5	9.4	50	105	40	115
Anthracene	83.0	9.7	55	110	45	120
Benz[a]anthracene	82.7	8.9	55	110	45	120
Benzo[a]pyrene	81.3	9.5	55	110	45	120

[5] A number of sporadic marginal exceedances of the control limits are allowed depending on the number of analytes spiked in the LCS. Refer to section G.2 and Table G-1 for guidance on the appropriate application of control and ME limits. LCS control limits are not available for Benzidine, 2,6-Dichlorophenol, and N-nitrosopyrrolidine. Sufficient data to perform statistically significant analyses were not received for those analytes during the LCS study. Additional limits for poor performing compounds can be found in section G.5.

Table G-6. LCS Control Limits for Semivolatile Organic Compounds SW-846 Method 8270 Water Matrix[5] (continued)

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
Benzo[b]fluoranthene	81.8	12.1	45	120	35	130
Benzo[k]fluoranthene	84.6	13.2	45	125	30	135
Benzo[g,h,i]perylene	80.5	14.1	40	125	25	135
Chrysene	82.1	8.9	55	110	45	120
Dibenz[a,h]anthracene	84.7	14.1	40	125	30	140
Fluoranthene	85.2	10.4	55	115	45	125
Fluorene	80.6	10.3	50	110	40	120
Indeno[1,2,3-cd]pyrene	84.3	13.6	45	125	30	140
Naphthalene	70.8	10.5	40	100	30	115
Phenanthrene	84.0	11.0	50	115	40	130
Pyrene	88.6	13.2	50	130	35	140
Phenolic/Acidic						
2,4,5-Trichlorophenol	79.7	10.3	50	110	40	120
2,4,6-Trichlorophenol	80.7	10.7	50	115	40	125
2,4-Dichlorophenol	76.3	9.6	50	105	40	115
2,4-Dimethylphenol	68.8	13.5	30	110	15	125
2,4-Dinitrophenol	75.8	20.6	15	140	10	160
2-Chlorophenol	71.3	11.4	35	105	25	115
2-Methylphenol	73.3	11.7	40	110	25	120
2-Nitrophenol	75.8	12.4	40	115	25	125
3-Methylphenol/4-Methylphenol	71.3	13.0	30	110	20	125
4,6-Dinitro-2-methylphenol	84.9	15.0	40	130	25	145
4-Chloro-3-methylphenol	78.6	10.7	45	110	35	120
Pentachlorophenol	77.6	13.3	40	115	25	130
Basic						
3,3'-Dichlorobenzidine	65.2	15.3	20	110	10	125
4-Chloroaniline	62.2	15.6	15	110	10	125
Phthalate Esters						
Bis(2-ethylhexyl) phthalate	84.2	14.0	40	125	30	140
Butyl benzyl phthalate	81.1	11.7	45	115	35	130
Di-n-butyl phthalate	84.8	10.3	55	115	45	125
Di-n-octyl phthalate	87.4	16.6	35	135	20	155
Diethyl phthalate	79.2	12.9	40	120	30	130
Dimethyl phthalate	75.9	16.9	25	125	10	145
Nitrosoamines						
N-Nitrosodi-n-propylamine	80.9	15.7	35	130	20	145
N-Nitrosodimethylamine	67.9	14.1	25	110	10	125
N-Nitrosodiphenylamine	79.6	10.6	50	110	35	120
Chlorinated Aliphatics						
Bis(2-chlorethoxy)methane	76.2	10.2	45	105	35	115
Bis(2-chloroethyl) ether	73.3	12.3	35	110	25	120
Bis(2-chloroisopropyl) ether	78.2	17.5	25	130	10	150
Hexachlorobutadiene	65.2	12.6	25	105	15	115
Hexachloroethane	60.9	11.1	30	100	15	105

Table G-6. LCS Control Limits for Semivolatile Organic Compounds SW-846 Method 8270 Water Matrix[5] (continued)

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
Halogenated Aromatics						
1,2,4-Trichlorobenzene	71.7	11.6	35	105	25	120
1,2-Dichlorobenzene	67.3	11.4	35	100	20	115
1,3-Dichlorobenzene	64.8	10.9	30	100	20	110
1,4-Dichlorobenzene	64.8	10.9	30	100	20	110
2-Chloronaphthalene	76.5	9.3	50	105	40	115
4-Bromophenyl phenyl ether	82.9	10.2	50	115	40	125
4-Chlorophenyl phenyl ether	80.6	10.3	50	110	40	120
Hexachlorobenzene	82.3	10.0	50	110	40	120
Nitroaromatics						
2,4-Dinitrotoluene	84.3	11.2	50	120	40	130
2,6-Dinitrotoluene	82.7	11.3	50	115	35	130
2-Nitroaniline	81.8	11.2	50	115	35	125
3-Nitroaniline	72.6	17.7	20	125	10	145
4-Nitroaniline	77.2	13.7	35	120	20	130
Nitrobenzene	76.8	10.8	45	110	35	120
Neutral Aromatics						
Carbazole	82.5	11.4	50	115	35	130
Dibenzofuran	80.3	8.8	55	105	45	115
Others						
1,2-Diphenylhydrazine	84.8	9.4	55	115	45	120
Benzyl alcohol	71.0	13.8	30	110	15	125
Isophorone	81.0	10.5	50	110	40	125

Table G-7. LCS Control Limits for Semivolatile Organic Compounds SW-846 Method 8270 Solid Matrix[6]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
Polynuclear Aromatics						
2-Methylnaphthalene	77.3	10.0	45	105	35	115
Acenaphthene	77.3	10.3	45	110	35	120
Acenaphthylene	75.7	10.4	45	105	35	115
Anthracene	79.9	9.0	55	105	45	115
Benz[a]anthracene	81.6	9.8	50	110	40	120
Benzo[a]pyrene	80.7	10.3	50	110	40	120
Benzo[b]fluoranthene	79.7	11.4	45	115	35	125
Benzo[k]fluoranthene	83.8	12.9	45	125	30	135
Benzo[g,h,i]perylene	81.8	14.7	40	125	25	140
Chrysene	82.6	9.9	55	110	45	120

[6] A number of sporadic marginal exceedances (ME) of the control limits are allowed, depending on the number of analytes spiked in the LCS. Refer to section G.2 and Table G-1 for guidance on the appropriate application of control and ME limits. LCS control limits are not available for Benzidine, 2,6-Dichlorophenol, 1,2-Diphenylhydrazine, and N-nitrosopyrrolidine. Sufficient data to perform statistically significant analyses were not received for those analytes during the LCS study. Additional limits for poor performing compounds can be found in section G.5.

Table G-7. LCS Control Limits for Semivolatile Organic Compounds
SW-846 Method 8270 Solid Matrix[6] (continued)

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
Dibenz[a,h]anthracene	82.9	13.9	40	125	25	140
Fluoranthene	83.9	10.1	55	115	45	125
Fluorene	78.3	9.8	50	110	40	115
Indeno[1,2,3-cd]pyrene	79.7	13.8	40	120	25	135
Naphthalene	73.4	11.1	40	105	30	120
Phenanthrene	80.1	10.0	50	110	40	120
Pyrene	84.4	12.8	45	125	35	135
Phenolic/Acidic						
2,4,5-Trichlorophenol	80.1	10.4	50	110	40	120
2,4,6-Trichlorophenol	76.3	11.0	45	110	30	120
2,4-Dichlorophenol	77.2	10.9	45	110	35	120
2,4-Dimethylphenol	67.3	11.9	30	105	20	115
2,4-Dinitrophenol	72.6	20.0	15	130	10	150
2-Chlorophenol	74.7	10.3	45	105	35	115
2-Methylphenol	71.7	10.6	40	105	30	115
2-Nitrophenol	76.2	11.5	40	110	30	120
3-Methylphenol/4-Methylphenol	73.9	10.9	40	105	30	120
4,6-Dinitro-2-methylphenol	83.1	18.0	30	135	10	155
4-Chloro-3-methylphenol	79.5	11.1	45	115	35	125
4-Nitrophenol	77.0	20.2	15	140	10	160
Pentachlorophenol	71.9	15.6	25	120	10	135
Phenol	69.7	10.2	40	100	30	110
Phthalate Esters						
Bis(2-ethylhexyl) phthalate	87.4	13.3	45	125	35	140
Butyl benzyl phthalate	86.4	12.3	50	125	35	135
Di-n-butyl phthalate	83.2	9.1	55	110	45	120
Di-n-octyl phthalate	86.4	15.2	40	130	25	145
Diethyl phthalate	82.2	10.6	50	115	40	125
Dimethyl phthalate	79.6	10.2	50	110	40	120
Nitrosoamines						
N-Nitrosodi-n-propylamine	76.8	12.3	40	115	30	125
N-Nitrosodimethylamine	66.1	15.9	20	115	10	130
N-Nitrosodiphenylamine	82.4	11.1	50	115	40	125
Chlorinated Aliphatics						
Bis(2-chlorethoxy)methane	75.5	10.9	45	110	30	120
Bis(2-chloroethyl) ether	71.1	11.2	40	105	25	115
Bis(2-chloroisopropyl) ether	68.4	15.7	20	115	10	130
Hexachlorobutadiene	78.2	12.9	40	115	25	130
Hexachloroethane	71.9	12.6	35	110	20	120
Halogenated Aromatics						
1,2,4-Trichlorobenzene	77.4	11.2	45	110	30	120
1,2-Dichlorobenzene	70.9	8.7	45	100	35	105
1,3-Dichlorobenzene	69.7	10.3	40	100	30	110
1,4-Dichlorobenzene	69.0	11.4	35	105	25	115

Table G-7. LCS Control Limits for Semivolatile Organic Compounds SW-846 Method 8270 Solid Matrix (continued)

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
2-Chloronaphthalene	75.2	9.9	45	105	35	115
4-Bromophenyl phenyl ether	81.7	11.8	45	115	35	130
4-Chlorophenyl phenyl ether	79.6	10.7	45	110	35	120
Hexachlorobenzene	82.5	11.7	45	120	35	130
Nitroaromatics						
2,4-Dinitrotoluene	82.0	11.4	50	115	35	130
2,6-Dinitrotoluene	80.2	10.7	50	110	35	125
2-Nitroaniline	81.0	12.2	45	120	30	130
3-Nitroaniline	68.8	13.8	25	110	15	125
4-Nitroaniline	73.6	13.1	35	115	20	125
Nitrobenzene	77.2	11.9	40	115	30	125
Neutral Aromatics						
Carbazole	80.4	12.3	45	115	30	130
Dibenzofuran	77.1	8.8	50	105	40	110
Others						
Benzyl alcohol	70.9	17.4	20	125	10	140
Isophorone	77.0	11.4	45	110	30	125

Table G-8. LCS Control Limits for Chlorinated Herbicides SW-846 Method 8151 Water Matrix[7]

Analyte	Median	Lower Control Limit	Upper Control Limit
2,4-D	88	35	115
2,4-DB	99	45	130
2,4,5-T	83	35	110
2,4,5-TP (Silvex)	87	50	115
Dalapon	62	40	110
Dicamba	86	60	110
Dichloroprop	91	70	120
Dinoseb	65	20	100
MCPA	93	60	145

[7] LCS control limits were generated using non-parametric statistics (see section G.1 for further explanation). LCS control limits are not available for MCPP. Sufficient data to perform statistically significant analyses were not received for the analyte during the LCS study.

Table G-9. LCS Control Limits for Chlorinated Herbicides SW-846 Method 8151 Solid Matrix[8]

Analyte	Median	Lower Control Limit	Upper Control Limit
2,4-D	88	35	145
2,4-DB	108	50	155
2,4,5-T	86	45	135
2,4,5-TP (Silvex)	90	45	125
Dicamba	90	55	110
Dichloroprop	99	75	140

Table G-10. LCS Control Limits for Polynuclear Aromatic Hydrocarbons SW-846 Method 8310 Water Matrix[9]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
Acenaphthene	70	11	35	105	25	115
Acenaphthylene	74	13	35	115	20	125
Anthracene	77	12	40	110	30	125
Benz[a]anthracene	81	11	50	110	40	125
Benzo[a]pyrene	79	11	45	115	35	125
Benzo[b]fluoranthene	82	10	50	110	40	125
Benzo[k]fluoranthene	79	10	50	110	40	120
Benzo[g,h,i]perylene	77	14	35	120	20	135
Chrysene	83	11	50	115	40	125
Dibenz[a,h]anthracene	64	15	20	110	10	125
Fluoranthene	82	11	50	115	35	125
Fluorene	69	11	35	105	25	115
Indeno[1,2,3-cd]pyrene	80	11	45	110	35	125
Naphthalene	68	12	35	105	20	115
Phenanthrene	80	13	40	120	25	135
Pyrene	80	9	50	110	45	115

[8] LCS control limits were generated using non-parametric statistics (see section G.1 for further explanation). LCS control limits are not available for Dalapon, MCPA, and MCPP. Sufficient data to perform statistically significant analyses were not received for those analytes during the LCS study. Additional limits for poor performing compounds can be found in section G.5.

[9] A number of sporadic marginal exceedances of the control limits are allowed, depending on the number of analytes spiked in the LCS. Refer to section G.2 and Table G-1 for guidance on the appropriate application of control and ME limits.

Table G-11. LCS Control Limits for Polynuclear Aromatic Hydrocarbons SW-846 Method 8310 Solid Matrix[10]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
Acenaphthene	71	12	35	110	20	120
Acenaphthylene	73	13	35	115	20	125
Anthracene	86	13	45	125	35	140
Benz[a]anthracene	78	9	50	105	40	115
Benzo[a]pyrene	86	15	40	135	25	150
Benzo[b]fluoranthene	89	11	55	120	45	130
Benzo[k]fluoranthene	84	12	50	120	35	135
Benzo[g,h,i]perylene[11]	85	10	55	115	45	125
Chrysene	87	11	55	120	45	130
Dibenz[a,h]anthracene	81	11	45	115	35	125
Fluoranthene	88	16	40	135	25	150
Fluorene	76	10	45	105	35	115
Indeno[1,2,3-cd]pyrene	95	13	55	135	45	145
Naphthalene	80	11	50	110	40	120
Phenanthrene	91	12	55	125	45	135
Pyrene	82	11	50	115	40	125

Table G-12. LCS Control Limits for Explosives SW-846 Methods 8330 and 8330A Water Matrix[12]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
1,3,5-Trinitrobenzene	102	13	65	140	50	150
1,3-Dinitrobenzene	103	18	45	160	30	175
2,4-Dinitrotoluene	98	12	60	135	50	145
2,6-Dinitrotoluene	99	13	60	135	50	150
2,4,6-Trinitrotoluene (TNT)	98	15	50	145	35	160
2-Amino-4,6-dinitrotoluene[13]	101	17	50	155	35	170
2-Nitrotoluene	88	15	45	135	30	150
3-Nitrotoluene	90	14	50	130	35	145
4-Amino-2,6-dinitrotoluene[13]	104	16	55	155	40	170
4-Nitrotoluene	90	14	50	130	35	145
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	106	18	50	160	35	180
Methyl-2,4,6-trinitrophenylnitramine (Tetryl)[13]	98	25	20	175	10	200
Nitrobenzene	94	15	50	140	35	155
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	99	6	80	115	75	120

[10] A number of sporadic marginal exceedances of the control limits are allowed, depending on the number of analytes spiked in the LCS. Refer to section G.2 and Table G-1 for guidance on the appropriate application of control and ME limits.

[11] Provisional limits – outlier analyses during the LCS study resulted in LCS-CLs generated with data from fewer than four laboratories. Limits may be adjusted in the future as additional data become available.

[12] A number of sporadic marginal exceedances of the control limits are allowed, depending on the number of analytes spiked in the LCS. Refer to section G.2 and Table G-1 for guidance on the appropriate application of control and ME limits. LCS control limits were generated using solid phase extraction with acetonitrile only, without removing outliers from the data set (see section G.1 for further explanation).

[13] Provisional limits – outlier analyses during the LCS study resulted in LCS-CLs generated with data from fewer than four laboratories. Limits may be adjusted in the future as additional data become available.

Table G-13. LCS Control Limits for Explosives SW-846 Methods 8330 and 8330A Solid Matrix[14]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
1,3,5-Trinitrobenzene	99	9	75	125	65	135
1,3-Dinitrobenzene	102	8	80	125	70	135
2,4-Dinitrotoluene	102	7	80	125	75	130
2,6-Dinitrotoluene	100	7	80	120	70	130
2,4,6-Trinitrotoluene (TNT)	99	14	55	140	45	155
2-Amino-4,6-dinitrotoluene	102	7	80	125	75	130
2-Nitrotoluene	101	7	80	125	70	130
3-Nitrotoluene	100	7	75	120	70	130
4-Amino-2,6-dinitrotoluene	101	7	80	125	75	130
4-Nitrotoluene	101	8	75	125	70	135
Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	103	10	70	135	65	145
Nitrobenzene	100	8	75	125	70	130
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	100	9	75	125	65	135

Table G-14. LCS Control Limits for Organochlorine Pesticides SW-846 Method 8081 Water Matrix[15]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
4,4'-DDD	88	20	25	150	10	170
4,4'-DDE	87	18	35	140	15	160
4,4'-DDT	92	15	45	140	30	155
Aldrin	83	19	25	140	10	155
alpha-BHC	94	11	60	130	50	140
alpha-Chlordane	93	10	65	125	55	135
beta-BHC	96	10	65	125	55	135
delta-BHC	91	15	45	135	30	150
Dieldrin	95	11	60	130	50	140
Endosulfan I[16]	80	10	50	110	40	120
Endosulfan II	79	17	30	130	10	150
Endosulfan sulfate	96	14	55	135	40	150
Endrin	95	13	55	135	45	145
Endrin aldehyde	96	14	55	135	40	150
Endrin ketone	102	8	75	125	70	135
gamma-BHC	82	18	25	135	10	155
gamma-Chlordane	94	11	60	125	50	135
Heptachlor	87	15	40	130	30	145
Heptachlor epoxide	96	11	60	130	50	140
Methoxychlor	103	16	55	150	40	165

[14] A number of sporadic marginal exceedances of the control limits are allowed, depending on the number of analytes spiked in the LCS. Refer to section G.2 and Table G-1 for guidance on the appropriate application of control and ME limits. Additional limits for poor performing compounds can be found in section G.5.

[15] A number of sporadic marginal exceedances of the control limits are allowed, depending on the number of analytes spiked in the LCS. Refer to section G.2 and Table G-1 for guidance on the appropriate application of control and ME limits. LCS control limits are not available for Hexachlorobenzene and Toxaphane. Sufficient data to perform statistically significant analyses were not received for those analytes during the LCS study. Additional limits for surrogate compounds can be found in section G.6.

[16] Provisional limits – outlier analyses during the LCS study resulted in LCS-CLs generated with data from fewer than four laboratories. Limits may be adjusted in the future as additional data becomes available.

Table G-15. LCS Control Limits for Organochlorine Pesticides SW-846 Method 8081 Solid Matrix [17]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
4,4'-DDD	81	18	30	135	10	155
4,4'-DDE	97	10	70	125	60	135
4,4'-DDT	92	16	45	140	30	155
Aldrin	93	16	45	140	30	155
alpha-BHC	93	10	60	125	50	135
alpha-Chlordane	92	10	65	120	55	130
beta-BHC	95	11	60	125	50	135
delta-BHC	94	12	55	130	45	145
Dieldrin	96	10	65	125	55	135
Endosulfan I	74	20	15	135	10	155
Endosulfan II	89	17	35	140	20	160
Endosulfan sulfate	99	12	60	135	50	145
Endrin	97	12	60	135	50	145
Endrin aldehyde	92	18	35	145	20	165
Endrin ketone	100	11	65	135	55	145
gamma-BHC	91	11	60	125	50	135
gamma-Chlordane	96	10	65	125	55	135
Heptachlor	96	15	50	140	35	155
Heptachlor epoxide	98	11	65	130	55	140
Methoxychlor	100	14	55	145	45	155

Table G-16. LCS Control Limits for Polychlorinated Biphenyls SW-846 Method 8082 Water Matrix[18]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
Aroclor 1016	85	20	25	145
Aroclor 1260	87	19	30	145

Table G-17. LCS Control Limits for Polychlorinated Biphenyls SW-846 Method 8082 Solid Matrix[18]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit
Aroclor 1016	90	16	40	140
Aroclor 1260	96	12	60	130

[17] A number of sporadic marginal exceedances of the control limits are allowed, depending on the number of analytes spiked in the LCS. Refer to section G.2 and Table G-1 for guidance on the appropriate application of control and ME limits. LCS control limits are not available for Hexachlorobenzene, Hexachlorocyclopentadiene, and Toxaphane. Sufficient data to perform statistically significant analyses were not received for those analytes during the LCS study. Additional limits for surrogate compounds can be found in section G.6.

[18] LCS control limits are not available for Aroclors 1221, 1232, 1242, 1248, 1262, and 1268. Sufficient data to perform statistically significant analyses were not received for those analytes during the LCS study. Additional limits for surrogate compounds can be found in section G.6.

Table G-18. LCS Control Limits for Metals SW-846 Methods 6010 and 7470 Water Matrix[19]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
Aluminum	97	5	80	120	80	120
Antimony	98	4	80	120	80	120
Arsenic	98	4	80	120	80	120
Barium	99	4	80	120	80	120
Beryllium	99	4	80	120	80	120
Cadmium	100	4	80	120	80	120
Calcium	98	4	80	120	80	120
Chromium	100	4	80	120	80	120
Cobalt	99	3	80	120	80	120
Copper	99	3	80	120	80	120
Iron	102	4	80	120	80	120
Lead	99	4	80	120	80	120
Magnesium	98	4	80	120	80	120
Manganese	100	4	80	120	80	120
Mercury	100	5	80	120	No ME	No ME
Molybdenum	95	5	80	120	75	120
Nickel	100	4	80	120	80	120
Potassium	98	4	80	120	80	120
Selenium	98	6	80	120	75	120
Silver	97	5	80	120	75	120
Sodium	99	4	80	120	80	120
Thallium	97	4	80	120	80	120
Vanadium	99	4	80	120	80	120
Zinc	100	4	80	120	80	120

[19] The as-generated limits have been adjusted to reflect Method requirements and acceptable calibration uncertainty. A number of sporadic marginal exceedances of the control limits are allowed for Method 6010, depending on the number of analytes spiked in the LCS. Refer to section G.2 and Table G-1 for guidance on the appropriate application of control and ME limits.

Table G-19. LCS Control Limits for Metals SW-846 Methods 6010 and 7471 Solid Matrix [20]

Analyte	Mean	Standard Deviation	Lower Control Limit	Upper Control Limit	Lower ME Limit	Upper ME Limit
Aluminum	95	5	80	120	75	120
Antimony	96	5	80	120	75	120
Arsenic	95	4	80	120	80	120
Barium	98	3	80	120	80	120
Beryllium	99	4	80	120	80	120
Cadmium	97	4	80	120	80	120
Calcium	97	4	80	120	80	120
Chromium	99	5	80	120	80	120
Cobalt	98	4	80	120	80	120
Copper	97	3	80	120	80	120
Iron	100	4	80	120	80	120
Lead	95	4	80	120	80	120
Magnesium	96	3	80	120	80	120
Manganese	97	4	80	120	80	120
Mercury	100	6	80	120	No ME	No ME
Molybdenum	96	5	80	120	75	120
Nickel	97	4	80	120	80	120
Potassium	96	4	80	120	80	120
Selenium	93	4	80	120	75	120
Silver	96	7	75	120	70	125
Sodium	96	4	80	120	80	120
Thallium	94	4	80	120	80	120
Vanadium	99	3	80	120	80	120
Zinc	95	5	80	120	75	120

[20] The as-generated limits have been adjusted to reflect Method requirements and acceptable calibration uncertainty. A number of sporadic marginal exceedances of the control limits are allowed for Method 6010, depending on the number of analytes spiked in the LCS. Refer to section G.2 and Table G-1 for guidance on the appropriate application of control and ME limits.

QC Acceptance Limits

Analyte (Matrix - Sediment)	CAS No.	Analytical Method	Lower Control Limit	Upper Control Limit	RPD
1,1'-Biphenyl	92-52-4	8270D	49	110	40
1,2,4,5-Tetrachlorobenzene	95-94-3	8270D	NS	NS	NS
2,2'-Oxybis(1-chloropropane)	108-60-1	8270D	31	102	40
2,3,4,6-Tetrachlorophenol		8270D	NS	NS	NS
2,4,5-Trichlorophenol	95-95-4	8270D	46	122	40
2,4,6-Trichlorophenol	88-06-2	8270D	38	115	40
2,4-Dichlorophenol	120-83-2	8270D	41	113	40
2,4-Dimethylphenol	105-67-9	8270D	33	123	40
2,4-Dinitrophenol	51-28-5	8270D	45	127	40
2,4-Dinitrotoluene	121-14-2	8270D	48	124	40
2,6-Dinitrotoluene	606-20-2	8270D	47	125	40
2-Chloronaphthalene	91-58-7	8270D	31	127	40
2-Chlorophenol	95-57-8	8270D	37	106	40
2-Methylnaphthalene	91-57-6	8270D/SIM-PAHs	10	107	40
2-Methylphenol	95-48-7	8270D	32	107	40
2-Nitroaniline	88-74-4	8270D	45	123	40
2-Nitrophenol	88-75-5	8270D	35	108	40
3,3'-Dichlorobenzidine	91-94-1	8270D	46	113	40
3-Nitroaniline	99-09-2	8270D	24	127	40
4,6-Dinitro-2-methylphenol	534-52-1	8270D	40	130	40
4-Bromophenyl-phenylether	101-55-3	8270D	46	118	40
4-Chloro-3-methylphenol	59-50-7	8270D	49	118	40
4-Chloroaniline	106-47-8	8270D	10	125	40
4-Chlorophenyl-phenyl ether	7005-72-3	8270D	47	116	40
4-Methylphenol	106-44-5	8270D	39	108	40
4-Nitroaniline	100-01-6	8270D	48	127	40
4-Nitrophenol	100-02-7	8270D	18	154	40
Acenaphthene	83-32-9	8270D/SIM-PAHs	12	111	40
Acenaphthylene	208-96-8	8270D/SIM-PAHs	18	90	40
Acetophenone	98-86-2	8270D	48	111	40
Anthracene	120-12-7	8270D/SIM-PAHs	16	122	40
Atrazine	1912-24-9	8270D	48	116	40
Benzaldehyde	100-52-7	8270D	34	99	40
Benzo(a)anthracene	56-55-3	8270D/SIM-PAHs	40	121	40
Benzo(a)pyrene	50-32-8	8270D/SIM-PAHs	36	114	40
Benzo(b)fluoranthene	205-99-2	8270D/SIM-PAHs	38	123	40
Benzo(g,h,i)perylene	191-24-2	8270D/SIM-PAHs	43	120	40
Benzo(k)fluoranthene	207-08-9	8270D/SIM-PAHs	40	126	40
Bis(2-chloroethoxy)methane	111-91-1	8270D	39	108	40
Bis(2-chloroethyl)ether	111-44-4	8270D	32	105	40
Bis(2-ethylhexyl)phthalate	117-81-7	8270D	45	128	40
Butylbenzylphthalate	85-68-7	8270D	46	128	40
Caprolactam	105-60-2	8270D	43	121	40
Carbazole	86-74-8	8270D	47	128	40
Chrysene	218-01-9	8270D/SIM-PAHs	41	124	40
Dibenzo(a,h)anthracene	53-70-3	8270D/SIM-PAHs	38	125	40
Dibenzofuran	132-64-9	8270D	45	112	40
Diethylphthalate	84-66-2	8270D	49	123	40
Dimethylphthalate	131-11-3	8270D	48	120	40

QC Acceptance Limits

Analyte (Matrix - Sediment)	CAS No.	Analytical Method	Lower Control Limit	Upper Control Limit	RPD
Di-n-butylphthalate	84-74-2	8270D	51	129	40
Di-n-octylphthalate	117-84-0	8270D	49	142	40
Fluoranthene	206-44-0	8270D/SIM-PAHs	26	133	40
Fluorene	86-73-7	8270D/SIM-PAHs	19	108	40
Hexachlorobenzene	118-74-1	8270D	44	122	40
Hexachlorobutadiene	87-68-3	8270D	33	103	40
Hexachlorocyclo-pentadiene	77-47-4	8270D	18	121	40
Hexachloroethane	67-72-1	8270D	30	96	40
Indeno(1,2,3-cd)pyrene	193-39-5	8270D/SIM-PAHs	42	123	40
Isophorone	78-59-1	8270D	41	113	40
Naphthalene	91-20-3	8270D/SIM-PAHs	10	112	40
Nitrobenzene	98-95-3	8270D	33	114	40
N-Nitroso-di-npropylamine	621-64-7	8270D	32	115	40
N-Nitrosodiphenylamine	86-30-6	8270D	53	150	40
Pentachlorophenol	87-86-5	8270D	27	138	40
Phenanthrene	85-01-8	8270D/SIM-PAHs	16	123	40
Phenol	108-95-2	8270D	36	108	40
Pyrene	129-00-0	8270D/SIM-PAHs	34	121	40
4,4'-DDD	72-54-8	8081B	68	139	20
4,4'-DDE	72-55-9	8081B	67	135	20
4,4'-DDT	50-29-3	8081B	67	148	20
Aldrin	309-00-2	8081B	60	137	20
alpha-BHC	319-84-6	8081B	59	136	20
alpha-Chlordane	5103-71-9	8081B	61	123	20
beta-BHC	319-85-7	8081B	60	136	20
delta-BHC	319-86-8	8081B	64	138	20
Dieldrin	60-57-1	8081B	68	137	20
Endosulfan I	959-98-8	8081B	63	129	20
Endosulfan II	33213-65-9	8081B	66	134	20
Endosulfan sulfate	1031-07-8	8081B	68	137	20
Endrin	72-20-8	8081B	75	149	20
Endrin aldehyde	7421-93-4	8081B	37	122	20
Endrin ketone	53494-70-5	8081B	68	118	20
gamma-BHC (Lindane)	58-89-9	8081B	59	146	20
gamma-Chlordane	5103-74-2	8081B	64	140	20
Heptachlor	76-44-8	8081B	58	129	20
Heptachlor epoxide	1024-57-3	8081B	63	132	20
Methoxychlor	72-43-5	8081B	71	151	20
Toxaphene	8001-35-2	8081B	70	130	20
Aroclor-1016	12674-11-2	8082A	70	130	20
Aroclor-1221	11104-28-2	8082A	NS	NS	NS
Aroclor-1232	11141-16-5	8082A	NS	NS	NS
Aroclor-1242	53469-21-9	8082A	NS	NS	NS
Aroclor-1248	12672-29-6	8082A	NS	NS	NS
Aroclor-1254	11097-69-1	8082A	NS	NS	NS
Aroclor-1260	11096-82-5	8082A	70	130	20
Aroclor-1262	37324-23-5	8082A	NS	NS	NS
Aroclor-1268	11100-14-4	8082A	NS	NS	NS
Aluminum	7429-90-5	6020A	80	120	20

QC Acceptance Limits

Analyte (Matrix - Sediment)	CAS No.	Analytical Method	Lower Control Limit	Upper Control Limit	RPD
Antimony	7440-36-0	6020A	**80**	**120**	**20**
Arsenic	7440-38-2	6020A	**80**	**120**	**20**
Barium	7440-39-3	6020A	**80**	**120**	**20**
Beryllium	7440-41-7	6020A	**80**	**120**	**20**
Cadmium	7440-43-9	6020A	**80**	**120**	**20**
Calcium	7440-70-2	6020A	**80**	**120**	**20**
Chromium	7440-47-3	6020A	**80**	**120**	**20**
Cobalt	7440-48-4	6020A	**80**	**120**	**20**
Copper	7440-50-8	6020A	**80**	**120**	**20**
Iron	7439-89-6	6020A	**80**	**120**	**20**
Lead	7439-92-1	6020A	**80**	**120**	**20**
Magnesium	7439-95-4	6020A	**80**	**120**	**20**
Manganese	7439-96-5	6020A	**80**	**120**	**20**
Mercury	7439-97-6	7471B	**80**	**120**	**20**
Nickel	7440-02-0	6020A	**80**	**120**	**20**
Potassium	7440-09-7	6020A	**80**	**120**	**20**
Selenium	7782-49-2	6020A	**80**	**120**	**20**
Silver	7440-22-4	6020A	**80**	**120**	**20**
Sodium	7440-23-5	6020A	**80**	**120**	**20**
Thallium	7440-28-0	6020A	**80**	**120**	**20**
Tin	7440-31-5	6020A	**80**	**120**	**20**
Vanadium	7440-62-2	6020A	**80**	**120**	**20**
Zinc	7440-66-6	6020A	**80**	**120**	**20**

NS = Not spiked

Surrogates

Analytical Method (Matrix - Sediment)	Analyte	Lower Control Limit	Upper Control Limit
8270 Solid:	2,4,6-Tribromophenol	**30**	**117**
	2-Fluorobiphenyl	**33**	**102**
	2-Fluorophenol	**28**	**104**
	Nitrobenzene-d5	**22**	**109**
	Phenol-d5	**27**	**103**
	Terphenyl-d14	**41**	**120**
SIM PAH Solid:	2-Methylnaphthalene-d10	**17**	**119**
	Fluoranthene-d10	**37**	**135**
8081 Solid:	Decachlorobiphenyl	**57**	**110**
	Tetrachloro-m-xylene	**37**	**91**
8082 Solid:	Decachlorobiphenyl	**41**	**132**
	Tetrachloro-m-xylene	**35**	**106**

All limits are in-house limits. Control limits are obtained from control charts or the method.
Results outside DoD QSM limits will be qualified and narrated.

QC Acceptance Limits

Analyte (Matrix - Surface Water)	CAS No.	Analytical Method	Lower Control Limit	Upper Control Limit	RPD
Aluminum	7429-90-5	6020A	**80**	**120**	**20**
Calcium	7440-70-2	6020A	**80**	**120**	**20**
Iron	7439-89-6	6020A	**80**	**120**	**20**
Magnesium	7439-95-4	6020A	**80**	**120**	**20**
Manganese	7439-96-5	6020A	**80**	**120**	**20**

Appendix I
Field Audit Checklists

Site: **Date:**

Evaluator/Title:

EVALUATED ITEM	Y	N	NA	Comments
Resolution Consultants SOP 3-02 Logbooks				
Indelible ink was used for all paper documentation.				
Records are legible.				
Errors in documentation were corrected without obliteration.				
Appropriate entries were made in the records such as:				
- Dates (month/day/year) and times (military) of all on-site activities and entries made in logbooks/forms.				
- Site name and description.				
- Weather conditions, including temperature and relative humidity.				
- Fieldwork documentation, including site entry and exit times.				
- Descriptions of, and rationale for, approved deviations from the Sampling and Analysis Plan.				
- Names of all sampling personnel.				
- Photograph references				
- Site sketches and diagrams made on site				
- Identification and description of sample morphology, collection locations, and sample numbers				
- The type(s) of sampling equipment used to collect all samples was recorded in the field record.				
- Sample collection information, including matrix, dates (month/day/year) and times (military) of sample collections, sample collection methods and devices, station location numbers, sample collection depths/heights, sample preservation information, sample pH (if applicable), analysis requested (analytical groups), etc.				
- Field quality control (QC) sample information				
- Site observations, field descriptions, equipment used, and field activities accomplished to reconstruct field operations				
- Field calculations				
- Calibration records				
- Equipment decontamination procedures and effectiveness				
- User signatures				
Resolution Consultants SOP 3-03A Sample Labeling and Chain-of-Custody				
Waterproof labels were applied to each sample container containing the following information:				
- Sample identification number				
- Date and time of sample collection				
- Samplers initials				
- Sample preservation (if chemical preservation is used)				
- Analysis to be performed on the sample				
All chain-of-custody forms were complete and contained the following information:				
- Sample identification number				
- Date and time of sample collection				
- Matrix				
- Sample preservation (if chemical preservation is used)				
- Analysis to be performed on the sample				
- Number of containers				
- Signature of the person relinquishing sample custody, and relinquishment date and time				
- The number of coolers in each shipment				

EVALUATED ITEM	Y	N	NA	Comments
- Whether the samples were iced				
- Courier and air bill number				
A minimum of two custody seals were on cooler.				
Resolution Consultants SOP 3-04A Sample Handling, Storage, and Shipping				
Environmental samples were packaged were properly packged as follows:				
- Sufficient headspace in each bottle (except for volatile organic compounds).				
- All bottle lids were tight.				
- Glass bottles were wrapped in bubble wrap, then placed in polyethylene bags.				
- The cooler was sturdy, had the drain plugs taped, and lined with plastic bag.				
- Cushioning/absorbent material was placed in the bottom of the cooler.				
- Blue or double bagged ice was used, as appropriate for analyses being performed.				
- All space in cooler was filled with ice, bubble wrap and/or absorbent material.				
- Large plastic bag holding the samples was securely fastened.				
- Completed COC form was sealed in a bag and adhered to the top of the cooler.				
- Cooler was closed and securely taped with COC seals affixed to opposing sides of the cooler.				
- Cooler was labeled with appropriate signage such as fragile or this-end-up.				
Air bill paperwork was properly prepared				
Copies of all COCs and air bills were retained for the project file				
Resolution Consultants SOP 3-05 IDW Management				
IDW was containerized using DOT approved drums				
Recycled drums were not used for hazardous waste, PCBs or other regulated shipments				
Only drums in sound condition were used. (No partially attached or missing rings).				
Drums were properly labeled from previous site data or as unknown awaiting test results				
Labels were constructed of weatherproof material and labeled with the following with a permanent marker:				
- Description of waste (i.e., purge water, soil cuttings)				
- Contact information (i.e., contact name and telephone number)				
- Date when the waste was first accumulated				
- EPA identification number {Hazardous Waste Only}				
Each container of waste generated were recorded in the field notebook				
Drums were stored properly.				
FDEP FC 1000 Cleaning / Decontamination				
Luminox (or a non-phosphate solvent based equivalent), Liqui-Nox (or non-phosphate equivalent) or Alconox (or equivalent) were used for decontamination. *FC 1001*				
When Luminox was used, no solvent rinse was performed. *FC 1001*				
When Liqui-Nox or Alconox were used, solvent rinses were used. *FC 1001*				
Water source was appropriate for the analytical method and documented in logbook. *FC 1001 Section 3*				
Decontamination water source was documented in logbook. *FC 1001 Section 3*				
Reagents were properly stored as follows: *FC 1002*				
- Detergents in original containers or HDPE or polypropylene container.				
- Solvents in original container until field use. Use dispensing containers constructed of glass, Teflon, or stainless steel.				
- Analyte-free water stored in container appropriate to the type of water being stored.				
All non-dedicated equipment was cleaned/decontaminated prior to sampling. *FC 1003*				
Clean and dirty equipment were stored separately. *FC 1003*				
Clean equipment were protected by using aluminum foil, plastic bags, etc. *FC 1003*				

EVALUATED ITEM	Y	N	NA	Comments
Equipment were rinsed with water after use even when cleaned elsewhere *FC1003 and FC 1110*				
The following procedure was used for all analyte groups for Teflon, Stainless Steel and Glass Equipment: *FC 1131*				
1. Rinse equipment with hot tap water.				
2. Soak equipment in a hot, sudsy water solution				
3. If necessary, use a brush to remove particulate matter or surface film.				
4. Rinse thoroughly with hot tap water.				
5. If samples for trace metals or inorganic analytes will be collected with the equipment and the equipment is not stainless steel, thoroughly rinse (wet all surfaces) with the appropriate acid solution.				
6. Rinse thoroughly with analyte-free water. Use enough water to ensure that all equipment surfaces are thoroughly flushed with water.				
7. If samples for volatile or extractable organics will be collected, rinse with isopropanol. Wet equipment surfaces thoroughly with free-flowing solvent. Rinse thoroughly with analyte-free water.				
8. Allow to air dry. Wrap and seal as soon as the equipment is air-dried.				
9. If isopropanol is used, the equipment may be air-dried without the final analyte-free water rinse; however, the equipment must be completely dry before wrapping or use.				
The following procedure was used for all analyte groups for Plastic Equipment: *FC 1131*				
1. Rinse equipment with hot tap water.				
2. Soak equipment in a hot, sudsy water solution				
3. If necessary, use a brush to remove particulate matter or surface film.				
4. Rinse thoroughly with hot tap water.				
5. Thoroughly rinse (wet all surfaces) with the appropriate acid solution				
6. Rinse thoroughly with analyte-free water. Use enough water to ensure that all equipment surfaces are thoroughly flushed with water.				
7. Wrap clean sampling equipment				
Sample tubing was checked for discoloration and elasticity. *FC 1160 section 1*				
New Teflon tubing was transported to the field in precut, *preleased* sections or was rinsed in the field with pesticide-grade solvent and allowed to dry overnight unless the supplier provided certification that the tubing is clean. *FC 1160 sections 2 and 3*				
New polyethylene and polypropylene tubing was cleaned in hot sudsy water followed by a tap water and analyte-free water rinse. *FC 1160 section 3.1.2*				
Flexible Tubing used in pump heads of automatic samplers and other peristaltic pumps were replaced after each sampling point. *FC 1160 section 4*				
Submersible pumps we reconstructed and tubing material were in accordance with Tables FS 1000-1, FS 1000-2, and FS-1000-3.				
Field instruments (tapes, meters, etc.) were decontaminated using the following procedures: *FC 1210*				
1. Equipment body, probes, and cables were wiped down with lab-grade detergent solution.				
2. Rinsed thoroughly with tap water.				
3. Rinsed thoroughly with analyte-free water.				
4. Equipment was stored in according to the manufacturer's recommendation or wrapped in aluminum foil, untreated butcher paper or untreated plastic bags.				
Containers were obtained from subcontracted laboratory that is accredited under the National Environmental Laboratory Accreditation Program (NELAP). *FC 1310*				

EVALUATED ITEM	Y	N	NA	Comments
For equipment decontaminated on-site in the field, the date and time of the cleaning procedure associated with the affected equipment was recorded in the field records. *FC 1410 section 1*				
Certificates of cleanliness provided by vendors supplying cleaned equipment or sample containers were archived and linked to the date of the sampling project and the types of equipment or sample containers used for the project. *FC 1410 section 2*				
Packing slips for laboratory-supplied containers were retained. *FC 1420 section 1*				
The lot numbers and inclusive dates of use were recorded for all reagents, detergents, solvents and other chemicals used for decontamination and preservation of samples. *FC 1430*				
FDEP FS 1000 General Sampling Procedures				
Preliminary Activities				
Equipment construction was appropriate for the analytes of interest. *FS 1001, section 2.2 and Tables FS 1000-1, FS 1000-2, & FS 1000-3*				
Equipment was brought precleaned to the field. *FS 1001, section 2.3*				
Dedicated equipment was decontaminated prior to use. *FS 1001, section 3.4*				
Sample container construction and materials were appropriate for the analytes collected. *FS 1001, section 4.1 and Table FS 1000-2, and Tables 1000-4 through FS 1000-9*				
All containers and container caps were free of cracks, chips, discoloration and other features that might affect the integrity of collected samples. *FS 1001, section 4.2*				
Contamination Prevention				
Every effort was made to prevent cross-contamination of samples and contamination of environment. *FS 1002 section 1.1*				
Sampling originated from the least contaminated or background location (source or site) first and progressed to the most contaminated location. *FS 1002, section 1.1.2*				
Samples were segregated during storage, transport and shipping where cross-contamination potential was suspected. *FS 1002, sections 1.1.2.1, 1.1.4 and 1.1.4.1*				
When collecting water samples, intermediate collection devices were rinsed with ample amounts of site water prior to collecting the sample. *FS 1004*				
Sample containers containing premeasured preservatives were not rinsed with sample prior to collection. *FS 1004*				
Samples for different analyte groups were collected in an appropriate order, unless field conditions or the sampling plan required an alternative collection sequence. *FS 1002, section 2.1*				
Care was taken to avoid contact with samples and sample container interiors. *FS 1003, section 3*				
Sample container tags or labels were attached so as to prevent contact between the sample and the label or tag when pouring or dispensing from the container. *FD 5000 section 1.2*				
Composite Samples				
Composite samples were collected according to the sampling plan, permit or other DEP program requirements. *FS 1002, section 3.1*				
Composite subsamples or aliquots were collected from each designated sampling point (source, location or depth). *FS 1002, section 3.2*				
Equal amounts of each subsample or aliquot were collected in appropriately cleaned sample containers. *FS 1002, section 3.2.2*				
Approximate or measured amounts of each aliquot or subsample collected were recorded in the field documentation, if applicable to the sampling plan. *FS 1002, section 3.2.3*				

EVALUATED ITEM	Y	N	NA	Comments
Use of Protective Gloves				
When required, new, clean, unpowdered gloves were worn and changed as needed by all samplers handling purging equipment, sampling equipment, measurement equipment and sample containers. *FS 1003, sections 2, 3, 4 and 5*				
Use of Fuel-Powered Equipment and Vehicles				
All fuel-powered equipment was placed and vehicles were parked downwind of or well away from sampling locations where fuel contamination of samples, purging equipment or sampling equipment may have interfered with representative sample collection. *FS 1005, section 1*				
Samplers wore disposable gloves while handling fuel powered equipment and disposed of fuel contaminated gloves downwind or well away from the sampling location. *FS 1005, section 2*				
Sampling activities were interrupted while fueling of vehicles or storage tanks occurred near the sampling location. *FS 1005, section 3*				
Preventive Maintenance and Repair of Equipment and Instruments				
Manufacturers' suggested maintenance activities and any repairs are performed and documented for all applicable equipment and instruments. *FS 1007 sections 1 & 3*				
Each equipment or instrument unit requiring documented maintenance or repair is assigned a unique identification code or designation. *FS 1007 section 2*				
Sample Preservation and Preservation Verification				
All sample preservation conformed to DEP SOP requirements. *FS 1006, sections 1 – 1.2 and Tables 1000-4 through FS 1000-9*				
All grab samples were preserved within 15 minutes of collection. *FS 1006, section 2*				
If required, composite sampling equipment was maintained as 4°C. *FS 1006, 3.1*				
When composite samples are collected, chemical preservation begins within 15 minutes of the last collected subsample. *FS 1006, section 3.2*				
FDEP FS 2000 General Aqueous Sampling				
Samples were collected starting at the downstream location and progressed to the upstream location, if applicable. FS 1002, section 1.1.2				
Intermediate collection devices were rinsed with ample amounts of site water prior to collecting the sample. *FS 2110, section 1.1.3.1*				
Rinse water from intermediate devices was discarded away from and downstream of the sampling location. *FS 2110, section 1.1.3.2*				
Sample containers containing premeasured preservatives were not rinsed with sample prior to collection. *FS 1004*				
Sample containers for oil & grease or TPH samples were not rinsed with sample prior to collection. *FS 1004*				
All samples requiring pH adjustment were tested for proper pH preservation during first-time sampling for the project. *FS 2000, section 1.4.2.1*				
pH paper was not inserted into sample containers. *FS 2001. section 3.6.2*				
Applicable samples were filtered using a 0.45 um pore size filter within 15 minutes of collection, before addition of chemical preservatives. *FS 2001, section 2.1 and 1.3.7*				
Bubbles present in the VOC sample comprised a combined volume of less than 5mm in diameter (pea-sized). *FS 2004, section 4.4.1*				
Unacidified VOC samples were collected where effervescence or large bubbles were observed after addition of acid. *FS 2004, section 3.3.1.2*				
Rinse water from intermediate devices was discarded away from and downstream of the sampling location. *FS 2110, section 1.1.2.1*				
Samples requiring pH adjustment were tested for proper pH preservation *FS 2000, section 1.4*				
pH paper was not inserted into sample containers *FS 2001, section 3.6.2*				

EVALUATED ITEM	Y	N	NA	Comments
When required samples are placed on wet ice. *FS 2003, section 3.2, FS 2004, section 5.4, FS 2005, section 5.2, FS 2006, section 4.6, FS 2009, section 3.6*				
Applicable samples were filtered within 15 minutes of collection, before addition of chemical preservatives. *FS 2000, section 1.3.4 & FS 2001, section 2.1*				
Unless otherwise specified by the sampling plan, applicable samples were filtered using a 0.45 um pore size for the filter. *FS 2000, section 1.3.5*				
FDEP FS 2100 Surface Water Sampling				
Contamination Prevention, Sampling Locations & General Cautions				
Samples were collected starting at the downstream location and progressed to the upstream location, where applicable. *FS 1002, section 1.1.3 & FS 2100, section 2.6*				
When wading, samples were collected upstream and away from the body. *FS 2100, section 2.2*				
Care was exercised to not disturb bottom sediments during sample collection. *FS 2100, section 2.3*				
Water samples were collected prior to sediment sampling at the same location or sample source. *FS 2100, section 2.4*				
The bow of the motorized watercraft was pointed upstream, where applicable. *FS 2100, section 2.1*				
Samples were collected at or near the bow of the watercraft, away and upwind from the watercraft engine and any other fuel or oil sources. *FS 2100, section 2.1*				
Representative sampling locations and depths were selected to account for homogeneous and heterogeneous conditions in the water body. *FS 2110, section 2.5*				
Unless directed by permit or other regulation, samples were collected away from artificial structures such as bridges, docks, weirs, dams, etc. *FS 2100, section 2.6*				
Manual Sampling Using Sampling Containers as Collection Device				
Sample containers were submerged neck first, inverted into the oncoming direction of flow where applicable, slowly filled leaving headspace and returned to the surface for preservation, if appropriate. *FS 2110, section 1.1.1*				
Pole samplers were used in a fashion similar to that described above, as practical. *FS 2110. Section 1.1*				
Samples collected within the top 12 inches of the water column. *FS 2110, 1.1*				
Use of Intermediate Vessels as the Collection Device				
Intermediate collection devices were constructed of material appropriate for the analytes to be measured. *FS 2110, section 1.1.2, FS 1001, section 2.2 and Tables FS 1000-1 through FS 1000-3*				
Intermediate collection devices were rinsed with ample amounts of site water prior to collecting the sample. *FS 2110, section 1.1.2.1*				
Rinse water from intermediate devices was discarded away from and downstream of the sampling location. *FS 2110, section 1.1.2.1*				
For depth sampling, the following procedures were performed: *FS 2110, sections 1.2.1, 1.2.2 & 1.2.3*				
- The water column was measured for maximum depth or was otherwise determined from reference information.				
- The sampling point depth was accurately determined and recorded.				
- Care was exercised to keep bottom sediments undisturbed during the depth-sampling procedure.				
If double-valve bailers were used, care was taken to determine the appropriateness of use for the sampling application and discrete depth samples were not required *FS 2110, section 1.2.2*				
Bailers were slowly lowered through the water column to allow maximum flushing of the bailer during descent. *FS 2110, section 1.2.2*				

EVALUATED ITEM	Y	N	NA	Comments
FDEP FS 2200 Groundwater Sampling				
Well head inspection and water level measurement				
Standing water present in the well head was removed. *FS 2211 section 2.1*				
Water levels were measured to the nearest 0.01 foot. *FS 2211 section 3.2.*				
The well bottom was not sounded with the measuring tape.				
General purging procedures				
Well volume was correctly determined. *FS 2211 section 5*				
Equipment volume was correctly determined. *FS 2211 section 6*				
The pump, tubing or bailer was not allowed to drop to the bottom of the well. *FS 2201, section 1*				
Depth to groundwater was measured at frequent intervals during purging. *FS 2213 sections 2.1.6, 2.2.6, 2.3.5, 2.4.5, 3.1.3 and 3.2.3*				
The placement of the pump or tubing intake was correctly determined according to the position of the water level in relation to the well screen interval and the purging procedure used. *FS 2213 sections 1.1 – 1.3*				
The placement depth of the pump or tubing intake was recorded for each instance of positioning.				
General procedures for purging with a pump				
Drawdown was stabilized so that the pumping rate matched the formation recharge rate. *FS 2213 sections 2.1.8, 2.2.8, 2.3.7, 2.4.7, 3.1.5 and 3.2.5*				
Purging minimal (equipment) volumes with a pump from the middle of a fully submerged well screen interval				
The well screen interval (length) was <10 feet. *FS 2213 section 1.1*				
The pump or tubing intake was placed within the middle of the screen interval. *FS 2213 section 1.1*				
A minimum total of at least 3 equipment volumes was purged. *FS 2212 section 2.2*				
The purging pump was also used to collect the samples. *FS 2213 section 1.1*				
Purging from the top of the water column with a pump				
The pump or tubing was placed at the top of the water column above the submerged well screen and a minimum total of 1½ well volumes was purged. *FS 2212 section 2.1*				
The pump or tubing was placed at the top of the water column in the partially submerged well screen interval and a total of at least one well volume was purged prior to commencing measurement of stabilization parameters. *FS 2212 section 2.3 and FS 2213 section 1.3*				
Purging in the middle of the partially submerged screen interval with a pump				
The pump/tubing was placed within the middle of the submerged portion of the screen interval and a minimum total of at least one well volume was purged prior to stabilization measurements. *FS 2212 section 2.3 and FS 2213 section 1.3*				
The purging pump was also used to collect the samples. *FS 2213 section 1.3*				
Frequency of measurement for purge stabilization parameters				
A flow cell was used to measure stabilization parameters during pumping.				
Downhole measurements were used for wells purged by bailing.				
If the well was purged from the top of the water column above a fully submerged screen, at least one well volume was purged prior to commencing purge stabilization measurements and at least ¼ well volume was purged at the stabilized pumping rate between consecutive purge stabilization measurements. *FS 2212 section 2.1*				
If the well was purged from the top of the water column in a partially submerged screen interval, at least one well volume was purged prior to commencing purge stabilization measurements and at least 2 minutes of continuous purging at the stabilized pumping rate elapsed between consecutive purge stabilization measurements. *FS 2212 section 2.3*				

EVALUATED ITEM	Y	N	NA	Comments
If the well was purged from the middle of a fully submerged screen interval, at least one equipment volume was purged prior to commencing purge stabilization measurements and at least 2 minutes of continuous purging at the stabilized pumping rate elapsed between consecutive purge stabilization measurements. *FS 2212 section 2.2*				
Determination of purging completion				
Three (3) consecutive measurements of the three parameters listed below were within stated limits *FS 2212 section 3.1 and 3.2.*				
Temperature: ±0.2° C				
pH: ±0.2 standard pH units				
Specific Conductance: ± 5.0% of reading				
Measured dissolved oxygen and turbidity were below the following thresholds. *FS 2212 section 3.1*				
DO ≤20% saturation at the measured temperature				
Turbidity ≤20 NTU				
For wells where DO and turbidity thresholds could not be met for justified reasons, consecutive measurements were within the above stated limits for pH, conductivity and temperature; and, DO and turbidity measurements were within the following stated limits. *FS 2212 section 3.2*				
DO: ±0.2 mg/L or 10%, whichever is greater				
Turbidity: ±5 NTUs or 10%, whichever is greater				
For wells failing to meet stabilization criteria after five (5) well volumes, testing instrumentation, calibrations, purging flow rate, flowcells and all tubing connections were determined to be functional and acceptable for measuring stabilization parameters. *FS 2212 section 3.3*				
Dry-purged wells were purged only once according to FS 2212, section 3.4.1 *FS 2212 section 3.4*				
Purging Low Permeability Wells				
The well was known to purge dry due to low formation permeability and the samplers determined that the well could not be purged according to FS 2212 and FS 2213. *FS 2212 section 3.4.1*				
Very small diameter Teflon, PE or PP tubing and the smallest possible pump chamber and flow cell volumes were used. *FS 2212 section 3.4.1.2*				
The pump tubing wall was thick enough to minimize oxygen transfer. *FS 2212 section 3.4.1.3*				
The pump or tubing intake was placed within the well screen interval. *FS 2212 section 3.4.1.1*				
The purging flow rate was ≤100 mL/min. *FS 2212 section 3.4.1.4*				
Pump rate was adjusted to minimize drawdown. *FS 2212 section 3.4.1.4*				
A minimum total of at least 2 equipment volumes was purged before stabilization parameters were measured and samples were collected. *FS 2212 section 3.4.1.5*				
Temperature, pH, conductivity, DO and turbidity were measured once immediately prior to collecting the samples during stabilized pumping after at least 2 equipment volumes were purged. *FS 2212 section 3.4.1.6 and FS 2222 section 2*				
The same pump was used to purge and collect the samples. *FS 2212 section 3.4.1*				
Collecting samples from Low Permeability Wells				
The same pump and tubing was used to purge and collect the samples. *FS 2222 section 1*				
The *purge* position of the pump or tubing intake was maintained throughout sample collection.				
The stabilized purge pumping rate was maintained throughout sample collection unless pumping was ceased to allow formation recharge. *FS 2222 section 1*				

EVALUATED ITEM	Y	N	NA	Comments
Samples were collected immediately after purging was completed while continuing a stabilized pumping rate or as soon as sufficient recharged sample water was available. *FS 2222 section 1*				
Maximum elapsed times between purging and sampling				
Stabilization parameters were re-measured if the start of sample collection began more than one hour after completion of purging. *FS 2212 section 4*				
The well was re-purged if the second set of stabilization measurements exceeded the original measurements by more than + 10%. *FS 2212 section 4*				
Dry-purged wells were allowed to recharge after one purge per FS 2212, section 3.4 before measuring stabilization parameters and collecting samples. *FS 2212 section 3.4 – 3.4.1.6 and FS 2222 section 1*				
Samples were collected within 6 hours of purging completion. *FS 2212 section 4*				
General Requirements for Sample Collection Equipment				
Pumps were decontaminated or replaced between wells. *FS 2213*				
Pump tubing was decontaminated or replaced between wells.				
Reusable bailers were decontaminated between wells.				
Material construction of pumps, tubing and bailers conformed with requirements of Tables FS 1000-1 through FS 1000-3 and Table FS 2200-1 for the analytes collected. *FS 2220 section 3.1 and FS 2201 section 2.2*				
Collecting samples with pumps				
Peristaltic pumps were used with an organic trap assembly to collect extractable organic samples. *FS 2221 section 1.1.2.2*				
Collection of volatile organic (VOC) samples with peristaltic pumps employed the "straw technique" for collection from the well and either gravity flow or reverse pumping for container filling. *FS 2221 section 1.1.1 – 1.1.1.16*				
Collecting samples with bailers				
Bailers were used to collect samples under the conditions specified in Table FS 2200-3. FS 2221 section 2				
The bailer was lowered and raised at the rate of 2 cm/sec into the top of the water column. FS 2221 sections 2.2.3.1, 2.2.6.1 and 2.2.9				
VOC samples were poured or drained into sample vials with no aeration or agitation.				
Samples for sulfites, sulfides or hydrogen sulfide were poured or drained into sample vials with no aeration or agitation.				
Filtering groundwater samples for metals				
The metals sample filtration procedure was preapproved by the FDEP project manager for the site or project. *FS 2225 section 1*				
A .45 µm filter was used for filtering non-metal constituents. *FS 2000 section 1.3.*				
A 1µm in-line filter was used for filtering metal samples. *FS 2225 section 1.1*				
All oxygen (air) was flushed from the in-line filter and any connected tubing prior to sample filtration. *FS 2225 section1.1.1 & 1.1.2*				
The equipment configuration for filtering metals conformed with prohibitions FS 2225 section 1.4. *FS 2225 section 1.4*				
Purging and sampling wells with in-place plumbing, air strippers or other plumbed remedial systems				
The purging and sampling point was located upstream of storage or pressure tanks where possible. *FS 2214, FS 2215 and FS 2223*				
Hoses, aerators and filters removed were removed prior to purging and sampling where possible. *FS 2214, FS 2215 and FS 2223*				
The plumbed system was purged at the selected purge point (valve or spigot) until the purge completion criteria listed in FS 2212 section 3 were met. *FS 2214 section 2 and FS 2215 section 1*				

EVALUATED ITEM	Y	N	NA	Comments
Air strippers and other remedial systems were purged for a minimum of one minute. *FS 2215 section 2*				
The flow rate was reduced to less than 500 mL/minute (1/8"" stream) or approximately 0.1 gal/minute before collecting samples. *FS 2214 section 3, FS 2215 and FS 2224*				
FDEP FS 4000 Sediment Sampling				
Surface water was collected prior to sediment samples. *FS 4000 section 1.3*				
Sediment was collected using appropriate equipment: scoops, corers and dredges or grab samplers. *FS 4000 section 3*				
Scoop and Core Sampling				
Scoop sampling was performed using the following procedures: *FS 4000 section 3.6*				
- Facing the direction of flow and approach the location from the downstream direction.				
- Bottom was not disturbed prior to scooping.				
- Sample was scooped in the upstream direction of flow.				
Core sampling was performed using the following procedures: *FS 4000 section 3.7*				
Sample washout was minimized by fitting the leading edge of the corer with a nosepiece or core catcher OR by fitting the top or back end with a check valve. *FS 4000 section 3.7.7*				
Corer was rotated, if needed around the axis and not back and forth. *FS 4000 3.7.8*				
Upon withdrawal from the water surface, the corer was capped to prevent the sample from sliding out. *FS 4000 3.7.9*				
Core was extruded into the sample bottles with an appropriate utensil. *FS 4000 3.7.11*				
Dredge or Grab Sampling				
Sampling was performed using the following procedures: *FS 4000 3.8*				
- Dredge was lowered to the bottom making sure it settled flat.				
- Tension was removed from the line enabling dredge to close as the line was pulled upward during retrieval.				
- Sample was pulled to the surface making sure the jaws were fully closed and no sample was lost.				
- Jaws were carefully opened and the sample was placed into the bottles with an appropriate utensil.				
FDEP FT Series SOPs				
General Requirements for Calibration Activities (FT 1000)				
All field-testing equipment and instruments brought to the field appeared to function properly. *FT 1000, section 1.3.4*				
All sample measurements were chronologically bracketed between acceptable calibration verifications. *FT 1000, sections 2.1.4 & 2.2.1*				
All sample measurements were quantitatively bracketed with an appropriate choice of calibration standards for calibrations or verifications. *FT 1000, sections 2.1.5 & 2.2.2*				
An initial calibration verification was performed immediately after an initial calibration was completed. *FT 1000, section 2.2.4*				
If the initial calibration verification failed to meet the acceptance criteria, the instrument was immediately recalibrated or removed from service. *FT 1000, section 2.2.4.1*				
If an instrument failed to meet continuing calibration verification acceptance criteria, either additional attempts were made to obtain an acceptable verification or an initial calibration was performed. *FT 1000, section 2.2.5.4*				
Sample measurements were qualified as estimated (“J” data qualifier code) when the instrument calibration could not be verified. *FT 1000, section 2.2.5.4*				
An explanatory narrative was provided in the field record for all sample “J” values. *FT 1000, section 2.2.5.4*				

EVALUATED ITEM	Y	N	NA	Comments
Documentation for Field Testing Activities				
Information about all calibration standards and reagents used for field testing were linked to the calibration information associated with the field testing measurements for the project. *FT 1000 section 4*				
The date of receipt, expiration date and date of first use for all calibration standards and reagents used on the sampling project were recorded. *FT 1000 section 4.1.1*				
The concentration or other assay value, the vendor catalog number and the description of the standard or reagent were recorded for all preformulated solutions, neat liquids and powders. *FT 1000 section 4.1.2*				
Certificates of assay, grade and other vendor specifications for all standards and reagents were retained and recorded. *FT 1000 section 4.1.2.2*				
For standards formulated in-house for use on the sampling project, the dates of preparation and all calculations used to prepare calibration standards and reagents were recorded. *FT 1000 section 4.1.4*				
All acceptable initial calibrations and calibration verifications were documented and linked to the field measurements for the sampling project. *FT 1000 section 4.2*				
Manufacturer-certified calibration specifications were retained for all factory-calibrated instruments used for the sampling project. *FT 1000 section 4.2.1*				
For each instrument unit used for the sampling project, the following information was recorded for all calibrations: *FT 1000 section 4.2*				
- Unique identification (designation code) for the instrument calibrated				
- Manufacturer name, model number and identifying number				
- Date and time of each initial calibration and calibration verifications				
- Instrument reading or result (display value) for all calibration verifications, with appropriate measurement units				
- Names of analysts performing each calibration for the instrument				
- Description of each calibration standard used to calibrate or verify the instrument, linked to the associated records for the calibration standard				
- Type and value of all calibration standards				
- The acceptance criteria for each calibration and verification used to accept the instrument calibration or verification				
- The assay specifications or acceptance criteria for any QC standard or sample used to independently verify the calibration of the instrument				
- Documentation of whether each calibration passed or failed				
- Date an time of all corrective actions performed on the instrument prior to attempting re-verification or recalibration of the instrument are linked to the records required for preventive maintenance				
- Any instances of discontinuation of use of the instrument due to calibration or verification failures				
FT 1100 pH				
The pH meter and electrode system met DEP SOP specifications for accuracy, reproducibility and design. *FT 1100 section 1.1*				
All measurements were corrected for temperature (manual or automatic). *FT 1100 sections 1.1.1 and 2.2.3*				
The temperature sensor calibration was verified according to FT 1400. *FT 1400 section 2.2.2.1*				
A pH 7 buffer was used as the first calibration standard for the initial calibration. *FT 1100, section 2.3.2.3*				
The pH electrode was rinsed with deionized or distilled water between buffer solutions and between sample measurements. *FT 1100 sections 2.3.1 & 2.6.4*				

EVALUATED ITEM	Y	N	NA	Comments
All sample measurements were chronologically bracketed with acceptable calibration verifications. *FT 1100 section 2.3.2*				
All sample measurements were quantitatively bracketed with an appropriate choice of at least two calibration buffers for calibrations or verifications. *FT 1100 sections 1.2, 2.3.3 & 2.3.4*				
All calibration verifications met the acceptance criteria of + 0.2 standard pH units. *FT 1100 sections 2.1.2 & 2.3.4.*				
The instrument pH readings stabilized before pH values were recorded. *FT 1100 section 2.6.3*				
FT 1200 Conductivity				
The specific conductance meter and electrode system met DEP SOP specifications for accuracy, reproducibility and design. *FT 1200 section 2.1*				
Unless the concentration range of the samples is less than 100 µmhos/cm, all sample measurements were quantitatively bracketed with an appropriate choice of calibration standards for calibrations and verifications. *FT 1200, Section 3.2*				
All continuing calibration verifications were performed using standards within the range of sample measurements. *FT 1200 section 3.2.4*				
All calibration verifications met the acceptance criteria of $\pm$ 5% of the verification standard value. *FT 1200 sections 3.2.2 & 3.2.4*				
All measurements were corrected for temperature (manual or automatic). *FT 1200 sections 1.2, 3.1.2,3.1.3, 3.2.4, 3.3.4, 3.3.5 & 3.4*				
The temperature sensor calibration was verified according to FT 1400. *FT 1400, section 2.2*				
The conductivity electrode was rinsed with deionized or distilled water between standard solutions and between sample measurements. *FT 1200 section 3.3.8*				
The instrument conductivity readings stabilized before measurement values were recorded. *FT 1200 section 3.3.3*				
FT 1300 Salinity				
The salinity measurement device met DEP SOP specifications for design and measurement resolution. *FT 1300 section 2*				
Instrument was calibrated using one calibration standard, either standard seawater or a KCl solution and the acceptance criterion for initial calibration or a calibration verification was within +/- 5% of the standard value. *FT 1300 section 3.1*				
Standards for initial calibrations were not reused. *FT 1300 section 3.1.1.6*				
Sample and sensor temperature was stabilized before measurement values were recorded. *FT 1300 section 3.1.3.1*				
Salinity sensor was rinsed with deionized water and fresh standard when calibrating or taking sample measurements. *FT 1300 3.1.3.2*				
FT 1400 Temperature				
The temperature measurement device met DEP SOP specifications for design and measurement resolution. *FT 1400 section 1.1*				
All sample measurements were quantitatively bracketed with calibration verifications of the temperature measurement device at several temperatures using the NIST-traceable thermometer. Note: quantitative brackets are not required for all daily calibration checks; however, quantitative check records should be present. *FT 1400 section 2.2.2*				
Historical, device-specific data justified calibration verification intervals of greater than one month (extended chronological calibration bracket). *FT 1400 section 2.2.3.1*				
The temperature device readings stabilized before measurement values were recorded. *FT 1400 section 2.3.2*				
Temperature was recorded to the nearest 0.1°C and remains constant.				
Groundwater samples were measured in situ (downhole) or by using a flow-through container. *FT 1400 section 2.3.2.1*				

EVALUATED ITEM	Y	N	NA	Comments
FT 1500 Dissolved Oxygen				
The dissolved oxygen meter and electrode system met DEP SOP specifications for accuracy, reproducibility and design. *FT 1500 section 1.1*				
All calibration verifications met the acceptance criteria of + 0.2 mg/L dissolved oxygen when compared to the table of theoretical values for water-saturated air. *FT 1500 sections 1.1., 2.2.2.2,. 2.3.1., 2.4.1, 2.4.2 and 2.4.3*				
All measurements were corrected for temperature (manual or automatic). *FT 1500 sections 1.1*				
The temperature sensor calibration was verified according to FT 1400. *FT 1500 section 1.1*				
All measurements were corrected for salinity, where applicable (manual or automatic). *FT 1500 sections 2.1.4 & 2.6.4*				
The salinity (conductivity) sensor calibration was verified according to FT 1200. *FT 1500 section 2.1.4*				
The dissolved oxygen electrode was rinsed with deionized or distilled water between sample measurements. *FT 1500 section 2.6.2*				
The dissolved oxygen electrode was stored in a water-saturated air environment when not in use. *FT 1500 sections 2.1.2 & 2.6.2*				
The instrument dissolved oxygen readings stabilized before measurement values were recorded. *FT 1500 sections 2.3.1.3 & 2.4.1.3*				
FT 1600 Turbidity				
The turbidimeter met DEP SOP design specifications. *FT 1600 section 2.1*				
Alternative design turbidimeters used for groundwater stabilization measurements met DEP performance criteria. *FT 1600, section 1*				
Initial calibration of the turbidimeter was performed using formazin or styrene divinylbenzene primary standards, whichever was required by the manufacturer of the instrument. *FT 1600 section 2.3*				
All calibration verifications met the DEP SOP acceptance criteria applicable to the NTU ranges associated with the verification standard values. *FT 1600 section 3.2.2*				
The sample cells (optical cuvettes) were inspected for scratches and discarded or coated with a silicone oil mask, as necessary. *FT 1600 section 2.2.2*				
The sample cells (optical cuvettes) were optically matched for calibrations and sample measurements. *FT 1600 section 2.2.3*				
The sample cells (optical cuvettes) were cleaned with detergent and deionized or distilled water between standard solutions and between sample measurements, as applicable. *FT 1600 section 2.2.1.2*				
The sample cells (optical cuvettes) were double rinsed with deionized or distilled water between standard solutions and between sample measurements, as applicable. *FT 1600, section 3.5.6*				
The sample cells (optical cuvettes) were double rinsed with sample prior to filling with sample for measurement. *FT 1600 section 3.5.2*				
The exterior of the sample cell (optical cuvette) was kept free of fingerprints and dried with a lint-free wipe prior to insertion in the turbidimeter. *FT 1600 sections 2.2.1.1 & 3.5.3*				
FT 1800 Water Flow and Velocity				
Area to be measured was carefully selected to allow the most accurate measurement. *FT 1800 1.1*				
An appropriate meter was used and was not changed during a transect. *FT 1800 section 1.2*				
Calibration was performed using manufacturer's instructions. *FT 1800 section 3*				

EVALUATED ITEM	Y	N	NA	Comments
Submersible sensor was positioned perpendicular to the current at the depth determined for the appropriate velocity method, and allowed several seconds for the meter to adjust to the current. *FT 1800 sections 3.1.3.1 and 3.2.2.1*				
Measurements were recorded then the scale switch was turned off prior to moving to the next position. *FT 1800 3.1.3.4 and 3.2.2.6*				
Cross-section of the water body was divided into subsections and the velocity, width, and depth of each subsection was measured and the sum of the products were calculated. *FT 1800 4.1.2*				
The following procedures were used for Mid Section Method: *FT 1800 section 4.2*				
- The end of the tag line/tape measure was secured to the right bank facing downstream.				
- The line was extended across the stream and secured the other end of the line to the left bank ensuring the tape was tight and numbers visible.				
- The measurements corresponding to both the left and right edges of the water were recorded the total width of the stream was calculated.				
- The stream was divided into approximately 15-20 subsections that were narrower where the depth and velocity was highest.				
- The length and depth were measured and recorded starting from the right edge of the water and standing on the downstream side of the tape.				
- If the depth was greater than 2.5 feet, the velocity was measured at two points in each vertical at depths corresponding to two-tenths and eight-tenths the total depth.				
- If the depth was less than 2.5 feet, velocity was measured at a depth of sixtenths the total depth.				
- Measurements were taken in positions that did not interfere with the current.				
HACH 8131 Sulfide				
Samples were collected in completely filled plastic or glass bottles that minimized exposure to air.				
Sulfide was analyzed at the wavelength of 665 nanometers.				
Excessive agitation was avoided when preparing the sample cell.				
Deionized water was used to prepare the blank.				
Samples were analyzed as soon as possible after collection.				
Sulfide Reagents 1 and 2 were added with the calibrated dropper and swirled to mix.				
After reagent additions, the samples sat for the 5-minute reaction time.				
The blank was analyzed first and the instrument was zeroed.				
The samples were analyzed after the blank.				
Proper dilutions were performed if the readings were off-scale.				
HACH 8143 Iron				
Samples were collected in completely filled plastic or glass bottles that minimized exposure to air.				
Ferrous Iron was analyzed at the wavelength of 510 nanometers.				
Excessive agitation was avoided when preparing the sample cell.				
A second sample aliquot was used to prepare the blank.				
Samples were analyzed as soon as possible after collection.				
One ferrous iron reagent packet was added to the sample and swirled to mix.				
After reagent addition, the samples sat for the 3-minute reaction time.				
The blank was analyzed first and the instrument was zeroed.				
The samples were analyzed after the blank.				
Proper dilutions were performed if the readings were off-scale.				