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Final

UFP-SAP for the Expanded Soil and Groundwater Background Study

Marine Corps Base, Camp Lejeune
Jacksonville, North Carolina

Prepared for

Department of the Navy

Naval Facilities Engineering Command
Mid-Atlantic Division

Contract No.
N62470-08-D-1000
CTO-0094

July 2010

Prepared by

CH2MHILL

SAP Worksheet #1—Title and Approval Page

(UFP-QAPP Manual Section 2.1)

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Prepared by:

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Executive Summary

Introduction

This document presents the Sampling and Analysis Plan (SAP) for the Expanded Base Background Study which is an environmental investigation including soil sampling, monitoring well installation, and groundwater sampling at Marine Corps Base Camp Lejeune (MCB CamLej) Jacksonville, North Carolina.

CH2M HILL prepared this document under the Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic Division, Comprehensive Long-term Environmental Action—Navy (CLEAN) 1000 Contract No. N62470-08-D-1000, Contract Task Order (CTO) 094 in accordance with the Navy's Uniform Federal Policy Sampling Analysis Plan (UFP-SAP) policy guidance to ensure that environmental data collected are scientifically sound, of known and documented quality, and suitable for intended uses. The *Final Master Project Plans for Marine Corps Base Camp Lejeune, Jacksonville, North Carolina* (CH2M HILL, 2008b) and the *Site Management Plan, Fiscal Year 2009, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina* (CH2M HILL, 2008c) provide additional information and background on MCB CamLej.

The purpose of this study is to expand upon the previous background soil and groundwater studies conducted by Baker in 2001 and 2002, respectively.

Background conditions for metals in soil were documented in the Base Background Study (Baker, 2001). As part of this study, 50 surface and 50 subsurface soil samples were collected from undeveloped areas around MCB CamLej. The majority of samples were classified as sands. However, surface soils at the Base vary significantly and since metals are present at different concentrations in finer grained soil (i.e. loams, silts, and clays) the background concentrations could be biased low.

Background conditions for metals in groundwater were documented in the Base Background Groundwater Study (Baker, 2002). As part of the study, 25 shallow (13 to 28 feet) and 25 intermediate (20 to 42 feet) temporary monitoring wells were installed in the surficial aquifer in unimpacted areas around MCB CamLej. One round of groundwater samples were collected from each of the temporary monitoring wells and analyzed for metals.

Because previous investigations (soil and groundwater) have focused on metal concentrations in undeveloped areas, this investigation is proposed to expand on the previous investigations that were conducted for metals and to evaluate the background concentrations of other potential anthropogenic chemicals (polycyclic aromatic hydrocarbons [PAHs] and pesticides).

Activities for the Expanded Base Background Study include the collection of 20 additional surface soil samples and 10 additional subsurface soil samples for metals and grain size analysis from predominately fine grain soils in undeveloped areas. This data will be

combined with the previous soil data (Baker, 2001) to form a more representative data set with respect to soil types in undeveloped areas for the Base. Additionally, to evaluate the background conditions of chromium, PAHs, and pesticides in undeveloped areas of the Base, 40 surface soil and 30 subsurface soil samples will be collected from background locations and analyzed for total chromium, hexavalent chromium, PAHs, pesticides, and grain size.

To evaluate the background conditions of metals, PAHs, and pesticides in developed areas of MCB CamLej, 20 surface soil and 20 subsurface soil samples will be collected and analyzed for target analyte list (TAL) metals, hexavalent chromium, PAHs, and pesticides, and grain size.

To assess background groundwater concentrations, 10 monitoring wells will be installed in the surficial aquifer and 5 monitoring wells will be installed in the Castle Hayne aquifer. Groundwater samples will be collected from these monitoring wells over four quarters to account for seasonal variation in concentrations due to rainfall and aquifer recharge. All of the groundwater samples will be analyzed for TAL metals, hexavalent chromium, PAHs, and pesticides.

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

SAP Outline

This SAP consists of 37 worksheets specific to the UFP-SAP. All tables are embedded within the worksheets. All figures are included at the end of the document. The project-specific Health and Safety Plan (HSP) is included as **Appendix A**. Field standard operating procedures (SOPs) are included in **Appendix B**. Data management guidelines are included in **Appendix C** and laboratory SOPs are included in **Appendix D**. Upon approval of this Draft SAP, the field activities will be scheduled and executed.

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C Data Management Guidelines
D Standard Operating Procedures – CompuChem
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Figures

1 Base Location Map
2 Proposed Soil and Monitoring Well Sample Locations

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Acronyms and Abbreviations

AM	Activity Manager
amu	atomic mass unit
ASTM	American Society for Testing and Materials
ATV	all-terrain vehicle
Baker	Baker Environmental, Inc.
BBLPS	behavior-based loss prevention system
bgs	below ground surface
CA	corrective action
CCC	Calibration Check Compound
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLEAN	Comprehensive Long-term Environmental Action—Navy
COPC	chemical of potential concern
CPR	cardiopulmonary resuscitation
Cr	chromium
CSM	conceptual site model
CTO	Contract Task Order
CV	calibration verification
°C	degrees Celsius
DDD	dichlorodiphenyldichloroethane
DDE	dichlorodiphenyldichloroethene
DDT	dichlorodiphenyltrichloroethane
DGM	digital geophysical mapping
DPT	direct push technology
DQI	data quality indicator
DV	data validation
EDD	electronic data deliverable
EIS	Environmental Information Systems
EMD	Environmental Management Division
FTL	Field Team Leader
GC/ECD	gas chromatograph/electron capture device
GC/MS	gas chromatograph/mass spectrometer
H&S	health and safety
HAZWOPER	hazardous waste operations and emergency response
HDPE	high-density polyethylene
HSM	Health and Safety Manager
HSO	Health and Safety Officer

HSP	Health and Safety Plan
HW	hazardous waste
ICAL	initial calibration
ICP-AES	inductively-coupled plasma/air emission spectroscopy
ICP-MS	inductively-coupled plasma/mass spectrometer
ICS	interference check sample
ID	identification
IDW	investigation-derived waste
IR	Installation Restoration
IS	internal standard
L	liter
LCS	laboratory control sample
LIMS	Laboratory Information Management Systems
µg/kg	microgram per kilogram
MCB	Marine Corps Base
MCB CamLej	Marine Corps Base Camp Lejeune
MCL	maximum contaminant level
MDL	method detection limit
mg/kg	milligrams per kilogram
MILCON	military construction
mL	milliliter
MLE	maximum-likelihood-estimate
MMRP	Military Munitions Response Program
MPC	measurement performance criteria
MS/MSD	matrix spike/matrix spike duplicate
N/A	not applicable
NA	not available
NAVFAC	Naval Facilities Engineering Command
Navy	Department of the Navy
NC	no criteria
NC HWS SSL	North Carolina Hazardous Waste Section Soil Screening Level
NC2LGW	North Carolina 2L Groundwater Standards
NCDENR	North Carolina Department of Environment and Natural Resources
NFESC	Naval Facilities Engineering Service Center
NIRIS	Naval Installation Restoration Information System
NTR	Navy Technical Representative
oz	ounce
PAH	polycyclic aromatic hydrocarbon
PAL	project action limit
PC	Project Chemist
PID	photoionization detector
PM	Project Manager
POC	point of contact

PQL	project quality limit
PQO	project quality objective
QA	quality assurance
QAM	Quality Assurance Manager
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	quality control
QL	quantitation limit
RCRA	Resource Conservation and Recovery Act
RL	reporting limit
ROS	regression on order statistics
RPD	relative percent difference
RPM	Remedial Project Manager
RSD	relative standard deviation
RSL	Residential Screening Level
RT	retention time
SAP	Sampling and Analysis Plan
SBO	safe behavior observation
SC	Safety Coordinator
SOP	standard operating procedure
SPCC	System Performance Check Compound
SSC	Site Safety Coordinator
STC	Senior Technical Consultant
SVOC	semivolatile organic compound
TAL	target analyte list
TCL	target compound list
TBD	to be determined
UFP	Uniform Federal Policy
USEPA	United States Environmental Protection Agency
UTL	upper tolerance limit
VOA	volatile organic analyte

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SAP Worksheet #2—SAP Identifying Information

(UFP-QAPP Manual Section 2.2.4)

Site Name/Number: Marine Corps Base (MCB) Camp Lejeune

Operable Unit: Not applicable (N/A)

Contractor Name: CH2M HILL

Contract Number: N62470-08-D-1000

Contract Title: Comprehensive Long-term Environmental Action—Navy (CLEAN) 1000 Program

Work Assignment Number (optional): Contract Task Order (CTO) 0094

1. This Sampling and Analysis Plan (SAP) was prepared in accordance with the requirements of:
   - *Intergovernmental Data Quality Task Force, Uniform Federal Policy for Quality Assurance Project Plans, Evaluating, Assessing, and Documenting Environmental Data Collection and Use Programs, Part 1: UFP-QAPP Manual Uniform Federal Policy – Quality Assurance Project Plan (UFP-QAPP)* (USEPA, 2005)
   - *Guidance for Quality Assurance Project Plans* (USEPA, 2002b)
   - *Quality Assurance (QA)/G-5, Quality Assurance Management Staff (QAMS)* (USEPA, 2002a)
   - *Guidance on Systematic Planning Using the Data Quality Objectives Process* (USEPA, 2006).
2. **Identify regulatory program:** N/A
3. This SAP is a project-specific SAP.
4. List dates of scoping sessions that were held:

Scoping Session	Date
Partnering Meetings	
Charlotte, North Carolina	November 18, 2009
Wilmington, North Carolina	May 5, 2010

SAP Worksheet #2—SAP Identifying Information (continued)

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

Title	Date
Base Background Study, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina (Baker, 2001)	April 2001
Base Background Groundwater Study, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina (Baker, 2002)	August 2002
Master Project Plans, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina (CH2M HILL, 2008b)	June 2008
Waste Management Plan, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina (CH2M HILL, 2008a)	March 2008

6. List organizational partners (stakeholders) and connection with lead organization:
   - North Carolina Department of Environment and Natural Resources (NCDENR)—regulatory stakeholder
   - United States Environmental Protection Agency (USEPA) Region 4—regulatory stakeholder
   - Naval Facilities Engineering Command (NAVFAC) Mid-Atlantic—lead organization
   - MCB CamLej—site owner
7. Lead organization:
   - Department of Navy (Navy)—Lead Agency
8. If any required SAP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below:
   - Crosswalk table is excluded, as all required information is provided in this SAP.

SAP Worksheet #3—Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
David Cleland, P.G.	Navy Technical Representative (NTR)	NAVFAC Mid-Atlantic	(757) 322-4851	david.t.cleland@navy.mil
Bob Lowder	Environmental Engineer	MCB CamLej-Environnemental Management Division (EMD)	(910) 451-9607	robert.a.lowder@usmc.mil
Gena Townsend	Remedial Project Manager (RPM)	USEPA Region 4	(404) 562-8538	townsend.gena@epa.gov
Randy McElveen	RPM	NCDENR	(919) 508-8467	randy.mcelveen@ncdenr.gov
Matt Louth, P.G.	Activity Manager (AM)	CH2M HILL	(757) 671-6240	matt.louth@ch2m.com
Kim Henderson	Deputy AM	CH2M HILL	(757) 671-6231	kimberly.henderson@ch2m.com
Tegwyn Williams, L.G.	Senior Technical Consultant (STC)/Quality Assurance Manager (QAM)	CH2M HILL	(704) 543-3297	tegwyn.williams@ch2m.com
Larry Hilscher	Subject Matter Expert (SME)	CH2M HILL	(512) 365-8244	larry.hilscher@ch2m.com
Paul Favara	UFP-SAP Reviewer	CH2M HILL	(352) 384-7067	paul.favara@ch2m.com
Paul Weber	Project Manager (PM)	CH2M HILL	(919) 760-1778	paul.weber@ch2m.com
Anita Dodson	Project Chemist (PC)	CH2M HILL	(757) 671-6218	anita.dodson@ch2m.com
Rebekha Shaw	Environmental Information Specialist (EIS)	CH2M HILL	(757) 671-6279	rebekha.shaw@ch2m.com
Susan Forker/ Kristin Rogers	Field Team Leader (FTL)	CH2M HILL	(919) 760-1785 (919) 760-1789	susan.forker@ch2m.com kristin.rogers@ch2m.com
Cathy Dover	PM	CompuChem	(919) 379-4089	cdover@compuchemlabs.com
Tammy Jordan	PM	KEMRON	(404) 636-0928	tjordan@kemron.com
Laura Maschoff	Data Validator	DataQual	(314) 330-1327	dataqual@charter.net

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SAP Worksheet #4—Project Personnel Sign-Off Sheet

Name	Organization/Title/Role	Telephone Number	Signature/ email receipt	SAP Section Reviewed	Date SAP Read
David Cleland, P.G.	NAFAC-Mid Atlantic/NTR	(757) 322-4851			
Bob Lowder	MCB CamLej/EMD	(910) 451-9607			
Gena Townsend	USEPA Region 4/RPM	(404) 562-8538			
Randy McElveen	NCDENR/RPM	(919) 508-8467			
Matt Louth, P.G.	CH2M HILL /AM	(757) 671-6240			
Kimberly Henderson	CH2M HILL /Deputy AM	(757) 671-6231			
Paul Weber	CH2M HILL /PM	(919) 760-1778			
Susan Forker/Kristin Rogers	CH2M HILL /FTL	(919) 760-1785 (919) 760-1789			
Tegwyn Williams, L.G.	CH2M HILL /STC, QAM	(704) 543-3297			
Paul Favara	CH2M HILL /UFP-SAP Reviewer	352-384-7067			
Max Bertram	CH2M HILL /Health and Safety Manager (HSM)	(865) 560-2884			
Anita Dodson	CH2M HILL /PC	(757) 671-6218			
Rebekha Shaw	CH2M HILL /EIS	(757) 671-6279			
Cathy Dover	CompuChem/PM	(919) 379-4089			
Jennifer Rebman	CompuChem/Quality Assurance Officer (QAO)	(919) 379-4100			
Tammy A. Jordan	KEMRON/PM	(404) 636-0928			
Laura Maschoff	DataQual/PM	(314) 330-1327			

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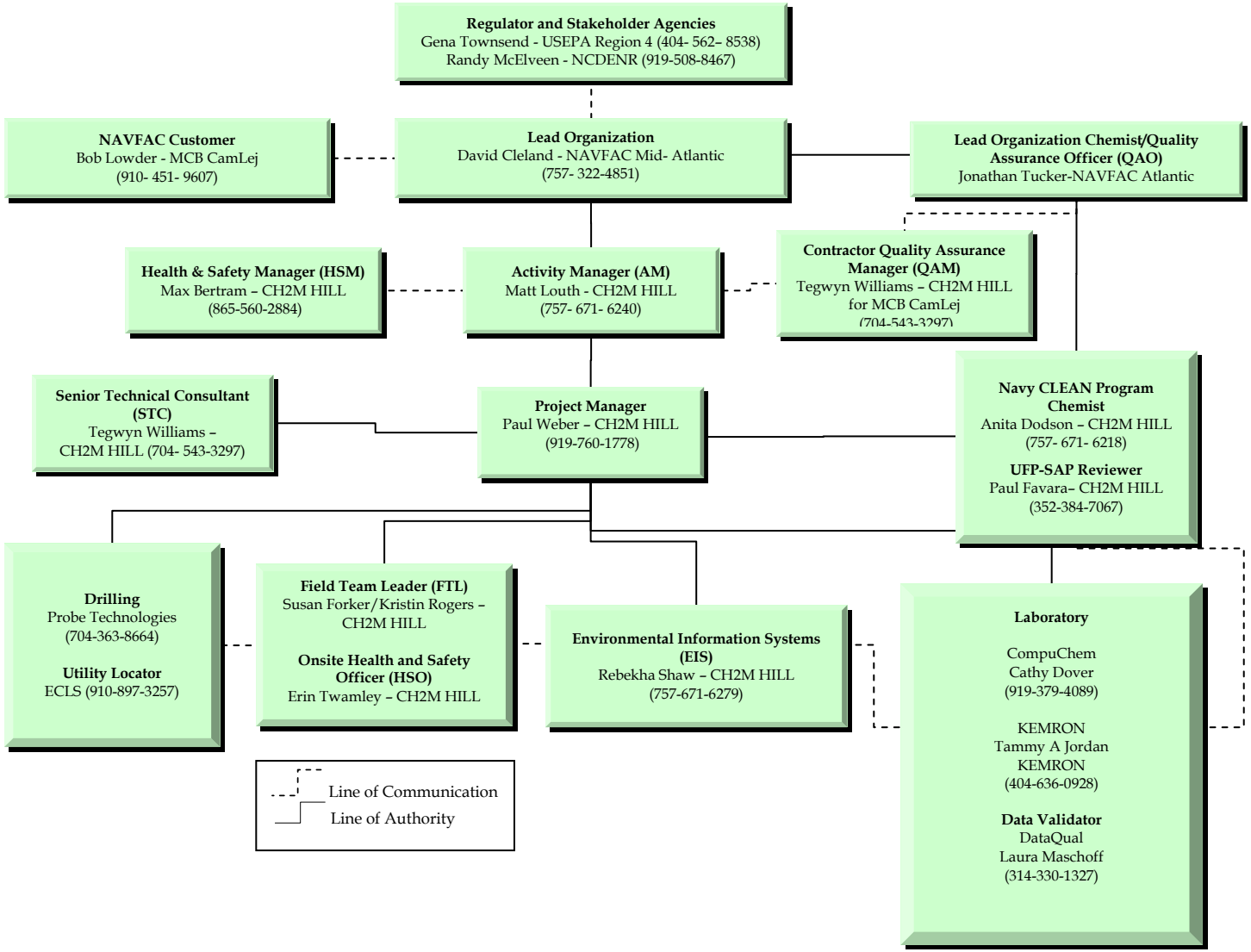
SAP Worksheet #5—Project Organizational Chart



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SAP Worksheet #6—Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure, Pathway, etc.
Communication with Navy (lead agency)	Navy NTR/RPM	David Cleland	david.t.cleland@navy.mil (757) 322-4851	Primary point of contact (POC) for Navy; can delegate communication to other internal or external POCs. RPM will notify USEPA and NCDENR via email or telephone call within 24 hours for field changes effecting the scope or implementation of the design occur. Navy will have 30 days for SAP review. All sampling data will be presented and discussed during partnering meetings.
Communication with USEPA Region 4	USEPA Region 4 RPM	Gena Townsend	townsend.gena@epa.gov (404) 562-8538	Primary POC for USEPA; can delegate communication to other internal or external POCs. Upon notification of field changes, USEPA will have 24 hours to approve or comment on the field changes. All data results will be presented and discussed during partnering meetings.
Communication with NCDENR	NCDENR RPM	Randy McElveen	randy.mcelveen@ncdenr.gov (919) 508-8467	Primary POC for NCDENR; can delegate communication to other internal or external POCs. Upon notification of field changes, NCDENR will have 24 hours to approve or comment on the field changes. All data results will be presented and discussed during partnering meetings.
Communication regarding overall project status and implementation and primary POC with Navy RPM, USEPA, and NCDENR	CH2M HILL AM	Matt Louth	matt.louth@ch2m.com (757) 671-6240	Oversees project and will be informed of project status by the PM. If field changes occur AM will work with the Navy RPM to communicate in field changes to the team via email within 24 hours. All data results will be communicated to the project team during the first partnering meeting following data receipt.
Technical communications for project implementation, and data interpretation	CH2M HILL STC	Tegwyn Williams	tegwyn.williams@ch2m.com (704) 543-3297	Contact senior consultant regarding questions/issues encountered in the field, input on data interpretation, as needed. STCs will have 24 hours to respond to technical field questions as necessary. Additionally, senior consultants will review the data (as necessary) prior to partnering team discussion and reporting review.
Quality issues during project implementation and data interpretation	CH2M HILL QAM for MCB CamLej	Tegwyn Williams	tegwyn.williams@ch2m.com (704) 543-3297	Contact the QAM regarding quality issues during project implementation. The QAM will report to the AM, the CH2M HILL Program Quality Manager, and the NAVFAC Atlantic QAO.
Communications regarding project management and implementation	PM	Paul Weber	paul.weber@ch2m.com (919) 760-1778	All information and materials about the project will be forwarded to the Navy, AMs and STCs as necessary. POC for field sampling team.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure, Pathway, etc.
Health and Safety (H&S)	CH2M HILL Safety Coordinator (SC)	Erin Twamley	Erin.Twamley@ch2m.com (252) 327-3797	Responsible for the adherence of team members to the site safety requirements described in the Health and Safety Plan (HSP). Will report H&S incidents and near losses to PM.
SAP changes in field	FTL	Susan Forker/ Kristin Rogers	Susan.Forker@ch2m.com Kristin.Rogers@ch2m.com	Documentation of deviations from the SAP will be made in the field logbook and the PM will be notified immediately. Deviations will be made only with approval from the PM.
QAPP Field Changes/ Field Progress Reports	FTL	Susan Forker/ Kristin Rogers	Susan.Forker@ch2m.com Kristin.Rogers@ch2m.com	Documentation of field activities and SAP deviations (made with the approval of AM and/or QAO) in field logbooks; provide daily progress reports to PM.
Data tracking from field collection to database upload	EIS	Rebekha Shaw	rebekha.shaw@ch2m.com (757) 671-6279	Tracking data from sample collection through database upload.
Reporting Laboratory Data Quality Issues	Laboratory PM	Cathy Dover/ CompuChem	cdover@compuchemlabs.com (919) 379-4089	All quality assurance (QA)/quality control (QC) issues with project field samples will be reported within 2 days to the PC by the laboratory.
Reporting Data Validation (DV) Issues	DV PMs	Laura Maschhoff, DataQual	dataqual@charter.net	All DV issues regarding resubmissions from the laboratory will copy the CH2M HILL EIS on communications. The DV report will be due to CH2M HILL within 14 calendar days of data receipt.
Field and analytical corrective actions (CAs)	PC	Anita Dodson	anita.dodson@ch2m.com (757) 671-6218	CAs for field and analytical issues will be determined by the FTL and/or the PC and reported to the PM within 4 hours.
Release of Analytical Data	PC	Anita Dodson	anita.dodson@ch2m.com (757) 671-6218	No analytical data can be released until validation of the data is completed and has been approved by the PC. The PC will review analytical results within 7 days of receipt for release to the project team.
Field CAs	FTL and PM	Susan Forker/ Kristin Rogers Paul Weber	paul.weber@ch2m.com (919) 760-1778	Field and analytical issues requiring CA will be determined by the FTL and/or PM; the PM will ensure QAPP requirements are met by field staff

SAP Worksheet #7—Personnel Identification and Responsibilities Table

Name	Title/Role	Organizational Affiliation	Responsibilities
David Cleland	NTR	NAVFAC Mid-Atlantic	Oversees project
Bob Lowder	Base EMD	MCB CamLej	Oversees project
Matt Louth	AM	CH2M HILL	Oversees project activities
Paul Weber	PM	CH2M HILL	Manages project
Tegwyn Williams	STC/QAM	CH2M HILL	Provides senior technical support for field sampling approach and implementation. Provides QA oversight.
Max Bertram	HSM	CH2M HILL	Prepares HSP; manages H&S for all field activities
James Frank	Task Manager	CH2M HILL	Manages project tasks
Anita Dodson	Navy Program Chemist	CH2M HILL	Provides UFP-SAP project delivery support and performs data evaluation and QA oversight
Rebekha Shaw	EIS	CH2M HILL	Data Management: manages sample tracking, communicates with laboratory and data validator
Susan Forker/ Kristin Rogers	FTL	CH2M HILL	Coordinates all field activities and sampling
Erin Twamley	Site HSO	CH2M HILL	Oversees H&S for all field activities
Cathy Dover	Laboratory PM	CompuChem	Manages samples tracking and maintains communication with PC and EIS
Jennifer Rebman	Laboratory QAO	CompuChem	Responsible for audits, CA, checks of QA performance within the laboratory
Tammy Jordan	Laboratory PM	KEMRON	
Laura Maschoff	Data Validator	DataQual	Validate laboratory data from an analytical standpoint prior to data use

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SAP Worksheet #8—Special Personnel Training Requirements Table

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel / Groups Receiving Training	Personnel Titles / Organizational Affiliation	Location of Training Records / Certificates
Field Sampling	Hazardous waste operations and emergency response (HAZWOPER) 40-hour training, 8-hour refreshers as applicable	Registered training organization	Initial 40-hr class, followed by annual* updates	All field staff	FTL, field team members / CH2M HILL	CH2M HILL Human Resources Department
Field Sampling	Cardiopulmonary Resuscitation (CPR)/First Aid Training	Registered training organization	CPR annually (depending on vendor), First Aid every 3 years*	SC-HW	FTL, field team members / CH2M HILL	
Field Sampling	Behavior-based Loss Prevention System (BBLPS)	CH2M HILL internal training	One time training	All field staff	FTL, field team members / CH2M HILL	
Field Sampling	Site Safety Coordinator – Hazardous Waste (SC-HW)	CH2M HILL internal training	Initial 12-hr class, followed by updates every 3 years*	Onsite HSO	SC / CH2M HILL	

* - Training records for field personnel are available on the CH2M HILL Virtual Office

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SAP Worksheet #9—Project Scoping Session Participants Sheet

Project Name: Expanded Base Background Study **Projected Date(s) of Sampling:** Fiscal Year 2010 **Project Manager:** Paul Weber	**Site Name:** MCB CamLej **Site Location:** Jacksonville, North Carolina

Date of Session: November 18, 2009
Scoping Session Purpose: Expanded Base Background Study

Name	Title/Project Role	Affiliation	Phone #	E-mail Address
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Comments: Team discussed the expanded background sampling approach presented for soil in developed and undeveloped areas and groundwater in the surficial aquifer. Team also discussed collecting background data for deeper groundwater within the Castle Hayne aquifer.

Action Items: CH2M HILL to complete the UFP-SAP for collecting soil samples from developed and undeveloped areas, installing wells in the surficial and Castle Hayne aquifer, and collecting quarterly groundwater samples

Consensus Decisions: The Team agrees to the expanded background sampling approach for soil in developed and undeveloped areas and groundwater (both shallow and deep) for metals, PAHs, and pesticides analysis.

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SAP Worksheet #10—Problem Definition

Introduction

MCB CamLej (**Figure 1**) wishes to update the existing environmental background data set for soil and groundwater to facilitate risk assessment evaluations at the various IR and RCRA sites at the Base. Previous evaluations of the distribution of naturally occurring "background" elements focused solely upon metals in soil and groundwater within undeveloped areas of the base. The proposed new work will include evaluation of anthropogenic chemicals (polycyclic aromatic hydrocarbons [PAHs] and pesticides), as well as naturally occurring elements in undeveloped and developed areas. In order to assess temporal variations in background hydrogeochemistry, the proposed work will also include a year-long groundwater quality assessment.

Background

In 2000, Baker Environmental, Inc. (Baker) collected surface and subsurface soil samples from a total of 50 locations within undeveloped areas around MCB CamLej (**Figure 2**). The study was documented in the Base Background Study (Baker, 2001). As shown below (**Table 1**), the surface soil samples were classified as either fine sands or loams. The background study consisted of 39 surface soil samples from fine sands and 11 from loams. The subsurface soil samples were classified as sand, silt, or clay. The background study consisted of 29 subsurface soil samples from sand, 12 from silt, and 9 from clay. The majority of samples were classified as sands. However, surface soils at the Base vary significantly (**Table 2**) and since metals are present at different concentrations in finer grained soil (i.e. loams, silts, and clays) the background concentrations could be biased low.

TABLE 1
2001 Base Background Study Samples

Surface Soil		Subsurface Soil		
Fine Sand	Loam	Sand	Silt	Clay
39	11	29	12	9

In 2002, Baker conducted an investigation to assess the occurrence of metals in groundwater. The study was documented in the Base Background Groundwater Study (Baker, 2002). The study involved the collection of a total of 50 groundwater samples from temporary groundwater monitoring wells (25 shallow, approximately 13 to 28 feet and 25 intermediate, approximately 20 to 42 feet) installed in the surficial aquifer in undeveloped areas around MCB CamLej (**Figure 2**). The groundwater samples were analyzed for metals only. There were no significant statistical differences observed between the shallow and intermediate surficial background groundwater data Baker collected in 2002 based on a central tendency comparison[1].

[1] These comparisons used the Wilcoxon Rank Sum test when both depth partitions were detected in 60% or more of the samples and the Gehan's test for those constituents with lower percentages of detects

SAP Worksheet #10—Problem Definition (continued)

Conceptual Site Model

The typical conceptual site model (CSM) focuses on a source area, pathways, and receptors. However, the proposed work focuses on substances that are naturally occurring or are related to non-point source releases of anthropogenic materials; therefore, the CSM approach does not apply.

TABLE 2
MCB CamLej Surface Soil Profile

ID	Soil Association	Soil Type	Area (acres)	Percentage of the Base
AnB	Alpin	fine sand	900.20	0.72
BaB	Baymeade	fine sand	18,161.80	14.56
BmB	Baymeade	fine sand	3,870.45	3.10
Bo	Bohicket	silty clay loam	2,899.98	2.33
Ca	Corolla	fine sand	11.08	0.01
Co	Craven	fine sandy loam	177.39	0.14
CrB	Craven	fine sandy loam	265.98	0.21
CrC	Croatan	muck	251.15	0.20
Ct	Carteret	fine sand	8,506.80	6.82
Da	Dorovan	muck	1,021.01	0.82
Dc	Duckston	fine sand	236.87	0.19
FoA	Foreston	loamy fine sand	5,072.36	4.07
GoA	Goldsboro	fine sandy loam	460.48	0.37
GpB	Goldsboro	fine sandy loam	1,507.38	1.21
KuB	Kureb	fine sand	5,136.43	4.12
La	Longshoal	muck	5.32	0.004
Le	Lenoir	loam	111.42	0.09
Ln	Leon	fine sand	14,232.96	11.41
Ly	Lynchburg	fine sandy loam	151.50	0.12
MaC	Marvyn	loamy fine sand	9,389.11	7.53
Mk	Muckalee	loam	8,704.49	6.98
Mu	Murville	fine sand	7,826.09	6.28
NeE	Newhan	fine sand	622.71	0.50
NfC	Newhan	fine sand	186.72	0.15
NnE	Newhan-Corolla	fine sand	470.57	0.38
NoA	Norfolk	loamy fine sand	80.78	0.06
NoB	Norfolk	loamy fine sand	1,152.14	0.92
On	Onslow	loamy fine sand	6,379.41	5.12
Pa	Pactolus	fine sand	1,643.92	1.32
Pn	Pantego	mucky fine sand	291.87	0.23
Pt	Pits	sand	166.88	0.13
Ra	Rains	fine sandy loam	815.15	0.65
St	Stallings	loamy fine sand	3,779.69	3.03
To	Torhunta	fine sandy loam	7,188.64	5.76
Ud	Udorthents	loamy	49.20	0.04
Ur	Urban land		892.06	0.72
WaB	Wando	fine sand	4,509.23	3.62
Wo	Woodington	loamy fine sand	7,445.96	5.97
YaA	Yaupon	fine sandy loam	123.68	0.10

SAP Worksheet #10—Problem Definition (continued)

Problem Statement and Environmental Questions to be Answered by the Expanded Base Background Study

The previous background soil study collected soil samples from predominantly sandy soils. The concentrations of the various metals within sands, silts, and clays vary markedly. This inherent variability was not adequately addressed by the previous study, and may have introduced a low bias to the data set.

The previous evaluation of background conditions for groundwater was based on a single monitoring event conducted in 2002. Since groundwater hydrogeochemistry can fluctuate seasonally due to variations in recharge and discharge it is believed that the previous data set does not adequately represent the potential temporal variability.

The following are the specific environmental questions to be answered by the Expanded Base Background Study:

Are the existing background concentrations of metals in soil within the undeveloped areas of the Base biased low?

Twenty surface soil samples and 10 subsurface soil samples will be collected from fine grained soils (predominantly silts and clays) at undeveloped areas of the Base (**Figure 2**) . The samples will be analyzed for TAL metals, hexavalent chromium, and grain size.

What are the background soil concentrations of chromium, PAHs, and Pesticides in the undeveloped areas of the Base?

Forty surface soil and 30 subsurface soil samples will be collected from a relatively even distribution of soil types at undeveloped areas of the Base (**Figure 2**), and analyzed for total chromium, hexavalent chromium, PAHs, pesticides, and grain size.

What are the background soil concentrations in the developed areas at the Base?

Twenty surface soil and 20 subsurface soil samples (**Figure 2**) will be collected from developed areas of the Base and analyzed for TAL metals, hexavalent chromium, PAHs, pesticides, and grain size.

What are the background groundwater concentrations of PAHs and Pesticides at the Base?

Ten monitoring wells will be installed in the middle of the surficial aquifer (approximately 15-25 ft bgs) at locations hydraulically upgradient of known waste sites, including underground storage tank areas (**Figure 2**). In addition, 5 groundwater monitoring wells will also be installed in the Castle Hayne aquifer, approximately 40-50 ft bgs (**Figure 2**). Samples will be collected from these monitoring wells and analyzed for PAHs and pesticides quarterly for 1 year to evaluate potential seasonal variation.

Do the concentrations of metals in groundwater vary seasonally?

The 15 groundwater monitoring wells will be collected and analyzed for TAL metals and hexavalent chromium quarterly for 1 year to assess the potential for seasonal variability.

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

Who will use the data?

- The data will be used by the MCB CamLej Partnering Team to evaluate the background concentrations of metals, PAHs, and pesticides in soil and groundwater at MCB CamLej.

What are the Project Action Limits (PALs)?

- Since this study is focused on background constituents, PALs are not applicable.

What will the data be used for?

- The analytical data derived from the soil samples collected from undeveloped areas will be combined with the previous data collected by Baker and will be evaluated to identify potential statistical differences relating to soil type or sample depth. The background comparison values listed below will be calculated for each statistically different data set.

  - Two times the mean
  - The mean plus two standard deviations
  - The 95/95 upper tolerance limits (UTLs). The 95/95 UTL is an upper bound (with 95 percent confidence) of the background 95th percentile.

  As long as at least 60 percent of the results are detected, the distributions appearing most appropriate via ProUCL's distributional checks (normal, lognormal, or gamma) will be used to calculate the UTL. For such cases, when all results are not detected, the ProUCL algorithms seek to apply maximum-likelihood-estimate (MLE) or regression on order statistics (ROS) techniques to estimate the mean and standard deviation parameters used in the calculation of the UTLs. When a UTL estimated using MLE or ROS techniques is possible within ProUCL's algorithms, that approach will be preferred over one using alternate proxy values (e.g., detection limit divided by 2).

  Another nonparametric approach provided in ProUCL is the Kaplan-Meier (KM) method. As applied in ProUCL, this approach estimates the mean and standard deviation for left-censored data sets (those with nondetects). The Kaplan-Meier (KM) method will be applied both to cases when fewer than 60 percent of the results are detected and when the percent detects is greater than 60 percent and no discernable distribution was available. This approach estimates the mean and standard deviation for left-censored data sets (those with nondetects).

- The analytical data for soil samples collected from developed areas will also be evaluated to identify statistical differences relating to soil type or sample depth. The background comparison values listed above will be calculated for each statistically different data set.

- The analytical data for the groundwater samples will be used to calculated background comparison values.

- The background comparison values for soil and groundwater will be used to evaluate if individual constituent concentrations at sites are consistent with background conditions.

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

What types of data are needed?

- Surface and subsurface soil samples from developed and undeveloped areas at the Base will be collected and analyzed for TAL metals, hexavalent chromium, PAHs, pesticides, and grain size.
- Groundwater samples will be collected and analyzed for metals, hexavalent chromium, PAHs, and pesticides.

How "good" does the data need to be in order to support the environmental decision?

- Data shall meet the measurement performance criteria (MPC) listed in the Quality Systems Manual.
- The analytical data needs to be of a quality that can be used for a statistical analysis of data representing background conditions in surface/subsurface soils and groundwater. Level 4 data packages and field QC sampling are required.

How much data should be collected?

- A minimum of ten samples will be collected for each desired partition of the background data set (e.g. undeveloped/developed, soil type [sands and finer grained], depth, etc.). This will provide sufficient background samples to calculate a background comparison value.
- Surface and subsurface soil samples will be collected from 20 of the background locations used by Baker, and analyzed for total chromium, hexavalent chromium, PAHs, pesticides, and grain size.
- Surface soil samples will be collected from 20 new locations in undeveloped areas, and analyze for TAL metals, hexavalent chromium, PAH, pesticides, and grain size. Subsurface soil samples will also be collected at 10 of the 20 new locations (selected based on desired soil type), and analyzed for TAL metals, hexavalent chromium, PAH, pesticides, and grain size.
- Surface and subsurface soil samples will be collected from 20 locations in developed areas, and analyzed for TAL metals, hexavalent chromium, PAH, pesticides, and grain size.
- Groundwater samples will be collected quarterly for 1 year from 15 monitoring wells. These samples will be analyzed for TAL metals, hexavalent chromium, PAHs, and pesticides.

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

- Samples will not be collected from locations that appear to be impacted by releases of hazardous substances.
- All proposed locations to be sampled are shown on **Figure 2.**

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

- The soil sampling and monitoring well installation will be conducted following approval of the UFP-SAP.
- The four quarters of groundwater sampling will be initiated after the monitoring wells have been installed.
- The data will be collected in accordance with the standard operating procedures (SOPs) presented in **Worksheet #21**.

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

- CH2M HILL staff will collect the surface and subsurface soil samples from the locations as outlined in **Worksheet #18**.
- CH2M HILL staff will collect the groundwater samples from the monitoring wells as outlined in **Worksheet #18**.
- Laboratory analyses will be performed by CompuChem and KEMRON under subcontract to CH2M HILL.
- All analytical data will be submitted to a data validator for validation against analytical methodology requirements and measurement performance criteria presented in this SAP.
- CH2M HILL will upload the data into Naval Installation Restoration Information System (NIRIS).
- A report will be prepared to summarize the field activities, analytical and geotechnical data, as well as statistical evaluations. In addition, an interim soils technical memorandum will also be prepared to expedite the usage of the updated background soil data. These documents will be submitted to the Navy as drafts for review prior to distribution to NCDENR and USEPA for review and approval.

How will the data be archived?

Data will be archived according to procedures dictated via the Navy CLEAN program/contract. All analytical data will be uploaded into a centralized database (NIRIS) and used for Navy projects. At the end of the project, paper copies of archived laboratory data and validation reports will be returned to the Navy.

Project Quality Objectives (PQOs) listed in the form of if/then qualitative and quantitative statements.

If a sample is considered to be a mathematical outlier based on the statistical evaluation then its location and magnitude will be reviewed before including the data for that sample as part of the background data set for MCB CamLej. When fewer than 25 results are available within a given partition, Dixon's Extreme Value test will be applied. When more than 25 results are available, Rosner's outliers test will be used.

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

(UFP-QAPP Manual Section 2.6.2)

Matrix: Surface Soil, Subsurface Soil

Analytical Group: TAL Metals

Concentration Level: Medium

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	TAL Metals	One per 10 field samples	Precision	Relative percent difference (RPD) ≤ 20%	S&A
Equipment Rinsate Blank		One per day of sampling	Contamination/bias	All target compounds <1/2 quantitation limit (QL)	S&A
Ambient Field Blank		One per week of sampling	Contamination/bias		S&A
Cooler Temperature Blank		One per cooler to the laboratory	Accuracy / representativeness	4 ± 2 degrees Celsius (°C)	S

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

Matrix: Surface Soil, Subsurface Soil

Analytical Group: Hexavalent Chromium

Concentration Level: Medium

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	Hexavalent Chromium	One per 10 field samples	Precision	Relative Percent Difference (RPD) ≤ 30%	S&A
Equipment Rinsate Blank		One per day of sampling	Contamination/bias	All target compounds <1/2 QL	S&A
Ambient Field Blank		One per week of sampling	Contamination/bias		S&A
Cooler Temperature Blank		One per cooler to the laboratory	Accuracy / representativeness	4 ± 2 °C	S

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

Matrix: Surface Soil, Subsurface Soil

Analytical Group: PAHs

Concentration Level: Low (SIM)

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	PAHs	One per 10 field samples	Precision	RPD ≤ 30%	S&A
Equipment Rinsate Blank		One per day of sampling	Contamination/bias	All target compounds <1/2 QL	S&A
Ambient Field Blank		One per week of sampling	Contamination/bias		S&A
Cooler Temperature Blank		One per cooler to the laboratory	Accuracy / Representativeness	4 ± 2 °C	S

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

Matrix: Groundwater

Analytical Group: TAL Metals

Concentration Level: Medium

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	TAL Metals	One per 10 field samples	Precision	RPD ≤ 20%	S&A
Equipment Rinsate Blank		One per day of sampling	Contamination/bias	All target compounds <1/2 QL	S&A
Ambient Field Blank		One per week of sampling	Contamination/bias		S&A
Cooler Temperature Blank		One per cooler to the laboratory	Accuracy/ representativeness	4 ± 2 °C	S

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

Matrix: Groundwater

Analytical Group: Hexavalent Chromium

Concentration Level: Medium

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	Hexavalent Chromium	One per 10 field samples	Precision	RPD ≤ 30%	S&A
Equipment Rinsate Blank		One per day of sampling	Contamination/bias	All target compounds <1/2 QL	S&A
Ambient Field Blank		One per week of sampling	Contamination/bias		S&A
Cooler Temperature Blank		One per cooler to the laboratory	Accuracy/ representativeness	4 ± 2 °C	S

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

Matrix: Groundwater

Analytical Group: PAHs

Concentration Level: Low (SIM)

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	PAHs	One per 10 field samples	Precision	RPD ≤ 30%	S&A
Equipment Rinsate Blank		One per day of sampling	Contamination/bias	All target compounds <1/2 QL	S&A
Ambient Field Blank		One per week of sampling	Contamination/bias		S&A
Cooler Temperature Blank		One per cooler to the laboratory	Accuracy/representativeness	4 ± 2 °C	S

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

Matrix: Groundwater

Analytical Group: Target Compound List (TCL) Pesticides

Concentration Level:

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	TCL Pesticides	One per 10 field samples	Precision	RPD ≤ 30%	S&A
Equipment Rinsate Blank		One per day of sampling	Contamination/bias	All target compounds <1/2 QL	S&A
Ambient Field Blank		One per week of sampling	Contamination/bias		S&A
Cooler Temperature Blank		One per cooler to the laboratory	Accuracy / representativeness	4 ± 2 °C	S

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

Matrix: Soil/Sediment

Analytical Group: TCL Pesticides

Concentration Level:

QC Sample	Analytical Group	Frequency	DQIs	MPC	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicates	TCL Pesticides	One per 10 field samples	Precision	RPD ≤ 30%	S&A
Equipment Rinsate Blank		One per day of sampling	Contamination/bias	All target compounds <1/2 QL	S&A
Ambient Field Blank		One per week of sampling	Contamination/bias		S&A
Cooler Temperature Blank		One per cooler to the laboratory	Accuracy / representativeness	4 ± 2 ° C	S

SAP Worksheet #13—Secondary Data Criteria and Limitations Table

Secondary Data	Data Source (originating organization, report title and date)	Data Generator(s) (originating organization, data types, data generation / collection dates)	How Data Will Be Used	Limitations on Data Use
2001; Base Background Study - Soil	Baker. 2001. *Base Background Study, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina.*	Baker; soil data; 2001	Data will be combined with the new data to evaluate background concentrations for metals in soil.	Data may not be representative subset of multiple soil types.
2002; Base Background Study - Groundwater	Baker. 2002. *Base Background Groundwater Study, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina.*	Baker; groundwater data; 2002.	Data will be combined with the new data to evaluate background concentrations for metals in groundwater.	Data may not be representative of temporal variations within aquifers.

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SAP Worksheet #14—Summary of Project Tasks

Pre-sampling Tasks

- Subcontractor procurement.
- Schedule field and support staff
- Utility Location (SOP-002, **Worksheet #21**)

Environmental Sampling Tasks

- **Surface and subsurface soil sampling—** The following surface and subsurface soil samples will be collected and analyzed for the parameters detailed on **Worksheet #18**:

  – Surface and subsurface soil samples will be collected from 20 of the locations previously used by Baker.

  – Surface soil samples will be collected from 20 new locations in undeveloped areas at the Base. Subsurface soil samples will also be collected at 10 of the new locations.

  – Surface and subsurface soil samples will be collected from 20 new locations in developed areas at the Base.

  A direct push technology (DPT) rig will be utilized to collect samples from locations where both surface and subsurface soil samples are required (SOP-006, **Worksheet #21**). At locations where only surface soil samples will be collected, a hand auger (or similar device) will be utilized. The soil cores or cuttings will be classified according to American Society for Testing and Materials (ASTM) Standard D2488-69, Description of Soils (Visual-Manual Procedure).

  Surface soil samples will be collected from 0 - 1 foot below ground surface (bgs). Subsurface soil samples will be collected above the water table, from the target soil type and from a depth of less than or equal to 10 feet, which are most likely to be encountered by construction and utility workers (**Worksheet #17**). The soil for each sample will be placed in a stainless steel bowl, homogenized, and then placed in the appropriate sample containers.

- **Monitoring Well Installation—** the monitoring wells to be installed within the surficial aquifer will be screened from roughly 15 to 25 feet bgs, while the Castle Hayne wells will be screened from ~40 to 55 ft bgs. All well borings will be advanced using rotary hollow stem. Final well depths may be modified by the field geologist to adjust for field conditions. Discrete soil samples will be collected at 5-foot intervals for lithologic characterization. Above grade well completions will be constructed for each of the monitoring wells. All monitoring wells will be constructed in accordance with North Carolina Well Construction standards. (SOP-003, **Worksheet #21)**.

- **Monitoring Well Development—** The newly installed monitoring wells will be developed by using a combination of surging throughout the well screen and pumping until physical and chemical parameters, measured using a water quality meter, have stabilized (SOP-003, **Worksheet #21)**.

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

- **Surveying—**All newly installed monitoring wells will be surveyed in accordance with *Camp Lejeune Specifications for Digital Data Deliverables* (IGI&S, 2009).
- **Groundwater Level Measurements—**Groundwater levels will be measured in all monitoring wells using an electronic water level indicator (SOP-004, **Worksheet #21)**. The depth from the top of casing to fluid level will be recorded to the nearest 0.01 foot. The indicator will be decontaminated after use in each well.
- **Groundwater sampling—**Groundwater samples will be collected from the 15 monitoring wells on a quarterly basis for a period of 1 year, using a low flow sampling technique (SOP-005, **Worksheet #21**). Samples will be analyzed for the parameters detailed on **Worksheet #18**.
- **Decontamination—**All non-disposable sampling equipment will be decontaminated before use and immediately after each use, in accordance with applicable SOPs referenced in **Worksheet #21**.
- **Investigation Derived Waste Handling—**The proposed sampling locations lie outside of known waste sites; therefore, soil cuttings and groundwater will be placed on the ground in the vicinity of the work area.

Analyses and Testing Tasks

- The analytical laboratory will process and prepare samples for analyses and will analyze all samples in accordance with **Worksheet #18**.

Quality Control Tasks

- Implement SOPs for field and laboratory activities being performed.
- QC samples are described on **Worksheet #20**.

Secondary Data

- Secondary data (**Worksheet #13**) provided by Baker will be incorporated into subsequent reports, as needed.

Data Validation, Review, and Management Tasks

- Procedures for recording data, including guidelines for recording and correcting data:
  - See the EIS Checklist for Validated and Unvalidated electronic data deliverables (EDDs) and Hard Copy Data Checklist in **Appendix C** for examples of CH2M HILL's hardcopy data reporting forms and verification checklists.
  - See **Appendix C** for an example of CH2M HILL's Navy CLEAN EDD format.

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

- Cradle to grave computerized and manual procedures of data. QC checks for error detection to ensure data integrity. The following documents (found in Appendix C) provide guidance on these procedures:
  - EIS QC Checklist for Unvalidated and Validated EDDs and Hard Copy Data Checklist
  - EDD Preparation for Raw and Detects Tables for Unvalidated or Validated Data
  - EDD Preparation for Load and Archive Files
- Guidance on data management steps such as data recording, data transformation, data reduction, data transfer and transmittal, data analysis, and data review
  - Found in the Data Management Checklist and Navy CLEAN Data Management Plan (found in **Appendix C**).
- Procedures for data tracking, storage, archiving, retrieval and security for both electronic and hardcopy data:
  - See the Data Management Checklist, NIRIS Instructions, and Navy CLEAN Data Management Plan for more information (**Appendix C**)
  - The Project EIS, Rebekha Shaw, is responsible for data tracking and storage
  - CH2M HILL will coordinate archiving and retrieval of data
- Perform DV via a third-party subcontractor as per **Worksheets #35** and **#36**.

Documentation and Reporting

- Field efforts and data summary for soil information will be documented in an interim technical memorandum and in the Expanded Base Background Study Report. Groundwater data will be reflected in the latter only.

Assessment/Audit Tasks

- **See Worksheets #31 and #32**

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

(UFP-QAPP Manual Section 2.8.1)

Matrix: Surface Soil, Subsurface Soil
Analytical Group: PAH SIM

Analyte	CAS Number	Regulatory Standard (µg/kg)	Regulatory Standard Reference	Project Quality Limit (PQL) Goal[1] (µg/kg)	Laboratory-specific	
					QLs (µg/kg)	Method Detection Limits (MDLs) (µg/kg)
Acenaphthene	83-32-9	8400	North Carolina Soil Screening Level (NC SSL)	4200	8.3	0.6
Acenaphthylene	208-96-8	11000	NC SSL	5500	8.3	0. 53
Anthracene	120-12-7	660000	NC SSL	330000	8.3	0.43
Benzo(a)anthracene	56-55-3	150	Adjusted Residential Soil Regional Screening Level (RSL)	75	8.3	0.55
Benzo(a)pyrene	50-32-8	15	Adjusted Residential Soil RSL	7.5	8.3	0.38
Benzo(b)fluoranthene	205-99-2	150	Adjusted Residential Soil RSL	75	8.3	0.55
Benzo(g,h,i)perylene	191-24-2	170000	Adjusted Residential Soil RSL	85000	8.3	0.38
Benzo(k)fluoranthene	207-08-9	1500	Adjusted Residential Soil RSL	750	8.3	0.43
Chrysene	218-01-9	15000	Adjusted Residential Soil RSL	7500	8.3	0.63
Dibenz(a,h)anthracene	53-70-3	15	Adjusted Residential Soil RSL	7.5	8.3	0.33
Fluoranthene	206-44-0	230000	Adjusted Residential Soil RSL	115000	8.3	1.3
Fluorene	86-73-7	56000	NC SSL	28000	8.3	0.45
Indeno(1,2,3-cd)pyrene	193-39-5	150	Adjusted Residential Soil RSL	75	8.3	0.37
Naphthalene	91-20-3	210	NC SSL	105	8.3	0. 72
Phenanthrene	85-01-8	57000	NC SSL	28500	8.3	1.3
Pyrene	129-00-0	170000	Adjusted Residential Soil RSL	85000	8.3	0.57

[1] PQL Goals were determined on a case by case basis and are at least 2 times less than the Regulatory Standard and greater than the laboratory QL. Exceptions where the PQL Goal or Regulatory Standard is less than the laboratory QL are shaded. Results between the MDL and QL will be J-qualified as estimated.
NC SSLs are from the NCDENR Inactive Hazardous Sites Program Guidelines for Assessment and Cleanup (January 2010).
The Residential Soil RSLs were adjusted from the USEPA Regional Screening Levels Table (May 2010).

Shading represents where Lab QL exceeds PQL goals.

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

Matrix: Groundwater
Analytical Group: PAH SIM

Analyte	CAS Number	Regulatory Standard (µg/L)	Regulatory Standard Reference	PQL Goal[1] (µg/L/)	Laboratory-specific	
					QLs (µg/L)	MDLs (µg/L)
Acenaphthene	83-32-9	80	North Carolina 2L Groundwater Standards (NC2LGW)	40	0.2	0.035
Acenaphthylene	208-96-8	200	NC2LGW	100	0.2	0.01
Anthracene	120-12-7	1100	Adjusted Tapwater RSL	550	0.2	0.02
Benzo(a)anthracene	56-55-3	0.029	Adjusted Tapwater RSL	0.015	0.2	0.02
Benzo(a)pyrene	50-32-8	0.0029	Adjusted Tapwater RSL	0.0015	0.2	0.01
Benzo(b)fluoranthene	205-99-2	0.029	Adjusted Tapwater RSL	0.015	0.2	0.01
Benzo(g,h,i)perylene	191-24-2	110	Adjusted Tapwater RSL	55	0.2	0.01
Benzo(k)fluoranthene	207-08-9	0.29	Adjusted Tapwater RSL	0.15	0.2	0.01
Chrysene	218-01-9	2.9	Adjusted Tapwater RSL	1.45	0.2	0.015
Dibenz(a,h)anthracene	53-70-3	0.0029	Adjusted Tapwater RSL	0.0015	0.2	0.01
Fluoranthene	206-44-0	150	Adjusted Tapwater RSL	75	0.2	0.01
Fluorene	86-73-7	150	Adjusted Tapwater RSL	75	0.2	0.045
Indeno(1,2,3-cd)pyrene	193-39-5	0.03	Adjusted Tapwater RSL	0.015	0.2	0.01
Naphthalene	91-20-3	0.14	Adjusted Tapwater RSL	0.07	0.2	0.03
Phenanthrene	85-01-8	200	NC2LGW	100	0.2	0.035
Pyrene	129-00-0	110	Adjusted Tapwater RSL	55	0.2	0.01

[1] PQL Goals were determined on a case by case basis and are at least 2 times less than the Regulatory Standard and greater than the laboratory QL. Exceptions where the PQL Goal or Regulatory Standard is less than the laboratory QL are shaded. Results between the MDL and QL will be J-qualified as estimated.
NC2LGWs are from the North Carolina 2L Standards for Groundwater (January 2010).
The Tapwater RSLs were adjusted from the USEPA Regional Screening Levels Table (May 2010).

Shading represents where Lab QL exceeds PQL goals.

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

Matrix: Surface Soil, Subsurface Soil
Analytical Group: Pesticides

Analyte	CAS Number	Regulatory Standard (µg/kg)	Regulatory Standard Reference	PQL Goal[1] (µg/kg)	Laboratory-specific	
					QLs (µg/kg)	MDLs (µg/kg)
4,4'-DDD	72-54-8	240	NC SSL	120	3.34	0.3334
4,4'-DDE	72-55-9	1400	Adjusted Residential Soil RSL	700	3.34	0.3316
4,4'-DDT	50-29-3	340	NC SSL	170	3.34	0.5001
Aldrin	309-00-2	29	Adjusted Residential Soil RSL	14.5	1.67	0.1667
Alpha-BHC	319-84-6	1.2	NC SSL	0.6	1.67	0.1667
Alpha-chlordane	5103-71-9	68	NC SSL	34	1.67	0.1667
Beta-BHC	319-85-7	1.2	NC SSL	0.6	1.67	0.1667
Delta-BHC	319-86-8	1.2	NC SSL	0.6	1.67	0.1667
Dieldrin	60-57-1	0.81	NC SSL	0.405	3.34	0.3316
Endosulfan I	959-98-8	5600	NC SSL	2800	1.67	0.1667
Endosulfan II	33213-65-9	5600	NC SSL	2800	3.34	0.3334
Endosulfan sulfate	1031-07-8	5600	NC SSL	2800	3.34	0.3334
Endrin	72-20-8	810	NC SSL	405	3.34	0.3334
Endrin Aldehyde	7421-93-4	810	NC SSL	405	3.34	0.3334
Endrin Ketone	53494-70-5	810	NC SSL	405	3.34	0.3334
Gamma-BHC (Lindane)	58-89-9	1.8	NC SSL	0.9	1.67	0.1667
Gamma-chlordane	5103-74-2	68	NC SSL	34	1.67	0.1667
Heptachlor	76-44-8	6.6		3.3	1.67	0.1667
Heptachlor epoxide	1024-57-3	0.82	NC SSL	0.41	1.67	0.1667
Methoxychlor	72-43-5	22000	NC SSL	11000	1.67	0.1667
Toxaphene	8001-35-2	46	NC SSL	23	100	33.8

[1] PQL Goals were determined on a case by case basis and are at least 2 times less than the Regulatory Standard and greater than the laboratory QL. Exceptions where the PQL Goal or Regulatory Standard is less than the laboratory QL are shaded. Results between the MDL and QL will be J-qualified as estimated.
NC SSLs are from the NCDENR Inactive Hazardous Sites Program Guidelines for Assessment and Cleanup (January 2010).
The Residential Soil RSLs were adjusted from the USEPA Regional Screening Levels Table (May 2010)

Shading represents where Lab QL exceeds PQL goals.

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

Matrix: Groundwater
Analytical Group: Pesticides

Analyte	CAS Number	Regulatory Standard (µg/L)	Regulatory Standard Reference	PQL Goal[1] (µg/L/)	Laboratory-specific	
					QLs (µg/L)	MDLs (µg/L)
4,4'-DDD	72-54-8	0.1	NC2LGW	0.05	0.1	0.005
4,4'-DDE	72-55-9	0.2	Adjusted Tapwater RSL	0.1	0.1	0.005
4,4'-DDT	50-29-3	0.1	NC2LGW	0.05	0.1	0.005
Aldrin	309-00-2	0.004	Adjusted Tapwater RSL	0.002	0.05	0.005
Alpha-BHC	319-84-6	0.011	Adjusted Tapwater RSL	0.0055	0.05	0.00495
Alpha-chlordane	5103-71-9	0.10	NC2LGW	0.50	0.05	0.005
Beta-BHC	319-85-7	0.02	NC2LGW	0.01	0.05	0.005
Delta-BHC	319-86-8	0.02	NC2LGW	0.01	0.05	0.005
Dieldrin	60-57-1	0.002	NC2LGW	0.001	0.05	0.0026
Endosulfan I	959-98-8	22	Adjusted Tapwater RSL	11	0.01	0.005
Endosulfan II	33213-65-9	22	Adjusted Tapwater RSL	11	0.1	0.00435
Endosulfan sulfate	1031-07-8	22	Adjusted Tapwater RSL	11	0.1	0.005
Endrin	72-20-8	1.1	Adjusted Tapwater RSL	0.55	0.1	0.0055
Endrin Aldehyde	7421-93-4	1.1	Adjusted Tapwater RSL	0.55	0.1	0.005
Endrin Ketone	53494-70-5	1.1	Adjusted Tapwater RSL	0.55	0.1	0.006
Gamma-BHC (Lindane)	58-89-9	0.03	NC2LGW	0.015	0.05	0.006
Gamma-chlordane	5103-74-2	0.1	NC2LGW	0.05	0.05	0.0046
Heptachlor	76-44-8	0.008	NC2LGW	0.004	0.05	0.045
Heptachlor epoxide	1024-57-3	0.004	NC2LGW	0.002	0.05	0.0055
Methoxychlor	72-43-5	18	Adjusted Tapwater RSL	9	0.5	0.025
Toxaphene	8001-35-2	0.03	NC2LGW	0.015	5	1.04

[1] PQL Goals were determined on a case by case basis and are at least 2 times less than the Regulatory Standard and greater than the laboratory QL. Exceptions where the PQL Goal or Regulatory Standard is less than the laboratory QL are shaded. Results between the MDL and QL will be J-qualified as estimated.
NC2LGWs are from the North Carolina 2L Standards for Groundwater (January 2010).
The Tapwater RSLs were adjusted from the USEPA Regional Screening Levels Table (May 2010).

Shading represents where Lab QL exceeds PQL goals.

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

Matrix: Surface Soil, Subsurface Soil
Analytical Group: Metals

Analyte	CAS Number	Regulatory Standard (mg/kg)	Regulatory Standard Reference	PQL Goal[1] (mg/kg)	Laboratory-specific	
					QLs (mg/kg)	MDLs (mg/kg)
Aluminum	7429-90-5	7700	Adjusted Residential Soil RSL	3850	20	3.5
Antimony	7440-36-0	3.1	Adjusted Residential Soil RSL	1.55	1	0.18
Arsenic	7440-38-2	0.39	Adjusted Residential Soil RSL	0.195	1	0.21
Barium	7440-39-3	580	NC SSL	290	20	0.097
Beryllium	7440-41-7	16	Adjusted Residential Soil RSL	8	0.5	0.037
Cadmium	7440-43-9	3	NC SSL	1.5	0.5	0.023
Calcium	7440-70-2	NC	N/A	500	500	4.3
Chromium	7440-47-3	0.29	Adjusted Residential Soil RSL	0.145	1	0.049
Cobalt	7440-48-4	2.3	Adjusted Residential Soil RSL	1.15	0.5	0.14
Copper	7440-50-8	310	Adjusted Residential Soil RSL	155	0.5	0.15
Iron	7439-89-6	150	NC SSL	75	10	1.3
Lead	7439-92-1	270	NC SSL	135	0.3	0.12
Magnesium	7439-95-4	NC	N/A	500	500	0.61
Manganese	7439-96-5	65	NC SSL	32.5	1	0.043
Mercury	7439-97-6	1.1	NC SSL	0.55	0.1	0.011
Nickel	7440-02-0	130	NC SSL	65	0.5	0.062
Potassium	7440-09-7	NC	N/A	500	500	0.97
Selenium	7782-49-2	2.1	NC SSL	1.05	0.5	0.062
Silver	7440-22-4	3.4	NC SSL	1.7	0.5	0.053
Sodium	7440-23-5	NC	N/A	500	500	17.9
Thallium	7440-28-0	NC	N/A	1	1	0.77
Vanadium	7440-62-2	39	Adjusted Residential Soil RSL	19.5	2	0.04
Zinc	7440-66-6	2300	Adjusted Residential Soil RSL	1150	2	0.73

[1] PQL Goals were determined on a case by case basis and are at least 2 times less than the Regulatory Standard and greater than the laboratory QL. Exceptions where the PQL Goal or Regulatory Standard is less than the laboratory QL are shaded. Results between the MDL and QL will be J-qualified as estimated.
NC SSLs are from the NCDENR Inactive Hazardous Sites Program Guidelines for Assessment and Cleanup (January 2010).
The Residential Soil RSLs were adjusted from the USEPA Regional Screening Levels Table (May 2010)
NC = No Criteria

Shading represents where Lab QL exceeds PQL goals.

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

Matrix: Surface Soil, Subsurface Soil
Analytical Group: Hexavalent Chromium

Analyte	CAS Number	Regulatory Standard (mg/kg)	Regulatory Standard Reference	PQL Goal[1] (mg/kg)	Laboratory-specific	
					QLs (mg/kg)	MDLs (mg/kg)
Hexavalent Chromium	18540-29-9	0.29	Adjusted Residential Soil RSL	0.145	4	0.8

[1] PQL Goals were determined on a case by case basis and are at least 2 times less than the Regulatory Standard and greater than the laboratory QL. Exceptions where the PQL Goal or Regulatory Standard is less than the laboratory QL are shaded. Results between the MDL and QL will be J-qualified as estimated.
The Residential Soil RSL value is adjusted from the USEPA Regional Screening Levels Table (May 2010)
NC = No Criteria

Shading represents where Lab QL exceeds PQL goals.

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

Matrix: Groundwater
Analytical Group: Metals

Analyte	CAS Number	Regulatory Standard (µg/L)	Regulatory Standard Reference	PQL Goal[1] (µg/L/)	Laboratory-specific	
					QLs (µg/L)	MDLs (µg/L)
Aluminum	7429-90-5	3700	Adjusted Tapwater RSL	1850	200	28.9
Antimony	7440-36-0	1.5	Adjusted Tapwater RSL	0.75	1	0.033
Arsenic	7440-38-2	0.045	Adjusted Tapwater RSL	0.0225	1	0.066
Barium	7440-39-3	700	NC2LGW	350	200	1.4
Beryllium	7440-41-7	4	MCL	2	1	0.021
Cadmium	7440-43-9	1.8	Adjusted Tapwater RSL	0.9	1	0.035
Calcium	7440-70-2	NC	N/A	5000	5000	35.6
Chromium	7440-47-3	0.043	Adjusted Tapwater RSL	0.0215	10	1.1
Cobalt	7440-48-4	1.1	Adjusted Tapwater RSL	0.55	1	0.016
Copper	7440-50-8	150	Adjusted Tapwater RSL	75	5	1.6
Iron	7439-89-6	300	NC2LGW	150	100	24.6
Lead	7439-92-1	15	Adjusted Tapwater RSL, NC2LGW & MCL	7.5	1	0.011
Magnesium	7439-95-4	NC	NC	5000	5000	31
Manganese	7439-96-5	50	NC2LGW	25	10	0.16
Mercury	7439-97-6	1	NC2LGW	0.5	0.2	0.088
Nickel	7440-02-0	73	Adjusted Tapwater RSL	36.5	5	0.9
Potassium	7440-09-7	NC	N/A	5000	5000	21.9
Selenium	7782-49-2	18	Adjusted Tapwater RSL	9	5	1.1
Silver	7440-22-4	18	Adjusted Tapwater RSL	9	5	0.68
Sodium	7440-23-5	NC	N/A	20	20	2.7
Thallium	7440-28-0	2	MCL	1	1	0.008
Vanadium	7440-62-2	18	Adjusted Tapwater RSL	9	1	0.014
Zinc	7440-66-6	1000	NC2LGW	500	20	2.7

[1] PQL Goals were determined on a case by case basis and are at least 2 times less than the Regulatory Standard and greater than the laboratory QL. Exceptions where the PQL Goal or Regulatory Standard is less than the laboratory QL are shaded. Results between the MDL and QL will be J-qualified as estimated.
NC2LGWs are from the North Carolina 2L Standards for Groundwater (January 2010).
The Tapwater RSLs were adjusted from the USEPA Regional Screening Levels Table (May 2010).
MCLs are from the USEPA National Primary Drinking Water Regulations (May 2009)
NC = No Criteria
Shading represents where Lab QL exceeds PQL goals.

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

Matrix: Groundwater
Analytical Group: Hexavalent Chromium

Analyte	CAS Number	Regulatory Standard (ug/L)	Regulatory Standard Reference	PQL Goal[1] (ug/L)	Laboratory-specific	
					QLs (ug/L)	MDLs (ug/L)
Hexavalent Chromium	18540-29-9	0.043	Adjusted Tapwater RSL	0.0215	10	1.1

[1] PQL Goals were determined on a case by case basis and are at least 2 times less than the Regulatory Standard and greater than the laboratory QL. Exceptions where the PQL Goal or Regulatory Standard is less than the laboratory QL are shaded. Results between the MDL and QL will be J-qualified as estimated.
The Tapwater RSL value was adjusted from the USEPA Regional Screening Levels Table (May 2010).
NC = No Criteria

Shading represents where Lab QL exceeds PQL goals.

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

Matrix: Surface Soil, Subsurface Soil

Analytical Group: Grain Size

Analyte	CAS Number	Laboratory-specific	
		QLs (mg/kg)	MDLs (mg/kg)
Grain Size	GRAIN SIZE[1]	N/A	N/A

[1]Contractor-generated CAS number

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

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
UFP SAP preparation	CH2M HILL	09/14/09	02/05/10	Draft UFP SAP	02/05/10
UFP SAP reviewed by Navy	Navy	02/08/10	03/8/10	Comments	03/8/10
Address Navy comments	CH2M HILL	03/09/10	03/22/10	Draft UFP SAP	03/22/10
UFP SAP reviewed by regulatory agencies	NCDENR, USEPA Region 4	03/23/10	06/16/10	Comments	06/16/10
Address regulatory agencies' comments	Navy, CH2M HILL	06/17/10	07/08/10	Draft UFP SAP	07/08/10
Final acceptance	Navy, NCDENR, USEPA Region 4	07/09/10	07/09/10	Final UFP SAP	07/09/10
Utility locating, brush clearing, and monitoring well installation	CH2M HILL	04/26/10	05/21/10	Monitoring wells, boring logs, registration forms	05/21/10
Field sampling	CH2M HILL	05/10/10	06/02/10	Soil samples, groundwater samples, field notes, Sample Data Sheets, Chains-of-Custody	06/02/10
Surveying	CH2M HILL	06/24/10	06/28/10	Survey coordinates	06/28/10
Laboratory analyses and DV	CH2M HILL	06/15/10	09/09/10	Analytical and DV reports	09/09/10
Data management and report	CH2M HILL	09/10/10	12/16/10	Draft interim background soil technical memorandum	12/16/10
Field sampling	CH2M HILL	09/06/10	09/13/10	Groundwater samples, field notes, sample data sheets, chains-of-custody	09/13/10
Laboratory analyses and DV	CH2M HILL	09/14/10	12/09/10	Analytical and DV reports	12/09/10

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

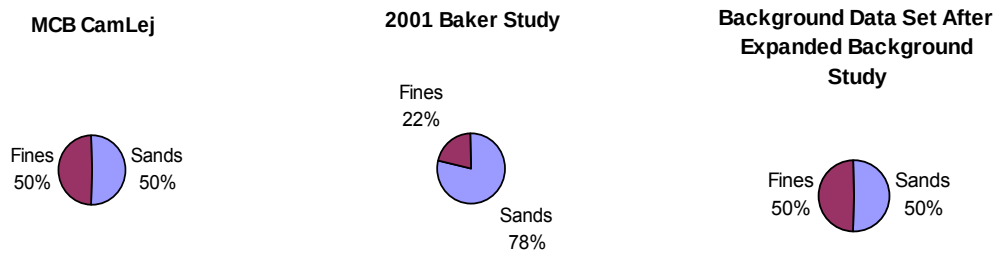
Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Field sampling	CH2M HILL	12/06/10	12/13/10	Groundwater samples, field notes, sample data sheets, chains-of-custody	12/13/10
Laboratory analyses and DV	CH2M HILL	12/14/10	03/10/11	Analytical and DV reports	03/10/11
Field sampling	CH2M HILL	03/07/11	03/14/11	Groundwater samples, field notes, sample data sheets, chains-of-custody	03/14/11
Laboratory analyses and DV	CH2M HILL	03/15/11	06/09/11	Analytical and DV reports	06/09/11
Data management and report	CH2M HILL	06/10/11	09/15/11	Draft Expanded Soil and Groundwater Background Study Report	09/15/11

SAP Worksheet #17—Sampling Design and Rationale

(UFP-QAPP Manual Section 3.1.1)

General Approach

As stated in worksheet 10, the previous Base Background Study (Baker, 2001) collected soil samples from predominantly sandy soils. The concentrations of the various metals within sands, silts, and clays vary markedly, with sand having potentially lower metals concentrations. This inherent variability was not adequately addressed by the previous background study, and may have introduced a low bias to the data set. The charts below identify the relative percentage of the two main surface soil types: sands and finer grained soil (loamy/silty/clayey) for MCB CamLej as a whole, the Base Background Study (Baker, 2001), and the background data set after Expanded Base Background Study is conducted.



The percentage of sands and fine grained soils in subsurface soils for MCB CamLej are unknown; however, for the purpose of the Expanded Base Background Study they are assumed to be the same as surface soil. The 2001 Baker Background collected 60 percent of the subsurface soil samples from sands and 40 percent from finer grained soils; therefore, this expanded background study will be collect samples from soils that will provide an even distribution of sands and finer grained soils.

The Baker Background Study (Baker, 2001) only evaluated metals concentrations in undeveloped areas of the Base. Because other anthropogenic chemicals (PAHs and pesticides) are most likely present at MCB CamLej, the Expanded Base Background Study will evaluate the background concentrations of these parameters as well. In addition, background concentrations in developed areas most likely vary from background concentrations in undeveloped areas so background concentrations for developed areas of MCB CamLej will be evaluated as part of the Expanded Base Background Study.

The previous evaluation of background conditions for groundwater was based on a single monitoring event conducted in 2002. Since groundwater hydrogeochemistry can fluctuate seasonally due to variations in recharge and discharge it is believed that the previous data set does not adequately represent the potential temporal variability.

Objectives

The sampling design for the proposed Expanded Base Background Study was developed with the following objectives based on the rationale above:

SAP Worksheet #17—Sampling Design and Rationale (continued)

- Provide additional data on metals concentrations for finer grained soils in undeveloped areas of the Base to provide a more even distribution of soil types for the data set. The new and existing background data for metals will be used to further evaluate background concentrations of metals at the Base.
- Evaluate the background concentration of PAHs and pesticides in soil for undeveloped areas of the Base.
- Evaluate the background concentrations of metals, PAHs, and pesticides in soil for developed areas of the Base.
- Further evaluate the background concentrations of metals in groundwater and evaluate the background concentrations for PAHs and pesticides.
- Provide a background data set for groundwater that accounts for seasonal variability

Sample Matrices

- Surface and subsurface soil
- Groundwater

Analytical Groups

The analytical group selected for this study includes naturally occurring substance (e.g., metals) as well as substances with anthropogenic origins (e.g., PAHs or pesticides). In addition, grain size was also selected to definitively classify soil types.

- Metals
  - TAL metals and hexavalent chromium at new sample locations and all groundwater samples
  - Total chromium and hexavalent chromium at previous sample locations
- PAHs (all soil and groundwater samples)
- Pesticides (all soil and groundwater samples)
- Grain size (all soil samples)

Sample Numbers and Locations

The total sample numbers were chosen for each area, undeveloped/developed, and soil type, sands/finer grained soils, with a minimum of ten samples ($n \geq 10$) per each type in order to run any useful statistical analysis. The locations were chosen as follows:

- **Soil Samples in Undeveloped Areas for Metals Analysis—**Surface soil samples will be collected from finer grained soils at 20 new locations to provide a more even distribution of soil types for the background data set (**Figure 2**). Subsurface soil samples will be collected from 10 of the new locations. The soil types for the new sample locations are shown in **Table 1**. There is no specific weighting applied to individual soil types rather the soils are categorized into broader categories of sand and finer grained (loamy/silty/clayey) soils.

SAP Worksheet #17—Sampling Design and Rationale (continued)

- **Soil Samples in Undeveloped Areas for PAH, Pesticide, and Grain Size Analysis—** Surface soil samples will be collected from the 20 new locations and from 20 of the locations previously used by Baker (**Figure 2**). Subsurface soil samples will be collected from 10 of the new locations and from 20 locations previously used by Baker. Soil types for the sample locations are shown in **Table 1**; these locations should provide a relatively even distribution of soil types for the background data set.
- **Soil Samples in Developed Areas for Metals, PAHs, Pesticide, and Grain Size Analysis—**Surface and subsurface soil samples at 20 new locations (**Figure 2**). Soil types for the sample locations are shown in **Table 1**.
- **Groundwater Samples for Metals, PAHs, and Pesticides—**10 monitoring wells in the surficial aquifer and 5 monitoring wells in the Castle Hayne aquifer will be installed at locations hydrogeologically upgradient of active sites (**Figure 2**). The monitoring wells will be sampled quarterly for 1 year to account for seasonal variability.

TABLE 1
Soil Types for Sampling Locations

Location	ID	Name	Soil Type	
			USDA Web Soil Survey	Baker
Previous Soil Sample Locations - Undeveloped Area				
BASE-BG02	BaB	Baymeade	fine sand	sand
BASE-BG05	BaB	Baymeade	fine sand	sand
BASE-BG08	BmB	Baymeade	fine sand	sand
BASE-BG11	BmB	Baymeade	fine sand	sand
BASE-BG12	BmB	Baymeade	fine sand	sand
BASE-BG18	BaB	Baymeade	fine sand	sand
BASE-BG23	BaB	Baymeade	fine sand	sand
BASE-BG24	Ln	Leon	fine sand	silt
BASE-BG25	BmB	Baymeade	fine sand	sand
BASE-BG31	BaB	Baymeade	fine sand	sand
BASE-BG32	BaB	Baymeade	fine sand	sand
BASE-BG33	KuB	Kureb	fine sand	sand
BASE-BG35	WaB	Wando	fine sand	sand
BASE-BG41	WaB	Wando	fine sand	sand
BASE-BG43	WaB	Wando	fine sand	sand
BASE-BG44	BaB	Baymeade	fine sand	sand
BASE-BG47	BaB	Baymeade	fine sand	sand
BASE-BG48	Ln	Leon	fine sand	sand
BASE-BG49	BaB	Baymeade	fine sand	sand
BASE-BG50	Ln	Leon	fine sand	sand
New Soil Sample Locations - Undeveloped Area				
BASE-BG51	Da	Dorovan	muck	N/A
BASE-BG52	FoA	Foreston	loamy fine sand	N/A
BASE-BG53	MaC	Marvyn	loamy fine sand	N/A
BASE-BG54	On	Onslow	loamy fine sand	N/A
BASE-BG55	MaC	Marvyn	loamy fine sand	N/A
BASE-BG56	Pn	Pantego	mucky loam	N/A

SAP Worksheet #17—Sampling Design and Rationale (continued)

TABLE 1
Soil Types for Sampling Locations

Location	ID	Name	Texture	
BASE-BG70	Mk	Muckalee	Loam	N/A
BASE-BG57	MaC	Marvyn	loamy fine sand	N/A
BASE-BG58	MaC	Marvyn	loamy fine sand	N/A
BASE-BG59	MaC	Marvyn	loamy fine sand	N/A
BASE-BG60	St	Stallings	loamy fine sand	N/A
BASE-BG61	On	Onslow	loamy fine sand	N/A
BASE-BG62	Ct	Croatan	Muck	N/A
BASE-BG63	Mk	Muckalee	Loam	N/A
BASE-BG64	On	Onslow	loamy fine sand	N/A
BASE-BG65	To	Torhunta	fine sandy loam	N/A
BASE-BG66	Bo	Bohicket	silty clay loam	N/A
BASE-BG67	Mk	Muckalee	Loam	N/A
BASE-BG68	MaC	Marvyn	loamy fine sand	N/A
BASE-BG69	Mk	Muckalee	Loam	N/A
New Soil Sample Locations - Developed Area				
BASE-BG71	GpB	Goldsboro	fine sandy loam	N/A
BASE-BG72	BmB	Baymeade	fine sand	N/A
BASE-BG73	NoB	Norfolk	loamy fine sand	N/A
BASE-BG74	BmB	Baymeade	fine sand	N/A
BASE-BG75	To	Torhunta	fine sandy loam	N/A
BASE-BG76	BmB	Baymeade	fine sand	N/A
BASE-BG77	BaB	Baymeade	fine sand	N/A
BASE-BG78	BmB	Baymeade	fine sand	N/A
BASE-BG79	On	Onslow	loamy fine sand	N/A
BASE-BG80	BmB	Baymeade	fine sand	N/A
BASE-BG81	WaB	Wando	fine sand	N/A
BASE-BG82	BaB	Baymeade	fine sand	N/A
BASE-BG83	BaB	Baymeade	fine sand	N/A
BASE-BG84	BmB	Baymeade	fine sand	N/A
BASE-BG85	To	Torhunta	fine sandy loam	N/A
BASE-BG86	GpB	Goldsboro	fine sandy loam	N/A
BASE-BG87	On	Onslow	loamy fine sand	N/A
BASE-BG88	CrB	Craven	fine sandy loam	N/A
BASE-BG89	On	Onslow	loamy fine sand	N/A
BASE-BG90	Mk	Muckalee	Loam	N/A

SAP Worksheet #17—Sampling Design and Rationale (continued)

Table 2 summarizes the total number of samples to be collected, including field duplicates:

TABLE 2
Sample Collection

Matrix	Depth of Samples	Analysis	Method	Number of Samples (including duplicates)	Rationale	Sampling Strategy
Surface/subsurface soil sample from Baker locations.	**Surface** – 0-1 ft bgs **Subsurface** – Above water table or ≤ 10 ft	Total Chromium Hexavalent Chromium PAHs Pesticides Grain size	PAHs – 8270 SIM Pesticides – SW846 8081A Grain size – ASTM D422	44	To evaluate the background concentrations of targeted analytes, (other metals were previously analyzed)	See **Figure 2** for proposed sampling locations.
Surface/subsurface soil samples from new locations in undeveloped areas	**Surface** – 0-1 foot bgs **Subsurface** – Above water table or ≤ 10 ft	Metals PAHs Pesticides Grain size	Metals - SW-846 6010B/ or 6020/7470A PAHs – 8270 SIM Pesticides – SW846 8081A Grain size – ASTM D422	33	To evaluate the background concentrations of targeted analytes	See **Figure 2** for proposed sampling locations.
Surface/subsurface soil samples from new locations in developed areas	**Surface** – 0-1 ft bgs **Subsurface** – Above water table or ≤ 10 ft	Metals PAHs Pesticides Grain size	SW-846 6010B/ or 6020/7470A PAHs – 8270 SIM Pesticides – SW846 8081A Grain size – ASTM D422	44		
Groundwater samples from newly installed monitoring wells	Middle of well screen	Metals PAHs Pesticides	SW-846 6010B/ or 6020/7470A PAHs – 8270 SIM Pesticides – SW846 8081A	68		

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

(UFP-QAPP Manual Section 3.1.1)

Sample ID	Matrix	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference[1]
Previous Soil Sample Locations - Undeveloped Area				
BBG-SS02-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	2 (duplicate)	See Worksheet #21
BBG-SS05-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS08-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS11-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS12-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS18-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS23-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS24-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS25-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS31-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS32-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	2 (duplicate)	See Worksheet #21
BBG-SS33-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS35-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS41-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS43-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS44-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS47-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS48-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS49-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS50-00-01-10B	Surface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB02-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	2 (duplicate)	See Worksheet #21
BBG-SB05-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB08-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB11-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB12-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21

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

(UFP-QAPP Manual Section 3.1.1)

Sample ID	Matrix	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference[1]
BBG-SB18-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB23-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB24-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB25-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB31-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB32-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	2 (duplicate)	See Worksheet #21
BBG-SB33-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB35-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB41-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB43-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB44-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB47-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB48-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB49-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB50-XX-XX-10B	Subsurface Soil	Total Chromium, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
New Soil Sample Locations - Undeveloped Area				
BBG-SS51-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	2 (duplicate)	See Worksheet #21
BBG-SS52-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS53-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS54-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS55-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS56-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS57-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS58-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS59-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21

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

(UFP-QAPP Manual Section 3.1.1)

Sample ID	Matrix	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference[1]
BBG-SS60-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS61-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	2 (duplicate)	See Worksheet #21
BBG-SS62-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS63-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS64-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS65-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS66-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS67-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS68-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS69-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS70-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB53-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	2 (duplicate)	See Worksheet #21
BBG-SB54-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB55-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB56-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB59-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB61-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB63-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB64-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB65-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB69-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB70-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21

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

(UFP-QAPP Manual Section 3.1.1)

Sample ID	Matrix	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference[1]
New Soil Sample Locations - Developed Area				
BBG-SS71-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	2 (duplicate)	See Worksheet #21
BBG-SS72-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS73-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS74-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS75-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS76-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS77-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS78-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS79-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS80-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS81-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	2 (duplicate)	See Worksheet #21
BBG-SS82-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS83-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS84-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS85-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS86-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS87-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS88-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS89-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SS90-00-01-10B	Surface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB71-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	2 (duplicate)	See Worksheet #21
BBG-SB72-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB73-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB74-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21

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

(UFP-QAPP Manual Section 3.1.1)

Sample ID	Matrix	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference[1]
BBG-SB75-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB76-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB77-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB78-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB79-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB80-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	2 (duplicate)	See Worksheet #21
BBG-SB81-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB82-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #21
BBG-SB83-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #22
BBG-SB84-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #23
BBG-SB85-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #24
BBG-SB86-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #25
BBG-SB87-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #26
BBG-SB88-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #27
BBG-SB89-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #28
BBG-SB90-XX-XX-10B	Subsurface Soil	TAL Metals, Hexavalent Chromium, PAHs, Pesticides, Grain Size	1	See Worksheet #29
Groundwater Sampling - 1st Quarter				
BBG-MW01-10B	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	2 (duplicate)	See Worksheet #21
BBG-MW02-10B	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW03-10B	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW04-10B	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW05-10B	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW06-10B	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW07-10B	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW08-10B	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21

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

(UFP-QAPP Manual Section 3.1.1)

Sample ID	Matrix	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference[1]
BBG-MW09-10B	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW10-10B	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW01UCH-10B	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	2 (duplicate)	See Worksheet #21
BBG-MW02UCH-10B	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW03UCH-10B	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW04UCH-10B	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW05UCH-10B	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
Groundwater Sampling – 2nd Quarter				
BBG-MW01-10C	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	2 (duplicate)	See Worksheet #21
BBG-MW02-10C	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW03-10C	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW04-10C	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW05-10C	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW06-10C	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW07-10C	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW08-10C	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW09-10C	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW01UCH-10C	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW02UCH-10C	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	2 (duplicate)	See Worksheet #21
BBG-MW03UCH-10C	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21

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

(UFP-QAPP Manual Section 3.1.1)

Sample ID	Matrix	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference[1]
BBG-MW04UCH-10C	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW05UCH-10C	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW01UCH-10C	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
Groundwater Sampling – 3rd Quarter				
BBG-MW01-10D	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	2 (duplicate)	See Worksheet #21
BBG-MW02-10D	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW03-10D	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW04-10D	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW05-10D	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW06-10D	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW07-10D	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW08-10D	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW09-10D	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW10-10D	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW01UCH-10D	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	2 (duplicate)	See Worksheet #21
BBG-MW02UCH-10D	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW03UCH-10D	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW04UCH-10D	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW05UCH-10D	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21

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

(UFP-QAPP Manual Section 3.1.1)

Sample ID	Matrix	Analytical Group	Number of Samples (identify field duplicates)	Sampling SOP Reference[1]
Groundwater Sampling – 4th Quarter				
BBG-MW01-11A	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	2 (duplicate)	See Worksheet #21
BBG-MW02-11A	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW03-11A	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW04-11A	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW05-11A	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW06-11A	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW07-11A	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW08-11A	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW09-11A	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW10-11A	Surficial Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW01UCH-11A	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	2 (duplicate)	See Worksheet #21
BBG-MW02UCH-11A	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW03UCH-11A	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW04UCH-11A	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21
BBG-MW05UCH-11A	Castle Hayne Groundwater	Metals, Hexavalent Chromium, PAHs, Pesticides	1	See Worksheet #21

[1]SOP or worksheet that describes the sample collection procedures

SAP Worksheet #19—Analytical SOP Requirements Table

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference	Containers (number, size, and type)	Sample Volume (units)	Preservation Requirements (chemical, temperature, light protected)	[1]Maximum Holding Time (preparation/ analysis)
Groundwater	SIM PAHs	SW-846 3510C/8270C, 2.5.2.1/2.4.4.5	Two 1 liter (L) glass amber bottles	1,000 mL	Cool to 4 ° C ± 2 °C	7 days until extraction/40 days to analysis
Surface Soil, Subsurface Soil	SIM PAHs	SW-846 3550B/8270C, 2.5.2.3/2.4.4.5	One 8 ounce (oz) glass jar	30 g	Cool to 4 ° C ± 2 °C	14 days until extraction/40 days to analysis
Groundwater	TCL Pesticides	SW-846 3510C/8081A, 2.2.4.1/2.2.4.10	Two 1 L glass amber bottles	1,000 mL	Cool to 4 ° C ± 2 °C	7 days until extraction/ 40 days to analysis
Surface Soil, Subsurface Soil	TCL Pesticides	SW-846 3550/8081A, 2.2.4.2/2.2.4.10	One 8 oz glass jar	30 g	Cool to 4 ° C ± 2 °C	14 days until extraction/40 days to analysis
Groundwater	Metals	6010B; 6020; 7470A/ 3.2.1.4; 3.2.1.6; 3.2.1.9; 3.2.1.13; 3.3.1; 3.3.4	One 1000 milliliter (mL) high-density polyethylene (HDPE)	250 mL	Nitric Acid (HNO_3) to pH<2	Hg 28 days; metals 180 days to analysis
Surface Soil, Subsurface Soil	Metals	6010B; 7471A/3.2.1.5; 3.2.1.6; 3.3.2; 3.3.4	One 2 oz glass jar	125 g	Cool to 4 °C ± 2°C	Hg 28 days; metals 180 days to analysis
Groundwater	Hexavalent Chromium	SW-846 7196A, 3.5.8.1	1-125 mL HDPE	50 mL	Cool to 4 ° C ± 2 ° C	24 hours to analysis
Surface Soil, Subsurface Soil	Hexavalent Chromium	SW-846 7196A, 3.5.8.3	1-2 oz glass jar	10 grams	Cool to 4 ° C ± 2 ° C	30 days to alkaline digestion: 7 days to analysis
Surface Soil, Subsurface Soil	Grain Size	ASTM D422	One 4 oz jar	200 grams	None	none

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

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SAP Worksheet #20—Field Quality Control Sample Summary Table

(UFP-QAPP Manual Section 3.1.1)

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates	No. of Matrix Spike/Matrix Spike Duplicates (MS/MSDs)[1]	No. of Field Blanks	No. of Equip. Blanks	Total No. of Samples to Laboratory
Groundwater	Total Metals	60	6	5/5	5	17	98
	Hexavalent Chromium	15	2	1/1	1	5	25
	PAHs	60	6	5/5	5	17	98
	TCL Pesticides	60	6	5/5	5	17	98
Surface Soil	Total Metals	40	4	3/3	2	9	61
	Hexavalent Chromium	60	6	4/4	2	8	84
	PAHs	60	6	4/4	2	8	84
	TCL Pesticides	60	6	4/4	2	8	84
	Grain Size	60	0	0	0	0	60
Subsurface Soil	Total Metals	30	3	3/3	2	9	50
	Hexavalent Chromium	50	5	3/3	2	7	70
	PAHs	50	5	4/4	2	8	73
	TCL Pesticides	50	5	4/4	2	8	73
	Grain Size	50	0	0	0	0	50

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SAP Worksheet #21—Project Sampling SOP References Table

Reference Number	Title, Revision Date and / or Number	Originating Organization of Sampling SOP	Equipment Type	Modified for Project Work? (Y/N)	Comments
SOP-001	*Preparing Field Log Books*, revised 01/2008	CH2M HILL	Log Book Indelible Pen	No	
SOP-002	*Locating and Clearing Underground Utilities,* revised 01/2008	CH2M HILL	Provided by subcontractors	No	
SOP-003	*Installation of Shallow Monitoring Wells,* revised 02/2008	CH2M HILL	All-terrain vehicle (ATV) drill rig equipped with Hollow Stem Auger, well installation materials	No	
SOP-004	*Water Level Measurement,* revised 01/2008	CH2M HILL	Water level meter	No	
SOP-005	*Low-Flow Groundwater Sampling from Monitoring Wells,* revised 5/2003	CH2M HILL	Adjustable-rate positive-displacement pump, submersible pump, or peristaltic pump	No	
SOP-006	*Direct Push Soil Sample Collection*, revised 01/2008	CH2M HILL	Truck-mounted hydraulic percussion hammer, soil sampling materials	No	
SOP-007	*Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, ORP, and Temperature* revised 01/2008	CH2M HILL	Water quality meter	No	
SOP-008	*Equipment Blank and Field Blank Preparation,* revised 01/2008	CH2M HILL	Laboratory-provided blank liquid and sample bottles	No	
SOP-009	*Chain-of-Custody,* revised 01/2008	CH2M HILL	Chain-of-custody form	No	
SOP-010	*Packaging and Shipping Procedures for Low-Concentration Samples,* revised 01/2008	CH2M HILL	Laboratory-supplied coolers	No	
SOP-011	*MiniRae Personal Monitor*	CH2M HILL	MiniRae®	No	
SOP-012	*Decontamination of Personnel and Equipment,* revised 01/2008	CH2M HILL	For cleansing reusable samplers	No	
SOP-013	*Decontamination of Drilling Rigs and Equipment,* revised 01/2008	CH2M HILL	For cleansing drill rig and associated well installation equipment	No	

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

Field Equipment	Activity[1]	Frequency	Acceptance Criteria	CA	Responsible Person	SOP Reference[2]	Comments
Drill Rig	Drilling kill switch	Daily	Drill rig must shut off	Repair as necessary before drilling	Driller and FTL	Not available (NA)	
Water Quality Meter	Calibrate probes using manufacturer-recommended standard solution	Daily, as needed	Parameter specific per model/instruction manual	Manufacturer technical support for calibration errors	FTL	SOP-007	**Appendix B**
Photoionization detector (PID)	Calibrate using manufacturer-recommended calibration gas	Daily and as needed	Parameter specific per model/instruction manual	Manufacturer technical support for calibration errors	FTL	SOP-011	**Appendix B**

[1] Activities may include: calibration, verification, testing, and maintenance.
[2] Specify the appropriate reference letter or number from the Project Sampling SOP References table (**Worksheet #21**).

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SAP Worksheet #23—Analytical SOP References Table

(UFP-QAPP Manual Section 3.2.1)

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
2.2.4.1	*Sample Preparation for Pesticides/PCBs in Water SW-846 and NYSASP,* Revision 11, reviewed 2/11/2009	Definitive	Organochlorine Pesticides	NA	CompuChem	N
2.2.4.10	*GC/ECD Analysis of Organochlorine Pesticides in Water and Soil Extracts by SW-846 Method 8081A and Method 8081B,* Revision 7, 3/6/09	Definitive	Organochlorine Pesticides	Gas chromatograph/electron capture device (GC/ECD)	CompuChem	N
2.2.4.2	*Low Level Preparation for Analysis of Pesticides/PCBs Soil/Sediment/Sludge by SW-846 and NYSASP,* Revision 11, 3/4/09	Definitive	Organochlorine Pesticides	NA	CompuChem	N
2.4.4.5	*GC/MS Selected Ion Monitoring (SIM) Semivolatile Analyses of Aqueous and Soil Samples using SW-846 and EPA CLP Methodologies (OLC03.2 and OLM04.3),* Revision 1, 6/20/06	Definitive	Semivolatiles	Gas chromatograph/ mass spectrometer (GC/MS)	CompuChem	N
2.5.2.1	*Preparation of Water Samples for the Analysis of Semivolatiles by SW-846 Method 3510C and EPA 625,* Revision 13, reviewed 2/11/2009	Definitive	Semivolatiles	NA	CompuChem	N
2.5.2.3	*Preparation of Soil/Sediment/Sludge Samples for the Analysis of Low-Level Semivolatiles by SW-846,* Revision 13, 10/13/09	Definitive	Semivolatiles	NA	CompuChem	N
3.2.1.4	*Digestion Block Preparation of Aqueous Samples for ICP Analysis of Total or Dissolved Metals by SW-846, MCAWW, and Standard Methods,* Revision 4, reviewed 6/25/2009	Definitive	Metals	NA	CompuChem	N
3.2.1.5	*Digestion Block Preparation of Soil Samples for ICP Determination of Total Metals by SW-846 Method 3050B,* Revision 7, reviewed 6/24/2009	Definitive	Metals	NA	CompuChem	N
3.2.1.6	*Inductively Coupled Plasma Atomic Emission Spectroscopy by SW-846 Method 6010B,* Revision 17, 8/31/09	Definitive	Metals	Inductively-coupled plasma/air emission spectroscopy (ICP-AES)	CompuChem	N
3.2.1.9	*Determination of Metals by Inductively Coupled Plasma -Mass Spectrometry (ICP-MS) by SW-846 Method 6020,* Revision 4, reviewed 6/25/2009	Definitive	Metals	Inductively-coupled plasma/mass spectrometer (ICP-MS)	CompuChem	N

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

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Modified for Project Work? (Y/N)
3.2.1.13	*Digestion Block Preparation of Aqueous Samples for ICP-MS Analysis of Total or Dissolved Metals by SW-846 Method 3005A,* Revision 1, reviewed 6/25/2009	Definitive	Metals	NA	CompuChem	N
3.3.1	*Mercury in Water, Manual Digestion Procedure for EPA CLP, NYSASP, SW-846, and MCAWW,* Revision 20, 9/3/09	Definitive	Mercury	NA	CompuChem	N
3.3.2	*Solid Sample Mercury Digestion by SW-846 Method 7471A,* Revision 17, 9/2/09	Definitive	Mercury	NA	CompuChem	N
3.3.4	*Automated Cold Vapor Determination for Mercury by CLP*, SW-846, MCAWW, and NYSASP, Revision 22, 10/12/09	Definitive	Mercury	CVAA	CompuChem	N
3.5.8.1	*Colorimetric Determination of Hexavalent Chromium in Aqueous Samples by Lachat, Standard Methods 3500 Cr-B and SW-846 7196A, Revision 7, 4/12/10*	Definitive	Hexavalent Chromium	Spectrophotometer	CompuChem	N
3.5.8.3	*Determination of Hexavalent Chromium in Soil Matrices using SW-846 Method 7196A, Revision 0, 5/4/06*	Definitive	Hexavalent Chromium	Spectrophotometer	CompuChem	N
4.1	*Receiving Samples,* Revision 35, 2/4/2009	NA	NA	NA	CompuChem	N
4.7	*Organizing and Designating Raw Samples for Disposal,* Revision 10, 2/18/09	NA	NA	NA	CompuChem	N
12.1	*Hazardous Waste Disposal,* Revision 7, reviewed 2/11/2009	NA	NA	NA	CompuChem	N
ASTM D422	*Standard Test Method for Particle-Size Analysis of Soils*	None	Grain Size	Sieve/Hydrometer	KEMRON	NO

SAP Worksheet #24—Analytical Instrument Calibration Table

(UFP-QAPP Manual Section 3.2.2)

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
GC-MS	Tune Verification	The tune is verified at the beginning of each 12-hour analytical sequence.	The tune verification must meet the ion abundance criteria required by the method.	Manually tune the instrument and/or replace the ion source or filament.	Analyst/ Laboratory Manager	2.4.4.5
GC-MS	Initial Calibration (ICAL)	Perform after major instrument maintenance and upon failure of second consecutive continuing calibration verification (CV).	The average RF for semivolatile organic compound (SVOC) System Performance Check Compounds (SPCCs) must be ≥ 0.05. The relative standard deviation (RSD) for Calibration Check Compounds(CCCs) for must be ≤ 30%; RSD for each analyte must be ≤ 15% or the linear least squares regression (r) must be ≥ 0.995	Recalibrate.		2.4.4.5
GC-MS	ICAL Verification	Perform after each ICAL.	The percent recovery of all analytes must be 75-125%.			2.4.4.5
GC-MS	Continuing Calibration Verification (CCV)	Perform one per 12-hour analysis period.	The RF for SVOC SPCC must be ≥ 0.05. The percent difference/drift for CCCs for must be ≤ 20%.			2.4.4.5
GC-ECD	Breakdown Check	Perform daily prior to sample analysis.	The degradation must be ≤ 15% for both Endrin and DDT	Column maintenance; injection port maintenance		2.2.4.10
GC-ECD	ICAL	Perform after major instrument maintenance and upon failure of second consecutive CCV	The RSD for each analyte must be ≤ 20% or linear least squares regression r ≥ 0.995.	Recalibrate.		2.2.4.10
GC-ECD	ICAL Verification	Perform after ICAL.	The percent recovery of all analytes must be 80-120%.			2.2.4.10
GC-ECD	CCV	Perform one per 12-hour analysis period.	The percent recovery of all analytes must be 80-120%.			2.2.4.10

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

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	CA	Person Responsible for CA	SOP Reference
ICP-AES	ICAL	Perform each analytical sequence.	There are no criteria; only one standard is analyzed.	Recalibrate (cont.)	Laboratory Area Supervisor	3.2.1.6
ICP-AES	ICAL Verification	Perform each analytical sequence.	The percent recovery of all analytes must be 90-110%.			3.2.1.6
ICP-AES	CCV	Perform after each 10 samples and at the end of the analysis sequence.	The percent recovery of all analytes must be 90-110%.			3.2.1.6
ICP-MS	Tuning	Each analytical sequence	Mass Calibration ≤ 0.1 atomic mass unit (amu) from true value; Resolution <0.9 amu full width at 10 peak height; For stability, RSD ≤ 5% for at least four replicates	Retune		3.2.1.9
ICP-MS	ICAL	Each analytical sequence	Correlation Coefficient ≥ 0.995	Recalibrate		3.2.1.9
ICP-MS	ICAL Verification	Each analytical sequence	All analytes within 10% of the expected value			3.2.1.9
ICP-MS	PQL Check	Each analytical sequence	All analytes within 20% of the expected value			3.2.1.9
ICP-MS	Interference Check Sample (ICS)	Each analytical sequence	All analytes within 20% of the expected value			3.2.1.9
ICP-MS	CCV	after each 10 samples and at the end of the analysis sequence	All analytes within 10% of the expected value			3.2.1.9
CVAA	ICAL	Perform daily prior to sample analysis.	The correlation coefficient must be ≥ 0.995			3.3.4
CVAA	Continuing Calibration	Perform every 10 samples and at the end of the analytical sequence.	The percent recovery must be 80-120%			3.3.4
Spectrophotometer	Initial Calibration	Perform daily prior to sample analysis and after a CCV failure	Correlation Coefficient ≥ 0.995	Recalibrate.	Lab Area Supervisor	3.5.8.1; 3.5.8.3
Spectrophotometer	Continuing Calibration	Perform every 10 samples and at the end of the analytical sequence.	The percent recovery must be 90-110%.	Recalibrate.	Lab Area Supervisor	3.5.8.1; 3.5.8.3
Hydrometer	NA	NA	NA	NA	Analyst/ Supervisor	ASTM D422
Sieves	NA	NA	NA	NA		

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

(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	Replace or clean ion source; clean injector, replace injector liner, replace or clip capillary column.	PAH SIM Semivolatiles	Ion source, injector liner, column, column flow	Perform as needed.	Initial and/or continuing calibration criteria must be met.	Repeat maintenance activity or remove from service.	Analyst/ Laboratory Manager	2.4.4.5
GC	Perform ECD maintenance; replace or clip capillary column.	Pesticides	ECD, injector, injector liner, column, adjust column flow,					2.2.4.10
ICP-AES	Clean plasma torch; clean filters; clean spray and nebulizer chambers; replace pump tubing	Metals	Torch, filters, nebulizer chamber, pump, pump tubing				Laboratory Area Supervisor	3.2.1.6
ICP-MS	Adjust resolution, flush system with a rinse blank, replace cones	QC standards	Inspect cones				Laboratory Manager	3.2.1.9
CVAA	Clean or replace dehydrator tubing and sample mixing coil tubing; replace sample probe; replace pump tubing; clean optical cell.	Mercury	Tubing, sample probe, optical cell				Laboratory Area Supervisor	3.3.4
Spectrophotometer	Flush/replace tubing	QC standards	Tubing	As needed	See SOP	See SOP	Lab Section Supervisor	3.5.8.1/3.5.8.3
Hydrometer	Soap and water	Settling test	Visual	Prior to test	Visually clean	Rewash	Analyst/ Supervisor	ASTM D422
Sieves	Dry brushing	Particle shaking	Visual	Prior to testing	No broken mesh areas	Replace sieve		

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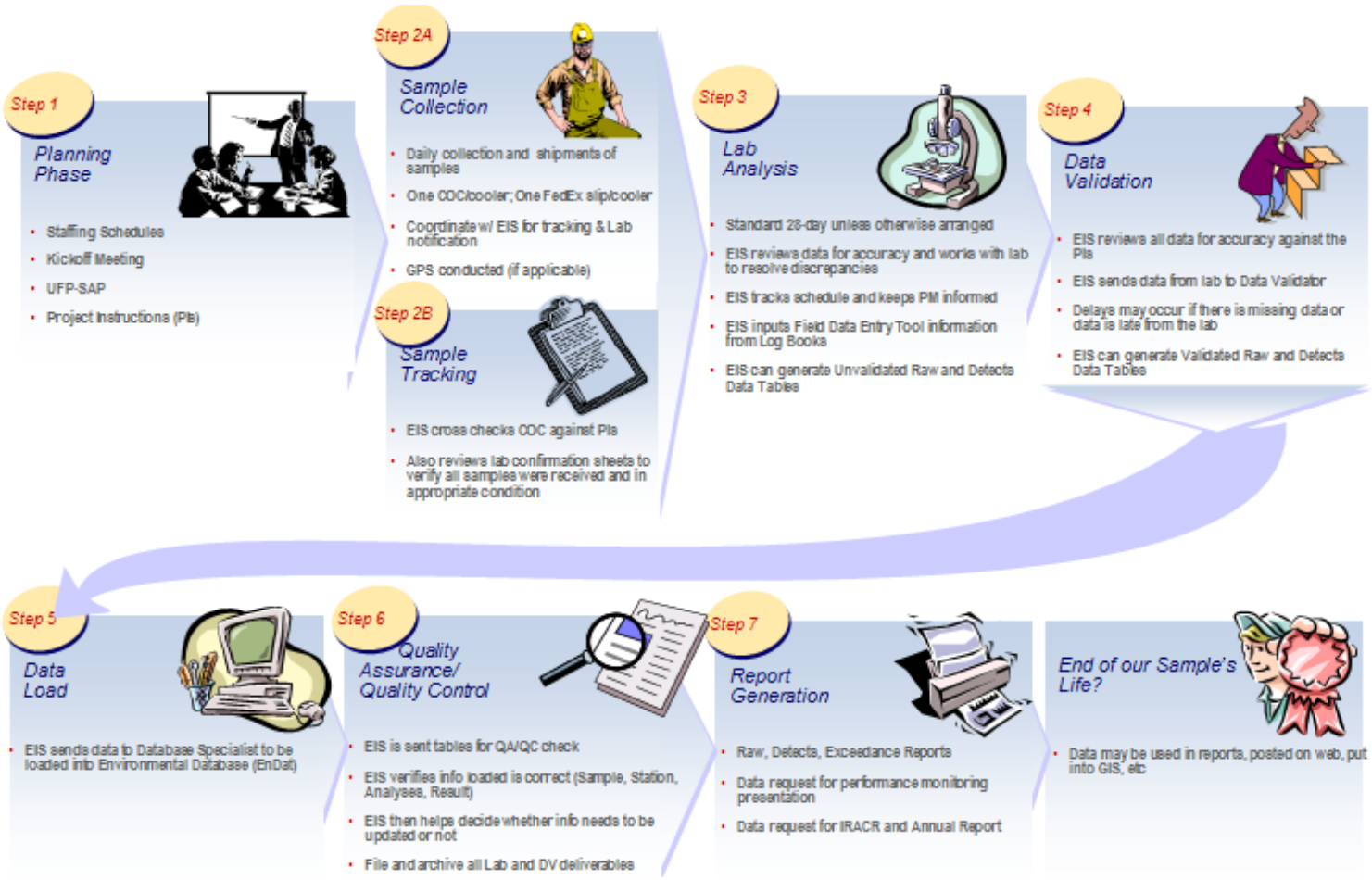
SAP Worksheet #26-1—Sample Handling System

(UFP-QAPP Manual Appendix A)

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Project Field Team, FTL/CH2M HILL. Field SOPs are in **Appendix C**.
Sample Packaging (Personnel/Organization): Project Field Team, FTL/CH2M HILL. Field SOPs are in **Appendix C**.
Coordination of Shipment (Personnel/Organization): FTL/CH2M HILL
Type of Shipment/Carrier: FedEx Priority Overnight
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Diane Byrd/ CompuChem, Tammy A. Jordan / KEMRON
Sample Custody and Storage (Personnel/Organization): Diane Byrd/ CompuChem, Tammy A. Jordan / KEMRON
Sample Preparation (Personnel/Organization): Organics: Rodney McKoy and James Feldhaus/CompuChem, Tammy A. Jordan / KEMRON
Sample Determinative Analysis (Personnel/Organization): Rebecca Mead/ CompuChem Tammy A. Jordan / KEMRON
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): 90 days from receipt
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 365 days
Biological Sample Storage (No. of days from sample collection): n/a
SAMPLE DISPOSAL
Personnel/Organization: Diane Byrd/ CompuChem, Tammy A. Jordan / KEMRON
Number of Days from Analysis: 60 days from submittal of final report or 90 days from receipt, whichever is longer /After submission, the laboratory will keep samples 90 days and the sample extracts for a minimum of 60 days.

SAP Worksheet #26-2—Sample's Life Flowchart



SAP Worksheet #27—Sample Custody Requirements Table

Sample Labeling Procedures

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

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

Field samples will be collected by the field team members under the supervision of the FTL. As samples are collected, they will immediately be placed in the appropriate containers and labeled, as outlined above. The labels will be filled out in the field by the field crew at the time of sample collection and QCed before being placed into the cooler, at which time the sample will be logged in on the chain-of-custody form and field logbook. The integrity of the sample labels will be maintained through the practice of placing sample containers in Ziploc bags.

Samples will be cushioned with packaging material and placed into coolers containing enough ice to keep the samples below 4 °C until they are received by the laboratory. The chain-of-custody will also be placed into the cooler. Coolers will be shipped to the laboratory via FedEx, with the airbill number indicated on the chain-of-custody (to relinquish custody). The FTL is responsible for the care and custody of samples until they are shipped or otherwise delivered to the laboratory custodian as described in Section 3.6.1 of the Master Project Plans (MPP) (CH2M HILL, 2008b). Upon delivery, the laboratory will log in each cooler and report the status of the samples as discussed below.

Chain-of-custody Procedures

Chains-of-custody will include, at a minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information. Sample information will include sample ID, date/time collected, number and type of containers, preservative information, analysis method, and comments. The chain-of-custody will also have the sampler's name and signature. The chain-of-custody will link location of the sample from the field logbook to the laboratory receipt of the sample. The laboratory will use the sample information to populate the laboratory information management system (LIMS) database for each sample.

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

The laboratory receiving samples will comply with all sample custody requirements outlined in the laboratory SOPs referenced in **Worksheet #23.** The SOPs for documenting sample custody are provided in **Appendix D**.

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

All samples will be shipped to CompuChem Laboratories. CompuChem will then send grain size samples to KEMRON.

Sample Integrity

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

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

SAP Worksheet #28-1—Laboratory QC Samples Table

Matrix: Surface Soil, Subsurface Soil

Analytical Group: Semivolatiles

Analytical Method/SOP Reference: SW846 8270C SIM/2.4.4.5

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQIs	MPC
Method Blank	One is performed for each batch of up to 20 samples.	All target analyte concentrations must be <½ reporting limit (RL).	Re-prepare and analyze associated samples.	Analyst/Laboratory Manager	Contamination and bias	All target analyte concentrations must be <½ RL.
Laboratory Control Sample (LCS)	One is performed for each batch of up to 20 samples.	The percent recoveries must meet control limits listed in **Worksheet #28-1A** with allowances for marginal exceedance failures as noted in the associated SOP.	Re-prepare and analyze associated samples.	Analyst/Laboratory Manager	Accuracy	The percent recoveries must meet control limits listed in **Worksheet #28-1a** with allowances for marginal exceedance failures as noted in the associated SOP.
Matrix Spike	One is performed for each batch of up to 20 samples.	The percent recoveries should meet control limits listed in **Worksheet #28-1A** with allowances for marginal exceedance failures as noted in the associated SOP.	If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC or contact client for guidance.	Analyst/Laboratory Manager	Accuracy	The percent recoveries should meet control limits listed in **Worksheet #28-1a** with allowances for marginal exceedance failures as noted in the associated SOP.
Matrix Spike Duplicate	One is performed for each batch of up to 20 samples.	The percent recoveries should meet control limits listed in **Worksheet #28-1A** with allowances for marginal exceedance failures as noted in the associated SOP and the RPD should be ≤ 30%.	If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC or contact client for guidance.	Analyst/Laboratory Manager	Accuracy and precision	The percent recoveries should meet control limits listed in **Worksheet #28-1a** with allowances for marginal exceedance failures as noted in the associated SOP and the RPD should be ≤ 30%.
Surrogates	Three are performed for each sample and QC sample: Nitrobenzene, 2-Fluorobiphenyl, and Terphenyl-d14	The percent recoveries must meet control limits listed in **Worksheet #28-1A**	Re-prepare and analyze associated samples.	Analyst/Laboratory Manager	Accuracy	The percent recoveries must meet control limits listed in **Worksheet #28-1a**
Internal Standards (ISs)	Every field sample, standard, and QC sample.	Retention times (RTs) for ISs must be within + 30 seconds and the responses within -50% to +100% of ICAL mid-point standard.	Inspect MS or GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Analyst/Laboratory Manager	Accuracy and bias	RTs for IS must be within ± 30 seconds and the responses within -50% to +100% of ICAL mid-point standard.

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SAP Worksheet 28-1A—Laboratory-Generated Control Limits

SVOCs SIM	CAS Number	USEPA Method	Soil/Sediment Accuracy % Recovery	Aqueous Accuracy % Recovery	Soil/Sediment Precision RPD	Aqueous Precision RPD
Acenaphthene	83-32-9	8270C	45-110	45-110	≤ 30	≤ 30
Acenaphthylene	208-96-8	8270C	50-105	50-105	≤ 30	≤ 30
Anthracene	120-12-7	8270C	55-105	55-110	≤ 30	≤ 30
Benzo(a)anthracene	56-55-3	8270C	50-110	45-120	≤ 30	≤ 30
Benzo(a)pyrene	50-32-8	8270C	50-110	55-110	≤ 30	≤ 30
Benzo(b)fluoranthene	205-99-2	8270C	45-114	45-120	≤ 30	≤ 30
Benzo(g,h,i)perylene	191-24-2	8270C	40-125	45-125	≤ 30	≤ 30
Benzo(k)fluoranthene	207-08-9	8270C	45-125	45-125	≤ 30	≤ 30
Chrysene	218-01-9	8270C	55-110	55-110	≤ 30	≤ 30
Dibenz(a,h)anthracene	53-70-3	8270C	40-125	40-125	≤ 30	≤ 30
Fluoranthene	206-44-0	8270C	55-115	55-115	≤ 30	≤ 30
Fluorene	86-73-7	8270C	50-110	50-110	≤ 30	≤ 30
Indeno(1,2,3-cd)pyrene	193-39-5	8270C	40-125	45-125	≤ 30	≤ 30
Naphthalene	91-20-3	8270C	40-105	40-110	≤ 30	≤ 30
Phenanthrene	85-01-8	8270C	50-110	50-115	≤ 30	≤ 30
Pyrene	129-00-0	8270C	45-125	50-130	≤ 30	≤ 30

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SAP Worksheet #28-2—Laboratory QC Samples Table

Matrix: Groundwater

Analytical Group: SIM PAHs

Analytical Method/SOP Reference: SW846 8270C SIM/2.4.4.5

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQIs	MPC
Method Blank	One is performed for each batch of up to 20 samples.	All target analyte concentrations must be <½ RL.	Re-prepare and analyze associated samples.	Analyst/Laboratory Manager	Contamination and bias	All target analyte concentrations must be <½ RL.
LCS	One is performed for each batch of up to 20 samples.	The percent recoveries must meet control limits listed in **Worksheet #28-1A** with allowances for marginal exceedance failures as noted in the associated SOP.	Re-prepare and analyze associated samples.	Analyst/Laboratory Manager	Accuracy	The percent recoveries must meet control limits listed in **Worksheet #28-1a** with allowances for marginal exceedance failures as noted in the associated SOP.
Matrix Spike	One is performed for each batch of up to 20 samples.	The percent recoveries should meet control limits listed in **Worksheet #28-1A** with allowances for marginal exceedance failures as noted in the associated SOP.	If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC or contact client for guidance.	Analyst/Laboratory Manager	Accuracy	The percent recoveries should meet control limits listed in **Worksheet #28-1a** with allowances for marginal exceedance failures as noted in the associated SOP.
Matrix Spike Duplicate	One is performed for each batch of up to 20 samples.	The percent recoveries should meet control limits listed in **Worksheet #28-1A** with allowances for marginal exceedance failures as noted in the associated SOP and the RPD should be ≤ 30%.	If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC or contact client for guidance.	Analyst/Laboratory Manager	Accuracy and precision	The percent recoveries should meet control limits listed in **Worksheet #28-1a** with allowances for marginal exceedance failures as noted in the associated SOP and the RPD should be ≤ 30%.
Surrogates	Three are performed for each sample and QC sample: Nitrobenzene, 2-Fluorobiphenyl, and Terphenyl-d14	The percent recoveries must meet control limits listed in **Worksheet #28-1A**	Re-prepare and analyze associated samples.	Analyst/Laboratory Manager	Accuracy	The percent recoveries must meet control limits listed in **Worksheet #28-1a**
ISs	Every field sample, standard, and QC sample.	RTs for ISs must be within ± 30 seconds and the responses within -50% to +100% of ICAL mid-point standard.	Inspect MS or GC for malfunctions; mandatory reanalysis of samples analyzed while system was malfunctioning.	Analyst/Laboratory Manager	Accuracy and bias	RTs for IS must be within ± 30 seconds and the responses within -50% to +100% of ICAL mid-point standard.

SAP Worksheet #28-3—Laboratory QC Samples Table

Matrix: Groundwater

Analytical Group: TCL Pesticides

Analytical Method/SOP Reference: 8081A/2.2.4.10

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	DQIs	MPC
Method Blank	One is performed for each batch of up to 20 samples.	All target analyte concentrations must be <½ RL.	Re-prepare and analyze associated samples.	Analyst/Laboratory Manager	Contamination and bias	No analytes > ½ RL
LCS	One is performed for each batch of up to 20 samples.	Percent recoveries must meet control limits listed in **Worksheet #28-3A** with allowances for marginal exceedance failures as noted in the associated SOP.	Re-prepare and analyze associated samples.	Analyst/Laboratory Manager	Accuracy	Percent recoveries must meet control limits listed in **Worksheet #28-3a** with allowances for marginal exceedance failures as noted in the associated SOP.
Matrix Spike	One is performed for each batch of up to 20 samples.	The percent recoveries should meet control limits listed in **Worksheet #28-3A** with allowances for marginal exceedance failures as noted in the associated SOP.	If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC or contact client for guidance.	Analyst/Laboratory Manager	Accuracy	The percent recoveries should meet control limits listed in **Worksheet #28-3a** with allowances for marginal exceedance failures as noted in the associated SOP.
Matrix Spike Duplicate	One is performed for each batch of up to 20 samples.	The percent recoveries should meet control limits listed in **Worksheet #28-3A** with allowances for marginal exceedance failures as noted in the associated SOP and the RPD should be ≤ 30%.	If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC or contact client for guidance.	Analyst/Laboratory Manager	Accuracy and precision	The percent recoveries should meet control limits listed in **Worksheet #28-3a** with allowances for marginal exceedance failures as noted in the associated SOP and the RPD should be ≤ 30%.

SAP Worksheet 28-3A—Laboratory-Generated Control Limits

Analyte	CAS Number	USEPA Method	Soil/ Sediment Accuracy % Recovery	Aqueous Accuracy % Recovery	Soil/ Sediment Precision RPD	Aqueous Precision RPD
4,4'-DDD	72-54-8	8081A	30-135	25-150	≤30	≤30
4,4'-DDE	72-55-9	8081A	70-125	35-140	≤30	≤30
4,4'-DDT	50-29-3	8081A	45-140	45-140	≤30	≤30
Aldrin	309-00-2	8081A	45-140	25-140	≤30	≤30
Alpha-BHC	319-84-6	8081A	60-125	60-130	≤30	≤30
Alpha-chlordane	5103-71-9	8081A	65-120	65-125	≤30	≤30
Beta-BHC	319-85-7	8081A	60-125	60-130	≤30	≤30
Delta-BHC	319-86-8	8081A	55-130	45-135	≤30	≤30
Dieldrin	60-57-1	8081A	65-125	60-130	≤30	≤30
Endosulfan I	959-98-8	8081A	15-135	50-110	≤30	≤30
Endosulfan II	33213-65-9	8081A	35-140	30-130	≤30	≤30
Endosulfan sulfate	1031-07-8	8081A	60-135	55-135	≤30	≤30
Endrin	72-20-8	8081A	60-135	75-125	≤30	≤30
Endrin Aldehyde	7421-93-4	8081A	35-145	55-135	≤30	≤30
Endrin Ketone	53494-70-5	8081A	65-135	55-145	≤30	≤30
Gamma-BHC (Lindane)	58-89-9	8081A	60-125	25-135	≤30	≤30
Gamma-chlordane	5103-74-2	8081A	65-125	60-125	≤30	≤30
Heptachlor	76-44-8	8081A	50-140	40-130	≤30	≤30
Heptachlor epoxide	1024-57-3	8081A	65-130	60-130	≤30	≤30
Methoxychlor	72-43-5	8081A	55-145	55-150	≤30	≤30
Toxaphene	8001-35-2	8081A	50-150	50-150	≤30	≤30
Surrogates						
Decachlorobiphenyl	2051-24-3	8081A	55-130	30-135	N/A	N/A
Tetrachloro-m-xylene	877-09-8	8081A	70-125	25-140	N/A	N/A

SAP Worksheet #28-4—Laboratory QC Samples Table

Matrix: Soil/Sediment

Analytical Group: TCL Pesticides

Analytical Method/SOP Reference: 8081A/2.2.4.10

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQIs	MPC
Method Blank	One is performed for each batch of up to 20 samples.	All target analyte concentrations must be <½ RL.	Re-prepare and analyze associated samples.	Analyst/Laboratory Manager	Contamination and bias	All target analyte concentrations must be <½ RL.
LCS	One is performed for each batch of up to 20 samples.	The percent recoveries must meet control limits listed in **Worksheet #28-3A**.	Re-prepare and analyze associated samples.	Analyst/Laboratory Manager	Accuracy	The percent recoveries must meet control limits listed in **Worksheet #28-3a.**
Matrix Spike	One is performed for each batch of up to 20 samples.	The percent recoveries should meet control limits listed in **Worksheet #28-3A**.	If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC or contact client for guidance.	Analyst/Laboratory Manager	Accuracy	The percent recoveries should meet control limits listed in **Worksheet #28-3a**
Matrix Spike Duplicate	One is performed for each batch of up to 20 samples.	The percent recoveries should meet control limits listed in **Worksheet #28-3A** with allowances for marginal exceedance failures as noted in the associated SOP and the RPD should be ≤ 30%.	If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC or contact client for guidance.	Analyst / Laboratory Manager	Accuracy and precision	The percent recoveries should meet control limits listed in **Worksheet #28-3a** with allowances for marginal exceedance failures as noted in the associated SOP.

SAP Worksheet #28-5—Laboratory QC Samples Table

Matrix: Soil/Sediment

Analytical Group: TAL Metals

Analytical Method/SOP Reference: 6010B/3.2.1.6; 3.3.4

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQIs	MPC
Method Blank	One is performed for each batch of up to 20 samples.	All target analyte concentrations must be <½ RL.	Re-prepare and analyze all associated samples.	Laboratory Section Supervisor	Contamination and bias	All target analyte concentrations must be <½ RL.
Calibration Blank	One is performed at the beginning of analytical sequence, after every 10 samples, and at the end of the sequence	All target analyte concentrations must be < 2x MDL.	Re-prepare and analyze all associated samples.	Laboratory Section Supervisor	Contamination and bias	All target analyte concentrations must be < 2x MDL
PQL Standard	Daily, after one-point ICAL	Must agree within ± 20% of expected value	flag results in associated samples as estimated concentrations	Laboratory Section Supervisor	Accuracy	Must agree within ± 20% of expected value
ICS	Each analytical sequence	Must be < 2x MDL for non-spiked analytes (unless verified impurity) for ICSA solution;± 20% of the analyte's true value in the ICSAB solution	Check system. Correct problem. Recalibrate	Laboratory Section Supervisor	Accuracy and bias	must be < 2x MDL for non-spiked analytes (unless verified impurity) for ICSA solution;± 20% of the analyte's true value in the ICSAB solution
LCS	One is performed for each batch of up to 20 samples.	The percent recovery must be 80-120%.	Re-prepare and analyze all associated samples.	Laboratory Section Supervisor	Accuracy	The percent recovery must be 80-120%.
Matrix Spike	One is performed for each batch of up to 20 samples.	The percent recovery should be 80-120%.	If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC or contact client for guidance.	Laboratory Section Supervisor	Accuracy	The percent recovery should be 80-120%.
Matrix Spike Duplicate	One is performed for each batch of up to 20 samples.	The percent recovery should be 80-120% and the RPD ≤ 20%.	If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC or contact client for guidance.	Laboratory Section Supervisor	Accuracy and precision	The percent recovery should be 80-120% and the RPD ≤ 20%
Serial Dilution	One is performed for per preparation batch for sample with concentration(s) > 50x MDL.	The result must agree within ± 10% of the original sample result.	Perform a Post Digestion Spike	Laboratory Section Supervisor	Accuracy and precision	The result must agree within ± 10% of the original sample result.
Post Digestion Spike (does not apply to Cold Vapor)	One is performed when serial dilution fails or analyte concentration(s) in all samples < 50x MDL.	The result must agree within ± 25% of expected result.	Flag results of samples of same matrix as estimates in SDG narrative.	Laboratory Section Supervisor	Accuracy and precision	The result must agree within ± 25% of expected result.

SAP Worksheet #28-6—Laboratory QC Samples Table

Matrix: Groundwater

Analytical Group: TAL Metals

Analytical Method/SOP Reference: 6010B/3.2.1.6; 3.3.4

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQIs	MPC
Method Blank	One is performed for each batch of up to 20 samples.	All target analyte concentrations must be <½ RL.	Re-prepare and analyze all associated samples.	Laboratory Section Supervisor	Contamination and bias	All target analyte concentrations must be <½ RL.
Calibration Blank	One is performed at the beginning of analytical sequence, after every 10 samples, at the end of the sequence	All target analyte concentrations must be < 2x MDL.	Re-prepare and analyze all associated samples.	Laboratory Section Supervisor	Contamination and bias	All target analyte concentrations must be < 2x MDL.
PQL Standard	Daily, after one-point ICAL	Must agree within ± 20% of expected value	flag results in associated samples as estimated concentrations	Laboratory Section Supervisor	Accuracy	Must agree within ± 20% of expected value
Interference Check Sample (ICS)	each analytical sequence	must be < 2x MDL for non-spiked analytes (unless verified impurity) for ICSA solution;± 20% of the analyte's true value in the ICSAB solution	Check system. Correct problem. Recalibrate	Laboratory Section Supervisor	Accuracy/bias	must be < 2x MDL for non-spiked analytes (unless verified impurity) for ICSA solution;± 20% of the analyte's true value in the ICSAB solution
LCS	One is performed for each batch of up to 20 samples.	The percent recovery must be 80-120%.	Re-prepare and analyze all associated samples.	Laboratory Section Supervisor	Accuracy	The percent recovery must be 80-120%.
Matrix Spike	One is performed for each batch of up to 20 samples.	The percent recovery should be 80-120%.	If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC or contact client for guidance.	Laboratory Section Supervisor	Accuracy	The percent recovery should be 80-120%.
Matrix Spike Duplicate	One is performed for each batch of up to 20 samples.	The percent recovery should be 80-120% and the RPD ≤ 20%.	If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC or contact client for guidance.	Laboratory Section Supervisor	Accuracy & precision	The percent recovery should be 80-120% and the RPD ≤ 20%.
Serial Dilution	One is performed for each preparation batch with sample concentration(s) > 50x MDL	The result must agree within ± 10% of the original sample result.	Perform Post Digestion Spike	Laboratory Section Supervisor	Accuracy & precision	The result must agree within ± 10% of the original sample result.
Post Digestion Spike (does not apply to Cold Vapor)	One is performed when serial dilution fails or analyte concentration(s) in all samples < 50x MDL.	The result must agree within ± 25% of expected result.	Flag results of samples of same matrix as estimates in SDG narrative.	Laboratory Section Supervisor	Accuracy & precision	The result must agree within ± 25% of expected result.

SAP Worksheet #28-7—Laboratory QC Samples Table

Matrix: Groundwater

Analytical Group: Metals: Sb, As, Be, Cd, Co, Pb, Tl, V

Analytical Method/SOP Reference: 6020/3.2.1.9 and 3.2.1.13

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQIs
Method Blank	One per preparation batch of up to 20 samples	Analyte concentration <½ RL	Reprepare and analyze associated samples	Laboratory area supervisor	Contamination and bias
Calibration Blank	At the beginning of analytical sequence, after every 10 samples, at the end of the sequence	Analyte concentration < 2x mdl	Reprepare and analyze associated samples	Laboratory area supervisor	Contamination and bias
PQL Standard	Daily, after one-point ICAL	Must agree within ± 20% of expected value	Flag results in associated samples as estimated concentrations	Laboratory area supervisor	Accuracy
ICS	Each analytical sequence	must be < 2x MDL for non-spiked analytes (unless verified impurity) for ICSA solution;± 20% of the analyte's true value in the ICSAB solution	Check system. Correct problem. Recalibrate	Laboratory area supervisor	Accuracy/bias
LCS	One per preparation batch of up to 20 samples	spike recovery must be within ± 20%	Reprepare and analyze associated samples	Laboratory area supervisor	Accuracy
Matrix Spike	One per preparation batch of up to 20 samples	spike recovery should be within ± 20%	If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC or contact client for guidance.	Laboratory area supervisor	Accuracy

SAP Worksheet #28-7—Laboratory QC Samples Table (continued)

Matrix: Groundwater

Analytical Group: Metals: Sb, As, Be, Cd, Co, Pb, Tl, V

Analytical Method/SOP Reference: 6020/3.2.1.9 and 3.2.1.13

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	DQIs
Matrix Spike Duplicate	One per preparation batch of up to 20 samples	Spike recovery should be within ± 20%; RPD ≤ 20%	If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC or contact client for guidance.	lab area supervisor	Accuracy and precision
Duplicate Sample	One per preparation batch of up to 20 samples	RPD ≤ 20%	Contact client for guidance.	Laboratory area supervisor	Precision
Serial Dilution	One per preparation batch for sample with concentration(s) > 100x MDL	Must agree within ± 10% of the original sample result	Perform Post Digestion Spike	Laboratory area supervisor	Accuracy and precision
Post Digestion Spike	One per preparation batch of up to 20 samples if LCS spike recovery not within ± 20% or Serial Dilution not ± 10%	Spike recovery must be within ± 25%	Contact client for guidance	Laboratory area supervisor	Accuracy

SAP Worksheet #28-8—Laboratory QC Samples Table

Matrix: Surface Soil, Subsurface Soil
Analytical Group: Hexavalent Chromium
Analytical Method/SOP Reference: 7196A/3.5.8.3

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
Method Blank	one per preparation batch of up to 20 samples	analyte concentration <½ RL	reprepare and analyze associated samples	lab area supervisor	contamination & bias
Calibration Blank	at the beginning of analytical sequence, after every 10 samples, at the end of the sequence	analyte concentration <½ RL	reprepare and analyze associated samples	lab area supervisor	contamination & bias
Initial Calibration Verification (Secon Source)	After one-point initial calibation	Percent Recovery within ± 10%	flag results in associated samples as estimated concentrations	lab area supervisor	accuracy
Continiung Calibration Verificaion Standard CCV	at the beginning of analytical sequence, after every 10 samples, at the end of the sequence	Percent Recovery within ± 10%	Recalibrate	lab area supervisor	accuracy
Laboratory Control Sample	one per preparation batch of up to 20 samples	spike recovery should be within ± 20%	reprepare and analyze associated samples	lab area supervisor	accuracy
Matrix Spike	one per preparation batch of up to 20 samples	spike recovery should be within ± 25%	If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC or contact client for guidance.	lab area supervisor	accuracy
Matix Spike Duplicate	one per preparation batch of up to 20 samples	spike recovery should be within ± 25%; RPD ≤ 20%	If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC or contact client for guidance.	accuracy	accuracy & precision
Post Digestion Spike (PDS)	one per preparation batch of up to 20 samples	spike recovery must be within ± 15%	dilute and reanalyze the PDS	lab area supervisor	accuracy

SAP Worksheet #28-9—Laboratory QC Samples Table

Matrix: Groundwater

Analytical Group: Hexavalent Chromium

Analytical Method/SOP Reference: 7196A/3.5.8.1

QC Sample:	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)
Method Blank	one per preparation batch of up to 20 samples	analyte concentration <½ RL	reprepare and analyze associated samples	lab area supervisor	contamination & bias
Calibration Blank	at the beginning of analytical sequence, after every 10 samples, at the end of the sequence	analyte concentration <½ RL	reprepare and analyze associated samples	lab area supervisor	contamination & bias
Initial Calibration Verification (Secon Source)	After one-point initial calibration	Percent Recovery within ± 10%	flag results in associated samples as estimated concentrations	lab area supervisor	accuracy
Continiung Calibration Verificaion Standard CCV	at the beginning of analytical sequence, after every 10 samples, at the end of the sequence	Percent Recovery within ± 10%	Recalibrate	lab area supervisor	accuracy
Laboratory Control Sample	one per preparation batch of up to 20 samples	spike recovery should be within ± 20%	reprepare and analyze associated samples	lab area supervisor	accuracy
Matrix Spike	one per preparation batch of up to 20 samples	spike recovery should be within ± 10%	If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC or contact client for guidance.	lab area supervisor	accuracy
Matix Spike Duplicate	one per preparation batch of up to 20 samples	spike recovery should be within ± 10%; RPD ≤ 20%	If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC or contact client for guidance.	accuracy	accuracy & precision

SAP Worksheet #29—Project Documents and Records Table

(UFP-QAPP Manual Section 3.5.1)

Sample Collection Documents and Records	On-site Analysis Documents and Records	Off-site Analysis Documents and Records	Data Assessment Documents and Records	Other
• Field Notebooks • Chain-of-Custody Records • Air Bills • Custody Seals • Corrective Action Forms • Electronic Data Deliverables • Identification of QC Samples • Meteorological Data from Field (Logging daily weather) • Sampling locations and sampling plan • Sampling notes	• No onsite analysis will take place	• Sample Receipt, Chain-of-Custody, and Tracking Records • Standard Traceability Logs • Equipment Calibration Logs • Sample Prep Logs • Run Logs • Equipment Maintenance, Testing, and Inspection Logs • Corrective Action Forms • Reported Field Sample Results • Reported Result for Standards, QC Checks, and QC Samples • Instrument printouts (raw data) for Field Samples, Standards, QC Checks, and QC Samples • Data Package Completeness Checklists • Sample disposal records • Extraction/Clean-up Records • Raw Data (stored on disk)	• Fixed Laboratory Audit Checklists • DV Reports • Corrective Action Forms • Laboratory QA Plan • MDL Study Information	

Sample collection documents and records will be scanned and saved on the network server. Field parameters will be loaded into the database using the FDE Tool.

Offsite analysis documents and records will be archived after a period of 6 months. Hardcopy deliverables from the data validator will be sent to Stacy Davenport in the WDC office for archival.

Data assessment documents and records will be archived as described above.

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SAP Worksheet #30—Analytical Services Table

(UFP-QAPP Manual Section 3.5.2.3)

Matrix	Analytical Group	Sample Locations/ ID Number	Analytical Method	Data Package Turnaround Time	Laboratory / Organization	Backup Laboratory / Organization
Groundwater, Surface Soil, Subsurface Soil	TAL Metals	**Worksheet #18**	SW846 6010B/ 6020/ 7470A/ 7471A	28 calendar days	CompuChem Laboratories 501 Madison Avenue Cary, NC 27513 919-379-4100	TBD
	Hexavalent Chromium		SW846 7196A			
	PAHs		SW846 8270 SIM			
	TCL Pesticides		SW846 8081A			
Surface Soil, Subsurface Soil	Grain Size		ASTM D422		KEMRON 1359-A Ellsworth Industrial Boulevard Atlanta, GA 30318 404-636-0928	

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SAP Worksheet #31—Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing CAs (title and organizational affiliation)	Person(s) Responsible for Monitoring Effectiveness of CA (title and organizational affiliation)
Offsite Laboratory Technical Systems Audit	Laboratory must have current Naval Facilities Engineering Service Center (NFESC) evaluation letter, which will identify the period of performance. The laboratory must be re-evaluated prior to expiration of period of performance	External	U.S. Navy (NFESC)	Project QAO- Pati Moreno/ NFESC, Port Hueneme, CA	Jennifer B. Rebman CompuChem QAO	Jennifer B. Rebman CompuChem QAO	Anita Dodson, Navy CLEAN Program Chemist
Field Performance Audit	One during sampling activities	Internal	CH2M HILL	Paul Weber PM, CH2M HILL	Susan Forker/ Kristin Rogers FTL, CH2M HILL	Paul Weber PM, CH2M HILL	Paul Weber PM, CH2M HILL
Safe Behavior Observation (SBO)	One during sampling activities	Internal	CH2M HILL	TBD SC, CH2M HILL	Field Team Member observed CH2M HILL	Max Bertram, HSM CH2M HILL	TBD SC / CH2M HILL

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SAP Worksheet #32—Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings (name, title, organization)	Timeframe of Notification	Nature of CA Response Documentation	Individual(s) Receiving CA Response (name, title, organization)	Timeframe for Response
Field Performance Audit	Checklist and Written Audit Report	Susan Forker/ Kristin Rogers, FTL CH2M HILL	Within 1 day of audit	Verbal and Memorandum	Susan Forker/ Kristin Rogers, FTL CH2M HILL	Within 1 day of receipt of CA Form
SBO	SBO Form	Max Bertram, HSM CH2M HILL	Weekly	Memorandum	Field Team Member CH2M HILL	Immediately

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Worksheet #32-1—Corrective Action Form

Person initiating corrective action (CA) _____ **Date** _____

Description of problem and when identified: _____

_____

_____

_____

_____

Cause of problem, if known or suspected: _____

_____

_____

_____

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

_____

_____

_____

_____

_____

_____

_____

CA implemented by: _____ **Date:** _____

CA initially approved by: _____ **Date:** _____

Follow-up date: _____

Final CA approved by: _____ **Date:** _____

Information copies to:

_____

_____

_____

_____

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SAP Worksheet #32-2—Field Performance Audit Checklist

Project Responsibilities

Project No.: Date: _____

Project Location: Signature: _____

Team Members:

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

Comments _____

_____

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

Comments _____

_____

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

Comments _____

_____

Sample Collection

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

Comments _____

_____

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

Comments _____

_____

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

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

Comments _____

_____

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

Comments _____

_____

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

Comments _____

_____

Yes No 6) Are quality assurance checks performed as specified in the work plan?

Comments _____

_____

Yes No 7) Are photographs taken and documented?

Comments _____

_____

Document Control

Yes No 1) Have any accountable documents been lost?

Comments _____

_____

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

Yes No 2) Have any accountable documents been voided?

Comments _____

_____

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

Comments _____

_____

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

Comments _____

_____

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

Comments _____

_____

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

Comments _____

_____

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

Comments _____

_____

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SAP Worksheet #33—QA Management Reports Table

Type of Report	Frequency (e.g., daily, weekly monthly, quarterly, annually)	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation (Title and organizational affiliation)	Report Recipient(s) (Title and organizational affiliation)
Field Audit Report	One during sampling activities	Submitted with Final Report	Paul Weber, PM CH2M HILL	Included in project files

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

(UFP-QAPP Manual Section 5.2.1)

Verification Input	Description	Internal/ External	Responsible for Verification
Chain-of-custody and Shipping Forms	Chain-of-custody forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the chain-of-custody will be initialed by the reviewer, a copy of the CoC retained in the site file, and the original and remaining copies taped inside the cooler for shipment. See Chain-of-Custody SOP (**Appendix B**) for further details.	Internal	FTL CH2M HILL
Planning Documents	Evidence of approval and completeness of UFP-SAP.	Internal	Paul Weber CH2M HILL
Field Log Notebooks	Field notes will be reviewed to ensure completeness of field data parameters, shipping information, sample collection times, etc. The logbook will also be used to document, explain, and justify all deviations from the approved UFP-SAP.	Internal	Paul Weber CH2M HILL
QC Summary Report	A summary of all QC sample results will be verified for completeness once the data is received from the laboratory.	External	Rebekha Shaw CH2M HILL
Chain of Custody Documentation	Upon their arrival at the laboratory, the samples will be cross-referenced against the chain-of-custody records. All sample labels will be checked against the COC, and any mislabeling will be identified, investigated, and corrected. The samples will be logged in at every storage area and work station required by the designated analyses. Individual analysts will verify the completeness and accuracy of the data recorded on the forms.	Internal	CompuChem and KEMRON employees

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

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

Step IIa/ IIb	Validation Input	Description	Responsible for Validation
IIa	SOPs	Review field logbooks, laboratory case narratives, data deliverables for compliance to methods.	Anita Dodson CH2M HILL DataQual Environmental Services
IIa	QC Results	Establish that all QC samples were run and compliant with method-required limits.	DataQual Environmental Services
IIb	QC Results	Verify that QC samples were run and compliant with limits established in the UFP-SAP.	DataQual Environmental Services
IIb	PQLs	Ensure all sample results met the project quantification and action limits specified in the SAP.	Paul Weber, Anita Dodson CH2M HILL
IIb	Raw data	10% review of raw data to confirm laboratory calculations.	DataQual Environmental Services

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SAP Worksheet #36—Analytical DV (Steps IIa and IIb) Summary Table

(UFP-QAPP Manual Section 5.2.2.1)

Step IIa/IIb	Matrix	Analytical Group	Validation Criteria	Data Validator
IIa	GW, SB, SS	TAL Metals, PAHs, TCL Pesticides	Analytical methods and laboratory SOPs as presented in this SAP will be used to evaluate compliance against QA/QC criteria. Should adherence to QA/QC criteria yield deficiencies, data may be qualified. The data qualifiers that may be used are those presented in *National Functional Guidelines for Organic Data Review, (October 1999)* and *National Functional Guidelines for Inorganic Data Review, (October 2004)*. National Functional Guidelines will not be used for DV; however, the specific qualifiers listed therein may be applied to data should non-conformances against the QA/QC criteria as presented in this SAP be identified.	Laura Maschoff DataQual
IIb	GW, SB, SS	TAL Metals, PAHs, TCL Pesticides	Action levels in **Worksheet #15**	Anita Dodson Paul Weber CH2M HILL

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SAP Worksheet #37—Usability Assessment

(UFP-QAPP Manual Section 5.2.3)

Summarize the usability assessment process and all procedures, including interim steps and any statistics, equations, and computer algorithms that will be used:

- Non-detected constituents will be evaluated to ensure that project required quantitation limits in Worksheet #15 were achieved. If project quantitation limits were achieved and the verification and validation steps yielded acceptable data, then the data is considered usable.
- The third-party data validator is the only party that may apply qualifiers to the data. Minor QC exceedances will result in "estimated" data, represented by J, NJ, and UJ qualifiers. Major QC exceedances will result in "rejected" data, represented by R-qualifiers. The affect on availability and usability of rejected results will be evaluated.
- For statistical comparisons non-detect values will be represented by a concentration equal to one-half the sample reporting limit. For duplicate sample results, the most conservative value will be used for project decisions.
- Analytical data will be checked to ensure the values and any qualifiers are appropriately transferred to the electronic database. These checks include comparison of hardcopy data and qualifiers to the electronic data deliverable. Once the data has been uploaded into the electronic database, another check will be performed to ensure all results were loaded accurately.
- Field and laboratory precision will be compared as relative percent difference (RPD) between the two results.
- Deviations from the SAP will be reviewed to assess whether corrective action is warranted and to assess impacts to achievement of project objectives.

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

- To assess whether a sufficient quantity of acceptable data are available for decision-making, the data will be reconciled with measurement performance criteria following validation and review of data quality indicator.
- If significant biases are detected with laboratory QA/QC samples, it will be evaluated to assess impact on decision-making. Low biases will be described in greater detail as they represent a possible inability to detect compounds that may be present.
- If significant deviations are noted between lab and field precision, the cause will be further evaluated to assess impact on decision-making.

SAP Worksheet #37—Usability Assessment (continued)

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

- Data tables will be produced to reflect detected and non-detected constituents and geochemical parameters. Data qualifiers will be reflected in the tables and discussed in the Expanded Base Background Study.
- A data validation report will be provided as appendix to the Expanded Base Background Study.
- If needed, a technical memorandum will be produced that will identify any data usability limitations and make recommendations for corrective action.

Identify the personnel responsible for performing the usability assessment:

- The CH2M HILL PM, PC and contributions from other team members as necessary.

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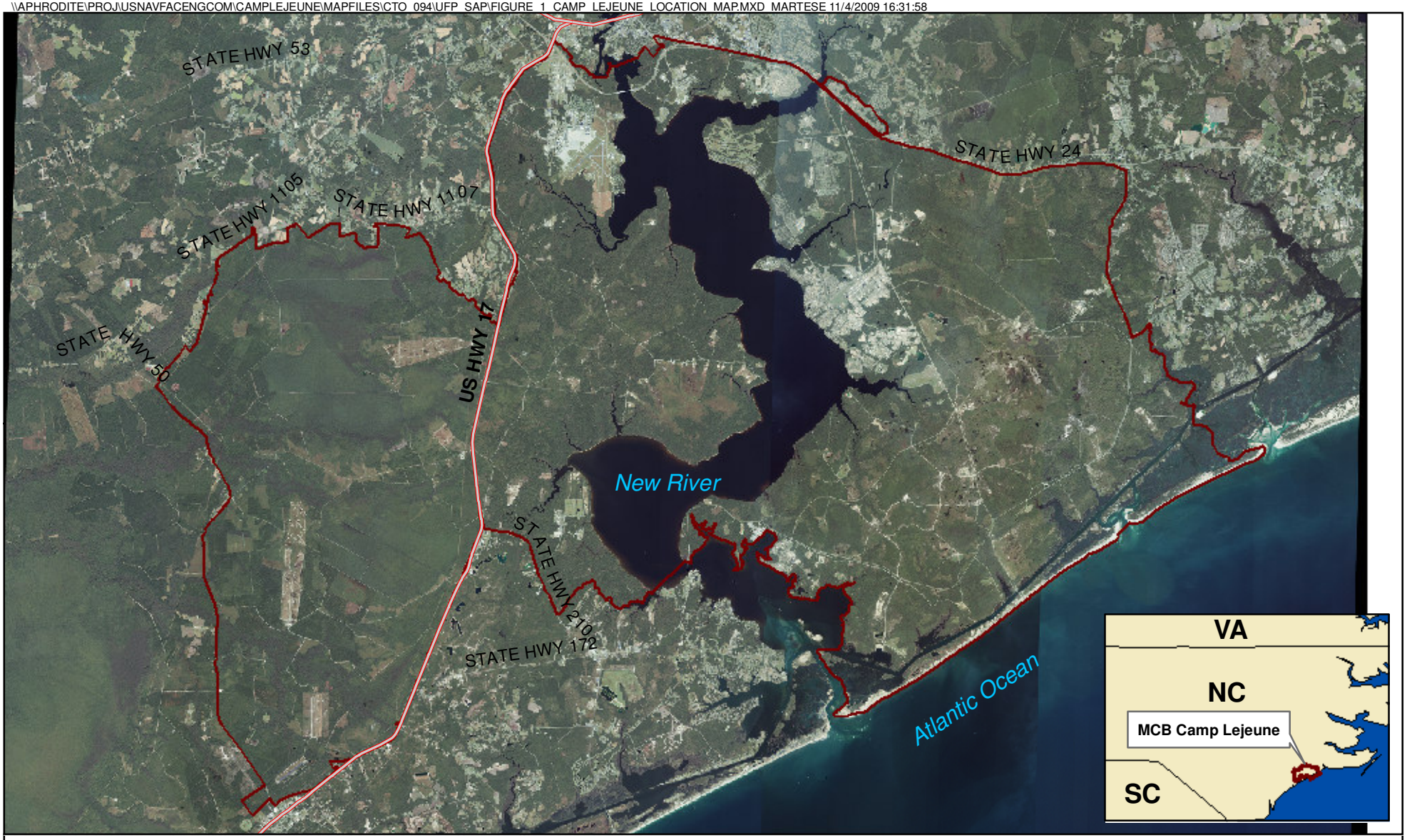
Figures

\\APHRODITE\PROJ\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\CTO_094\UFP_SAP\FIGURE_1_CAMP_LEJEUNE_LOCATION_MAP.MXD MARTESE 11/4/2009 16:31:58



Legend

Highways

Installation Boundary

N

0 8,000 16,000 32,000 Feet

1 inch = 16,000 feet

Figure 1
Camp Lejeune Location Map
Expanded Base Background Study
MCB Camp Lejeune
North Carolina

CH2MHILL

Generated by: *Verd Anna Cunningham/RDU* Checked by: *Paul Weber/RDU*

\\NORTHEND\PROJ\SIMA\FACEN\DOM\CAMPLEJEUNE\MAPFILES\CTO_206\UFP SAP\FIGURE 2 SOIL AND GROUNDWATER SAMPLE LOCATIONS NO ENV REST AREAS & 18 10.MXD MARTEFIE 6/24/2010 13:14:14

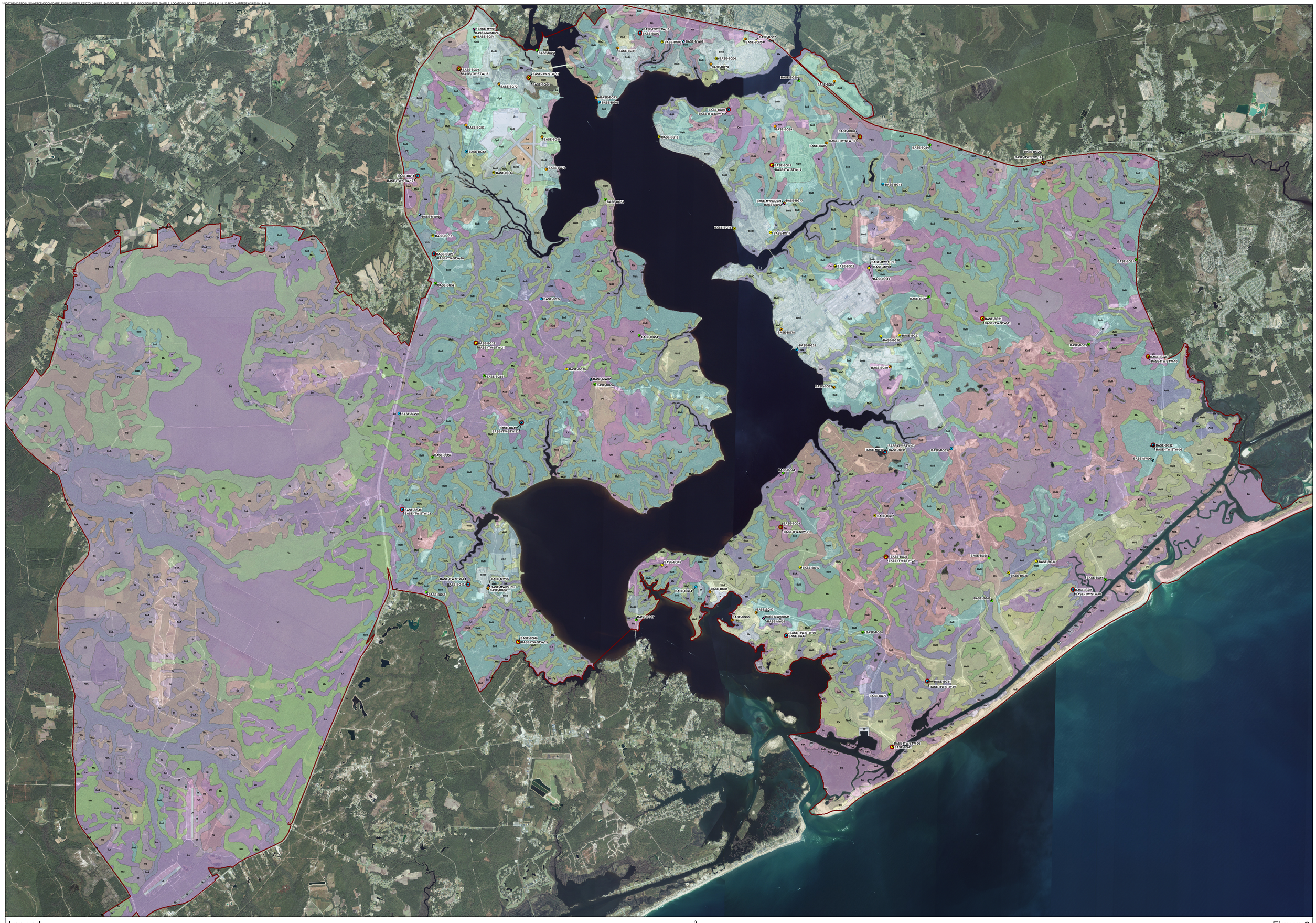


Figure 2
Soil and Groundwater Sample Locations
Expanded Base Background Study
MCB Camp Lejeune
North Carolina

CH2MHILL

Generated By: *Verd Anna Cunningham/RDU*

Checked By: *Paul Weber/RDU*

Appendix A
Site Specific Health & Safety Plan

Draft

Health and Safety Plan
Expanded Base Background Study

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Contract Task Order 094

November 2009

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

NAVFAC CLEAN 1000 Program
Contract N62470-08-D-1000

Prepared by

CH2MHILL

Raleigh, North Carolina

CH2M HILL Health and Safety Plan

This Health and Safety Plan (HSP) will be kept on the site during field activities and will be reviewed as necessary. The plan will be amended or revised as project activities or conditions change or when supplemental information becomes available. The plan adopts, by reference, the Enterprise-wide Core Standards (CS) and Standard Operating Procedures (SOPs), as appropriate. In addition, this plan adopts procedures in the project Work Plan. The Safety Coordinator (SC) is to be familiar with the CSs and SOPs and the contents of these instructions. CH2M HILL's personnel and subcontractors must be trained on this plan and sign Attachment 1.

Project Information and Background

PROJECT NO: 395307

CLIENT: Department of the Navy, Mid-Atlantic Division, Naval Facilities Engineering Command

PROJECT/SITE NAME: CTO-094 Expanded Base Background (Soil and Groundwater)

SITE ADDRESS: MCB Camp Lejeune

CH2M HILL PROJECT MANAGER: Weber, Paul

CH2M HILL OFFICE: Raleigh

DATE HEALTH AND SAFETY PLAN PREPARED: November 2, 2008

DATE(S) OF SITE WORK: February - March 2010

SITE BACKGROUND AND SETTING: The areas of focus are non-environmental sites throughout the entire Base of MCB Camp Lejeune.

DESCRIPTION OF SPECIFIC TASKS TO BE PERFORMED: CH2M HILL employees will oversee the installation of monitoring wells and collect soil and groundwater samples from non-environmentally impacted sites.

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Site Map

This page is reserved for a Site Map.

1. Tasks to be Performed Under This Plan

1.1 Description of Tasks

Refer to project documents (i.e., UFP-SAP) for detailed task information. A health and safety risk analysis (Table 1) has been performed for each task and is incorporated in this plan through task-specific hazard controls and requirements for monitoring and protection. Tasks other than those listed below require an approved amendment or revision to this plan before tasks begin. Refer to Section 8.2 for procedures related to "clean" tasks that do not involve potential for hazardous waste operations and emergency response (Hazwoper).

1.1.1 Hazwoper-Regulated Tasks

- Well installation
- Drilling
- Groundwater monitoring
- Soil sampling

1.1.2 Non-Hazwoper-Regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. **Prior approval from the Responsible Health and Safety Manager (RHSM) is required before these tasks are conducted on regulated hazardous waste sites.**

Table 1 Hazard Analysis

(Refer to Section 2.0 for Hazard Controls)

POTENTIAL HAZARDS	Project Activities									
	Drilling	Soil Sampling	Groundwater Sampling							
Chemical Hazard-Dermal/ Inhalation)	x	x	X							
Compressed Gas Cylinders		X	X							
Drilling	X									
Electrical Safety	X									
Fall Protection	X									
Fire Prevention	X									
Hand & Power Tools	X		X							
Heavy Equipment	X	x	x							
Lockout /Tagout										
Manual Lifting	X	X	X							
Noise	X									
Pressure Washing/ Equip Decon	X	X								
Utilities (underground/overhead)	X									
Vehicle Traffic	X	X	X							
Visible Lighting	x	x	X							

2. Hazard Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. These practices and controls are to be implemented by the party in control of either the site or the particular hazard. CH2M HILL employees and subcontractors must remain aware of the hazards affecting them regardless of who is responsible for controlling the hazards. CH2M HILL employees and subcontractors who do not understand any of these provisions should contact the RHSM for clarification.

The health and safety hazards posed by field activities have been identified for each project activity and are provided in the Hazard Analysis Table (Table 1). Hazard control measures for project-specific and general H&S hazards are provided in 2.1 and 2.2 of this section.

In addition to the controls specified in this section, Project-Activity Self-Assessment Checklists are contained in Attachment 5. These checklists are to be used to assess the adequacy of CH2M HILL and subcontractor site-specific safety requirements. The objective of the self-assessment process is to identify gaps in project safety performance, and prompt for corrective actions in addressing these gaps. Self-assessment checklists should be completed early in the project, when tasks or conditions change, or when otherwise specified by the RHSM. The self-assessment checklists, including documented corrective actions, should be made part of the permanent project records.

Applicable project activity self-assessment checklists (see Attachment 5) shall be completed weekly by a CH2M HILL representative during the course of the project depending on the work performed at the time.

2.1 Project-Specific Hazards

2.1.1 Drilling Safety

- The drill rig is not to be operated in inclement weather.
- The driller is to verify that the rig is properly leveled and stabilized before raising the mast.
- Personnel should be cleared from the sides and rear of the rig before the mast is raised.
- The driller is not to drive the rig with the mast in the raised position.
- The driller must check for overhead power lines before raising the mast. A minimum distance of 15 feet between mast and overhead lines (<50 kV) is recommended. Increased separation may be required for lines greater than 50 kV.
- Personnel should stand clear before rig startup.
- The driller is to verify that the rig is in neutral when the operator is not at the controls.
- Become familiar with the hazards associated with the drilling method used (cable tool, air rotary, hollow-stem auger, etc.).

- Do not wear loose-fitting clothing, watches, etc., that could get caught in moving parts.
- Do not smoke or permit other spark-producing equipment around the drill rig.
- The drill rig must be equipped with a kill wire or switch, and personnel are to be informed of its location.
- Be aware and stand clear of heavy objects that are hoisted overhead.
- The driller is to verify that the rig is properly maintained in accordance with the drilling company's maintenance program.
- The driller is to verify that all machine guards are in place while the rig is in operation.
- The driller is responsible for housekeeping (maintaining a clean work area).
- The drill rig should be equipped with at least one fire extinguisher.
- If the drill rig comes into contact with electrical wires and becomes electrically energized, do not touch any part of the rig or any person in contact with the rig, and stay as far away as possible. Notify emergency personnel immediately

2.1.2 Manual Lifting

(Reference CH2M HILL SOP HSE-112, *Manual Lifting*)

- Back injuries are the leading cause of disabling work and most back injuries are the result of improper lifting techniques or overexertion. Office or field tasks and activities involving manual lifting are to be identified and a program implemented to assist employees to mitigate the risks associated with manual lifting.
- When possible, the task should be modified to minimize manual lifting hazards.
- Effectiveness of manual handling control measures will be evaluated during assessments (HSE-114, Office & Warehouse Safety Program, or HSE-109, Audits).
- Manual handling incidents are reviewed as part of the HSE Program reviews, and the results influence program development, training, and education efforts.
- Lifting of loads weighing more than 40 pounds (18 kilograms) should be evaluated by the SC using the Lifting Evaluation Form contained in SOP HSE-112.
- Using mechanical lifting devices is the preferred means of lifting heavy objects such as forklifts; cranes, hoists, and rigging; hand trucks; and trolleys.
- Personnel shall seek assistance when performing manual lifting tasks that appear beyond their physical capabilities.
- Physical differences make it difficult to set up safe lifting limits, unless extensive individual testing is performed. In general, the following steps must be practiced when planning and performing manual lifts: Assess the situation before you lift; ensure good lifting and body positioning practices; ensure good carrying and setting down practices.
- All employees must receive training for the correct procedures to lift safely using the computer-based health and safety training or project-specific training.

2.1.3 Noise

(Reference CH2M HILL SOP HSE-108, *Hearing Conservation*)

- A noise assessment shall be conducted by the RHSM or designee based on potential to emit noise above 85 dBA.
- Areas or equipment emitting noise at or above 90dBA shall be evaluated to determine feasible engineering controls. When engineering controls are not feasible, administrative controls can be developed and appropriate hearing protection will be provided.
- Areas or equipment emitting noise levels at or above 85 dBA, hearing protection must be worn.
- Employees exposed to 84 dBA or a noise dose of 50% must participate in the Hearing Conservation program including initial and annual (as required) audiograms.
- The RHSM will evaluate appropriate controls measures and work practices for employees who have experienced a standard threshold shift (STS) in their hearing.
- Hearing protection is selected based upon noise levels and specific tasks to be performed.
- Employees are trained in the hazards of noise and how to properly wear and maintain their hearing protection.
- Hearing protection will be maintained in a clean and reliable condition, inspected prior to use and after any occurrence to identify any deterioration or damage, and damaged or deteriorated hearing protection repaired or discarded.
- In work areas where actual or potential high noise levels are present at any time, hearing protection must be worn by employees working or walking through the area.
- Areas where tasks requiring hearing protection are taking place may become hearing protection required areas as long as that specific task is taking place.
- High noise areas requiring hearing protection should be posted or employees must be informed of the requirements in an equivalent manner.

2.1.4 Utilities (underground)

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

Examples of the type of geophysical technologies include:

- **Ground Penetrating Radar (GPR),** which can detect pipes, including gas pipes, tanks, conduits, cables etc, both metallic and non-metallic at depths up to 30 feet depending on equipment. Sensitivity for both minimum object size and maximum depth detectable depends on equipment selected, soil conditions, etc.

- **Radio Frequency (RF),** involves inducing an RF signal in the pipe or cable and using a receiver to trace it. Some electric and telephone lines emit RF naturally and can be detected without an induced signal. This method requires knowing where the conductive utility can be accessed to induce RF field if necessary.
- **Dual RF**, a modified version of RF detection using multiple frequencies to enhance sensitivity but with similar limitations to RF
- **Ferromagnetic Detectors**, are metal detectors that will detect ferrous and non-ferrous utilities. Sensitivity is limited, e.g. a 100 mm iron disk to a depth of about one meter or a 25 mm steel paper clip to a depth of about 20 cm.
- **Electronic markers,** are emerging technologies that impart a unique electronic signature to materials such as polyethylene pipe to facilitate location and tracing after installation. Promising for future installations but not of help for most existing utilities already in place.

Procedure

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

- The survey contractor shall determine the most appropriate geophysical technique or combinations of techniques to identify the buried utilities on the project, based on the survey contractor's experience and expertise, types of utilities anticipated to be present and specific site conditions.
- The survey contractor shall employ the same geophysical techniques used on the project to identify the buried utilities, to survey the proposed path of subsurface construction work to confirm no buried utilities are present.
- Identify customer specific permit and/or procedural requirements for excavation and drilling activities. For military installations contact the Base Civil Engineer and obtain the appropriate form to begin the clearance process.
- Contact utility companies or the state/regional utility protection service at least two (2) working days prior to excavation activities to advise of the proposed work, and ask them to establish the location of the utility underground installations prior to the start of actual excavation.
- Schedule the independent survey.
- Obtain utility clearances for subsurface work on both public and private property.
- Clearances are to be in writing, signed by the party conducting the clearance.
- Underground utility locations must be physically verified by hand digging using wood or fiberglass-handled tools when any adjacent subsurface construction activity (e.g. mechanical drilling, excavating) work is expected to come within 5 feet of the marked underground system. If subsurface construction activity is within 5 feet and parallel to a marked existing utility, the utility location must be exposed and verified by hand digging every 100 feet.
- Protect and preserve the markings of approximate locations of facilities until the markings are no longer required for safe and proper excavations. If the markings of utility locations

are destroyed or removed before excavation commences or is completed, the Project Manager must notify the utility company or utility protection service to inform them that the markings have been destroyed.

- Conduct a site briefing for employees regarding the hazards associated with working near the utilities and the means by which the operation will maintain a safe working environment. Detail the method used to isolate the utility and the hazards presented by breaching the isolation..
- Monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon during drilling or change in color, texture or density during excavation that could indicate the ground has been previously disturbed).

2.1.5 Utilities (overhead)

Proximity to Power Lines

No work is to be conducted within 50 feet of overhead power lines without first contacting the utility company to determine the voltage of the system. No aspect of any piece of equipment is to be operated within 50 feet of overhead power lines without first making this determination.

Operations adjacent to overhead power lines are PROHIBITED unless one of the following conditions is satisfied:

- Power has been shut off, positive means (such as lockout) have been taken to prevent the lines from being energized, lines have been tested to confirm the outage, and the utility company has provided a signed certification of the outage.
- The minimum clearance from energized overhead lines is as shown in the table below, or the equipment will be repositioned and blocked to ensure that no part, including cables, can come within the minimum clearances shown in the table.

MINIMUM DISTANCES FROM POWERLINES

Powerlines Nominal System Kv	Minimum Required Distance, Feet
0-50	10
51-100	12
101-200	15
201-300	20
301-500	25
501-750	35
751-1000	45

(These distances have been determined to eliminate the potential for arcing based on the line voltage.)

- The power line(s) has been isolated through the use of insulating blankets which have been properly placed by the utility. If insulating blankets are used, the utility will determine the minimum safe operating distance; get this determination in writing with the utility representative's signature.

- All inquiries regarding electric utilities must be made in writing and a written confirmation of the outage/isolation must be received by the Project Manager/Construction Manager prior to the start of work.

2.1.6 Visible Lighting

- While work is in progress outside construction areas shall have at least 33 lux (lx).
- Construction work conducted inside buildings should be provided with at least 55 lux light.
- The means of egress shall be illuminated with emergency and non-emergency lighting to provide a minimum 11 lx measured at the floor. Egress illumination shall be arranged so that the failure of any single lighting unit, including the burning out of an electric bulb will not leave any area in total darkness.

2.2 \General Hazards

2.2.1 General Practices and Housekeeping

- Site work should be performed during daylight hours whenever possible.
- Good housekeeping must be maintained at all times in all project work areas.
- Common paths of travel should be established and kept free from the accumulation of materials.
- Keep access to aisles, exits, ladders, stairways, scaffolding, and emergency equipment free from obstructions.
- Provide slip-resistant surfaces, ropes, and/or other devices to be used.
- Specific areas should be designated for the proper storage of materials.
- Tools, equipment, materials, and supplies shall be stored in an orderly manner.
- As work progresses, scrap and unessential materials must be neatly stored or removed from the work area.
- Containers should be provided for collecting trash and other debris and shall be removed at regular intervals.
- All spills shall be quickly cleaned up. Oil and grease shall be cleaned from walking and working surfaces.
- Review the safety requirements of each job you are assigned to with your supervisor. You are not expected to perform a job that may result in injury or illness to yourself or to others.
- Familiarize yourself with, understand, and follow jobsite emergency procedures.
- Do not fight or horseplay while conducting the firm's business.
- Do not use or possess firearms or other weapons while conducting the firm's business.
- Report unsafe conditions or unsafe acts to your supervisor immediately.
- Report occupational illnesses, injuries, and vehicle accidents.

- Do not remove or make ineffective safeguards or safety devices attached to any piece of equipment.
- Report unsafe equipment, defective or frayed electrical cords, and unguarded machinery to your supervisor.
- Shut don and lock out machinery and equipment before cleaning, adjustment, or repair. Do not lubricate or repair moving parts of machinery while the parts are in motion.
- Do not run in the workplace.
- When ascending or descending stairways, use the handrail and take one step at a time.
- Do not apply compressed air to any person or clothing.
- Do not wear steel taps or shoes with metal exposed to the sole at any CH2M HILL project location.
- Do not wear finger rings, loose clothing, wristwatches, and other loose accessories when within arm's reach of moving machinery.
- Remove waste and debris from the workplace and dispose of in accordance with federal, state, and local regulations.
- Note the correct way to lift heavy objects (secure footing, firm grip, straight back, lift with legs), and get help if needed. Use mechanical lifting devices whenever possible.
- Check toe work area to determine what problems or hazards may exist.

Personal Hygiene

- Keep hands away from nose, mouth, and eyes.
- Keep areas of broken skin (chapped, burned, etc.) covered.
- Wash hands with hot water and soap frequently prior to eating and smoking.

Drugs and Alcohol

The following situations pertaining to drugs and alcohol are prohibited:

- Use or possession of intoxicating beverages while performing CH2M HILL work
- Abuse of prescription or nonprescription drugs
- Regulations. Use or possession of illegal drugs or drugs obtained illegally
- Sale, purchase, or transfer of illegal or illegally obtained drugs
- Arrival at work under the influence of legal or illegal drugs or alcohol

2.2.2 Hazard Communication

(Reference CH2M HILL SOP HSE-107, *Hazard Communication)*

The Hazard Communication Coordinator is to perform the following:

- Complete an inventory of chemicals brought on site by CH2M HILL using Attachment 2.

- Confirm that an inventory of chemicals brought on site by CH2M HILL subcontractors is available.
- Request or confirm locations of Material Safety Data Sheets (MSDSs) from the client, contractors, and subcontractors for chemicals to which CH2M HILL employees potentially are exposed.
- Before or as the chemicals arrive on site, obtain an MSDS for each hazardous chemical.
- Label chemical containers with the identity of the chemical and with hazard warnings, and store properly.
- Give employees required chemical-specific HAZCOM training using Attachment 3.
- Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

2.2.3 Shipping and Transportation of Chemical Products

(Reference CH2M HILL's Procedures for Shipping and Transporting Dangerous Goods)

Chemicals brought to the site might be defined as hazardous materials by the U.S. Department of Transportation (DOT). All staff who ship the materials or transport them by road must receive CH2M HILL training in shipping dangerous goods. All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. Contact the RHSM or the Warehouse Coordinator for additional information.

2.2.4 Ultraviolet (UV) Radiation (sun exposure)

Health effects regarding UV radiation are confined to the skin and eyes. Overexposure can result in many skin conditions, including erythema (redness or sunburn), photoallergy (skin rash), phototoxicity (extreme sunburn acquired during short exposures to UV radiation while on certain medications), premature skin aging, and numerous types of skin cancer.

Acute overexposure of UV radiation to the eyes may lead to photokeratitis (inflammation of the cornea), also known as snow blindness. Symptoms include redness of the eyes and a gritty feeling, which progresses to pain and an inability to tolerate any kind of light. This condition can also occur when working in or around water and other UV radiation reflectors. In addition, long-term exposure to sunlight is thought to cause cataracts or clouding of the lens of the eye.

Limit Exposure Time

- Rotate staff so the same personnel are not exposed all of the time.
- Limit exposure time when UV radiation is at peak levels (approximately 2 hours before and after the sun is at its highest point in the sky).
- Avoid exposure to the sun, or take extra precautions when the UV index rating is high.

Provide Shade

- Take lunch and breaks in shaded areas.

- Create shade or shelter through the use of umbrellas, tents, and canopies.
- Fabrics such as canvas, sailcloth, awning material and synthetic shade cloth create good UV radiation protection.
- Check the UV protection of the materials before buying them. Seek protection levels of 95 percent or greater, and check the protection levels for different colors.

Clothing

- Reduce UV radiation damage by wearing proper clothing; for example, long sleeved shirts with collars, and long pants. The fabric should be closely woven and should not let light through.
- Head protection should be worn to protect the face, ears, and neck. Wide-brimmed hats with a neck flap or "Foreign Legion" style caps offer added protection.
- Wear UV-protective sunglasses or safety glasses. These should fit closely to the face. Wrap-around style glasses provide the best protection.

Sunscreen

- Apply sunscreen generously to all exposed skin surfaces at least 20 minutes before exposure, allowing time for it to adhere to the skin.
- Re-apply sunscreen at least every 2 hours, and more frequently when sweating or performing activities where sunscreen may be wiped off.
- Choose a sunscreen with a high sun protection factor (SPF). Most dermatologists advocate SPF 30 or higher for significant sun exposure.
- Waterproof sunscreens should be selected for use in or near water, and by those who perspire sufficiently to wash off non-waterproof products.
- Check for expiration dates, because most sunscreens are only good for about 3 years. Store in a cool place out of the sun.
- Remember—no sunscreen provides 100% protection against UV radiation. Other precautions must be taken to avoid overexposure.

2.2.5 Heat Stress

- Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50°F to 60°F should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons per day. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.
- Acclimate yourself by slowly increasing workloads (e.g., do not begin with extremely demanding activities).
- Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency.

- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.
- Avoid direct sun whenever possible, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods.
- Provide adequate shelter/shade to protect personnel against radiant heat (sun, flames, hot metal).
- Maintain good hygiene standards by frequently changing clothing and showering.
- Observe one another for signs of heat stress. Persons who experience signs of heat syncope, heat rash, or heat cramps should report it to their supervisor immediately to avoid progression of heat-related illness.

SYMPTOMS AND TREATMENT OF HEAT STRESS					
	Heat Syncope	Heat Rash	Heat Cramps	Heat Exhaustion	Heat Stroke
Signs and Symptoms	Sluggishness or fainting while standing erect or immobile in heat.	Profuse tiny raised red blister-like vesicles on affected areas, along with prickling sensations during heat exposure.	Painful spasms in muscles used during work (arms, legs, or abdomen); onset during or after work hours.	Fatigue, nausea, headache, giddiness; skin clammy and moist; complexion pale, muddy, or flushed; may faint on standing; rapid thready pulse and low blood pressure; oral temperature normal or low	Red, hot, dry skin; dizziness; confusion; rapid breathing and pulse; high oral temperature.
Treatment	Remove to cooler area. Rest lying down. Increase fluid intake. Recovery usually is prompt and complete.	Use mild drying lotions and powders, and keep skin clean for drying skin and preventing infection.	Remove to cooler area. Rest lying down. Increase fluid intake.	Remove to cooler area. Rest lying down, with head in low position. Administer fluids by mouth. Seek medical attention.	Cool rapidly by soaking in cool–but not cold–water. Call ambulance, and get medical attention immediately!

Monitoring Heat Stress

These procedures should be considered when the ambient air temperature exceeds 70°F, the relative humidity is high (>50 percent), or when workers exhibit symptoms of heat stress.

The heart rate (HR) should be measured by the radial pulse for 30 seconds, as early as possible in the resting period. The HR at the beginning of the rest period should not exceed 100 beats/minute, or 20 beats/minute above resting pulse. If the HR is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same. If the pulse rate still exceeds 100 beats/minute at the beginning of the next rest period, the work cycle should be further shortened by 33 percent. The procedure is continued until the rate is maintained below 100 beats/minute, or 20 beats/minute above resting pulse.

2.2.6 Cold Stress

- Be aware of the symptoms of cold-related disorders, and wear proper, layered clothing for the anticipated fieldwork. Appropriate rain gear is a must in cool weather.
- Consider monitoring the work conditions and adjusting the work schedule using guidelines developed by the U.S. Army (wind-chill index) and the National Safety Council (NSC).
- Wind-Chill Index is used to estimate the combined effect of wind and low air temperatures on exposed skin. The wind-chill index does not take into account the body part that is exposed, the level of activity, or the amount or type of clothing worn. For those reasons, it should only be used as a guideline to warn workers when they are in a situation that can cause cold-related illnesses.
- NSC Guidelines for Work and Warm-Up Schedules can be used with the wind-chill index to estimate work and warm-up schedules for fieldwork. The guidelines are not absolute; workers should be monitored for symptoms of cold-related illnesses. If symptoms are not observed, the work duration can be increased.
- Persons who experience initial signs of immersion foot, frostbite, hypothermia should report it immediately to their supervisor/PM to avoid progression of cold-related illness.
- Observe one another for initial signs of cold-related disorders.
- Obtain and review weather forecast – be aware of predicted weather systems along with sudden drops in temperature, increase in winds, and precipitation.

SYMPTOMS AND TREATMENT OF COLD STRESS			
	Immersion (Trench) Foot	**Frostbite**	**Hypothermia**
Signs and Symptoms	Feet discolored and painful; infection and swelling present.	Blanched, white, waxy skin, but tissue resilient; tissue cold and pale.	Shivering, apathy, sleepiness; rapid drop in body temperature; glassy stare; slow pulse; slow respiration.
Treatment	Seek medical treatment immediately.	Remove victim to a warm place. Re-warm area quickly in warm–but **not** hot–water. Have victim drink warm fluids, but **not** coffee or alcohol. Do not break blisters. Elevate the injured area, and get medical attention.	Remove victim to a warm place. Have victim drink warm fluids, but **not** coffee or alcohol. Get medical attention.

2.3 Biological Hazards and Controls

2.3.1 Snakes

Snakes typically are found in underbrush and tall grassy areas. If you encounter a snake, stay calm and look around; there may be other snakes. Turn around and walk away on the same path you used to approach the area. If a person is bitten by a snake, wash and immobilize the injured area, keeping it lower than the heart if possible. Call the occupational nurse at 1-866-893-2514 immediately. **DO NOT** apply ice, cut the wound, or apply a tourniquet. Try to identify the type of snake: note color, size, patterns, and markings.

2.3.2 Poison Ivy, Poison Oak, and Poison Sumac

Poison ivy, poison oak, and poison sumac typically are found in brush or wooded areas. They are more commonly found in moist areas or along the edges of wooded areas. Shrubs are usually 12 to 30 inches high, or can also be a tree-climbing vine, with triple leaflets and short, smooth hair underneath. Plants are red and dark green in Spring and Summer, with yellowing leaves anytime especially in dry areas. Leaves may achieve bright reds in Fall, but plants lose its (yellowed, then brown) leaves in Winter, leaving toxic stems. All parts of the plant remain toxic throughout the seasons. These plants contain urushiol (you-ROO-shee-ol), a colorless or pale yellow oil that oozes from any cut or crushed part of the plant, including the roots, stems and leaves and causes allergic skin reactions when contacted. The oil is active year round.

Become familiar with the identity of these plants (see below). Wear protective clothing that covers exposed skin and clothes. Avoid contact with plants and the outside of protective clothing. If skin contacts a plant, wash the area with soap and water immediately. If the reaction is severe or worsens, seek medical attention.

Poison Ivy

Poison Sumac

Poison Oak

Contamination with poison ivy, sumac or oak can happen through several pathways, including:

- Direct skin contact with any part of the plant (even roots once above ground foliage has been removed).
- Contact with clothing that has been contaminated with the oil.
- Contact from removing shoes that have been contaminated (shoes are coated with urishol oil).
- Sitting in a vehicle that has become contaminated.
- Contact with any objects or tools that have become contaminated.
- Inhalation of particles generated by weed whacking, chipping, vegetation clearing.

If you must work on a site with poison ivy, sumac or oak the following precautions are necessary:

- Do not drive vehicles onto the site where it will come into contact with poison ivy, sumac or oak. Vehicles which need to work in the area, such as drill rigs or heavy equipment must be washed as soon as possible after leaving the site.

- All tools used in the poison ivy, sumac or oak area, including those used to cut back poison oak, surveying instruments used in the area, air monitoring equipment or other test apparatus must be decontaminated before they are placed back into the site vehicle. If on-site decontamination is not possible, use plastic to wrap any tools or equipment until they can be decontaminated.
- Personal protective equipment, including Tyvek coveralls, gloves, and boot covers must be worn. PPE must be placed into plastic bags and sealed if they are not disposed immediately into a trash receptacle.
- As soon as possible following the work, shower to remove any potential contamination. Any body part with suspected or actual exposure should be washed with "Tecnu" or other product designed for removing urushiol. If you do not have Tecnu wash with cold water. Do not take a bath, as the oils can form and invisible film on top of the water and contaminate your entire body upon exiting the bath.
- Tecnu may also be used to decontaminate equipment.
- Use IvyBlock or similar products to prevent poison oak, ivy and sumac contamination. Check with the closest CH2M HILL warehouse to see if these products are available. Follow all directions for application.

If you do come into contact with one of these poisonous plants and a reaction develops, contact your supervisor and the occupational nurse 1-866-893-2514.

2.3.3 Ticks

Every year employees are exposed to tick bites at work and at home putting them at risk of illness. Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch in size.

In some geographic areas exposure is not easily avoided. Wear tightly woven light-colored clothing with long sleeves and pant legs tucked into boots; spray **only outside** of clothing with permethrin or permanone and spray skin with only DEET; and check yourself frequently for ticks.

Where site conditions warrant (vegetation above knee height, tick endemic area) or when tasks warrant (e.g., having to sit/kneel in vegetation) that diminish the effectiveness of the other controls mentioned above, bug-out suits (obtained from MKE warehouse)/Tyvek shall be used. Bug-out suits are more breathable than Tyvek.

Take precautions to avoid exposure by including pre-planning measures for biological hazards prior to starting field work. Contact the MKE Warehouse for preventative equipment such as repellants, protective clothing and tick removal kits. Use the buddy system and perform tick inspections prior to entering the field vehicle. If ticks were not planned to be encountered and are observed, do not continue field work until these controls can be implemented.

See Tick Fact Sheet attached to this HSP for further precautions and controls to implement when ticks are present. Information includes the procedure for submitting a removed tick for testing. If bitten by a tick, follow the removal procedures found in the tick fact sheet, call the occupational nurse at 1-866-893-2514.

Be aware of the symptoms of Lyme disease or Rocky Mountain spotted fever (RMSF). Lyme: a rash might appear that looks like a bullseye with a small welt in the center. RMSF: a rash of red spots under the skin 3 to 10 days after the tick bite. In both RMSF and Lyme disease, chills, fever, headache, fatigue, stiff neck, and bone pain may develop. If symptoms appear, again contact the occupational nurse at 1-866-893-2514.

Be sure to complete an Incident Report (either use the HITS system on the VO) or see Attachment 5 if you do come in contact with a tick. For more detailed information go to HSSE website or contact the RHSM.

2.3.4 Mosquito Bites

Due to the recent detection of the West Nile Virus in the Southwestern United States it is recommended that **preventative measures** be taken to reduce the probability of being bitten by mosquitoes whenever possible. Mosquitoes are believed to be the primary source for exposure to the West Nile Virus as well as several other types of encephalitis. The following guidelines should be followed to reduce the risk of these concerns for working in areas where mosquitoes are prevalent.

- Stay indoors at dawn, dusk, and in the early evening.
- Wear long-sleeved shirts and long pants whenever you are outdoors.
- Spray clothing with repellents containing permethrin or DEET since mosquitoes may bite through thin clothing.
- Apply insect repellent sparingly to exposed skin. An effective repellent will contain 35% DEET (N,N-diethyl-meta-toluamide). Repellents may irritate the eyes and mouth, so avoid applying repellent to the hands.
- Whenever you use an insecticide or insect repellent, be sure to read and follow the manufacturer's DIRECTIONS FOR USE, as printed on the product.
- Note: Vitamin B and "ultrasonic" devices are NOT effective in preventing mosquito bites.

Symptoms of Exposure to the West Nile Virus

Most infections are mild, and symptoms include fever, headache, and body aches, occasionally with skin rash and swollen lymph glands. More severe infection may be marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, paralysis, and, rarely, death.

The West Nile Virus incubation period is from 3-15 days.

Contact the project RHSM with questions, and immediately report any suspicious symptoms to your supervisor/PM and contact the occupational nurse at 1-866-893-2514.

2.3.5 Bees and Other Stinging Insects

Bee and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform your

supervisor and/or buddy. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for allergic reaction; seek medical attention if a reaction develops.

2.3.6 Spiders - Brown Recluse

It is regarded by many as the most dangerous spider in the United States. Because of interstate shipping/transportation, the Brown Recluse spider can be found most anywhere in the United States. Brown Recluse Spiders are usually 1 inch or larger in size, including the legs and can grow as large as 3 inches. Young Brown Recluse spiders are smaller. Brown recluse spider bites don't always hurt right away. away. In fact, you may not know that you have been bitten until other symptoms appear. Symptoms of a brown recluse spider bite may include the following:

- Reddened skin followed by a blister that forms at the bite site.
- Mild to intense pain and itching for 2 to 8 hours following the bite.
- An open sore with a breakdown of tissue (necrosis) that develops within a few hours to 3 to 4 days following the bite and the area may become painful, itchy, hot, swollen, red and tender. An irregular ulcerous sore, caused by necrosis, will often appear that is from 1/4 inch to 10 inches in diameter. Prompt attention is the best defense against preventing the necrosis. The wound is often described as being reddish and surrounded by a bluish area with a narrow whitish separation in between the red and the blue. This gives it the famous "bull's eye" pattern. In just hours, a bite from the highly venomous Brown Recluse spider can create blisters and cause tissue damage.

Some people have a severe, systemic (whole-body) reaction to brown recluse spider bites, including the rapid destruction of red blood cells and anemia. Signs and symptoms include:

Fever and chills.

- Skin rash all over the body with many tiny, flat purple and red spots.
- Nausea or vomiting.
- Joint pain.

If you think you have been bitten by a brown recluse spider:

- Remain calm. Too much excitement or movement will increase the flow of venom into the blood.
- Try to collect the spider, without being bitten, (even a mangled specimen has diagnostic value), if possible, for positive identification by a spider expert. A plastic bag, small jar, or pill vial is useful and no preservative is necessary, but rubbing alcohol helps to preserve the spider.
- Apply a cool, wet cloth to the bite or cover the bite with a cloth and apply an ice bag to the bite.

- Do not apply a tourniquet. It may cause more harm than benefit.
- Try to positively identify the spider to confirm its type.
- Seek prompt medical attention.

A brown recluse bite can be serious and will likely require immediate medical care. Seek medical attention if you believe you have been bitten by a recluse spider, especially if severe symptoms develop throughout your body or an open sore and necrosis develop. A brown recluse spider bite is diagnosed through a physical examination and questions about the bite. You should be prepared to describe the spider, where and when the bite took place, and what you were doing at the time. Your health professional will ask what your main symptoms are, when they began, and how they have developed, progressed, or changed since the bite.

2.3.7 Widow Spiders

The Northern Black Widow spider may be encountered in Northern Regions of the United States. Other similar widow spiders are the Red Widow and the Brown Widow. Female widow spiders range from 8-15 mm in body length; males are smaller, sometimes very small (2 mm). Most have globose, shiny abdomens that are predominantly black with red markings (although some may be pale and/or have lateral stripes), with moderately long, slender legs. These spiders are nocturnal and build a three-dimensional tangled web, often with a conical tent of dense silk in a corner where the spider hides during the day. In nature, most species are found under rocks and logs, but they readily adapt to human-altered environments, where they are most commonly found in outbuildings (sheds, barns, privies), water meter holes, nursery cans, and under any item or structure (*e.g.*, barbeque grill, slide, sand box) that has been undisturbed for a lengthy period. Formerly, most bites by black widows (almost all by female spiders) occurred in outhouses, but presently, widow bites occur most frequently when the spider is trapped against human skin, either by reaching under objects where the spider is hiding or when putting on clothing, gloves or shoes containing the spider. Widow spiders are generally very timid and only bite in self-defense when they accidentally contact humans.

Black Widow

Red Widow

Brown Widow

Bite symptoms are systemic, spreading through the lymphatic system, and usually start about 1-3 hours after the bite. The most common symptoms are intense pain, rigid abdominal muscles, muscle cramping, malaise, local sweating, nausea, vomiting, and hypertension. Other symptoms may includetremors, labored breathing, restlessness, increased blood pressure, and fever. If left untreated, widow bite symptoms usually last 3-5 days.

If bitten, remain calm, and immediately seek medical attention (contact your physician, hospital and/or poison control center). Apply an ice pack directly to the bite area to relieve swelling and

pain. Try to collect the spider, without being bitten, (even a mangled specimen has diagnostic value), if possible, for positive identification by a spider expert. A plastic bag, small jar, or pill vial is useful and no preservative is necessary, but rubbing alcohol helps to preserve the spider. A hospital stay may be recommended, particularly for those with a heart condition or with health problems. A physician may administer a specific antivenin to counteract the venom or calcium gluconate to relieve pain. Calcium gluconate and/or antivenin may be administered to relieve or counteract symptoms.

2.3.8 Bloodborne Pathogens

(Reference CH2M HILL SOP HSE-202, *Bloodborne Pathogens*)

Exposure to bloodborne pathogens may occur when rendering first aid or CPR, or when coming into contact with landfill waste or waste streams containing potentially infectious material (PIM).

- Employees trained in first-aid/CPR or those exposed to PIM must complete CH2M HILL's 1-hour bloodborne computer-based training module annually.
- Hepatitis B vaccine (HBV) is offered to employees who may be exposed to PIM when they complete training and within 10 working days of assignment. (Note: Employees whose exposure stems only from rendering first aid as a collateral duty receives the vaccine after exposure.)
- Employees who decline the HBV vaccine must sign the declination form (contact regional Safety Program Assistant [SPA]) indicating they declined the vaccination. Anyone who declines the vaccination and chooses to receive the vaccination at a later time may still receive the vaccination by contacting the SPA.
- Hepatitis B and tetanus vaccinations can be requested by completing the medical portion of the enrollment form, located under Tools & Forms at the HS&E web page, or by contacting the regional SPA.

Work Controls

- Observe universal precautions to prevent contact with blood or other PIMs. Where differentiation between body fluid types is difficult or impossible, consider all body fluids to be potentially infectious materials.
- Always wash your hands and face with soap and running water after contacting PIMs. If washing facilities are unavailable, use an antiseptic cleanser with clean paper towels or moist towelettes. These must be provided for employees who have been exposed to PIMs. When antiseptic cleansers or towelettes are used, always rewash your hands and face with soap and running water as soon as available. Do not consume food or beverages until after thoroughly washing your hands and face.
- Decontaminate all potentially contaminated equipment and environmental surfaces with chlorine bleach as soon as possible. Clean and decontaminate on a regular basis (and immediately upon visible contamination) all bins, pails, cans, and other receptacles intended for reuse that have the potential for becoming contaminated.

- Use one part chlorine bleach (5.25 percent sodium hypochlorite solution) diluted with 10 parts water for decontaminating equipment or surfaces after initially removing blood or other PIMs. Remove contaminated PPE as soon as possible before leaving a work area.
- Place regulated waste in containers that are closable; are constructed to contain all contents and prevent leakage of fluids during handling, storage, transport or shipping; are labeled with a Biological warning label or color-coded; and are tightly closed prior to removal to prevent spillage or protrusion of contents during handling, storage, transport, or shipping.

Post Exposure

CH2M HILL will provide exposed employees with a confidential medical examination should an exposure to PIM occur. This examination includes the following procedures:

- Documenting the exposure
- Testing the exposed employee's and the source individual's blood (with consent)
- Administering post-exposure prophylaxis

2.3.9 Mosquito Bites

Due to the recent detection of the West Nile Virus in the Southwestern United States it is recommended that **preventative measures** be taken to reduce the probability of being bitten by mosquitoes whenever possible. Mosquito's are believed to be the primary source for exposure to the West Nile Virus as well as several other types of encephalitis. The following guidelines should be followed to reduce the risk of these concerns for working in areas where mosquitoes are prevalent.

- Stay indoors at dawn, dusk, and in the early evening.
- Wear long-sleeved shirts and long pants whenever you are outdoors.
- Spray clothing with repellents containing permethrin or DEET since mosquitoes may bite through thin clothing.
- Apply insect repellent sparingly to exposed skin. An effective repellent will contain 35% DEET (N,N-diethyl-meta-toluamide). DEET in high concentrations (greater than 35%) provides no additional protection.
- Repellents may irritate the eyes and mouth, so avoid applying repellent to the hands.
- Whenever you use an insecticide or insect repellent, be sure to read and follow the manufacturer's DIRECTIONS FOR USE, as printed on the product.
- Note: Vitamin B and "ultrasonic" devices are NOT effective in preventing mosquito bites.

Symptoms of Exposure to the West Nile Virus

Most infections are mild, and symptoms include fever, headache, and body aches, occasionally with skin rash and swollen lymph glands. More severe infection may be marked by headache, high fever, neck stiffness, stupor, disorientation, coma, tremors, convulsions, muscle weakness, paralysis, and, rarely, death.

The West Nile Virus incubation period is from 3-15 days.

Contact the project RHSM with questions, and immediately report any suspicious symptoms to your supervisor/PM.

2.4 Radiological Hazards and Controls

Refer to CH2M HILL's Core Standard, Radiological Control and Radiological Controls Manual for additional requirements.

Hazards	Controls
None Known	None Required

2.5 Contaminants of Concern

Contaminants of Concern

Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
There are no known contaminants of concern as these are all "clean" sites with no historical use. This table will be updated if analytes are detected.	NA	NA	NA	NA	NA

Footnotes:

[a] Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), S (Surface Soil), SL (Sludge), SW (Surface Water).

[b] Appropriate value of PEL, REL, or TLV listed.

[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.

[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

NR – not regulated

Potential Routes of Exposure

Dermal: Contact with contaminated media. This route of exposure is minimized through proper use of PPE, as specified in Section 4. **Inhalation:** Vapors and contaminated particulates. This route of exposure is minimized through proper respiratory protection and monitoring, as specified in Sections 4 and 5, respectively.	**Other:** Inadvertent ingestion of contaminated media. This route should not present a concern if good hygiene practices are followed (e.g., wash hands and face before drinking or smoking).

3. Project Organization and Personnel

3.1 CH2M HILL Employee Medical Surveillance and Training

(Reference CH2M HILL- SOPs HSE-113, Medical Surveillance, and HSE-110, Training)

The employees listed meet state and federal hazardous waste operations requirements for 40-hour initial training, 3-day on-the-job experience, and 8-hour annual refresher training. Employees designated "SC" have completed a 12-hour site safety coordinator course, and have documented requisite field experience. An SC with a level designation (D, C, B) equal to or greater than the level of protection being used must be present during all tasks performed in exclusion or decontamination zones. Employees designated "FA-CPR" are currently certified by the American Red Cross, or equivalent, in first aid and CPR. At least one FA-CPR designated employee must be present during all tasks performed in exclusion or decontamination zones. The employees listed below are currently active in a medical surveillance program that meets state and federal regulatory requirements for hazardous waste operations. Certain tasks (e.g., confined-space entry) and contaminants (e.g., lead) may require additional training and medical monitoring.

Pregnant employees are to be informed of and are to follow the procedures in CH2M HILL-SOP HSE-120, *Reproductive Health*, including obtaining a physician's statement of the employee's ability to perform hazardous activities before being assigned fieldwork.

Employee Name	Office	Responsibility	SSC/FA-CPR

3.2 Field Team Chain of Command and Communication Procedures

3.2.1 Client

Client Contact
Dave Cleland
NAVFAC Mid-Atlantic
Code: OPCEV

Base Contact
Robert Lowder
Camp Lejeune - EMD
Building 12

6506 Hampton Blvd
Norfolk, Virginia 23508-1278
Direct: (757) 322-4734
Fax: (757) 322-4851
david.t.cleland@navy.mil

Marine Corps Base Camp Lejeune, NC 28542-0004
Direct (910) 451-9607
Fax: (910) 451-5997
robert.a.lowder@usmc.mil

3.2.2 CH2M HILL

Program Manager:
Project Manager (PM): Paul Weber/RDU
Responsible Health and Safety Manager (RHSM): Max Bertram/KNV
Field Team Leader: James Frank/RDU
Safety Coordinator (SC):

The PM is responsible for providing adequate resources (budget and staff) for project-specific implementation of the HS&E management process. The PM has overall management responsibility for the tasks listed below. The PM may explicitly delegate specific tasks to other staff, as described in sections that follow, but retains ultimate responsibility for completion of the following in accordance with this SOP:

- Include standard terms and conditions, and contract-specific HS&E roles and responsibilities in contract and subcontract agreements (including flow-down requirements to lower-tier subcontractors)
- Select safe and competent subcontractors by:
  - obtaining, reviewing and accepting or rejecting subcontractor pre-qualification questionnaires
  - ensuring that acceptable certificates of insurance, including CH2M HILL as named additional insured, are secured as a condition of subcontract award
  - including HS&E submittals checklist in subcontract agreements, and ensuring that appropriate site-specific safety procedures, training and medical monitoring records are reviewed and accepted prior to the start of subcontractor's field operations
- Maintain copies of subcontracts and subcontractor certificates of insurance (including CH2M HILL as named additional insured), bond, contractors license, training and medical monitoring records, and site-specific safety procedures in the project file accessible to site personnel
- Provide oversight of subcontractor HS&E practices per the site-specific safety plan
- Manage the site and interfacing with 3rd parties in a manner consistent with our contract and subcontract agreements and the applicable standard of reasonable care
- Ensure that the overall, job-specific, HS&E goals are fully and continuously implemented

The CH2M HILL RHSM is responsible for:

- Review and accept or reject subcontractor pre-qualification questionnaires that fall outside the performance range delegated to the Contracts Administrator (KA)
- Review and accept or reject subcontractor training records and site-specific safety procedures prior to start of subcontractor's field operations
- Support the oversight of subcontractor (and lower-tier subcontractors) HS&E practices and interfaces with on-site 3rd parties per the site-specific safety plan

The SC is responsible for verifying that the project is conducted in a safe manner including the following specific obligations:

- Verify this HSP is current and amended when project activities or conditions change.
- Verify CH2M HILL site personnel and subcontractor personnel read the HSP and sign Attachment 1, Employee Sign-Off Form prior to commencing field activities.
- Verify CH2M HILL site personnel and subcontractor personnel have completed any required specialty training (e.g., fall protection, confined space entry) and medical surveillance as identified in Section 2.
- Verify compliance with the requirements of this HSP and applicable subcontractor health and safety plan(s)
- Act as the project "Hazard Communication Coordinator" and perform the responsibilities outlined in Section 2.2.2
- Act as the project "Emergency Response Coordinator" and perform the responsibilities outlined in Section 9.
- Post OSHA job-site poster; the poster is required at sites where project field offices, trailers, or equipment-storage boxes are established.
- Verify that safety meetings are conducted and documented in the project file initially and as needed throughout the course of the project (e.g., as tasks or hazards change)
- Verify that project H&S forms and permits, found in Attachment 5 and 6, are being used as outlined in Section 2.
- Perform oversight and/or assessments of subcontractor HS&E practices per the site-specific safety plan and verify that project activity self-assessment checklists, found in Attachment 6, are being used as outlined in Section 2
- Verify that project files available to site personnel include copies of executed subcontracts and subcontractor certificates of insurance (including CH2M HILL as named additional insured), bond, contractors license, training and medical monitoring records, and site-specific safety procedures prior to start of subcontractor's field operations
- Manage the site and interfacing with 3rd parties in a manner consistent with our contract/subcontract agreements and the applicable standard of reasonable care
- Coordinate with the RHSM regarding CH2M HILL and subcontractor operational performance, and 3rd party interfaces

- Ensure that the overall, job-specific, HS&E goals are fully and continuously implemented

The training required for the SC is as follows:

- SC-Initial and SC-Construction
- OSHA 10-hour course for Construction
- First Aid and CPR
- Relevant Competent Person Courses (excavation, confined space, scaffold, fall protection, etc.)

The SC is responsible for contacting the Field Team Leader and Project Manager. In general, the Project Manager will contact the client. The RHSM should be contacted as appropriate.

3.2.3 CH2M HILL Subcontractors

(Reference CH2M HILL SOP HSE-215, *Contracts and Subcontracts)*

Subcontractor: Subcontractor Contact Name: Telephone:	TBD
Subcontractor: Subcontractor Contact Name: Telephone:	TBD
Subcontractor: Subcontractor Contact Name: Telephone:	TBD

The subcontractors listed above are required to submit their own Accident Prevention Plan, specific to this project. Other plans, such as Lead or Asbestos Abatement Compliance plans, may be required as well. Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit their plans to CH2M HILL for review before the start of field work.

Subcontractors are also required to prepare an Activity Hazard Analysis (AHA) before beginning each activity posing H&S hazards to their personnel using the AHA form provided in Attachment 6 as a guide. The AHA shall identify the principle steps of the activity, potential H&S hazards for each step and recommended control measures for each identified hazard. In addition, a listing of the equipment to be used to perform the activity, inspection requirements and training requirements for the safe operation of the equipment listed must be identified.

CH2M HILL should continuously endeavor to observe subcontractors' safety performance and adherence to their Accident Prevention Plan and AHAs. This endeavor should be reasonable, and include observing for hazards or unsafe practices that are both readily observable and occur in common work areas. CH2M HILL is not responsible for exhaustive observation for hazards and unsafe practices. Self-assessment checklists contained in Attachment 5 are to be used by CH2M HILL personnel to review subcontractor performance. CH2M HILL oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

Health and safety related communications with CH2M HILL subcontractors should be conducted as follows:

- Brief subcontractors on the provisions of this plan, and require them to sign the Employee Signoff Form included in Attachment 1.
- Request subcontractor(s) to brief project team on the hazards and precautions related to their work.
- When apparent non-compliance/unsafe conditions or practices are observed, notify the subcontractor safety representative and require corrective action – the subcontractor is responsible for determining and implementing necessary controls and corrective actions.
- When repeat non-compliance/unsafe conditions are observed, notify the subcontractor safety representative and stop affected work until adequate corrective measures are implemented.
- When an apparent imminent danger exists, immediately remove all affected CH2M HILL employees and subcontractors, notify subcontractor safety representative, and stop affected work until adequate corrective measures are implemented. Notify the PM and RHSM as appropriate.
- Document all oral health and safety related communications in project field logbook, daily reports, or other records.

4. Personal Protective Equipment (PPE)

(Reference CH2M HILL- SOP HSE-117, *Personal Protective Equipment*)

- PPE must be worn by employees when actual or potential hazards exist and engineering controls or administrative practices cannot adequately control those hazards.
- A PPE assessment has been conducted by the RHSM based on project tasks (see PPE specifications below). Verification and certification of assigned PPE by task is completed by the RHSM or designee.
- Employees must be trained to properly wear and maintain the PPE.
- In work areas where actual or potential hazards are present at any time, PPE must be worn by employees working or walking through the area.
- Areas requiring PPE should be posted or employees must be informed of the requirements in an equivalent manner.
- PPE must be inspected prior to use and after any occurrence to identify any deterioration or damage.
- PPE must be maintained in a clean and reliable condition.
- Damaged PPE shall not be used and must either be repaired or discarded.
- PPE shall not be modified, tampered with, or repaired beyond routine maintenance.

Note that PPE is required when exposed to the general hazards listed below. Because certain tasks (e.g., welding, energized work, etc.) require specialized PPE, refer to Section 2 for task-specific PPE requirements.

4.1 Respiratory Protection

(Reference CH2M HILL SOP HSE-121, *Respiratory Protection*)

- Respirator users must have completed appropriate respirator training within the past 12 months. Level C training is required for air-purifying respirators (APR) use.
- Respirator users must complete the respirator medical monitoring protocol and been approved for the specific type of respirator to be used.
- Tight-fitting facepiece respirator (negative or positive pressure) users must have passed an appropriate fit test within past 12 months.
- Respirator use shall be limited to those activities identified in this plan. If site conditions change that alters the effectiveness of the specified respiratory protection, the RHSM shall be notified to amend the written plan.
- Tight-fitting facepiece respirator users shall be clean-shaven and shall perform a user seal check before each use.

- Canisters/cartridges shall be replaced according to the change-out schedule specified in this plan. Respirator users shall notify the SC or RHSM of any detection of vapor or gas breakthrough. The SC shall report any breakthrough events to the RHSM for schedule upgrade.
- Respirators in regular use shall be inspected before each use and during cleaning
- Respirators in regular use shall be cleaned and disinfected as often as necessary to ensure they are maintained in a clean and sanitary condition.
- Respirators shall be properly stored to protect against contamination and deformation.
- Field repair of respirators shall be limited to routine maintenance. Defective respirators shall be removed from service.

PPE Specifications [a]

Task	Level	Body	Head	Respirator [b]
General site entry	D	Work clothes; safety toed leather work boots and gloves	Hardhat [c] Safety glasses with side shields Ear protection [d]	None required
Groundwater sampling Soil Sampling Soil boring	Modified D	Work clothes or cotton coveralls **Boots:** Safety-toe, chemical-resistant boots OR Safety -toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Safety glasses with side shields Ear protection [d]	None required
Tasks requiring upgrade	C	**Coveralls:** Polycoated Tyvek® **Boots:** Safety -toe, chemical-resistant boots OR Safety -toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] Ear protection [d] Spectacle inserts	APR, full face, MSA Ultratwin or equivalent; with GME-H cartridges or equivalent[e].

Reasons for Upgrading or Downgrading Level of Protection

Upgrade[f]	Downgrade
• Request from individual performing tasks. • Change in work tasks that will increase contact or potential contact with hazardous materials. • Occurrence or likely occurrence of gas or vapor emission. • Known or suspected presence of dermal hazards. • Instrument action levels (Section 5) exceeded.	• New information indicating that situation is less hazardous than originally thought. • Change in site conditions that decrease the hazard. • Change in work task that will reduce contact with hazardous materials.

[a] Modifications are as indicated. CH2M HILL will provide PPE only to CH2M HILL employees.
[b] No facial hair that would interfere with respirator fit is permitted.
[c] Hardhat and splash-shield areas are to be determined by the SSC.
[d] Ear protection should be worn when conversations cannot be held at distances of 3 feet or less without shouting.
[e] Cartridge change-out schedule is at least every 8 hours (or one work day), except if relative humidity is > 85%, or if organic vapor measurements are > midpoint of Level C range (refer to Section 5)--then at least every 4 hours. If encountered conditions are different than those anticipated in this HSP, contact the HSM.
[f] Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the HSM, and an SSC qualified at that level is present.

5. Air Monitoring/Sampling

(Reference CH2M HILL SOP HSE-207, Exposure Monitoring for Airborne Chemical Hazards)

5.1 Air Monitoring Specifications

Instrument	Tasks	Action Levels[a]	Action to be Taken when Action Level reached	Frequency [b]	Calibration
PID: OVM with 10.6eV lamp or equivalent	All intrusive tasks	<1 ppm 1 to 10 ppm >10 ppm	Level D Level C Evacuate work area and contact HSM.	Initially and periodically during task	Daily
CGI: MSA model 260 or 261 or equivalent	All intrusive tasks	0-10% : 10-25% LEL: >25% LEL:	No explosion hazard Potential explosion hazard Explosion hazard; evacuate or vent	Continuous during advancement of boring or trench	Daily
O_2Meter: MSA model 260 or 261 or equivalent	All intrusive tasks	>25%[c] O_2: 20.9%[c] O_2: <19.5%[c] O_2:	Explosion hazard; evacuate or vent Normal O_2 O_2 deficient; vent or use SCBA	Continuous during advancement of boring or trench	Daily

[a] Action levels apply to sustained breathing-zone measurements above background.
[b] The exact frequency of monitoring depends on field conditions and is to be determined by the SSC; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate. Monitoring results should be recorded. Documentation should include instrument and calibration information, time, measurement results, personnel monitored, and place/location where measurement is taken (e.g., "Breathing Zone/MW-3", "at surface/SB-2", etc.).
[c] If the measured percent of O_2 is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O_2 action levels apply only to ambient working atmospheres, and not to confined-space entry. More-stringent percent LEL and O_2 action levels are required for confined-space entry (refer to Section 2).
[d] Refer to SOP HS-10 for instructions and documentation on radiation monitoring and screening.
[e] Noise monitoring and audiometric testing also required.

5.2 Calibration Specifications

(Refer to the respective manufacturer's instructions for proper instrument-maintenance procedures)

Instrument	Gas	Span	Reading	Method
PID: OVM, 10.6 or 11.8 eV bulb	100 ppm isobutylene	RF = 1.0	100 ppm	1.5 lpm reg T-tubing
PID: MiniRAE, 10.6 eV bulb	100 ppm isobutylene	CF = 100	100 ppm	1.5 lpm reg T-tubing
PID: TVA 1000	100 ppm isobutylene	CF = 1.0	100 ppm	1.5 lpm reg T-tubing
CGI: MSA 260, 261, 360, or 361	0.75% pentane	N/A	50% LEL ± 5% LEL	1.5 lpm reg direct tubing

5.3 Air Sampling

Sampling, in addition to real-time monitoring, may be required by other OSHA regulations where there may be exposure to certain contaminants. Air sampling typically is required when site contaminants include lead, cadmium, arsenic, asbestos, and certain volatile organic compounds. Contact the HSM immediately if these contaminants are encountered.

Method Description

Additional sampling is not anticipated.

Personnel and Areas

Results must be sent immediately to the RHSM. Regulations may require reporting to monitored personnel. Results reported to:

RHSM: Max Bertram/KNV

6. Decontamination

(Reference CH2M HILL SOP HSE-218, *Hazardous Waste Operations*)

The SC must establish and monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SC. The SC must ensure that procedures are established for disposing of materials generated on the site.

6.1 Decontamination Specifications

Personnel

- Boot wash/rinse
- Glove wash/rinse
- Outer-glove removal
- Inner-glove removal
- Respirator removal
- Hand wash/rinse
- Face wash/rinse
- Shower ASAP
- Dispose of PPE in municipal trash, or contain for disposal
- Dispose of personnel rinse water to facility or contain for offsite disposal

Sample Equipment

- Wash/rinse equipment
- Solvent-rinse equipment
- Contain solvent waste for offsite disposal

Drill Rig/Heavy Equipment

- Power wash
- Steam clean
- Dispose of equipment rinse water to facility or sanitary sewer, or contain for offsite disposal

6.2 Diagram of Personnel-Decontamination Line

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SC should establish areas for eating, drinking, and smoking. Contact lenses are not permitted in exclusion or decontamination zones.

Figure 6-1 illustrates a conceptual establishment of work zones, including the decontamination line. Work zones are to be modified by the SC to accommodate task-specific requirements

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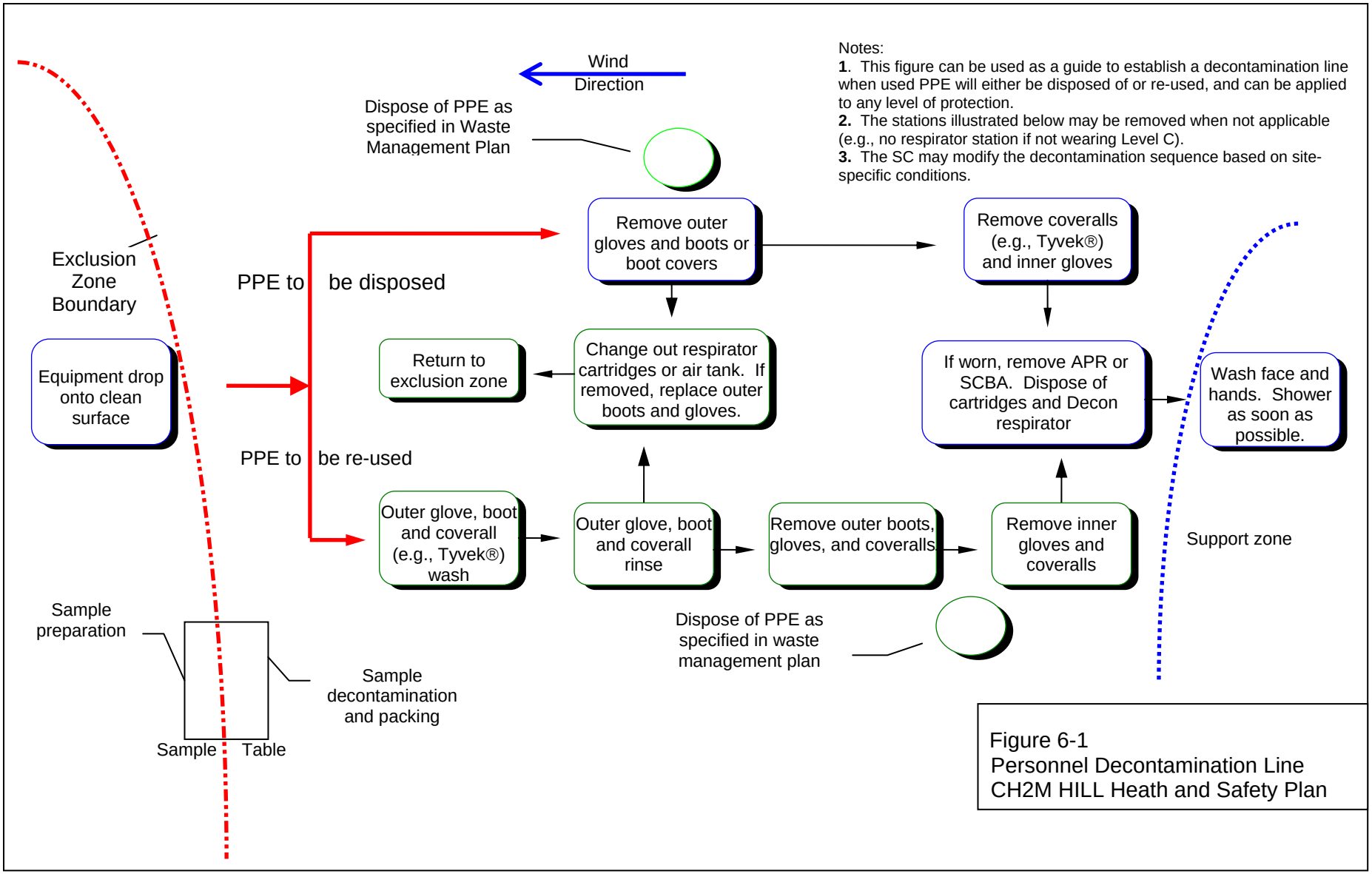


Notes:
1. This figure can be used as a guide to establish a decontamination line when used PPE will either be disposed of or re-used, and can be applied to any level of protection.
2. The stations illustrated below may be removed when not applicable (e.g., no respirator station if not wearing Level C).
3. The SC may modify the decontamination sequence based on site-specific conditions.

Figure 6-1
Personnel Decontamination Line
CH2M HILL Heath and Safety Plan

7. Spill Containment Procedures

Sorbent material will be maintained in the support zone. Incidental spills will be contained with sorbent and disposed of properly.

8. Site-Control Plan

8.1 Site-Control Procedures

(Reference CH2M HILL SOP HSE-218, *Hazardous Waste Operations)*

- The SSC will conduct a site safety briefing (see below) before starting field activities or as tasks and site conditions change.
- Topics for briefing on site safety: general discussion of Health and Safety Plan, site-specific hazards, locations of work zones, PPE requirements, equipment, special procedures, emergencies.
- The SSC records attendance at safety briefings in a logbook and documents the topics discussed.
- Post the OSHA job-site poster in a central and conspicuous location in accordance with CH2M HILL- SOP, *OSHA Postings*.
- Establish support, decontamination, and exclusion zones. Delineate with flags or cones as appropriate. Support zone should be upwind of the site. Use access control at entry and exit from each work zone.
- Establish onsite communication consisting of the following:
  - Line-of-sight and hand signals
  - Air horn
  - Two-way radio or cellular telephone if available
- Establish offsite communication.
- Establish and maintain the "buddy system."
- Initial air monitoring is conducted by the SC in appropriate level of protection.
- The SC is to conduct periodic inspections of work practices to determine the effectiveness of this plan – refer to Sections 2 and 3. Deficiencies are to be noted, reported to the HSM, and corrected.

8.2 Hazwoper Compliance Plan

(Reference CH2M HILL SOP HSE-220, Written Plans and HSE-218 Hazardous Waste Operations)

Certain parts of the site work are covered by state or federal Hazwoper standards and therefore require training and medical monitoring. Anticipated Hazwoper tasks (Section 1.1.1) might occur consecutively or concurrently with respect to non-Hazwoper tasks. This section outlines procedures to be followed when approved activities specified in Section 1.1.2 do not require 24- or 40-hour training. Non-Hazwoper-trained personnel also must be trained in accordance with all other state and federal OSHA requirements.

- In many cases, air sampling, in addition to real-time monitoring, must confirm that there is no exposure to gases or vapors before non-Hazwoper-trained personnel are allowed on the site, or while non-Hazwoper-trained staff is working in proximity to Hazwoper activities. Other data (e.g., soil) also must document that there is no potential for exposure. The RHSM must approve the interpretation of these data. Refer to Sections 2.0 and 5.0 for contaminant data and air sampling requirements, respectively.
- When non-Hazwoper-trained personnel are at risk of exposure, the SC must post the exclusion zone and inform non-Hazwoper-trained personnel of the:
  - nature of the existing contamination and its locations
  - limitations of their access
  - emergency action plan for the site
- Periodic air monitoring with direct-reading instruments conducted during regulated tasks also should be used to ensure that non-Hazwoper-trained personnel (e.g., in an adjacent area) are not exposed to airborne contaminants.
- When exposure is possible, non-Hazwoper-trained personnel must be removed from the site until it can be demonstrated that there is no longer a potential for exposure to health and safety hazards.
- Remediation treatment system start-ups: Once a treatment system begins to pump and treat contaminated media, the site is, for the purposes of applying the Hazwoper standard, considered a treatment, storage, and disposal facility (TSDF). Therefore, once the system begins operation, only Hazwoper-trained personnel (minimum of 24 hour of training) will be permitted to enter the site. All non-Hazwoper-trained personnel must not enter the TSDF area of the site.

9. Emergency Response Plan

(Reference CH2M HILL SOP HSE-106, *Emergency Planning*)

9.1 Pre-Emergency Planning

- The Emergency Response Coordinator (ERC) performs the applicable pre-emergency planning tasks before starting field activities and coordinates emergency response with CH2M HILL onsite parties, the facility, and local emergency-service providers as appropriate.
- Review the facility emergency and contingency plans where applicable.
- Determine what onsite communication equipment is available (e.g., two-way radio, air horn).
- Determine what offsite communication equipment is needed (e.g., nearest telephone, cell phone).
- Confirm and post emergency telephone numbers, evacuation routes, assembly areas, and route to hospital; communicate the information to onsite personnel.
- Field Trailers: Post "Exit" signs above exit doors, and post "Fire Extinguisher" signs above locations of extinguishers. Keep areas near exits and extinguishers clear.
- Review changed site conditions, onsite operations, and personnel availability in relation to emergency response procedures.
- Where appropriate and acceptable to the client, inform emergency room and ambulance and emergency response teams of anticipated types of site emergencies.
- Designate one vehicle as the emergency vehicle; place hospital directions and map inside; keep keys in ignition during field activities.
- Inventory and check site emergency equipment, supplies, and potable water.
- Communicate emergency procedures for personnel injury, exposures, fires, explosions, and releases.
- Rehearse the emergency response plan before site activities begin, including driving route to hospital. Drills should take place periodically but no less than once a year.
- Brief new workers on the emergency response plan.
- The ERC will evaluate emergency response actions and initiate appropriate follow-up actions.

9.2 Emergency Equipment and Supplies

The ERC should mark the locations of emergency equipment on the site map and post the map.

Emergency Equipment and Supplies	Location
20 (or two 10) class A,B,C fire extinguisher	Field Vehicle/Field Trailer Lot 203
First aid kit	Field Vehicle/Field Trailer Lot 203
Eye Wash	Field Vehicle/Field Trailer Lot 203
Emergency Shower	Field Vehicle/Field Trailer Lot 203
Potable water	Field Vehicle/Field Trailer Lot 203
Bloodborne-pathogen kit	Field Vehicle/Field Trailer Lot 203
Additional equipment (specify):	

9.3 Incident Response

In fires, explosions, or chemical releases, actions to be taken include the following:

- Notify appropriate response personnel.
- Shut down CH2M HILL operations and evacuate the immediate work area.
- Account for personnel at the designated assembly area(s).
- Assess the need for site evacuation, and evacuate the site as warranted.
- Implement HSE-111, Incident Notification, Reporting and Investigation.
- Notify and submit reports to clients as required in contract.

Small fires or spills posing minimal safety or health hazards may be controlled with onsite spill kits or fire extinguishers without evacuating the site. When in doubt evacuate. Follow the incident reporting procedures in Section 5.7.

9.4 Emergency Medical Treatment

Emergency medical treatment is needed when there is a life-threatening injury (such as severe bleeding, loss of consciousness, breathing/heart has stopped). When in doubt if an injury is life-threatening or not, treat it as needing emergency medical treatment.

- Notify 911 or other appropriate emergency response authorities as listed in Attachment 4.
- The ERC will assume charge during a medical emergency until the ambulance arrives or until the injured person is admitted to the emergency room.
- Prevent further injury, perform decontamination (if applicable) where feasible; lifesaving and first aid or medical treatment takes priority.
- Initiate first aid and CPR where feasible.
- Notify supervisor and if the injured person is a CH2M HILL employee. The supervisor will call the occupational nurse at 1-866-893-2514 and make other notifications as required by HSE SOP-111, *Incident Notification, Reporting and Investigation*.

- Make certain that the injured person is accompanied to the emergency room.
- Follow the Serious Incident Reporting process in HSE SOP-111, Incident Notification, Reporting and Investigation.
- Notify and submit reports to client as required in contract

9.5 Evacuation

- Evacuation routes, assembly areas, and severe weather shelters (and alternative routes and assembly areas) are to be specified on the site map.
- Evacuation route(s) and assembly area(s) will be designated by the ERC or designee before work begins.
- Personnel will assemble at the assembly area(s) upon hearing the emergency signal for evacuation.
- The ERC and a "buddy" will remain on the site after the site has been evacuated (if safe) to assist local responders and advise them of the nature and location of the incident.
- The ERC will account for all personnel in the onsite assembly area.
- A designated person will account for personnel at alternate assembly area(s).
- The ERC will follow the incident reporting procedures in Section 9.7.

9.6 Evacuation Signals

Signal	Meaning
Grasping throat with hand	Emergency-help me.
Thumbs up	OK; understood.
Grasping buddy's wrist	Leave area now.
Continuous sounding of horn	Emergency; leave site now.

9.7 Incident Notification and Reporting

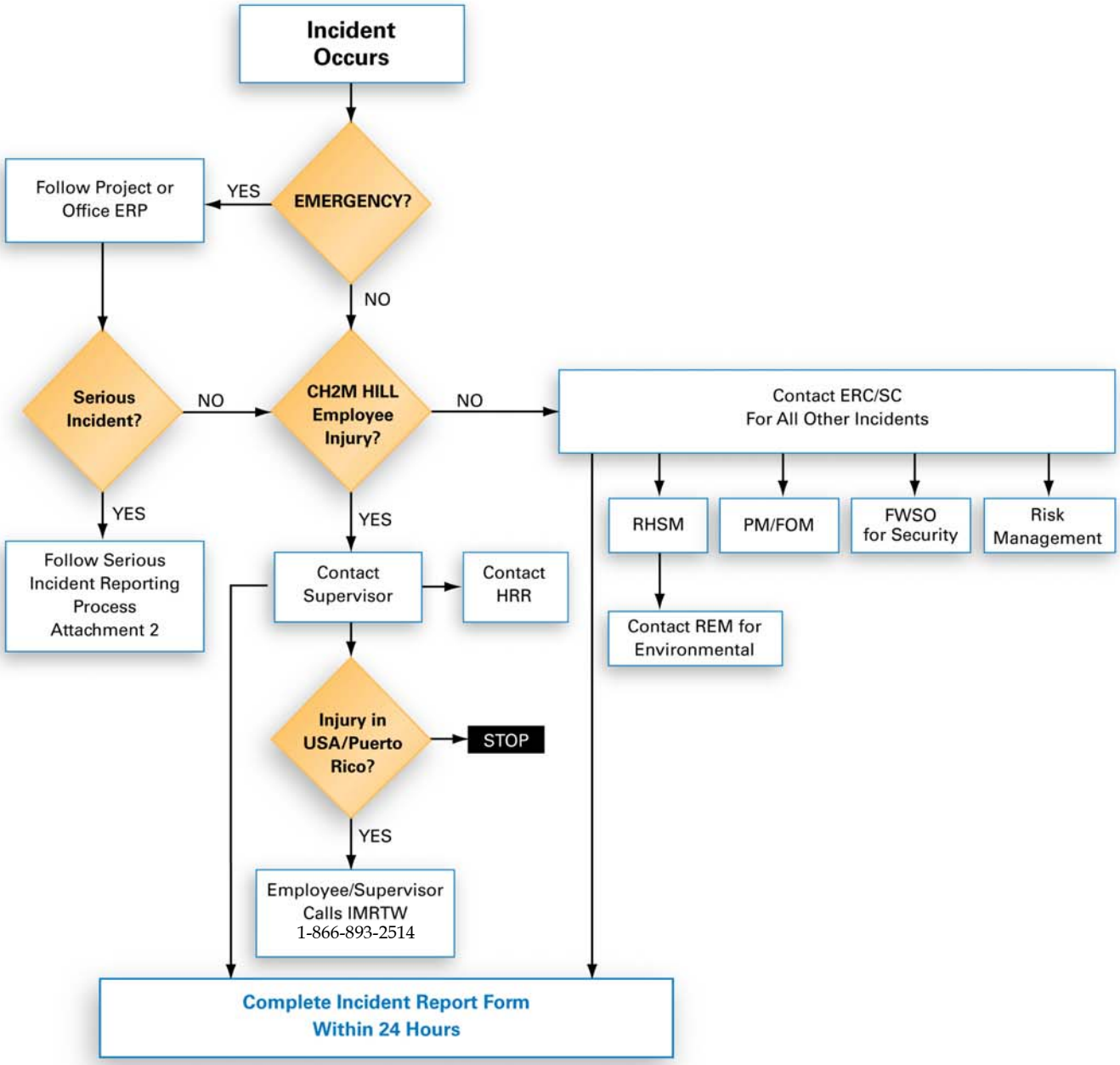
(Reference CH2M HILL SOP HSE-111, *Incident Notification*, *Reporting and Investigation*)

- If you are injured at work, notify your supervisor immediately and contact the Injury Management/Return-to-Work toll free number (for US and Puerto Rico) 1- 866.893.2514. All supervisors must contact their Human Resources Representative and complete the employee injury/illness in the Incident Report Form (IRF) in the HITS database within 24 hours of the incident
- Immediately notify the Project Manager (PM), Emergency Response Coordinator (ERC), and/or Responsible Health and Safety Manager (RHSM) for any project incident (fire, spill/release, injury/illness, near miss, property damage, or security-related)
- Report any **serious incidents** (life-threatening injury/illness, death, kidnap/missing person, terrorism, property damage greater than $500K, significant environmental release) **immediately** to your ERC, PM, or RHSM. The Serious Incident Reporting number is 720-286-4911.

- For serious incidents, the Corporate Legal Department will determine who completes the IRF.
- For CH2M HILL subcontractor incidents, immediately notify the ERC and HSM to complete and submit an IRF.
- The RHSM will inform the Responsible Environmental Manager (REM) of any environmental incidents.
- Evaluation and follow-up of the IRF will be completed by the type of incident by the RHSM, REM, or FWSO. The Business Group (BG) HSE Lead will review all BG incidents and modify as required.
- Incident Investigations must be initiated and completed as soon as possible but no later than 72 hours after the incident.
- See the following flowcharts for Immediate Incident Reporting and Serious Incident Reporting.

CH2MHILL

Attachment 1
CH2M HILL Immediate Incident Notification

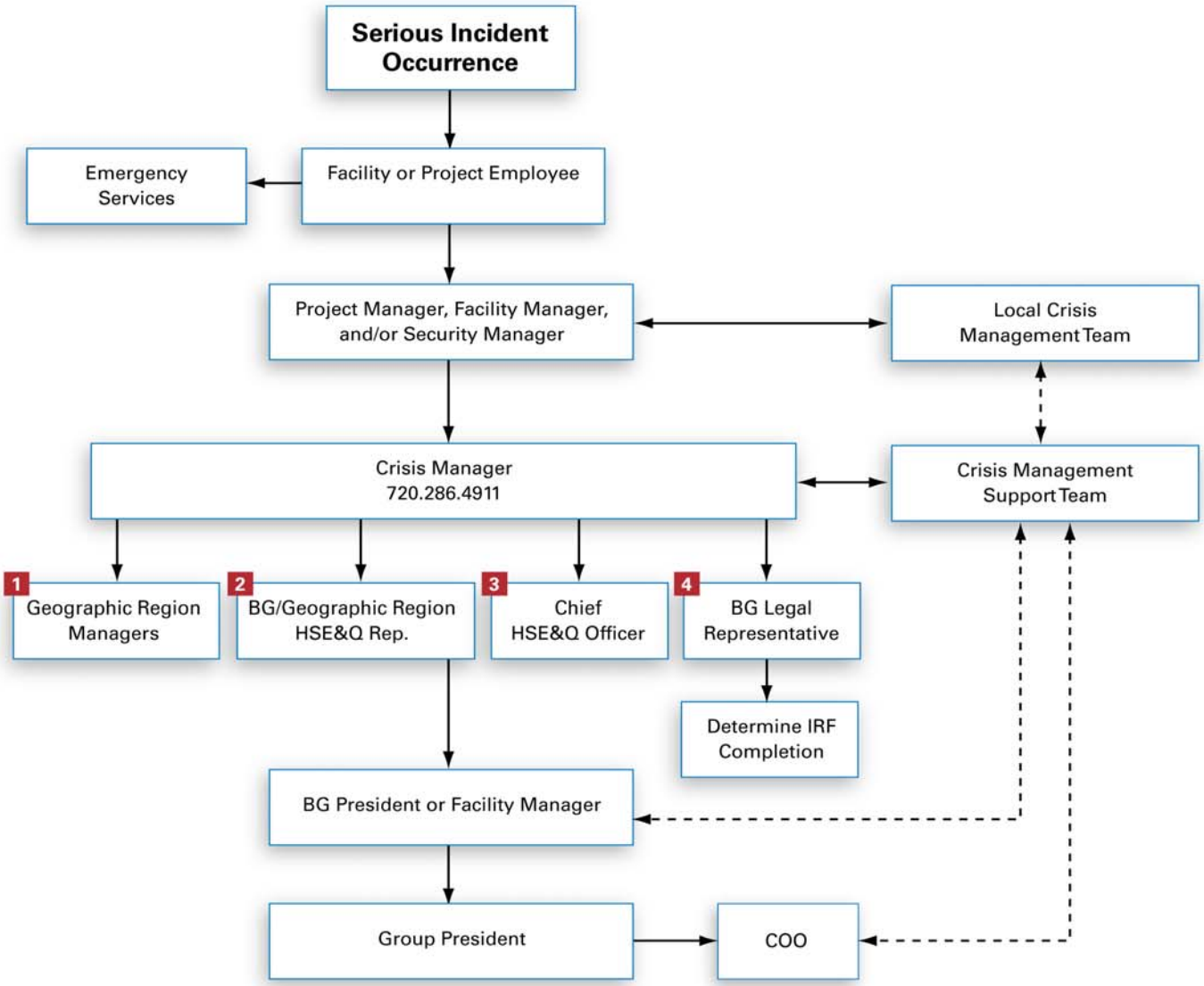


ERC = Emergency Response Coordinator (designated in Emergency Response Plan)
ERP = Emergency Response Plan
FOM = Facility Office Manager
FWSO = Firm Wide Security Operations
HRR = Human Resources Representative
IMRTW = Injury Management/Return-to-Work
PM = Project Manager
REM = Responsible Environmental Manager
RHSM = Responsible Health & Safety Manager
SC = Safety Coordinator

HS052007002MKT

CH2MHILL

Attachment 2
CH2M HILL Serious Incident Notification



LEGEND:

Direct line of communication

Indirect line of communication

DEFINITIONS:

Local Crisis Management Team: Team comprised of key facility, project and/or business group personnel. Team is assembled as necessary and as appropriate to effectively manage and respond to a crisis situation (serious incident) at/on scene.

Crisis Management Support Team: Team comprised of key corporate personnel. Team is assembled as necessary and as appropriate to effectively support, direct, and /or supplement a Local Crisis Management Team.

Crisis Manager: Corporate based Crisis Manager, contactable by pager 24/7.

HS052007002MKT

10. Behavior Based Loss Prevention System

(Reference CH2M HILL SOP HSE-103, *Behavior Based Loss Prevention System*)

A Behavior Based Loss Prevention System (BBLPS) is a system to prevent or reduce losses using behavior-based tools and proven management techniques to focus on behaviors or acts that could lead to losses.

The four basic Loss Prevention tools that will be used by CH2M HILL projects to implement the BBLPS include:

- Activity Hazard Analysis (AHA)
- Pre-Task Safety Plans (PTSP)
- Safe Behavior Observations (SBO)
- Loss and Near Loss Investigations (NLI)

The SC or designated CH2M HILL representative onsite is responsible for implementing the BBLPS on the project site. The Project Manager remains accountable for its implementation. The SC or designee shall only oversee the subcontractor's implementation of their AHAs and PTSPs processes on the project.

10.1 Activity Hazard Analysis

An Activity Hazard Analysis (AHA) defines the activity being performed, the hazards posed and control measures required to perform the work safely. Workers are briefed on the AHA before doing the work and their input is solicited prior, during and after the performance of work to further identify the hazards posed and control measures required.

Activity Hazard Analysis will be prepared before beginning each project activity posing H&S hazards to project personnel using the AHA form provided in Attachment 5. The AHA shall identify the work tasks required to perform each activity, along with potential H&S hazards and recommended control measures for each work task. In addition, a listing of the equipment to be used to perform the activity, inspection requirements and training requirements for the safe operation of the equipment listed must be identified.

An AHA shall be prepared for all field activities performed by CH2M HILL and subcontractor activities during the course of the project. Hazard Controls (found in Sections 2.0 and its subsections of the HSP), the Hazard Analysis Table (Table 1), and applicable CH2M HILL CSs and SOPs should be used as a basis for preparing AHAs.

CH2M HILL subcontractors are required to provide AHAs specific to their scope of work on the project for acceptance by CH2M HILL. Each subcontractor shall submit AHAs for their field activities, as defined in their work plan/scope of work, along with their project-specific safety plan/accident prevention plan. Additions or changes in CH2M HILL or subcontractor field activities, equipment, tools or material to perform work or additional/different hazard encountered that require additional/different hazard control measures requires either a new AHA to be prepared or an existing AHA to be revised.

10.2 Pre-Task Safety Plans

Daily safety meetings are held with all project personnel in attendance to review the hazards posed and required H&S procedures/AHAs, which apply for each day's project activities. The PTSPs serve the same purpose as these general assembly safety meetings, but the PTSPs are held between the crew supervisor and their work crews to focus on those hazards posed to individual work crews. At the start of each day's activities, the crew supervisor completes the PTSP, provided in Attachment 5, with input from the work crew, during their daily safety meeting. The day's tasks, personnel, tools and equipment that will be used to perform these tasks are listed, along with the hazards posed and required H&S procedures, as identified in the AHA. The use of PTSPs, better promotes worker participation in the hazard recognition and control process, while reinforcing the task-specific hazard and required H&S procedures with the crew each day. The use of PTSPs is a common safety practice in the construction industry.

10.3 Safe Behavior Observations

Safe Behavior Observations (SBOs) shall be conducted by SC or designee for specific work tasks or operations comparing the actual work process against established safe work procedures identified in the project-specific HSP and AHAs. SBOs are a tool to be used by supervisors to provide positive reinforcement for work practices performed correctly, while also identifying and eliminating deviations from safe work procedures that could result in a loss. The SC or designee shall perform at least one SBO each week for tasks/operations addressed in the project-specific HSP or AHA. The SC or designee shall complete the SBO form in **Attachment 5** for the task/operation being observed and submit the SBO form weekly to Margaret Dombrowski/MKE.

10.4 Loss/Near Loss Investigations

Loss/Near Loss Investigations shall be performed for CH2M HILL and subcontractor incidents involving:

- Person injuries/illnesses and near miss injuries,
- Equipment/property damage,
- Spills, leaks, regulatory violations,
- Motor vehicle accidents.

The cause of loss and near loss incidents are similar, so by identifying and correcting the causes of near loss causes, future loss incidents may be prevented. The following is the Loss/Near Loss Investigation Process:

- Gather all relevant facts, focusing on fact-finding, not fault-finding, while answering the who, what, when, where and how questions.
- Draw conclusions, pitting facts together into a probable scenario.
- Determine incident root cause(s), which are basic causes on why an unsafe act/condition existed.

- Develop and implement solutions, matching all identified root causes with solutions.
- Communicate incident as a Lesson Learned to all project personnel.
- Filed follow-up on implemented corrective active action to confirm solution is appropriate.

The SC or designee shall perform an incident investigation, as soon as practical after incident occurrence during the day of the incident, for all Loss and Near Loss Incidents that occur on the project. Loss and Near Loss incident investigations shall be performed using the following incident investigation forms provided in **Attachment 5.**

- Incident Report Form (IRF)
- Root Cause Analysis Form

All Loss and Near Loss incident involving personal injury, property damage in excess of $1,000 or near loss incidents that could have resulted in serious consequences shall be investigated by completing the incident investigation forms and submitting them to the PM and RHSM within 24 hours of incident occurrence. A preliminary Incident Investigation and Root Cause Analysis shall be submitted to the Project Manager and RHSM within 24 hours of incident occurs. The final Incident Investigation and Root Cause Analysis shall be submitted after completing a comprehensive investigation of the incident.

11. Approval

This site-specific HSP has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions, purposes, dates, and personnel specified and must be amended if those conditions change.

Original Plan

Written By: James Frank **Date: November 2, 2009**

Approved By: Max Bertram **Date: November 16, 2009**

Revisions

Revisions Made By: Max Bertram **Date: November 16, 2009**

Revisions to Plan: Updated emergency contact information, biological hazard section and Behavior Based Loss Control section (11/16)

Revisions Approved By: **Date:**

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12. Attachments

Attachment 1:	**Employee Signoff Form – Health and Safety Plan**
Attachment 2:	**Chemical Inventory/Register Form**
Attachment 3:	**Chemical-Specific Training Form**
Attachment 4:	**Emergency Contacts**
Attachment 5:	**Project Activity Self-Assessment Checklists/Permits**
Attachment 6:	**Behavior Based Loss Prevention Forms**
Attachment 7:	**Material Safety Data Sheets**

CH2M HILL Health and Safety Plan

Attachment 1

Health and Safety Plan Employee Sign-off Form

EMPLOYEE SIGNOFF FORM

Health and Safety Plan

The CH2M HILL project employees and subcontractors listed below have been provided with a copy of this HSP, have read and understood it, and agree to abide by its provisions.

Project Name: CTO-094 Expanded Base Background Study **Project Number:** 395307

EMPLOYEE NAME (Please print)	**EMPLOYEE SIGNATURE**	**COMPANY**	**DATE**

CH2M HILL Health and Safety Plan

Attachment 2

Chemical Inventory/Register Form

CH2MHILL

CHEMICAL INVENTORY/REGISTER FORM

Refer to Standard of Practice HSE-107 Attachment 1 for instructions on completing this form.

Location: _____

HCC: _____

☐ Office ☐ Warehouse ☐ Laboratory ☐ Project: _____

Project No.: _____

Regulated Product	Location	Container labeled (✓if yes)	MSDS available (✓if yes)

MSDS for the listed products will be maintained at: _____

CH2M HILL Health and Safety Plan

Attachment 3

Chemical-Specific Training Form

CH2MHILL

CHEMICAL-SPECIFIC TRAINING FORM

Refer to Standard Operating Procedure HSE-107 Attachment 1 for instructions on completing this form.

Location:	Project # :
HCC:	Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

The HCC shall use the product MSDS to provide the following information concerning each of the products listed above.

☐ Physical and health hazards

☐ Control measures that can be used to provide protection (including appropriate work practices, emergency procedures, and personal protective equipment to be used)

☐ Methods and observations used to detect the presence or release of the regulated product in the workplace (including periodic monitoring, continuous monitoring devices, visual appearance or odor of regulated product when being released, etc.)

Training participants shall have the opportunity to ask questions concerning these products and, upon completion of this training, will understand the product hazards and appropriate control measures available for their protection.

Copies of MSDSs, chemical inventories, and CH2M HILL's written hazard communication program shall be made available for employee review in the facility/project hazard communication file.

CH2M HILL Health and Safety Plan

Attachment 4

Emergency Contacts

Emergency Contacts

24-hour CH2M HILL Serious Incident Reporting Number
720-286-4911

If injured on the job, notify your supervisor and then call 1-866-893-2514 to contact CH2M HILL'S Occupational Nurse

Medical Emergency – 911 or
Hospital ER (On-Base) #: (910) 451-4840
(910) 451-4841
(910) 451-4842
Onslow County ER (Off-Base) #: (910) 577-2240
Ambulance (On-Base) #: (910) 451-3004
(910) 451-3005
Ambulance (Public) #: (910) 451-9111
LEPC (Poison Control)#: (800) 222-1222

CH2M HILL- Medical Consultant
Work Care
Dr. Peter P. Greaney
300 S. Harbor Blvd, Suite 600
Anaheim , CA 92805
1-866-893-2514

Local Occupational Physician
Occupational Medicine Specialists
4815 Oleander Dr.
Wilmington, NC 28403
910 452-1111

Fire/Spill Emergency – 911 or
Base Fire Response #: (910) 451-9111

CH2M HILL Director Security Operations
Thomas Horton/DEN
720/273-3100 (cell) or 720/286-0022 (office)

Security & Police – 911 or
Base Security #: (910) 451-2555

Health and Safety Manager (HSM)
Name: Max Bertram
Phone: (865) 456-4310

On-Scene Coordinator
Name: Fire Chief
Phone: (910) 451-5815

Regional Human Resources Department
Name: Mary Jo Jordan/GNV
Phone: 352/355-2867

Utilities Emergency
Water:
Gas: Contact Base EMD
Electric:

Worker's Compensation:
Contact Business Group HR dept. to have form completed or contact Albert Jerman after hours: 303/741-5927

Safety Coordinator (SC)
Name:
Phone:

Media Inquiries Corporate Strategic Communications
Name: John Corsi
Phone: (720) 286-2087

Project Manager
Name: Paul Weber/RDU
Phone: 919-760-1778

Automobile Accidents:
Rental: Linda Anderson/COR 720/286-2401
CH2M HILL owned vehicle: Linda George 720-286-2057

Federal Express Dangerous Goods Shipping
Phone: 800/238-5355

CH2M HILL Dangerous Goods Shipping
Phone: 800/255-3924

Facility Alarms: TBD

Evacuation Assembly Area(s): TBD by the SC-HW; will probably be the local hotel where the field team is staying

Facility/Site Evacuation Route(s): follow main roads towards access gates and off the Base

Directions to Local Hospital

Nearest On-Base hospital:
Base Naval Hospital (only to be used in extreme emergency)
Building NH100
100 Brewster Blvd.
Camp Lejeune, NC 28547
Phone: (910) 451-4840, (910) 451-4841, (910) 451-4842

Local hospital:
Onslow County Memorial Hospital
317 Western Boulevard
Jacksonville, NC 28546
Phone: (910) 577-2240

Local ambulance service:
Base Ambulance: (910) 451-3004, (910) 451-3005
Public Ambulance: (910) 451-9111

From MCB Camp Lejeune

Directions to the Base Naval Hospital (Building NH100)
(nearest hospital; only to be used in an extreme emergency)

1. Proceed north to Holcomb Boulevard (towards Highway 24).
2. Turn left onto Brewster Boulevard (heading west)
3. Continue on Brewster Boulevard until intersection with the driveway to the Naval Hospital.
4. Turn onto Hospital driveway, and proceed to emergency room.

Directions to Onslow County Memorial Hospital :

1. From Holcomb Boulevard, exit Base through main gate.
2. Follow Highway 24 west until intersecting with Western Boulevard.
3. Turn right onto Western Boulevard.
4. The Onslow County Memorial Hospital is on the left, approximately 2 miles (fifth stop light) from Highway 24.
5. Follow the signs to the emergency room.

From Air Station and Camp Geiger

Directions to Onslow County Memorial Hospital:

1. Proceed through the main gate, turn right, and head north on Ocean Highway 17.
2. Follow Ocean Highway 17 north to Highway 24 and head east.
3. Travel east until Western Boulevard, turn left onto Western Boulevard.
4. The Onslow County Memorial Hospital is on the left, approximately 2 miles (fifth stop light) from Highway 24.
5. Follow the signs to the emergency room.

Route to Hospital:

Directions to **Onslow County Memorial Hospital from Mainside.**

HOLCOMB BLVD. / Piney Green Rd. / NC-172 go North to Base Exit
Merge onto **NC-24 W/ LEJEUNE BLVD.** heading West
Turn **RIGHT** onto **WESTERN BLVD.** (@ the traffic signal with Tire Country on the right)
End at **Onslow Memorial Hospital**: 317 Western Blvd
Hospital is on west side of road next to the motorcycle dealership and across from IHOP Restaurant.

Route to Hospital:

Directions to **Onslow County Memorial Hospital from Air Station side of Base**
Take either Curtis Rd. / Verona Rd. / NC-210 to US-17 and head North.
Follow signs for US-17 and NC 24 E toward MCB Camp Lejeune Main Gate
Turn left (second traffic signal) on Western Blvd and follow for approx. 1.3 miles until you reach the hospital at **317 Western Blvd.**
Hospital is on west side of road next to the motorcycle dealership and across from IHOP Restaurant.

CH2M HILL Health and Safety Plan

Attachment 5

Project Activity Self-Assessment Checklists/Permits/Forms

- **Drilling**

CH2MHILL

HS&E Self-Assessment Checklist - DRILLING

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's written safety plan.

This checklist is to be used at locations where: 1) CH2M HILL employees are potentially exposed to drilling hazards, 2) CH2M HILL staff are providing support function related to drilling activities, and/or 3) CH2M HILL oversight of a drilling subcontractor is required.

Safety Coordinator may consult with drilling subcontractors when completing this checklist, but shall not direct the means and methods of drilling operations nor direct the details of corrective actions. Drilling subcontractors shall determine how to correct deficiencies and we must carefully rely on their expertise. Items considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately, or all exposed personnel shall be removed from the hazard until corrected.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to drilling hazards (complete Section 1).
☐ Evaluate CH2M HILL support functions related to drilling activities (complete Section 2)
☐ Evaluate a CH2M HILL subcontractor's compliance with drilling safety requirements (complete entire checklist).
Subcontractors Name: _____

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the drilling subcontractor. Section 3 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in SOP HSE-35.

SECTION 1 - SAFE WORK PRACTICES (4.1)	Yes	No	N/A	N/O
1. Personnel cleared during rig startup	☐	☐	☐	☐
2. Personnel clear of rotating parts	☐	☐	☐	☐
3. Personnel not positioned under hoisted loads	☐	☐	☐	☐
4. Loose clothing and jewelry removed	☐	☐	☐	☐
5. Smoking is prohibited around drilling operation	☐	☐	☐	☐
6. Personnel wearing appropriate personal protective equipment (PPE), per written plan	☐	☐	☐	☐
7. Personnel instructed not to approach equipment that has become electrically energized	☐	☐	☐	☐
SECTION 2 - SUPPORT FUNCTIONS (4.2)				
FORMS/PERMITS (4.2.1)				
8. Driller license/certification obtained	☐	☐	☐	☐
9. Well development/abandonment notifications and logs submitted and in project files	☐	☐	☐	☐
10. Water withdrawal permit obtained, where required	☐	☐	☐	☐
11. Dig permit obtained, where required	☐	☐	☐	☐
UTILITY LOCATING (4.2.2)				
12. Location of underground utilities and structures identified	☐	☐	☐	☐

SECTION 2 (Continued)

WASTE MANAGEMENT (4.2.3)	Yes	No	N/A	N/O
13. Drill cuttings and purge water managed and disposed properly	☐	☐	☐	☐
DRILLING AT HAZARDOUS WASTE SITES (4.2.4)				
14. Waste disposed of according to project's written safety plan	☐	☐	☐	☐
15. Appropriate decontamination procedures being followed, per project's written safety plan	☐	☐	☐	☐
DRILLING AT ORDNANCE EXPLOSIVES (OE)/UNEXPLODED ORDNANCE (UXO) SITES (4.2.5)				
16. OE plan prepared and approved	☐	☐	☐	☐
17. OE/UXO avoidance provided, routes and boundaries cleared and marked	☐	☐	☐	☐
18. Initial pilot hole established by UXO technician with hand auger	☐	☐	☐	☐
19. Personnel remain inside cleared areas	☐	☐	☐	☐

SECTION 3 - DRILLING SAFETY REQUIREMENTS (4.3)

GENERAL (4.3.1)				
20. Only authorized personnel operating drill rigs	☐	☐	☐	☐
21. Daily safety briefing/meeting conducted with crew	☐	☐	☐	☐
22. Daily inspection of drill rig and equipment conducted before use	☐	☐	☐	☐
DRILL RIG PLACEMENT (4.3.2)				
23. Location of underground utilities and structures identified	☐	☐	☐	☐
24. Safe clearance distance maintained from overhead power lines	☐	☐	☐	☐
25. Drilling pad established, when necessary	☐	☐	☐	☐
26. Drill rig leveled and stabilized	☐	☐	☐	☐
27. Additional precautions taken when drilling in confined areas	☐	☐	☐	☐
DRILL RIG TRAVEL (4.3.3)				
28. Rig shut down and mast lowered and secured prior to rig movement	☐	☐	☐	☐
29. Tools and equipment secured prior to rig movement	☐	☐	☐	☐
30. Only personnel seated in cab are riding on rig during movement	☐	☐	☐	☐
31. Safe clearance distance maintained while traveling under overhead power lines	☐	☐	☐	☐
32. Backup alarm or spotter used when backing rig	☐	☐	☐	☐

DRILL RIG OPERATION (4.3.4)

33. Kill switch clearly identified and operational	☐	☐	☐	☐
34. All machine guards are in place	☐	☐	☐	☐
35. Rig ropes not wrapped around body parts	☐	☐	☐	☐
36. Pressurized lines and hoses secured from whipping hazards	☐	☐	☐	☐
37. Drill operation stopped during inclement weather	☐	☐	☐	☐
38. Air monitoring conducted per written safety plan for hazardous atmospheres	☐	☐	☐	☐
39. Rig placed in neutral when operator not at controls	☐	☐	☐	☐

DRILL RIG SITE CLOSURE (4.3.5)

	Yes	No	N/A	N/O
40. Ground openings/holes filled or barricaded	☐	☐	☐	☐
41. Equipment and tools properly stored	☐	☐	☐	☐
42. All vehicles locked and keys removed	☐	☐	☐	☐
DRILL RIG MAINTENANCE (4.3.6)				
28. Defective components repaired immediately	☐	☐	☐	☐
29. Lockout/tagout procedures used prior to maintenance	☐	☐	☐	☐
30. Cathead in clean, sound condition	☐	☐	☐	☐
31. Drill rig ropes in clean, sound condition	☐	☐	☐	☐
32. Fall protection used for fall exposures of 6 feet (U.S.) 1.5 meters (Australia) or greater	☐	☐	☐	☐
33. Rig in neutral and augers stopped rotating before cleaning	☐	☐	☐	☐
34. Good housekeeping maintained on and around rig	☐	☐	☐	☐

SECTION 4

Complete this section for all items checked "No" in previous sections. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: _____ Project Manager: _____

CH2M HILL Health and Safety Plan

Attachment 6

Behavior Based Loss Prevention System Forms

Activity Hazard Analysis Template

Pre-Task Safety Plans

Safe Behavior Observation

Incident Report and Investigation

(use electronic form when possible)

HITS

Activity:	**Date:**
	Project:
Description of the work:	**Site Supervisor:**
	Site Safety Officer:
	Review for latest use: **Before the job is performed.**

Work Activity Sequence (Identify the principal steps involved and the sequence of work activities)	Potential Health and Safety Hazards (Analyze each principal step for potential hazards)	Hazard Controls (Develop specific controls for each potential hazard)

Equipment to be used (List equipment to be used in the work activity)	Inspection Requirements (List inspection requirements for the work activity)	Training Requirements (List training requirements including hazard communication)

	PRINT NAME	SIGNATURE	
Supervisor Name:	_____	_____	**Date/Time:**_____
Safety Officer Name:	_____	_____	**Date/Time:**_____
Employee Name(s):	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____
	_____	_____	**Date/Time:**_____

CH2MHILL

Pre-Task Safety Plan (PTSP)

Project: _____ Location: _____Date:_____

Supervisor: _____ Job Activity:_____

_____

Task Personnel:

_____

_____

_____

_____

List Tasks:

_____

_____

_____

_____

Tools/Equipment Required for Tasks (ladders, scaffolds, fall protection, cranes/rigging, heavy equipment, power tools):

_____

_____

_____

Potential H&S Hazards, including chemical, physical, safety, biological and environmental (check all that apply):

__ Chemical burns/contact	__ Trench, excavations, cave-ins	__ Ergonomics
__ Pressurized lines/equipment	__ Overexertion	__ Chemical splash
__ Thermal burns	__ Pinch points	__ Poisonous plants/insects
__ Electrical	__ Cuts/abrasions	__ Eye hazards/flying projectile
__ Weather conditions	__ Spills	__ Inhalation hazard
__ Heights/fall > 6 feet	__ Overhead Electrical hazards	__ Heat/cold stress
__ Noise	__ Elevated loads	__ Water/drowning hazard
__ Explosion/fire	__ Slips, trip and falls	__ Heavy equipment
__ Radiation	__ Manual lifting	__ Aerial lifts/platforms
__ Confined space entry	__ Welding/cutting	__ Demolition

Other Potential Hazards (Describe):

_____

_____

_____

CH2MHILL

Hazard Control Measures (Check All That Apply):			
PPE __ Thermal/lined __ Eye __ Dermal/hand __ Hearing __ Respiratory __ Reflective vests __ Flotation device	Protective Systems __ Sloping __ Shoring __ Trench box __ Barricades __ Competent person __ Locate buried utilities __ Daily inspections	Fire Protection __ Fire extinguishers __ Fire watch __ Non-spark tools __ Grounding/bonding __ Intrinsically safe equipment	Electrical __ Lockout/tagout __ Grounded __ Panels covered __ GFCI/extension cords __ Power tools/cord inspected
Fall Protection __ Harness/lanyards __ Adequate anchorage __ Guardrail system __ Covered opening __ Fixed barricades __ Warning system	Air Monitoring __ PID/FID __ Detector tubes __ Radiation __ Personnel sampling __ LEL/O2 __ Other	Proper Equipment __ Aerial lift/ladders/scaffolds __ Forklift/heavy equipment __ Backup alarms __ Hand/power tools __ Crane with current inspection __ Proper rigging __ Operator qualified	Welding & Cutting __ Cylinders secured/capped __ Cylinders separated/upright __ Flash-back arrestors __ No cylinders in CSE __ Flame retardant clothing __ Appropriate goggles
Confined Space Entry __ Isolation __ Air monitoring __ Trained personnel __ Permit completed __ Rescue	Medical/ER __ First-aid kit __ Eye wash __ FA-CPR trained personnel __ Route to hospital	Heat/Cold Stress __ Work/rest regime __ Rest area __ Liquids available __ Monitoring __ Training	Vehicle/Traffic __ Traffic control __ Barricades __ Flags __ Signs
Permits __ Hot work __ Confined space __ Lockout/tagout __ Excavation __ Demolition __ Energized work	Demolition __ Pre-demolition survey __ Structure condition __ Isolate area/utilities __ Competent person __ Hazmat present	Inspections: __ Ladders/aerial lifts __ Lanyards/harness __ Scaffolds __ Heavy equipment __ Cranes and rigging	Training: __ Hazwaste __ Construction __ Competent person __ Task-specific (THA) __ Hazcom
Field Notes:_____ _____ _____			

Name (Print): _____

Signature:_____ Date:_____

Safe Behavior Observation Form		
Project Name:	Observer:	Date:
Program / Client:	Project Mgr. & No.:	
Position/Title of worker observed:	Background Information/ comments:	
Task/Observation Observed:		

- Identify and reinforce safe work practices/behaviors
- Identify and improve on at-risk practices/acts
- Identify and improve on practices, conditions, controls, and compliance that eliminate or reduce hazards
- Proactive PM support facilitates eliminating/reducing hazards (do you have what you need?)
- Positive, corrective, cooperative, collaborative feedback/recommendations

Actions & Behaviors	Safe	At-Risk	Observations/Comments
Current & accurate Pre-Task Planning/Briefing (Project safety plan, STAC, AHA, PTSP, tailgate briefing, etc., as needed)			**Positive Observations/Safe Work Practices:**
Properly trained/qualified/experienced			
Tools/equipment available and adequate			
Proper use of tools			**Questionable Activity/Unsafe Condition Observed:**
Barricades/work zone control			
Housekeeping			
Communication			
Work Approach/Habits			
Attitude			
Focus/attentiveness			**Observer's Corrective Actions/Comments:**
Pace			
Uncomfortable/unsafe position			
Inconvenient/unsafe location			
Position/Line of fire			
Apparel (hair, loose clothing, jewelry)			
Repetitive motion			**Observed Worker's Corrective Actions/Comments:**
Other…			

Appendix B
Standard Operating Procedures—CH2M HILL

STANDARD OPERATING PROCEDURE

Preparing Field Log Books

I. Purpose

To provide general guidelines for entering field data into log books during site investigation and remediation field activities.

II. Scope

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

III. Equipment and Materials

- Log book
- Indelible pen

IV. Procedures and Guidelines

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

A. PROCEDURES FOR COMPLETING FIELD LOG BOOKS

1. Field notes commonly are kept in bound, orange-covered logbooks used by surveyors and produced, for example, by Peninsular Publishing Company and Sesco, Inc. Pages should be water-resistant and notes should be taken only with water-proof, non-erasable permanent ink, such as that provided in Sanford Sharpie® permanent markers.

2. On the inside cover of the log book the following information should be included:

   - Company name and address
   - Log-holders name if log book was assigned specifically to that person

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

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

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

5. Daily entries will be made chronologically.

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

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

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

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

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

B. INFORMATION TO BE INCLUDED IN FIELD LOG BOOKS

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

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

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

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

5. Tail Gate Safety Meetings: Record time and location of meeting, who was present, topics discussed, issues/problems/concerns identified, and corrective actions or adjustments made to address concerns/ problems, and other pertinent information.

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

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

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

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

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

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

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

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

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

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

16. Any conditions that might adversely affect the work or any data

obtained (e.g., nearby construction that might have introduced excessive amounts of dust into the air).

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

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

C. SUGGESTED FORMAT FOR RECORDING FIELD DATA

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

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

3. Sketch sampling locations and other pertinent information.

4. Sketch well construction diagrams.

V. Attachments

Example field notes.

STANDARD OPERATING PROCEDURE

Locating and Clearing Underground Utilities

I. Purpose

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

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

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

II. Scope

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

Scenario 1

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

Scenario 2

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

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

Scenario 1 is preferred because under this scenario the Navy tends to assume the responsibility if the location is improperly cleared, a utility is struck, and property damage results. However, our experience has been that the clearance services provided by the Navy do not meet the standards that we consider to be adequate, in that they often simply rely on available base maps to mark utilities and do not verify locations

using field geophysics. And if they do use locating tools, they do not provide adequate documentation or marking to confirm that a location has been cleared. So while the Navy's process may protect us from liability for property damage, it does not adequately protect our staff and subcontractors from health risks nor does it compensate us for down time, should a utility be hit.

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

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

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

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

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

III. Services and Equipment

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

Services

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

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

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

Equipment

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

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

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

IV. Procedures and Guidelines

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

Activity Notification and Dig Permit Procedures

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

Activity Specific: To be provided by Activity or Project Manager

CH2M HILL Utility Clearance Procedures

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

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

- **Ground Penetrating Radar (GPR),** which can detect pipes, including gas pipes, tanks, conduits, cables etc, both metallic and non-metallic at depths up to 30 feet depending on equipment. Sensitivity for both minimum object size and maximum depth detectable depends on equipment selected, soil conditions, etc.
- **Radio Frequency (RF),** involves inducing an RF signal in the pipe or cable and using a receiver to trace it. Some electric and telephone lines emit RF naturally and can be detected without an induced signal. This method requires knowing where the conductive utility can be accessed to induce RF field if necessary.

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

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

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

sidewalks and streets. ***Any particular marking requirements need to be provided in the subcontractor SOW.***

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

IV. Attachments

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

Attachment A – Example SOW for Subcontracting Underground Utilities Locating Services

CTO-XXX

Scope of Work

Subsurface Utility Locating

Site XX

Navy Activity

City, State

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

Proposed Scope of Work

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

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

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

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

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

Field Marking and Documentation

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

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

Bid Sheet/Payment Units

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

Health and Safety Requirements

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

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

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

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

Security

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

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

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

Quality Assurance

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

Subcontractor Standby Time

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

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

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

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

Down Time

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

Schedule

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

Attachment B - Services Available for Identifying and Marking Underground Utilities

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

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

Each are discussed below.

Navy Public Works Department

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

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

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

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

Miss Utility or "One Call" service centers are information exchange centers for excavators, contractors and property owners planning any kind of excavation or digging. The "One Call" center notifies participating public utilities of the upcoming excavation work so they can locate and mark their underground utilities in advance to prevent possible damage to underground utility lines, injury, property damage and service outages. In some instances, such with southeastern Virginia bases, the Navy has entered into agreement with Ms. Utilities and is part of the response process for Miss Utilities. Generally, a minimum of 48 hours is required for the public utility mark-outs

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

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

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

Private Subcontractors

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

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

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

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

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

Notes:

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

[1]Equipment types are:

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

[2]Other services include:

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

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

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

Attachment C – Equipment Used for Identifying Underground Utilities

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

CH2M HILL In-house Utility Location Experts

Tamir Klaff/WDC

Home Office Phone – 703-669-9611

Electromagnetic Induction (EMI) Methods

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

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

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

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

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

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

Ground Penetrating Radar (GPR)

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

Magnetic Field Methods

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

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

Optical Methods

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

Attachment D – Utility Clearance Documentation Form

Attachment E – Utility Marking Color Codes

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

White – Proposed excavations and borings

Pink – Temporary survey markings

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

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

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

Blue – Potable water

Purple – Reclaimed water, irrigation and slurry lines

Green – Sewer and storm drain lines

STANDARD OPERATING PROCEDURE

General Guidance for Monitoring Well Installation

I. Purpose

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

II. Scope

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

III. Equipment and Materials

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

IV. Procedures and Guidelines

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

5. A record of the finished well construction will be compiled.

6. All soils and liquids generated during well installations will be drummed for proper disposal.

Monitoring Well Installation

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

- The annular space above the bentonite seal will be filled to grade with a bentonite-cement slurry grout mixture.
- The grout mixture consists of 94 pounds (lbs) of cement (1 bag) per 6 gallons of water and 2 to 3 lbs of powdered bentonite per bag of cement to reduce shrinkage.
- The grout mix will be carefully applied to avoid disturbing the bentonite seal; the method of grout placement must force grout from the bottom of the space to be grouted to the surface.
- After allowing the grout to settle and set up overnight, additional grout will be added to maintain grade.
- A protective steel casing equipped with keyed alike locking caps will be grouted in place for each new well; the casing will extend at least 2 feet above grade and 3 feet below grade, and will be painted a bright color.

Well Development

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

V. Attachments

None.

VI. Key Check and Items

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

STANDARD OPERATING PROCEDURE

Water-Level Measurements

I. Purpose and Scope

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

II. Equipment and Materials

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

III. Procedures and Guidelines

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

Measure the distance from this point to the closest interval marker on the tape, and record the water level reading in the logbook. Water levels will be measured to the nearest 0.01-foot. Also measure and record the three following readings: (1) the depth of the piezometer or well; (2) the distance from the reference point to the top of the protective casing; and (3) the distance to the surface of the concrete pad or to ground. The depth of the piezometer or well may be measured using the water-level probe with the instrument turned off.

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

constant sound is emitted from the device when free product is encountered and an alternating on/off beep sound is emitted when water is encountered.

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

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

Where WL_c = Corrected water-level elevation

Wl_a = Apparent water-level elevation

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

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

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

IV. Attachments

None.

V. Key Checks

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

STANDARD OPERATING PROCEDURE

Low-Flow Groundwater Sampling from Monitoring Wells

I. Purpose and Scope

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

II. Equipment and Materials

- Flow-through cell with inlet/outlet ports for purged groundwater and watertight ports for each probe
- Meters to monitor pH, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (ORP), and temperature (e.g., Horiba® U-22 or similar)
- Water-level indicator
- In-line disposable 0.45µm filters (QED® FF8100 or equivalent)
- Adjustable-rate positive-displacement pump, submersible pump, or peristaltic pump
- Generator
- Disposable polyethylene tubing
- Plastic sheeting
- Well-construction information
- Calibrated bucket or other container and watch with second indicator to determine flow rate
- Sample containers
- Shipping supplies (labels, coolers, and ice)
- Field book

III. Procedures and Guidelines

A. Setup and Purging

1. For the well to be sampled, information is obtained on well location, diameter(s), depth, and screened interval(s), and the method for disposal of purged water.

2. Instruments are calibrated according to manufacturer's instructions.

3. The well number, site, date, and condition are recorded in the field logbook.

4. Plastic sheeting is placed on the ground, and the well is unlocked and opened. All decontaminated equipment to be used in sampling will be placed only on the plastic sheeting until after the sampling has been completed. To avoid cross-contamination, do not let any downhole equipment touch the ground.

5. All sampling equipment and any other equipment to be placed in the well is cleaned and decontaminated before sampling in accordance with SOP *Decontamination of Personnel and Equipment*.

6. Water level measurements are collected in accordance with SOP *Water Level Measurements*. **Do not measure the depth to the bottom of the well at this time**; this reduces the possibility that any accumulated sediment in the well will be disturbed. Obtain depth to bottom information from well installation log.

7. Attach and secure the polyethylene tubing to the low-flow pump. Lower the pump slowly into the well and set it at approximately the middle of the screen. Place the pump intake at least 2 feet above the bottom of the well to avoid mobilization of any sediment present in the bottom. Preferably, the pump should be in the middle of the screen.

8. Insert the measurement probes into the flow-through cell. The purged groundwater is directed through the cell, allowing measurements to be collected before the water contacts the atmosphere.

9. Start purging the well at 0.2 to 0.5 liters per minute. Avoid surging. Purging rates for more transmissive formations could be started at 0.5-liter to 1 liter per minute. The initial field parameters of pH, specific conductance, dissolved oxygen, ORP, turbidity, and temperature of water are measured and recorded in the field logbook.

10. The water level should be monitored during purging, and, ideally, the purge rate should equal the well recharge rate so that there is little or no drawdown in the well (i.e., less than 0.5-foot). The water level should stabilize for the specific purge rate. There should be at least 1 foot of water over the pump intake so there is no risk of the pump suction being broken, or entrainment of air in the sample. Record adjustments in the purge rate and changes in depth to water in the logbook. Purge rates should, if needed, be decreased to the minimum capabilities of the pump (0.1- to 0.2-liter per minute) to avoid affecting well drawdown.

11. During purging, the field parameters are measured frequently (every 3 to 5 minutes) until the parameters have stabilized. Field parameters are considered stabilized when measurements meet the following criteria:

    - pH: within 0.1 pH units

- Specific conductance: within 3 percent
- Dissolved oxygen: within 10 percent
- Turbidity: within 10 percent or as low as practicable given sampling conditions
- ORP: within 10 mV

B. Sample Collection

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

Samples will be placed in bottles that are appropriate to the respective analysis and that have been cleaned to laboratory standards. Each bottle typically will have been previously prepared with the appropriate preservative, if any.

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

1. Sample identification (site name, location, and project number; sample name/number and location; sample type and matrix; whether the sample is filtered or not; time and date; sampler's identity)
2. Sample source and source description
3. Field observations and measurements (appearance, volatile screening, field chemistry, sampling method), volume of water purged prior to sampling, number of well volumes purged, and field parameter measurements
4. Sample disposition (preservatives added; laboratory sent to, date and time sent; laboratory sample number, chain-of-custody number, sample bottle lot number)

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

1. The cap is removed from the sample bottle, and the bottle is tilted slightly.
2. The sample is slowly discharged from the pump so that it runs down the inside of the sample bottle with a minimum of splashing. The pumping rate should be reduced to approximately 100 ml per minute when sampling VOCs.
3. Samples may be field filtered before transfer to the sample bottle. Filtration must occur in the field immediately upon collection. Inorganics, including metals, are to be collected and preserved in the filtered form as well as the unfiltered form. The recommended method is through the use of a disposable in-line filtration module (0.45-micron

filter) using the pressure provided by the pumping device for its operation.

4. Samples for analysis for volatile organic compounds should be collected first, if such samples are required.

5. Adequate space is left in the bottle to allow for expansion, except for VOC vials, which are filled to overflowing and capped.

6. The bottle is capped, then labeled clearly and carefully following the procedures in SOP *Packaging and Shipping Procedures*.

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

C. Additional remarks

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

2. It may not be possible to prevent drawdown in the well if the water-bearing unit has sufficiently low permeability. If the water level was in the screen to start with, do not worry about it because there is no stagnant water in the riser above the screen to begin with.

   If the water level in the well is in the riser above the screen at the beginning of purging, then be sure you pump out sufficient volume from the well to remove the volume of water in the riser above the screen. For a 2-inch diameter well, each foot of riser contains 0.163 gallons; for a 4-inch riser, each foot of riser contains 0.653 gallons; for a 6-inch riser, each foot of riser contains 1.47 gallons.

   Alternatively, the water in the riser above the screen can be removed by lowering the pump into the well until the pump intake is just below the water level, starting the pump, running it at a low rate, and slowly lowering the pump as the water level in the riser declines. This approach can be terminated when the water level reaches the top of the screen, at which time the stagnant water in the riser has been removed. This may not be a practical approach for dedicated sampling equipment. As with typical low-flow sampling, the flow rate should be kept as low as practicable.

3. There may be circumstances where a positive-displacement or submersible pump cannot be used. An example is at isolated, hard-to-reach locations where the required power supply cannot be brought. In this case, a peristaltic pump may be used. Samples can be collected by the procedures described above for all but those for VOC analysis. The water to be placed in the vials for VOC analysis should not be run

through the peristaltic pump but instead should be collected by the following:

- Stop the pump when it is time to collect the VOC sample.
- Disconnect the tubing upstream from the pump (a connector must be installed in the line to do this).
- Pinching the tubing to keep the water in the tubing, remove the tubing from the well. Be sure that the tubing does not contact other than clean surfaces.
- Place the end of the tubing that was in the well into each VOC vial and fill the vial by removing the finger from the other end of the tube.
- Once the vials are filled, return the tubing to the well and collect any other samples required.

4. Nondedicated sampling equipment is removed from the well, cleaned, and decontaminated in accordance with SOP *Decontamination of Personnel and Equipment*. Disposable polyethylene tubing is disposed of with PPE and other site trash.

IV. Attachments

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

V. Key Checks and Preventative Maintenance

- The drawdown in the well should be minimized as much as possible (preferably no more than 0.5-foot to 1 foot) so that natural groundwater-flow conditions are maintained as closely as possible.
- The highest purging rate should not exceed 1 liter per minute. This is to keep the drawdown minimized.
- Stirring up of sediment in the well should be avoided so that turbidity containing adsorbed chemicals is not suspended in the well and taken in by the pump.
- Overheating of the pump should be avoided to minimize the potential for losing VOCs through volatilization.
- Keep the working space clean with plastic sheeting and good housekeeping.
- Maintain field equipment in accordance with the manufacturer's recommendations. This will include, but is not limited to:
    - Inspect sampling pump regularly and replace as warranted

- Inspect quick-connects regularly and replace as warranted
- Verify battery charge, calibration, and proper working order of field measurement equipment prior to initial mobilization and daily during field efforts

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

White Paper on Low-Flow Sampling

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

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

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

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

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

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

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

STANDARD OPERATING PROCEDURE

Direct-Push Soil Sample Collection

I. Purpose

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

II. Scope

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

III. Equipment and Materials

- Truck-mounted hydraulic percussion hammer.
- Sampling rods
- Sampling tubes and acetate liners
- Pre-cleaned sample containers and stainless-steel sampling implements
- Clean latex or surgical gloves.

IV. Procedures and Guidelines

1. Decontaminate sampling tubes and other non-dedicated downhole equipment in accordance with SOP *Decontamination of Personnel and Equipment*.

2. Drive sampling tube to the desired sampling depth using the truck-mounted hydraulic percussion hammer. If soil above the desired depth is not to be sampled, first drive the lead rod, without a sampling tube, to the top of the desired depth.

3. Remove the rods and sampling tube from the borehole and remove the sample from the tube.

4. Fill all sample containers, beginning with the containers for VOC analysis, using a decontaminated or dedicated sampling implement.

5. Decontaminate all non-dedicated downhole equipment (rods, sampling tubes, etc.) in accordance with SOP *Decontamination of Personnel and Equipment*.

6. Backfill borehole at each sampling location with grout or bentonite and repair the surface with like material (bentonite, asphalt patch, concrete, etc.), as required.

V. Key Checks and Items

1. Verify that the hydraulic percussion hammer is clean and in proper working order.

2. Ensure that the direct-push operator thoroughly completes the decontamination process between sampling locations.

3. Verify that the borehole made during sampling activities has been properly backfilled.

STANDARD OPERATING PROCEDURE

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

I. Purpose and Scope

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

II. Equipment and Materials

- Horiba® U-22 Water Quality Checker with flow-though cell
- Distilled water in squirt bottle
- Horiba® U-22 Auto-Calibration Standard Solution

III. Procedures and Guidelines

A. Parameters and Specifications:

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

B. Calibration:

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

1. Fill the calibration beaker to about 2/3 with the pH 4 standard solution.
2. Fit the probe into the beaker. All the parameter sensors will now be immersed in the standard solution except the D.O. sensor; the D.O. calibration is done using atmospheric air.
3. Turn power on.
4. Press CAL key to put the unit in the calibration mode.
5. Press the ENT key to start automatic calibration. Wait a moment, and the upper cursor will gradually move across the four auto-calibration parameters one by one: pH, COND, TURB, and DO. When the calibration is complete, the readout will briefly show END. The instrument is now calibrated.
6. If the unit is calibrated properly, pH will read 4.0 +/- 3%, conductivity will read 4.49 +/- 3%, and turbidity will read 0 +/- 3%

C. Sample Measurement:

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

IV. Key Checks and Preventive Maintenance

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

STANDARD OPERATING PROCEDURE

Equipment Blank and Field Blank Preparation

I. Purpose

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

II. Scope

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

III. Equipment and Materials

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

IV. Procedures and Guidelines

A. Decontaminate all sampling equipment that has come in contact with sample according to SOP *Decontamination of Personnel and Equipment.*

B. To collect an equipment blank for volatile analysis from the surfaces of sampling equipment other than pumps, pour blank water over one piece of equipment and into two 40-ml vials until there is a positive meniscus, then seal the vials. Note the sample number and associated piece of equipment in the field notebook as well as the type and lot number of the water used.

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

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

C. When collecting an equipment blank from a pump, run an extra gallon of deionized water through the pump while collecting the pump outflow into appropriate containers. Make sure the flow rate is low when sampling VOCs. If a Grundfos Redi-Flo2 pump with disposable tubing is used, remove the disposable tubing after sampling but before decon. When decon is complete, put a 3- to 5-foot segment of new tubing onto the pump to collect the equipment blank.

D. To collect a field blank, slowly pour ASTM Type II or lab grade water directly into sample containers.

E. Document and ship samples in accordance with the procedures for other samples.

F. Collect next field sample.

V. Attachments

None.

VI. Key Checks and Items

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

STANDARD OPERATING PROCEDURE

Chain-of-Custody

I Purpose

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

II Scope

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

III Definitions

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

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

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

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

IV Responsibilities

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

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

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

V Procedures

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

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

V.1 Sample Identification

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

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

- Field Sampler(s),
- Contract Task Order (CTO) Number,
- Project Sample Number,
- Sample location or sampling station number,

- Date and time of sample collection and/or measurement,
- Field observations,
- Equipment used to collect samples and measurements, and
- Calibration data for equipment used

Measurements and observations shall be recorded using waterproof ink.

V.1.1 Sample Label

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

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

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

V.2 Chain-of-Custody Procedures

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

V.2.1 Field Custody Procedures

- Samples are collected as described in the site Sampling and Analysis Plan. Care must be taken to record precisely the sample location and to ensure that the sample number on the label matches the Chain-of-Custody Record exactly.

- A Chain-of-Custody Record will be prepared for each individual cooler shipped and will include ***only*** the samples contained within that particular cooler. The Chain-of-Custody Record for that cooler will then be sealed in a zip-log bag and placed in the cooler prior to sealing. This ensures that the laboratory properly attributes trip blanks with the correct cooler and allows for easier tracking should a cooler become lost during transit.

- The person undertaking the actual sampling in the field is responsible for the care and custody of the samples collected until they are properly transferred or dispatched.

- When photographs are taken of the sampling as part of the documentation procedure, the name of the photographer, date, time, site location, and site description are entered sequentially in the site logbook as photos are taken. Once downloaded to the server or developed, the electronic files or photographic prints shall be serially numbered, corresponding to the logbook descriptions; photographic prints will be stored in the project files. To identify sample locations in photographs, an easily read sign with the appropriate sample/ location number should be included.

- Sample labels shall be completed for each sample, using waterproof ink unless prohibited by weather conditions (e.g., a logbook notation would explain that a pencil was used to fill out the sample label if the pen would not function in freezing weather.)

V.2.2 Transfer of Custody and Shipment

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

- Enter header information (CTO number, samplers, and project name).

- Enter sample specific information (sample number, media, sample analysis required and analytical method grab or composite, number and type of sample containers, and date/time sample was collected).

- Sign, date, and enter the time under "Relinquished by" entry.

- Have the person receiving the sample sign the "Received by" entry. If shipping samples by a common carrier, print the carrier to be used in this space (i.e., Federal Express).

- If a carrier is used, enter the airbill number under "Remarks," in the bottom right corner;

- Place the original (top, signed copy) of the Chain-of-Custody Record Form in a plastic zipper-type bag or other appropriate sample-shipping package. Retain the copy with field records.

- Sign and date the custody seal, a 1-inch by 3-inch white paper label with black lettering and an adhesive backing. Attachment C is an example of a custody seal. The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field. Custody seals shall be provided by the analytical laboratory.

- Place the seal across the shipping container opening (front and back) so that it would be broken if the container were to be opened.

- Complete other carrier-required shipping papers.

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

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

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

VI Quality Assurance Records

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

VII Attachments

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

VIII References

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

STANDARD OPERATING PROCEDURE

Packaging and Shipping Procedures for Low-Concentration Samples

I. Purpose and Scope

The purpose of this guideline is to describe the packaging and shipping of low-concentration samples of various media to a laboratory for analysis.

II. Scope

The guideline only discusses the packaging and shipping of samples that are anticipated to have low concentrations of chemical constituents. Whether or not samples should be classified as low-concentration or otherwise will depend upon the site history, observation of the samples in the field, odor, and photoionization-detector readings.

If the site is known to have produced high-concentration samples in the past or the sampler suspects that high concentrations of contaminants might be present in the samples, then the sampler should conservatively assume that the samples cannot be classified as low-concentration. Samples that are anticipated to have medium to high concentrations of constituents should be packaged and shipped following procedures for dangerous-goods shipping specified by the intended shipper (e.g., Federal Express).

III. Equipment and Materials

- Coolers
- Clear tape
- "This Side Up" labels
- "Fragile" labels
- Vermiculite
- Ziplock bags or bubble wrap
- Ice
- Chain-of-Custody form (completed)
- Custody seals

IV. Procedures and Guidelines

Low-Concentration Samples

A. Prepare coolers for shipment:

- Tape drains shut.
- Affix "This Side Up" labels on all four sides and "Fragile" labels on at least two sides of each cooler.
- Place mailing label with laboratory address on top of coolers.
- Fill bottom of coolers with about 3 inches of vermiculite or absorbent pads.

B. Arrange decontaminated sample containers in groups by sample number. Consolidate VOC samples into one cooler to minimize the need for trip blanks.

C. Affix appropriate adhesive sample labels to each container. Protect with clear label protection tape.

D. Seal each sample bottle within a separate ziplock plastic bag or bubble wrap, if available. Tape the bag around bottle. Sample label should be visible through the bag.

E. Arrange sample bottles in coolers so that they do not touch.

F. If ice is required to preserve the samples, cubes should be repackaged in zip-lock bags and placed on and around the containers.

G. Fill remaining spaces with vermiculite or absorbent pads.

H. Complete and sign chain-of-custody form (or obtain signature) and indicate the time and date it was relinquished to Federal Express or the courier.

J Close lid and latch.

K. Carefully peel custody seals from backings and place intact over lid openings (right front and left back). Cover seals with clear protection tape.

L. Tape cooler shut on both ends, making several complete revolutions with strapping tape. Cover custody seals with tape to avoid seals being able to be peeled from the cooler.

M. Relinquish to Federal Express or to a courier arranged with the laboratory. Place airbill receipt inside the mailing envelope and send to the sample documentation coordinator along with the other documentation.

Medium- and High-Concentration Samples:

Medium- and high-concentration samples are packaged using the same techniques used to package low-concentration samples, with several additional restrictions. The sample handler must refer to instructions associated with the shipping of dangerous goods for the necessary procedures for shipping by Federal Express or other overnight carrier.

V. Attachments

None.

VI. Key Checks and Items

- Be sure laboratory address is correct on the mailing label
- Pack sample bottles carefully, with adequate vermiculite or other packaging and without allowing bottles to touch
- Be sure there is adequate ice
- Include chain-of-custody form
- Include custody seals

STANDARD OPERATING PROCEDURE

Multi RAE Photoionization Detector (PID)

I. Purpose

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

II. Scope

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

III. Definitions

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

Volatile Organic Compound (VOC) – Expresses the VOC concentration in parts per million (ppm)

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

Hydrogen Sulfide Sensor (H_2S) - Expresses the Hydrogen Sulfide concentration in parts per million (ppm).

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

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

IV. Responsibilities

Project Manager - The Project Manager is responsible for ensuring that project-specific plans are in accordance with these procedures, where applicable, or that other approved procedures are developed. The Project Manager is responsible for selecting qualified individuals for the monitoring activities.

Health and Safety Coordinator - The Health and Safety Coordinator is responsible for developing a site-specific Health and Safety Plan (HASP) which specifies air monitoring requirements.

Field Team Leader - It is the responsibility of the Field Team Leader to implement these procedures in the field, and to ensure that the field team performing air monitoring activities have been briefed and trained to execute these procedures before the start of site operations.

Safety Coordinator-Hazard Worker (SC-HW)- The SC-HW is responsible for ensuring that the specified air monitoring equipment is on site, calibrated, and used correctly by the field personnel. The SC-HW will coordinate these activities with the Field Team Leader if the SC-HW is not the Field Team Leader as well.

Field team - It is the responsibility of the field team to follow these procedures or to follow documented project-specific procedures as directed by the Field Team Leader/ Safety Coordinator-Hazard Worker. The field personnel are responsible for documenting all air monitoring results in the field logbook during each field investigation.

V. Procedures

The Multi RAE utilizes the principle of detecting sensors. The PID operates on the principle that most organic compounds and some inorganic compounds are be ionized when they are bombarded by high-energy ultraviolet light. These compounds absorb the energy of the light, which excites the molecule and results in a loss of electron and the formation of a positively charged ion. The number of ions formed and the ion current produced is directly proportional to mass and concentration. The amount of energy required to displace an electron is called ionization potential (IP). The air sample is drawn into a UV lamp using a pump or a fan. The energy of the lamp determines whether a particular chemical will be ionized. Each chemical compound has a unique ionizing potential. When the UV light energy is greater than the ionization potential of the chemical, ionization will occur. When the sample is ionized, the electrical signal is displayed on an analog or digital output. Although the output does not distinguish between chemicals, it does detect an increase in the ion current. If only one chemical is present in the air, it is possible to use PIDs quantitatively. Chemical structure and lamp intensity affects the sensitivity of the instrument to a given contaminant. All PID readings are relative to the calibration gas, usually isobutylene. It is important to calibrate the PID in the same temperature and elevation that the equipment will be used, and to determine the background concentrations in the field before taking measurements. For environments where background readings are high, factory zero calibration gas should be used.

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

A. Calibration

For Multi RAE configured with O_2, LEL, H_2S, CO, sensors and a 10.6eV PID Lamp.

Start up Instrument

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

On!……..

Multi RAE Version X.XX

Model Number SN XXXX

Date Time Temp

Checking Sensor Ids….

VOC Installed

CO Installed

H_2S Installed

OXY Installed

LEL Installed

H_2S VOC CO LEL OXY

Alarm Limits=

XX XX.X XX XX High XX.X

XX XX.X XX XX Low XX.X

XX XX.X XX STEL

XX XX.X XX TWA

```
Battery = X.XV
Shut off at 4.2V
```

```
User Mode=
```

```
Alarm Mode=
```

```
Datalog Time Left
```

```
Datalog Mode
```

```
Datalog Period
```

```
Unit ready in…..
10 Seconds
```

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

Calibration Check and Adjustment

Allow instrument to warm up for 15 minutes.

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

```
Calibrate
Monitor?
```

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

```
Fresh Air
Calibration?
```

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

```
Zero….
In progress…
```

CO Zeroed! Reading = X

VOC Zeroed! Reading = X

LEL Zeroed! Reading = X

OXY Zeroed! Reading = X

Zero Cal done!
H_2S Zeroed! Reading = X

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

- Display will then read:

Multiple Sensor Calibration?

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

CO H_2S LEL OK? OXY

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

Apply Mixed gas

Calibration In progress …

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

CO cal'ed Reading=50

H_2S cal'ed Reading=25

LEL cal'ed Reading=50

OXY cal'ed Reading=20.9

Calibration done Turn off gas!

- Display will read:

Single Sensor Calibration?

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

CO VOC H_2S LEL pick? OXY

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

Apply VOC Gas

Calibration In progress…

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

VOC cal'd Reading=100

Calibration done Turn off gas!

Single Sensor Calibration?

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

B. Operation

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

C. Site Maintenance

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

D. Scheduled Maintenance

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

VI. Quality Assurance Records

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

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

VII. References

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

STANDARD OPERATING PROCEDURE

Decontamination of Personnel and Equipment

I. Purpose

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

II. Scope

This is a general description of decontamination procedures.

III. Equipment and Materials

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

IV. Procedures and Guidelines

A. PERSONNEL DECONTAMINATION

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

1. Wash boots in Liquinox® solution, then rinse with water. If disposable latex booties are worn over boots in the work area, rinse with Liquinox® solution, remove, and discard into DOT-approved 55-gallon drum.

2. Wash outer gloves in Liquinox® solution, rinse, remove, and discard into DOT-approved 55-gallon drum.

3. Remove disposable coveralls ("Tyveks") and discard into DOT-approved 55-gallon drum.

4. Remove respirator (if worn).

5. Remove inner gloves and discard.

6. At the end of the work day, shower entire body, including hair, either at the work site or at home.

7. Sanitize respirator if worn.

B. SAMPLING EQUIPMENT DECONTAMINATION—GROUNDWATER SAMPLING PUMPS

Sampling pumps are decontaminated after each use as follows.

1. Don phthalate-free gloves.

2. Spread plastic on the ground to keep equipment from touching the ground

3. Turn off pump after sampling. Remove pump from well and remove and dispose of tubing. Place pump in decontamination tube.

4. Turn pump back on and pump 1 gallon of Liquinox® solution through the sampling pump.

5. Rinse with 1 gallon of 10% methanol solution pumped through the pump. (DO NOT USE ACETONE).

6. Rinse with 1 gallon of tap water.

7. Rinse with 1 gallon of deionized water.

8. Keep decontaminated pump in decontamination tube or remove and wrap in aluminum foil or clean plastic sheeting.

9. Collect all rinsate and dispose of in a DOT-approved 55-gallon drum.

10. Decontamination materials (e.g., plastic sheeting, tubing, etc.) that have come in contact with used decontamination fluids or sampling equipment will be disposed of in DOT-approved 55-gallon drums.

C. SAMPLING EQUIPMENT DECONTAMINATION—OTHER EQUIPMENT

Reusable sampling equipment is decontaminated after each use as follows.

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

D. HEALTH AND SAFETY MONITORING EQUIPMENT DECONTAMINATION

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

E. SAMPLE CONTAINER DECONTAMINATION

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

1. Wipe container with a paper towel dampened with Liquinox® solution or immerse in the solution AFTER THE CONTAINERS HAVE BEEN SEALED. Repeat the above steps using potable water.

2. Dispose of all used paper towels in a DOT-approved 55-gallon drum.

F. HEAVY EQUIPMENT AND TOOLS

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

1. Set up a decontamination pad in area designated by the Facility

2. Steam clean heavy equipment until no visible signs of dirt are observed. This may require wire or stiff brushes to dislodge dirt from some areas.

V. Attachments

None.

VI. Key Checks and Items

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

STANDARD OPERATING PROCEDURE

Decontamination of Drilling Rigs and Equipment

I. Purpose and Scope

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

II. Equipment and Materials

- Portable steam cleaner and related equipment
- Potable water
- Phosphate-free detergent such as Liquinox®
- Buckets
- Brushes
- Distilled organic-free water
- Methanol, pesticide grade
- ASTM–Type II grade water or Lab Grade DI Water
- Aluminum foil

III. Procedures and Guidelines

A. Drilling Rigs and Monitoring Well Materials

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

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

B. Downhole Drilling Tools

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

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

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

C. Field Analytical Equipment

1. Water Level Indicators

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

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

2. Probes

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

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

- The effectiveness of field cleaning procedures will be monitored by rinsing decontaminated equipment with organic-free water and submitting the rinse water in standard sample containers for analysis. Anytime a sampling event occurs, at least one such quality control sample shall be collected.

Appendix C
Data Management Guidelines

Version 1

Navy CLEAN
Data Management Plan

Prepared for

Navy CLEAN & Joint Venture Programs

October 2009

CH2MHILL

Preface

This document presents the standardized six-step workflow process for environmental data management being performed for the Navy Comprehensive Long-Term Environmental Action - Navy (CLEAN) and Joint Venture Programs. Included in Appendix A is the responsible, approve, support, consult, and inform (RASCI) diagram along with the associated roles and responsibilities, which is the basis for the Navy CLEAN and Joint Venture Programs Data Management Plan (DMP). Following are the six steps in the workflow process:

1. Project planning and database setup
2. Sample collection and management
3. Laboratory analysis
4. Data validation and loading
5. Data management
6. Data evaluation and reporting

Figure P-1 presents a simplified presentation of the workflow process specific to the Navy CLEAN and Joint Venture Programs.

Figure P-2 presents, in more detail, the tools used in each step of the process. CH2M HILL uses the Sample Tracking Program (STSP) to initiate the sample collection, documentation, and tracking processes. During the laboratory analysis and data validation phase, the CH-Analyzer and Validation Data Management System (VDMS) software will be used to help evaluate the quality of the data. At the data management step, the CH-ERPTool will be used to format the data and the CH-IMPTool will be used to transfer the data into the Navy CLEAN data warehouse. At the data evaluation stage, the XTabReports Tool will be used to query data from the data warehouse, and the Crosstab Cleanup Tool and RDE Formatting Tool will produce and format data tables and comparisons to project action levels. The Site Information Management System Visual Interface to the data warehouse is an application that is often used to access and query data. Appropriate section(s) of the DMP include additional details on each of the tools used.

Change Management

This DMP is a "living" document and content may be revised or amended to accommodate changes in the scope of environmental investigations or data management requirements that affect the entire Navy CLEAN Program. In addition, the DMP appendices will be subject to modification as new or improved methods of data management are developed and implemented.

Any modifications made to the tools will be communicated to the project team via e-mail. As revisions are finalized, they will be distributed electronically to all users. After revision, it is the user's responsibility to conform to revised portions of the DMP.

Amendments will be versioned and released according to the following naming scheme: [Document Name_v#.#_yymmdd]. If a significant change is made to any of these files, the

version number will increase by one integer. The revision history is shown in the following table.

REVISION HISTORY
Navy CLEAN and Joint Venture Programs Data Management Plan

Revision Date	Initiator	Purpose

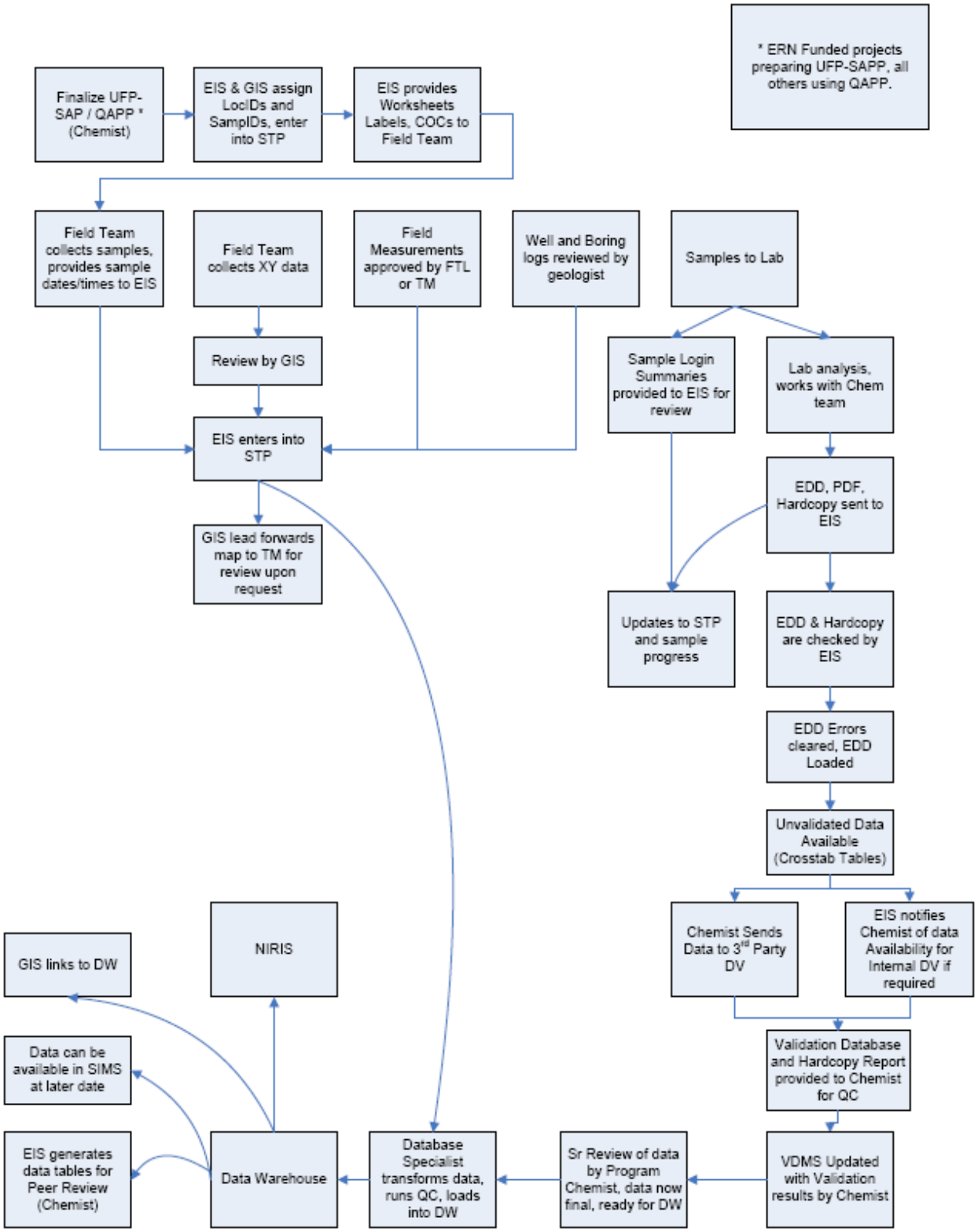

FIGURE P-1
ENVIRONMENTAL DATA MANAGEMENT WORKFLOW PROCESS

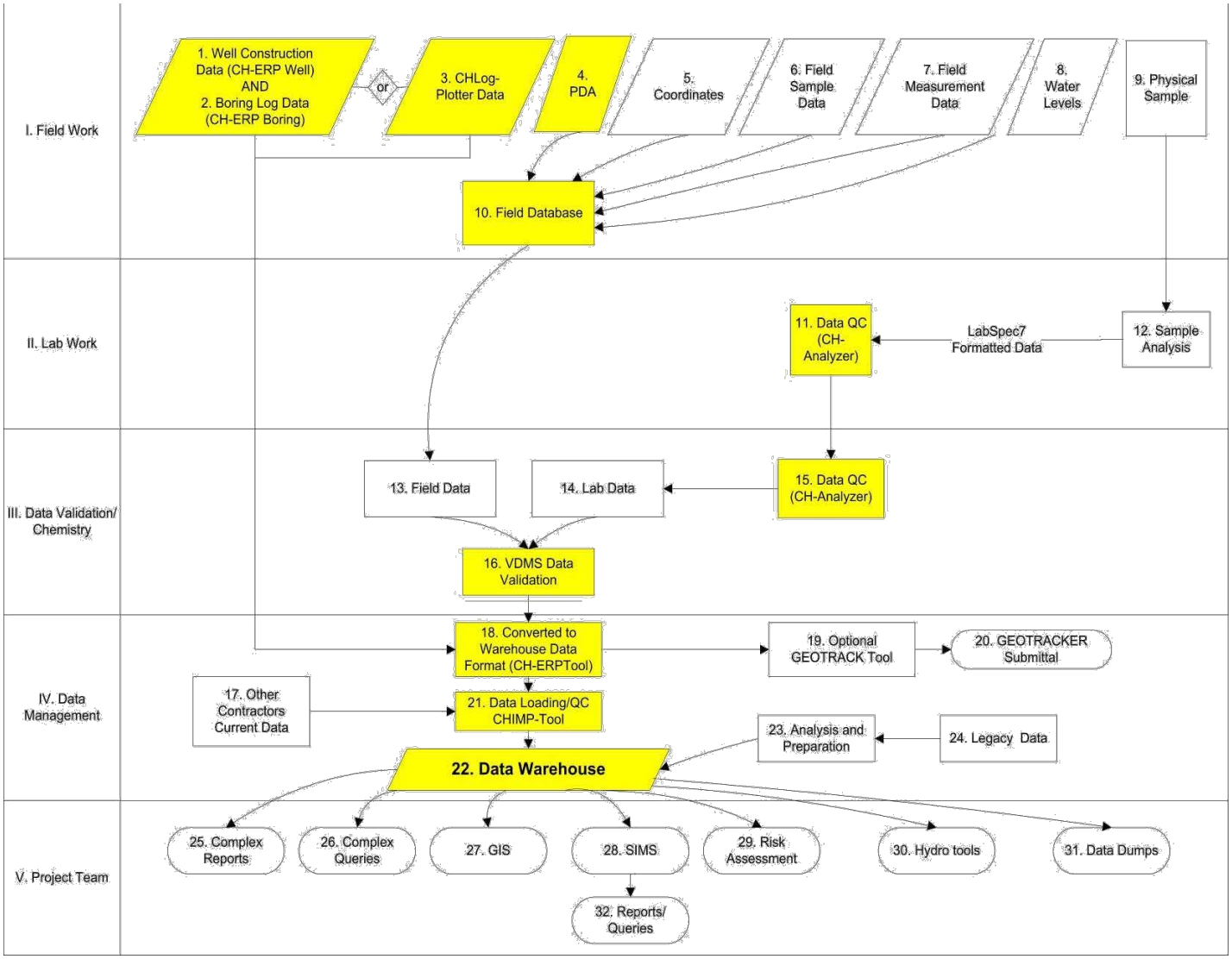

FIGURE P-2
DBMS PROCESS

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Acronyms and Abbreviations

AFCEE	Air Force Center for Engineering and the Environment
AM	Activity Manager
CAD	computer-aided design
COC	chain-of-custody
DBMS	Database Management System
DBS	Database Specialist
EIS	Environmental Information Specialist
DMP	Data Management Plan
EDD	electronic data deliverable
EDM	Environmental Data Management
EMS	Enterprise Management Solutions
ERP	Environmental Restoration Program
ERPIMS	Environmental Restoration Program Information Management System
EVS	Environmental Visualization System
FD	field duplicate
FTL	Field Team Leader
GA	GIS Analyst
GIS	geographic information system
ID	identification
IDW	investigation-derived waste
IRP	Installation Restoration Program
MS	matrix spike
MSD	matrix spike duplicate
N/FD	normal/field duplicate
NAVFAC	Naval Facilities Engineering Command
NEDD	NIRIS Electronic Data Deliverable
NIRIS	Naval Installation Restoration Information Solution

ODBC	open database connectivity
PC	Project Chemist
PCL	Program Chemistry Lead
PDL	Program Data Management Lead
PGL	Program GIS Lead
PM	Project Manager
QA	quality assurance
QC	quality control
RASCI	responsible, approve, support, consult, and inform
RDM	Regional Database Manager
SDG	Sample Delivery Group
SIMS	Site Information Management System
SOP	standard operating procedure
STSP	Sample Tracking Program
VDMS	Validated Data Management System

SECTION 1

Introduction

This Data Management Plan (DMP) describes the methods CH2M HILL will use to manage and present environmental data to support work it is conducting for the Navy CLEAN and Joint Venture Programs. These processes and procedures are part of an overall environmental data management system called the Validation Data Management System (VDMS) hosted by CH2M HILL.

Project members and any subcontractors supporting program data needs for site characterization and remediation activities can use this DMP. It is a living document that is flexible enough to meet the dynamic needs of the teams and stakeholders. Data management program details and procedures are included in the appendices.

1.1 Purpose

This document outlines how environmental data for the Navy CLEAN and Joint Venture Programs will be obtained and managed using an Enterprise Management Solutions (EMS) approach. The systematic approach will facilitate the retrieval of data from project files and the data warehouse when they are needed, help ensure that the required data are collected and are of the appropriate quality, and help ensure that data records are not lost during transfer to the central program database repository.

1.2 Scope of the Data Management Plan

The scope of the data management activities addressed by this plan includes the following:

- **Roles.** Definition of staff roles and responsibilities.
- **Project Planning and Setup.** Use standard templates and database applications; provide guidance and standard operating procedures (SOPs) for formatting, reviewing, and transferring data collected in the field to the Database Management System (DBMS).
    - **Provide a structured, yet flexible data set.** The DBMS will store all types of environmental data and provides a standard framework for all projects within the Navy CLEAN Program to use. The DBMS is organized and structured, yet flexible enough to allow additional data and data types to be added at any time over the life of the program.
    - **Provide data that are well documented.** Retain enough descriptive and source information for technical defensibility and legal admissibility of the data.
- **Sample Collection and Management.** Items that will be captured through standardized forms or applications include chains-of-custody (COCs), field parameter information, groundwater elevation data, and sample tracking records.

- **Laboratory Analysis.** Laboratory data will be reported in the Electronic Data Deliverable (EDD) format specifications that analytical laboratories are required to use to transfer analytical data electronically to CH2M HILL. (Provided to laboratories via a scope of work.) Management and archive procedures will be implemented for hard copy and electronic project documentation.
- **Data Validation.** Internal and external data validation will be conducted in accordance with the appropriate Program and EPA requirements. All deliverables will be subjected to Senior Review quality assurance (QA) and quality control (QC) measures. Management and archive procedures will be implemented for hard copy and electronic project documentation.
- **Data Management.** Implement quality assurance (QA) and quality control (QC) measures to provide accurate representation of all data collected and to be stored in the DBMS. QA/QC procedures include restricting data import or entry to specific valid value lists that will not allow incorrect data to be included in the DBMS.
- **Data Evaluation and Reporting.** Provide reporting and delivery support from a single DBMS source and allow relatively simple and rapid access to stored data for environmental characterization, report generation, modeling, geographic information system (GIS) mapping, statistical analyses, and risk assessments.
    - **Provide data visualization capabilities.** Allow accurate representation of data used in models, GIS, boring log programs (Environmental Visualization System [EVS), computer-aided design (CAD), graphics, and other software used for mapping, graphing, charting, analyzing, and displaying environmental data.
    - **Provide the ability to compare data electronically.** Allow electronic comparison of project data to specific reference or screening criteria.
    - **Provide the ability to transfer data to different formats.** Provide the ability to reformat, convert, and transfer the data to any format as required by specific end-user applications.

SECTION 2

Roles and Responsibilities

The Navy CLEAN and Joint Venture Programs Environmental Data Management (EDM) team will work together to properly execute the DMP and ensure that the project objectives and scope are realized. The EDM team is composed of data management, Chemistry, and GIS resources. The EDM team is responsible for all aspects of planning, execution, management and reporting environmental of data. Data are derived from sampling events related to investigative and remedial activities for Navy CLEAN and Joint Venture projects.

Responsibilities related to data management and information solutions functions are grouped into roles, as listed in Table 1. The Checklist_VDMS-DM-Process_20090615 referenced in Appendix C documents the specific responsibilities associated with each of these roles.

TABLE 1
Navy CLEAN and Joint Venture Environmental Data Management Program Team
The Navy CLEAN Program Data Management Plan

Title	Name/Address	Phone	Fax	E-mail
Navy CLEAN Activity Manager (AM)	Various	Various	Various	Various
Navy CLEAN Project Manager (PM)	Various	Various	Various	Various
Field Team Leader (FTL)	Various	Various	Various	Various
Program Critigen Team Lead	Mike Dierstein 5700 Cleveland Street Suite 101 Virginia Beach, VA 23462	757-671-6216	757-497-6885	mdierste@critigen.com
Program Data Management Lead (PDL)	Chelsea Leigh 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6208	773-695-1378	cleigh@critigen.com
Database Specialist (DBS)	Bhavana Reddy 15010 Conference Center Dr. Suite 200 Chantilly, VA 20151	703- 462-3784	703- 376-5010	breddy@critigen.com
Program Chemistry Lead (PCL)	Anita Dodson 5700 Cleveland Street Suite 101 Virginia Beach, VA 23462	757-671-6218	757-497-6885	adodson@ch2m.com
Project Chemist (PC)	Mike Zamboni 15010 Conference Center Dr. Suite 200 Chantilly, VA 20151	703-376-5111	703-376-5801	mzamboni@ch2m.com
Project Chemist (PC)	Megan Hilton 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	401-619-2657	703-376-5801	mhilton@ch2m.com

TABLE 1
Navy CLEAN and Joint Venture Environmental Data Management Program Team
The Navy CLEAN Program Data Management Plan

Title	Name/Address	Phone	Fax	E-mail
Project Chemist (PC) / Environmental Information Specialist (EIS)	Bianca Kleist 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6281	757-497-6885	bkleist@ch2m.com
Environmental Information Specialist (EIS)	Genevieve Moore 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6284	757-497-6885	gmoore@ch2m.com
Environmental Information Specialist (EIS)	Emma Brower 15010 Conference Center Dr. Suite 200 Chantilly, VA 20151	703-376-5305	703-376-5805	ebrower@ch2m.com
Environmental Information Specialist (EIS)	Rebekha Shaw 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6279	757-497-6885	rshaw22@ch2m.com
Environmental Information Specialist (EIS)	Gwendolyn Buckley 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-8311	757-497-6885	Gbuckle1@ch2m.com
Environmental Information Specialist (EIS)	Victoria Brynildsen 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462		757-497-6885	vbrynildsen@ch2m.com
Program GIS Lead (PGL)	Mike Dierstein 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6216	757-497-6885	mdierstein@critigen.com
GIS Analyst (GA)	Blake Hathaway 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6230	757-497-6885	bhathawa@critigen.com

TABLE 1
Navy CLEAN and Joint Venture Environmental Data Management Program Team
The Navy CLEAN Program Data Management Plan

Title	Name/Address	Phone	Fax	E-mail
GIS Analyst (GA)	Mary Beth Artese 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6228	757-497-6885	martese@critigen.com
GIS Analyst (GA)	Mark Unwin 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6261	757-497-6885	munwin@critigen.com
GIS Analyst (GA)	Chris Bowman 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6276	757-497-6885	cbowman@critigen.com
GIS Analyst (GA)	Matt Rissing 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6243	757-497-6885	mrissing@critigen.com
GIS Analyst (GA)	Forrest Cain 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6271	757-497-6885	fcain@critigen.com

SECTION 3

Data Management System Description

During field investigation, monitoring, and remedial activities, CH2M HILL will collect a variety of environmental information to support data analysis, reporting, and decision-making activities. To meet current regulatory QA requirements, a complete audit trail of the information flow must be implemented. The six steps in the workflow process are (Appendix B):

1. Project planning and database setup
2. Sample collection and management
3. Laboratory analysis
4. Data validation
5. Data management and loading
6. Data evaluation and reporting

Each step in the data management process must be adequately planned, executed, and documented. Figure 1 presents a simplified presentation of the workflow process specific to the Navy CLEAN and Joint Venture Programs. Figure 2 presents, in more detail, the tools used in each step of the process.

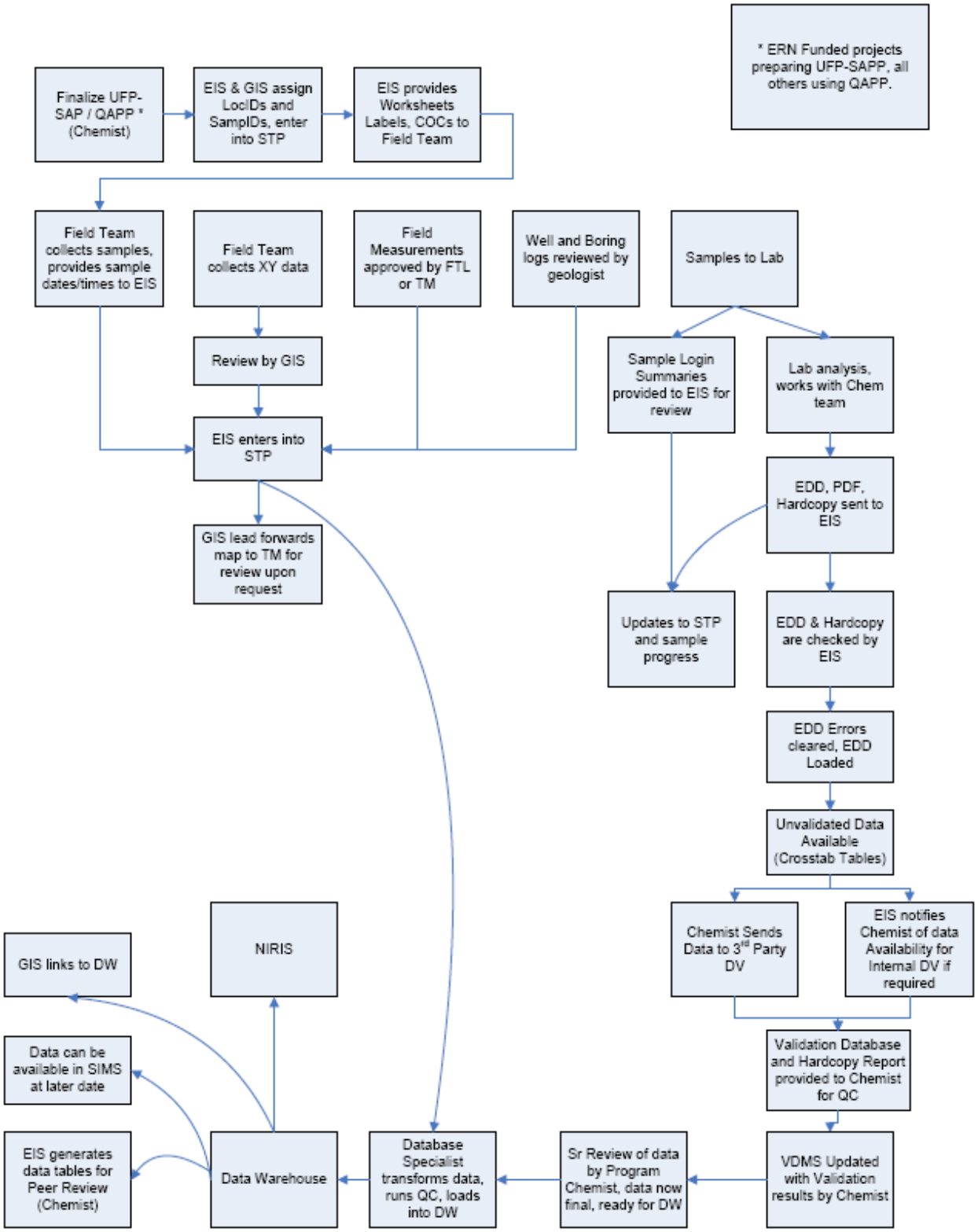


FIGURE 1
ENVIRONMENTAL DATA MANAGEMENT WORKFLOW PROCESS

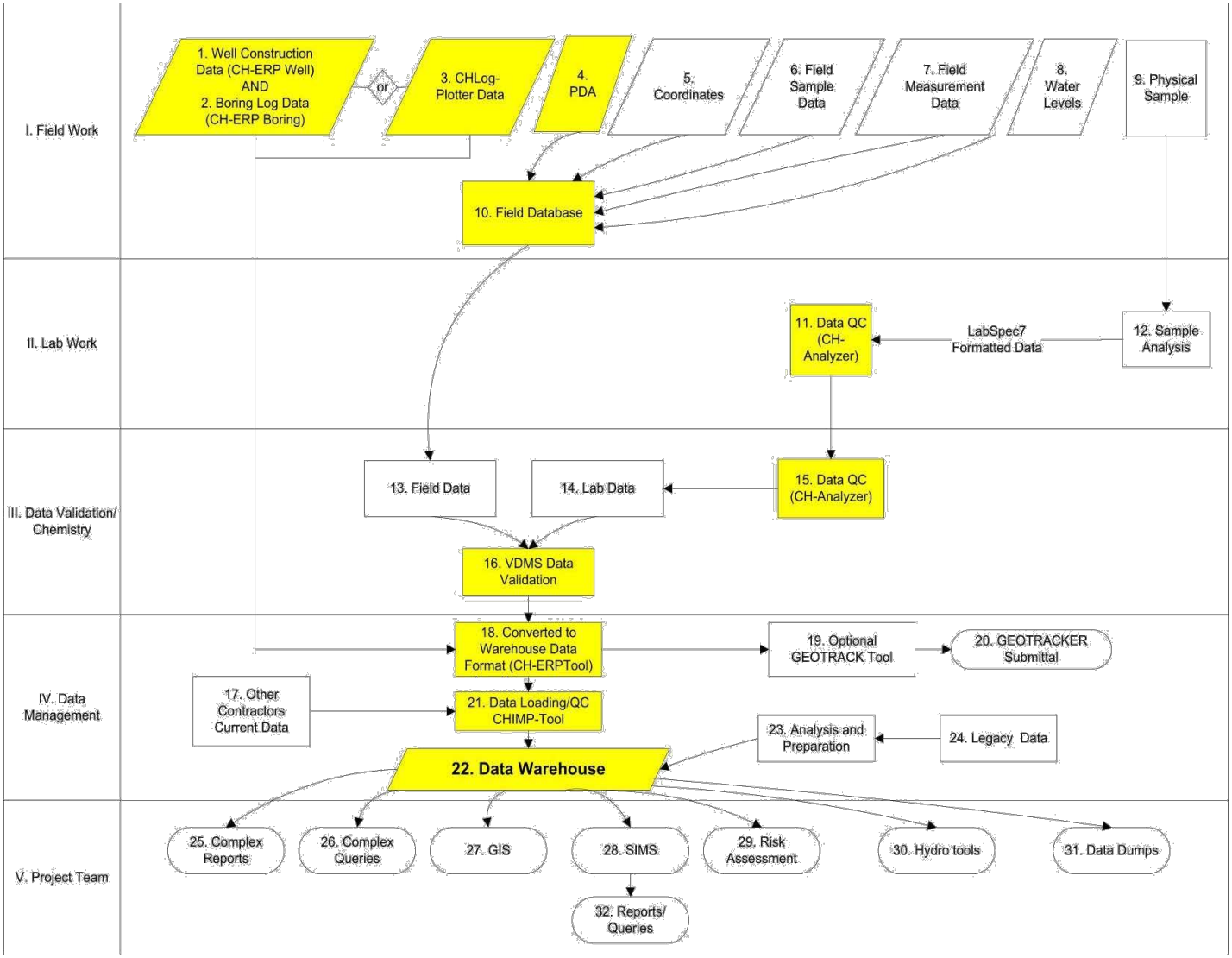


FIGURE 2
DBMS PROCESS

SECTION 4

Phases of Data Management

4.1 Project Planning and Setup

Project planning starts when a new project or task is identified in the program. Evaluation of what is required from the data management and visualization occurs to determine the data needs. The Program Critigen Team Lead (Critigen Lead) works with the Program Data Management Lead (PDL) and the project and/or program manager to determine what is expected and required from the data management and visualization team. Specific items that should be considered are as follows:

- Inputs – Determine what data will be collected and stored in the database. Determine frequency and quantity. Determine what tools will be used to handle data input.
- Historical Data – This is a unique data input and requires special consideration. The PDL ***must*** work with the other technical leads to assess what effort will be required. This step is often missed, and the resulting data quality issues created from inadequate planning in this area can plague the project for its entire duration.
- Outputs – Determine what data will need to be presented in reports, figures, and electronic deliverables. Determine frequency and quality requirements. Determine preliminary data, validated data, and what tools will most effectively handle the output requirements. Discuss how the outputs needed by the team will be requested and documented.
- Visualization – Determine necessity for GIS and CAD.

After the information above is determined, the data management scope, schedule, and budget are developed and endorsed by the Project Manager (PM), PDL, Program GIS Lead (PGL) and Program Chemistry Lead (PCL). The team can then proceed upon client authorization of the overall project budget. Figure 3 shows the process for project planning.

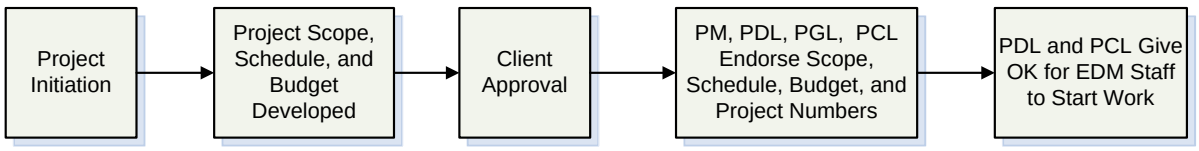


FIGURE 3
PROJECT PLANNING

4.1.1 Database Setup and Administration

CH2M HILL Database

The PDL will oversee the administration of the DBMS, including the design, development, and maintenance of the program database and data management processes. Database and data management process design and development will focus on providing rapid data entry and data retrieval while promoting data integrity through various automated procedures. The PDL will perform the database maintenance, which consists of the following:

- Assisting with the allocation of sufficient system storage for the program database
- Adding, altering, and deleting users, roles, and privileges
- Periodically defragmenting and compacting the database for more efficient operation
- Upgrading database software and associated applications as necessary
- Maintaining an approved list of valid values for data consistency
- Maintaining redundancy control to ensure that each data record is unique and consistent with conventions
- Performing routine virus checks on incoming and outgoing data

The DBMS is comprised of the STSP, VDMS and the Data Warehouse, and will support the storage, analysis, display, and reporting of the Navy's environmental, analytical, and geotechnical data. The DBMS will consist of primary data tables that store the environmental data, dependent tables that store more details related to the data in the primary tables, and look-up tables that store valid values to provide input to the primary tables. The EIS will maintain the table content and the PDL will manage it.

Valid values are critical to any large relational database. Tables 2 and 3 provide examples of valid values for the Navy CLEAN and Joint Venture Programs' sites, stations, and samples. Inconsistencies in naming conventions, subtle analyte or method spelling differences, and the use of non-standard abbreviations can result in lost data and incorrect conclusions. Most tables and forms in the program database will use look-up tables for acceptable valid values and will not allow the entry of data that do not conform.

The primary purpose of managing data in a relational database environment is to ensure that each data record is unique and that the information contained within each field is consistent with conventions defined in other areas of the database. To ensure that each record is unique, a key field or fields will be identified within each data table. The VDMS architecture supports this approach and eliminates the possibility of data redundancy.

NIRIS Database

All Navy CLEAN and Joint Venture data must be loaded into the Navy's own internal database system, the Naval Installation Restoration Information Solution (NIRIS). NIRIS is a web-based centralized database that has been implemented across all Naval Facilities Engineering Command (NAVFAC) offices and will be used by the Navy and contractors to manage, evaluate, and visualize data, documents and records for Navy and the Marine Corps sites. NIRIS manages all Environmental Restoration Program (ERP) analytical and spatial data, which

includes the Munitions Response and Installation Restoration Program (IRP) data, ensuring institutional memory is preserved, land use controls are maintained, and remedial actions are effective.

CH2M HILL will use the VDMS system to track, collect, review, and prepare Navy-related sample and project data for loading into NIRIS. Project data stored in VDMS must be consistent and comparable with data that is loaded and stored within NIRIS. As such, all associations between VDMS and NIRIS valid values, output reports, and data tables will be tracked and maintained.

4.1.2 Data Security Procedures

Some VDMS applications and data are stored in a secure location with login and password protection. Authorized users of the STSP tool and VDMS will have logins and passwords in advance. The PDL will provide security access to these tools. Access2003 must be installed on the computer that the user will be using to run these applications, and proper licenses distributed. Files received from any subcontractors will be scanned for common viruses using industry standard, current virus protection programs. The file servers storing the data must be running current virus software, with automatic virus signature updates.

NIRIS data are stored in a secure location with login and password protection. Users who require access to NIRIS and the data contained therein will need to follow procedures outlined in the SOP Access to NIRIS to procure security certificates, training, and access rights to installation-specific data. Authorized users of NIRIS will be assigned logins and passwords maintained by the Navy. For further information on NIRIS or obtaining NIRIS access, consult with the Critigen Lead or PDL.

4.1.3 Data Backup and Recovery

All project data management files will reside on CH2M HILL's terminal server, "Gaia," and will have a tape backup or equivalent created in accordance with CH2M HILL's network server management policy.

4.2 Sample Collection and Management

Sample control during the sampling phase is required to ensure the integrity of the associated data. Sample control must be maintained and documented from the point of collection through the point of disposal. Sample control will be managed both in the field and in the laboratory, and will be documented through the use of field log books and a Chain of Custody (COC). When custody of a sample is transferred from one party to another, the recipient of the sample assumes responsibility for maintaining control of the sample and documenting that control on the COC. Figure 4 shows the process for planning and executing field sampling events.

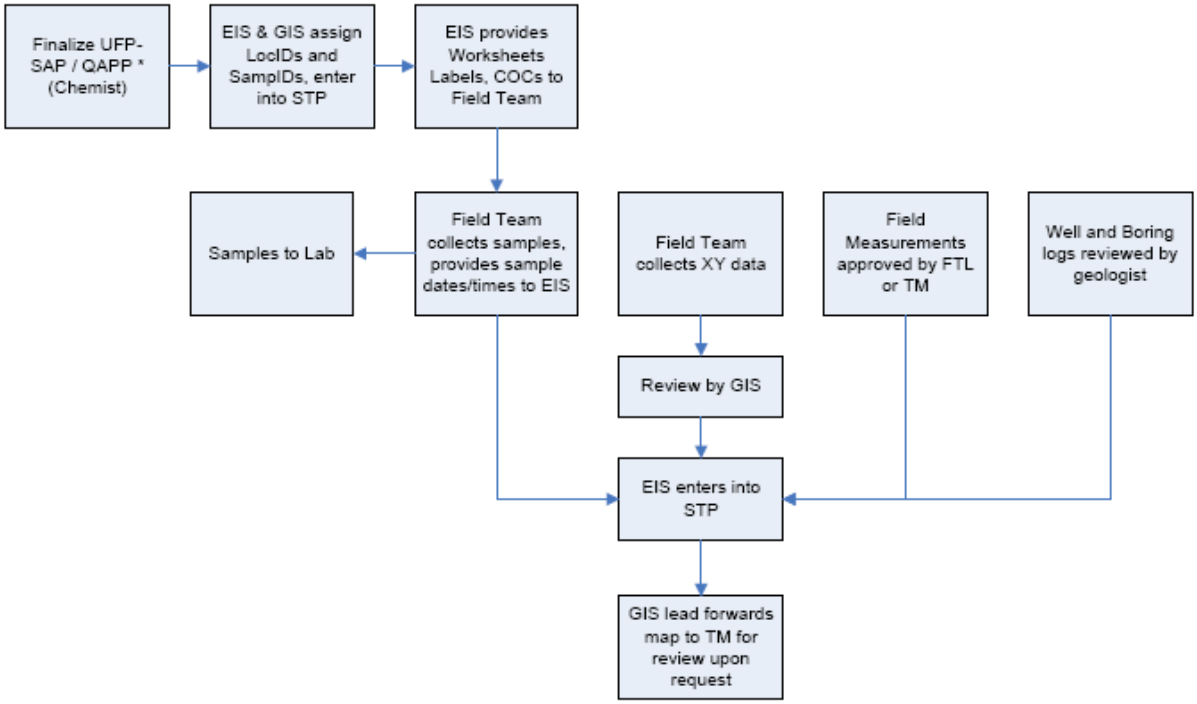


FIGURE 4
FIELD SAMPLING

4.2.1 Sample Tracking Program

During the planning stage, the PM specifies the data requirements for the sampling event. The work plan or similar document will provide project-specific data requirements for a given sampling event. The PC is responsible for reviewing the Sampling and Analysis Plan and ensuring that the FTL is aware of the number of field and laboratory QC samples required for the sampling event (trip blanks, equipment blanks, field blanks, field duplicates, matrix spikes, and matrix spike duplicates). All of this information is to be entered into the STSP.

The STSP tool will be used in advance to develop daily assignments for field crews, identify sampling container and preservation requirements, identify analytical laboratories for samples, print labels for sample bottles before the sampling event, and prepare and print COC forms after sampling is complete.

4.2.2 Sample Nomenclature Guidelines

The following guidelines are provided for sample nomenclature, COC clarification, and eData expectations.

Station ID (Location)

Field station data are information assigned to a physical location in the field at which some sort of sample is collected. For example, a monitoring well that has been installed will require a name that will uniquely identify it with respect to other monitoring wells or other types of sample locations. The station name provides a key in a database to which any samples collected from that location can be linked to form a relational database structure.

Navy Clean		
First Segment	**Second Segment**	
Facility, Site Number	Station Type	Station Number, Modifier
AA,ANN	AA	NNN_A
Notes: "A"= alphabetic "N"= numeric		

Facility:

A = ABL
AN = Anacostia
BA = Bainbridge
BW = Bloodsworth Island
BR = Bremerton
CA = Cheatham Annex
CH = Cherry Point
CI = Craney Island
CL = Camp Lejeune
CP = Camp Peary
CR = Carderock
DA = Dahlgren
DN = Dam Neck
DR = Driver
IH = Indian Head
LS = Little Creek
NA = Naval Academy
NB = Naval Station Norfolk
NM = NNMC (Bethesda Naval Hospital)
NN = Norfolk Naval Shipyard
NR = Naval Research Laboratory
NWA = Northwest Annex
OC = Oceana
PA = Pax River
PI = Pineros Islands
QU = Quantico
RO = Rota
RR = Roosevelt Roads
SI = Sigonella
SJ = St. Juliens
SS = Sabana Seca
VE = Vieques East
VW = Vieques West
WN = Washington Navy Yard
WO = White Oak
Y = Yorktown

Site/AOC/SWMU Number – Sequential Number:

Site = S01, S02, S03…
Site Screening Area = SA01, SA02, SA03…
AOC = A01, A02, A03…
AOI = AI01, AI02, AI03…
SWMU = W01, W02…
Building = B01, B02, B03…
Range = R01, R02…
LIA – LI Area, East Vieques

BSxx = Background locations outside of site (BS25 = Background Site 25)
BKL = Background locations outside of the facility
BKG = Background locations (inside base)

QC and IDW Stations
Site ID (First Segment) followed by –QC or -IDW

Station Type:

AGT = Above Ground Tank
AS = Ash
BH = Borehole
CO = Concrete
DP = Direct Push
DR = Drill Rig
EW = Extraction Well
FG = Frog
FS = Fish
GB = Geotechnical Boring
GP = Geoprobe
GV = Gas Vent
HP = Holding Pond/Lagoon
IDW = Investigative Derived Waste
IW = Injection Well
LW = Leach Well
MA = Alluvial Monitoring Well
MB = Bedrock Monitoring Well
MU = UST Monitoring Well
MW = Monitoring Well (GW for Y)
PC = Paint Chip
PW = Production Well
QC = Quality Control
RK = Rock
RC = Recovery Well
RM = Remediation Well
RW = Residential Well
SD = Sediment Location
SG = Soil Gas
SL = Storm Sewer Line Sediment
SO = Soil Location
SP = Seep
ST = Storm Water
SU = Sump
SV = Soil Vapor
SW = Surface Water
SWS = Surface Water Body (for SW and SD)
UST = Underground Storage Tank
TA = Tap Water
TD = Tidal Station
TI = Tissue Sample (general)
TO = Tadpole
TP = Test Pit
TR = Trench Sediment
TS = Treatment System
TW = Temporary Well
WA = Alluvial Extraction Well
WB = Bedrock Extraction Well
WL = Water Supply Well
WN = Pore Water
WP = Wipe Sample
WT = Water Table Piezometer

Station Number:
Sequential Station Number (i.e., 01, 02, 03…)

Modifier (used selectively):
D = Deep monitoring well
S = Shallow monitoring well

Example Station IDs:

YS01-DP02 = Direct push soil location #2 at Yorktown Naval Weapons Station Site 1
CHR05-MW02S = Shallow monitoring well location 2, at the Cheatham Annex facility, Range 5.
NMBKL-SD02 = Background sediment location #2 located outside of NNMC
CHBS03-SO05 = Soil location #5, located in reference area outside of Site 3 in Cherry Point
VEW04-QC = QC Station at East Vieques SWMU-4
CAA08-IDW = IDW Station at Cheatham Annex AOC-8

TABLE 2

STATION ID SCHEME

Navy Clean			
First Segment	**Second Segment**	**3rd Segment**	**Fourth Segment**
Site ID Facility, AOC Number	Station/Sample Type, Station Number, Modifier	Depth (As Needed)	Date (MMYY) $_A$
AA,ANN	AANNN$_A$	A	NNNN$_A$
Notes: "A"= alphabetic "N"= numeric			

A = ABL
AN = Anacostia
BA = Bainbridge
BW = Bloodsworth Island
BR = Bremerton
CA = Cheatham Annex
CH = Cherry Point
CI = Craney Island
CL = Camp Lejeune
CP = Camp Peary
CR = Carderock
DA = Dahlgren
DN = Dam Neck
DR = Driver
IH = Indian Head
LS = Little Creek
NA = Naval Academy
NB = Naval Station Norfolk
NM = NNMC (Bethesda Naval Hospital)
NN = Norfolk Naval Shipyard
NR = Naval Research Laboratory
NWA = Northwest Annex
OC = Oceana
PA = Pax River
PI = Pineros Islands
QU = Quantico
RO = Rota
RR = Roosevelt Roads
SI = Sigonella
SJ = St. Juliens
SS = Sabana Seca
VE = Vieques East
VW = Vieques West
WN = Washington Navy Yard
WO = White Oak
Y = Yorktown

Site/AOC/SWMU – Sequential Number:

Site = S01, S02, S03…
Site Screening Area = SA01, SA02, SA03…
AOC = A01, A02, A03…
AOI = AI01, AI02, AI03…
SWMU = W01, W02…
Building = B01, B02, B03…
Range = R01, R02…
LIA – LI Area, East Vieques

BSxx = Background locations outside of site (BS25 = Background Site 25)
BKL = Background locations outside of the facility
BKG Background locations (inside base)

Sample Type:
AGT = Above Ground Tank
AH = Air - Headspace
AS = Ash
BH = Borehole
CO = Concrete
DR = Drill Rig
DS = Direct Push—Soil
DW = Direct Push—Groundwater
EW = Extraction Well
FG = Frog
FS = Fish
GB = Geotechnical Boring
GP = Geoprobe
GV = Gas Vent
HP = Holding Pond/Lagoon
IW = Injection Well
LF = Free Product
LW = Leach Well
MA = Alluvial Monitoring Well
MB = Bedrock Monitoring Well
MU = UST Monitoring Well
MW = Monitoring Well (GW for Y)
PC = Paint Chip
PW = Production Well
RK = Rock
SW = Surface Water
RC = Recovery Well
RM = Remediation Well
RW = Residential Well
SB = Subsurface Soil
SD = Sediment Location
SG = Soil Gas
SL = Storm Sewer Line Sediment
SO = Soil Location (Composite)
SP = Seep
SS = Surface Soil
SSD = Subsurface Sediment
ST = Storm Water
SU = Sump
SV = Soil Vapor
SW = Surface Water
UST = Underground Storage Tank
TA = Tap Water
TD = Tidal Station
TI = Tissue Sample (general)
TO = Tadpole
TP = Test Pit
TR = Trench Sediment
TS = Treatment System
TW = Temporary Well
WA = Alluvial Extraction Well
WB = Bedrock Extraction Well
WL = Water Supply Well
WN = Pore Water
WP = Wipe Sample
WT = Water Table Piezometer

Station Number:
Sequential Number (e.g., 001, 002, 003)

Modifier (used selectively):
D = Deep monitoring well
S = Shallow monitoring well
P = Duplicate

Depth:

Use only if applicable. A sequential letter is used to reflect varying depths, as actual depths can change in the field after sample planning has occurred. E.g. A, B, C…

Sample Number:

1. Duplicate Samples - Use a 'P' modifier in the second segment of the sample ID, directly after the location number to indicate a duplicate sample. E.g. AB01-MW11P-0506

2. MS/MSD Samples – Append a modifier of '-MS' for matrix spike or '-SD' for matrix spike duplicate to the end of the sample ID.

3. QC & IDW Samples (Blank Samples & Waste Char.) - Format consists of Facility, AOC Number, Qualifier Code, Sequential Qualifier Number-Date (AAANN-AANN-MMDDYY). E.g. LSA05-TB02-061106

Qualifier Codes:
TB = Trip Blank
FB = Field Blank
EB = Equipment Blank
WQ = Source Blank
WS = Waste Char. Soil
WW = Waste Char. Water

4. Drill Rig Samples – Format consists of Facility, AOC Number, Station Type, Station Number, Date. E.g. YS12-DR02-020507

5. Multiple samples - Should multiple samples be collected from the same location in a given day/month (affects only samples not differentiated by depth), a sequential letter will be added to the end of the fourth segment (date). E.g. A, B, C…

Example Sample IDs:

WNA01-MW102S-0105A = The first shallow groundwater sample collected at monitoring well location 102 in January 2005 in AOC01 at the Washington Navy Yard facility.
PIW01-SW023P-0306 = Pineros Island duplicate surface water sample collected at location 23, at SMWU-1 in March 2006.
SSW06-FB01-061106 = The first field blank collected on June 11, 2006 at SMWU-6 in Sabana Seca.

TABLE 3

STATION ID SCHEME

Before beginning fieldwork, the FTL will review the proposed level of effort and coordinate a list of unique station identification names, or station IDs, with the PDL or EIS. The FTL will be responsible for enforcing the use of the standardized ID system and agreed upon station IDs during all field activities.

Each station will be uniquely identified by an alphanumeric code that will describe the station's attributes. These attributes are facility, Area of Concern (AOC)/Site/Operable Unit (OU) number, station type, sequential station number, and possibly an additional qualifier as needed. The naming scheme to be used for the identification of a sampling station is documented in Table 2.

For example, if the first sample location at next month's event within Yorktown Site 30 is at a soil location, then the location ID could possibly be YS30-SO391 because that was the next available sequence number for soil locations. This should also be reflected in the Sample ID. QC and IDW station IDs must be established for each site that they are associated with.

Please consult with the PDL or EIS should any questions arise. This will avoid complications that could occur if a station is mislabelled and ensure there are unique identifiers for every sampling location. Required deviations to this format in response to field conditions will be documented in the field logbook.

Sample ID

Field sample data are information assigned to a physical piece of material collected in the field for which some sort of analysis will be run. Before collecting samples, the FTL will review the proposed level of effort and coordinate a list of unique sample identification names, or sample IDs, with the PDL or EIS. The FTL will be responsible for enforcing the use of the standardized ID system and agreed upon sample IDs during all field activities.

Each sample will be uniquely identified by an alphanumeric code that will describe the sample's attributes. These attributes are facility, Area of Concern (AOC)/Site/Operable Unit (OU) number, sample/station type, sequential station number, modifier (as needed), depth (as needed), date, and date modifier (as needed). The naming scheme to be used for the identification of samples is documented in Table 3.

The standardized ID system will identify all samples collected during sampling activities. The system will provide a tracking procedure to ensure accurate data retrieval of all samples taken. For example, a surface soil sample collected from station YS30-SO391 reference above in June of 2009 will result in a sample ID of YS30-SS391-0609.

Please consult with the PDL or EIS should any questions arise. This will avoid complications that could occur if a sample is mislabelled and ensure there are unique identifiers for every sample. Required deviations to this format in response to field conditions will be documented in the field logbook.

4.2.3 Sample Collection

A photocopy of each field logbook page completed during sampling and of each COC will be made by the FTL and forwarded to the EIS at predefined intervals during sampling events. This information will serve as notification to the EIS of samples being shipped to an offsite lab and of the field crew's sampling progress.

Communication with field and laboratory staff will occur daily during the field event. The EIS will resolve issues that arise in the field (i.e. bottle ware shortage, equipment failure, etc). The lab will be informed of the shipment dates and the number of coolers or samples being sent. Laboratory login reports will be reviewed to ensure samples were received in good condition (i.e. no breakage, within holding time, within designated temperature). The field crew and PM will be notified if there were problems with shipment.

4.2.4 Chain-of-Custody and eData

A single COC number per project / laboratory / cooler should be generated each day (there can be multiple pages to one COC number). MSs and MSDs will be requested at a set frequency for each project (usually one per 20 samples collected). MS and MSD samples should not be taken from field duplicates (FDs) or field blanks. FDs will be requested at a set frequency for each project (usually one per 10 samples). FDs should not be taken from MSs, MSDs, or field blanks. The MS and MSD samples listed on the COC should be spiked and analyzed by the laboratory.

A 100% QC will be performed on COCs received from the field crew. The field crew and/or lab will be notified if corrections need to be made to the COCs or lab login reports. Any corrections or modifications made will be noted in a Corrections-To-File Letter.

Once the field data and samples are collected, information on sampling date and time are to be entered into the STSP by the EIS, and as necessary field measurements, such as water levels and other data collected in the field also should be entered. Any data entered into the STSP must be exported into an excel file to facilitate a manual QC review of the data. The correction of any anomalies should be verified with the PM and PC. The information entered into the STSP will be exported into CH2M HILL's VDMS where field data and laboratory analytical data are linked by location and sample ID. This allows verification that all sample and method combinations have been received and reported by the laboratory.

4.2.5 Sample and Document Tracking

A Sample Tracking Sheet (STS) will be generated from the sample information entered and QC'd in the STSP. The STS should be updated and kept current throughout the data management process. All samples collected, resulting deliverables, and deliverable dates will be tracked throughout the data management process to ensure that the project schedule is met and subcontractor invoices are evaluated correctly.

All documentation acquired during the data management process, including Statements of Work (SOWs), Bids, COCs, Field Notes, Sample Tracking Sheets, Login Reports, Corrections-to-File Letters, FDETool QC tables, Post Load Reports, Invoices, and Communication Logs shall be compiled throughout the process to be stored in the appropriate Activity's Project Notebook.

4.3 Laboratory Analysis

Figure 5 shows the laboratory analysis process. Upon receipt of samples from the field, the laboratory will check that the COC forms correctly cover all samples submitted. Each COC

form must be signed with the date and time of receipt by the laboratory. Samples will be logged in by the laboratory using information from the COC forms and the project instructions.

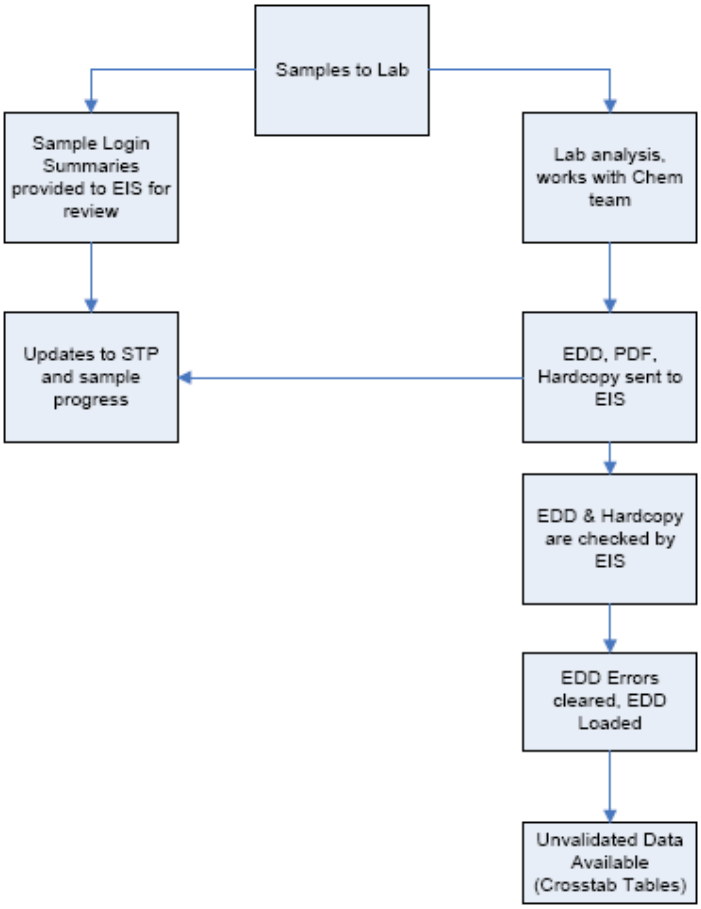


FIGURE 5
LABORATORY ANALYSIS

Samples will be analyzed as specified on the accompanying COC forms and in the Laboratory SOW. Generally, questions or noted inconsistencies identified by the laboratory should be addressed directly to the EIS.

The laboratory will attach the signed COCs to their hard copy data deliverables to officially relinquish control of the data back to the Environmental Contractor within the specified turn around time.

Hard copy data and EDDs will be reviewed to ensure that they are complete and acceptable as outlined in the EIS QC For Unvalidated Data Checklist. A 10% QC check will be performed on the analysis results to ensure that the hard copy data matches the EDD. All detected errors should be resolved with the laboratory.

Preliminary raw and detects tables will be generated following data import into VDMS by querying data with the VDMS XTab Tool and formatting the output with the Crosstab Cleanup and Raw, Detects, and Exceedance Formatting Tools. A separate table must be created for each matrix, and provided to the PM for review.

Data archiving forms will be generated and affixed to each laboratory report received per Sample Delivery Group (SDG) for cataloguing, tracking, and archiving purposes.

The tools used to QC the laboratory's EDD are as follows:

- **CH-Analyzer**: Before the laboratory analytical data is entered into VDMS, the laboratory EDD must be processed through CH2M HILL's CH-Analyzer Microsoft Access database application. The CH-Analyzer application includes several automated diagnostic checks to verify format and content compliance with EDD specifications. The analytical laboratory must correct any errors before transmitting the EDD to CH2M HILL. The laboratory will forward the CH-Analyzer report, checked EDD, and hard copy of the data to the EIS who will manage the EDD verification process and data entry to VDMS.
    - The EDD will be checked again using CH-Analyzer to verify correct format and content. If errors are found, the file will be returned to the laboratory for correction and re-submittal. Even if the formatting of the EDD is completely correct, the data loader may reject the EDD if the contents of the file do not comply with the data library standardization requirements.
    - The CH-Analyzer also should be used to compare COCs, hard copy, and EDD content, and resolve discrepancies and document data error issues (for example, EDD re-submissions, turnaround time problems, hard copy incompleteness). These checks ensure the consistency and the validity of the EDD's content before the data are electronically transferred to VDMS. The objective of using the CH-Analyzer is to ensure that the validation process is performed on consistently high-quality data and minimize the chance of finding data errors later in the validation process, which would require the laboratory to resend corrected data and start the validation process over again.
- **VDMS**: Once the EDD verification is complete, it is electronically transferred into CH2M HILL's VDMS tool for data quality verification and validation according to project specifications. During import, the data are checked against a list of valid values. Once all error messages are resolved, validation can begin.

4.4 Data Validation

The data validator will be notified by the PC in advance of when to expect data and of any samples or analyses that should not be validated. (i.e. grain size should not be validated). For internal data validation, the EIS will notify the PC of data availability, and provide the hardcopy data and a QC Association Table.

Upon receipt of data from CH2M HILL, data validation will be performed in accordance with the Data Validation SOW, UFP SAP, and any other documents required. Generally, questions or noted inconsistencies identified by the validator should be addressed directly to laboratory, with the PC notified of issues and resolutions identified.

4.4.1 External Data Validation

For external data validation, a subset of the analytical data will be loaded into the third Party DV Tool, a CH2M HILL Microsoft Access database designed for external data validation. The tool will allow external data validators to configure various with tables with QC information, associated validation logic, and qualifiers applied when QC criteria are not achieved. Qualifier criteria will be based on the Quality Assurance Project Plan.

The hard copy data, third Party DV Tool, and a QC Association Table will be provided to the data validator. The PC will coordinate the return of the data package to CH2M HILL for archiving with the data validator.

Data Validators will provide the following materials to the PC within the required turn around time:

- Hardcopy Data Validation Report
- Validated Version of 3rd Party DV Tool (external validation)
- Validated Version of Data in VDMS (internal validation)

Once returned to CH2M HILL, the data in VDMS will be updated with the results in the 3rd Party DV Tool. The validated data will be reviewed by the PC to ensure that they are complete and acceptable as outlined in the VDMS and Chemist PreLoad Checklist. A 100% QC check will be performed on the validated results to ensure that the hard copy data matches the EDD. All detected errors should be resolved with the data validator.

Data archiving forms will be generated and affixed to each Data Validation Report per SDG received for cataloguing, tracking, and archiving purposes.

Validated raw and detects tables will be generated by querying data with the VDMS XTab Tool and formatting the output with the Crosstab Cleanup and RDE Formatting Tools. A separate table must be created for each matrix, and provided to the PM for review.

4.4.2 Internal Data Validation

VDMS will be operated in a semi-automated mode, which will require the chemist to configure various with tables with QC information, associated validation logic, and qualifiers applied when QC criteria are not achieved. Qualifier criteria will be based on the Quality Assurance Project Plan. A hardcopy data validation report will be generated. Data archiving forms will be generated and affixed to each Data Validation Report per SDG validated for cataloguing, tracking, and archiving purposes

Validated raw and detects tables will be generated by querying data with the VDMS XTab Tool and formatting the output with the Crosstab Cleanup and RDE Formatting Tools. A separate table must be created for each matrix and provided to the PM for review.

4.4.3 Unvalidated Data Preload Check

Occasionally, unvalidated data will need to be loaded into the database. Although this data will not be validated, it will undergo a basic Preload Check by the PC to ensure laboratory

compliance with project guidelines and determine results to be reported as the best result where multiple runs were conducted for a given sample/analysis. The PCL will provide input and oversight to ensure that data flags are applied correctly by the PC.

4.4.4 Senior Review

The PCL will verify that the validated hardcopy data and data contained in VDMS are complete and acceptable. Any identified discrepancies will be resolved with the assistance of the PC, EIS, laboratory, or validator as needed.

4.5 Data Preparation and Loading

Once the data are validated and approved by the PCL, they are exported from VDMS to the project warehouse. Field and laboratory data are merged into a format that is amenable to the warehouse. The backbone is a SQL-server-based data warehouse.

4.5.1 Data Preparation

As part of the normal process of loading data into the warehouse, data standardization tasks must be completed. A Database Specialist (DBS) will load data into the warehouse using the following two programs: CH-ERPTool and CH-IMPTool. The CH-ERPTool runs an extensive series of logical QC checks and formats the data to be compatible with the data warehouse structure.

4.5.2 Data Loading

CH2M HILL Loading

The CH-IMPTool runs an additional series of QC checks and adds project-specific formatting and valid values, and loads the data into the warehouse. The following tasks need to be completed to load the data for project use:

- **Unit Standardization:** Analytical units and the associated results, reporting limits, and method detection limits will need to be converted to a consistent set of units as required by the project.
- **Resolve Reanalysis and Dilutions:** All samples that had an associated reanalysis or dilution run by the laboratory must have all of the excluded or rejected results marked as not the best result for reporting.
- **Resolve Analytical Overlap and Split Samples:** Analytical overlap occurs when a sample is analyzed by two or more methods that report the same analyte. To resolve this, the following logic is used to select the usable result:
  - If the overlapping results are all non-detections, the lowest non-detection result is selected.
  - If the overlapping results are all detected, the highest detected result is selected.
  - If the overlapping results consist of a mixture of detections and non-detections, the highest detected result is selected.

When data are loaded into the warehouse, an automated script will run to identify the "best" result when more than one analytical result exists.

NIRIS Loading

All Navy CLEAN and Joint Venture data must be loaded into NIRIS. Following the successful loading of data into the data warehouse, the DBS will use the NEDD Creator Tool to generate project NIRIS Electronic Data Deliverables (NEDD) files.

The DBS will use NIRIS's Data Checker Loader Tool to QC and submit the project NEDD files into NIRIS. The NIRIS Regional Database Manager (RDM) will load the data into NIRIS, and will work with the DBS to resolve any potential issue that may arise during loading. Following notification of successful data loading from the RDM, the DBS will query the data from NIRIS for review to ensure data integrity and accuracy.

4.5.3 Data Warehouse

The data warehouse is a Microsoft SQL Server 2005 relational database. This database, and all other "CH" tools used, has a data structure designed to achieve compliance with the Environmental Restoration Program Information Management System (ERPIMS) standard specified by Air Force Center for Engineering and the Environment (AFCEE). ERPIMS is an effective, comprehensive standard for environmental management.

The warehouse will use valid value tables when applying reference attributes to project data. Such reference data include the names of site objects and sampling locations, sampling matrix and method categories, analyte names, units. These reference tables are critical for maintaining the completeness and accuracy of data sets and are essential for accurate querying of the data.

Data are loaded and stored so that relationships among categories of data are enforced. For instance, all sampling records must be associated with a valid site object such as a planned sediment sampling location. The project repository database and collection, analysis, and reporting tools used in the DBMS are designed to enforce, for any project data record, entries in fields that refer to other types of data as required by the overall data model.

The data warehouse will automatically update the SIMS application whenever data are added or changed.

4.6 Data Reporting

Data reporting includes the following tasks:

- Retrieving data from the data warehouse for project deliverables, data visualization, or consumption by third parties
- Reviewing initial data and producing data queries and draft reports to dissect and disassemble the data
- Producing any requested client and regulatory agency data deliverables

Data for project deliverables, data visualization, or consumption by third parties will be retrieved from the warehouse, and will be equivalent to the real-time state of the project

repository database. PMs and GIS Analysts (GAs) will work with the EIS and PCL for quality queries and data for reports.

4.6.1 Tables, Figures, and Diagrams

Once the data have been sufficiently analyzed, the list of requested data reports (tables, figures, diagrams) can be developed and finalized by the project team and submitted to the PCL and PM for review.

All requests for figures or graphics are to be directed to the GA assigned as the Point of Contact (POC) for that particular Navy installation. All requests for analytical data (crosstab tables, data dumps, third party deliverables etc) should be directed to the EIS assigned as the POC for that particular Navy installation. The EIS will generate a data deliverable from the data warehouse or NIRIS (as needed) suitable for end use and will provide data support to the end user. All requests for data statistics and calculations should be directed to the Risk Assessor assigned to the project.

4.6.2 GIS

The Navy CLEAN program will utilize ESRI's suite of GIS software for the majority of GIS-related tasks. The GIS data model will consist of one or more geodatabases (GDBs) per installation. Each installation will maintain one common installation GDB, which will store the common infrastructure data such as buildings, roads, topography, hyrdography, utilities, etc.. The common installation GDB should adhere, as much as possible, to the Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE) data model. All project specific GDBs shall be developed and named for ease of interpretation by the GA.

All station location information for each installation will be pulled directly from the data warehouse and stored in the common installation GDB as a data table. The data warehouse must contain valid coordinate information for the locations to be displayed correctly. Valid coordinate information will be maintained in the data warehouse by the EIS, and updated as necessary by the DBS.

ESRI's ArcMap 9.3 (or the latest version available) will be utilized for spatially displaying the environmental data within maps and figures, as well as for spatial analysis. The GA will need to coordinate efforts with the EIS on all requests that require the display of environmental sample data on a map to ensure that the appropriate data is queried from the data warehouse and linked to the appropriate station location table within the GIS.

4.6.3 Site Information Management System

This is currently not being used on the Navy CLEAN and Joint Venture Programs.

SIMS is a tool for publishing data of sufficient quality from the project. However, the project data warehouse will remain the database of record for the project.

SIMS provides many standard report formats, all of which are used in conjunction with the Query Tool feature, to isolate and retrieve information. Users can generate and save their queries using a graphical point-and-click tool. Reports in a wide variety of formats also can be requested and produced.

4.6.4 Legacy Data

Legacy data are those collected from any contractor other than CH2M HILL and data collected by CH2M HILL that have not been managed in accordance with Navy CLEAN and Joint Venture Program requirements. Legacy data are commonly compiled from various electronic and hard copy sources including spreadsheets, databases, technical reports, and laboratory hard copy data reports. When working with legacy data, usability assessment must be completed for the project team to be able to use the data with confidence. In order to assess the data properly, the legacy data needs to be evaluated by skilled professionals that are familiar with the type of data being evaluated so that any errors identified in the data can be corrected when possible or qualified in a manner to reflect the limitations of the data's use.

The PM has overall responsibility for the selection for inclusion of legacy data into the data management process. The PDL and PCL will work with the PM to establish the data review and import process, compile a comprehensive data inventory, and identify staff to facilitate data review.

The PDL and PCL will work with the EIS to determine the appropriate intermediary files and tools used to collect the data. The PDL and PCL will oversee the data review and flagging process and approve the data for upload into the Data Warehouse. The EIS is responsible for assembling the field and laboratory data in formats that facilitate data review, aid the PDL and PCL in overseeing the data review and flagging process, schedule, conversion of the data to the proper data warehouse format, and then loading the data into the Data Warehouse after approval by the PDL and PCL.

The GA, PDL, PCL, and PM have the primary responsibility for reviewing the data in their area of expertise and providing the PCL with data usability flags to be associated with each record.

SECTION 5

Project Closeout

The project completion/closeout phase includes the following:

- Archive hard copy and electronic documents
- Conduct project closeout meeting

5.1 Archive Procedures

A large variety of technical data will be generated during the field investigations. The EIS and PC will collect all hard copy and electronic data they are responsible for and verify that the incoming records are legible and in suitable condition for storage. Record storage will be performed in two stages:

- Storage during the project
- Permanent storage following project completion

During the project, CH2M HILL will store data hardcopy reports in CH2M HILL offices. Physical records will be secured in steel file cabinets or shelves, and labelled with the appropriate project identification. Electronic data will be maintained on CH2M HILL's corporate local area network servers.

Information generated from field activities will be documented on appropriate forms and will be maintained in the project file. These include COC records, field logbooks, well construction forms, boring logs, location sketches, and site photographs. In addition, notes from project meetings and telephone conversations will be filed.

Following project completion, both hard copy and electronic data deliverables will be archived. Team staff will provide all hard copies of laboratory and validation reports to the Data Closeout Coordinator to be prepped and shipped to Stone Mountain for archiving. Final laboratory EDDs and loading files will be provided to the PDL, to be archived on CH2M HILL's corporate local area network servers.

Any modifications made to the tools will be communicated to the project team via e-mail. As revisions are finalized, they will be distributed electronically to all users. After revision, it is the user's responsibility to conform to revised portions of the DMP.

5.2 Invoice Review and Approval

The EIS is responsible for tracking all data deliverables throughout the data management process to ensure that the project schedule is maintained, subcontractors comply with all required turn around times, and data provided are complete and acceptable. Following project completion, EISs are to review and provide comments on all laboratory and data validator invoices regarding data quality and schedule compliance prior to approval by the PM.

5.3 Project Closeout

At the end of each project, the PM will notify team staff of project closeout. The PM will coordinate and verify that all pertinent data has been archived. The PM may also review lessons learned, suggest process improvements, or revisions to the DMP and other project documentation as deemed necessary.

Appendix A
Workflow Process

Environmental Data Management Work Process

1.0 Project Planning & Setup	2.0 Sample Collection & Management	3.0 Lab Analysis	4.0 Data Validation	5.0 Data Management	6.0 Data Evaluation & Reporting
1.1 Project Setup	2.1 Sample Management	3.1 Sample Analysis	4.1 Internal Chemical Data Validation	5.1 CH2M HILL Data	6.1 Data Prep & Processing for Reporting
1.2 QAPP, SAP, DMP, DQOs Integration	2.2 Sample Collection	3.2 EDD Management	4.2 External Chemical Data Validation	5.2 Other Contractor & Legacy Data	6.2 Tabular Data Queries & Reports
1.3 Laboratory Setup	2.3 Sample Data Management	3.3 Hard Copy Management	4.3 Senior Review of Validated Data	5.3 Database Maintenance & Administration	6.3 Field Logs and Graphs
1.4 Database Setup					6.4 GIS Queries and Maps

Appendix B
Life of a Sample

A Sample's Life

Step-by-Step Outline of Navy CLEAN and JV Data Management Process, and Roles & Responsibilities

Step 1

Planning Phase

- Staffing Schedules
- Kickoff Meeting – Include the EIS & PC
- Project Instructions (PIs)
  - Sample Nomenclature provided in table
  - Reviewed by DMC (Chelsea Bennet) or Database Specialist

Step 2A

Sample Collection

- Daily collection and shipments of samples
- One COC/cooler; One FedEx slip/cooler
- Coordinate w/ EIS for tracking & Lab notification
- GPS conducted (if applicable)

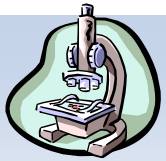
Step 2B

Sample Tracking

- EIS cross checks COC against PIs
- Also reviews lab confirmation sheets to verify all samples were received and in appropriate condition

Step 3

Lab Analysis



- Standard 28-day unless otherwise arranged
- EIS reviews data for accuracy and works with lab to resolve discrepancies
- EIS tracks schedule and keeps PM informed
- EIS inputs STSP information from Log Books
- EIS can generate Unvalidated Raw and Detects Data Tables

Step 4

Data Validation

- PC reviews all data for accuracy against the PIs
- PC sends data from lab to Data Validator
- Delays may occur if there is missing data or data is late from the lab\
- EIS can generate Validated Raw and Detects Data Tables

Step 5

Data Load

- PCL sends data to Database Specialist to be loaded into the Data Warehouse (DW)
- (Sometimes this involves assistance from PM, FTL, PC, and/or EIS)

Step 6

Quality Assurance/ Quality Control

- EIS & PC are notified that data is loaded
- EIS verifies info loaded is correct (Sample, Station, Analyses, Result)
- EIS then helps decide whether info needs to be updated or not
- File and archive all Lab and DV deliverables

Step 7

Report Generation

- Raw, Detects, Exceedance Reports
- Data Requests
- Exceedance Reports (criteria needed prior to this step and selected by PM)
- Human Health Risk Assessment
- Eco Risk Assessment

End of our Sample's Life?

- Data may be used in reports, posted on web, put into GIS, etc
- In that regard, a sample's life doesn't really ever end!
- Hopefully our sample had no exceedances and everyone is happy.

Appendix C
Standard Operating Procedures

Checklist - EIS Project Startup Questions

Project Information

CTO / TO: _____ Base/Site: _____

PM: _____ FTL: _____

Chemist: _____

Project Number(s): _____

Lab: _____ TAT: _____

DV: _____ TAT: _____

Startup Information

Project Instructions? Y or N

Kick off meeting? (If not, check with the PM to discuss sampling event) Y or N

Sampling Schedule: _____

Field Team/Contact Info: _____

Project Schedule/Report Due? _____

Pre Sampling

Bottle Order: Due _____ Ordered? Y or N

Sample Table Generation? _____

Sample Label Generation: _____

Field QC Sample Collection/Specs: _____

STP and VDMS Setup by Chemist: _____

Lab and DV Contracts: □ Provided □ TBD

Sampling

Provision of Field Logbook: □ Daily □ Weekly □ End of Event

Provision of COCs: □ Daily Paper □ Daily Email

Provision of Station Coordinates? □ End of Event by GIS □ End of Event by FTL

Notes

_____

_____

_____

_____

_____

Data QC Checklist - SNEDD

Sample Tracking Sheet/Lab Login Reports (EIS)

☐ Compare COCs and STS to the Project Instruction tables to verify that the COCs and Lab Logins reflect all requested analyses. Check with PM/Lab if there are any discrepancies.

Unvalidated SNEDD and Hardcopy Data QC (EIS)

☐ Save SNEDD as a tab delimited Text File. Import the text file into a new xls file, indicating that EVERY column present is a Text field. Replace original Lab SNEDD with the newly formatted SNEDD.

☐ Electronic Data QC

- ☐ Import SNEDD into the SNEDD QC Tool. Click on each button on the Unvalidated side of the tool. Correct all identified issues in the SNEDD xls file, and save the updated copy.
- ☐ Review SNEDD and ensure the following are correct:
  - ☐ Compare the analyses reported in the SNEDD to the STS to very that the lab has reported all requested analyses for each sample. Resolve any discrepancies with the PM/Lab/Chemist.
  - ☐ Sample IDs match the STS exactly.
  - ☐ Contract ID, DO_CTO_Number are correct.
  - ☐ Correct units are reported for the solid/aqueous matrices

☐ SNEDD to Hardcopy QC. Perform a 10 - 20% comparison check on each analysis group to ensure that the hard copy data matches the SNEDD. Verify results for reextraction/reanalyses are reported in Hardcopy and SNEDD. Resolve any discrepancies with the Lab/Chemist.

☐ Affix Lab Data Archiving Form to laboratory hardcopy report.

☐ Provide copies of Unvalidated Raw and Detects tables to PM for review.

Validated SNEDD and Hardcopy Data QC (PC)

☐ Save SNEDD as a tab delimited Text File. Import the text file into a new xls file, indicating that EVERY column present is a Text field. Replace original Validated SNEDD with the newly formatted SNEDD.

☐ Electronic Data QC. Import SNEDD into the SNEDD QC Tool. Click on each button on the Validated side of the tool. Correct all identified issues in the SNEDD xls file, and save the updated copy.

☐ SNEDD to Hardcopy QC. Perform a 100% comparison check to ensure that the hard copy data matches the SNEDD. Verify that the validator has copied over all non-detects from the Lab_Qual the DV_Qual column. If errors are found, inform the PM and coordinate with the validator to correct the data.

☐ Affix Validation Data Archiving Form to Validation hardcopy report.

☐ Provide copies of Validated SNEDD to EIS for validated table generation.

Senior Review and QC (PCL)

☐ Save Final SNEDD as a tab delimited Text File. Import the text file into a new xls file, indicating that EVERY column present is a Text field. Replace original Final SNEDD with the newly formatted SNEDD.

☐ Electronic Data QC. Import SNEDD into the SNEDD QC Tool. Click on each button on the Validated side of the tool. Correct all identified issues in the SNEDD xls file, and save the updated copy.

☐ Update SNEDD to indicate results that should be Excluded from reporting in the database (ie. R flagged results due to dilution/re-extraction should be marked as Exclude)

Checklist – Generating Raw, Detects, and Exceedance Tables - SNEDD

SNEDD Prep for Raw and Detects Tables for Unvalidated or Validated Data

1. Combine SNEDDs into one SNEDD, and save file as "Combined Unval EDD for Tbl Macro".
2. Remove Lab QC data from the SNEDD – Filter for records that do not equal TRG in the field Analysis_Result_type, and delete records. Filter for records that do not equal REG in the field Lab_QC_Type, and delete records.
3. Select and Open "Raw & Detects Tables From Unvalidated or Validated EDD - SNEDD format – 20081014.xls". When prompted, select Enable Macros.
4. Filter out samples in the SNEDD by Site and Media
5. Copy and Paste filtered records from the SNEDD into the worksheet "DATA" the correct formatting macro. Make certain that the column formats match.
6. Indicate validated records by updating the field "Valid_YN" on the "DATA" worksheet
7. Select Input Options
    a. Indicate validation status of the data, and enter header text for the data table.
8. Run Macro
    a. Select Tools / Macro / Macros.
    b. Select and run each macro in the following order: "CROSSTAB", "RAW_FORMATTING" and "DETECT_FORMATTING".
9. DO NOT SAVE DATA INTO THE MACRO!
10. Move formatted tables to a new workbook
    a. Highlight both worksheets "Raw" and "Detects".
    b. Right click one of the worksheets
    c. Select "Move or Copy"
    d. Select "Move to New Book", and click "OK"
11. Additional Table Formatting
    a. Ensure that Borders, Column Header Fonts, and Notes section look correct.
    b. Select File / Page Setup
        i. Page - Format tables to 11 x 17 paper, landscape orientation, 80 % size
        ii. Set Margins to: Top = 1.33, Left = .75, Bottom = .5, Bottom Footer = .35, Right = .5
        iii. Header/Footer
            1. Ensure appropriate header format. Ex. TO-45, NSN-CALF, Unvalidated Groundwater Raw Analytical Results, March 2006 LTM
            2. Ensure appropriate footer. Only page number should be displayed in the right.
        iv. Sheet – Ensure Gridlines is not selected.
12. Repeat for each Site and Media.

DW Crosstab Tables (Final Loaded Data)

1. On Gaia Desktop, download XTabReports, Navy_RDE_Formatting_Tool, and Navy_Crosstab_Cleanup_Tool.
2. Query Unvalidated or Validated Data from the DW
   a. Select Installation. Click 'Update Links', 'Use Current Links', 'Continue'
   b. Create Excel Crosstabs
   c. Select Subset
      i. Specific Project Tables: Enter name of Project from STSP and Matrix. Move 'Y' from Best_Result to Best_Result_N_FD. Click Save. **Generate separate tables per Site and Media.
      ii. User Defined Tables: Enter filtering criteria to obtain user-defined sample set. Move 'Y' from Best_Result to Best_Result_N_FD. Click Save. ** Generate separate tables per Site and Media.
   d. Build List of Available Reports
   e. Select Reports for Export. Check the box next to the displayed record
   f. Select Display Options:
      i. Show All Data
      ii. Combined Result and Flag, append all selected Screening Levels
      iii. Show Result Value with R Flag
      iv. Reduced to N/FD level or above
      v. Bold Detects, Shaded Exceedances
      vi. To combine matrices, select 'Combine all selected Sites and Matrices'
   g. Manage Screening Levels
      i. Click: Refresh Screening Levels. Select requested screening levels from list.
      ii. Click: Review Screening Levels. Ignore any checked boxes here.
      iii. Click: Upload Screening Levels to Warehouse – IGNORE Units
   h. Click: 'QC Selected Data Units'. This will list any units in the dataset that do NOT match criteria units. If any items are listed, you will need to fix your units.
   i. Export Reports.
      i. Close ALL xls programs and Click button. Indicate location to save output file.
      ii. Enter Project Name and Report Title. Click 'Export Reports'.
      iii. Data Output is only ready once 'Done' box is displayed.
3. Format XTabReports Output File to Navy CLEAN Standard Format
   j. Open Navy_RDE_Formatting_Tool. Follow instructions in RDE Formatting Tool.
   k. Save copy of Raw, Detects, and Exceedance (if needed) worksheets to new xls file.
   l. Page Setup
      i. Page – Verify page format to 11 x 17 paper, landscape orientation, 80 % size
      ii. Set Margins to: Top = 1.33, Left = .75, Bottom = .5, Bottom Footer = .35, Right = .5
      iii. Header - Ensure appropriate header format. Ex. TO-45, NSN-CALF, Unvalidated Groundwater Raw Analytical Results, March 2006 LTM

13. Repeat for Each Site and Matrix

Archive File and NIRIS Load Prep

1. Combine SNEDDs into one SNEDD. Three file versions can be generated (I. EnDat Archive EDD, II. EnDat Load EDD, and III. NIRIS NEDD)
2. Open the ALPTool, and follow the directions and buttons listed in steps 1 through 4
    a. Step 1 – a) Click on the button 'Prepare ALPTool'. b) Click on the folder button, selected the SNEDD file to be imported from the appropriate director, and click on the button 'Import SNEDD'
        i. If File will not import, clean the SNEDD file: Save the SNEDD as a tab delimited text file. Open a new excel workbook. Go to Data/Import External Data/Import data, and follow the wizard to import the text file into excel. When selecting the fields to import, be sure to specify the formatting type for each as Text. Save the new file, and return to step 1a.
    b. Step 2 – Click on the button 'Check Analyte IDs'. If any records are listed in the pop up, resolve any incorrect analyte IDs.
    c. Step 3 – a) Click on the button 'Archive EDD'. Follow the directions in the pop up to save the file. B) Click on the button 'Load EDD'. Follow the directions in the pop up to save the file.
    d. Step 4 – Click the button 'NEDD'. Follow the directions in the pop up to save the file. Click the button 'Close' to close the entire application.
    e. Save Files
        i. Save the Archive EDD. Ex file name = CP_CTO-74_Site-30_SD_May-07_ARCHIVE_EDD
        ii. Save the Load EDD. Ex file name = CP_CTO-74_Site-30_SD_May-07_LOAD_EDD
        iii. Save the NIRIS EDD. Ex file name = CP_CTO-74_Site-30_SD_May-07_NIRIS_NEDD
3. Open the FDET, and generate Field NEDDs
    a. Click on Reports in upper tool bar, and select each NEDD Report to be generated for your project
    b. After each report opens, click the 'hidden' button in the upper tool bar, and select Tools / Office Links / Analyze it with Microsoft Excel. Save each Field NEDD in xls.
4. Submit 2 separate zip files for each project to the DMC for archiving:
    a. DW Archive File: Final SNEDD, EnDat Archive EDD
    b. NIRIS Archive File: Final SNEDD, Field NEDDs (from FDET), Analytical NEDD (from ALPTool)
5. Submit NIRIS Archive File to DBS to be loaded into NIRIS

SNEDD Data Management Checklist

Project Start Up

☐ **Attend Kick-off Meeting.** (Review project instructions, assign sample nomenclature, go over the EIS level of effort needed and budget with PM).

☐ **Aid in field preparation.**

- PC: Setup SOWs with labs/validators and provide copies to EIS.
- EIS: Generate laboratory bottleware order, sample tables, and sample labels/COCs if requested. Inform lab of sampling schedule. Coordinate sample delivery to the lab (pick up, overnight, drop off) and frequency; ensure lab is aware of the required turn around times.

☐ **Communication with field staff and lab during field event.** EIS: Communicate with field staff daily. Help resolve issues that arise in the field (bottle ware shortage, equipment failure, etc). Inform the lab of the shipment dates and the number of coolers or samples being sent. Ensure samples were received in good condition (no breakage, within holding time, within designated temperature). Notify field crew and project manager if there were problems with shipment.

☐ **Sample Tracking.**

- EIS: Receive COCs from field crew: Perform a 100% quality check of the chains of custody (COC). Inform field crew and/or lab if corrections need to be made.
- EIS: Create a Sample Tracking Sheet and update it as samples are collected.
- EIS: Receive confirmation sheets from lab. Verify they have the correct information. Coordinate with lab if their information needs to be corrected.
- EIS: Generate a Corrections-to-File letter for any COC/field log book/login discrepancy. Provide a copy to the laboratory, data validator, Project Manager, and Project Notebook. (See files SOP_Corrections-to-File, and Example_Corrections-to-File)
- EIS: Track samples throughout the data management process. Ensure that all Lab and Validator deliverables are delivered on time. Note any issues. Inform project manager if SDGs are late and remind lab/validator of late penalty (if there is one in place).

☐ **Track EIS Budget.** Use the EIS Budget Tracking Form as needed to track the number of hours spent on each task. Inform the project manager if you suspect you will go over budget.

Field Data Entry

☐ EIS: Request a copy of the FDET for your project/base from Chelsea Leigh/VBO or Bhavana Reddy/WDC. Enter field data into the FDET using Project Instructions, Sample Tables, field log books and COCs. Be as specific as possible with the information entered (check with the project manager and/or Field Team Leaders if you are unsure of information.)

☐ EIS: Have GIS perform a QC Check on Northing and Easting data provided to ensure the correct coordinate system per base is reported. Enter coordinate data into the FDET. All Stations, excluding QC and IDW, MUST have corresponding coordinates.

☐ **QC FDET Data.** EIS: Complete FDET output reports and QC. Send to another EIS or project manager to review accuracy.

Lab Data QA/QC

☐ **QC lab data (For Specifics see EIS QC Checklist):**

- EIS: Verify that the hardcopy and SNEDDs are complete and acceptable, and contain all requested analyses/results.
- EIS: Run SNEDD through SNEDD QCTool, and work with the Lab/Chemist to resolve issues.
- EIS: Perform a 10% comparison check to ensure that the hard copy data matches the EDD. If errors are found, inform the project manager and ask the lab to send corrected data.

☐ **Communication with Lab.** EIS: If there is missing data from the EDD or hardcopy, contact the project manager and coordinate with the lab to receive the missing data.

☐ **Run Unvalidated Tables.** EIS: Run unvalidated data tables with the "*Raw & Detects Tables from Unvalidated or Validated SNEDD.xls*" macro to create tables to assist the PM in their preliminary analysis of the data.Create a separate table for EACH matrix and Site (solid/aqueous)

☐ **Hard Copy Management.**

- EIS: Fill out the Data Archiving Form for the lab data and file on the top of each SDG.
- EIS: Create a QC Association Table using the COCs and field notes. Notify Project Chemist when data is ready for validation or preload check, and provide them with the SNEDDs, Hardcopy, Unvalidated Raw and Detects Tables, and QC Association Table.

☐ **Preparation for Validation.**

- PC: If data are being externally validated, notify the validator know when to expect data. Inform validator of any samples or analyses that should not be validated. (For example grain size should not be validated). Mail/email the hard copy data, QC association table, SNEDD to the validator. A Form I summary report should also be provided.
- PC: If data are being internally validated or loaded as unvalidated, coordinate receipt of hardcopy data, Unvalidated Raw and Detects Tables, and QC Association table with EIS.

Data Validation

☐ **External Data Validation QC.**

- PC: Affix Data Archiving Form to hardcopy validation package. Notify EIS of date that Validation deliverables were received.
- PC: Run validated SNEDD through SNEDD QC Tool, and resolve any identified issues.
- PC: Perform a 100% comparison check to ensure that the hard copy data matches the EDD. If errors are found, inform the project manager and coordinate with the validator to correct the data.
- PC: Provide Validation Report and SNEDD to Program Chemist (PCL) for Senior Review and SNEDD to EIS for the generation of Validated Raw and Detects tables.

☐ **Internal Data Validation or Unvalidated QC.**

- PC: Perform data validation. Mark up laboratory Form Is appropriately. Affix Data Archiving Form to hardcopy validation package.
- PC: Provide Validation Report and SNEDD to Program Chemist (PCL) for Senior Review and SNEDD to EIS for the generation of Validated Raw and Detects tables.

☐ **Unvalidated Data Preload Check.** PC: For the loading of unvalidated data, perform basic QC of lab data. Notify PCL that data is ready for Senior Review.

Post-Validation

☐ **Run Validated Tables.**

- EIS: Run validated raw and detects tables with the "*Raw & Detects Tables from Unvalidated or Validated SNEDD.xls*" macro upon request by the PM. Verify any specific needs on the table with the PM. (i.e. headers, footers, or other special needs).
- EIS: Provide the tables to the PM. Also ask the PM if they would like a copy of the Sample Tracking Sheet or Project Instructions to assist them in their review.

☐ **Senior Review by Program Chemist (PCL).**

- PCL: Verify that the validated hard copy data and SNEDD are complete and acceptable. Resolve any identified issues with Project Chemist.
- PCL: Update SNEDD to indicate results that should be Excluded from reporting in the database.
- PCL: Provide Final SNEDD to EIS to be submitted for loading to the Data Warehouse.

Data Loading

☐ **Submit Data.** EIS: Submit final SNEDD and FDET to the DBS to have data loaded to the DW.

☐ **Format Data for Load.**

- DBS: Use SNEDD QC Tool to perform final QC.
- DBS: Use SVMTool to transform data into the loading flatfile, and generate project-specific load files (EMI, LDI, etc) for the CHIMPTool.

☐ **Load Data to DW.** DBS: Use CHIMPTool to load data into the Navy CLEAN Data Warehouse. Verify that all data has been loaded appropriately.

☐ **Post Load Reports.** DBS: Notify EIS that data is loaded and available for reporting.

- DBS: Generate post load reports for EIS review, and make any necessary corrections to the DW.
- DBS: Provide updated copies of the SNEDD and FDET to EIS.

☐ **NIRIS Load.**

- EIS: Following review of Post Load Reports and approval of data, generate Field NEDDs from the FDET and Analytical NEDD from the ALPTool.
- EIS: Provide NEDDs to DBS with notification to proceed with NIRIS Loading, if applicable.
- DBS: Create a NIRIS workspace and submit data load to NIRIS through the NIRIS Data/Checker/Loader Tool. Notify EIS when load is completed.

Post Load:

☐ **Data Archiving.**

- EIS: Provide 2 Zip files of electronic data to Data Coordinator for archiving.: 1) SNEDD and Archive EDD; 2) SNEDD, Field NEDDs, Analytical NEDD.
- EIS/PC: Ship all lab and DV hardcopy reports to WDC. Instruct validators to ship any hardcopy reports they are holding in house.

☐ **Run Tables.** EIS: Meet with the PM to verify the needs on the tables (i.e. headers, footers, or other special needs). Generate final crosstab reporting tables from DW Crosstab Tool.

- A raw and detects table must be created for EACH matrix and site (solid/aqueous). Ask the PM how they would like these tables run before you start.
- Query data from the DW with the XTabReports Tool. Reformat data reported by the XTabReports Tool with the RDE Formatting Tool and Navy Crosstab Cleanup Tools.
- Provide copy of table to Project Chemist for Peer Review prior to providing to PM.

☐ **Review Laboratory and Validator Invoices:** EIS: Track invoices and approval dates on the tracking sheet. Provide comments through Consult-Reply to the PM through Workflow.

☐ **File Project Paperwork:** EIS: File all documentation generated during the project (STS, Corrections to file, COCs, Lab Logins, etc) into the appropriate project binder for future reference.

Obtaining Access to NIRIS

The following sections will go through the steps required for new users to obtain access to NIRIS. These steps will consist of: Obtaining a PKI Software Certificate, Completing Information Assurance Awareness Training; Obtaining a NAVFAC Portal Account; Requesting NIRIS Access

I. Obtaining a PKI Software Certificate

Before applying for the PKI Certificate it is important to know that the process will result in a digital certificate that is applicable to **ONLY** the one machine that you are applying from. If you are applying from a computer that is not connected directly to the CH2M HILL network, be sure that you are VPN'd in first; otherwise you will be unable to connect to NIRIS while working from the office.

There is a $99 annual PKI renewal fee. These charges should be applied to the project for which access is required. Only one PKI is required for NIRIS, regardless of the number of installations being accessed.

1. Go to www.eca.orc.com
2. Click on the green arrow for US Citizens

3. Online Application: Click the Next arrow

4. Identity Verification: You will need the following listed below.
    a. Two Forms of photo identification. One of which must be a valid, current, official government ID such as a passport, driver's license, or government issued photo identity card or badge. The second photo ID can be an official company, or institutional, issued photo identity card or badge.

        Examples:

        i. Photocopy of Driver's License
        ii. Photocopy of NAVFAC Contractor Badge
        iii. Photocopy of CH2M HILL Photo Badge and Office Security Card Number

    b. Proof of Nationality

        i. Photocopy of Birth Certificate or Passport

    c. Proof of Organizational Affiliation,

        i. if **NOT** using CH2M HILL Photo Badge, you will need to fill out the form 'ECA_IndivProofofOrganizationalAffiliation.doc' located: \\ariadne\Proj\USNAVFACENGCOMClean1000\380582NIRIS\Team Documents\ACCESStoNIRIS

d. Credit Card/Corporate Credit Card

Click Next Arrow. Next

5. Secure Online Certificate Delivery: Click the Next Arrow Next
6. Trust the Certificate Authority: Click the Trust CA's button Trust CA's
7. Select a Certificate Type: Select the **Identity Certificate**
8. You will now begin the Online Application for the Identity Certificate
9. Subscriber Obligations: Select I Agree I Agree
10. Medium Assurance Identity Request:

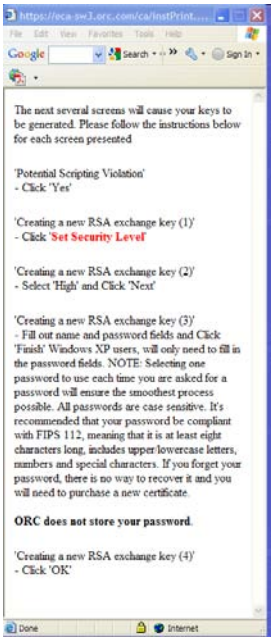
    a. Select an Identity Certificate Enrollment Period of 1 year

    b. Fill out your personal and contact information

    c. Click Submit Submit

    d. Click This is Correct This is Correct

    e. Potential Scripting Violation Pop-up: Follow instructions on screen



11. Print out your certificate

    a. Select Continue at the end of the certificate

    b. Complete certificate by hand, and mail to the following address within 14 days:

       ORC Inc.
       11250 Waples Mill, South Tower Suite 210
       Fairfax, VA 22030

12. You will receive two emails from ORC, within a week or two. The first will be a confirmation email for the purchase of the PKI. The second email will be an issuance of the PKI certificate. The subject line will be similar to – "ORC ECA-SW3 PKI Certificate Issuance Notification"

13. Once you receive the second email. Follow the instructions that are within. This will walk you through how to import your Certificate and test it to make sure it has been properly imported.

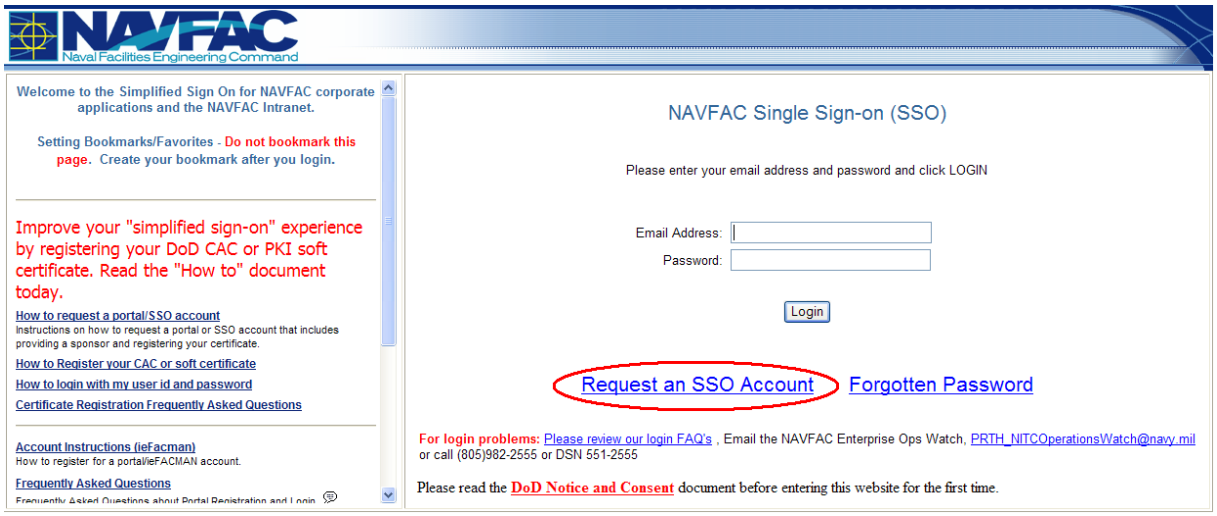
14. Create a backup of your certificate (**Highly Recommended**) and store the backup in a location OFF of your computer. Below is the link to directions for creating a backup. http://eca.orc.com/instructions_backupCertMSIE.html

II. Obtaining a NAVFAC Portal Account

This step will guide the user through registering for a NAVFAC Single Sign-On (SSO) account . This SSO will allow the user to login to the NAVFAC Portal and request access to NIRIS. This process can only be done after the PKI has been imported.

1. Go To: https://portal.navfac.navy.mil/private (note: security alerts will pop-up, Click Yes on all)

2. Click Request an SSO Account



3. Complete the SSO User Registration Form and click Submit Registration

   a. Affiliation: NAVFAC

   b. Component: NAVFAC ATLANTIC or appropriate component i.e. MID-ATLANTIC

   c. Type: Contractor

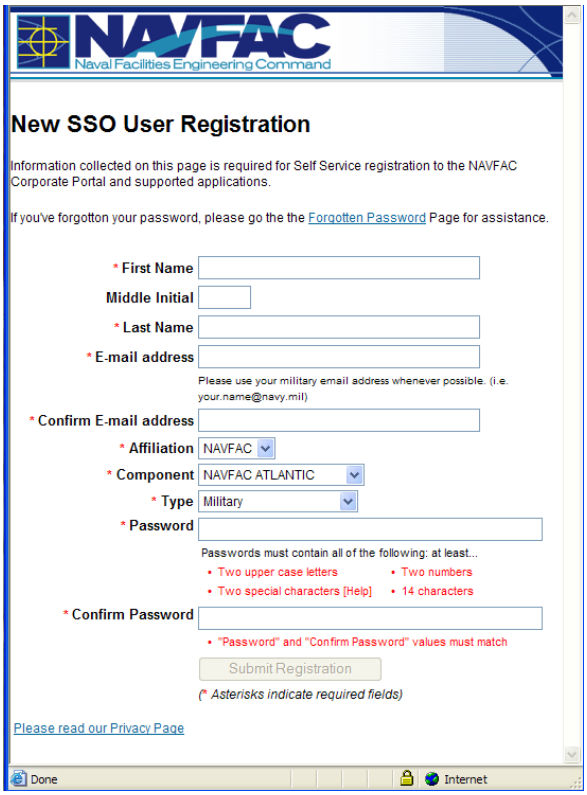
4. Complete Sponsor Information and click Submit.

   a. Sponsor Name: NTR of you installation or Robert Magee for all others

   b. Sponsor Email: NTR Email or Robert.Magee@navy.mil

   c. Registrant Phone Number: NTR Phone Number or Robert Magee 757.322.4766

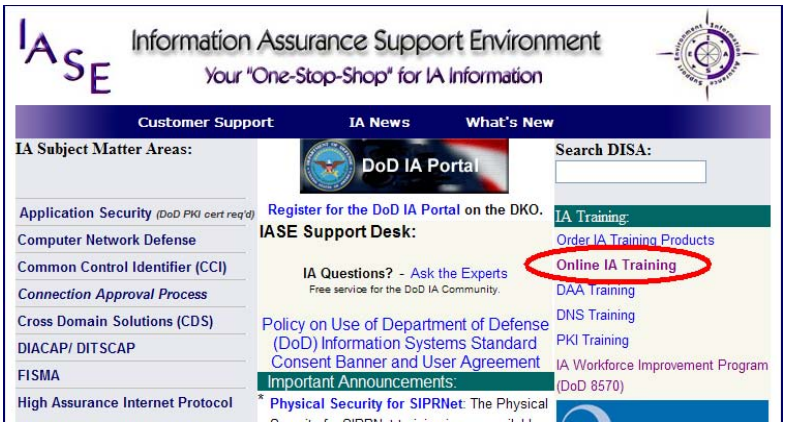
5. Two Emails will be returned. The first will be shortly after the submittal indicating that the request has been sent. The second email will be received once the Sponsor has approved the request.



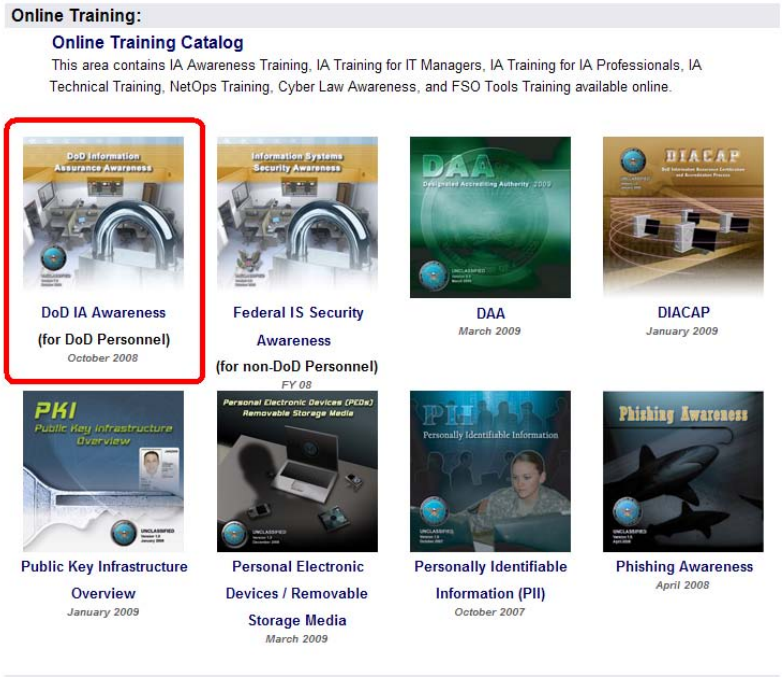
III. Completing Information Assurance Awareness Training

Information Assurance Awareness Training is required by DoD for obtaining access to the NAVFAC Portal. This IA Awareness training is required to be completed on an annual basis by the DoD.

1. Go To: http://iase.disa.mil/index2.html
2. Click on Online IA Training (in upper right hand corner

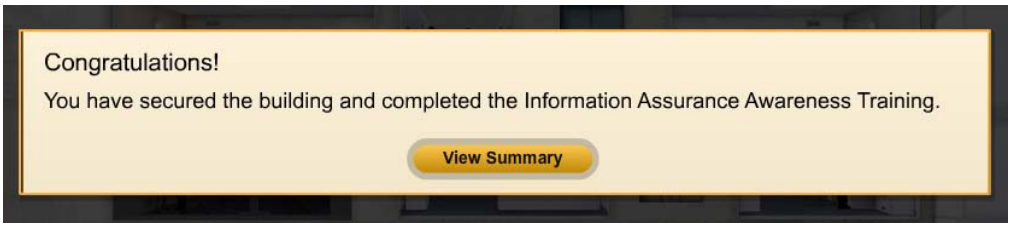


3. Click on DoD IA Awareness (for DoD Personnel) on upper left of screen



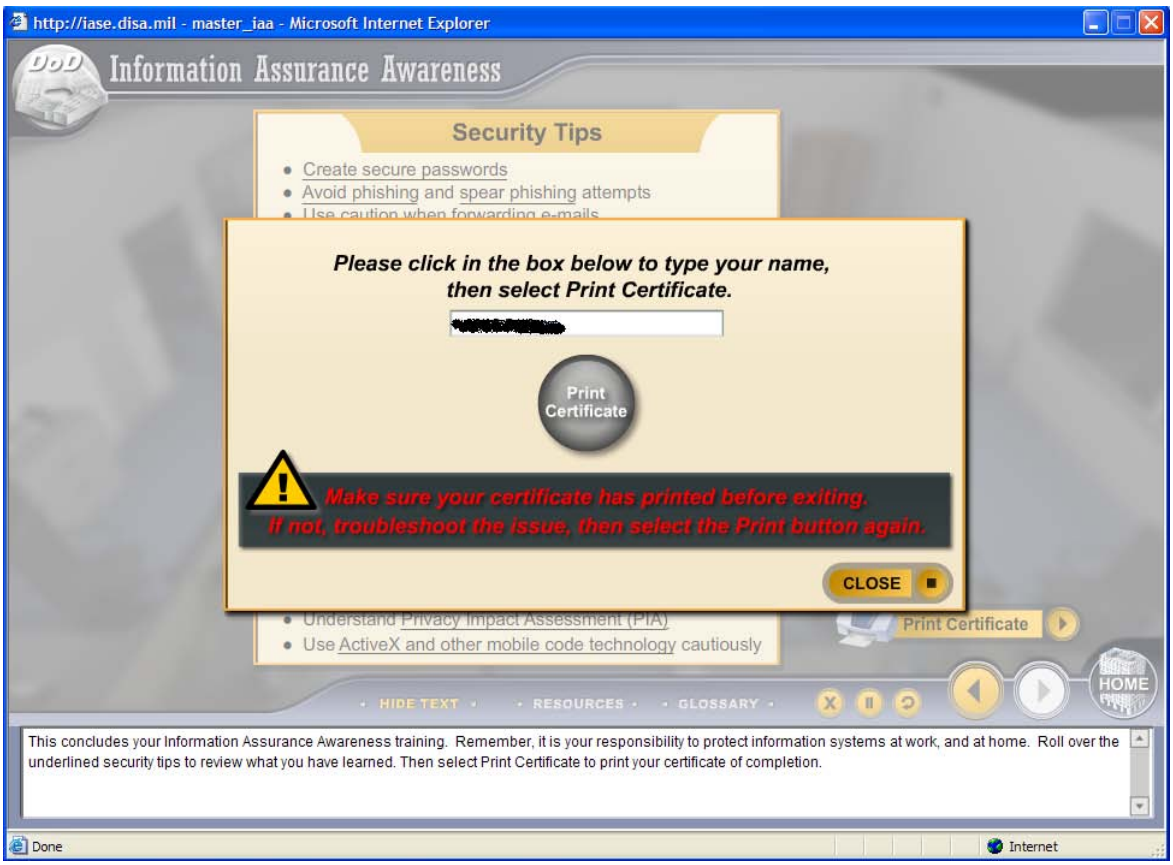
4. Click Launch Information Assurance Awareness course
5. Click Launch new course

6. Follow through the IAA course. Click on the forward arrow in the lower, right-hand corner at the end of each section to proceed through the course. You will have completed the course once the following screening appears.



7. Click the View Summary button to proceed.

8. At the end of the course you will need to create and print a Certificate of Completion



9. It is recommended that the Certificate be saved along with an additional hardcopy for your records.

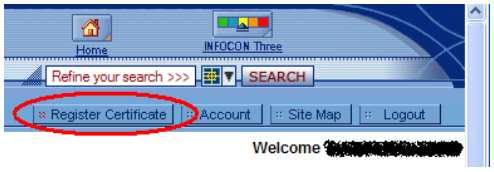
10. After the certificate is printed, click on Exit.

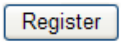
11. Send a digital copy of the certificate to the respective NAVFAC Remedial Project Manager who will process notification of the completion to the appropriate NAVFAC authorities.

IV. Requesting NIRIS Access

This step will guide the user through requesting access to NIRIS and filling out the NIRIS Provisioning Form. This process can only be done after obtaining a NAVFAC SSO account.

1. Log into the SSO Account at https://portal.navfac.navy.mil/private
    a. Webpage that should open after login: https://portal.navfac.navy.mil/portal/page/portal/navfachq
2. Register your certificate, which will allow you to bypass having to login to you SSO Account every time.
    a. In the webpage that has opened click on "Register Certificate" in the right hand corner of the webpage, this will launch a new window



    b. Click on Register in the new window 

    c. The screen should tell you that you have successfully registered your certificate, you may now close this window
3. Now, back at the main portal webpage. Pan over the eTools link in the upper left corner, and select More Links (this will open a new window).

4. Locate NIRIS in the left-hand menu, under 'Manage Links'. Select Acct Request (this will open the NIRIS Provisioning Form).
5. Complete the NIRIS Provisioning Form as follows and click Submit.
    a. Company/Organization: CH2M HILL
    b. Phone Number: 757-XXX-XXXX (BE SURE TO USE DASHES)
    c. User Type: Contractor
        i. If access to SAP Documents is required, please select this module.
    d. Select the Region Associated with the facility you need access: Mid Atlantic, Washington, Northwest, Atlantic, etc…
        i. Note: You Can only select one region at a time
    e. Now select the installations that you require NIRIS access for from the list on the right.
        i. Hold down the <Ctrl> key to select multiple installations
    f. Referral Information (Sponsor Name, Email, Phone), should be the NTR for the installation you support or if you don't have a specific NTR to list you may list the following for each Region respectively:
        i. NAVFAC Washington: Nathan DeLong, Nathan.Delong@navy.mil, 202.685.3279

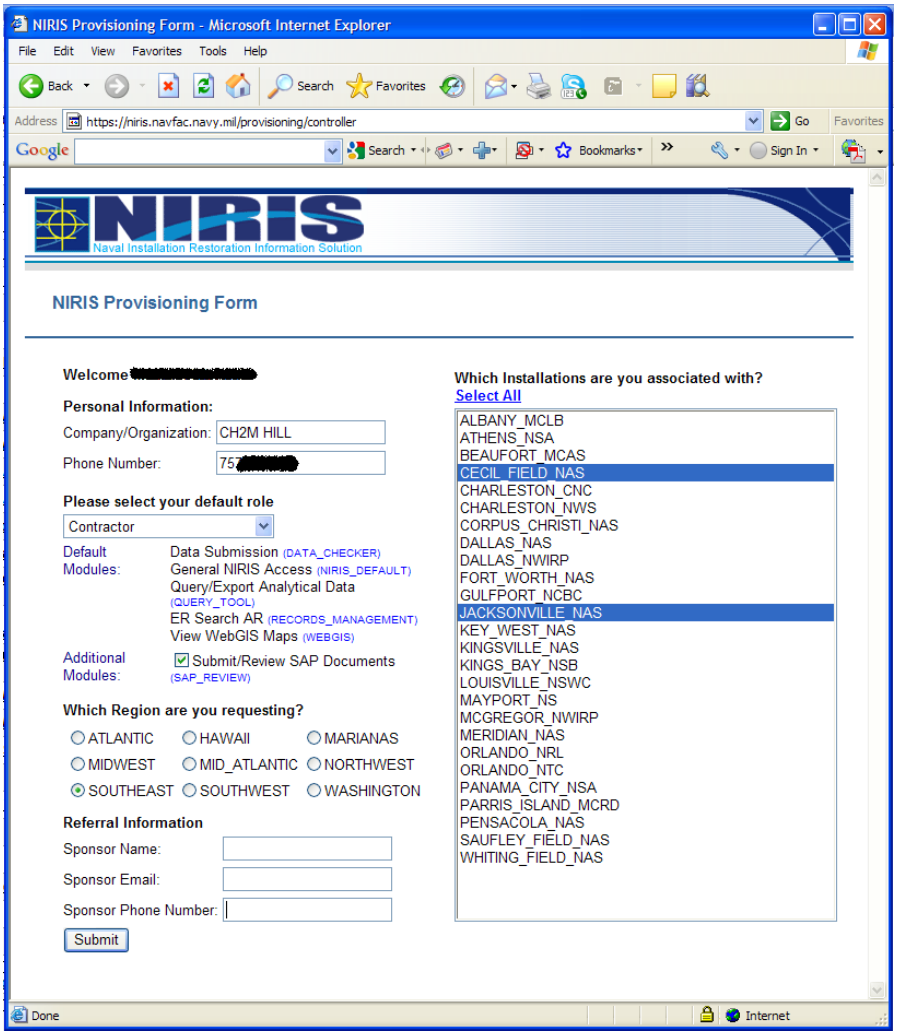
ii. NAVFAC Mid-Atlantic: Mark Barnes, mark.m.barnes@navy.mil, 757.444.9090

iii. NAVFAC Atlantic: Robert Magee, Robert.Magee@navy.mil, 757.322.4766

g. Click the Submit button

h. You will be presented with a screen that states "Your Provisioning Request has Been Submitted Successfully!"

i. Hit the "Back" button on your browser to resubmit for a new region.



6. This completes the Provisioning for NIRIS Access. You will receive an email response indicating that the NIRIS access approval is granted.

7. After email notification log back into the NAVFAC Portal. Select NIRIS from eTools and a new window launching NIRIS should open. You should bookmark the NIRIS welcome page for easy access.
https://portal.navfac.navy.mil/portal/page/portal/niris

Cherry Point Exceedance Table, Formatting Wizard instructions

Purpose: To update the Cherry Point exceedance table, once you have run the EnDat Macro.

Instructions: In order for this Wizard to work properly, there has to be at least 2 criteria selected from EnDat.

1. The EnDat criteria must be in a specific order on the spreadsheet. The wizard is set up have at lease 2 but no more than 3 criteria selected. Column B must have a criterion in it, but it can NOT have the "NC2LGW" criteria. Column C MUST have the "NC2LGW" criteria. If there is not a 3rd criterion, Column D must be left blank. If there is a 3rd criterion it would be place in column D. If there is no 3rd criteria column D would look like this;

	A	B	C	D
1	Station ID	MCL-Ground water	NC2LGW (December 2005)	
2	Sample ID			
3	Sample Date			
4	Chemical Name			

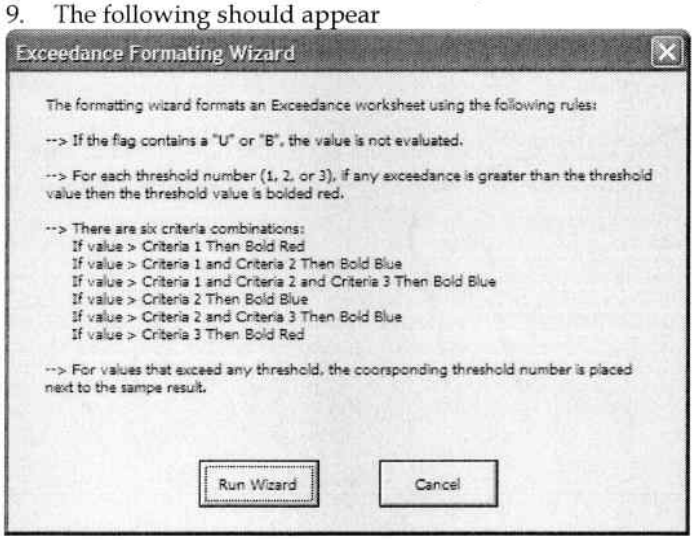
2. Save the Exceedance_Formatting_Wizard_v1-3.xla wizard in your "My Documents" folder.
3. In Excel, select Tools--> Add-Ins--> Browse.
4. Browse to "My Documents" and double click on Exceedance_Formatting_Wizard_v1-3.xla and select "OK".
5. Once you have run the EnDat Macro and saved your files to a new spreadsheet, go to your "EXCEED" workbook. The exceedance table workbook must be named "EXCEED" in order for the wizard to work.
6. The bottom of the "EXCEED"workbook should look like this;

Exceeds one or more criteria

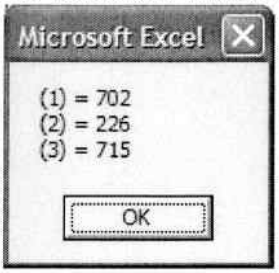
7. Place "Notes:" in the shaded area so it looks like this;

Notes: Exceeds one or more criteria

8. Select Tools--> Exceedance Formatting Wizard…
9. The following should appear



10. Select Run Wizard. After the wizard is complete there will be 2 pop-ups



11. Select OK and then OK. The Wizard is complete.

1. Use SVMTool to generate loading files from the project SNEDD and FDET.
2. Open CHIMPTool
3. Select Project for base to have data loaded
4. Import the following files from SVMTool:
    a. CL_Flatfile
    b. CL_Import_EMI
    c. CL_Import_LDI
    d. CL_Import SLX
5. Append CL_Flatfile to Flatfile
6. Select Load FlatFile (Access)
    a. Click continue on Data Warehouse Import Utility form. Click Yes, Yes.
    b. Click Import to Temp Tables.
    c. On Utility form, select Strip LabQC. Click Cleanup
    d. Append all CL_Import files to appropriate Import tables. Append queries should be setup for this.
        i. Update SLX and LDI Import tables with SiteIDs for locations in the DW to see if any already exist in the DW. Remove records that already exist.
        ii. Update SLX and LDI with Site IDs for new records to be loaded. Update query should be setup.
    e. Review all appropriate tables: Samples, Tests, Results, EMI, LDI, SLX
        i. Populate field Parent Sample ID in Samples table.
7. Select Run Project Updates on main form.
    a. Click Run Updates. Exit when done.
8. Select Process QC Checks on Main Form.
    a. QCLevel should be Standard (as setup in dbo.Projects)
    b. Click Process QC Checks.
        i. Remove any records from EMI, LDI that already exist in DW.
        ii. If any sample results are already loaded, will need to increase the Sample number by 1 to load records.
        iii. Null Errors to ignore: ESTDate, DQType, Expected, Precision
        iv. Rerun Checks until all look ok. Exit out.
9. Select Review Data. Review all pop up tables for accuracy.

10. Select Append Data.
    a. Click append to warehouse
    b. Click QC record counts. Make sure they match original record counts.
    c. TblHistory form will pop up if all appended. Enter description of data load, Origin ID, directory where data is saved.
11. Select **Reduce Data**. Click yes.
12. Copy the Field Sample ID into EMI.Original_LocID
13. Generate Post Load reports for EIS review.
14. Provide Post Loads, Corrected SNEDD, and Corrected FDET to EIS. Correct data in DW should discrepancies be identified.
15. Exit.
16. Archive Load Files on Gaia: Save Final SNEDD, FDET, SVMTool, and CHIMPTool to a Zip File, and save to the appropriate Base folder on Gaia.
17. Archiving and NIRIS Load
    a. Following approval of Post Loads, EIS should generate analytical and field NEDDs from FDET and SNEDD. Provide NEDDs to DBS for loading into NIRIS.

CHERP Tool (Use Navy CLEAN Version)

1. Obtain load file from the ERPIMs Ready Folder on Gaia. Save load file to Gaia desktop.
2. Open CHERPTool.
3. Delete the tables tblAnalyticalData1 and tblFieldSample1.
4. Import the tables tblAnalyticalData and tblFieldSample from the load file into the CHERPTool.
    a. Link tables GSI, SLX, LDI, AnalyteSort to the Navy CLEAN base data will be loaded for.
        i. Ensure tblFieldSample is using correct Site and Location IDs.
        ii. If there are new sites, add them to GSI in the DW by hand
5. From Main Menu click on Warehouse Only.
6. Click Initial Process
    a. Clear Tables
    b. Click Link Main tblFieldSample
        i. Click Link
        ii. Click Update LAN tblFieldSample
            1. Query Settings for UpdateTo should be: ERPIMS_Initiated = True, EPRIMS_Notes = “Warehouse Only”, NO_ERPIMS = True.
            2. Run Query
            3. Exit
        iii. Click Append Field, Analytical
            1. Resolve any unlinked records errors. Samples in tblFieldSample without records in tblAnalyticalData can be removed.
            2. In tblFieldSample, copy values in column Location to Loc ID
        iv. Append Field Data to tblEMI.
            1. Create an append to table query that will link a distinct list of location IDs for project to be loaded to tblFieldMeasurements_Linked to tblFieldMeasurementResults_Links and load field results to tblEMI.
            2. Review tblEMI for accuracy and update VVs and fields where needed.
        v. Create LDI and SLX tables
            1. Append data to LDIExport and SLXExport.
            2. Update with missing information
        vi. Click Run Initial QC Check. Correct all errors, and re-run until no errors are present. Note any issues or errors in Project Notes form. Helpful Hints:
            1. Check for: Samples on multiple COCs, do Not have Field Filtered checked, Cannot have 2 labs on the same COC
            2. Ignore Error: Negative results for metals. This is ok.

3. Ignore Error: Null or High MDL values. MDLs are not required. However, RLs are needed.
4. Ignore Error: LABLOTCTL missing N, FD, EB, AB, etc (Navy does not load Lab QC data)
5. Ignore Error: AnaMethod / Extraction Method Cross-reference. Check VVs though.
6. Correct all Dissolved, TCLP, SPLP, and AVS/SEM ParamID, CAS#, and Analyte names as per Navy VVs if not submitted correctly:
    a. For Dissolved, ParamID & CAS should end with "_D", and Analyte should end ", Dissolved"
    b. For TCLP, ParamID & CAS should end with "_T", and Analyte should end ", TCLP"
    c. For SPLP, ParamID & CAS should end with "_S", and Analyte should end ", SPLP"
    d. For AVS/SEM, ParamID & CAS should end with "_SEM", and Analyte should end ", SEM"
7. Sample Depths and Units are required. Default is 999.
8. Update blank Sample Methods to UNK
9. AB, EB, FBLots should be in the format DDMMYYNN
10. LRType should not contain 000. Correct 000 or 0 to null.
11. Correct QAQCType or LR to N.
12. Remove surrogates.
13. Navy has it's own VVs for Lab Code, Analytical Method, Extraction Method. Do spot check for accuracy.
14. If qryQC_ERPIMSInitiated pops up with ERPIMS Initiated and NO_ERPIMS = -1, then data is already loaded in DW.

vii. Click Return to Main Menu

7. Click Process Analytical Data
    a. Check only: Final QC. Click Continue
    b. Matrix conversions MUST match Navy CLEAN valid values. Click OK.
    c. Enter AFIID for data to be loaded. LogCode = CHM
    d. On Warehouse side of form, Select 'Allow Excluded and Rejected Data'.
        i. Resolve any pop-up boxes with potential issues.
        ii. Review the following fields:
            1. Field QC station IDs should NOT change
            2. QAPP Flags should match Lab Flag exactly
            3. Remove _F on Analytical Methods Update

4. DQType = PQ
5. Ensure PRCCode in Bchres matches the analysis group assigned to the analytical methods in tblfieldsample. (pay attention to filtered results)

e. Click GWD Checks and resolve issues

f. Click EMI Checks and resolve issues. Ignore Error: Units for EMI results. Tool does not use Navy values.

g. Click Export Warehouse Files

i. Click Export Samp, Test, Res Extra Files

ii. Click Export EMI Extra (if needed)

iii. Click Export LDI Extra (if needed)

iv. Click Export SLX Extra (if needed)

8. Save copy of CHERP Tool for archive file.

CHIMPTool

1. Obtain Load Files generated from CHERPTool and save to Gaia Desktop
2. Open CHIMPTool on Gaia Desktop
3. Select Navy CLEAN base
4. Click Update Links, Compile All Code, Use Current Links
5. Click Load Import Data
    a. Select the folder that the load files are saved in
    b. Import Specs = CH
    c. Data Identifier – will automatically populate with CH and today's date. Update the CH to Oracle_
    d. Click clear Previous Data and Temp Tables. Click Yes, Yes.
    e. Data Import Utility
        i. Click Do Not import for any files that should NOT be imported.
        ii. Ensure all txt files are mapped to correct DW tables.
        iii. Click Import to Temp Tables
        iv. Select Cleanup Navy and Click Cleanup
        v. Exit Out
6. Review all Import_Samples, Tests, and Results for accuracy and to ensure all LabQC and surrogates have been removed.
    a. Review PRCCode in table Import_Results (should match analysis group assigned to the analytical method in the STSP).
    b. Ensure correct Parent Sample IDs in Import_Samples
    c. Ensure that field QAPPFlag in Import_Results matches tblAnalyticalResults.LabFlag
    d. Update CH2_DQ_Flag in Import_Results with values from tblAnalyticalResults.Validated. Convert to T or F values (0=F, -1=T).
    e. Ensure that any Exclude flags are fully spelled out in Import_Results.EPAFlag and CH2FinalFlag
7. Review Import_LDI, Import_SLX, and Import_EMI for accuracy
    a. Add new Sites to dbo.GIS
    b. Assign Site Names and Site IDs to Import_LDI and Import_SLX
8. Click Run Project Updates. Click Run Updates on pop-up screen.
9. Click Process QC Checks on Main Form.
    a. QCLevel should be Standard (as setup in dbo.Projects)
    b. Click Process QC Checks.
        i. Remove any records from EMI, LDI that already exist in DW.

ii. If any sample results are already loaded, will need to increase the Sample number by 1 to load records.

iii. Null Errors to ignore: ESTDate, DQType, Expected, Precision, EPA Flags do not Agree with PARVQ

iv. Rerun Checks until all look ok. Exit out.

10. Select Review Data. Review all pop up tables for accuracy.
11. Select Append Data.
    a. Click append to warehouse
    b. Click QC record counts. Make sure they match original record counts.
    c. TblHistory form will pop up if all appended. Enter description of data load, Origin ID, directory where data is saved.
        i. Save Flatfile, EMI, SLX, LDI tables to xls. Put into zip file with Load SNEDD and save zipfile to project folder on Gaia.
12. Select **Reduce Data**. Click yes.
13. Generate Post Load Reports for EISs.
14. Save a copy of the CHIMP Tool for the archive file.
15. Use NEDD Creator tool to generate and load NEDD Files for NIRIS.

SOP – Corrections to File Memo

General Information

- Errors to paperwork after the shipment of samples should be noted properly so when someone needs to track down how the changes got made there is documentation.
- All paperwork or data corrections should be noted in a memo or letter for discrepancies discovered **after shipment** of samples.

Memo Layout and Format

- To correct errors on paperwork after the samples have been shipped to the laboratory the EIS must write a "Corrections-to-File" document to note the changes. If this needs to go to the laboratory please make sure it is addressed to the "sample custodian" or "contact".
- Included should be a synopsis of the error that occurred and an explanation of the information that should have been sent or the action that should have occurred.
- A separate letter should be written for each CTO that is involved so the letter can be filed appropriately. A "Correction-to-File" should be written as soon as the problem is discovered so it can be documented properly.
- At a minimum the document should include the following information:
  - Base name
  - CTO number
  - Lab Name
  - Sample number(s)
  - Airbill number
  - Time and date of sampling
  - COC number (if this pertains to a change on the COC)

- Please see Example_Corrections-To-File for an example of how the layout and format of the memo should look.

Correction-to-File Distribution

At least one copy of original must be made with distribution as follows:

(1) One copy needs to be in the EIS notebook (2) a copy needs to go in the file with the original lab data if a copy was not sent to the lab (3) If necessary, a copy to the project chemist if the method has changed (4) If necessary, a copy to the field team leader (5) If necessary, a copy to the PM if they need to be informed

(2) If this is a correction to the COC this documentation should be addressed to the lab with the change in sample ID, analyses listed on COC, date collected, or another change the lab should be aware of to make this correction in a timely manner.

SOP – Data Archiving Procedures

Electronic Data Deliverable Archiving

Upon Successful completion of electronic data loading into the data warehouse, electronic data should be archived on the server.

EIS Responsibilities:

1. EIS: For SNEDD and FDETool Projects, provide the following 2 zip files to the Critigen Data Management Coordinator:
    a. Archive EDD and SNEDD that was run through the ALPTool
    b. SNEDD run through ALPTool, analytical NEDD from ALPTool, and FDETool NEDDs

Chemist Responsibilities:

1. Chemist: For all Projects that have gone through the full VDMS Process, provide the following zip files to the Critigen Data Management Coordinator:
    c. Lab EDD (coordinate with EIS)
    d. Load Files generated after Senior Review

Critigen Data Management Coordinator Responsibilities:

1. Save copies of all SNEDD or VDMS files to be archived to \\orion\proj\CLEANII\DATAMGMT\EDD_Archive
2. After NEDDs are generated and loaded into NIRIS, save copies of all NEDD files generated to \\orion\proj\CLEANII\DATAMGMT\EDD_Archive\0-NIRIS

Hardcopy Report Archiving

Following successful data loading, data packages may be sent from EISs to the Data Closeout Coordinator in the WDC office. If the Project Manager does not want the hardcopy reports to be archived, ask them where they would like to retain the copies. As an EIS, there is not enough room in a cubical to continuously hold on to lab or validation reports and process new data.

EIS Responsibilities:

1. Inform the Project Manager that the data is going to be prepped for archiving. Verify with the PM that the following information is correct: CTO, Base, Contract (Clean II, III, 1000, AgviQ), PN for archiving, PN for labor.
2. Prepare and ship all in-house data validation and laboratory hardcopy reports associated with the project to the Closeout Coordinator. Each SDG should have a Data Archiving Form affixed to it.
3. Contact the project data validator, and request that all project-related lab packages held by them be shipped to the WDC office, to the attention of the Closeout Coordinator. All lab packages should have a Data Archiving Form affixed to each SDG.
4. Email the Closeout Coordinator with the approximate number of boxes to be shipped, and date that they are scheduled to arrive.
5. Update the Archiving tab in the CLEAN DM Tracking Table with the type of data to be archived, date it was shipped, and the archiving project number.

Data Closeout Coordinator Responsibilities:

1. Once the lab data or validation reports are received in WDC, verify that all packages were returned by the validator. Mark the arrival date for each CTO on the CLEAN DM Tracking Table (Archiving tab).
2. Email the Archiving Specialist with the following questions/comments:
   - Inform the Archiving Specialist of the approximate number of banker boxes that are coming and the date they are scheduled for archiving so staffing is available.
   - Ask the Archiving Specialist what the next box number/binder is needed for each CTO. **All boxes/binders for each project should follow a consecutive numerical order: i.e. if there are 5 binders in Box #1 and another 5 binders in box #2 – then box 1 will have binders 1-5 and box 2 will have binders 6-10.** Please remember CLEAN II CTO-009 is different from CLEAN III CTO-009.
3. Organize data by SDG and start to fill the White Navy Boxes with laboratory data or validation reports. Place color pieces of paper in between sections of analysis and SDGs so the Archiving Specialist knows the proper place to divide large SDGs when making binders. Only fill the White Navy Boxes 80-90% because the binders should be able to be picked up out of the boxes easily.
4. Use the Data Archiving Forms previously filled out by the EIS to create a new Data Archiving Form for the box. Use the information from the Archiving Specialist to fill out the Box and Binder #s.
5. Two different CTOs can be combined into one box when both CTOs are not expecting to have any more laboratory or validation reports within the next 6 months. Two Data Archiving Forms must be completed (one for each CTO) and placed in the Navy's White Boxes. If there is more than 1 CTO per box try and place CTOs that are from the same Naval Base within the same box.

6. Place the "CLEAN_XX_CTO_XXX_Box_XXX.doc" form on top of each box and email the Data Archiving Coordinator letting them know the data is ready to be bound. Attach the "CLEAN_XX_CTO_XXX_Box_XXX.doc" within the email to the Data Archiving Specialist.

Archiving Specialist Responsibilities

1. Be familiar with estimated number of banker boxes that are coming and the date they are scheduled for archiving upon notification from the Closeout Coordinator to ensure that sufficient staffing is available. Please remember CLEAN II CTO-009 is different from CLEAN III CTO-009.
2. Schedule time for archiving based on the Closeout Coordinator's archiving requests.
3. Assemble binders for data to be archived. All data must be Acco bound and organized into binders, punch holes if needed. Create binder labels and place on binders before placing binders in a box.
4. Fill out the "Archived By" portion of the "CLEAN_XX_CTO_XXX_Box_XXX.doc " for every box. Save the "CLEAN_XX_CTO_XXX_Box_XXX.doc" in the appropriate place for each CTO.
   - CLEAN II files should be saved under the following link
     - \\orion\Proj\CLEANII\CLEAN 2\Archived and Closed_clean 2
   - CLEAN III files should be saved under the following link

     \\orion\Proj\CLEANII\CLEAN 3\Archived and Closed_Clean 3
5. Notify the Data Closeout Coordinator that the binding has been completed and the box has to be prepared for shipment to Iron Mountain. Update CLEAN DM Tracking Table (the Archiving tab) located on the server at \\orion\proj\CLEANII\DATAMGMT\Data Management Projects\Clean_DM_Tracking_Tbl.xls with the date the boxes were shipped to Iron Mountain.
6. Print a total of 4 copies of the "CLEAN_XX_CTO_XXX_Box_XXX.doc" form. Enter the information into the Iron Mountain Database.
   - 1 copy in the White Navy Boxes stapled with the Navy Forms
   - 1 copy for CH2M HILL binders stapled with the Navy Forms
   - 1 copy for Navy CLEAN binders stapled with the Navy Forms
   - 1 copy sent to the project manager stapled with the Navy Forms through interoffice mail
7. Send boxes to Iron Mountain Warehouse.
8. Every time a Navy CLEAN box that has been previously archived is recalled, please make sure you know the person who checked out the box, office of the person who checked out the box, CLEAN II or CLEAN III, CTO# and Iron Mountain Box Number.
9. Forms in the CH2M HILL archiving binders should be filed by the Code 1.182, then project number. They should be filed from CLEAN number then CTO.

Notes:

- If additional White Navy Boxes must be ordered, notify the Archiving Coordinator, who will then email Bonnie Capito, bonnie.capito@navy.mil and CC Heather Allison/VBO. Boxes must be ordered in bundles of 50, and may take as long as **1 month** for shipment and receipt.
- Do NOT write on the outside of the Navy White Boxes. Upon shipment to the Navy, the and eventually the Federal Records Center must write on each box.

Project File Archiving

Project Manager's Responsibilities

1. Collect all documents that are needed for archiving. If there are additional questions about what documents are required please contact the Closeout Coordinator.
2. Email the Closeout Coordinator with the approximate number of boxes and the date archiving must be completed by. Also include the CTO, Base, Clean II or Clean III, project number for archiving reference, and project number for labor.
3. Look over the Project Files Requirements for PMs Form to determine if data should be filed with Navy files or with CH2M HILL files. Documents should be separated accordingly. Once all of the documents are gathered email the Closeout Coordinator so the archiving process can begin.

Closeout Coordinator Responsibilities

1. When the Project Manager sends notification that archiving will be occurring please verify the estimated number of banker boxes to be received and the date they are scheduled for archiving to ensure that staffing is available. Schedule time for archiving based on the Project Mangers' archiving requests and coordinate with Archiving Specialist.
2. Update the CLEAN DM Tracking Table spreadsheet (the Archiving tab) located on the server at \\orion\proj\CLEANII\DATAMGMT\Data Management Projects\ Clean_DM_Tracking_Tbl.xls with the type of data to be archived (Project Files), the date it was received by the Closeout Coordinator, and the archiving project number.
3. Fill in the top section of the Project Files Data Archiving Form with information obtained from *Project Snapshot* or Table1-1.
4. Email the Archiving Specialist with the number of boxes ready to be archived and the partially completed Project Files Data Archiving Form to allow them to start archiving procedures.

Archiving Specialist:

1. Hole punch and bind data. All data must be Acco bound and organized into binders. Create binder labels and place on binders before placing binders in a box. Place all project files in the Iron Mountain Boxes and not the White Navy Boxes.
2. Fill out the "Archived By" portion of the "CLEAN_XX_CTO_XXX_Box_XXX.doc" for every box. Save this sheet as "CLEAN_XX_CTO_XXX_Box_XXX.doc" in the appropriate place for each CTO.
   - CLEAN II files should be saved under the following link:

     \\orion\Proj\CLEANII\CLEAN 2\Archived and Closed_clean 2
   - CLEAN III files should be saved under the following link:

     \\orion\Proj\CLEANII\CLEAN 3\Archived and Closed_Clean 3
3. Notify the Data Closeout Coordinator that the binding has been completed and the box has to be prepared for shipment to Iron Mountain. Update CLEAN DM Tracking Table (the Archiving tab) located on the server at \\orion\proj\CLEANII\DATAMGMT\Data Management Projects\ Clean_DM_Tracking_Tbl.xls with the date the boxes were shipped to Iron Mountain.

4. Enter the information into the Iron Mountain Database and print out 4 copies of the "CLEAN_XX_CTO_XXX_Box_XXX.doc" form.
    - 1 copy in the White Navy Boxes stapled with the Navy Forms
    - 1 copy for CH2M HILL binders stapled with the Navy Forms
    - 1 copy for Navy CLEAN binders stapled with the Navy Forms
    - 1 copy sent to the project manager stapled with the Navy Forms through interoffice mail
5. Send boxes to Iron Mountain Warehouse.
6. Every time a Navy CLEAN box that has been previously archived is recalled, please make sure you know the person who checked out the box, office of the person who checked out the box, CLEAN II or CLEAN III, CTO# and Iron Mountain Box Number.
7. Forms in the CH2M HILL archiving binders should be filed by the Code 1.182, then project number. They should be filed from CLEAN number then CTO.

SOP – Data Shipping

You will need:

- Scale (We have 2. One is located with the FO Staff, the other in the 4th floor kitchen)
- Boxes to package your data in (FedEx or cardboard box)
- Packing Tape
- FedEx Shipping Pouches
- Shipping form generated from: VO/Company Resources/Online Shipping/CHExpress

Prepare Your Data

- Pack all hardcopy reports, and CDs if required, into desired shipping box.
- Tape the box securely so that contents will not be lost/disturbed during shipping
- Note the length, width, and height dimensions in inches for boxes other than FedEx
- Note the weight of the box to be shipped, in pounds

Generate Shipping Form

- Navigate to: VO/Company Resources/Online Shipping/CHExpress
- **From.** The "From" contact information should automatically populate with your information. Complete the form if this does not happen. Select Next.
- **Ship To.** You can type out each field, or you can do a quick lookup at the bottom of the page by selecting the type of Recipient, and viewing options in the drop down box. Once complete, select Next.
- **Package Settings.** Select the Service Category based on how quickly data must get to its destination. Generally, 2-day is used. Select Package Type of Other (non-FedEx boxes), or Box (FedEx boxes). If Other is selected, enter in box dimensions. Enter package weight, to one decimal place. Do not select any Declared Value or Special Services. Select Next.
- **Rate.** Click on the "Compare to FedEx Rates" button. Select the FedEx rate that corresponds to your Service Category. Select Next
- **Package Summary.** Under Payment Type, select "Bill 3rd Party/Bill Recipient". The Payer Account Number is **186718208**. The Reference Number is the project number that you bill your project time to. Select Ship this Package.

Ship the Package

- Print the shipping form that is generated. Place the shipping form into the FedEx Shipping pouch, and affix the pouch to the package.
- Place packages to be shipped at the office's FedEx pickup location.
- Save a copy of the shipping confirmation number provided by email
- Notify the recipient of the package shipment, expected delivery date, and FedEx tracking number.

SOP – Field Data Entry Tool (FDETool)

*During sampling events have each page of field notes copied and keep in a binder.

*Request a copy of the most current base-specific FDET from the Critigen DMC or DBS.

- **Project Information**
- Enter requested information for each of the fields on the Project Information form. Once complete, click on the button 'Next/FieldData'

- **Entering New Stations and Samples:**
- Blue Field Headers indicate required information.
- Go to the bottom of FDET window (very bottom option). Beside 'Record' choose the >* key to go to the end of the existing data and start a new entry. At this time the blank record should be for example Record 12 of 12.
- Begin Entry with the Site name using the drop down menu. Choose from existing site names or choose to add a new site.
- Next enter the Station name followed by any other information pertaining to the Station in the upper portion of the window. This upper portion is strictly used for the Station information. The lower portion is for Sample information. (One Station may have multiple Samples.)
- If you are unsure of the Station Type and/or Station Status ask the PM or field crew. (The more info. provided the better) You can also gather information regarding surveying in order to add Northings, Eastings, Measuring pt. Elevations, and Survey Method. **Northings and Eastings are REQUIRED**.
- Once the Station information is entered, begin entry of the Sample information. The Sample name, once entered, will automatically be copied into the Parent name box. If the Parent name and Sample name are different the Parent name will need to be entered first. Then enter the Sample name. If the Sample name is changed the program will ask if the Parent name should also be changed. Choose appropriate option.
- The Sample Alias box is used when the lab has issued a Sample name that we do not want loaded into the database or you would like to rename a sample and keep track of what the sample used to be called. This should be noted in case of questions for the lab at a later date.
- Next, enter as much information from the field book you have pertaining to this sample. Once again, if you are not sure what to choose from the drop down list, gather as much information from your PM or field crew. Collection dates and times should be entered into their own respective boxes, not together.
- Finally, any field parameters should be entered. Choose from the drop down menu for all parameters. Make sure when the parameter is chosen the units agree with those used in the field. It is important to always check units to avoid discrepancies in the database.

Adding a new Sample to an existing Station:

- First choose your Station name from the drop down menu. Once the correct Station is selected quickly check the Station information. In order to add a new Sample, go to the bottom of the Sample window and choose the >* option. This adds a new blank record to the existing sample records for a specific station. Now you have a new window to enter the Sample information, but the Station window remains. Go through the Sample entry as directed earlier.
- Once you are through entering sample information and are ready to move on to a new Station, use the >* option at the very bottom of the window to create a new Station or chose the existing Station you need from the Station drop down menu.
- When all data for a specific base is entered and the analytical data is ready for loading, send the updated copy and analytical data to the Critigen DMC or DBS for loading. It is a good idea to keep track of when and which FDETs are sent for loading to prevent confusion as to which Tool is the most current.

FDETool Data QC

There are four reports that get generated: Stations, Samples, Field Results, Full Detail. First you have to decide which reports are needed for the QC of the data that you just entered!

To Generate FDETool Tables to QC

- Go to the Report Tab (in the FDET), and select Full Detail
- Select Full Detail
- Select the Hidden Button / Tools / Analyze it with Excel
- Save the generated Excel File to the server as 'FDETool QC Full Detail'
- Repeat this process for New Stations, New Samples, and New Field Results

Then go into Excel to format the file to be reviewed

- Select all columns, and resize to AutoFit
- Format Date Columns into the MM/DD/YYYY MM:HH format
- Save with new format

Then you need to sort the file to be reviewed

- Highlight all data Cells
- Select Data / Sort
- Sort column data into easiest sort order for you to QC (ex. New Field Result should be sorted as: Sample ID, Field Parameter)

MAKE SURE YOU CHECK THE DATES / TIMES CAREFULLY – THE TIMES ARE NOT INCLUDED IN THE REPORT.

- Go through the file and highlight any rows that do not pertain to the specific data set that you are QCing. Delete the highlighted rows.
- Once all of the rows have been deleted from earlier samples you then need to print out what is left to be QC'd

Put on a filter so you can review what is in each column.

- Highlight the first row containing the Column headers
- Select Data / Filter / AutoFilter
- Hit the Save button

Get the table ready to be printed

- File
- Page Set-up
- Sheet
- Repeat rows at the top (click the cursor on Row 1)
- Click "OK"
- Print Preview to see if your table will fit onto one page

Hide some of the columns that do not have any data

- First look under the filter of the blank column to make sure that column is empty
- Click on the Column letter
- Stay with-in the highlighted area and right click
- Click "Hide"

Also you can adjust the size of your columns

- Simply pull the right side of the column letter in to adjust to the size of the data in that column (make sure you know what the name of that column is so when you are checking your data you know what you are checking)

If your table does not fit onto one page here are some ways to fix that or to make it easier to review

- File
- Page Set-Up
- Papersize
- Tabloid
- Adjust to 85% or 90% (Normal size) – if it is hard to see leave it at 100%
- Click "OK"

Then hit Print Preview again if your data gets chopped off by a few rows then:

- File
- Page Set-Up
- Landscape (or Tabloid = 11 x 17)
- File - SAVE

For the last table (of the 4 in Excel) – Station ID - Make sure you format the data prior to sorting so that it will format correctly

- Change the date format to include the time
- Highlight the column(s) that the date needs to be reformatted
- Keep the cells highlighted
- Right click in the highlighted area and go to Format cells
- Go under the number tab
- Go to the bottom under custom
- Go to the format of mm/dd/yyyy h:mm and change that format to be mm/dd/yyyy hh:mm:ss AM/PM
- This should move to the bottom of your custom selections so if you need to use this again that is where it will be located

QCing the Tables

- Review each column of data against your STS, COCs, and Field notes to ensure that you have entered the data correctly. Highlight any cells that will need to be corrected.
- Once complete, open the FDETool, and make any necessary corrections that were needed.

SOP – Field Data Entry Tool (FDETool) Setup

Open the blank FDET database template.

1) Open table "Select_AFIID_ForImport" .
    a) Select the AFIID assigned to the Navy CLEAN base that the FDET will be setup for.
    b) Close out of the table.
2) Run Macro "QC_PreLoad". This will run the below listed queries and open the table "TBL_DataErrors". This table will list any errors the QC queries found. Resolve any issues listed in this table.
    a) 0_UpdateContractID
    b) 00_Delete_Existing_Errors
    c) 1_dbo_LDI_LTCCODE _Without Matching TBLLUSTATIONTYPE
    d) 2_dbo_LDI_STATUS_Without Matching TBLLUSTATIONSTATUS
    e) 3_dbo_LDI_CRDMETH_ Without Matching TBLLUSURVEYMETHOD
    f) 4_dbo_SAMPLES_SACODE_ Without Matching TBLLUSAMPLEQCTYPE
    g) 5_dbo_SAMPLES_SMCODE_ Without Matching TBLLUSAMPLEMETHOD
    h) 6_dbo_SAMPLES_MATRIX_Without Matching TBLLUMATRIX
    i) 7_ParentSampleDoesnotExistAsASampleInTable_dbo_Samples
3) Run Macro "LOAD_FDET".
    a) This Macro will load the data into the Template and return the count of the number of records for that AFIID in the Data Warehouse and the actual number of records imported.
    b) If there is a discrepancy in the number of records in the returned report please resolve and rerun macro.

SOP – NIRIS Importer / Validator Tool

Before you Begin:

- Query analytical results for desired dataset from NIRIS using the NIRIS Query Tool, and save results to Gaia desktop.
- The NIRIS Importer / Validator Tool will compare the results reported by NIRIS to the data present in the Data Warehouse, and report which sample results are present in NIRIS but not in the Data Warehouse.

Standard Operating Procedure:

1. **Select NIRIS Data**: Select the Excel file generated by the NIRIS QueryTool.
2. **Import NIRIS Data**: This will import the Excel file into a local Access table.
3. **Normalize Units**: This will update the Results and Units in the imported data to match the Data Warehouse preferred units.
   a. A QC check will run to show any analyte groups that have not been updated. These should be updated as much as possible to allow a complete normalization (required for comparing the imported data to the data existing in the DW.)
4. **Load Data to Temp Tables**: This will load the data into a local copy of tblAnalyticalData and tblFieldSample, and create a bare tlkpAccuracy_Precision. Assumptions here are that
   a. only Reportable data will be used,
   b. all QAQC types are "N",
   c. only Target data will be used, and
   d. there is no surrogate data to exclude.
5. **Compare to Warehouse Data**: Select the project to compare the data against,
6. **Link to Project Data**. This will link the tool to the Installation's data in the Data Warehouse.
7. **Compare Data**. This will compare the NIRIS data file to data in the Data Warehouse. Three queries will open:
   a. qryFullLink_dat shows data linked on Field ID, Sample Date, Method, Analyte, Result, and Flag. The results of this query will display samples and associated results that match between NIRIS and the Data Warehouse.
   b. qryPartialLink_dat shows data linked on Field ID, Sample Date, Method, and Analyte, but not Result and Flag. The results of this query will display samples analyses that match between NIRIS and the Data Warehouse.
   c. qryUnLinked_dat shows data that does not link on one or more of these fields: Field ID, Sample Date, Method, or Analyte. The results of this query will display samples and associated results that do NOT match between NIRIS and the Data Warehouse.
8. **Verify Data to Be Reported in Data Request**. User should verify with PM if data request should include sample data from NIRIS that does not exist in the Data Warehouse. If NIRIS data should be included, tables can be generated from the Temp Tables.

9. **Generating Raw, Detects, Exceedance Tables From NIRIS Output**.

   a. Open the XTabVDMS tool and link pertinent tables to the temp tables in the NIRIS_VDMS_Importer.

   b. Generate Crosstab tables and reformat to Navy CLEAN format using the XTab Cleanup and RDE Formatting Tools.

   c. Note - should more than one screening criteria be necessary for comparison, user will need to add extra criteria by hand prior to running the RDE Formatting Tool.

SOP – SVM Tool

The SNEDD to VDMS Mapping Tool (SVMTool) is to be used for the generation of CHIMPTool flatfiles for data import into the Data Warehouse. The SVMTool will link the Navy CLEAN SNEDD and associated Field Data Entry Tool (FDETool) together to create the flatfile.

1. Review SNEDD for completeness and accurate valid values.

   a. Perform QC of SNEDD file with SNEDD QC Tool. Correct all errors

   b. Note the number of records to be imported for tracking purposes.

2. Save FDET to Desktop

   a. Open the database window.

   b. Refresh all linked tables to the FDET saved to the desktop (excluding dbo.AnalyteSort).

3. Import SNEDD File into SVMTool.

   a. Verify the Run Numbers are correct. Fix any errors in the SNEDD File.

   b. Verify the removal of Lab QC and Surrogates is correct. Fix any errors in the SNEDD File.

4. Prep FDET Linking.

   a. Click 'Find Unlinked Samples'. Any samples listed do not exist in the FDET and should be added.

   b. Click 'Compare Date/Times. Ensure that the Date/Time Collected for each sample matches between the SNEDD and FDET.

   c. Click 'Check for Missing Required Data'. Obtain missing data for any identified records.

5. Generate the Flat File and Review the Load Information File

   a. Review Load Information to populate the Project field in the Flatfile.

   b. Build the Flat file.

      i. Update Origin to new unused value in format Oracle_C, Oracle_D, etc.

      ii. Update Project with Load information.

      iii. Ensure that all records have a LocID and SiteID. Resolve any discrepancies.

      iv. Correct LogDate and LogTime to appropriate format

      v. Review Excluded Results for accuracy. Make sure original flag is noted in Result_Narrative.

   c. QC Analytes, then generate final file.

6. Generate Field Data Load Files

   a. EMI: Build EMI File. Resolve any duplicate record issues. The DW only allows one result per Station, Date, and Field Parameter. To get around this, increase the sample time on duplicate records by 1 second. Click last EMI button.

   b. LDI: Build LDI file to append to Import_LDI.

c. SLX: Build SLX file to append to Import_SLX.

7. Close the SVMTool. Do NOT clear the Flatfile, EMI, LDI, or SLX tables.

8. Open the CHIMPTool , and follow the SOP_Clean SNEDD Loading with CHIMPTool.

SOP – Valid Value Setup

Requests for new Valid Values (VVs):

1. Once request for a new VV is received, verify requested value with Program Chemist.
2. Check NIRIS to see if a VV already exists, or if a new value must be setup. If a VV already exists in NIRIS, use the existing value.
3. Once a new VV has been determined, update the following databases, tables, tools:
    a. NIRIS (if needed)
    b. Data Warehouse (analytes only)
    c. AdminTracking DB on Gaia. This holds all Navy CLEAN valid values.
    d. SNEDD Specs
    e. SNEDD QC Tool
    f. ALPTool
    g. FDET (if needed)

Reconciling NIRIS Valid Value Lists with Navy CLEAN Lists (to add any new NIRIS values to our list of values):

1. Download NIRIS valid value lists into the NIRIS tables in AdminTracking DB on Gaia.
2. Run unmatched query between VV tables and NIRIS tables to determine which new valid values should be added to the CLEAN VVs.
3. Compile a list of all new VVs to add to Navy Values.
4. Update the following databases, tables, tools:
    a. NIRIS (if needed)
    b. Data Warehouse (analytes only)
    c. Admin Tracking DB on Gaia. This holds all Navy CLEAN valid values.
    d. SNEDD Specs
    e. SNEDD QC Tool
    f. ALPTool
    g. FDET (if needed)
    h.

EDM SOP-126:
Using Cross-Tab Reporting

PREPARED BY: Michele Spence/RDD

DATE OF PREPARATION: September 18, 2008

VERSION NO.: 1.0

REVISION DATE: --

REVISED BY: --

1.0 Introduction

This Standard Operating Procedure (SOP) establishes responsibilities, requirements, and instructions for XTabReports V3.0 (XTab).

This SOP provides information on the operation of XTabReports V3.0 program for reformatting the edata into a cross-tab format from the VDMS data warehouse.

2.0 Definitions

DSN represents Data Source Name. Data Source Name provides connectivity to a warehouse database through an ODBC driver. The DSN contains database name, directory, database driver, UserID, password, and other information. Once a DSN is created for a particular database, the DSN can be used in an application to call information from the database.

3.0 Responsibilities

Personnel shall conduct data management activities so as to maintain the highest standards of quality to ensure the integrity and defensibility of project data. The following individuals are identified as having responsibilities associated with this procedure:

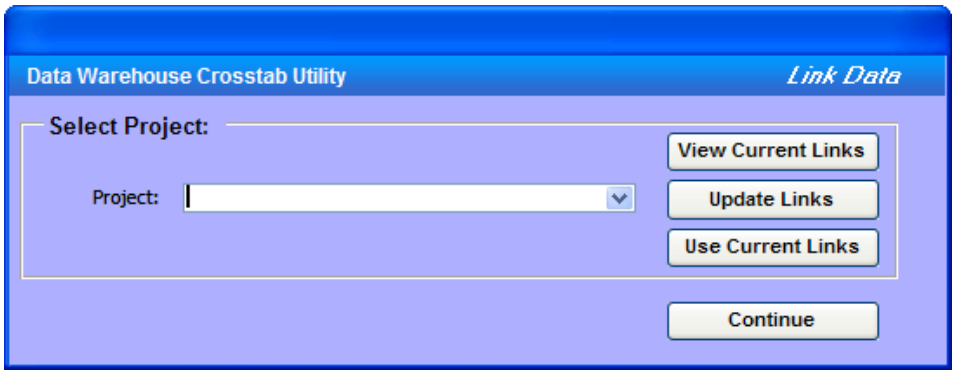
- The Data Manager receives a data request for edata in a reportable format. Responsibilities include accuracy of the reformatted data.
- The Critigen Data Management Team (Denny Spector/RDD or Michele Spence/RDD) are the contacts for program issues. Responsibilities include providing technical and operational support for the program.

4.0 Process and Procedure

XTab is a program to reformat analytical data from the data warehouse into a reportable Excel spreadsheet. The Data Manager's computer **MUST** have a DSN source that matches the project name in the pulldown list to allow an automatic link to the data warehouse. If this process needs to be set up, please review EDM SOP-114, using the CHIMPTool. Procedures for XTabReports V3.0 are discussed below.

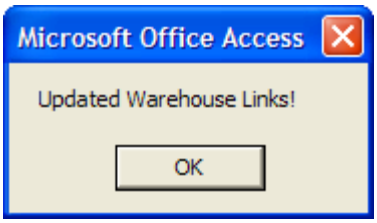
4.1 Startup

Open XTab using Microsoft ACCESS 2003. Use the pulldown list to select the warehouse from where the analytical data will be coming. Select **Update Links** to link all the appropriate tables on the SQL server to the Xtab database.

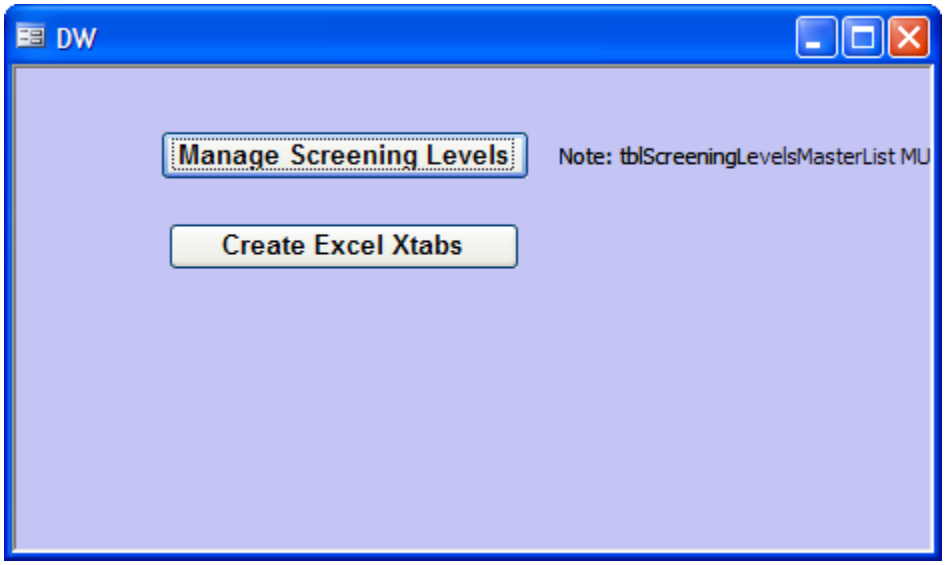


A pop-up window appears when the links have all been reestablished. Click on the **OK** button to return to the main menu.

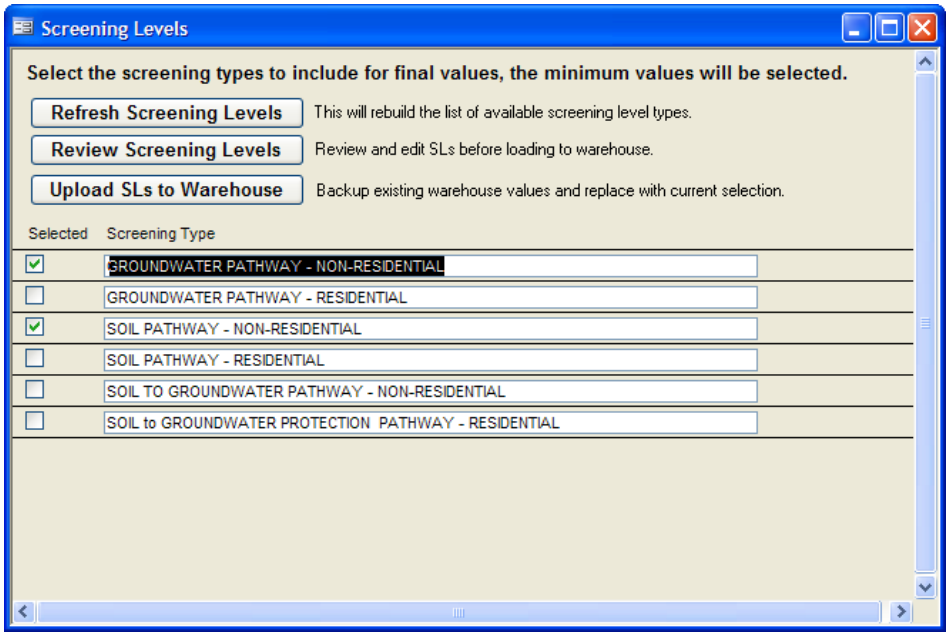
4.2 Screening Levels



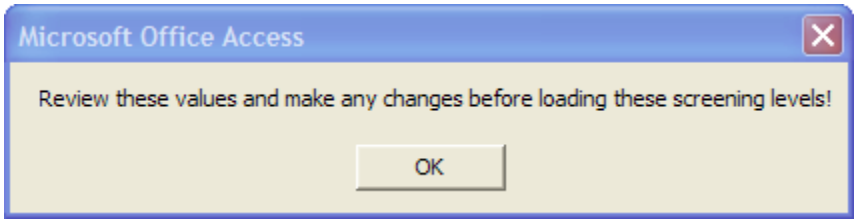
The first form allows the user to review and modify the screening levels that the analytical data will be compared with or to directly create the cross-tab reports. To modify or review the screening levels available, click on **Manage Screening Levels**.

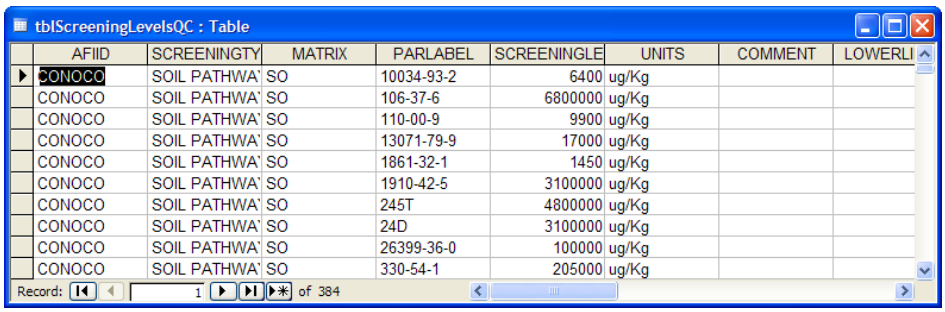


The **Screening Levels** form contains the options **Refresh Screening Levels**, **Review Screening Levels**, and **Upload SLs to Warehouse**.



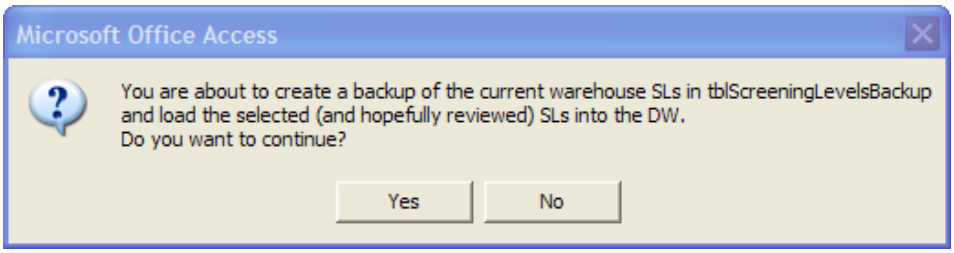
The **Refresh Screening Levels** button rebuilds the list of available screening-level types in the warehouse and shows them in the lower half of the form. The **Review Screening Levels** button allows the user to review the screening levels that are selected and modify them for the specific cross-tab reports. A pop-up reminds the user to review the values and make any changes before loading these screening levels into the warehouse for the cross-tab reports. A table of the screening levels then opens for modification.





AFIID	SCREENINGTY	MATRIX	PARLABEL	SCREENINGLE	UNITS	COMMENT	LOWERLI
CONOCO	SOIL PATHWA'	SO	10034-93-2	6400	ug/Kg		
CONOCO	SOIL PATHWA'	SO	106-37-6	6800000	ug/Kg		
CONOCO	SOIL PATHWA'	SO	110-00-9	9900	ug/Kg		
CONOCO	SOIL PATHWA'	SO	13071-79-9	17000	ug/Kg		
CONOCO	SOIL PATHWA'	SO	1861-32-1	1450	ug/Kg		
CONOCO	SOIL PATHWA'	SO	1910-42-5	3100000	ug/Kg		
CONOCO	SOIL PATHWA'	SO	245T	4800000	ug/Kg		
CONOCO	SOIL PATHWA'	SO	24D	3100000	ug/Kg		
CONOCO	SOIL PATHWA'	SO	26399-36-0	100000	ug/Kg		
CONOCO	SOIL PATHWA'	SO	330-54-1	205000	ug/Kg		

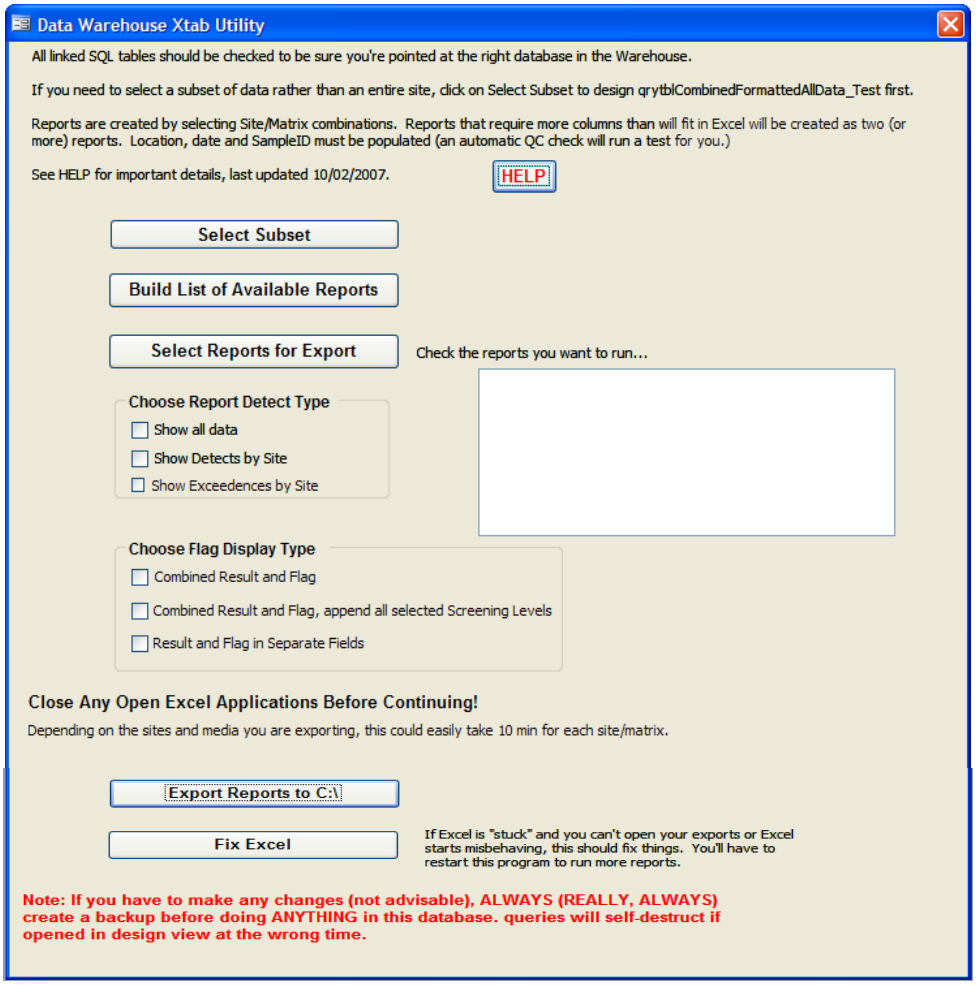
The **Upload SLs to Warehouse** button allows the modified screening levels to be uploaded into the warehouse to be used only in the cross-tab reports. A pop-up reminds the user that the modified screening levels will be uploaded into the warehouse. Select **Yes** to continue and the modified screening levels are uploaded into the warehouse.



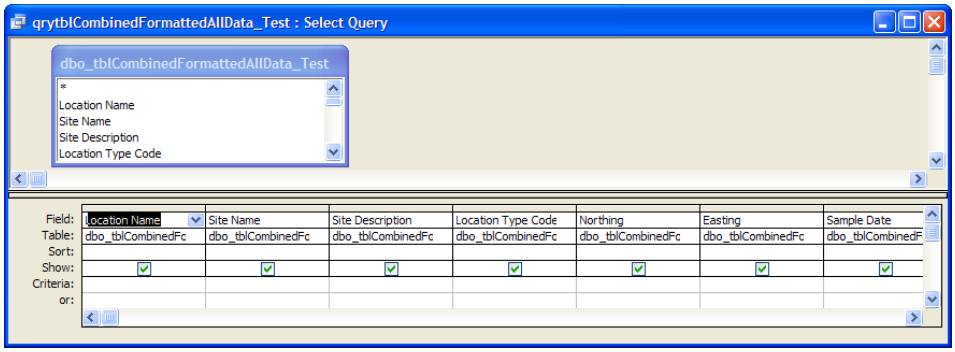
Select **No** and the user returns to the **Screening Levels** form. When done, close the **Screening Levels** form to return to the first form that opened.

4.3 Cross-tab Reports

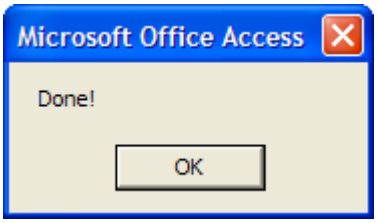
To create the cross-tab reports, click on **Create Excel XTabs** and the following **Data Warehouse Xtab Utility** form will open.



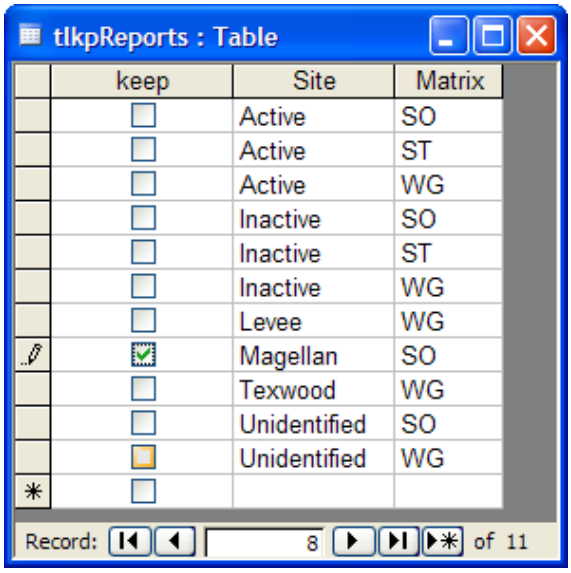
The text box to the right of the form is for notes. To generate the cross-tab reports, start by clicking the **Select Subset** button. A query will open so that criteria may be set such as specific locations or specific sample delivery groups.



Once criteria have been entered, save and close the query. Click **Build List of Available Reports**. This will run the query above and create a table of all the site and matrix combinations for the dataset. When the table is built, a pop-up opens showing that the process is done. Click **OK** to close the window.

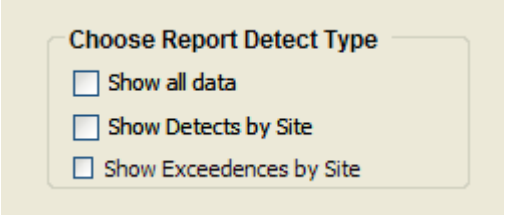


Now click **Select Reports for Export** and the table that lists all the site and matrix combinations for the dataset opens. Simply select each combination to generate a cross-tab report.



keep	Site	Matrix
☐	Active	SO
☐	Active	ST
☐	Active	WG
☐	Inactive	SO
☐	Inactive	ST
☐	Inactive	WG
☐	Levee	WG
☑	Magellan	SO
☐	Texwood	WG
☐	Unidentified	SO
☐	Unidentified	WG
☐		

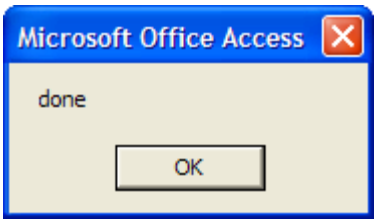
Close the table when done with selection. There are different ways to generate the cross-tab reports. In the **Choose Report Detect Type** section, the options are to (1) **Show All Data**, which shows all detect and non-detect data, (2) **Show Detects by Site**, which shows only the detects per site (if an analyte is detected in one sample, then all results for that analyte are shown for all the other samples), and (3) **Show Exceedances by Site,** which shows only the data that exceed the screening levels per (if an analyte is detected in one sample, then all results for that analyte are shown for all the other samples). In all reports, the exceedances are shaded in gray, and the detects are bolded. Check the appropriate "report detect type" needed. The report will need to be rerun for each type needed.



In the **Choose Flag Display Type** section, the options are to (1) **Combine Result and Flag,** which puts the result and the flag in the same field, (2) **Combine Result and Flag, append all selected screening levels**, which puts the result and the flag in the same field and appends all selected screening levels, and (3) **Result and Flag in Separate Fields**, which

puts the result and the flag in the two fields for each sample. Check off the flag display type needed. The report will need to be rerun for each type needed.

Finally, to create the report, click on the Export Reports to C:\. **Remember, do not have Excel open when creating the reports or there will be errors**. When all reports have been generated, a pop-up opens stating that the selected reports are now out on the C:\ drive.



Sometimes, when generating a number of reports, Excel might have problems and the reports cannot be opened. When this happens, make sure Excel is closed, and click on the **Fix Excel** button and processing should continue. When finished generating reports, simply **Exit** the program.

Appendix D
Electronic Data Deliverable Specifications

NavySpec7 EDD Specification Table						
Field Number	**Field Name**	**Data Type**	**Data Length**	**Rqmt**	**VVL**	**Description and Comments**
1	VersionCode	text	15	R	Y	Code identifying the NavySpec7 version. Value is 1.02
2	LabName	text	20	R	Y	Identification code for the laboratory performing the work. This value is used to distinguish among different facilities.
3	SDG	text	15	R	N	Sample delivery group designation. Always populated for all samples, including QC. The value in this field must match the filename.
4	FieldID	text	35	R	N	Client sample ID as appears on COC (COC may indicate MS and SD suffixes) with optional lab-assigned suffixes and/or prefixes to make it unique. A FieldID may have a suffix from the COC and another suffix from the laboratory (such as MSMS). If the sample identifier on the COC and the prefix/suffix is greater than 35 characters, abbreviate the value but make it unique. For laboratory QC samples (i.e., method blanks, lab control samples), use a unique lab sample identifier. Intended for internal laboratory use.
5	NativeID	text	30	R	N	Client sample ID, <u>exactly</u> as on the COC. <u>No</u> prefix or suffix allowed on client sample IDs except those that are on the COC. Used to identify the native sample from which other samples are derived (e.g., QAQCType = “LR”, “MS”, or “SD”). For laboratory QC samples (i.e., method blanks, lab control samples), use the FieldID value that was assigned. However, for lab blank spike duplicate samples, use the FieldID value that was assigned to the associated lab blank spike sample.
6	QAQCType	text	2	R	Y	This is the code for the sample type. Any field sample that is not used as lab QC and is not otherwise marked on the COC should have the designation of “N” (normal field sample). The QAQCType should be "MS" or "SD" if the laboratory spiked the sample. The QAQCType should be "LR" if the laboratory is performing a laboratory replicate. No suffix allowed (i.e., do not add numbers as suffixes to the QAQCType values).
7	LRType	text	4	C	Y	This is the code to identify the reason for duplicate results. Such reasons are dilutions , reanalyses, and re-extractions. Laboratory replicates (also known as laboratory duplicates or matrix duplicates) should also be indicated here.

NavySpec7 EDD Specification Table						
Field Number	**Field Name**	**Data Type**	**Data Length**	**Rqmt**	**VVL**	**Description and Comments**
8	Matrix	text	3	R	Y	Sample matrix code. Valid values are as follows: “AIR”, “SO”, “AQ”, "TIS" unless otherwise provided by the project data manager and marked on the COC. The use of “liquid”, “solid”, etc. for lab QC is not allowed.
9	LabSampleID	text	25	R	N	Laboratory sample ID that is assigned by the laboratory. Prefix or suffix is allowed. This is where dilutions or re-extractions are noted. Ex: “D97-11111RE” is acceptable.
10	AnalysisMethod	text	25	R	Y	Analysis method code. This is the identifier of the analytical method that was performed on the sample. Example: SW8260A. Generic names such as “EPA” should not be used. Note that the leachate method is sometimes incorporated into the analysis method valid value (such as 1311-6010).
11	ExtractionMethod	text	25	R	Y	Preparation method code. A value in this field is required. If the preparation is described in the method, use “METHOD”. If there is no separate preparation required, use “NONE”.
12	SampleDate	date		C	N	Date of sample collection. Value is required for all samples sent to the laboratory and samples derived from those samples. Format: mm/dd/yyyy
13	SampleTime	time		C	N	Time of sample collection. Value is required for all samples sent to the laboratory and samples derived from those samples. 24-hour format: hh:mm
14	ReceiveDate	date		C	N	Date of sample receipt in the lab. Value is required for all samples sent to the laboratory and samples derived from those samples. Format: mm/dd/yyyy
15	ExtractDate	date		C	N	Date of sample preparation (extraction or digestion). Value is required if the ExtractionMethod field value is other than “NONE”. Format: mm/dd/yyyy
16	ExtractTime	time		C	N	Time of sample preparation. Value is required if the ExtractionMethod field value is other than “NONE”. 24-hour format: hh:mm
17	AnalysisDate	date		R	N	Date of sample analysis. Value is required for all records. Format: mm/dd/yyyy

NavySpec7 EDD Specification Table						
Field Number	**Field Name**	**Data Type**	**Data Length**	**Rqmt**	**VVL**	**Description and Comments**
18	AnalysisTime	time		R	N	Time of sample analysis. Value is required for all records. 24-hour format: hh:mm
19	PercentSolids	number		R	N	Percent solids within the sample. Should be zero for water samples.
20	LabLotCtlNum	text	10	C	N	Identifier of an autonomous group of environmental samples and associated QC samples **prepared** together. For example, its value can be a digestion or extraction batch ID. If there is no separate extraction or preparation performed, leave this field blank.
21	CAS	text	20	R	Y	CH2M HILL assigned CAS number of analyte from ParamID valid value list. Surrogates and TICs are not subject to valid values. Note new valid values for dissolved TCLP, SPLP, and SEM parameters.
22	ParamID	text	25	R	Y	Parameter identifier code for the parameter listed in the Analyte field. Surrogates and TICs are not subject to valid values. Note new valid values for dissolved TCLP, SPLP, and SEM parameters.
23	Analyte	text	60	R	Y	Name of analyte, chemical name. Surrogates and TICs are not subject to valid values. Note new valid values for dissolved TCLP, SPLP, and SEM parameters.
24	Result	text	10	R	N	Result of the analysis. Surrogate analytes will be reported in units of percent. All others will be reported in sample concentration units. If undetected, report the adjusted RL. (Reported as a text field to preserve significant figures.)
25	ExpectedValue	number	10	C	N	“100” for surrogates; “0” (zero) for blanks; spike level plus parent result for LCS, and MS/MSD; parent value for lab duplicate; etc.
26	Units	text	25	R	Y	Units of measure used in the analysis. Report “PCT_REC” for surrogate analytes and concentration units for all others.
27	Dilution	number		R	N	Total dilution reported in the analysis. Default value should be 1 (one). This value should reflect changes to sample preparation amounts as defined by the method (e.g., less sample used for standard VOC analysis).

NavySpec7 EDD Specification Table						
Field Number	**Field Name**	**Data Type**	**Data Length**	**Rqmt**	**VVL**	**Description and Comments**
28	MDL	number		C	N	Minimum detection limit adjusted for preparation and dilution. Note that this value may be the method detection limit or the instrument detection limit, depending on the method and the project requirements. This value is **not** adjusted for percent moisture.
29	RL	number		C	N	Reporting limit adjusted for preparation and dilution. Value is **not** adjusted for percent moisture.
30	LabQualifier	text	6	R	N	Lab qualifier for the results, as reported on the hard copy. Use “=” as the only qualifier value for detected results if there are no other qualifiers for the result.
31	Surrogate	text	1	R	Y	Is the chemical a surrogate? Report “Y” for yes or “N” for no.
32	Comments	text	240	O	N	Comment field
33	ParValUncert	text	16	C	N	Radiological parameter value uncertainty.
34	Recovery	number		C	N	Percent recovery for MS, SD, LCS, LCSD, and surrogate compounds.
35	LowerControlLimit	number		C	N	Lower control limit value for spiked compounds, expressed in units of Percent. A value in this field is required if there is a value in the Recovery field (Field No. 34).
36	UpperControlLimit	number		C	N	Upper control limit value for spiked compounds, expressed in units of Percent. A value in this field is required if there is a value in the Recovery field (Field No. 34).
37	Basis	text	3	R	Y	Weight basis for sample analysis.
38	ConcQual	text	1	R	Y	Concentration qualifier. Use "U" for undetected result, "J" for detects less than RLAdjusted, "=" for results greater than or equal to the RLAdjusted and within the calibration range, and "E" for results that exceed the calibration range.
39	MDLAdjusted	number		C	N	Minimum detection limit adjusted for preparation, dilution **and percent moisture**. See the description of the MDL field (Field No. 28) for an explanation of the contents of this field.
40	RLAdjusted	number		C	N	Reporting limit adjusted for preparation, dilution **and percent moisture**. Equivalent to PQL

NavySpec7 EDD Specification Table						
Field Number	**Field Name**	**Data Type**	**Data Length**	**Rqmt**	**VVL**	**Description and Comments**
41	SampleDescription	text	30	O	N	Full sample identifier value as it appears on the COC. In some cases, this may be the name of the sampling location instead of the sample. Required for all samples that are either collected in the field and specified on the COC, or derived from samples that are collected in the field and specified on the COC.
42	LeachMethod	text	25	R	Y	Analytical method used for leaching the sample. This applies to TCLP, SPLP, or other leaching or pre-extraction leaching procedures. Use “NONE” if the sample was not leached.
43	LeachDate	date		C	N	Date that the leaching method was performed (start date for multi-date leaching procedures). Value is required if the LeachMethod field value is other then “NONE”. Format: mm/dd/yyyy.
44	LeachTime	time		C	N	Time that the leaching procedure started. Value is required if the LeachMethod field value is other then “NONE”. 24-hour format: hh:mm.
45	LeachLot	text	10	C	N	Identifier of an autonomous group of environmental samples and associated QC samples **leached** at the same time. Value is required if the LeachMethod field value is other then “NONE”. If the sample was not leached, leave this field blank.
46	AnalysisLot	text	10	R	N	Identifier of an autonomous group of environmental samples and associated QC samples **analyzed** together. A value in this field is mandatory (i.e., it should not be blank).
47	CalRefID	text	10	C	N	Identifier of a group of environmental and QC samples linked by a common set of calibration records. All results with the same CalRefID value will have had the same initial calibration run.

Appendix D
Standard Operating Procedures—CompuChem

Laboratory SOPs are proprietary and confidential.
They are provided upon request at the discretion of the Project Manager.

Appendix E
Response to Comments
Draft UFP-SAP for the Expanded Soil and Groundwater Background Study

Response to Comments
Draft UFP-SAP for the Expanded Soil and Groundwater Background Study
Marine Corps Base Camp Lejeune, North Carolina

PREPARED FOR:	Bob Lowder, MCB CamLej Charity Rychak, MCB CamLej Dave Cleland, NAVFAC Mid-Atlantic Gena Townsend, EPA Region 4 Randy McElveen, NCDENR
PREPARED BY:	CH2M HILL
DATE:	June 23, 2010

Introduction

The purpose of this document is to address comments on the Draft UFP-SAP – Expanded Soil and Groundwater Background Study. The North Carolina Department of Environment and Natural Resources (NCDENR) Superfund Section and the United States Environmental Protection Agency (USEPA) provided the comments listed below. Responses to comments are provided in bold.

NCDENR Comments (dated May 13, 2010)

1. The Soil Screening Standards listed in SAP Worksheets #15-1 through #15-6 should be updated to the new NC Superfund, Federal Remediation Branch (FRB) Tables. The updated FRB Tables reflect the EPAs updated Maximum Contaminant Levels (MCLs) date December 2009 and the NC DENR updated Groundwater Quality NCAC 2L Standards dated January 2010. Please make the appropriate corrections in the Final SAP Work Plan.

   UFP-SAP Worksheets #15-1 through #15-6 will be updated with the Soil Screening Standards in the January 2010 Federal Remediation Branch Tables.

2. The SOP for low-flow groundwater sampling from monitoring wells is provided in Appendix B. The instructions in step nine on page 2 is acceptable and appropriate. However, as previously discussed with the partnering team, a purge rate less than 0.3 liters per minute often does not provide a representative groundwater sample from the aquifer. This is especially true if the screened interval of the monitoring well is greater than 5 feet in length. These extremely low purge rates provide discrete interval samples of the groundwater.

   I acknowledge the White Paper on Low-Flow Sampling at the end of this section of the SOP and generally agree with these procedures. Every effort should be made to complete purging and sampling of monitoring wells consistent with these procedures. However, issues of volatilization are minor compared to the issue of discrete sampling of the aquifer and missing the more permeable section of the aquifer and thus the primary contaminant flow interval of the aquifer. If purging of the aquifer at rates less

than 0.3 liters per minute is required the well can be purged dry and sampled after recovery or other sampling methods should be considered (PDBs, etc.).

In general, if the water table drops slightly then we know that the entire screened interval is being purged and therefore a representative sample is being collected. This would be true of all types of aquifers even fine grained aquifers.

The first round of groundwater sampling has been completed. The standard operating procedure for low-flow groundwater sampling was followed and all wells were purged at a rate greater than or equal to 0.3 liters per minute (lpm) with the exception of one well (MW-02). This well was purged at a final rate of 0.2 lpm but had been purged at a higher rate prior to sampling and experienced draw-down.

During subsequent rounds of groundwater sampling for the Expanded Base Background Study, wells will be purged at a rate greater than or equal to 0.3 lpm when possible.

USEPA Comments (dated June 16, 2010)

1. SAP Worksheet #3, the email address for the EPA representative is incorrect (last name is misspelled).

   The email address will be corrected.

2. SAP Worksheet #10 "background groundwater" question should state that locations are upgradient of any known waste sites (this would also include the UST areas).

   UFP-SAP Worksheet #10 will be revised to state that monitoring wells will be installed at locations hydraulically upgradient of any known waste sites (including underground storage tank areas).