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MCB CAMP LEJEUNE
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FINAL SAMPLING AND ANALYSIS PLAN FOR INTRUSIVE INVESTIGATION UXO 2 AND 14

MCB CAMP LEJEUNE NC

11/01/2011

CH2M HILL

SAP Worksheet #1: Title and Approval Page

Final

Sampling and Analysis Plan

Intrusive Investigation for Military Munitions Response Program; Sites Unexploded Ordnance (UXO)-02 - Former Unnamed Explosive Contaminated Range (ASR #2.20) and UXO-14 - Former Indoor Pistol Range (ASR #2.199) and Former Gas Chamber (ASR #2.200)

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

November 2011

Prepared for:

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

Prepared under:
NAVFAC CLEAN 1000 Program
Contract N62470-08-D-1000
CTO-WE41

Prepared by:

CH2MHILL

Knoxville, Tennessee

Review Signature: July 28, 2011

Keith LaTorre, Date
CH2M HILL – Project Manager

8/17/11

Chris Bozzini Date
CH2M HILL – Activity Quality Manager

Approval Signature:

Jan Nielsen Date
NAVFAC Atlantic – Chemist/QA Officer

Other Approval Signature: 17 Aug 2011

Dave Cleland Date
NAVFAC Mid-Atlantic – Remedial Project Manager

8/17/11

Gena Townsend Date
USEPA Region 4 – Remedial Project Manager

Marti Morgan 8/17/2011

Marti Morgan Date
NCDENR – Remedial Project Manager

Executive Summary

This document presents the plan for the intrusive investigation including environmental sampling at Site Unexploded Ordnance (UXO)-02, Former Unnamed Explosive Contaminated Range (ASR #2.20) and UXO-14, Former Indoor Pistol Range (ASR#2.199) and Former Gas Chamber (ASR#2.200), herein referred to as Site UXO-02 and UXO-14, located at MCB Camp Lejeune (MCB CamLej) in Jacksonville, North Carolina.

CH2M HILL prepared this document under the U.S. Navy, Naval Facilities Engineering Command (NAVFAC) Atlantic Division, Comprehensive Long-Term Environmental Action - Navy (CLEAN) 1000 Contract N62470-08-D-1000, Contract Task Order WE41 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 *Site Management Plan, Fiscal Year 2010, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina* (CH2M HILL, 2010a) provides additional information and background on MCB CamLej. This intrusive investigation will be conducted under Contract Task Order WE41, Modification 2.

Environmental Conservation Laboratories, Jacksonville and Orlando, Florida, as well as GEL Laboratories, Charleston, South Carolina will be responsible for analyzing environmental samples from Site UXO-02 and UXO-14. If additional laboratory services are requested requiring modification to the existing sampling and analysis plan (SAP), revised SAP worksheets will be submitted to the Navy and regulatory agencies for approval.

The primary objective of this SAP is to further characterize previously identified potential human health and ecological risks at Site UXO-02 and UXO-14. At Site UXO-02, surface soil and sediment sampling will be performed to advance the baseline ecological risk assessment (BERA) that was initiated for Site 69 for pesticides. Additionally, groundwater sampling and analysis for metals at Site UXO-02 will be performed to further assess risks posed by metals in shallow groundwater, identified during the Preliminary Assessment/Site Inspection (PA/SI). At Site UXO-14, surface and subsurface soil sampling will be performed to determine the nature and extent of antimony, lead, and mercury contamination identified during the PA/SI in the Former Indoor Pistol Range area. If munitions and explosives of concern (MEC) is identified and destroyed at either site, surface soil samples will be collected to evaluate impact by munitions constituents (MCs) resulting from demolition. Analytical data from these sampling efforts will be used to determine if additional assessment or interim action is warranted.

UFP-SAP Outline

This SAP consists of 37 worksheets specific to the UFP-SAP. All tables are embedded within the worksheets.

Field standard operation procedures (SOPs) are included in Attachment 1. Data management guidelines are included in Attachment 2 and Department of Defense (DoD) Environmental Laboratory Accreditation Program (ELAP) Accreditation Letters are included in Attachment 3. The Environmental Protection Plan is contained in **Chapter 8 of the Work Plan**. The Accident Prevention Plan/Health and Safety Plan (APP/HSP) is **Appendix A of the Work Plan**. Upon approval of this Draft UFP-SAP, the sampling activities will be scheduled and executed.

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SAP Worksheets

Figures

Attachments

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Acronyms and Abbreviations

AHA	activity hazard analysis
APP	accident prevention plan
AQM	Activity Quality Manager
ASR	archive search report
BERA	baseline ecological risk assessment
BHC	benzene hexachloride
CA	corrective action
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
COC	contaminant of concern
COPC	constituent of potential concern
COPEC	constituent of potential ecological concern
CSM	conceptual site model
CTO	Contract Task Order
CVOC	chlorinated volatile organic carbon
CWM	chemical warfare materiel
DCE	dichloroethene
DDT	dichlorodiphenyltrichloroethane
DGM	digital geophysical mapping
DO	dissolved oxygen
DoD	Department of Defense
DPT	direct push technology
DQI	data quality indicator
DQO	data quality objective
DV	data validation
ELAP	Environmental Laboratory Accreditation Program
ERS	ecological risk screening
FS	feasibility study
FTL	field team leader
GC	gas chromatograph
GPS	Global Positioning System
GW	groundwater
HE	high explosive
HHRS	human health risk screening
HSP	health and safety plan
ICP	Inductively Coupled Plasma
IDW	investigation-derived waste
IEUBK	Integrated Exposure Uptake Biokinetic
LCS	laboratory control sample
LIMS	Laboratory Information Management Systems

MC	munitions constituents
MCB CamLej	Marine Corps Base Camp Lejeune
MCL	maximum contaminant level
MDL	method detection limit
MEC	munitions and explosives of concern
MPPEH	material potentially presenting and explosive hazard
MQO	measurement quality objectives
MS/MSD	matrix spike/matrix spike duplicate
mV	millivolt
NAVFAC	Naval Facilities Engineering Command, Mid-Atlantic
NCDENR	North Carolina Department of Environment and Natural Resources
ORP	oxidation reduction potential
PA/SI	preliminary assessment/site investigation
PAL	project action limit
PC	project chemist
PCBs	polychlorinated biphenyls
PE	Professional Engineer
PETN	pentaerythritol tetranitrate
PG	Professional Geologist
PM	Project Manager
PQL	project quanitation limit
PQO	project quality objective
QA	quality assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	quality control
QL	quantitation limit
QSM	Quality Systems Manual
RPD	relative percent difference
RPM	Remedial Project Manager
RSD	relative standard deviation
RT	retention time
SAP	sampling and analysis plan
SB	subsurface soil
SD	sediment
SOP	standard operating procedure
SS	surface soil
SSC	site safety coordinator
SVOC	semivolatile organic compounds
SW	surface water
TAL	target analyte list
TBD	to be determined
TCE	trichloroethene
TOC	total organic carbon

UCL	upper confidence limit
UFP	Uniform Federal Policy
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UXO	unexploded ordnance
VC	vinyl chloride
VOC	volatile organic compounds
WQP	water quality parameter

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SAP Worksheet #2: Sampling and Analysis Plan Identifying Information

Site Name/Number: Site UXO-02 and Site UXO-14

Operable Unit: N/A

Contractor Name: CH2M HILL

Contract Number: N62470-08-D-1000

Contract Title: Navy Comprehensive Long-Term Environmental Action Navy (CLEAN) 1000

Work Assignment Number (optional): Contract Task Order (CTO) WE41

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

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

3. This SAP is a **project-specific** SAP.
4. List organizational partners (stakeholders) and identify the connection with lead organization:
   - North Carolina Department of Environment and Natural Resources (NC DENR)– regulatory stakeholder
   - USEPA Region 4 – regulatory stakeholder
   - NAVFAC Mid-Atlantic – lead organization
   - MCB CamLej – site owner
5. Lead organization: U.S. Department of Navy – Lead Agency
6. If any required SAP elements and required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below:

   Crosswalk table is excluded, as all required information is provided in this SAP.

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SAP Worksheet #3: Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
Dave Cleland	Navy Technical Representative (NTR)	NAVFAC Mid-Atlantic	(757) 322-4851	david.t.cleland@navy.mil
Charity Rychak	Environmental Engineer	MCB CamLej- Environmental Management Division (EMD)	(910) 451-9386	charity.rychak@usmc.mil
Gena Townsend	Remedial Project Manager (RPM)	USEPA Region 4	(404) 562-8538	townsend.gena@epa.gov
Randy McElveen	UXO-02 RPM	NCDENR	(919) 707-8341	randy.mcelveen@ncdenr.gov
Marti Morgan	UXO-14 RPM	NCDENR	(919) 707-8342	martha.morgan@ncdenr.gov
Matt Louth	Activity Manager (AM)	CH2M HILL	(757) 671-6240	matt.louth@ch2m.com
Tom Roth	Senior MR Consultant /Activity Quality Manager (AQM)	CH2M HILL	(404) 474-7640	tom.roth@ch2m.com
Teg Williams	Senior Technical Consultant	CH2M HILL	(704) 543-3297	tegwyn.williams@ch2m.com
Keith LaTorre	Project Manager (PM)	CH2M HILL	(865) 769-3204	keith.latorre@ch2m.com
Lael Feist	Task Manager	CH2M HILL	(256) 529-7671	laelruth.feist@ch2m.com
Paul Favara	UFP-SAP Reviewer	CH2M HILL	(352) 384-7067	paul.favara@ch2m.com
Carl Woods	Health & Safety (H&S) Manager	CH2M HILL	(513) 889-5771	carl.woods@ch2m.com
Roni Warren	Human Health Risk Assessor (HHRA)	CH2M HILL	(814) 364-2454	roni.warren@ch2m.com
Jonathon Weier	Ecological Risk Assessor (ERA)	CH2M HILL	(770) 485-7503	jonathon.weier@ch2m.com
To be determined (TBD)	Field Team Leader (FTL)/Site Safety Coordinator (SSC)	CH2M HILL		
Anita Dodson	Navy Program Chemist	CH2M HILL	(757) 671-6218	anita.dodson@ch2m.com
Bianca Kleist	Project Chemist	CH2M HILL	(704) 543-3274	bianca.kleist@ch2m.com
Troy Horn	Project Data Manager	CH2M HILL	(757) 671-6288	troy.horn@ch2m.com
Ronnie Wambles	Laboratory PM	ENCO Laboratories	(407) 826-5314	rwambles@encolabs.com

SAP Worksheet #3: Distribution List (continued)

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
Lori Mangram	Laboratory Quality Assurance Officer (QAO)	ENCO Laboratories	(407) 826-5314	lmangrum@encolabs.com
Ann Skradski	Laboratory PM	GEL Laboratories	(843)-556-8171	ann.skradski@gel.com
Robert Pullano	Laboratory QAO	GEL Laboratories	(843)-556-8171	bob.pullano@gel.com
Laura Maschoff	Data Validator	DataQual	(314) 330-1327	dataqual@charter.net

SAP Worksheet #4: Project Personnel Sign-Off Sheet

Name	Organization/Title/Role	Telephone Number	Signature/ email receipt	SAP Section Reviewed	Date SAP Read
Charity Rychak	MCB CamLej/ EMD	(910) 451-9386			
Matt Louth	CH2M HILL/ AM	(757) 671-6240			
Paul Favara	CH2M HILL / Navy CLEAN Program UFP-SAP Reviewer	(352) 384-7067			
Teg Williams	CH2M HILL/ Senior Technical Consultant	(704) 543-3297			
Keith LaTorre	CH2M HILL/PM	(865) 769-3204			
Lael Feist	CH2M HILL/Task Manager	(256) 529-7671			
Roni Warren	CH2M HILL/ HHRA	(814) 364-2454			
Jonathon Weier	CH2M HILL/ ERA	(770) 485-7503			
Carl Woods	CH2M HILL/ H&S Manager	(513) 889-5771			
Anita Dodson	CH2M HILL / Navy CLEAN Program Chemist	(757) 671-6218			
Bianca Kleist	CH2M HILL / Project Chemist	(704) 543 - 3274			
Troy Horn	CH2M HILL/ Project Data Manager	(757) 671-6288			
Ronnie Wambles	ENCO/PM	(407) 826-5314			
Lori Mangram	ENCO/QAO	(407) 826-5314			
Ann Skradski	GEL/ PM	(843) 556-8171			
Robert Pullano	GEL/QAO	(843) 556-8171			
Laura Maschoff	Dataqual/President	(314) 330-1327			

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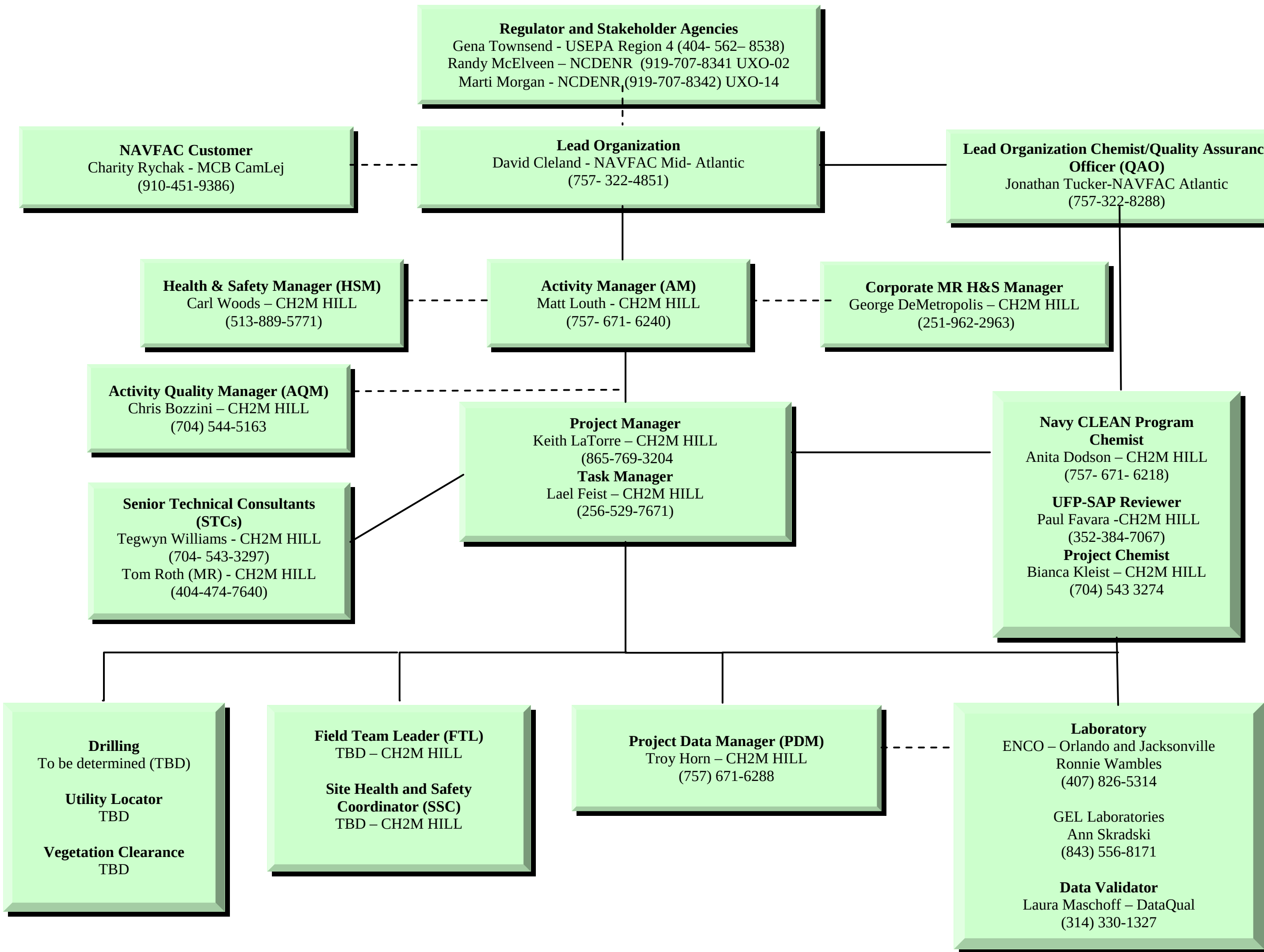
SAP Worksheet #5: Project Organizational Chart



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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	Dave 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 work plan 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 UXO-02 NCDENR RPM UXO-14	Randy McElveen Marti Morgan	Randy.McElveen@ncdenr.gov (919) 707-8341 martha.morgan@ncdenr.gov (919) 707-8342	Project 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.
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 24hrs. 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 Senior Consultants	Tom Roth Teg Williams	tom.roth@ch2m.com tegwyn.williams@ch2m.com	Contact senior consultant regarding questions/issues encountered in the field, input on data interpretation, as needed. Sr. Consultants will have 24 hrs to respond to technical field questions as necessary. Additionally, Sr. consultants will review of the data as necessary prior to partnering team discussion and reporting review.
Quality issues during project implementation and data interpretation	CH2M HILL AQM	Chris Bozzini	chris.bozzini@ch2m.com	Contact the AQM regarding quality issues during project implementation. The AQM will report to the AM and the NAVFAC Mid-Atlantic QAO.
Communications regarding project management and implementation	PM	Keith LaTorre	keith.latorre@ch2m.com	All information and materials about the project will be forwarded to the Navy, AM, and Senior Consultants as necessary. POC for field sampling team.

SAP Worksheet #6: Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure, Pathway, etc.
Coordinate activities between PM and Field Team / Sub-contractors	Task Manager	Lael Feist	laelruth.feist@ch2m.com	All field team and reporting activities will be forwarded to PM for further dissemination if necessary. Responsible for field team members' and subcontractors adherence to work plan.
Health and Safety (H&S)	CH2M HILL SSC	TBD		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.
Work Plan or QAPP changes in field/ Field Progress Reports	FTL	TBD		Documentation of deviations from the Work Plan will be made in the field logbook (made with the approval of AM and/or QAO) and the PM will be notified immediately. Provide daily progress reports to PM. Deviations will be made only with approval from the PM.
Communication regarding risk assessments	Human Health and Ecological Risk Assessors	Roni Warren (Human Health) Jonathan Weier (Ecological)	roni.warren@ch2m.com jonathon.weier@ch2m.com	Responsible for conducting risk assessments. Technical questions regarding this project must be answered within 24 hours.
Data tracking from field collection to database upload	PDM	Troy Horn	troy.horn@ch2m.com (757) 671-6288	Tracking data from sample collection through database upload.
Reporting Lab Data Quality Issues	Laboratory QAO	Lori Mangrum (ENCO) and Robert Pullano (GEL)	lmangrum@encolabs.com (407) 826-5314 Bob.pullano@gel.com (834) 556-8171	All QA/quality control (QC) issues with project field samples will be reported within 2 days to the PC by the laboratory.
Reporting Data Validation Issues	Data Validation (DV) PM	Laura Maschoff	dataqual@charter.net (314) 330-1327	All data validation issues regarding resubmissions from the laboratory will be communicated to the CH2M HILL project chemist and PDM.
Field and analytical corrective actions (CAs)	Project Chemist (PC)	Bianca Kleist	bianca.kleist@ch2m.com (704) 543-3274	Any 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	Project Chemist	Bianca Kleist	bianca.kleist@ch2m.com (704) 543-3274	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.

SAP Worksheet #7: Personnel Responsibilities Table

Name	Title/Role	Organizational Affiliation	Responsibilities
Dave Cleland	Navy Technical Representative	NAVFAC Mid-Atlantic	Oversees project
Charity Rychak	Environmental Engineer, Base Environmental Management Division	MCB CamLej	Oversees project
Gena Townsend	USEPA RPM	USEPA	USEPA POC
Randy McElveen	NCDENR RPM (UXO-02)	NCDENR	NCDENR POC (UXO-02)
Marti Morgan	NCDENR RPM (UXO-14)	NCDENR	NCDENR POC (UXO-14)
Matt Louth, PG	Activity Manager	CH2M HILL	Oversees project activities
Chris Bozzini	Activity Quality Manager	CH2M HILL	Oversees project quality
Paul Favara	Navy CLEAN Program UFP-SAP Reviewer	CH2M HILL	Navy CLEAN Program UFP-SAP Reviewer
Tom Roth, PE	Activity Quality Manager	CH2M HILL	Provides senior MR technical support for remedial action design and implementation
Tim Garretson	Senior Technical Consultant (Munitions Response)	CH2M HILL	Provides senior MR technical support for MEC
Teg Williams, PG	Senior Technical Consultant	CH2M HILL	Provides senior technical support for field investigations and implementation
Carl Woods	H&S Manager	CH2M HILL	Prepares H&S Plan; manages H&S for all field activities
Keith LaTorre	Project Manager	CH2M HILL	Manages Project and coordinates project tasks and project staff
Lael Feist	Task Manager	CH2M HILL	Manages project tasks and coordinates between field Team and PM
TBD	FTL/SSC	CH2M HILL	Coordinates all field activities and sampling/ Oversees H&S for all field activities
Anita Dodson	Navy CLEAN Program Chemist	CH2M HILL	Provides UFP-SAP project delivery support, provides senior review of UPF-SAP prior to submittal to Navy, and performs data evaluation and QA oversight
Bianca Kleist	Project Chemist	CH2M HILL	Communicates with laboratory and data validator
Troy Horn	Project Data Manager	CH2M HILL	Data Management, manages sample tracking
Ronnie Wambles	PM	ENCO	Manages sample tracking and maintains good communication with PC and PDM
Lori Mangrum	Laboratory QA Officer	ENCO	Responsible for audits, CA, checks of QA performance within the laboratory
Ann Skradski	PM	GEL	Manages sample tracking and maintains good communication with PC and PDM
Robert Pullano	Laboratory QA Officer	GEL	Responsible for audits, CA, checks of QA performance within the laboratory
Laura Maschoff	DV	DataQual	Validate data received from laboratory 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
UXO Safety	UXO Safety (unexploded ordnance) Training Package	Registered training CH2M HILL online (UXO Safety-USAF)	Annually	PM and all field staff	FTL, field team members / CH2M HILL	CH2M HILL HSE

[a] - 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: CTO-WE41 Intrusive Investigation of Site UXO-02 and Site UXO-14	
Projected Date(s) of Sampling: July-August 2011	**Site Name:**UXO-02 and UXO-14 CamLej
PM: Keith LaTorre	**Site Location:** CamLej, Jacksonville, North Carolina

Dates of Session: May 19, 2011
Scoping Session Purpose: The purpose of the scoping session was to present the Site UXO-01 (ASR#2.23), UXO-01 (ASR#2.79a ,b, and c), UXO-02, UXO-07, UXO-11, UXO-14, and UXO-21 intrusive investigation scope of work to the CamLej Project Team and reach a consensus on the project approach.

Name	Title	Affiliation	Phone #	E-mail Address	Project Role
Dave Cleland	RPM	NAVFAC Mid-Atlantic	757-322-4851	david.t.cleland@navy.mil	Primary Navy POC
Charity Rychak	RPM	EMD EMC CamLej	910-451-9386	charity.rychak@usmc.mil	CamLej Navy POC
Gena Townsend	RPM	USEPA	404-562-8538	townsend.gena@epa.gov	EPA oversight lead
Randy McElveen	RPM	NCDENR	919- 707-8341	Randy.McElveen@ncdenr.gov	NCDENR MMRP oversight lead (UXO-02)
Marti Morgan	RPM	NCDENR	919- 707-8342	martha.morgan@ncdnr.gov	NCDENR MMRP oversight lead (UXO-14)
Matt Louth	CamLej Activity Manager	CH2M HILL	757 671-8311 x417	matt.louth@ch2m.com	Activity Manager for CamLej projects. Coordinates CH2M HILL projects at CamLej with Navy contacts.
Kim Henderson	Deputy CamLej Activity Manager	CH2M HILL	757-671-8311	kim.henderson@ch2m.com	Deputy Activity Manager for CamLej projects
Chris Bozzini	CamLej Quality Activity Manager	CH2M HILL	704-544-5163	Chris.bozzini@ch2m.com	Quality Activity Manager for CamLej projects

Comments/Decisions:

Consensus: The Team will receive and comment on work plans associated with the PA/SIs and ESIs presented in the session presentation. Any comments or changes in the investigation approach will be addressed by the team over the course of the field investigation. The Team agrees to initiate mobilization to complete the PA/SIs and Expanded SIs at UXO-01 (ASR#2.23), 01 (ASR#2.79a, b, c), 02, 07, 10, 11, 14, 21, 22, and 24.

Action Items: Prepare a Work Plan and UFP-SAP for review by the Project Team

Consensus Decisions: The Team agreed that the general approach for investigating UXO-01 (ASR#2.23), UXO-01 (ASR#2.79a ,b, and c), UXO-02, UXO-07, UXO-11, UXO-14, and UXO-21 is acceptable.

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SAP Worksheet #10: Conceptual Site Model

This worksheet is broken down into Worksheet #10-1 and Worksheet # 10-2 to provide conceptual site models for each site addressed by this document.

SAP Worksheet #10-1: Conceptual Site Model- Site UXO-02

The objective of this SAP is to guide the assessment of potential environmental impacts related to metals and pesticides resulting from munitions use and historical waste management practices within Site UXO-02 and to evaluate whether potential impacts warrant further assessment at Site UXO-02. This objective will be addressed by sampling and analysis of environmental media for chemicals of concern identified in previous investigations, and human health and ecological risk screening.

Background and Site History

Site UXO-02 is a 127-acre area located on military grid squares 7728 and 7828 (United States Army Corps of Engineers [USACE], 2001). It is accessed by entering the Tactical Landing Zone Owl Gate at Everett Creek Road located on NC Highway 210 immediately south of the Stone Bay Entrance and following the gravel access road (**Figure 10-1**). Operable Unit No. 14, Installation Restoration (IR) Site 69 is located within Site UXO-02.

Site 69, the Rifle Range Chemical Dump, a 14-acre area within site UXO-02, was historically used (from 1950 to 1976) for the disposal of chemical wastes, including polychlorinated biphenyls (PCBs), solvents, and pesticides. Based on available documentation, Site 69 may also have a history of chemical warfare materiel (CWM) disposal. Discarded M9 chemical agent (CA) detector kits were observed during a 1982 site visit (Water and Air Research, 1983). Formal documentation of disposal methods, particularly related to CWM, is unavailable. In a disposal single incident in 1953 or 1954 approximately 50 to 60 drums of suspected training agent were reportedly delivered to the Site and disposed of in two trenches, each approximately 20 feet deep. Another disposal incident occurred in 1970 when 5-gallon cans and 55-gallon drums of dichlorodiphenyltrichloroethane (DDT), trichloroethene (TCE), and calcium hypochlorite were placed together in a common pit. When soil was being placed over the containers, an explosion occurred, resulting in a brush fire and ejection of drums as far as 120 feet from the pit (Water and Air Research, 1983).

Soil and groundwater contamination resulting from chemicals disposed of at the Site 69 has been identified during past environmental investigations and subsequent investigations. The primary constituents at Site 69 are chlorinated volatile organic compounds (CVOCs) TCE and its daughter products cis-1,2-dichloroethene (cis-1,2-DCE) and vinyl chloride (VC) in groundwater.

Site UXO-02 was identified in the Final Range Identification and Preliminary Range Assessment as an unnamed range of unspecified use on a 1973 range map and on another range overlay maps as an "…unknown UXO contaminated area…" (USACE, 2001). The 1946 Range overlay map indicated that the location was Mortar Range "L-2", established in a 1945 Camp Training Order. However, by March 1946, it was disestablished and no longer used for firing live ammunition. Though USACE concluded that 60-millimeter (mm) and 81-mm mortar (practice, high explosive [HE] white phosphorus, illumination) may have been fired on Mortar Range "L-2" (USACE, 2001), a former Range Control Officer indicated Mortar Range "L-2" was used a Platoon/Squad maneuver range with mortar projectiles used for illumination (Redmond, 2011). As such, 60mm and 81-mm mortar, illumination and 40mm grenade, practice would have been

SAP Worksheet #10-1: Conceptual Site Model- Site UXO-02 (continued)

used on Mortar Range “L-2”. The firing position for Mortar Range “L-2” was located along the southern boundary of UXO-02, with impact trajectories due north into the New River.

The objective of the intrusive investigation is to assess the nature and extent of subsurface munitions and explosives of concern (MEC) that may be present within the site. In addition, environmental samples will be collected at site UXO-02 to further characterize previously identified potential human health and ecological risks.

SAP Worksheet #10-1: Conceptual Site Model – Site UXO-02 (continued)

Previous Site Investigations

The table below summarizes the historical and ongoing investigations at Site UXO-02, including investigations related to Site 69.

Table 10-1: Previous and ongoing investigations at Site UXO-02

Site 69 Investigation	Year	Media Investigated	Purpose of Investigation	Target Analytes	Activities	Aquifer	Results and Conclusions
Rifle Range WWTP and Chemical Dump Sampling (U.S. Navy, 1981; U.S. Navy, 1982)	1981, 1982	Groundwater (GW)/(surface water (SW)	Sample water supply wells, monitoring wells, and surface water to monitor for contaminants due to proximity to suspected dump site.	Volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), Pesticides, PCBs, Metals	Groundwater and surface water sampling.	NA	Elevated chlorinated VOCs, and trihalomethanes detected in groundwater samples collected from monitoring wells.
Initial Assessment Study (WAR, 1983)	1983	NA	Evaluate historical records for evidence of environmental releases.	All	Historical records review, site visits.	NA	Drums of suspected chemical agents, 5-gallon cans and 55-gallon drums of DDT, other pesticides, TCE sludge, wood preservative compounds, training agents, and PCBs. Disposal was reportedly in pits/trenches between 6 and 20 feet deep. At least 12 different occurrences of dumping have been documented.
Site Assessment Report (Confirmation Study) (ESE, 1992)	1984	GW/SW/SD	Verify and characterize the presence and/or absence of contamination at Site 69 by investigating environmental media.	VOCs, organochlorine pesticides, PCBs, pentachlorophenol, mercury, residual chlorine	Install 8 surficial aquifer monitoring wells IR69-GW01 through IR69-GW08 (1984) Sample: 8 surficial groundwater monitoring wells (all phases of investigation), surface water and sediment (all phases of investigation), and shellfish (1991 only).	Surficial	VOCs were detected in groundwater in the southern portion of the site near monitoring well IR69-GW02. The most significant compounds were: TCE, trans-1,2-DCE, and vinyl chloride detected in both IR69-GW02 and IR69-GW03. Lower concentrations of VOCs were detected in surface water and pesticides were detected in off-site sediment samples.
	1986	GW/SW/SD		1984 analyses, tetrachlorodioxin, xylene, MEK, MIBK, ethylene dibromide			
	1991	GW/SW/SD/ Shellfish		Full target compound list VOCs, SVOCs, pesticides, metals			

SAP Worksheet #10-1: Conceptual Site Model – Site UXO-02 (continued)

Site 69 Investigation	Year	Media Investigated	Purpose of Investigation	Target Analytes	Activities	Aquifer	Results and Conclusions
Remedial Investigation (Baker, 1997)	1992	Subsurface soil (SB)	Identify potential subsurface waste disposal areas.	NA	Conduct geophysical investigation in transects near suspected disposal trenches.	NA	The geophysical investigation indicated there is potential buried waste in the south and east portions of Site 69. VOCs were detected in the surficial, upper and middle Castle Hayne aquifer in the southern portion of Site 69. The highest concentrations were located near monitoring well IR69-GW15 cluster, which is the suspected source area. The human health risk assessment indicated that unacceptable risk from future residential use of groundwater existed. No unacceptable risk exists from exposure to site soils.
	January - March 1994	GW/Soil/SW/ SD/Biota	Assess the nature and extent of impacts in all site media resulting from historical site use.	VOCs, SVOCs, pesticides, PCBs, inorganics, and CWM degradation compounds	Collect 29 surface soil, 16 subsurface soil, 7 surface water and sediment samples. Sample surficial groundwater via hydro punch in 14 locations. Install surficial groundwater monitoring wells IR60-GW09 through IR69-GW12 (12.5 to 20 ft bgs), install upper Castle Hayne aquifer monitoring wells IR69-GW02DW (50 ft bgs), IR69-GW12DW (58 ft bgs). Sample all monitoring wells.	Surficial, Upper Castle Hayne	
	May 1994	GW	Vertically and horizontally delineate VOC impacts in groundwater.	VOCs	Install surficial monitoring well IR69-GW13 (13 ft bgs), upper Castle Hayne aquifer monitoring wells IR69-GW03DW and IR69-GW13DW (60 ft bgs), and middle Castle Hayne aquifer well IR69-GW02DD (125 ft bgs)	Surficial, Upper and Middle Castle Hayne	
	December 1994	GW	Horizontally delineate VOC impacts in groundwater in southern direction.	VOCs	Install and sample well cluster IR69-GW14 (14 ft bgs), GW14IW (62 ft bgs), and GW14DW (127 ft bgs).	Surficial, Upper and Middle Castle Hayne	

SAP Worksheet #10-1: Conceptual Site Model – Site UXO-02 (continued)

Site 69 Investigation	Year	Media Investigated	Purpose of Investigation	Target Analytes	Activities	Aquifer	Results and Conclusions
Remedial Investigation (Baker, 1997) (cont.)	January 1995	GW, SB	Locate the source area near IR-69-GW02 and delineate the northern boundary of VOC impacts in groundwater.	VOCs	Conduct geophysical investigation near well cluster IR69-GW02. Sample surficial groundwater using hydro punch in 9 locations near anomalies detected in the geophysics survey.	Surficial	
	March 1995	GW	Monitor source area groundwater.	VOCs	Install and sample well cluster IR69-GW15 (13 ft bgs) and IR69-GW15IW (60 ft bgs) near highest concentration of VOCs detected during hydro punch investigation.	Surficial, Upper Castle Hayne	
	September 1995	GW	Support treatment study, assess vertical concentrations of VOCs in source area.	VOCs	Install and sample upper Castle Hayne aquifer monitoring well IR69-GW15UW (37 ft bgs) and middle Castle Hayne aquifer monitoring well IR69-GW15DW (120 ft bgs).	Upper and Middle Castle Hayne	
	March - April 1996	GW	Vertically delineate VOCs in source area.	VOCs	Install and sample lower Castle Hayne aquifer monitoring wells IR69-GW15BCH, IR69-GW02BCH, and IR69-GW03BCH (230 ft bgs).	Lower Castle Hayne	

SAP Worksheet #10-1: Conceptual Site Model – Site UXO-02 (continued)

Site 69 Investigation	Year	Media Investigated	Purpose of Investigation	Target Analytes	Activities	Aquifer	Results and Conclusions
Treatability Study (Baker and SBP Technologies, 1998)	1996 - 1997	GW	Test in-well aeration as a remediation technology to remove VOCs in surficial and upper Castle Hayne aquifers.	VOCs	Phase I: Install UVB treatment system (UVB injection well screened at 35-40 and 66-70 ft bgs, and 12 monitoring wells to 45 and 75 ft bgs) and KGB treatment system (KGB injection well and 8 shallow monitoring wells to 9 and 12 ft bgs) to assess VOC removal and the zone of influence of each treatment system using dye tests and analytical sampling. Phase II: move UVB system to higher area of contamination (IR69-GW15UW), run both treatment systems and continue to monitor groundwater VOC concentrations.	Surficial, Upper Castle Hayne	The UVB system was successful in reducing high concentrations in the treatment well, subsurface litho logy prevented widespread treatment and the rate of decrease was low. The KGB system failed to operate and perform consistently due to formation material plugging the screens and sandpack. Overall in-well aeration was not recommended as a treatment for Site 69 groundwater VOC impacts.
Feasibility Study (Baker, 1998)	1997	Soil/GW	Identify and present remedial alternatives for Site 69 soils and groundwater contamination.	NA	Analyzed 2 soil remedial alternatives 1) no action and 2) institutional controls and 5 groundwater remedial alternatives 1) no action, 2) institutional controls and natural attenuation, 3) groundwater extraction and physical treatment with institutional controls and monitoring, 4) dual-phase vacuum	Surficial, upper and middle Castle Hayne	Removal of soil and waste material was not an option because indefinite storage of CWM contaminated materials was required and such storage was unavailable at the time of the Feasibility Study (FS).

SAP Worksheet #10-1: Conceptual Site Model – Site UXO-02 (continued)

Site 69 Investigation	Year	Media Investigated	Purpose of Investigation	Target Analytes	Activities	Aquifer	Results and Conclusions
					extraction and groundwater extraction and physical treatment, institutional controls and monitoring, and 5) In-situ air stripping with institutional controls and monitored natural attenuation.		
Interim Record of Decision (Baker, 2000)	2000	Soil/GW	Present selected interim remedy for Site 69 impacted media (soil and groundwater).	NA	Selected remedy for soil was institutional land use controls. Selected remedy for groundwater was institutional aquifer use controls and monitored natural attenuation.	Surficial, Upper, Middle and Lower Castle Hayne	Remedy included 5 years of quarterly sampling 24 monitoring wells screened in all aquifer zones, followed by 25 years of semi-annual sampling of 12 monitoring wells to be selected based on quarterly sampling results.
Long Term Monitoring (Engineering and Environment Inc., 2005)	1998-2005	GW	Present analytical results from long term monitoring of Site 69 groundwater.	VOCs	Collect groundwater from selected monitoring wells (surficial: IR69-GW01, -GW02, -GW03, -GW10, -GW12, GW13, GW14, GW15; upper Castle Hayne: IR69-GW02DW, -GW03DW, -GW12DW, -GW13DW, -GW14IW, -GW15IW and middle Castle Hayne: IR69-GW15DW).	Surficial, Upper and Middle Castle Hayne	VOCs were detected in Upper Castle Hayne aquifer samples, indicating that contamination was migrating vertically.

SAP Worksheet #10-1: Conceptual Site Model – Site UXO-02 (continued)

Site 69 Investigation	Year	Media Investigated	Purpose of Investigation	Target Analytes	Activities	Aquifer	Results and Conclusions
Supplemental Investigation	2010	Surface and subsurface soil, surface water, sediment, groundwater	Digital Geophysical Mapping (DGM) to delineate buried debris, environmental sampling to refine the nature and extent of impacted media	VOCs, semivolatile organic compounds (SVOCs), pesticides, PCBs, and metals. Real time screening for Chemical Agent (CA).		surficial, upper Castle Hayne, middle Castle Hayne, and lower Castle Hayne	Potential risks associated with future residential and industrial worker ingestion of groundwater from the surficial and upper Castle Hayne aquifers were above the USEPA's acceptable risk range and hazard level, but LUCs are in place that prohibit use of groundwater as drinking water. For ecological receptors, pesticides in soil and sediment were identified as posing a risk to lower trophic level receptors, but not to upper trophic level receptors, although the data set for sediments was limited. In surface soil, Endrin and gamma BHC (benzene hexachloride) were retained for further risk evaluation. In sediment, the pesticides 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-chlordane, dieldrin, endosulfan I, endosulfan sulfate, endrin, gamma-BHC (lindane), heptachlor, and methoxychlor potentially posed a significant risk to lower level receptors. Potential risks to lower trophic level receptors from pesticide exposure to groundwater discharging to the surface were identified. The pesticides contributing to the elevated risk include 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-chlordane, dieldrin, endosulfan I, endosulfan sulfate, endrin, gamma-BHC ,heptachlor, and methoxychlor. Recommended feasibility study and The specific recommendations included the completion of Step 3b (problem formulation development) to evaluate the distribution of pesticides, the potential for Site 69 to

SAP Worksheet #10-1: Conceptual Site Model – Site UXO-02 (continued)

Site 69 Investigation	Year	Media Investigated	Purpose of Investigation	Target Analytes	Activities	Aquifer	Results and Conclusions
							be the source of pesticides found in the downgradient areas, and their potential toxicity to site receptors.

Notes:

GW- groundwater

SW- Surface water

SD- sediment

NA- Not applicable

VOCs- volatile organic compounds

MEK-methyl ethyl ketone

MIBK-Methyl isobutyl ketone

PCB-Polychlorinated biphenyls

SVOC- Semi-Volatile Organic Compound

TCE-Trichloroethene

1,2 DCE-1,2-Dichloroethene

CWM - Chemical warfare materiel

SAP Worksheet #10-1: Conceptual Site Model –Site UXO-02 (continued)

Step 3b (Problem Formulation Development)

Step 3b of the USEPA Ecological Risk Assessment 8-step process was performed as part of the current work plan with data collected for Site 69.

The specific recommendations included the completion of Step 3b (problem formulation development) to evaluate the distribution of pesticides, the potential for Site 69 to be the source of pesticides found in the downgradient areas, and their potential toxicity to site receptors.

Endrin and gamma-BHC in surface soil remain constituents of potential ecological concern (COPECs) as a result of the Step 3b evaluation. Endrin and gamma-BHC are organochlorine pesticides. The other organochlorine pesticides detected in soil were not considered to pose risk. Because no organophosphates were detected in soil, additional soil sampling is only necessary for the organochlorine pesticides endrin and gamma-BHC.

All of the pesticides identified in Step 3a as COPECs in sediment for lower trophic level receptors (DDD, DDE, DDT, alpha chlordane, beta-BHC, delta-BHC, dieldrin, endosulfan I, endosulfan sulfate, endrin, gamma-BHC, gamma chlordane, heptachlor, and methoxychlor) remain as COPECs after the Step 3b evaluation. Additionally, gamma- chlordane was also considered to pose potential risk based on the identified surrogate screening value used in Step 3b. One organophosphate pesticide, monocrotophos, was detected at a concentration one to two orders of magnitude greater than other detected pesticides. While an ecological screening value (ESV) was not available to evaluate this analyte, it was retained as a COPEC because of the detected concentration.

PA/SI for Site UXO-02

A PA/SI was conducted in February and March 2010 for Site UXO-02 to evaluate the potential presence and nature of impacts to environmental media resulting from historical munitions use at the site, and to determine whether additional investigation and/or remediation activities were necessary.

A DGM survey completed in February 2010 covered approximately 10 percent (11.3 acres) of Site UXO-02. A total of 1,457 geophysical anomalies were identified within the survey area with a signal greater than 3 millivolts (mV) (shown on **Figure 10-2**). Approximately 21 percent of the detected anomalies (308 of the 1,457 total anomalies) were observed to be either cultural items or signal noise. The cultural items were associated with debris from roadways, power lines, or other trash/debris. A total of 1,149 anomalies were identified that could represent potential subsurface MEC.

Environmental sampling included collection of:

- 205 surface soil samples (0-2 inches bgs) collected from Site UXO-02 using the TR-02-1 approach.
- 31 subsurface soil samples collected from the unsaturated portion of the soil core collected using a DPT drilling rig at a depth immediately above the estimated water table during DPT soil boring.

SAP Worksheet #10-1: Conceptual Site Model –Site UXO-02 (continued)

- Groundwater samples collected from 28 temporary monitoring wells in UXO-02 and from 7 existing monitoring wells within the fenced perimeter of Site 69.
- Ten surface water and sediment samples each collected at co-located sites.

All samples were analyzed for explosives residues (including pentaerythritol tetranitrate [PETN] and nitroglycerine), perchlorate, and TAL metals. Additional analyses for dissolved metals were conducted for surface water samples and groundwater samples collected from 20 of the temporary monitoring wells within UXO-02, and from the 7 pre-existing wells located within the fenced area of Site 69.

The human health risk evaluation for Site UXO-02 concluded that exposure to surface soil and surface water at Site UXO-02 is not expected to result in unacceptable human health risks. In subsurface soil, sediment, and groundwater, the 95% UCL of the mean concentration resulted in a cumulative carcinogenic risk above the screening criteria, however, chromium was the main contributor to the carcinogenic risk associated with each media. The analytical data for chromium are for total chromium; however, the RSL used for the screening was for hexavalent chromium, the more toxic (and carcinogenic) form as compared to trivalent chromium. In the past, prior to including the New Jersey EPA oral cancer slope factor for hexavalent chromium in the table, USEPA’s RSL table presented a residential soil RSL for total chromium assuming a 1 to 6 ratio of hexavalent chromium to trivalent chromium. Assuming this ratio applies to subsurface soil, sediment, and groundwater, exposure to subsurface soil, sediment, and groundwater at Site UXO-02 were not expected to result in unacceptable human health risks.

The Integrated Exposure Uptake Biokinetic (IEUBK) model was used to determine that lead in groundwater at Site UXO-02 does not pose a health risk under residential use of the site. Since residential exposures are the most conservative, risks for any other potential receptor (i.e., construction worker) would be less than residential risks.

Based on the sample analysis for munitions constituents (MC), no significant risks to populations of ecological receptors were identified within Site UXO-02.

The report recommended that the 1,149 anomalies potentially representing subsurface MEC be investigated, that groundwater conditions should be additionally investigated under the ongoing Site 69 investigation, and that additional assessment of MC will be re-evaluated upon completion of the recommended intrusive investigation of geophysical anomalies.

SAP Worksheet #10-1: Conceptual Site Model –Site UXO-02 (continued)

Conceptual Site Model- Site UXO-02

A conceptual site model (CSM) is critical to the development of an investigation strategy. The following sections describe the site features, potential source areas and release mechanisms, and their relationship with surrounding environmental media and receptors. A hypothetical three-dimensional CSM for MCs at generic UXO sites is provided as **Figure 10-3**.

Physical Characteristics

The site topography ranges from low-lying gently undulating terrain to the north, deeply incised gullies in the south, and steep bluffs bordering the New River. The local topographic high, of roughly 36 feet above mean sea level, lies within the hummocky terrain of Site 69. The vast majority of Site UXO-02 is wooded with some areas supporting dense undergrowth and other areas with a high percent canopy closure and sparse understory. Much of the low-lying area is covered by wetlands that discharge into the New River. An unnamed tributary of the New River is located north of Site 69 and Everett Creek is located south of Site 69.

Site UXO-02 is underlain by clay and silt to very fine- to fine-grained sands of the surficial aquifer. The surficial aquifer consists of predominantly sandy lean clay in the northern portion of the site, grading to silty sand and poorly graded, fine-grained sand with lesser amounts of clayey sand and sandy silt toward the southern areas of the site. Below the surficial aquifer is the Belgrade Formation confining unit comprising of silty clays with lesser amounts of sand with thicknesses ranging from 12-30 feet and thinning towards the east. Below the Belgrade Formation are the sand and limestone aquifers of the Castle Hayne Formation (upper, middle and lower aquifers respectively). The Castle Hayne Formation ranges from approximately 30 ft bgs to greater than 230 ft bgs, the greatest depth drilled at Site 69 (CH2MHILL, 2010c).

The direction of shallow groundwater flow is north, south, east and west from the topographically high Site 69.

Release History and Potential Sources of Release

Potential sources of hazardous materials include the dumping area defined as Site 69, and potential sources of metals include munitions fired or discarded across the site. Site 69 was identified as a dumping area in the Initial Assessment Study (WAR, 1983) for suspected chemical agent and pesticides (see Table 10-1 for the site history).

Fate and Transport

MEC may be present on the surface and shallow subsurface. Soil and streambed erosion may expose subsurface MEC. Surface water may transport MEC onsite.

Metals may be present on the surface and in the shallow subsurface and could potentially release into surface water bodies and underlying sediments. Since no metals were identified in surface soil or sediments above screening criteria, it is likely that concentrations of metals in groundwater above screening criteria result from high turbidity in samples collected from temporary monitoring wells, however.

SAP Worksheet #10-1: Conceptual Site Model –Site UXO-02 (continued)

Pesticides may be present on the surface and in the shallow subsurface and could potentially release into surface water bodies and underlying sediments. The origin of pesticides would likely be from storage and disposal conducted within Site 69 and release from subsequent degradation of materials. The degraded material could be transported by erosional forces (surface water runoff and wind) to drainage features (e.g., wetlands) and deposited as sediments.

In addition, surface pesticides could potentially become dissolved by precipitation and along with subsurface contaminants, could subsequently leach through the vadose zone until reaching the water table. Thereafter, the dissolved pesticides could be transported through the aquifer by groundwater flux. The rate and direction of migration would be dependent upon the aquifer properties and chemical-specific characteristics.

Potential Receptors

The potential receptors for Site UXO-02 include: current military personnel, future residents (i.e., children and adults), and future construction workers. Exposure scenarios evaluated included: exposure to surface soil for current military personnel and future residents; exposure to subsurface soil for future construction workers; exposure to groundwater for future residents; exposure to constituents of potential concern (COPCs) from ingestion of fish for current and future recreational fishermen; and inhalation of airborne particles for future residents, future construction workers, and current military personnel.

Problem Definition

Past investigations indicate that pesticide contamination is present at Site 69 (within Site UXO-02), but no previous investigation has been conducted for the remaining areas of Site UXO-02. Past PA/SI activities in Site UXO-02 indicate that metals may exceed regulatory levels in groundwater. If one or more releases of pesticides or metals have occurred, it is unknown whether such release(s) pose a potentially unacceptable risk to human health and/or ecological receptors; therefore, further assessment is warranted.

SAP Worksheet #10-1 —Conceptual Site Model –Site UXO-02 (continued)

The environmental questions and problems to be addressed by the investigation are:

1. **Have there been releases of pesticides to soil?** This question will be addressed by collecting six surface soil samples from areas of UXO-02 outside the Site 69 fence line and submitting them for laboratory analysis. The grab soil samples will be collected as shown on **Figure 10-4.** Soil samples will be collected from depths of 0 to 2 inches bgs. Surface soil samples will be analyzed for the organochlorine pesticides endrin and gamma-BHC.

2. **Have there been releases of pesticides to sediment?** This question will be addressed by collecting up to twelve sediment samples will be collected from surface water drainage areas across Site UXO-02, as shown on **Figure 10-4**. Sediment samples will be analyzed for the organophosphate pesticide monocrotophos and organochlorine pesticides.

3. **Have there been releases of metals to groundwater?** This question will be addressed by collecting and analyzing groundwater samples from five new and five existing monitoring wells screened within the surficial aquifer. The five new monitoring wells will be constructed adjacent to areas where metals concentrations were detected above screening values in previous investigations (**Figure 10-5**). The actual monitoring well locations may be adjusted based upon site conditions (e.g., flooded areas) and access. Three selected samples collected from monitoring wells in proximity to surface water bodies will also be analyzed for dissolved metals and dissolved hexavalent chromium to assess transport pathways to surface water and sediment and availability to receptors.

4. **If MEPPH/MEC is disposed via detonation onsite or is observed with filler that appears to have leaked into adjacent soil, has a release of MC occurred?** To address this question, samples will be collected at locations where controlled detonations/blow-in-place (BIP) operations are conducted and at locations where MEC/material potentially presenting an explosive hazard (MPPEH) filler appears to have leaked into the adjacent soil. Composite surface soil samples will be collected using the TR-02-1 sampling approach in the resulting crater, and the incremental sampling method will be utilized to collect a sample from outside of the crater. In the instances where MEC/MPPEH is consolidated for controlled detonation and where it the MEC/MPPEH filler appears to have leaked to the adjacent soil, composite soil samples will be collected using the TR-02-01 sampling approach. Samples will be analyzed for explosives residues (nitroaromatics and nitroamines, PETN, nitroglycerin, perchlorate), and TAL metals.

5. **If releases are identified through environmental sampling and analysis, what is the appropriate next step?**

This determination will be made based on an evaluation of the analytical data in accordance with the decision analysis tree shown in Worksheet #11.

SAP Worksheet #10-2: Conceptual Site Model- Site UXO-14

The objective of this SAP is to guide the assessment of potential environmental impacts related to the metals: antimony, lead, and mercury at Site UXO-14 resulting from munitions use; and to evaluate whether potential impacts warrant further assessment at Site UXO-14. This objective will be addressed by sampling and analysis of antimony, lead, and mercury in site soils, and human health and ecological risk screening.

Site Background and History

Site UXO-14 includes two separate areas located west of Powder Lane in the Stones Bay area of MCB CamLej (**Figure 10-6)**. The eastern area of Site UXO-14, the Former Indoor Pistol Range area, includes approximately 0.09 acres of level terrain consisting of maintained grass and a loose sandy area in the vicinity of the former building footprint. Construction debris, unrelated to the site, was stockpiled but removed from the Former Indoor Pistol Range area prior to the 2009 PA/SI field activities. The building that comprised the Indoor Pistol Range appeared on base maps from 1950 until 1996. The Indoor Pistol Range appears in the 1962 and 1989 historical aerial photographs. According to Base Range Safety Officer Duane Richardson, the Indoor Pistol Range was only used for small arms training.

The western area of Site UXO-14, the Former Gas Chamber area, is approximately 0.04 acres in size and is heavily wooded with thick underbrush. The land surface within the Former Gas Chamber area slopes toward the south and west, toward an unnamed tributary of the New River. The Former Gas Chamber area been used for scrap metal storage, though none was present during the 2009 PA/SI field activities. Building RR-63, the former Gas Chamber, appeared on maps as a gas chamber from 1950 through 1954. After 1954 it was designated as storage and was present on maps until 1965. On the 1962 historical aerial photograph, the area is completely overgrown and Building RR-63 is not visible. The 1989 historical aerial photograph also shows the area as being heavily wooded. According to the *Final Range Identification and Preliminary Range Assessment,* it is assumed that tear gas was used at this facility (USACE, 2001).

The objective of the intrusive investigation is to assess the nature and extent of subsurface munitions and explosives of concern (MEC) that may be present within the site. In addition, environmental samples will be collected at the Site UXO-14 Former Indoor Pistol Range area to further characterize previously identified potential human health and ecological risks.

SAP Worksheet #10-2: Conceptual Site Model- Site UXO-14 (continued)

Previous Site Investigations

A PA/SI was conducted in 2009 for Site UXO-14 to evaluate the potential presence and nature of impacts to environmental media resulting from historical munitions use at the site, and to determine whether additional investigation and/or remediation activities were necessary. The PA/SI included a DGM survey over approximately 20 percent (approximately 0.008 acre) of the Former Gas Chamber portion of Site UXO-14 and environmental sampling for MC. The DGM survey yielded a total of 17 geophysical anomalies with a signal greater than 3 mV and representing potential subsurface MEC, primarily concentrated in the eastern half of the site (CH2M HILL, 2011c). **Figure 10-7** shows the DGM area and the distribution of anomalies representing potential subsurface MEC.

Environmental sampling for MC analysis within Site UXO-14 consisted of:

- 20 surface soil samples collected using the TR-02-1 approach at a depth interval of 0 to 2 inches bgs.
- Four subsurface soil samples from soil cores collected using a DPT rig.
- Four groundwater samples collected from temporary groundwater monitoring wells.

Soil samples collected from the Former Indoor Pistol Range area of Site UXO-14 were analyzed for TAL metals. Soil samples collected from the Former Gas Chamber area of Site UXO-14 were analyzed for SVOCs. Groundwater samples were analyzed for total and dissolved TAL metals (within the Former Indoor Pistol Range area of Site UXO-14 only) and SVOCs (within the Former Gas Chamber area of Site UXO-14 only).

Human health and ecological risk screening indicates that further investigation of Site UXO-14 is necessary to delineate the extent of elevated metals concentrations within the surface and subsurface soils at the Former Indoor Pistol Range area. Surface and subsurface soil exceedances of screening criteria are shown on **Figure 10-8** and **Figure 10-9,** respectively. Antimony, mercury (from ERS only), and lead were identified as COPCs in surface soils within the Former Indoor Pistol Range area during the ecological risk screening (ERS) and human health risk screening (HHRS) processes. Antimony and lead were identified as COPCs in subsurface soils within the Former Indoor Pistol Range area. The risk screening process indicated that the detected concentrations of SVOCs and metals in Site UXO-14 groundwater did not present an unacceptable risk to human health or ecological receptors. Additionally, the human health and ecological risk screening indicates that no unacceptable risk to human health or ecological receptors were identified for exposure to soil and groundwater within the Former Gas Chamber area of Site UXO-14.

Based on the DGM results, the report recommended that an intrusive investigation be performed to assess the nature of the geophysical anomalies representing potential subsurface MEC at the Former Gas Chamber area. It also recommended that additional sampling of MC be re-evaluated. Additional investigation was recommended to delineate extent of the identified impacts to surface and subsurface soil at the Former Indoor Pistol Range area.

SAP Worksheet #10-2: Conceptual Site Model- Site UXO-14 (continued)

Conceptual Site Model

The following sections describe the site features, potential source areas and release mechanisms, and their relationship with surrounding environmental media and receptors for Site UXO-14. Hypothetical three-dimensional CSM for MCs at generic UXO sites is provided as **Figure 10-3**.

Physical Characteristics

The former Indoor Pistol Range area is located on level terrain consisting of maintained grass and a loose sandy area representing the former building footprint. The former Gas Chamber area is heavily wooded with thick underbrush. The land surface within the former Gas Chamber area slopes toward the south and west, toward an unnamed tributary of the New River.

Based on soil cores collected during the PA/SI, subsurface geology at the site consists of shallow deposits at the site consist of discontinuous layers of fine-grained sediments consistent with the Undifferentiated formation. Particle sizes ranged from clays to fine-grained sands.

Site-specific hydrogeologic information was derived from the installation of four shallow temporary monitoring wells during the PA/SI. The temporary well depths for Site UXO-14 ranged from 15 to 18 ft bgs which were screened above the Castle Hayne confining unit in the surficial aquifer. In December 2009, groundwater flow in the surficial aquifer mimicked topography and generally flowed toward the southwest.

Potential Sources of Release

Potential sources of MC include soils formerly composing firing berms or backstops as well as expended or intact small arms ammunition.

Fate and Transport

Metals may be present on the surface and in the shallow subsurface and could potentially release into offsite surface water bodies and underlying sediments.

Potential Receptors

The potential receptors for Site UXO-14 include: visitors, trespassers, Base/industrial workers, and maintenance workers. Current receptors may come in contact with surface soil. Exposure routes may include incidental ingestion of and dermal contact with the surface soil and inhalation of volatile and particulate emissions from the surface soil.

Future site use is not expected to change significantly from current site use; therefore, potential future receptors include current receptors and construction workers who perform any future construction projects at the site. Additionally, although unlikely, future residents are included as a worst-case scenario, to evaluate unrestricted future site use. Future receptors could be exposed to surface and subsurface soil if future construction at the site were to result in re-working the soil and exposing the subsurface soil. Exposure routes for future exposure to the surface and subsurface soil are the same as those for current surface soil: incidental ingestion of

SAP Worksheet #10-2: Conceptual Site Model- Site UXO-14 (continued)

and dermal contact with the soil, and inhalation of volatile and particulate emissions from the soil.

Problem Definition

Past investigations indicate that antimony, lead, and mercury contamination is present at Site UXO-14 within Former Pistol Range area. If one or more releases of metals have occurred, it is unknown the nature and extent of area which presents potentially unacceptable risk to human health and/or ecological receptors; therefore, further assessment is warranted.

The environmental questions and problems to be addressed by the investigation are:

1. **Have there been releases of antimony, lead, and mercury to soil?** This question will be addressed by collecting fourteen surface soil and seven subsurface soil samples in and around the Former Pistol Range area and submitting them for laboratory analysis. Soil sampling locations are shown on **Figure 10-10**. Surface soil samples will be collected using the TR-02-1 sampling method. Surface soil samples will be collected by compositing a minimum of 30 sample increments from random locations within each 1m x 1m sampling location from depths of 0 to 2 inches. Seven subsurface soil samples will be collected from the unsaturated zone immediately above the water table (estimated at 5 feet below ground surface) by hand augering. Soil samples will be analyzed for antimony, lead, and mercury.

2. **If MEPPH/MEC is disposed via detonation onsite or is observed with filler that appears to have leaked into adjacent soil, has a release of MC occurred?** Although unlikely at a small arms range, if MEC/ MPPEH is identified and disposed onsite, samples will be collected at locations where controlled detonations/blow-in-place (BIP) operations are conducted and at locations where MEC/MPPEH filler appears to have leaked into the adjacent soil. Composite surface soil samples will be collected using the TR-02-1 sampling approach in the resulting crater, and the incremental sampling method will be utilized to collect a sample from outside of the crater. In the instances where MEC/MPPEH is consolidated for controlled detonation and where it the MEC/MPPEH filler appears to have leaked to the adjacent soil, composite soil samples will be collected using the TR-02-01 sampling approach. Samples will be analyzed for explosives residues (nitroaromatics and nitroamines, PETN, nitroglycerin, perchlorate), and TAL metals.

3. **If releases are identified through environmental sampling and analysis, what is the appropriate next step?**

This determination will be made based on an evaluation of the analytical data in accordance with the decision analysis tree shown in Worksheet #11.

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

This section presents the project quality objectives for the investigations at Site UXO-02 and UXO-14.

Who will use the data?

At Site UXO-02, the data will be used by the MCB CamLej project team to evaluate pesticide impacts to surface soil and sediment from onsite disposal activities and metal impacts to groundwater potentially from munitions use. At site UXO-14, the data will be used to evaluate metals impacts to surface and subsurface soils from small arms use. The data at both sites will be used to assess whether the potential releases warrant further assessment or action.

What are the project action limits?

The project action limits were developed by the project team and are based on established criteria, as summarized below:

<u>Site UXO-02</u>

Groundwater

1. In accordance with policy developed by the Project Team, groundwater analytical results for metals will be compared to two times the mean base background concentrations (Baker, 2002).
2. Groundwater analytical results will be compared to North Carolina Administrative Code (NCAC) 2L Groundwater Quality Standards (NCGWQS) (NCDENR, 2010b).
   - If a standard for a substance is less than the laboratory practical quantitation limit, the detection of that substance at or above the practical quantitation limit shall constitute a violation of the NCGWQS. The practical quantitation limit for this project is set at the laboratory limit of quantitation (LOQ).
3. Groundwater analytical results also will be compared to the adjusted U.S. Environmental Protection Agency (USEPA) regional screening levels (RSLs) for tap water (USEPA, 2011) and drinking water maximum contaminant levels (MCLs). The RSLs based on noncarcinogenic effects will be adjusted by dividing by 10 to account for exposure to multiple constituents; the RSLs based on carcinogenic effects will be used as presented in the USEPA RSL table.

Surface Soil

1. Surface soil analytical results also will be compared to the adjusted (as defined above) USEPA RSLs for industrial and residential soil (USEPA, 2011).
2. Surface soil analytical results also will be compared to the NCDENR Soil Screening Levels (SSLs) (NCDENR, 2011).

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

Sediment

Concentrations of target analytes detected in sediment samples will be compared to the USEPA RSLs for residential soil. The adjusted USEPA soil RSLs are the established screening criteria for sediment at MCB CamLej.

Site UXO-14

Surface and subsurface Soil

1. Subsurface soil analytical results also will be compared to the adjusted (as defined above) USEPA RSLs for industrial and residential soil (USEPA, 2011).
2. Subsurface soil analytical results also will be compared to the NCDENR Soil Screening Levels (SSLs) (NCDENR, 2010a).

What will the data be used for?

The data will be used to evaluate:

- Human health screening and ecological risk assessments, the nature of any contamination, its significance of release and if releases took place, and if so, whether further assessment or interim action is warranted.

What types of data are needed?

- Worksheet #10-1 and Worksheet #10-2 define the sample media and target analyte list to be used during this investigation of Site UXO-02 and Site UXO-14, respectively. Since previous investigations resulted in COPCs, the target analytes list for Site UXO-02 includes metals for groundwater, and the organochlorine pesticides endrin and gamma-BHC for surface soil and organochlorine pesticides, monocrotophos, and total organic carbon (TOC) for sediment; the target analytes list for Site UXO-14 includes selected metals: antimony, lead, and mercury for surface and subsurface soil.

- Water quality parameters, including field testing for pH, conductivity, oxidation-reduction potential, dissolved oxygen, temperature, and turbidity, will be measured during the purging of the monitoring wells and sampling of surface water at Site UXO-02.

- Lithologic logging of soil cuttings will be conducted during drilling operations at Site UXO-02. The logging activities will facilitate selection of well screen intervals and will supplement the CSM.

- Surface and subsurface soil and sediment sample locations will be recorded by hand-held global positioning system (GPS) devices during environmental sampling activities. Following sample collection, the Site UXO-02 monitoring well locations and elevations will be surveyed by a NC-licensed surveyor. Field activities will be recorded in a field notebook to document adherence to the approved work plan. The CH2M HILL "Preparing Field Log Books SOP" located in **Attachment 2** describes the documentation required for log book completion.

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

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

- Laboratory analytical data will be distributed to a third-party validator for data quality evaluation. Data validation procedure requirements are detailed in Worksheet #36. The data needs to be of sufficient quality for determining the concentration of constituents in media samples such that the project objectives can be achieved.
- Visual observations (soil saturation, staining etc.) will be used to determine appropriate well screen placement for groundwater sampling at Site UXO-02 and to help select subsurface soil sampling intervals at Site UXO-14.
- The groundwater sampling activities must result in the collection of samples that are representative of the water-bearing formation. This will be ensured, in part, by installing and developing the groundwater monitoring wells at Site UXO-02 in accordance with the CH2M HILL "Installation of Shallow Monitoring Wells SOP" **(Attachment 2**).
- In addition to correct installation procedures, monitoring wells at Site UXO-02 must be purged to allow for a representative sample to be collected. Purging will be considered complete when the water quality parameters (temperature, pH, specific conductance, DO, turbidity and ORP) have stabilized for three consecutive readings (every 3 to 5 minutes), and at least 1 well volume has been purged with minimal drawdown. Stabilization is achieved when the water quality parameters meet the following criteria:
  - Temperature: within 1 degree Celsius
  - 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
  - Groundwater sampling procedures for Site UXO-02 are detailed in Worksheet #14.

During the investigation, QA/QC samples will be collected along with the various media samples as a check on sampling and analytical protocol. Worksheet #20 describes the QA/QC quantities and analyses for this UFP-SAP.

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

How much data should be collected?

1. For environmental sampling this question will be answered by the following. The number of samples and rationale are provided in Worksheet #17:

   - UXO-02 Surface Soil and Sediment: A total of six surface soil samples and up to 12 sediment samples are proposed for collection and subsequent analysis for organochlorine pesticides endrin and gamma-BHC for surface soil and organochlorine pesticides, monocrotophos, and total organic carbon (TOC) for sediment. Investigation activities for pesticides are focused primarily on historical disposal activities involving Site 69.
   - UXO-02 Groundwater: Based on metals having been detected above screening levels in groundwater during the PA/SI, additional groundwater data will be collected for TAL metals. A total of ten samples will be collected from monitoring wells (5 newly installed and 5 existing) and subsequently TAL metals analysis.
   - UXO-14 Soil: Based on the metals : antimony, lead, and mercury having been detected above screening levels in soil during the PA/SI, fourteen surface soil samples and seven subsurface soil samples will be collected to define the nature and extent of contamination. Soil samples will be analyzed for antimony, lead, and mercury.

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

- The environmental samples will be collected within and west of Site UXO-02 as shown on **Figures 10-4 and 10-5** (Site UXO-02) and **Figure 10-10** (Site UXO-14).
- The proposed investigation will be conducted in July 2011.
- The environmental samples will be collected in accordance with the SOPs presented in Worksheet #21.

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

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

- CH2M HILL staff will collect environmental samples, including groundwater, subsurface soil, sediment, and surface water, as outlined in Worksheets #10-1, #10-2, and #18.
- Borehole drilling, monitoring well installation, and well development at Site UXO-02 will be performed by a North Carolina-licensed well drilling subcontractor with oversight provided by CH2M HILL staff.
- Laboratory analytical services will be provided by a qualified analytical laboratory under subcontract to CH2M HILL.
- Once generated, analytical data will be submitted to a qualified data validation company for validation against analytical methodology requirements and measurement performance criteria presented in this UFP SAP.
- CH2M HILL will receive validated data and upload the data into a centralized electronic database used for Navy projects by project team.
- Data will be reported in the intrusive investigation report, which will be submitted to the Navy as a draft for review prior to distribution to the NCDENR and USEPA for review and approval.

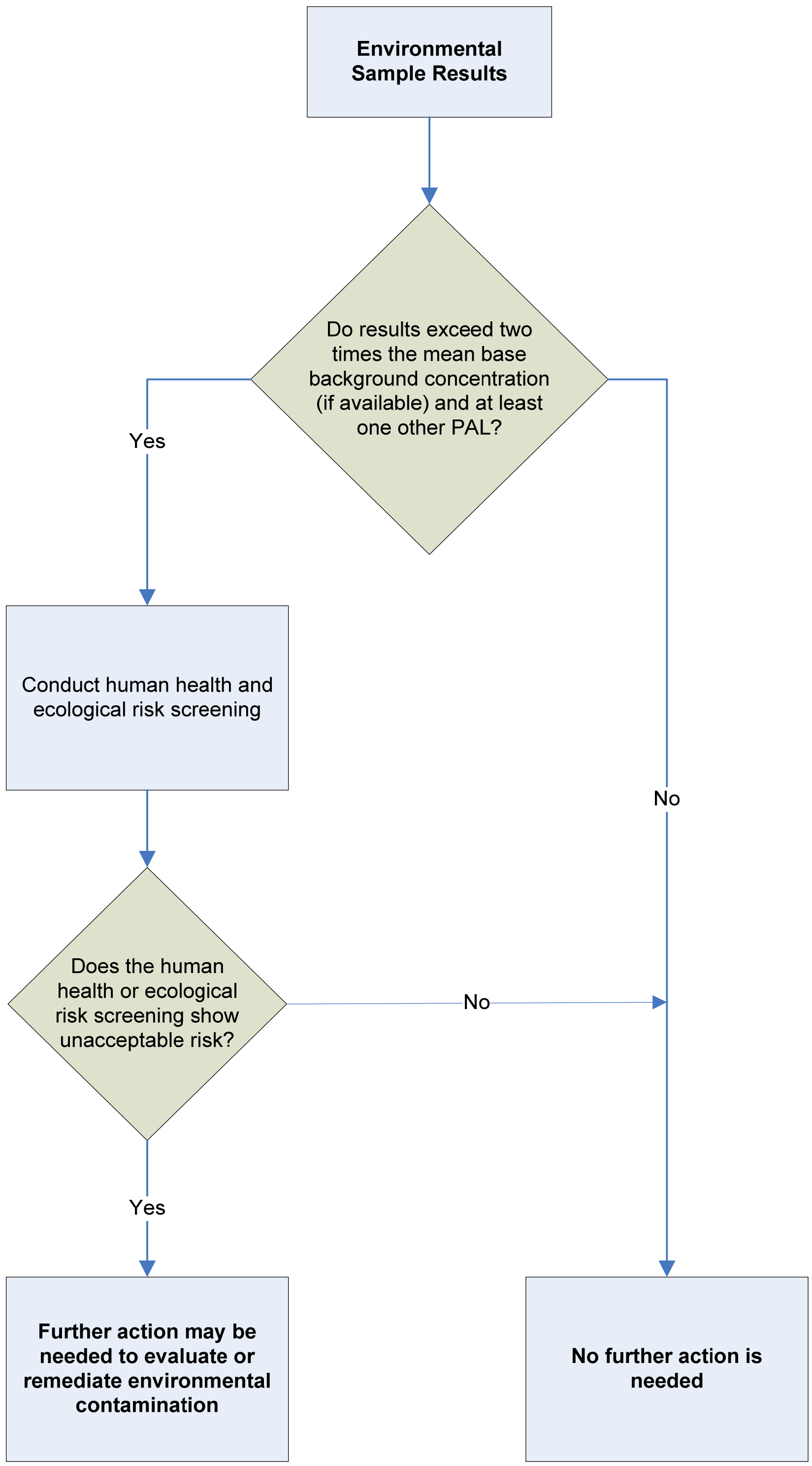
How will the data be archived?

Data will be archived according to the Navy CLEAN program/contract requirements. Data will be uploaded into a centralized database Naval Installation Restoration Information Solution (NIRIS) maintained by CH2M HILL 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 listed in the form of if/then qualitative and quantitative statements.

The decision analysis process depicted on **Figure 11-1** represents the project quality objectives (PQOs) for the environmental media sample data collected at the sites. The general objective of the decision analysis process is to evaluate whether a CERCLA-related release occurred and, if so, whether the release warrants further investigation or action.

Figure 11-1
Project Quality Objectives Decision Flow Chart
Contract Task Order WE41, Site UXO-02 and UXO-14,
MCB CamLej



SAP Worksheet #12-1: Field Quality Control Samples- Site UXO-02

Matrix: Surface Soil

Analytical Group: Organochlorine (OC) Pesticides (Select: Endrin and Gamma-BHC)

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Organochlorine (OC) Pesticides (Select: Endrin and Gamma BHC)	One per 10 field samples	Precision	Relative Percent Difference (RPD) ≤30%	S & A
Equipment Rinseate Blank		One per day	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	2-6 degrees Celsius (°C)	S

SAP Worksheet #12-2: Field Quality Control Samples- Site UXO-02

Matrix: Sediment

Analytical Group: Organochlorine (OC) Pesticides

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Organochlorine (OC) Pesticides (Full List)	One per 10 field samples	Precision	RPD ≤30%	S & A
Equipment Rinseate Blank		One per day	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	2-6 degrees Celsius (°C)	S

SAP Worksheet #12-3: Field Quality Control Samples- Site UXO-02

Matrix: Sediment

Analytical Group: Organophosphorus (OP) Pesticides (Select: Monocrotophos)

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Organophos-phorus (OP) Pesticides (Select: Monocrotophos)	One per 10 field samples	Precision	RPD ≤30%	S & A
Equipment Rinseate Blank		One per day	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	2-6 degrees Celsius (°C)	S

SAP Worksheet #12-4: Field Quality Control Samples- Site UXO-02

Matrix: Sediment

Analytical Group: Total Organic Carbon (TOC)

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Total Organic Carbon (TOC)	One per 10 field samples	Precision	RPD ≤30%	S & A
Equipment Rinseate Blank		One per day	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	2-6 degrees Celsius (°C)	S

SAP Worksheet #12-5: Field Quality Control Samples- Site UXO-02

Matrix: Groundwater

Analytical Group: Total and Dissolved TAL Metals, including Mercury and Hexavalent Chromium) [1]

Concentration Level: Low

QC Sample[1]	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Total and Dissolved TAL Metals, including Mercury and Hexavalent chromium	One per 10 field samples	Precision	RPD ≤20%	S & A
Equipment Rinseate Blank		One per day	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	2-6 degrees Celsius (°C)	S

[1] All field QC presented in this Worksheet will be collected for each analytical method (SW-846 6010C, 7470A, and 7196A), for both total and dissolved constituents.

SAP Worksheet #12-6: Field Quality Control Samples- Site UXO-14

Matrix: Surface Soil, Subsurface Soil

Analytical Group: Metals (Antimony, Lead, and Mercury)

Concentration Level: Low

QC Sample[1]	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Metals (Select: Antimony, Lead, and Mercury)	One per 10 field samples	Precision	RPD ≤20%	S & A
Equipment Rinseate Blank		One per day	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	2-6 degrees Celsius (°C)	S

SAP Worksheet #12-7: Field Quality Control Samples- Sites UXO-02 & UXO-14 Post Detonation Sampling

Matrix: Surface Soil and Surface Soil Composite

Analytical Group: Explosives, including Perchlorate[1]

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	Explosives, including Perchlorate	One per 10 field samples[2]	Precision	For Explosives RPD ≤20% For Perchlorate RPD ≤15%	S & A
Equipment Rinseate Blank		One per day[3]	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	2-6 degrees Celsius (°C)	S

[1] All field QC will be collected for each analytical method (SW-846 8330B and 6850).
[2] For Field Duplicates, surface soil and surface soil composite samples will be treated as separate matrices.
[3] Equipment blanks will be collected one per day per piece of deconned equipment. It is anticipated that surface soil grab and composite samples will be collected with different equipment.

SAP Worksheet #12-8: Field Quality Control Samples- Sites UXO-02 & UXO-14 Post Detonation Sampling

Matrix: Surface Soil Composite

Analytical Group: TAL Metals, including Mercury

Concentration Level: Low

QC Sample	Analytical Group	Frequency	Data Quality Indicators (DQIs)	Measurement Performance Criteria	QC Sample Assesses Error for Sampling (S), Analytical (A), or both (S&A)
Field Duplicate	TAL Metals, including Mercury	One per 10 field samples[1]	Precision	RPD ≤20%	S & A
Equipment Rinseate Blank		One per day[2]	Bias / Contamination	Same as Field Blank	S & A
Temperature Blank		One per cooler	Accuracy / Representativeness	2-6 degrees Celsius (°C)	S

[1] For Field Duplicates, inner crater and outer crater composite samples will be treated as separate matrices (Refer to **Worksheet #18**).
[2] Equipment blanks will be collected one per day per piece of decon equipment. It is anticipated that surface soil grab and composite samples will be collected with different equipment.

SAP Worksheet #13: Secondary Data Criteria and Limitations Table

Secondary Data	Data Source	Data Generator(s)	How The Data Will Be Used	Limitations on Data Use
Site UXO-02				
2009 Archival Report	CH2M HILL, *Archival Records Search Report for the Preliminary Assessment/Site Inspection of Site UXO-02, Unnamed Explosive Range ASR #2.201*	Marine Corp Library at Quantico National Archives and Records Administration CamLej Base Files Base Personnel Interviews	Planning and Sample Location Selection	Data and Archival Records range in age from 3-69 years old and may not be representative of current conditions
2011 Site 69 Supplemental Investigation	CH2M HILL, Supplemental Investigation Site 69, Operable Unit No. 14— Rifle Range Chemical Dump	CH2M HILL soil, sediment surface water and groundwater data 2010	Planning and Sample Location Selection	Data is limited to approximately 14 acres of the 127 acre investigation area
2011 PA/SI Report	CH2M HILL, Preliminary Assessment/Site Inspection Report MMRP Site UXO-02, Unnamed Explosive Contaminated Range, ASR #2.201	CH2M HILL DGM, soil, sediment surface water and groundwater data 2010	Planning and Sample Location Selection	Data is limited to TAL metals, explosives (including PETN and nitroglycerin), and perchlorate.

SAP Worksheet #13: Secondary Data Criteria and Limitations Table (continued)

Secondary Data	Data Source	Data Generator(s)	How The Data Will Be Used	Limitations on Data Use
Site UXO-14				
2009 Archival Report	CH2M HILL, Archival Records Search Report for the Preliminary Assessment/Site Inspection of Site UXO-14, Former Site of Indoor Pistol Range and Gas Chamber (Rifle Range Area) ASR #2.199 and #2.200	Marine Corp Library at Quantico National Archives and Records Administration CamLej Base Files Base Personnel Interviews	Planning and Sample Location Selection	Data and Archival Records range in age from 3-69 years old and may not be representative of current conditions
2011 PA/SI Report	CH2M HILL, Preliminary Assessment/Site Inspection Report MMRP Site UXO-14 Former Indoor Pistol Range(ASR #2.199) and Gas Chamber (ASR #2.200) (Rifle Range Area)	CH2M HILL. Groundwater and soil data 2009	Planning and Sample Location Selection	Data is limited to area within the site UXO-14 boundary

SAP Worksheet #14: Summary of Project Tasks

Pre-Field Tasks

- Procure subcontractors.
- Schedule field and support staff.
- Procure or rent all equipment and bottleware.
- Conduct an Operational Readiness Review (ORR) to determine that all Standard Operating Procedures (SOPs) and the Accident Prevention Plan/Health and Safety Plan (APP/HSP) are in place for field tasks.

Field Tasks

The field investigation will accomplish the project objectives through the following activities, which will be conducted in accordance with CH2M HILL SOPs and the MMRP Master Project Plans. MEC anomaly avoidance will be conducted by a UXO technician as described in the APP/HSP (**Appendix A of the Work Plan**) during all field tasks.

Mobilization

A mobilization period will include identifying, briefing, and mobilizing staff, as well as securing and deploying equipment. Mobilization activities include general activities and a kickoff and site safety meeting

General Activities

- Identify/procure, package, ship, and inventory project equipment, including GPS equipment, hand tools, and supplies.
- Coordinate with local agencies, including the Marine Corps, Base staff, police, and fire department, as appropriate.
- Coordinate communications and other logistical support.
- Finalize operating schedules.
- Test and inspect equipment.
- Conduct site-specific training on the UFP SAP, APP/HSP, and MEC avoidance procedures and hazards.
- Review subcontractor Activity Hazard Analysis (AHA) forms.
- Verify that all forms and other project documentation are in order and that project team members understand their responsibilities regarding project-reporting requirements

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

Kickoff/Safety Meeting

During mobilization, a kickoff and site safety meeting will be conducted. This meeting will include a review of this UFP SAP and review and acknowledgment of the APP/HSP by all site personnel. Additional meetings will occur as needed, as new personnel, visitors, and/or subcontractors arrive at the site.

Land Surveying

Land surveying services will be conducted in accordance with Section 7.4 of the MMRP Master Project Plans. MEC anomaly avoidance will be practiced as described in the APP/HSP (**Appendix A of the Work Plan**)). A survey will be conducted at Site UXO-02 will occur after environmental sampling activities have concluded and will include surveying the coordinates and elevations of the newly installed monitoring wells locations.

Vegetation Clearance

If necessary, limited vegetation clearance will be conducted to provide access for sampling activities. Vegetation less than 6 inches in diameter will be removed to within 6 inches of the ground surface. Vegetation clearing will be accomplished using a combination of mechanical and manual methods.

UXO technicians will conduct MEC avoidance activities in the vegetation removal areas according to the MEC avoidance procedures included in the APP/HSP (**Appendix A of the Work Plan**). The brush and trees will be mulched and left in place. Trees greater than 6 inches in diameter will not be removed.

In the event that plant species are encountered that are listed by the United States Fish and Wildlife Service as threatened or endangered, steps will be taken to manage site activities in accordance with the Environmental Protection Plan (**Chapter 8 of the Work Plan**).

Geospatial Information and Electronic Submittals

Methods, equipment, accuracy, and submittal requirements for survey locations and mapping are described in Section 7.4 of the MMRP Master Project Plans.

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

Environmental Site Sampling

- Anomaly avoidance will be practiced during all sampling activities as described in the **Appendix A of the Work Plan**.
- Monitoring Well Installation- Site UXO-02
  - Shallow groundwater monitoring wells will be constructed at Site UXO-02 to allow collection of groundwater samples. Each well will be constructed of 2-inch Schedule 40 polyvinyl chloride (PVC). Wells will be constructed using 10 feet of 2-inch inside diameter, 0.010-inch machine slotted Schedule 40 PVC screen with a bottom cap. The wells will be installed by auger in accordance with the "Monitoring Well Installation SOP" located in Worksheet #21. The well screen will be installed to bracket the water table. Each well will be completed with a #2 filter pack from the bottom of the well to 2 feet above the top of the screen interval. A 2-foot hydrated bentonite will be installed above the filter pack and allowed to hydrate for 30 minutes prior to grouting with a bentonite /Portland cement slurry to ground surface. Each well will be completed with a flush-mounted, traffic-rated well monument and locking well cap.
  - The monitoring wells will be developed by the drilling contractor. The primary purpose of well development is to reduce turbidity.
  - Static groundwater elevations will be measured in all monitoring wells using a water level indicator or oil/water interface probe, as appropriate. 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- Site UXO-02
  - Groundwater samples will be collected using a peristaltic or bladder pump following low-flow sampling protocol, and analyzed for parameters as detailed on Worksheet #20 and the "Groundwater Sampling SOP" located in Worksheet #21. All groundwater samples will be collected by placing the sample tubing or pump intake in the middle of the water column.
  - Water quality parameters (WQPs), including specific conductance, pH, turbidity, temperature, dissolved oxygen (DO), and oxidation reduction potential (ORP), will be measured and recorded prior to sampling using a multi-parameter water quality meter. The meter will be calibrated on a daily basis and thereafter as warranted. Sampling will begin when the WQPs have stabilized: pH within 0.1 pH units, specific conductance within 3 percent, dissolved oxygen within 10 percent, ORP within 10 mV and turbidity within 10 percent or as low as practicable for three consecutive readings. Depth to water, purge volume, WQPs, and total well depth measurements will be recorded in the field logbook.

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

- Sediment Sampling- Site UXO-02
  - Sediment samples will be collected in accordance with the SOPs listed in Worksheet #21. Sediment will be collected using a decontaminated trowel and bowl, drained of excess water, and placed into the appropriate sample containers.
  - Actual sediment sample location coordinates will be determined using a hand-held GPS in the field. All coordinates will be recorded in the field logbook.
- Surface Soil Sampling- Site UXO-02 and UXO-14
  - Surface soil samples will be collected using the TR-02-1 sampling method, which is used to assess shallow soil conditions in areas constrained by development or dense vegetation. Each sampling location will be defined as an area 1m x 1m in size. Soil samples will be collected by compositing a minimum of 30 sample increments from random locations within each 1m x 1m sampling location. The sample increments will be approximately equal in the amount of soil, which will be collected from depths of 0-2 inches. The sample increments at each location will be composited into a single sample following the *Homogenization of Soil and Sediment Samples* SOP in Appendix C of the MRP Master Project Plans (CH2M HILL, 2008a).
  - The location of each sample will be pre-populated in a handheld global positioning system (GPS) prior to the sampling event. The field team will make every effort to locate the coordinates; however, the sample location may be slightly adjusted to a field-suitable location (i.e. poison ivy free area, etc.). The actual coordinates of the sampling locations will then be logged into the GPS and will be based on the center of the sampling area.
- Subsurface Soil Sampling- UXO-14
  - Subsurface soil samples will be collected from the unsaturated zone immediately above the water table (estimated at 5 feet below ground surface) by hand augering.
  - The location of each sample will be pre-populated in a handheld global positioning system (GPS) prior to the sampling event. The field team will make every effort to locate the coordinates; however, the sample location may be slightly adjusted to a field-suitable location (i.e. poison ivy free area, etc.). The actual coordinates of the sampling locations will then be logged into the GPS.

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

- Post-detonation Soil Sampling- Sites UXO-02 and UXO-14 (as applicable)
  - Soil samples will be collected at locations where controlled detonations/blow-in-place (BIP) operations are conducted and at locations where MEC/MPPEH filler appears to have leaked into the adjacent soil. Composite surface soil samples will be collected using the TR-02-1 sampling approach in the resulting crater, and the incremental sampling method will be utilized to collect a sample from outside of the crater (as described in **Section 3.4 of the Work Plan**). In the instances where MEC/MPPEH is consolidated for controlled detonation and where it the MEC/MPPEH filler appears to have leaked to the adjacent soil, composite soil samples will be collected using the TR-02-01 sampling approach.
  - The coordinates of the sampling locations will be logged into the GPS.

Decontamination and IDW Handling

- All non-disposable sampling equipment will be decontaminated before use and immediately after each use in accordance with applicable SOPs referenced in Worksheet #21. The water level indicator will be cleaned with an alconox solution spray and rinsed with deionized water between each measurement.
- Wastes generated during the investigation of potentially contaminated sites are classified as investigation-derived waste (IDW) and will be managed to protect human health and the environment, as well as to meet legal requirements. IDW will be managed in accordance with the Waste Management Plan. The Field Team Leader (FTL) will be responsible for the documentation, containerization, and transportation to the appropriate on-base storage facility. The containers will be labeled in accordance with the Waste Management Plan either with a indelible marker or preprinted label. Trash will be placed in opaque, black garbage bags and placed into on-base trash receptacles.

Demobilization

Full demobilization will occur when the project is completed and appropriate quality assurance (QA)/QC checks have been performed at each site. The following activities will occur prior to demobilization:

- Anomaly removal verification is complete.
- Chain-of-custody records will be reviewed to ensure that all field and QC samples were collected as planned and were submitted for appropriate analyses.
- Verification of adequate site restoration at each site.
- All field equipment will be inspected, packaged, and shipped to the appropriate location.

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

Analyses and Testing Tasks

- The analytical laboratories will process and prepare samples for analyses and will analyze all samples for various groups of parameters in accordance with Worksheet #20.

Quality Control Tasks

- SOPs for field and laboratory activities will be implemented.
- QC samples are described on Worksheet #20.

Secondary Data

- Secondary data (Worksheet #13) provided by CH2M HILL 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 Navy CLEAN **Data Management Plan** in the **Data Management Guidelines** presented in **Attachment 2** of this UFP-SAP.
- Computerized and manual procedures for data from generation to final use and storage and QC checks for error detection to ensure data integrity:
  - See the Navy CLEAN **Data Management Plan** in the **Data Management Guidelines** presented in **Attachment 2** of this UFP-SAP.
- Guidance on data management steps such as data recording, data transformation, data reduction, data transfer and transmittal, data analysis, and data review:
  - See the Navy CLEAN **Data Management Plan** in the **Data Management Guidelines** presented in **Attachment 2** of this UFP-SAP.
- Procedures for data tracking, storage, archiving, retrieval, and security for both electronic and hardcopy data:
  - See the Navy CLEAN **Data Management Plan** in the **Data Management Guidelines** presented in **Attachment 2** of this UFP-SAP for more information.
  - The Project PDM, Troy Horn, is responsible for data tracking and storage.
  - CH2M HILL will coordinate archiving and retrieval of data.
- Perform data validation via third party subcontractor (EDS) as per Worksheets #35 and #36.

Documentation and Reporting

- Work and data will be documented in the draft Intrusive Investigation Report.

Assessment/Audit Tasks

- See Worksheets #31 and #32.

SAP Worksheet #15-1: Reference Limits and Evaluation Tables – UXO-02

Matrix: Surface Soil
Analytical Group: OC Pesticides (Select)

Analyte	CAS Number	Project Action Limit (ug/kg)	Project Action Limit Reference[1]	Project Quantitation Limit (PQL) Goal[2] (ug/kg)	Laboratory-specific		
					LOQs (ug/kg)	LODs (ug/kg)	DLs (ug/kg)
Endrin	72-20-8	810	NCSSL	405	1.7	1	0.74
Gamma BHC	58-89-9	1.8	NCSSL	0.9	1.7	1	0.45

Note: Project Action Limit (PAL) and Project Quantitation Limit (QL) assumes dry weight basis.

[1] PALs were developed to be protective of human health and the environment. See **Worksheet #11** for a discussion of the PALs**.**

[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.

NCSSLs are from NCDENR (June 2011).

SAP Worksheet #15-2: Reference Limits and Evaluation Tables – UXO-02

Matrix: Sediment
Analytical Group: OC Pesticides

Analyte	CAS Number	Project Action Limit (ug/kg)	Project Action Limit Reference[1]	Project Quantitation Limit Goal[2] (ug/kg)	Laboratory-specific		
					LOQs (ug/kg)	LODs (ug/kg)	DLs (ug/kg)
4,4' - DDD	72-54-8	240	NCSSL	120	1.7	1	0.48
4,4' - DDE	72-55-9	240	NCSSL	120	1.7	1	0.52
4,4' – DDT	50-29-3	340	NCSSL	170	1.7	1	0.66
Aldrin	309-00-2	3	NCSSL	1.5	1.7	1	0.49
Alpha BHC	319-84-6	0.4	NCSSL	0.6	1.7	1	0.49
Alpha-Chlordane	5103-71-9	68	NCSSL	34	1.7	1	0.45
Beta BHC	319-85-7	1.2	NCSSL	0.6	1.7	1	1
Delta BHC	319-86-8	1.2	NCSSL	0.6	1.7	1	0.48
Dieldrin	60-57-1	0.81	NCSSL	0.405	1.7	1	0.45
Endosulfan I	959-98-8	5600	NCSSL	2800	1.7	1	0.39
Endosulfan II	33213-65-9	5600	NCSSL	2800	1.7	1	0.48
Endosulfan Sulfate	1031-07-8	8040	NCSSL	4020	1.7	1	0.49
Endrin	72-20-8	810	NCSSL	405	1.7	1	0.74
Endrin aldehyde	7421-93-4	810	NCSSL	405	1.7	1	0.5
Endrin ketone	53494-70-5	810	NCSSL	405	1.7	1	0.45
Gamma BHC	58-89-9	1.8	NCSSL	0.9	1.7	1	0.45
Gamma-Chlordane	5103-74-2	68	NCSSL	34	1.7	1	0.45
Heptachlor	76-44-8	6.6	NCSSL	3.3	1.7	1	0.48
Heptachlor Epoxide	1024-57-3	0.82	NCSSL	0.41	1.7	1	0.53
Methoxychlor	72-43-5	22000	NCSSL	11000	1.7	1	0.8
Toxaphene	8001-35-2	46	NCSSL	23	1	1	8

Note: PAL and Project QL assumes dry weight basis.

[1] PALs were developed to be protective of human health and the environment. See **Worksheet #11** for a discussion of the PALs**.**

[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.

NCSSLs are from NCDENR (June 2011).

The Residential Soil RSLs were adjusted from the USEPA Regional Screening Levels Table (May 2011).

Shading represents cases where the PAL is lower than the laboratory LOD.

SAP Worksheet #15-3: Reference Limits and Evaluation Tables – UXO-02

Matrix: Sediment
Analytical Group: OP Pesticides (Select)

Analyte	CAS Number	Project Action Limit (ug/kg)	Project Action Limit Reference[1]	Project Quantitation Limit Goal[2] (ug/kg)	Laboratory-specific		
					LOQs (ug/kg)	LODs (ug/kg)	DLs (ug/kg)
Monocrotophos	6923-22-4	NC	NA	20	33	20	9.5

Note: PAL and Project QL assumes dry weight basis.
[1] PALs were developed to be protective of human health and the environment. See **Worksheet #11** for a discussion of the PALs**.**
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.

Shading represents cases where the PAL is lower than the laboratory LOD.

SAP Worksheet #15-4: Reference Limits and Evaluation Tables – UXO-02

Matrix: Sediment
Analytical Group: TOC

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference[1]	Project Quantitation Limit Goal[2] (mg/kg)	Laboratory-specific		
					LOQs (mg/kg)	LODs (mg/kg)	DLs (mg/kg)
TOC	TOC[3]	NC	NA	500	500	500	500

Note: PAL and Project QL assumes dry weight basis.
[1] PALs were developed to be protective of human health and the environment. See **Worksheet #11** for a discussion of the PALs**.**
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
[3]Contractor-generated CAS number. TOC will be used to assess contaminant mobility.

SAP Worksheet #15-5: Reference Limits and Evaluation Tables – UXO-02

Matrix: Groundwater
Analytical Group: Total and Dissolved Metals

Analyte	CAS Number	Camp Lejeune Base Background[1] (µg/L)	NC2L[1] (µg/L)	RSLs Tapwater Adjusted[1] (µg/L)	Project Quantitation Limit Goal[2] (µg/L)	Laboratory-specific LOQs (µg/L)	Laboratory-specific LODs (µg/L)	Laboratory-specific DLs (µg/L)
Aluminum	7429-90-5	1886	NC	3700	943	200	100	32
Antimony	7440-36-0	3.28	NC	1.5	0.75	40	20	13
Arsenic	7440-38-2	5.77	10	0.045	0.023	20	10	6.7
Barium	7440-39-3	86.2	700	730	43.1	10	5.0	0.27
Beryllium	7440-41-7	0.308	NC	7.3	0.154	1.0	0.5	0.1
Cadmium	7440-43-9	0.358	2	1.8	0.179	4.0	2.0	0.37
Calcium	7440-70-2	69078	NC	NC	34539	500	250	7.5
Chromium	7440-47-3	3.13	10	0.043	0.022	10	5.0	1.3
Chromium (Hexavalent)[3]	18540-29-9	NC	NC	0.043	0.022	30	15	5.4
Cobalt	7440-48-4	3.4	NC	1.1	0.55	10	5.0	0.76
Copper	7440-50-8	2.76	1000	150	1.38	10	5.0	1.5
Iron	7439-89-6	5999	300	2600	150	50	25	10
Lead	7439-92-1	2.8	15	15	1.4	20	10	2.9
Magnesium	7439-95-4	6363	NC	NC	3182	500	250	28
Manganese	7439-96-5	214	50	88	25	20	10	0.69
Mercury	7439-97-6	0.1	1	1.1	0.05	0.2	0.033	0.011
Nickel	7440-02-0	7.97	100	73	3.99	10	5.0	1.1
Potassium	7440-09-7	3277	NC	NC	1639	500	250	200
Selenium	7782-49-2	3.14	20	18	1.57	40	20	8.9
Silver	7440-22-4	0.77	20	18	0.39	10	5.0	1.5
Sodium	7440-23-5	22508	NC	NC	11254	500	250	150
Thallium	7440-28-0	3.78	NC	0.037	.0185	20	10	6.6
Vanadium	7440-62-2	4.72	NC	18	2.36	10	5	1.3
Zinc	7440-66-6	42.1	1000	1100	21.1	10	10	3.5

[1] PALs were developed to be protective of human health and the environment. See **Worksheet #11** for a discussion of the PALs.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
[3] Hexavalent Chromium will only be analyzed for filtered samples.
Base Background values are 2x the mean base background concentrations.
Tapwater RSLs were adjusted from the USEPA Regional Screening Levels Table (June 2011).
NC2L values are from the North Carolina Administrative Code (NCAC) 2L Groundwater Quality Standards (January 2010).
Shading represents cases where the PAL goal is lower than the laboratory LOD.

SAP Worksheet #15-6: Reference Limits and Evaluation Tables – UXO-14

Matrix: Surface Soil
Analytical Group: Metals (Select)

Analyte	CAS Number	Base Background[1] (mg/kg)	NCSSL[1] (mg/kg)	RSLs Industrial for soil[1] (mg/kg)	RSLs Residential for soil[1] (mg/kg)	Project Quantitation Limit Goal[2] (mg/kg)	Laboratory-specific LOQs (mg/kg)	Laboratory-specific LODs (mg/kg)	Laboratory-specific DLs (mg/kg)
Antimony	7440-36-0	0.447	0.9	41	3.1	0.224	2	1	0.49
Lead	7439-92-1	12.3	270	800	400	6.15	1	0.5	0.24
Mercury	7439-97-6	0.081	1	31	2.3	0.0405	0.0019	0.0081	0.0162

[1] PALs were developed to be protective of human health and the environment. See **Worksheet #11** for a discussion of the PALs.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Base Background values are 2x the mean base background concentrations in surface soil.
Industrial and Residential Soil RSLs were adjusted from the USEPA Regional Screening Levels Table (June 2011).
NCSSL values are from the June 2011
Shading represents cases where the PAL goal is lower than the laboratory LOD.

SAP Worksheet #15-7: Reference Limits and Evaluation Tables – UXO-14

Matrix: Subsurface Soil
Analytical Group: Metals (Select)

Analyte	CAS Number	Base Background[1] (mg/kg)	NCSSL[1] (mg/kg)	RSLs Industrial for soil[1] (mg/kg)	RSLs Residential for soil[1] (mg/kg)	Project Quantitation Limit Goal[2] (mg/kg)	Laboratory-specific		
							LOQs (mg/kg)	LODs (mg/kg)	DLs (mg/kg)
Antimony	7440-36-0	0.36	0.9	41	3.1	0.224	2	1	0.49
Lead	7439-92-1	8.49	270	800	400	4.25	1	0.5	0.24
Mercury	7439-97-6	0.071	1	31	2.3	0.0405	0.0019	0.0081	0.0162

[1] PALs were developed to be protective of human health and the environment. See **Worksheet #11** for a discussion of the PALs.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Base Background values are 2x the mean base background concentrations in subsurface soil.
Industrial and Residential Soil RSLs were adjusted from the USEPA Regional Screening Levels Table (June 2011).
NCSSL values are from the June 2011.
Shading represents cases where the PAL goal is lower than the laboratory LOD.

SAP Worksheet #15-8: Reference Limits and Evaluation Tables – Sites UXO-02 and UXO-14 Post Detonation Sampling

Matrix: Surface Soil Composite
Analytical Group: Explosives, including PETN, nitroglycerin, and perchlorate

Analyte	CAS Number	Project Action Limit[1] (ugkg)	Project Action Limit Reference	Project Quantitation Limit Goal[2] (ug/kg)	Laboratory-specific (ug/kg)		
					LOQs	LODs	DLs
1,3,5-Trinitrobenzene	99-35-4	220000	RSL Residential for Soil	110000	500	200	100
1,3-Dinitrobenzene	99-65-0	610	RSL Residential for Soil	305	500	200	100
2,4,6-Trinitrotoluene	118-96-7	3600	RSL Residential for Soil	1800	500	200	100
2,4-Dinitrotoluene	121-14-2	1600	RSL Residential for Soil	800	500	200	100
2,6-Dinitrotoluene	606-20-2	6100	RSL Residential for Soil	3050	500	200	100
2-Amino-4,6-dinitrotoluene	35572-78-2	15000	RSL Residential for Soil	7500	500	300	150
2-Nitrotoluene	88-72-2	2900	RSL Residential for Soil	1450	2000	1460	730
3-Nitrotoluene	99-08-1	610	RSL Residential for Soil	305	500	300	150
4-Amino-2,6-dinitrotoluene	19406-51-0	15000	RSL Residential for Soil	7500	500	200	100
4-Nitrotoluene	99-99-0	24000	RSL Residential for Soil	12000	500	300	150
HMX	2691-41-0	380000	RSL Residential for Soil	190000	500	300	100
Nitrobenzene	98-95-3	4800	RSL Residential for Soil	2400	500	200	100
Nitroglycerin	55-63-0	610	RSL Residential for Soil	305	1000	500	250
PETN	78-11-5	12000	RSL Residential for Soil	6000	1000	500	250
RDX	121-82-4	5600	RSL Residential for Soil	2800	500	200	100
Tetryl	479-45-8	24000	RSL Residential for Soil	12000	500	200	100
Perchlorate	14797-73-0	5500	RSL Residential for Soil	2750	2	1	0.5

[1] PALs were developed to be protective of human health and the environment.
[2] PQL Goals are half of the PAL.
Residential Soil RSL values were adjusted from the USEPA Regional Screening Levels Table (June 2011).
NC indicates that there are no applicable criteria.

SAP Worksheet #15-9: Reference Limits and Evaluation Tables – Sites UXO-02 and UXO-14 Post Detonation Sampling

Matrix: Surface Soil Composite
Analytical Group: TAL Metals, including mercury

Analyte	CAS Number	Base Background[1] (mg/kg)	NCSSL[1] (mg/kg)	RSLs Industrial for soil[1] (mg/kg)	RSLs Residential for soil[1] (mg/kg)	Project Quantitation Limit Goal[2] (mg/kg)	Laboratory-specific		
							LOQs (mg/kg)	LODs (mg/kg)	DLs (mg/kg)
Aluminum	7429-90-5	5487	NC	99000	7700	2874	10	5	2.7
Antimony	7440-36-0	0.447	0.9	41	3.1	0.18	2	1	0.49
Arsenic	7440-38-2	0.626	5.8	1.6	0.39	0.195	2	1	0.39
Barium	7440-39-3	14.5	580	19000	1500	7.25	5	0.25	0.019
Beryllium	7440-41-7	0.103	63	200	16	0.0515	0.05	0.025	0.0071
Cadmium	7440-43-9	0.033	3	80	7	0.165	0.2	0.1	0.014
Calcium	7440-70-2	6360	NC	NC	NC	3180	25	12.5	0.67
Chromium	7440-47-3	6.05	3.8	5.6	0.29	0.145	0.5	0.25	0.05
Cobalt	7440-48-4	0.294	0.9	30	2.3	0.147	0.5	0.25	0.03
Copper	7440-50-8	4.83	700	4100	310	2.415	0.5	0.25	0.16
Iron	7439-89-6	3245	150	72000	5500	75	10	5	1.4
Lead	7439-92-1	12.3	270	800	400	6.15	1	0.5	0.24
Magnesium	7439-95-4	238	NC	NC	NC	119	25	12.5	1.4
Manganese	7439-96-5	13.7	65	2300	180	6.85	1	0.5	0.045
Mercury	7439-97-6	0.081	1	31	2.3	0.04	0.0019	0.0081	0.0162
Nickel	7440-02-0	1.21	130	2000	150	0.605	0.5	0.25	0.08
Potassium	7440-09-7	116	NC	NC	NC	58	25	12.5	7.9
Selenium	7782-49-2	0.563	2.1	510	39	0.2815	2	1	0.48
Silver	7440-22-4	0.14	3.4	510	39	0.07	0.5	0.25	0.063
Sodium	7440-23-5	80.9	NC	NC	NC	40.45	25	12.5	9
Thallium	7440-28-0	0.36	0.28	1	0.078	0.039	1	0.5	0.32
Vanadium	7440-62-2	8.9	6	520	39	4.45	0.5	0.25	0.072
Zinc	7440-66-6	10.8	1200	31000	2300	5.4	0.5	0.25	0.19

[1] PALs were developed to be protective of human health and the environment. See **Worksheet #11** for a discussion of the PALs**.**
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Base Background values are 2x the mean base background concentrations in surface soil.
Industrial and Residential Soil RSLs were adjusted from the USEPA Regional Screening Levels Table (June 2011).
NCSSL values are from the June 2011.
Shading represents cases where the PAL goal is lower than the laboratory LOD.

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SAP Worksheet #16: Project Schedule/Timeline Table

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Work Plan preparation	CH2M HILL	5/19/11	6/17/11	Draft Work Plan Draft UFP SAP	6/17/11
Work Plan reviewed by Navy	Navy	6/20/11	6/24/11	Comments	
Work Plan – address Navy comments	CH2M HILL	6/27/11	7/1/11	Draft Work Plan Draft UFP SAP	7/1/11
Work Plan Review and Approval by Regulatory Agencies	NC DENR, USEPA Region 4	7/5/11	7/18/11	Comments	
Comment resolution	Navy, CH2M HILL	7/18//11	7/19/11	Final Work Plan Final UFP SAP	7/19/11
Final acceptance	Navy, NC DENR, USEPA Region 4	7/20/11	7/25/11	Final Work Plan Final UFP SAP	7/25/11
Subcontracting	CH2M HILL	5/19/11	7/19/11	Subcontractor Contracts	
Site UXO-02 Vegetation and Utility Clearance	Subcontractors w/ CH2M HILL	7/8/11	7/12/11	Vegetation and Utility Clearance	
Site UXO-02 Intrusive Anomaly Investigation	Subcontractor w/ CH2M HILL	8/17/11	8/25/11	Anomaly Investigation	
Site UXO-02 Field Sampling Activities	CH2M HILL, Subcontractor for drilling/well installation	7/18/11	7/29/11	Environ. Samples	
Site UXO-14 Vegetation and Utility Clearance	Subcontractors w/ CH2M HILL	7/19/11	7/19/11	Vegetation and Utility Clearance	
Site UXO-14 Intrusive Anomaly Investigation	Subcontractor w/ CH2M HILL	7/26/11	7/26/11	Anomaly Investigation	

SAP Worksheet #16: Project Schedule/Timeline Table

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Site UXO-14 Field Sampling Activities	CH2M HILL	7/14/11	7/18/11	Environ. Samples	
Laboratory analyses and data validation	CH2M HILL	7/19/11	8/19/11	Analytical and DV Reports	8/19/11
Site UXO-02 Data management and report preparation	CH2M HILL	8/22/11	9/23/11	Site UXO-02 Draft Expanded SI Report	9/23/11
Site UXO-14 Data management and report preparation	CH2M HILL	8/9/11	9/6/11	Site UXO-02 Draft Expanded SI Report	9/6/11

SAP Worksheet #17: Sampling Design and Rationale

General Approach: The general approach for sampling was developed to meet Navy, USEPA, and NCDENR requirements for the expanded site inspection. One of the objectives of this investigation is to further characterize previously identified potential human health and ecological risks at Site UXO-02 and UXO-14. At Site UXO-02, surface soil and sediment sampling will be performed to advance the baseline ecological risk assessment (BERA) that was initiated for Site 69 for pesticides. Additionally, groundwater sampling and analysis for metals at Site UXO-02, will be performed to further assess risks posed by metals in shallow groundwater, identified during the PA/SI. At Site UXO-14, surface and subsurface soil sampling will be performed to determine the nature and extent of antimony, lead, and mercury contamination identified during the PA/SI in the Former Indoor Pistol Range area.

The site investigation will draw upon historical information and the results of the previous and ongoing investigations to guide the selection of areas for sample collection. The sample locations at Site UXO-02 are based upon a known disposal site at Site 69.

Sample Matrices: Sample matrices at Site UXO-02 will include surface soil, sediment and groundwater. Sample matrices at Site UXO-14 include surface and subsurface soil.

Analytical Groups: The target analytical groups for Site UXO-02 will be organochlorine pesticides (endrin and gamma-BHC only) (for surface soil); organochlorine pesticides, one organophosphate pesticide: monocrotophos, and total organic carbon (for sediment); and total TAL metals, dissolved TAL metals (limited to three locations closest to the New River), and dissolved hexavalent chromium (limited to three locations closest to the New River)(for groundwater). The rationale for the selection of target analytical groups was based on the Ecological Risk Assessment Problem 3b Formulation (**Appendix F of the Work Plan**) for pesticides and the results of the previous PA/SI for metals. Three groundwater samples will be analyzed for dissolved metals and hexavalent chromium to assess transport pathways to surface water and sediment and assess availability to ecological receptors.

The target analytical groups for Site UXO-14 will be TAL metals (antimony lead, and mercury) (for surface and subsurface soil). The rationale for the selection of the target analytes was based on the results of the PA/SI at Site UXO-14.

Site Sample Numbers and Locations: The sampling approach, the rationale for the matrices to be sampled, the number of samples per matrix, the analytical groups, and the relevant concentration action levels are discussed in Worksheets #10-1 (Site UXO-02), #10-2 (Site UXO-14), #11, #14 and #15. Sample location figures are in Worksheets #10-1 and #10-2. Exact sampling locations will be determined in the field during the site reconnaissance conducted by CH2M HILL staff, and may be re-located to avoid site obstructions, if present. Site sampling locations were agreed upon by the project team.

Sampling Frequency and Seasonal Considerations: The field sampling activities will be completed in a single mobilization for each site. Since the objective of this investigation is only to identify the presence of potential environmental impacts, the assessment activities will not evaluate seasonal influences.

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SAP Worksheet #18-1: Location-Specific Sampling Methods/SOP Requirements Table - UXO-02

Site	Matrix	Sample Location	Screening Interval	Sample ID[1]	Sampling Frequency		Sampling SOP Reference	Analytical Group				
					First Event	Second Event		TAL Metals (SW-846 USEPA 6010C and 7470A/7471B)	Dissolved TAL Metals (SW-846 USEPA 6010C and 7470A/7471B)	Dissolved Hexavalent Chromium (SW-846 7196A)	Organochlorine Pesticides (SW-846 8081B)	Organophosphorous Pesticides (SW-846 8141A)
Groundwater Sampling												
Site 69[2]	GW	MR02-IR69-MW9	10.5 to 20.5 ft	MR02-IR69-GW09-11C	X			X				
Site 69	GW	MR02-IR69-MW10	6.0 to 16.0 ft	MR02-IR69-GW10-11C	X			X				
Site 69	GW	MR02-IR69-MW11	9.0 to 19.0 ft	MR02-IR69-GW11-11C	X			X				
Site 69	GW	MR02-IR69-MW12	2.0 to 13.0 ft	MR02-IR69-GW12-11C	X			X				
Site 69	GW	MR02-IR69-MW13	3.0 to 13.0 ft	MR02-IR69-GW13-11C	X			X				
Site 69	GW	MR02-IR69-MW14	3.0 to 13.0 ft	MR02-IR69-GW14-11C	X			X				
Site 69	GW	MR02-IR69-MW15	3.0 to 13.0 ft	MR02-IR69-GW15-11C	X			X				
UXO-02	GW	MR02-MW01	TBD	MR02-GW01-11C	X		See Worksheet #21	X	X	X		
UXO-02	GW	MR02-MW02	TBD	MR02-GW02-11C	*X*			X	X	X		
UXO-02 QA/QC - Duplicate[3]	*GW*	*MR02-MW02*	TBD	*MR02-GW02D-11C*	*X*			*X*	*X*	*X*		
UXO-02	GW	MR02-MW03	TBD	MR02-GW03-11C	*X*			X				
UXO-02 QA/QC - MS/MSD[3]	GW	MR02-MW03	TBD	MR02-GW03-11C-MS	*X*			X	X	X		
UXO-02 QA/QC - MS/MSD[3]	GW	MR02-MW03	TBD	MR02-GW03-11C-SD	*X*			X	X	X		
UXO-02	GW	MR02-MW04	TBD	MR02-GW04-11C	*X*			X				
UXO-02	GW	MR02-MW05	TBD	MR02-GW05-11C	X			X	X	X		
Surface Soil												
UXO-02	SS	MR02-SS185	0-2" bgs	MR02-SS185-11C	X						X	X
UXO-02	SS	MR02-SS186	0-2" bgs	MR02-SS186-11C	X						X	X
UXO-02	SS	MR02-SS187	0-2" bgs	MR02-SS187-11C	X						X	X
UXO-02	SS	MR02-SS188	0-2" bgs	MR02-SS188-11C	X						X	X
UXO-02 QA/QC - Duplicate[3]	*SS*	*MR02-SS188*	0-2" bgs	*MR02-SS188D-11C*	*X*		See Worksheet #21				*X*	*X*
UXO-02	SS	MR02-SS189	0-2" bgs	MR02-SS189-11C	X						X	X
UXO-02	SS	MR02-SS190	0-2" bgs	MR02-SS190-11C	X						X	X
UXO-02 QA/QC - MS/MSD[3]	SS	MR14-SS190	0-2" bgs	MR02-SS190-11C-MS	X						X	X
UXO-02 QA/QC - MS/MSD[2]	SS	MR14-SS190	0-2" bgs	MR14-SS190-11C-SD	X						X	X

SAP Worksheet #18-1: Location-Specific Sampling Methods/SOP Requirements Table - UXO-02 (continued)

					Sampling Frequency			Analytical Group				
Site	**Matrix**	**Sample Location**	**Screening Interval**	**Sample ID[1]**	**First Event**	**Second Event**	**Sampling SOP Reference**	**TAL Metals (SW-846 USEPA 6010C and 7470A/7471B)**	**Dissolved TAL Metals (SW-846 USEPA 6010C and 7470A/7471B)**	**Dissolved Hexavalent Chromium (SW-846 7196A)**	**Organochlorine Pesticides (SW-846 8081B)**	**Organophosphorous Pesticides (SW-846 8141A)**
Sediment												
UXO-02	SD	MR02-SD11		MR02-SD11-11C	X		See Worksheet #21				X	X
UXO-02	SD	MR02-SD12		MR02-SD12-11C	X						X	X
UXO-02	SD	MR02-SD13		MR02-SD13-11C	X						X	X
UXO-02 QA/QC - Duplicate[3]	SD	*MR02-SD13*		*MR02-SD13D-11C*	*X*						X	X
UXO-02	SD	MR02-SD14		MR02-SD14-11C	X						X	X
UXO-02	SD	MR02-SD15		MR02-SD15-11C	X						X	X
UXO-02 QA/QC - MS/MSD[3]	SD	MR02-SD15		MR02-SD15-11C-MS	X						X	X
UXO-02 QA/QC - MS/MSD[3]	SD	MR02-SD15		MR02-SD15-11C-SD	X						X	X
UXO-02	SD	MR02-SD16		MR02-SD16-11C	X						X	X
UXO-02	SD	MR02-SD17		MR02-SD17-11C	X						X	X
UXO-02	SD	MR02-SD18		MR02-SD18-11C	X						X	X
UXO-02	SD	MR02-SD19		MR02-SD19-11C	X						X	X
UXO-02	SD	MR02-SD20		MR02-SD20-11C	X						X	X
UXO-02 QA/QC - Duplicate[3]	SD	*MR02-SD20*		*MR02-SD20D-11C*	*X*						X	X
UXO-02	SD	MR02-SD21		MR02-SD21-11C	X						X	X
UXO-02	SD	MR02-SD22		MR02-SD22-11C	X						X	X
Non-Well Location QA/QC Samples												
QA/QC	*AQ*	*N/A*	*N/A*	*MR02-EB##-MMDDYY*			See Worksheet #21	*X*	*X*	*X*	*X*	*X*
QA/QC	*AQ*	*N/A*	*N/A*	*MR02-FB##-MMDDYY*				*X*	*X*	*X*	*X*	*X*

QA/QC are dependent on the total number of samples collected and therefore will be adjusted as the number of sampling locations is adjusted. QA/QC sample IDs include additional identifiers; D = Duplicate; EB = Equipment Blank; FB = Field Blank; TB = Trip Blank.

[1] For EB and FB samples, the actual number of equipment and field blanks collected will be based upon the number of days of sampling. Refer to **Worksheet #12** for field QC sampling frequency.
[2]*Site 69 is located within Site UXO-02.*
[3]QA/QC samples consisting of Duplicates and Matrix Spike/Matrix Spike Duplicates (MS/MSDs) are identified with sample locations for nomenclature purposes only. The actual number and location of these samples may vary between sampling events. Duplicate collection frequency is designated in **Worksheet #12**, MS/MSD collection frequency is designated in **Worksheet #28**.

SAP Worksheet #18-2: Location-Specific Sampling Methods/SOP Requirements Table - UXO-14

Site	Matrix	Sample Location	Screening Interval	Sample ID[1]	Sampling SOP Reference	Analytical Group Select Metals: Antimony, Lead, Mercury (SW-846 6010C & 7470A/7471B)
Surface Soil						
UXO-14	SS	MR14-SS21	0-2" bgs	MR14-SS21-11C	See Worksheet #21	X
UXO-14	SS	MR14-SS22	0-2" bgs	MR14-SS22-11C		X
UXO-14	SS	MR14-SS23	0-2" bgs	MR14-SS23-11C		X
UXO-14	SS	MR14-SS24	0-2" bgs	MR14-SS24-11C		X
UXO-14	SS	MR14-SS25	0-2" bgs	MR14-SS25-11C		X
UXO-14 QA/QC - MS/MSD[2]	SS	MR14-SS25	0-2" bgs	MR14-SS25-11C-MS		X
UXO-14 QA/QC - MS/MSD[2]	SS	MR14-SS25	0-2" bgs	MR14-SS25-11C-SD		X
UXO-14	SS	MR14-SS26	0-2" bgs	MR14-SS26-11C		X
UXO-14	SS	MR14-SS27	0-2" bgs	MR14-SS27-11C		X
UXO-14 QA/QC - Duplicate[2]	*SS*	*MR14-SS27*	0-2" bgs	*MR14-SS27D-11C*		*X*
UXO-14	SS	MR14-SS28	0-2" bgs	MR14-SS28-11C		X
UXO-14	SS	MR14-SS29	0-2" bgs	MR14-SS29-11C		X
UXO-14	SS	MR14-SS30	0-2" bgs	MR14-SS30-11C		X
UXO-14	SS	MR14-SS31	0-2" bgs	MR14-SS31-11C		X
UXO-14	SS	MR14-SS32	0-2" bgs	MR14-SS32-11C		X
UXO-14 QA/QC - Duplicate[2]	*SS*	*MR14-SS32*	0-2" bgs	*MR14-SS32D-11C*		*X*

SAP Worksheet #18-2: Location-Specific Sampling Methods/SOP Requirements Table - UXO-14 (continued)

Site	Matrix	Sample Location	Screening Interval	Sample ID[1]	Sampling SOP Reference	Analytical Group: Select Metals: Antimony, Lead, Mercury (SW-846 6010C & 7470A/7471B)
Subsurface Soil						
UXO-14	SB	MR14-IS05	approx. 5' bgs	MR14-IS05-##-##-11C	See Worksheet #21	X
UXO-14	SB	MR14-IS06	approx. 5' bgs	MR14-IS06-##-##-11C		X
UXO-14 QA/QC - Duplicate[2]	*SB*	*MR14-IS06*	approx. 5' bgs	*MR14-IS06D-##-##-11C*		*X*
UXO-14	SB	MR14-IS07	approx. 5' bgs	MR14-IS07-##-##-11C		X
UXO-14	SB	MR14-IS08	approx. 5' bgs	MR14-IS08-##-##-11C		X
UXO-14	SB	MR14-IS09	approx. 5' bgs	MR14-IS09-##-##-11C		X
UXO-14	SB	MR14-IS10	approx. 5' bgs	MR14-IS10-##-##-11C		X
UXO-14 QA/QC - MS/MSD[2]	SB	MR14-IS10	approx. 5' bgs	MR14-IS10-##-##-11C-MS		X
UXO-14 QA/QC - MS/MSD[2]	SB	MR14-IS10	approx. 5' bgs	MR14-IS10-##-##-11C-SD		X
UXO-14	SB	MR14-IS11	approx. 5' bgs	MR14-IS11-##-##-11C		X
Non-Well Location QA/QC Samples						
QA/QC	*AQ*	*N/A*	*N/A*	*MR02-EB##-MMDDYY*	See Worksheet #21	
QA/QC	*AQ*	*N/A*	*N/A*	*MR02-FB##-MMDDYY*		

QA/QC are dependent on the total number of samples collected and therefore will be adjusted as the number of sampling locations is adjusted. QA/QC sample IDs include additional identifiers; D = Duplicate; EB = Equipment Blank; FB = Field Blank.

[1] For EB and FB samples, the actual number of equipment and field blanks to be collected will be based upon the number of days it takes to perform sampling. Refer to Worksheet #12 for field QC sampling frequency.

[2] QA/QC samples consisting of Duplicates and MS/MSD are identified with sample locations for nomenclature purposes only. The actual number and location of these samples may vary between sampling events. Duplicate collection frequency is designated in **Worksheet #12**, MS/MSD collection frequency is designated in **Worksheet #28**.

SAP Worksheet #18-3: Location-Specific Sampling Methods/SOP Requirements Table – Post Detonation Sampling UXO-02 and UXO-14

Site	Matrix	Sample Location	Screening Interval	Sample ID[1]	Sampling SOP Reference	Analytical Group: TAL Metals (SW-846 6010C & 7470A/7471B)	Analytical Group: Explosives (SW-846 8330B)	Analytical Group: Perchlorate (SW-846 6850)
Composite Surface Soil[3]								
UXO-02	SO	MR02-SS197	0-2" bgs	MR02-SS197-IC-11C	See Worksheet #21	X	X	X
UXO-02 QA/QC - Duplicate[2]	*SO*	*MR02-SS197*	0-2" bgs	*MR02-SS197D-IC-11C*		X	X	X
UXO-02	SO	MR02-SS197	0-2" bgs	MR02-SS197-OC-11C		X	X	X
UXO-02 QA/QC - Duplicate[2]	*SO*	*MR02-SS197*	0-2" bgs	*MR02-SS197D-OC-11C*		X	X	X
UXO-14	SO	MR14-SS34	0-2" bgs	MR14-SS34-IC-11C		X	X	X
UXO-14- MS/MSD[2]	*SO*	*MR14-SS34*	*0-2" bgs*	*MR14-SS34-IC-11C-MS*		*X*	*X*	*X*
UXO-14- MS/MSD[2]	*SO*	*MR14-SS34*	*0-2" bgs*	*MR14-SS34-IC-11C-MSD*		*X*	*X*	*X*
UXO-14	SO	MR14-SS34	0-2" bgs	MR14-SS34-OC-11C		X	X	X
UXO-14- MS/SD[2]	*SO*	*MR14-SS34*	*0-2" bgs*	*MR14-SS34-OC-11C-MS*		*X*	*X*	*X*
UXO-14- MS/SD[2]	*SO*	*MR14-SS34*	*0-2" bgs*	*MR14-SS34-OC-11C-MSD*		*X*	*X*	*X*
Non-Well Location QA/QC Samples								
QA/QC	*AQ*	*N/A*	*N/A*	*MR02-EB##-MMDDYY*	See Worksheet #21	*X*	*X*	*X*
QA/QC	*AQ*	*N/A*	*N/A*	*MR02-FB##-MMDDYY*		*X*	*X*	*X*

QA/QC are dependent on the total number of samples collected and therefore will be adjusted as the number of sampling locations is adjusted. QA/QC sample IDs include additional identifiers; D = Duplicate; EB = Equipment Blank; FB = Field Blank.

[1] For EB and FB samples, the actual number of equipment and field blanks to be collected will be based upon the number of days it takes to perform sampling. Refer to **Worksheet #12** for field QC sampling frequency.

[2] QA/QC samples consisting of Duplicates and MS/MSD are identified with sample locations for nomenclature purposes only. The actual number and location of these samples may vary between sampling events. Duplicate collection frequency is designated in **Worksheet #12**, MS/MSD collection frequency is designated in **Worksheet #28**.

[3] Post-detonation Composite samples are samples collected Inside and Outside Crater of a denotation location. Sample ID's provided indicate the sample name for the first post-detonation inside crater and outside crater samples. Sampling of zero or more than one post-detonation location may occur, pending the results of the investigation.

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SAP Worksheet #19: Field Sampling Requirements Table

Matrix	Analytical Group	Analytical and Preparation Method / SOP Reference	Containers	Sample Volume	Preservation Requirements	Maximum Holding Time
UXO-02						
Surface Soil	OC Pesticides (Select: Endrin and Gamma-BHC)	SW-846 8081B / SVGC-04	4oz. glass jar	30g	Cool to 0-6°C	7 days to extraction
Sediment	OC Pesticides	SW-846 8081B / SVGC-04	4oz. glass jar	30g	Cool to 0-6°C	7 days to extraction
	OP Pesticides (Select: Monocrotophos)	SW-846 8141A / SVGC-11	4oz. glass jar	30g	Cool to 0-6 °C	7 days to extraction
	TOC					
Groundwater	Total TAL Metals	SW-846 6010C and 7470A / MET-03 and MET-05	250mL plastic container	80mL	pH < 2 with HNO3 and cool to 0-6 °C	180 days; 28 days for mercury
	Dissolved TAL Metals		250mL plastic container	80mL	pH < 2 with HNO3 and cool to 0-6 °C	180 days; 28 days for mercury
	Dissolved Hexavalent Chromium	SW-846 7196A / WETS-64	250mL plastic container	25mL	Cool to 0-6 °C	24-hours
UXO-14						
Surface Soil, Subsurface Soil	Metals (Select)	SW-846 6010C and 7471B / MET-05 and MET-16	4oz.glass jar	2g	Cool to 0-6 °C	180 days; 28 days for mercury
UXO-02 and UXO-14 Post Detonation Sampling						
Surface Soil Composite	Explosives	SW-846 8330B and 6850 / GL-OA-E-068 and GL-OA-E-067	4oz. glass jar	40g	Cool to 0-6°C	14 days
	TAL Metals	SW-846 6010C and 7471B / MET-05 and MET-16	4oz. glass jar	2g	Cool to 0-6 °C	180 days; 28 days for mercury

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SAP Worksheet #20: Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates	No. of MS/MSDs	No. of Field Blanks	No. of Equip. Blanks	Total No. of Samples to Lab
UXO-02							
Surface Soil	OC Pesticides (Select: Endrin and Gamma-BHC)	6	1	1/1	1	2	12
Sediment	OC Pesticides	12	2	1/1	1	4	21
	OP Pesticides (Select: Monocrotophos)	12	2	1/1	1	4	21
	TOC	12	2	1/1	1	4	21
Groundwater	Total TAL Metals	10	1	1/1	1	2	16
	Dissolved TAL Metals	3	1	1/1	1	1	8
	Dissolved Hexavalent Chromium	3	1	1/1	1	1	9
UXO-14							
Surface Soil	Select Metals (Antimony, Lead, and Mercury)	14	2	1/1	1	4	23
Subsurface Soil	Select Metals (Antimony, Lead, and Mercury)	7	1	1/1	1	2	13
UXO-02 and UXO-14 Post-Detonation[1]							
Surface Soil Composite	TAL Metals	6	2	2/2	1	1	14
Surface Soil	Explosives including Perchlorate	6	2	2/2	1	1	14

[1]Post-detonation sample counts assume three detonations per site.

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SAP Worksheet #21: Project Sampling SOP References Table

Reference Number	Title, Revision Number and / or Date	Originating Organization	Equipment Type	Modified for Project Work?	Comments
SOP-001	Completing Log Books, rev. 5/2011	CH2M HILL	Log Book Indelible Pen	No	
SOP-002	Locating and Clearing Underground Utilities, rev. 5/2011		Electromagnetic Inductance		
SOP-004	Sediment Sampling, rev. 5/2011		Stainless Steel Spoon and Bowls		
SOP-005	Soil Boring and Abandonment, rev. 5/2011		Drill rig		
SOP-06	Installation of Shallow Monitoring Wells, rev5/2011		Drill rig	Yes	Monitoring Well Installation through HSA drilling techniques
SOP-07	Field Measurement of pH, Specific Conductance, Turbidity, Dissolved Oxygen, ORP, and Temperature Using a multi parameter water quality meter with Flow through Cell, rev. 5/2011		Water quality meter with flow-though cell	Yes	
SOP-08	Low-Flow Groundwater Sampling from Monitoring Wells, rev. 5/2011		Peristaltic Pump or Bladder pump, Plastic Tubing		Include purging a minimum of one well volume per NCDENR
SOP-09	Decontamination of Personnel and Equipment, rev. 5/2011		reusable sampling equip.	No	
SOP-010	Decontamination of Drilling Rigs and Equipment, rev. 5/2011		steam cleaner and decon pad		
SOP-011	Disposal of Waste Solids and Fluids, rev. 5/2011		5-gallon buckets with on-base disposal		
SOP-012	Equipment Blank and Field Blank Preparation, rev. 5/2011		Lab provided blank liquid and sample bottles		
SOP-013	Packaging and Shipping Procedures for Low-Concentration Samples, rev. 5/2011		Lab supplied coolers		
SOP-014	Chain-of-Custody, rev. 5/2011		Chain-of-Custody Form		
SOP-015	UXO Contacts		Staff Form		
SOP-016	DPT Soil Sample Collection 5/2011		Direct-push rig		

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

Field Equipment	Activity[1]	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference[2]	Comments
Peristaltic Pump/ ProActive Mini-Monsoon Submersible Pump/ Bladder pump	Maintenance	As Needed, Regularly	Specific per model/instruction manual	Rental and/or manufacturer support for pump malfunctions	Field Team Leader	SOP-08	
Water quality meter	Calibrate probes	Daily, As Needed	Parameter specific per model/instruction manual	Manufacturer technical support for calibration errors	Field Team Leader	SOP-07	

[1] Activities may include calibration, verification, testing, and maintenance.
[2] See Worksheet #21.

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SAP Worksheet #23: Analytical SOP References Table

Lab SOP Number	Title, Revision Date, and/or Number	Date Last Reviewed If Not Revised	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to QSM	Modified for Project Work? (Y/N)
ADMIN-14	Waste Disposal and Characterization, Revision No. 5 (12/1/2009)	*04/22/2011*	NA	All	NA	ENCO – Jacksonville and Orlando	None	N
EXMT-09	Acid Digestion of Soil and Waste Samples for Analysis by ICP and ICP-MS, Revision No. 5 (12/4/2009)	*3/30/2011*	Definitive	Solid Metals	NA	ENCO – Jacksonville	None	N
EXMT-12	Acid Digestion of Aqueous Samples for Analysis by ICP and ICP-MS, Revision No. 4 (11/30/2009)	*11/30/2010*	Definitive	Aqueous Metals	NA	ENCO – Jacksonville	None	N
EXSV-16	Extraction of Soil/Solid Samples Using Sonication, Revision No. 6 (3/23/2010)	04/14/2011	Definitive	Solid OP and OC Pesticides	NA	ENCO – Orlando	None	N
EXSV-27	Extraction of Aqueous Samples Using Separatory Funnel Techniques, Revision No. 4 (3/2/2010)	04/14/2011	Definitive	Aqueous OP and OC Pesticides	NA	ENCO – Orlando	None	N
LOGIN-03	Receiving Samples, Revision No. 10 (1/23/2010)	04/20/2011	NA	All	NA	ENCO – Jacksonville and Orlando	None	N
MET-03	Mercury in Waters by Digestion / CCVA, Revision No. 4 (12/4/2009)	1/11/2011	Definitive	Aqueous Mercury	FIMS	ENCO – Jacksonville	ENCO does not perform Method of Standard Additions	N
MET-05	Metals Analysis by ICP-AES, Revision No. 7 (10/30/2009)	05/17/2011	Definitive	Solid and Aqueous Mercury	ICP-AES	ENCO – Jacksonville		N
MET-16	Mercury in Soils by Digestion / CCVA, Revision No. 4 (3/1/2010)	Change Request approved 12/1/2010	Definitive	Solid Mercury	FIMS	ENCO – Jacksonville		N
SVGC-04	Organochlorine Pesticides by GC/ECD, Revision No. 9 (11/9/2009)	01/07/2011	Definitive	Aqueous OP and OC Pesticides	GC/ECD	ENCO – Orlando	Internal Standard procedures per SW-846 8000 will be used for all OCPs except Toxaphene and Chlordane Toxaphene and Chlordane are not included in LCS/MS/MSD/CCVs. All chromatograms are examined for the presence of Toxaphene and Chlordane. In the event Toxaphene or Chlordane are identified, the sample extracts are re-analyzed with Toxaphene/Chlordane-specific calibrations.	N
SVGC-11	Organophosphorous Pesticide Analysis by GC/FPD, Revision No. 12 (1/31/2011)	--	Definitive	Aqueous OP and OC Pesticides	GC/FPD	ENCO – Orlando	None	N
WETS-64	Hexavalent Chromium (Colorimetric), Revision No. 8 (1/23/2010)	04/21/2011	Definitive	Aqueous Hexavalent Chromium	UV-VIS	ENCO - Orlando	None	N

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

Lab SOP Number	Title, Revision Date, and/or Number	Date Last Reviewed If Not Revised	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Organization Performing Analysis	Variance to QSM	Modified for Project Work? (Y/N)
GL-LB-G-001	Laboratory Waste Management Plan, Revision No. 19 (Feb 2011)	--	NA	All	NA	GEL Laboratories	None	N
126	The Processing, Extraction, and Analysis of Nitroaromatics, Nitroamines, and Nitrate Esters by SW-846 8330B (Sample analysis)		Definitive	Solid Explosives	LC/MS/MS	GEL Laboratories	None	N
GL-OA-E-067	Definitive Low Level Perchlorate Analysis Utilizing LC/MS/MS by USEPA Method 6850 Modified, Revision No. 7 (Oct 2010)	--	Definitive	Solid Perchlorate	LC/MS/MS	GEL Laboratories	None	N
107	Nitroaromatics and Nitramines by HPLC, 29 Sept. 2010, GL-OA-E-033, Rev. 18 (For sample extraction only)	--	Definitive	Solid Explosives	NA (prep method)	GEL Laboratories	None	N
GL-SR-E-001	Sample Acceptance Policy, Sample Login and Storage, Revision No. 32 (March 2011)	--	NA	All	NA	GEL Laboratories	None	N

SAP Worksheet #24-1: Analytical Instrument Calibration Table

Instrument[2]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
GC-ECD (SW-846 8081B) and GC-FPD (SW-846 8141A)	Retention Time (RT) Window	Calculated for each analyte and surrogate at method set up and after major maintenance.	RT width is ± 3 times standard deviation for each analyte RT from a 72-hour study.	NA	Analyst	SVGC-04 and SVGC-11
	Minimum five-point initial calibration (ICAL)	For all analytes, prior to sample analysis.	One of the options below: Option 1: Relative Standard Deviation (RSD) for each analyte ≤20% Option 2: linear least squares regression: r ≥ 0.995 Option 3: non-linear regression: coefficient of determination (COD) r^2 ≥ 0.99 (6 points shall be used for second order, 7 points for third order).	Correct problem then repeat ICAL.		
	Retention Time Window Position Establishment	For each analyte and surrogate, once per ICAL and at the beginning of the analytical shift.	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	NA		
	Second Source Calibration Verification (ICV)	Immediately following ICAL.	All project analytes and surrogates within ± 20% of true value.	Correct problem, rerun ICV. If that fails, repeat ICAL.		
	Continuing Calibration Verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All project analytes and surrogates within ± 20% of true value.	Correct problem, then rerun the CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last successful CCV.		

[1]Referenced SOPs are listed in **Worksheet #23**.
[2]DoD Quality Systems Manual (QSM) v. 4.1 is the basis for specifications on this table. Specifications are based on the SW-846 method that will be performed. Laboratory SOPs and analytical methods are the basis for TOC methods.

SAP Worksheet #24-2: Analytical Instrument Calibration Table

Instrument[2]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
ICP-AES (SW-846 6010C)	Instrument Detection Limit (IDL) Study	At initial set-up and after significant change in instrument type, personnel, test method, or sample matrix.	IDLs shall be ≤ LOD	N/A	Analyst	MET-05
	Linear dynamic range or high-level check standard	Every 6 months	Within ±10% of true value.	N/A		
	Initial Calibration (ICAL) - minimum one high standard and a calibration blank for all analytes	Daily ICAL prior to sample analysis.	If more than one calibration standard is used, r ≥ 0.995.	Correct problem, then repeat ICAL. Flagging criteria are not appropriate. No samples may be run until an ICAL is analyzed that meets acceptance criteria.		
	Second Source Calibration Verification (ICV)	Once after each ICAL, prior to beginning a sample run.	Value of second source for all analytes(s) within ±10% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL. Flagging criteria are not appropriate. No samples may be run until calibration has been verified.		
	Continuing Calibration Verification (CCV)	After every 10 field samples and at the end of the analysis sequence.	Within ± 10% of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification.		
	Low-level calibration check standard	Daily, after one-point ICAL.	Within ±20% of true value.	Correct problem, then reanalyze. Flagging criteria are not appropriate. No samples may be analyzed without a valid low-level calibration check standard.		
	Calibration Blank	Before beginning a sample run.	No analytes > LOD.	Correct problem.		

[1]Referenced SOPs are listed in **Worksheet #23**.
[2]DoD QSM v. 4.1 is the basis for specifications on this table. Specifications are based on the SW-846 method that will be performed. Laboratory SOPs and analytical methods are the basis TOC methods.

SAP Worksheet #24-3: Analytical Instrument Calibration Table

Instrument[2]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
CVAA (SW-846 7470A/7471B)	Initial Calibration (ICAL) - minimum three standards and a calibration blank	For all analytes, daily ICAL prior to sample analysis.	r ≥ 0.995.	Correct the problem, then repeat ICAL.	Analyst	MET-03 and MET-16
	Second Source Calibration Verification (ICV)	Once after each ICAL, prior to beginning a sample run.	Value of second source for all analytes(s) within ±10% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL. Flagging criteria are not appropriate. No samples may be run until calibration has been verified.		
	Continuing Calibration Verification (CCV)	After every 10 field samples and at the end of the analysis sequence.	Within ± 10% of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification. If reanalysis cannot be performed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification.		
	Calibration Blank	Before beginning a sample run.	No analytes > LOD.	Correct problem.		

[1]Referenced SOPs are listed in **Worksheet #23**.
[2]DoD QSM v. 4.1 is the basis for specifications on this table. Specifications are based on the SW-846 method that will be performed. Laboratory SOPs and analytical methods are the basis for pH, and TOC methods.

SAP Worksheet #24-4: Analytical Instrument Calibration Table

Instrument[2]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
UV-VIS (SW-846 7196A)	Initial Calibration (ICAL) - minimum three standards and a calibration blank	Daily ICAL prior to sample analysis.	r ≥ 0.995	Correct problem and repeat ICAL. Flagging criteria are not appropriate.	Analyst	WETS-64
	Second Source Calibration Verification (ICV)	Before beginning a sample run.	Value of second source within ± 10% of true value.	Correct problem and verify second source standard. Rerun ICV, if that fails, correct problem and repeat calibration. Flagging criteria are not appropriate.		
	Continuing Calibration Verification (CCV)	After every 15 field samples and at the end of the analysis sequence.	Value of CCV within of ± 10% the true value.	Correct problem then repeat CCV and reanalyze all samples since last successful calibration verification. If reanalysis cannot be preformed, data must be qualified and explained in the case narrative. Apply Q-flag to all results for the specific analyte(s) in all samples since the last acceptable calibration verification.		

[1]Referenced SOPs are listed in **Worksheet #23**.
[2]DoD QSM v. 4.1 is the basis for specifications on this table. Specifications are based on the SW-846 method that will be performed. Laboratory SOPs and analytical methods are the basis for pH, and TOC methods.

SAP Worksheet #24-5: Analytical Instrument Calibration Table

Instrument[2]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
LC/MS/MS(SW-846 8330B)	Initial Calibration (ICAL) - minimum five-points for all analytes	ICAL prior to sample analysis. Once calibration curve or line is generated, the lowest calibration standard must be reanalyzed.	The apparent signal-to-noise ratio at the RL must be at least 5:1. If linear regression is used, r ≥ 0.995. If using Internal Standardization, RSD ≤ 15%.	Correct problem then repeat ICAL.	Analyst	126
	Second Source Calibration Verification (ICV)	Immediately following ICAL.	All project analytes and surrogates within ± 20% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		
	Continuing Calibration Verification (CCV)	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence.	All target analytes and surrogates within ± 20% of the expected value from the ICAL.	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.		

[1]Referenced SOPs are listed in **Worksheet #23**.
[2]DoD QSM v. 4.1 is the basis for specifications on this table. Specifications are based on the SW-846 method that will be performed. Laboratory SOPs and analytical methods are the basis for pH, and TOC methods.

SAP Worksheet #24-6: Analytical Instrument Calibration Table

Instrument[2]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
LC/MS/MS (SW846 6850)	Initial Calibration (ICAL)	Minimum of five calibration standards to establish linearity at method set-up and after major maintenance.	r ≥ 0.995 or RSD ≤ 20%. The concentration corresponding to the absolute value of the calibration curve's Y-intercept must be ≤ LOD.	Correct problem then repeat ICAL.	Analyst	GL-OA-E-067
	Initial Calibration Verification (ICV)	Once after each ICAL, analysis of a second source standard at the midpoint of the calibration.	Within ±15% of true value.	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		
	Continuing Calibration Verification (CCV)	Analysis of mid-level standard after every 10 field samples. All samples must be bracketed by the analysis of a standard demonstrating that the system was capable of accurately detecting and quantifying perchlorate.	Within ±15% of true value.	Correct problem, then rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since last acceptable CCV.		
	Tuning	Prior to ICAL and after any mass calibration or maintenance is performed.	Tuning standards must contain the analytes of interest and meet acceptance criteria outlined in the laboratory SOP.	Retune instrument. If the tuning will not meet acceptance criteria, an instrument mass calibration must be performed and the tuning redone.		
	Limit of Detection Verification (LODV) (per batch)	Prior to sample analysis and at the end of the analysis sequence. It can be analyzed after every 10 samples in order to reduce the reanalysis rate.	Within ± 30% of true value.	Correct problem and rerun LODV and all samples analyzed since last successful LODV. If a sample with perchlorate concentration at or between the LOD and RL is bracketed by a failing LODV, it must be reanalyzed. A sample with concentration above the RL can be reported.		

SAP Worksheet #24-6: Analytical Instrument Calibration Table (continued)

Instrument[2]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[1]
	Mass Calibration	Instrument must have a valid mass calibration prior to any sample analysis. The mass calibration is updated on an as-needed basis (e.g., QC failures, ion masses show large deviations from known masses, major instrument maintenance is performed, or the instrument is moved).	Mass calibration range must bracket the ion masses of interest without greatly exceeding the range. The most recent mass calibration must be used for an analytical run, and the same mass calibration must be used for all data files in an analytical run. Mass calibration must be verified by acquiring a full scan continuum mass spectrum of a perchlorate stock standard. Perchlorate ions should be within ± 0.3 m/z of mass 99, 101, and 107 or their respective daughter ion masses (83, 85, and 89), depending on which ions are quantitated.	If the mass calibration fails, recalibrate. If it still fails, consult manufacturer instructions on corrective maintenance.		

[1]Referenced SOPs are listed in **Worksheet #23**.

[2]DoD QSM v. 4.1 is the basis for specifications on this table. Specifications are based on the SW-846 method that will be performed. Laboratory SOPs and analytical methods are the basis for pH, and TOC methods.

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SAP Worksheet #25-1: Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
ICP-AES (SW846 6010C)	Change tubing	Monitor ISTD counts for variation	Instrument performance and sensitivity	Weekly	Stable ISTD values	Replace tubing, recalibrate and reanalyze	Analyst	MET 15
	Clean cones	Monitor vacuum pressure	Instrument control panel	As needed	Vacuum pressure > 5 x 10ee -06 Torr, Stable ISTD values	Clean cones, re-install, re-optimize and re-calibrate		
	Change pump oil	Smooth operation, oil not dark in color or smelling burnt.	Instrument control panel, site glass of pumps.	Bi-weekly in interface pump and every 6 mo. in roughing pump	Vacuum pressure consistently lower than 5 x 10ee -06 Torr	Change pump oil		
	Clean Nebulizer	Monitor oxide and double charge analytes in tune solution	View of Cyclonic chamber , Daily Performance parameters.	Bi- weekly	Vacuum pressure consistently lower than 5 x 10ee -06 Torr, Stable ISTD values	Clean nebulizer, re-optimize, re-calibrate		
	Clean air filters	Monitor torch box temperature	Visual	Monthly	Torch box temp < 70 C	Clean air filters and monitor instrument.		
	Auto Lens Optimization	Monitor voltages applied to lens	Auto Lens optimization workspace and print-out	Daily	Upward trending but relatively linear curve of voltages	Re-optimize		
	Cooling system check (Chiller operation and blower operation)	Temperature of interface and torch box	Instrument control panel (Diagnostics)	Daily	Torch box < 70 C and Interface < 40 C	Replace blower fan belt, replace coolant in chiller.		

Notes:

SAP Worksheet #25-2: Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
CVAA (SW-846 7470A/7471B)	Check Cell	Monitor signal in Continuous graphics mode	Software functionality	Daily	ABS. < 0.7	Clean cell	Analyst	MET -03 and MET - 16
	Clean cell	Monitor signal in Continuous graphics mode	Software functionality, then visual check	As needed	ABS. < 0.7	Clean cell		
	PTFE filter change	Monitor cell for moisture	Visual inspection of cell for moisture	Daily	Cell dry	Replace filter		
	Check pump flows	Monitor reagent flows	Measurement of flow rate using Class A graduated cylinder.	Daily	Reductant 5-7 ml/min , Carrier 9-11 ml/min	Readjust tension of platens on tubing.		
	Clean air filter	none	Visual	Monthly	none	none		
	Change tubing	Sensitivity check	Instrument performance and sensitivity	Daily	Passing curve and passing CCV/CCB	Replace tubing, recalibrate and reanalyze		

SAP Worksheet #25-3: Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GC - ECD	Injection port maintenance	Degradation check run every 12 hrs	DDT and Endrin breakdown <15%	beginning of each 12 hour 8081 sequence	DDT and Endrin breakdown <15%	clip the guard column, replace the injection port liner, replace the gold seal, clean the injection port and repeat degradation check.	Analyst	SVGC-11

SAP Worksheet #25-4: Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
GC - FPD	Injection port maintenance	NA	evaluate baseline and peak shapes	as needed	analyst judgment of excessive tailing or baseline fluctuation	clip the guard column, replace the injection port liner, replace the gold seal, clean the injection port	Analyst	SVGC-05

SAP Worksheet #25-5: Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
LCMSMS	Check solvent levels, pump, and lines. Check syringe.	Explosives	Instrument performance and sensitivity	Daily	Acceptable instrument quality control and sensitivity.	Fill solvent reservoirs, prime pump and lines. Calibrate syringe placement.	Analyst	SOP-126

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SAP Worksheet #26: Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): Field Team/CH2M HILL
Sample Packaging (Personnel/Organization): FTL/ CH2M HILL
Coordination of Shipment (Personnel/Organization): FTL/ CH2M HILL
Type of Shipment/Carrier: Overnight Carrier/ FedEx
SAMPLE RECEIPT AND ANALYSIS
Sample Receipt (Personnel/Organization): Sample Custody Personnel / ENCO-Orlando, ENCO-Jacksonville and GEL Labs
Sample Custody and Storage (Personnel/Organization): Sample Custody Personnel / ENCO-Orlando, ENCO-Jacksonville and GEL Labs
Sample Preparation (Personnel/Organization): Sample Preparation Personnel / ENCO-Orlando, ENCO-Jacksonville and GEL Labs
Sample Determinative Analysis (Personnel/Organization): Analysts / ENCO-Orlando, ENCO-Jacksonville and GEL Labs
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): 60 days
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 45 days
Biological Sample Storage (No. of days from sample collection): Not Applicable
SAMPLE DISPOSAL
Personnel/Organization: Sample Disposal Personnel / ENCO-Orlando, ENCO-Jacksonville and GEL Labs
Number of Days from Analysis: 30 days from issuance of report

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SAP Worksheet #27: Sample Custody Requirements

Field Sample Custody Procedures (sample collection, packaging, shipment, and delivery to laboratory): Samples will be collected by field team members under the supervision of the FTL. As samples are collected, they will be placed into containers and labeled. Labels will be taped to the jar to ensure they do not separate. Samples will be cushioned with packaging material and placed into coolers containing enough ice to keep the samples 0-6 °C until they are received by the laboratory. The chain of custody (COC) form will be placed into the cooler in a Ziploc bag. Coolers will be taped up and shipped to the laboratories via Fed Ex overnight, with the air bill number indicated on the COC (to relinquish custody). Upon delivery, the laboratory will log in each cooler and report the status of the samples to CH2M HILL. See **Worksheet #21** for CH2M HILL SOPs containing sample custody guidance. The CH2M HILL field team will ship all samples directly to the laboratory performing the analysis(ENCO Orlando, ENCO Jacksonville, and GEL Laboratories), refer to **Worksheet #30**.
Laboratory Sample Custody Procedures (receipt of samples, archiving, disposal): Laboratory custody procedures can be found in SOP LOGIN-03 and GL-SR-E-001, which are referenced in **Worksheet #23**.
Sample Identification Procedures: Sample labels will include, at a minimum, client name, site, sample ID, date/time collected, analysis group or method, preservation, and sampler's initials. The field logbook will identify the sample ID with the location and time collected and the parameters requested. Sample IDs will conform to the nomenclature specified in **Worksheet #18**. The laboratory will assign each field sample a laboratory sample ID based on information in the chain of custody. The laboratory will send sample log-in forms to the PC and PDM to check that sample IDs and parameters are correct.
Chain-of-custody Procedures: Chain of custodies will include, at minimum, laboratory contact information, client contact information, sample information, and relinquished by/received by information. Sample information will include sample ID. Date/time collected, number and type of containers, preservative information, analysis method, and comments. The chain of custody will link location of the sample from the field logbook to the laboratory receipt of the sample. The laboratory will use the sample information to populate the Laboratory Information Management Systems (LIMS) database for each sample.

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SAP Worksheet #28-1: Laboratory QC Samples Table

Matrix: Surface Soil, Sediment
Analytical Group: OC Pesticides
Analytical Method / SOP Reference: SW-846 8081B / SVGC-04

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analyte detected > ½ RL and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct problem, then see criteria in Box D-1 of DoD QSM v. 4.1. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Accuracy/Bias / Precision	No analyte detected > ½ RL and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.
Laboratory Control Sample (LCS)	One per preparatory batch.	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. In-house control limits may not be greater than 3 times the standard deviation of the mean LCS recovery. Refer to **Worksheet #28-1A.**	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to Appendix G of DoD QSM v. 4.1.	Analyst	Accuracy/Bias	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. In-house control limits may not be greater than 3 times the standard deviation of the mean LCS recovery. Refer to **Worksheet #28-1A.**
Matrix Spike	One per preparatory batch.	Same as LCS, refer to **Worksheet #28-1A.**	Examine the project-specific Data Quality Objectives (DQOs). Contact the client as to additional measures to be taken.	Analyst	Accuracy/Bias	Same as LCS, refer to **Worksheet #28-1A.**
Matrix Spike Duplicate	One per preparatory batch.	Same as MS and RPD ≤30%.	Same as MS.	Analyst	Accuracy/Bias / Precision	Same as MS and RPD ≤30%.
Surrogate Spike	All field and QC samples.	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. Decachlorobiphenyl – 55-130 TCMX - 70-125	For QC and field samples, correct problem then reprepare and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	Analyst	Accuracy	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. Decachlorobiphenyl – 55-130 TCMX - 70-125
Confirmation of positive results	All positive results must be confirmed.	Calibration and QC criteria same as for initial or primary column analysis. Results between primary and second column RPD ≤ 40%.	NA	Analyst	Accuracy / Precision	Calibration and QC criteria same as for initial or primary column analysis. Results between primary and second column RPD ≤ 40%.

[1]DoD QSM v. 4.1 is the basis for specifications on this table.

SAP Worksheet #28-1A: Laboratory QC Samples Table - LCS Recovery Limits

Analyte	CAS Number	LCS Recovery Limits (%R)
4,4'-DDD	72-54-8	30-135
4,4'-DDE	72-55-9	70-125
4,4'-DDT	50-29-3	45-140
Aldrin	309-00-2	45-140
alpha-BHC	319-84-6	60-125
Chlordane-alpha	5103-71-9	65-120
beta-BHC	319-85-7	60-125
delta-BHC	319-86-8	55-130
Dieldrin	60-57-1	65-125
Endosulfan I	959-98-8	15-135
Endosulfan II	33213-65-9	35-140
Endosulfan sulfate	1031-07-8	60-135
Endrin	72-20-8	60-135
Endrin aldehyde	7421-93-4	35-145
Endrin ketone	53494-70-5	65-135
gamma-BHC	58-89-9	60-125
Chlordane-gamma	5103-74-2	65-125
Heptachlor	76-44-8	50-140
Heptachlor epoxide	1024-57-3	65-130
Methoxychlor	72-43-5	55-145
Toxaphene	8001-35-2	60-140

SAP Worksheet #28-2: Laboratory QC Samples Table

Matrix: Surface Soil, Sediment
Analytical Group: OP Pesticides
Analytical Method / SOP Reference: SW-846 8141A / SVGV-11

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analyte detected > ½ RL and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct problem, then see criteria in Box D-1 of DoD QSM v. 4.1. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Accuracy/Bias / Precision	No analyte detected > ½ RL and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.
Laboratory Control Sample	One per preparatory batch.	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. In-house control limits may not be greater than 3 times the standard deviation of the mean LCS recovery. Refer to **Worksheet #28-2A.**	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to Appendix G of DoD QSM v. 4.1.	Analyst	Accuracy/Bias	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. In-house control limits may not be greater than 3 times the standard deviation of the mean LCS recovery. Refer to **Worksheet #28-2A.**
Matrix Spike	One per preparatory batch.	Same as LCS, refer to **Worksheet #28-2A.**	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Analyst	Accuracy/Bias	Same as LCS, refer to **Worksheet #28-2A.**
Matrix Spike Duplicate	One per preparatory batch.	Same as MS and RPD ≤30%.	Same as MS.	Analyst	Accuracy/Bias / Precision	Same as MS and RPD ≤30%.
Surrogate Spike	All field and QC samples.	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. Tributyl Phosphate – 15-142 Triphenyl phosphate – 27-172	For QC and field samples, correct problem then reprepare and reanalyze all failed samples for failed surrogates in the associated preparatory batch, if sufficient sample material is available. If obvious chromatographic interference with surrogate is present, reanalysis may not be necessary.	Analyst	Accuracy	QC acceptance criteria specified by DoD, if available. Otherwise, use in-house control limits. Tributyl Phosphate – 15-142 Triphenyl phosphate – 27-172
Confirmation of positive results	All positive results must be confirmed.	Calibration and QC criteria same as for initial or primary column analysis. Results between primary and second column RPD ≤ 40%.	NA	Analyst	Accuracy / Precision	Calibration and QC criteria same as for initial or primary column analysis. Results between primary and second column RPD ≤ 40%.

[1]DoD QSM v. 4.1 is the basis for specifications on this table.

SAP Worksheet #28-2A: Laboratory QC Samples Table - LCS Recovery Limits

Analyte	CAS Number	LCS Recovery Limits (%R)
Monocrotophos [2C]	6923-22-4	10-195

SAP Worksheet #28-3: Laboratory QC Samples Table

Matrix: Groundwater
Analytical Group: TAL Metals (except mercury)
Analytical Method / SOP Reference: SW-846 6010B / MET-05

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > 1/2 RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 of DoD QSM v 4.1) .	Correct problem, then see criteria in Box D-1 of DoD QSM v. 4.1. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Accuracy/Bias, Contamination	No analytes detected > 1/2 RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 of DoD QSM v 4.1) .
Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOQ.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst	Accuracy/Bias, Contamination	No analytes detected > LOQ.
Interference Check Solutions (ICS)	At the beginning of an analytical run.	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spike analytes) ICS-AB: Within ±20% of true value.	Terminate analysis; locate and correct problem; reanalyze ICS; reanalyze all samples.	Analyst	Accuracy/Bias	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spike analytes) ICS-AB: Within ±20% of true value.
Laboratory Control Sample	One per preparatory batch.	Recovery 80-120%. Limits are as per DoD QSM v. 4.1.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to Appendix G of DoD QSM v. 4.1.	Analyst	Accuracy/Bias	Recovery 80-120%. Limits are as per DoD QSM v. 4.1.

SAP Worksheet #28-3: Laboratory QC Samples Table (continued)

QC Sample1	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spike	One per preparatory batch per matrix.	Same as LCS.	Examine the project-specific DQOs. If the matrix spike falls outside of DoD criteria, additional quality control tests are required to evaluate matrix effects.	Analyst	Accuracy/Bias	Same as LCS.
Matrix Spike Duplicate	One per preparatory batch per matrix.	Same as MS and RPD ≤ 20%.	Same as MS.	Analyst	Accuracy/Bias, Precision	Same as MS and RPD ≤ 20%.
Serial Dilution	One per preparatory batch.	Five-fold dilution must agree within ±10% of the original measurement. Only applicable for samples with concentrations > 50X LOQ.	Perform post-digestion spike (PDS) addition.	Analyst	Accuracy	Five-fold dilution must agree within ±10% of the original measurement. Only applicable for samples with concentrations > 50X LOQ.
Post-digestion Spike (PDS)	When dilution test fails or analyte concentration in all samples < 50X LOD.	75-125%R	Run all associated samples in the preparatory batch by method of standard additions (MSA). Or, for the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Analyst	Accuracy	75-125%R

SAP Worksheet #28-4: Laboratory QC Samples Table

Matrix: Groundwater
Analytical Group: Mercury
Analytical Method / SOP Reference: SW-846 7470A / MET-03

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ.	Correct problem, then see criteria in Box D-1 of DoD QSM v. 4.1. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Accuracy/Bias, Contamination	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ.
Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOQ.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst	Accuracy/Bias, Contamination	No analytes detected > LOQ.
Laboratory Control Sample	One per preparatory batch.	Recovery 80-120%. Limits are as per DoD QSM v. 4.1.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to Appendix G of DoD QSM v. 4.1.	Analyst	Accuracy/Bias	Recovery 80-120%. Limits are as per DoD QSM v. 4.1.
Matrix Spike (MS)	One per preparatory batch per matrix.	Same as LCS.	Examine the project-specific DQOs. If the matrix spike falls outside of DoD criteria, additional quality control tests are required to evaluate matrix effects.	Analyst	Accuracy/Bias	Same as LCS.
Matrix Spike Duplicate (MSD)	One per preparatory batch per matrix.	Same as MS and RPD ≤ 20%.	Same as MS.	Analyst	Accuracy/Bias, Precision	Same as MS and RPD ≤ 20%.

[1] DoD QSM v. 4.1 is the basis for specifications on this table.

SAP Worksheet #28-5: Laboratory QC Samples Table

Matrix: Groundwater
Analytical Group: Hexavalent Chromium
Analytical Method / SOP Reference: SW-846 7196A / WETS-64

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Reference Blank (Reagent Water)	Before beginning standards or sample analysis.	N/A	N/A	Analyst	N/A	N/A
Method Blank	One per preparatory batch.	No analytes detected > 1/2 RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct problem, then see criteria in Box D-1 of DoD QSM v. 4.1 . If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Accuracy/Bias, Contamination	No analytes detected > 1/2 RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.
Laboratory Control Sample	One per preparatory batch	RPD ≤15 %. Limits are as per DoD QSM v.4.1, which states that when no DoD limits are provided, statistical in-house limits are to be used.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated batch for the failed analyte in all samples in the associated preparatory batch, if sufficient sample material is available.	Analyst	Accuracy/Bias	RPD ≤15 %. Limits are as per DoD QSM v.4.1, which states that when no DoD limits are provided, statistical in-house limits are to be used.
Matrix Spike	Once for every sample matrix analyzed.	Same as LCS.	If check indicates interference, dilute and reanalyze sample; persistent interference indicates the need to use alternative method or analytical conditions, or to use method of standard additions.	Analyst	Accuracy/Bias	Same as LCS.
Matrix Spike Duplicate	One per preparatory batch per matrix.	Same as MS and ≤ RPD 20%.	Examine the project-specific DQOs. Contact the client as to additional measure to be taken. Flagging criteria are not appropriate.	Analyst	Accuracy/Bias	Same as MS and ≤ RPD 20%.
Post-digestion Spike (PDS)	One per preparatory batch.	Same as LCS.	Correct problem and rehomogenize, redigest, and reanalyze samples. Persistent interference indicates the need to use an alternative method or analytical conditions, or to use method of standard additions.	Analyst	Accuracy/Bias	Same as LCS.

[1] DoD QSM v. 4.1 is the basis for specifications on this table.

SAP Worksheet #28-6: Laboratory QC Samples Table

Matrix: Surface Soil, Surface Soil Composite, Subsurface Soil
Analytical Group: TAL Metals, except mercury
Analytical Method / SOP Reference: SW-846 6010C / MET-05

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > 1/2 RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 of DoD QSM v 4.1) .	Correct problem, then see criteria in Box D-1 of DoD QSM v. 4.1. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Accuracy/Bias, Contamination	No analytes detected > 1/2 RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ (see Box D-1 of DoD QSM v 4.1) .
Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOQ.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst	Accuracy/Bias, Contamination	No analytes detected > LOQ.
Interference Check Solutions (ICS)	At the beginning of an analytical run.	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spike analytes) ICS-AB: Within ±20% of true value.	Terminate analysis; locate and correct problem; reanalyze ICS; reanalyze all samples.	Analyst	Accuracy/Bias	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are a verified trace impurity from one of the spike analytes) ICS-AB: Within ±20% of true value.
Laboratory Control Sample	One per preparatory batch.	Recovery 80-120%, except for silver, 75-120%. Limits are as per DoD QSM v. 4.1.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to Appendix G of DoD QSM v. 4.1.	Analyst	Accuracy/Bias	Recovery 80-120%, except for silver, 75-120%. Limits are as per DoD QSM v. 4.1.

SAP Worksheet #28-6: Laboratory QC Samples Table (continued)

QC Sample1	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spike	One per preparatory batch per matrix.	Same as LCS.	Examine the project-specific DQOs. If the matrix spike falls outside of DoD criteria, additional quality control tests are required to evaluate matrix effects.	Analyst	Accuracy/Bias	Same as LCS.
Matrix Spike Duplicate	One per preparatory batch per matrix.	Same as MS and RPD ≤ 20%.	Same as MS.	Analyst	Accuracy/Bias, Precision	Same as MS and RPD ≤ 20%.
Serial Dilution	One per preparatory batch.	Five-fold dilution must agree within ±10% of the original measurement. Only applicable for samples with concentrations > 50X LOQ.	Perform post-digestion spike (PDS) addition.	Analyst	Accuracy	Five-fold dilution must agree within ±10% of the original measurement. Only applicable for samples with concentrations > 50X LOQ.
Post-digestion Spike (PDS)	When dilution test fails or analyte concentration in all samples < 50X LOD.	75-125%R	Run all associated samples in the preparatory batch by method of standard additions (MSA). Or, for the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Analyst	Accuracy	75-125%R

[1]DoD QSM v. 4.1 is the basis for specifications on this table.

SAP Worksheet #28-7: Laboratory QC Samples Table

Matrix: Surface Soil, Surface Soil Composite, Subsurface Soil
Analytical Group: Mercury
Analytical Method / SOP Reference: SW-846 7471B / MET-16

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ.	Correct problem, then see criteria in Box D-1 of DoD QSM v. 4.1. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Accuracy/Bias, Contamination	No analytes detected > 1/2 LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results. For common laboratory contaminants, no analytes detected > LOQ.
Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOQ.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.	Analyst	Accuracy/Bias, Contamination	No analytes detected > LOQ.
Laboratory Control Sample	One per preparatory batch.	Recovery 80-120%. Limits are as per DoD QSM v. 4.1.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to Appendix G of DoD QSM v. 4.1.	Analyst	Accuracy/Bias	Recovery 80-120%. Limits are as per DoD QSM v. 4.1.
Matrix Spike (MS)	One per preparatory batch per matrix.	Same as LCS.	Examine the project-specific DQOs. If the matrix spike falls outside of DoD criteria, additional quality control tests are required to evaluate matrix effects.	Analyst	Accuracy/Bias	Same as LCS.
Matrix Spike Duplicate (MSD)	One per preparatory batch per matrix.	Same as MS and RPD ≤ 20%.	Same as MS.	Analyst	Accuracy/Bias, Precision	Same as MS and RPD ≤ 20%.

[1] DoD QSM v. 4.1 is the basis for specifications on this table.

SAP Worksheet #28-8: Laboratory QC Samples Table

Matrix: Surface Soil Composite
Analytical Group: Explosives, except perchlorate
Analytical Method / SOP Reference: SW-846 8330B and 6850 / GL-OA-E-067 and GL-OA-E-068

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch.	No analytes detected > 1/2 RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct problem, then see criteria in Box D-1 of DoD QSM v. 4.1. If required, reprepare and reanalyze method blank and all samples processed with the contaminated blank.	Analyst	Accuracy/Bias, Contamination	No analytes detected > 1/2 RL and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.
Laboratory Control Sample	One per preparatory batch.	A solid reference material containing all reported analytes must be prepared and analyzed in exactly the same manner as a field sample. In-house laboratory control limits for the LCS must demonstrate the laboratory's ability to meet the project's Measurement Quality Objectives (MQOs). Refer to **Worksheet #28-8A**.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to Appendix G of DoD QSM v. 4.1.	Analyst	Accuracy/Bias	A solid reference material containing all reported analytes must be prepared and analyzed in exactly the same manner as a field sample. In-house laboratory control limits for the LCS must demonstrate the laboratory's ability to meet the project's MQOs. Refer to **Worksheet #28-8A**.
Matrix Spike	One per preparatory batch per matrix.	Same as LCS, refer to **Worksheet #28-8A**.	Examine the project-specific DQOs. Contact the client as to additional measures to be taken. For the specific analyte(s) in the parent sample, apply J-flag if acceptance criteria are not met.	Analyst	Accuracy/Bias	Same as LCS, refer to **Worksheet #28-8A** .
Matrix Spike Duplicate	One per preparatory batch per matrix.	Same as MS and RPD ≤20%.	Same as MS.	Analyst	Accuracy/Bias, Precision	Same as MS and RPD ≤20%.
Confirmation analysis	When target analytes are detected on the primary column using the UV Detector (HPLC) at concentrations exceeding the LOD.	Calibration and QC criteria are the same as for initial or primary column analysis. Results between primary and second column RPD ≤ 40%.	Report from both columns. If there is a > 40% RPD between the two column results, data must be J-flagged accordingly.	Analyst	Accuracy / Precision	Calibration and QC criteria are the same as for initial or primary column analysis. Results between primary and second column RPD ≤ 40%.

[1]DoD QSM v. 4.1 is the basis for specifications on this table.

SAP Worksheet #28-8A: Laboratory QC Samples Table - LCS Recovery Limits

Analyte	CAS Number	LCS Recovery Limits (%R)
1,3,5-Trinitrobenzene	99-35-4	56 - 120
1,3-Dinitrobenzene	99-65-0	80 - 120
2,4,6-Trinitrotoluene	118-96-7	70 - 130
2,4-Dinitrotoluene	121-14-2	77 - 123
2,6-Dinitrotoluene	606-20-2	80 - 120
2-Amino-4,6-dinitrotoluene	35572-78-2	71 - 135
2-Nitrotoluene	88-72-2	63 - 128
3-Nitrotoluene	99-08-1	63 - 124
4-Amino-2,6-dinitrotoluene	1946-51-0	72 - 130
4-Nitrotoluene	99-99-0	64 - 129
HMX	2691-41-0	51 - 132
Methyl-2,4,6-trinitrophenylnitramine	479-45-8	32 - 111
Nitrobenzene	98-95-3	65 - 123
Nitroglycerin	55-63-0	49 - 135
PETN	78-11-5	58 - 150
RDX	121-82-4	65 - 136

SAP Worksheet #28-9: Laboratory QC Samples Table

Matrix: Surface Soil Composite
Analytical Group: Perchlorate
Analytical Method / SOP Reference: SW-846 6850 / GL-OA-E-067

QC Sample[1]	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Laboratory Reagent Blank	Prior to calibration, after samples with overrange concentration of perchlorate, and at the end of the analytical sequence.	No perchlorate detected > 1/2 RL.	Reanalyze reagent blank until no carryover is observed, and all samples processed since the contaminated blank.	Analyst	Contamination	No perchlorate detected > 1/2 RL.
Method Blank	One per preparatory batch.	No perchlorate detected > ½ RL and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	If associated detects are < LOD, the results will be reported and the contamination will be narrated. If associated detects > LOD, the batch will be re-extracted and reanalyzed.	Analyst	Accuracy/Bias, Contamination	No perchlorate detected > ½ RL and greater than 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.
Laboratory Control Sample	One per preparatory batch. LCS must be spiked at the RL.	Recovery between method requirements, laboratory generated limits or 80-120% (whichever is more stringent) to verify calibration and check method performance.	Correct problem, then reprepare and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes, if sufficient sample material is available. Refer to Appendix G of DoD QSM v. 4.1.	Analyst	Accuracy/Bias	Recovery between method requirements, laboratory generated limits or 80-120% (whichever is more stringent) to verify calibration and check method performance.
Matrix Spike	One per preparatory batch per matrix. The MS must be spiked at the RL	Recovery between laboratory generated limits or 80-120% (whichever is more stringent).	Examine the project-specific DQOs. Contact the client as to additional measures to be taken.	Analyst	Accuracy/Bias	Recovery between laboratory generated limits or 80-120% (whichever is more stringent).

SAP Worksheet #28-9: Laboratory QC Samples Table

QC Sample1	Frequency / Number	Method / SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Matrix Spike Duplicate	One per preparatory batch per matrix. The MS must be spiked at the RL	Same as MS and RPD <15%.	Same as MS.	Analyst	Accuracy/Bias, Precision	Same as MS and RPD <15%.
Interference Check Sample	Once ICS is prepared with every batch of 20 samples and must undergo the same preparation and pretreatment steps as the samples in the batch. It verifies the method performance at the matrix conductivity threshold (MCT). At least one ICS must be analyzed daily.	Within ±30% of true value.	Correct problem and then reanalyze all samples in that batch. If poor recovery from the cleanup filters is suspected, a different lot of filters must be used to reextract all samples in the batch. If column degradation is suspected, a new column must be calibrated before the samples can be reanalyzed.	Analyst	Accuracy	Within ±30% of true value.
Isotope ratio $^{35}Cl/^{37}Cl$	Every sample, batch QC sample, and standard.	Monitor for either the parent ion at masses 99/101 or the daughter ion at masses 83/85 depending on which ions are quantitated. Theoretical ratio ~3.06. Must fall within 2.3 to 3.8 .	If criteria are not met, the sample must be rerun. If the sample was not pretreated, the sample should be reextracted using cleanup procedures. If, after cleanup, the ratio still fails, use alternative techniques to confirm presence of perchlorate (i.e., a post spike sample, dilution to reduce any interference, etc.).	Analyst	Accuracy	Monitor for either the parent ion at masses 99/101 or the daughter ion at masses 83/85 depending on which ions are quantitated. Theoretical ratio ~3.06. Must fall within 2.3 to 3.8 .
Internal Standard	Addition of ^{18}O-labeled perchlorate to every sample, batch QC sample, standard, instrument blank, and method blank.	Measured ^{18}O IS area within ±50% of the value from the average of the IS area counts of the ICAL. RRT of the perchlorate ion must be 1.0±2% (0.98-1.02).	Rerun the sample at increasing dilutions until the ±50% acceptance criteria are met. If criteria cannot be met with dilution, the interference are suspected and the sample must be reprepped using additional pretreatment steps.	Analyst	Accuracy/Bias	Measured ^{18}O IS area within ±50% of the value from the average of the IS area counts of the ICAL. RRT of the perchlorate ion must be 1.0±2% (0.98-1.02).

[1]DoD QSM v. 4.1 is the basis for specifications on this table.

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SAP Worksheet #29: Project Documents and Records Table

Document	Where Maintained
• Field Notebooks • Chain-of-Custody Records • Air Bills • Custody Seals • CA Forms • Electronic Data Deliverables (EDDs) • Identification of QC Samples • Meteorological Data from Field • Sampling instrument calibration logs • Sampling locations and sampling plan • Sampling notes and drilling logs • Water quality parameters • Sample Receipt, Chain-of-Custody, and Tracking Records • Standard Traceability Logs • Equipment Calibration Logs • Sample Prep Logs • Run Logs • Equipment Maintenance, Testing, and Inspection Logs • CA Forms • Reported Field Sample Results • Reported Result for Standards, QC Checks, and QC Samples • Instrument printouts (raw data) for Field Samples, Standards, QC Checks, and QC Samples • Data Package Completeness Checklists • Sample disposal records • Extraction/Clean-up Records • Raw Data (archived per Navy CLEAN contract) • DV Reports • CA Forms • Laboratory QA Plan • Method detection limit (MDL) Study Information	• Field data deliverables such as logbooks entries, chain of custodies, air bills, EDDs, etc will be kept on CH2M HILL's local internet server. • Field parameter data will be loaded with the analytical data into the Navy database. • Analytical laboratory hardcopy deliverables and DV reports will be saved on the network server and archived per the Navy CLEAN contract. • Electronic data from the laboratory will be loaded into the Navy database. • Off-site analysis documents and records will be archived after a period of 6 months. Hardcopy deliverables from the data validator as well as other data assessment documents and records will be archived. All archived documents will be archived with Iron Mountain Inc., headquartered at 745 Atlantic Avenue, Boston, MA 02111.

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SAP Worksheet #30: Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID Numbers	Analytical SOPs	Data Package Turnaround Time	Laboratory/Organization[1]	Backup Laboratory/Organization[2]
UXO-02						
Surface Soil, Sediment	OC Pesticides	Refer to **Worksheet #18**	Refer to **Worksheet #23**	7 Calendar Days	ENCO - Orlando Ronnie Wambles 10775 Central Port Drive Orlando, FL (407)-826 5314	TBD
Sediment	OP Pesticides (Select)					
	TOC					
Groundwater	Hexavalent Chromium					
	TAL Metals				ENCO - Jacksonville 4810 Executive Park Court #110 Jacksonville, FL 32216 (904)-296-3007	
UXO-14						
Surface Soil, Subsurface Soil	Metals (Select)	Refer to **Worksheet #18**	Refer to **Worksheet #23**	7 Calendar Days	ENCO – Jacksonville 4810 Executive Park Court #110 Jacksonville, FL 32216 (904)-296-3007	TBD
UXO-02 and UXO-14 Post Detonation Sampling						
Surface Soil Composite	TAL Metals	Refer to **Worksheet #18**	Refer to **Worksheet #23**	7 Calendar Days	ENCO – Jacksonville	TBD
	Explosives, including perchlorate				GEL Laboratories Ann Skradski 2040 Savage Road Charleston, SC (843)-566-8171	

Notes:
[1] Laboratories meet accreditation requirements to support project needs, the respective DoD ELAP acceptance letters are provided in **Attachment 4**.
[2] A backup laboratory has not been determined. If circumstances render the subcontracted laboratory unable to perform analytical services, another laboratory will be determined at that time.

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SAP Worksheet #31: Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment (title and organizational affiliation)	Person(s) Responsible for Responding to Assessment Findings (title and organizational affiliation)	Person(s) Responsible for Identifying and Implementing CA (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 Department of Defense (DoD) ELAP accreditation, which will identify the period of performance. The laboratory must be re-evaluated prior to expiration of period of performance	External	Third party accrediting body	TBD, Third party accrediting body	Lori Mangrum / ENCO QAO Robert Pullano / GEL QAO	Lori Mangrum / ENCO QAO Robert Pullano / GEL QAO	Anita Dodson, Navy Program Chemist
Field Performance Audit	One during additional investigation field activities	Internal	CH2M HILL	Keith LaTorre Project Manager / CH2M HILL	Field Team Leader / CH2M HILL	Keith LaTorre Project Manager / CH2M HILL	Keith LaTorre PM CH2M HILL
Safe Work Observation	One per week during field activities	Internal	CH2M HILL	TBD Site Safety Coordinator CH2M HILL	Field Team Member observed / CH2M HILL	Carl Woods HSM CH2M HILL	TBD Site Safety Coordinator / CH2M HILL

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SAP Worksheet #32: Assessment Findings and Corrective Action Responses Table

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of Corrective Action Response Documentation	Individual(s) Receiving Corrective Action Response	Timeframe for Response
Field Performance Audit	Checklist and Written Audit Report	Field Team Leader CH2M HILL	Within one day of audit	Verbal and Memorandum	Field Team Leader CH2M HILL	Within one day of receipt of Correction Action Form
Laboratory Performance and Systems Audits	Written Audit Report	ENCO Laboratories QAO GEL Laboratories QAO	Within 2 months of audit	Memorandum	DoD ELAP Auditor	Within two months of receipt of initial notification
Safe Behavior Observation (SBO)	Safe Behavior Observation Form	Carl Woods H&S Manager CH2M HILL	Within one week of SBO.	Memorandum	Field Team Member CH2M HILL	Immediately

SAP Worksheet #32-1: Laboratory CA Form

Person initiating corrective action ________________________ **Date** ________________

Description of problem and when identified: ______________________________________

____

____

____

____

Cause of problem, if known or suspected: ______________________________________

____

____

____

<u>Sequence of Corrective Action (CA):</u> (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:

____

____

____

____

SAP Worksheet #32-2: Field Performance Audit Checklist

Project Responsibilities

Project No.: ___ Date: ___________________________________

Project Location: __ Signature: _______________________________

Team Members:

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

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

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

Sample Collection

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

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

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

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

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

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

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

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

Document Control

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

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

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

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

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

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

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

.

SAP Worksheet #32-3: SBO Form

<table>
<tr><th colspan="4">Safe Behavior Observation Form</th></tr>
<tr><td>Project:</td><td colspan="2">Observer:</td><td>Date:</td></tr>
<tr><td>Position/Title of worker observed:</td><td colspan="2"></td><td>Background Information/comments:</td></tr>
<tr><td>Task/Observation Observed:</td><td colspan="3"></td></tr>
<tr><td colspan="4">❖ 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</td></tr>
<tr><th>Actions & Behaviors</th><th>Safe</th><th>At-Risk</th><th>Observations/Comments</th></tr>
<tr><td>Current & accurate Pre-Task Planning/Briefing (Project safety plan, STAC, AHA, PTSP, tailgate briefing, etc., as needed)</td><td></td><td></td><td rowspan="3">Positive Observations/Safe Work Practices:</td></tr>
<tr><td>Properly trained/ qualified/ experienced</td><td></td><td></td></tr>
<tr><td>Tools/equipment available and adequate</td><td></td><td></td></tr>
<tr><td>Proper use of tools</td><td></td><td></td><td rowspan="6">Questionable Activity/Unsafe Condition Observed:</td></tr>
<tr><td>Barricades/work zone control</td><td></td><td></td></tr>
<tr><td>Housekeeping</td><td></td><td></td></tr>
<tr><td>Communication</td><td></td><td></td></tr>
<tr><td>Work Approach/Habits</td><td></td><td></td></tr>
<tr><td>Attitude</td><td></td><td></td></tr>
<tr><td>Focus/attentiveness</td><td></td><td></td><td rowspan="6">Observer's Corrective Actions/Comments</td></tr>
<tr><td>Pace</td><td></td><td></td></tr>
<tr><td>Uncomfortable/unsafe position</td><td></td><td></td></tr>
<tr><td>Inconvenient/unsafe location</td><td></td><td></td></tr>
<tr><td>Position/Line of fire</td><td></td><td></td></tr>
<tr><td>Apparel (hair, loose clothing, jewelry)</td><td></td><td></td></tr>
<tr><td>Repetitive motion</td><td></td><td></td><td rowspan="2">Observed Worker's Corrective Actions/Comments:
None:</td></tr>
<tr><td>Other…</td><td></td><td></td></tr>
</table>

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SAP Worksheet #33: Quality Assurance Management Reports Table

Type of Report	**Frequency** (daily, weekly monthly, quarterly, annually, etc.)	**Projected Delivery Date(s)**	**Person(s) Responsible for Report Preparation** (title and organizational affiliation)	**Report Recipient(s)** (title and organizational affiliation)
Field Audit Report	One during additional investigation field activities and one during treatability study field activities	Submitted with Final Report	Keith LaTorre Project Manager / CH2M HILL	Included in project files

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SAP Worksheets #34: Verification (Step I)[1] Process Table

Verification Input	Description	Internal / External	Responsible for Verification
Planning Documents	Evidence of approval and completeness of UFP-SAP.	Internal	PM: Keith LaTorre / CH2M HILL
Chain-of-custody and shipping forms	Chain-of-custody forms and shipping documentation will be reviewed internally upon their completion and verified against the packed sample coolers they represent. The shipper's signature on the chain-of-custody will be initialed by the reviewer, a copy of the chain-of-custody retained in the site file, and the original and remaining copies taped inside the cooler for shipment. See chain-of-custody SOP (on CD) for further details.	Internal	FTL: TBD PC: Bianca Kleist / CH2M HILL
Field Log Notebooks	Field notes will be reviewed to ensure completeness of field data parameters, shipping information, and sample collection times, etc. The logbook will also be used to document, explain, and justify all deviations from the approved work plan and UFP-SAP.	Internal	PM: Keith LaTorre / CH2M HILL
Sample Login/ Receipt	Upon their arrival at the laboratory, the samples will be cross-referenced against the chain-of-custody records. All sample labels will be checked against the chain-of-custody, and any mislabeling will be identified, investigated, and corrected. The samples will be logged in at every storage area and work station required by the designated analyses. Individual analysts will verify the completeness and accuracy of the data recorded on the forms.	Internal	ENCO – Jacksonville, ENCO – Orlando and GEL Employees
QC Summary Report	A summary of all QC sample results will be verified for completeness once the data is received from the laboratory.	External	PC: Bianca Kleist CH2M HILL
Field Investigation Interpretive Data	Immediately following receipt of the analytical data from the laboratory and prior to submittal to the data validator, a population to population comparison will be conducted comparing site results and the results from the background sample set. The background population to population comparison for will be used to determine the likelihood of a release relative to background. The data will also be compared to screening criteria (**Worksheet #15**).	Internal	PM: Keith LaTorre CH2M HILL

1 III=compliance with methods, procedures, and contracts [see Table 10, page 117, UFP-QAPP manual, V.1, March 2005.]
Ibis=comparison with measurement performance criteria in the SAP [see Table 11, page 118, UFP-QAPP manual, V.1, March 2005

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SAP Worksheets #35: Verification (Step II) Process Table

Step IIa / IIb[1]	Validation Input	Description	Responsible for Validation
IIa	SOPs	Review field logbooks, laboratory case narratives, data deliverables for compliance to methods and signatures.	FTL: TBD PM: Keith LaTorre / CH2M HILL
IIa	QC Results	Establish that all field and lab QC samples were run and compliant with method-required limits as specified in **Worksheets #12 and #28**.	DV: Laura Maschoff / DataQual
IIb	QC Results	Verify that QC samples were run and compliant with limits established in the UFP-SAP.	PC: Bianca Kleist / CH2M HILL Data Validator: Laura Maschoff / DataQual
IIb	Project QLs	Ensure all sample results met the project quantification and action limits specified in **Worksheet #15.**	PC: Bianca Kleist / CH2M HILL
		Verify precision and bias at the LOD by analyzing four standards at the QL to establish percent recovery and percent relative standard deviation.	QAO: Lori Mangrum / ENCO, Robert Pullano / GEL
IIb	Raw data	10% review of raw data to confirm laboratory calculations.	Data Validator: Laura Maschoff / DataQual

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SAP Worksheets #36: Analytical Data Validation (Steps IIa and IIb) Summary Table

Step IIa / IIb	Matrix	Analytical Group	Validation Criteria	Data Validator
IIa and IIb	Surface Soil, Sediment	OC 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* (USEPA, 1999) or *National Functional Guidelines for Inorganic Data Review* (USEPA, 2004), as appropriate. National Functional Guidelines will not be used for validation; however, the specific qualifiers listed therein may be applied to data should non-conformances against the QA/QC criteria as presented in this SAP be identified.	Laura Maschoff / DataQual
		OP Pesticides		
	Groundwater	Total and Dissolved TAL Metals		
		Dissolved Hexavalent Chromium		
	Surface Soil, Subsurface Soil	Select Metals (Antimony, Lead, and Mercury)		
	Surface Soil Composite	TAL Metals		
		Explosives, including perchlorate		

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SAP Worksheet #37: Usability Assessment

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

- Non-detected site contaminants will be evaluated to ensure that project required QLs in **Worksheet #15** were achieved. If project quantitation limits (PQLs) were achieved and the verification and validation steps yielded acceptable data, then the data is considered usable.
- During verification and validation steps, data may be qualified as estimated with the following qualifiers: J, , J+, J-, or UJ. These qualifiers represent minor QC deficiencies which will not affect the usability of the data. When major QC deficiencies are encountered, data will be qualified with an R and in most cases is not considered usable for project decisions.
  - J – Analyte present. Reported value may or may not be accurate or precise
  - J- - Analyte present. Reported value may be biased low
  - J+ - Analyte present. Reported value may be biased high
  - UJ - Analyte not detected. Quantitation limit may be inaccurate or imprecise
  - R - Rejected result. Result not reliable.
- Additional qualifiers that may be given by the validator are:
  - N - Tentative Identification. Consider Present. Special methods may be needed to confirm its presence or absence in future sampling efforts
  - NJ - Qualitative identification questionable due to poor resolution. Presumptively present at approximate quantity
  - U - Not Detected
- 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 RPD between the two results.
- Deviations from the SAP will be reviewed to assess whether CA is warranted and to assess impacts to achievement of project objectives.

SAP Worksheet #37: Usability Assessment (continued)

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

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

The following will be prepared by CH2M HILL and presented to and submitted to the MCB CamLej Partnering Team for review and decisions on the path forward for the site.

- Data tables will be produced to reflect detected and non-detected site COCs and geochemical parameters. Data qualifiers will be reflected in the tables and discussed in the data quality evaluation.
- Graphical representations will be produced to reflect increasing and/or decreasing concentrations of COCs.
- A data quality evaluation considering all of the above will be provided as part of presentations to the Tier I Partnering Team, followed by the technical memorandum prepared to assess remedy effectiveness. The technical memorandum will identify any data usability limitations and make recommendations for CA if necessary.

Identify the personnel responsible for performing the usability assessment.

The CH2M HILL Team, including the PM and PC, will review the data and compile a presentation for the Partnering Team. The MCB CamLej Partnering Team as a whole will assess the usability of the data.

Figures

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_11_1_SITE_UXO-02_SITE_LOCATION.MXD MARTESE 6/7/2011 12:40:50 PM

Legend
- Jurisdictional Wetlands
- Site 69 Boundary
- Site UXO-02- Former Unnamed Explosive Contaminated Range (ASR #2.201)
- Installation Boundary

N

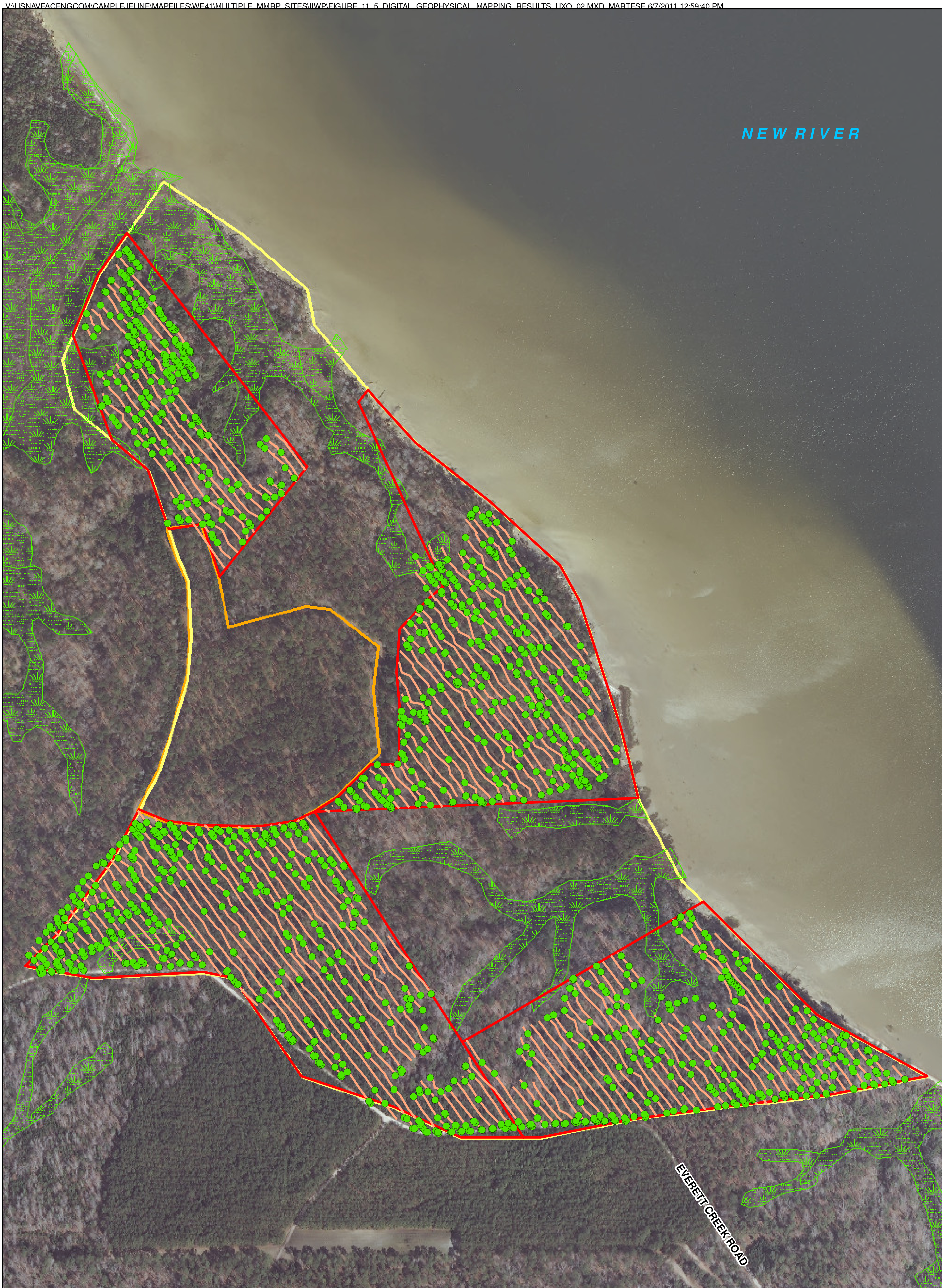
0 750 1,500 Feet

1 inch = 1,500 feet

Figure 10-1
UXO-02 Site Location
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_11_5_DIGITAL_GEOPHYSICAL_MAPPING_RESULTS_UXO_02.MXD MARTESE 6/7/2011 12:59:40 PM



Legend

- Geophysical Anomaly (greater than 3 mV)(EM61-MK2)
- DGM Transect
- Site UXO-02 Sampling Areas
- Jurisdictional Wetlands
- Site UXO-02 Boundary
- Site 69 Boundary

N

0 175 350 700 Feet

1 inch = 350 feet

Figure 10-2

Site UXO-02 Digital Geophysical Mapping Results
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

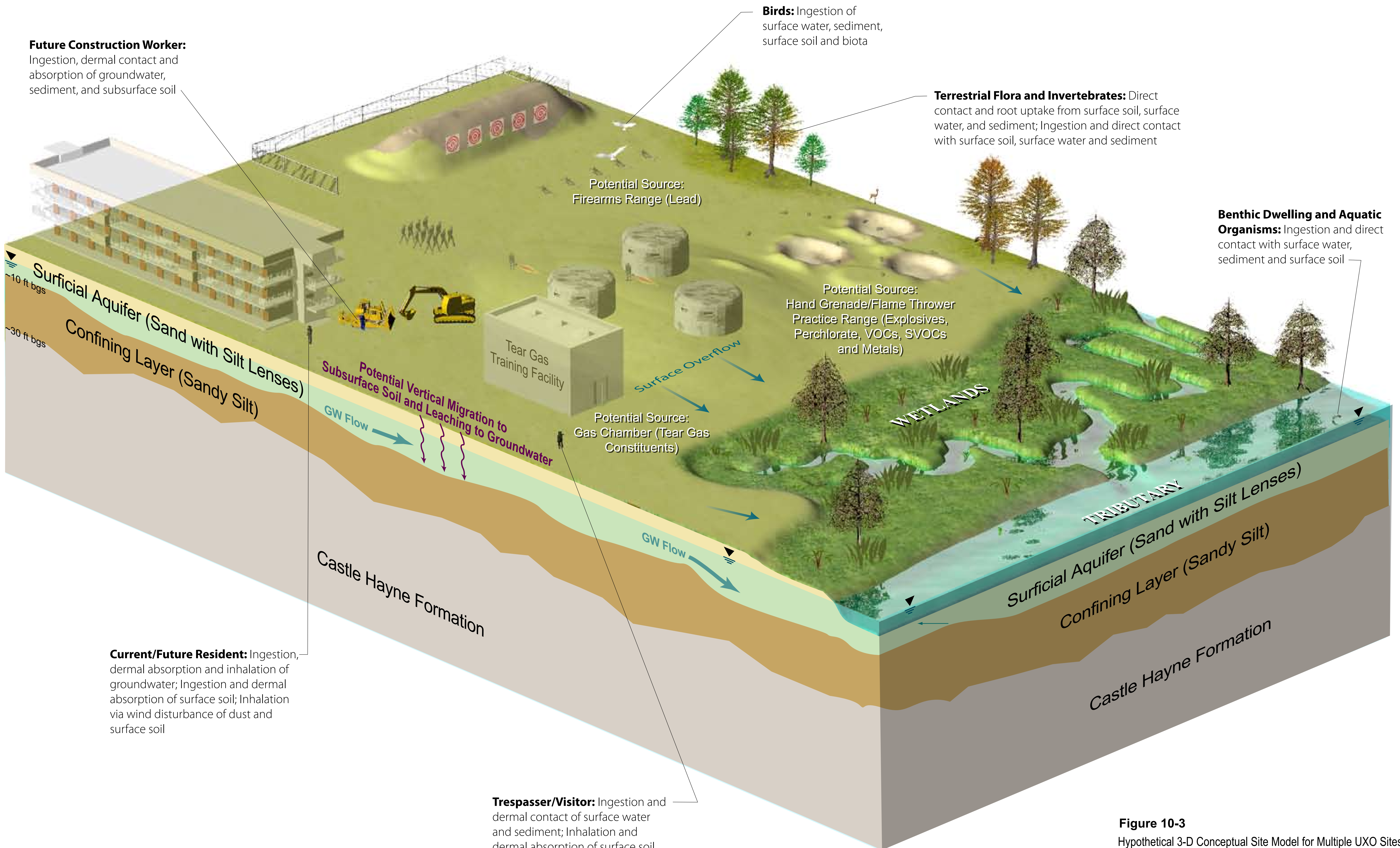


Figure 10-3

Hypothetical 3-D Conceptual Site Model for Multiple UXO Sites
Multi-site UXO PA/SI
MCB Camp Lejeune, NC

CH2MHILL

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_11_7_SURFACE_SOIL_AND_SD_SAMPLE_LOCATIONS_UXO_02.MXD MARTESE 6/8/2011 3:09:20 PM

Legend
- Surface Soil Sampling Locations
- Sediment Sampling Locations
- Jurisdictional Wetland Area
- Site UXO-02 Boundary
- Site 69 Boundary

N

0 175 350 700 Feet

1 inch = 350 feet

Figure 10-4
Site UXO-02 Surface Soil and Sediment Sampling Locations
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

Legend

- Proposed Monitoring Well (Surficial Aquifer)
- Existing Monitoring Well (Surficial Aquifer)
- Site UXO-02 Boundary
- Site 69 Boundary

N

0 175 350 700 Feet

1 inch = 350 feet

Figure 10-5
Site UXO-02 Groundwater Sampling Locations
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_14_1_UXO-14_SITE_LOCATION.MXD MARTESE 6/7/2011 3:11:02 PM

Legend

- Site UXO-14 – Former Indoor Pistol Range (ASR #2.199) boundary
- Site UXO-14 – Former Gas Chamber (ASR #2.200) boundary
- Installation Boundary

N

0 100 200 400 Feet

1 inch = 200 feet

Figure 10-6

UXO-14 Site Location
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_14_2_DIGITAL_GEOPHYSICAL_MAPPING_RESULTS_UXO_14_PA_SI.MXD MARTESE 6/7/2011 3:15:41 PM

Legend

- Geophysical Anomaly (greater than 3 mV)(EM61-MK2)
- DGM Transect
- Site UXO-14 Boundary (Former Indoor Pistol Range Area)
- Site UXO-14 Boundary (Former Gas Chamber Area)

N

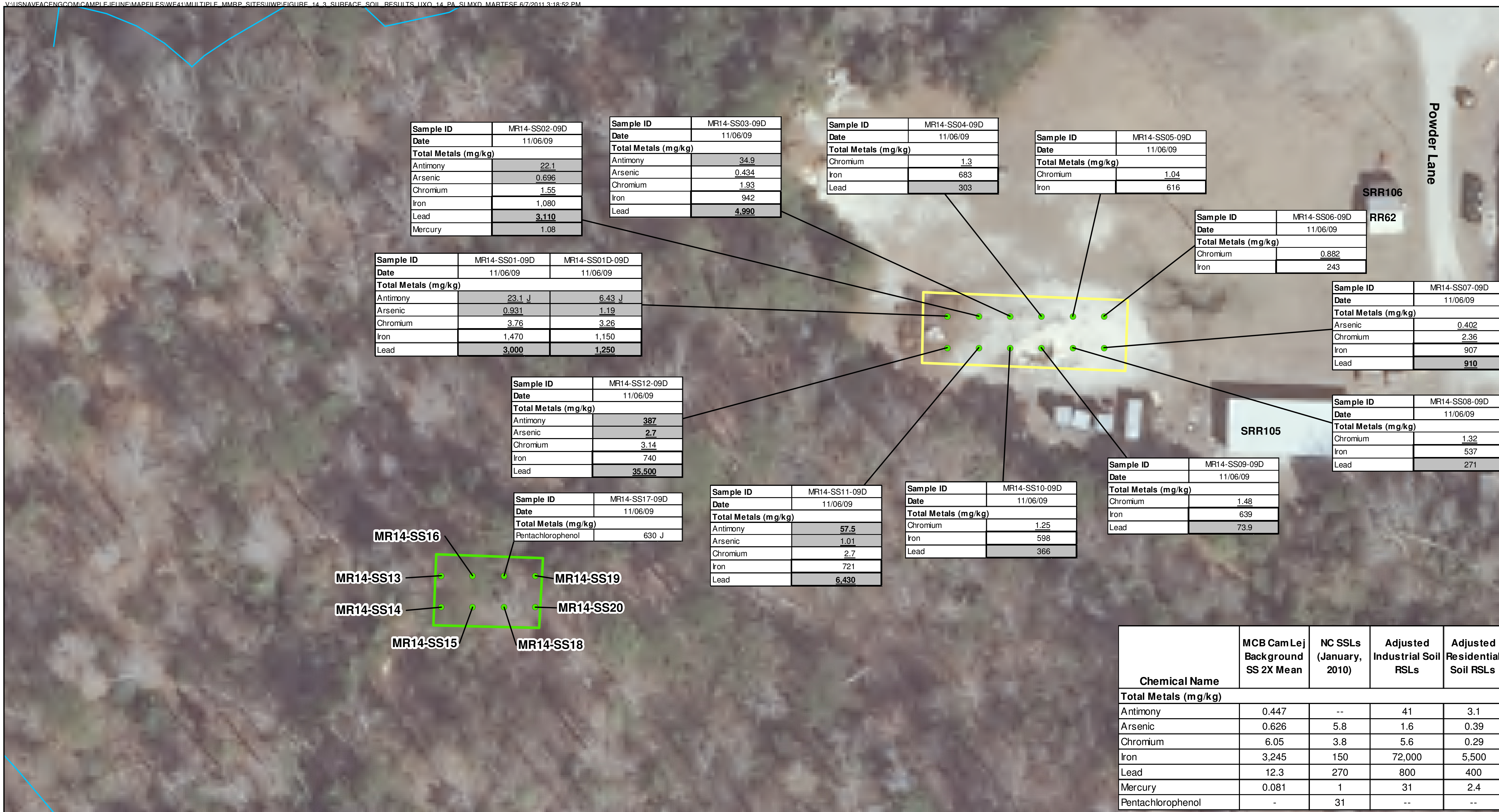
0 10 20 40 Feet

1 inch = 20 feet

Figure 10-7

Site UXO-14 Digital Geophysical Mapping Results
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL



Sample ID	MR14-SS02-09D
Date	11/06/09
Total Metals (mg/kg)	
Antimony	22.1
Arsenic	0.696
Chromium	1.55
Iron	1,080
Lead	**3,110**
Mercury	1.08

Sample ID	MR14-SS03-09D
Date	11/06/09
Total Metals (mg/kg)	
Antimony	34.9
Arsenic	0.434
Chromium	1.93
Iron	942
Lead	**4,990**

Sample ID	MR14-SS04-09D
Date	11/06/09
Total Metals (mg/kg)	
Chromium	1.3
Iron	683
Lead	303

Sample ID	MR14-SS05-09D
Date	11/06/09
Total Metals (mg/kg)	
Chromium	1.04
Iron	616

Sample ID	MR14-SS06-09D
Date	11/06/09
Total Metals (mg/kg)	
Chromium	0.882
Iron	243

Sample ID	MR14-SS01-09D	MR14-SS01D-09D
Date	11/06/09	11/06/09
Total Metals (mg/kg)		
Antimony	23.1 J	6.43 J
Arsenic	0.931	1.19
Chromium	3.76	3.26
Iron	1,470	1,150
Lead	**3,000**	**1,250**

Sample ID	MR14-SS07-09D
Date	11/06/09
Total Metals (mg/kg)	
Arsenic	0.402
Chromium	2.36
Iron	907
Lead	**910**

Sample ID	MR14-SS12-09D
Date	11/06/09
Total Metals (mg/kg)	
Antimony	**387**
Arsenic	**2.7**
Chromium	3.14
Iron	740
Lead	**35,500**

Sample ID	MR14-SS08-09D
Date	11/06/09
Total Metals (mg/kg)	
Chromium	1.32
Iron	537
Lead	271

Sample ID	MR14-SS09-09D
Date	11/06/09
Total Metals (mg/kg)	
Chromium	1.48
Iron	639
Lead	73.9

Sample ID	MR14-SS10-09D
Date	11/06/09
Total Metals (mg/kg)	
Chromium	1.25
Iron	598
Lead	366

Sample ID	MR14-SS11-09D
Date	11/06/09
Total Metals (mg/kg)	
Antimony	**57.5**
Arsenic	1.01
Chromium	2.7
Iron	721
Lead	**6,430**

Sample ID	MR14-SS17-09D
Date	11/06/09
Total Metals (mg/kg)	
Pentachlorophenol	630 J

Chemical Name	MCB CamLej Background SS 2X Mean	NC SSLs (January, 2010)	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs
Total Metals (mg/kg)				
Antimony	0.447	--	41	3.1
Arsenic	0.626	5.8	1.6	0.39
Chromium	6.05	3.8	5.6	0.29
Iron	3,245	150	72,000	5,500
Lead	12.3	270	800	400
Mercury	0.081	1	31	2.4
Pentachlorophenol	-	31	--	--

Legend
- Surface Soil Sampling Location
- Surface Water
- Site UXO-14 Boundary (Former Indoor Pistol Range Area)
- Site UXO-14 Boundary (Former Gas Chamber Area)

Notes:
- Analytical exceedances from the PA/SI
- Shading indicates exceedance of two times the mean base background concentration for surface soil
- Bold box indicates exceedance of NC SSLs
- **Bold text indicates exceedance of Adjusted Industrial Soil RSLs**
- Underline indicates exceedance of Adjusted Residential Soil RSLs
- RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
- mg/kg - Milligrams per kilogram
- µg/kg - Micrograms per kilogram
- J - Analyte present, vale may or may not be accurate or precise

N

0 25 50 100 Feet

1 inch = 50 feet

Figure 10-8
Site UXO-14 Surface Soil Exceedances
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

V:\USNAVEFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_14_4_SUBSURFACE_SOIL_RESULTS_UXO_14_PA_SI.MXD MARTESE 6/7/2011 3:31:32 PM

Sample ID	MR14-IS01-2-3-09D
Date	12/04/09
Total Metals (mg/kg)	
Chromium	<u>1.06</u>
Iron	370
Lead	290

Sample ID	MR14-IS03-2-3-09D
Date	12/04/09
Total Metals (mg/kg)	
Chromium	<u>0.748</u>
Iron	183

Sample ID	MR14-IS02-2-3-09D
Date	12/04/09
Total Metals (mg/kg)	
Chromium	<u>0.74</u>
Iron	322

Chemical Name	MCB CamLej Background SB 2X Mean	NC SSLs (January, 2010)	Adjusted Industrial Soil RSLs	Adjusted Residential Soil RSLs
Total Metals (mg/kg)				
Chromium	14.5	3.8	5.6	0.29
Iron	5,439	150	72,000	5,500
Lead	12.3	270	800	400

Legend

- Subsurface Soil Sampling Location
- Surface Water
- Site UXO-14 Boundary (Former Indoor Pistol Range Area)
- Site UXO-14 Boundary (Former Gas Chamber Area)

Notes:
- Analytical exceedances from the PA/SI
- Shading indicates exceedance of two times the mean base background concentration for subsurface soil
- Bold box indicates exceedance of NC SSLs
- **Bold text indicates exceedance of Adjusted Industrial Soil RSLs**
- <u>Underline indicates exceedance of Adjusted Residential Soil RSLs</u>
- RSLs were adjusted for noncarcinogens to account for exposure to multiple constituents
- mg/kg - Milligrams per kilogram

N

0 25 50 100 Feet

1 inch = 50 feet

Figure 10-9.

Site UXO-14 Subsurface Soil Exceedances
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\WE41\MULTIPLE_MMRP_SITES\IIWP\FIGURE_14_5_SURFACE_SUBSURFACE_SOIL_SAMPLING_LOCATIONS_UXO_14.MXD MARTESE 6/15/2011 5:35:18 PM

Legend
- Proposed Surface Soil Sampling Location
- Proposed Subsurface Soil Sampling Location
- Proposed Surface and Subsurface Soil Sampling Location
- Surface Water
- Site UXO-14 Boundary (Former Indoor Pistol Range Area)

N

0 25 50 100 Feet

1 inch = 50 feet

Figure 10-10
UXO-14 Surface/Subsurface Soil Sampling Locations
Intrusive Investigation Work Plan Addendum
MCB CamLej
North Carolina

CH2MHILL

Attachment 1
Standard Operating Procedures—CH2M HILL

STANDARD OPERATING PROCEDURE

Preparing Field Log Books

I. Purpose

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

II. Scope

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

III. Equipment and Materials

- Log book
- Indelible pen

IV. Procedures and Guidelines

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

A. PROCEDURES FOR COMPLETING FIELD LOG BOOKS

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

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

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

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

5. Daily entries will be made chronologically.

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

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

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

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

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

B. INFORMATION TO BE INCLUDED IN FIELD LOG BOOKS

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

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

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

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

5. Tail Gate Safety Meetings: Record time and location of meeting, who

was present, topics discussed, issues/ problems/ concerns identified, and corrective actions or adjustments made to address concerns/ problems, and other pertinent information.

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

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

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

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

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

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

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

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

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

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

16. Any conditions that might adversely affect the work or any data obtained (e.g., nearby construction that might have introduced

excessive amounts of dust into the air).

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

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

C. SUGGESTED FORMAT FOR RECORDING FIELD DATA

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

V. Attachments

Example field notes.

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

Buried Utility Location Tracking Form

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

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

CH2M HILL Purchase Order:

Utility Location Subcontractor:
Subcontractor POC:

Dates of location activities:

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

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

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

______________________________ __________

Surface Water Sampling

I. Purpose and Scope

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

II. Materials and Equipment

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

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

III. Procedures and Guidelines

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

A. Manual Sampling

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

A sample is taken with the following specific steps:

1. The location and desired depth for water sampling are selected.

2. The sample site is approached from downstream in a manner that avoids disturbance of bottom sediments as much as possible. The sample bottle is gently submerged with the mouth pointed upstream and the bottle tilted slightly downstream. Bubbles and floating materials should be prevented from entering the bottle. If using a Peristaltic pump, lower the tubing into the water to the desired depth.

3. For weighted bottle samplers, the assembly is slowly lowered to the desired depth. The bottle stopper is unseated with a sharp tug and the bottle is allowed to fill until bubbles stop rising to the surface.

4. When the bottle is full, it is gently removed from the water. If sample transfer is required, it should be performed at this time.

5. Measure dissolved oxygen, specific conductance, temperature, and pH at the sampling location.

IV. Attachments

None.

V. Key Checks and Items

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

STANDARD OPERATING PROCEDURE

VOC Sampling-Water

I. Purpose

To provide general guidelines for sampling aqueous volatile organic compounds.

II. Scope

Standard techniques for collecting representative samples are summarized. Site-specific details are discussed in the Field Sampling Plan.

III. Equipment and Materials

- Sample vials pre-preserved at laboratory with Hydrochloric acid (HCl)
- Surgical or latex gloves

IV. Procedures and Guidelines

1. Sample VOCs before sampling other analyte groups.

2. When sampling for VOCs, especially residential wells, evaluate the area around the sampling point for possible sources of air contamination by VOCs. Products that may give off VOCs and possibly contaminate a sample include perfumes and cosmetics, skin applied pharmaceuticals, automotive products (gasoline, starting fluid, windshield deicers, carburetor cleaners, etc.) and household paint products (paint strippers, thinners, turpentine, etc.).

3. Keep the caps off the sample vials for as short a time as possible.

4. Wear clean latex or surgical gloves.

5. Fill the sample vial immediately, allowing the water stream to strike the inner wall of the vial to minimize formation of air bubbles. DO NOT RINSE THE SAMPLE VIALS BEFORE FILLING.

6. Fill the sample vial with a minimum of turbulence, until the water forms a positive meniscus at the brim.

Water-Level Measurements

I. Purpose and Scope

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

II. Equipment and Materials

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

III. Procedures and Guidelines

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

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

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

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

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

Where WL_c = Corrected water-level elevation

Wl_a = Apparent water-level elevation

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

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

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

IV. Attachments

None.

V. Key Checks

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

7. Replace the cap by gently setting it on the water meniscus. Tighten firmly, but DO NOT OVERTIGHTEN.

8. Invert the vial and tap it lightly. If you see air bubbles in the sample, do not add more sample. Use another vial to collect another sample. Repeat if necessary until you obtain a proper sample.

V. Attachments

None.

VI. Key Checks and Items

- Check for possible sources of contamination.
- Fill slowly, with as little turbulence as possible.
- Check for air bubbles.

STANDARD OPERATING PROCEDURE

Sediment Sampling

I. Purpose

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

II. Scope

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

III. Equipment and Materials

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

IV. Procedures and Guidelines

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

3. Note in the field book any possible outside sources of contamination. For example, the outlet to a drainage culvert in the water body near your sampling location.

4. Transfer sample into appropriate sample jars with a stainless steel utensil or plastic disposable scoop. Be especially careful to avoid the loss of the very fine clay/ silt particles when collecting the sample. The fine particles have a higher adsorption capacity than larger particles. Minimize the amount of water that is collected within the sample matrix. Decant the water off of the sample slowly and carefully to maximize retention of the very fine particles. The sampler's fingers should never touch the sediment since gloves may introduce organic interference into the sample. Classify the soil type of the sample using the Unified Soil Classification System, noting particularly the percentage of silt and clay.

5. Samples for volatile organics should immediately be placed in jars. Rocks and other debris should be removed before placement in jars.

6. For channel sampling, be on the alert for submerged hazards (rocks, tree roots, drop-offs, loss silt and muck) which can make wading difficult.

7. Sample sediment for TOC and pH also, to give context to organic and inorganic data during the risk assessment.

8. Follow the site safety plan designed for the specific nature of the site's sampling activities and locations.

9. Decontaminate all sampling implements and protective clothing according to prescribed procedures.

V. Attachments

None.

VI. Key Checks and Items

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

Soil Boring Drilling and Abandonment

I. Purpose and Scope

The purpose of this guideline is to describe methods to obtain samples of subsurface soil using either hollow-stem auger, rotary or sonic drilling methods, or tripod-mounted rig and then backfill boreholes to the surface. The guideline covers both split-spoon sampling and thin-walled tube sampling and includes soil borings through surface casings installed to prevent potential contamination in shallow water-bearing units from migrating downward into deeper units.

II. Equipment and Materials

- Truck-mounted drilling rig, skid rig, or tripod rig
- Hollow-stem augers and associated equipment or either rotary-drilling or sonic-drilling equipment
- Black iron steel or Schedule 80 PVC casing, at least 6-inch inside diameter (if surface casing is required), or sonic rig with telescoping casing
- Split-spoon or thin-walled tube samplers
- Downhole compacting tool (e.g., a pipe with a flat plate attached to the bottom)
- Cement
- Bentonite

III. Procedures and Guidelines

A. Drilling

Continuous-fight hollow-stem augers (HSA) with an inside diameter of at least 3.25 inches typically are used. The use of water or other fluid to assist in hollow-stem drilling will be avoided. Rotary drilling will be with a similar minimum diameter.

The bit of the auger or drill is placed on the ground at the location to be drilled and then turned with the drilling or soil-coring rig. The drilling is advanced to a depth just above the top of the interval to be sampled. For sonic drilling, a continuous core is collected and the sample interval is selected from the length of core run.

While advancing the auger or drill to the full borehole depth, the soils removed from the boring will be screened using a portable volatile organics detector.

A tripod drilling rig is generally a tripod equipped to collect soil samples using a hammer-driven sampler. The soil sample collection will be the same as that outlined for hollow-stem and rotary drilling. Borehole collapse due to soft sediments may occur when collecting samples using a tripod drilling rig.

Temporary surface casing may be installed where soil borings will penetrate a confining layer. The surface casing will be installed to prevent potential contamination in shallow water-bearing units from migrating downward into deeper units. Typically, surface casing has a 6-inch inside diameter (ID).

If the split-spoon sampling is to be advanced with a 3.25-inch ID and 7.25-inch outside diameter (O.D.) HSA, it will be necessary to pull the 3.25-inch augers and ream the hole with a minimum 10.25-inch ID HAS for the installation of the temporary surface casing. Alternatively, if the split-spoon sampling is advanced with mud-rotary drilling, it would require a 10.25-inch rotary bit to make room for the 6-inch I.D. surface casing.

The surface casing will be seated at least 5 feet into an underlying clay or silt layer and will be sealed in place using a bentonite slurry or bentonite pellets. This seal will prevent movement of groundwater downward from the shallow water-bearing unit but will allow the casing to be removed easily when the split-spoon sampling is completed. The split-spoon sampling will then be advanced with a 6-inch mud-rotary bit.

B. Sampling

Using the drilling rig, a hole is advanced to the desired depth. For split-spoon sampling, the samples are then collected following the ASTM D 1586 standard (attached). The sampler is lowered into the hole and driven to a depth equal to the total length of the sampler; typically this is 24 inches. The sampler is driven in 6-inch increments using a 140-pound weight (``hammer'') dropped from a height of 30 inches. The number of hammer blows for each 6-inch interval is counted and recorded on the boring log and/ or field notebook. To obtain enough volume of sample for subsequent laboratory analysis, use of a 3-inch ID sampler may be required. Blow counts obtained with a 3-inch ID spoon would not conform to ASTM D 1586 and would therefore not be used for geotechnical evaluations. Samples will be collected from the soil borings at 2-foot to 5-foot intervals. For sonic drilling, a continuous core is collected and the sample interval is selected from the length of core run.

Once retrieved from the hole, the sampler is carefully split open. Care should be taken not to allow material in the sampler to fall out of the open end of the sampler. Samples may be collected for chemical analysis. These samples are collected in either decontaminated stainless-steel split-spoon samplers or new plastic sleeves for sonic drilling. Sampling the soil for chemical analysis is described in SOP *Soil Boring Sampling – Split Spoon.*

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

C. Abandonment

The borehole will be grouted from total depth to the surface with bentonite-cement grout. The cement-bentonite grout will be installed continuously in one operation from the bottom of the space to be grouted to the ground surface. When installing grout in soil borings, the grout will be installed through a tremie pipe that is placed inside the augers or to the bottom of the borehole. The grouting will be completed before the augers or any temporary casing or drilling mud is removed.

D. Decontamination and Waste Disposal

Before sampling begins, equipment will be decontaminated according to the procedures identified in SOPs *Decontamination of Personnel and Equipment* and *Decontamination of Drilling Rig and Equipment.* The location to be sampled is cleared of debris and trash, and the location is noted in the logbook.

The soil cuttings are to be drummed and managed as described in SOP *Disposal of Waste Fluids and Soils* and the investigation-derived waste management plan.

IV. Attachments

ASTM D 1586 *Standard Test Method for Penetration Test and Split-Barrel Sampling of Soils*

ASTM D 1587 *Standard Practice for Thin-Walled Tube Sampling of Soils*

V. Key Checks and Preventative Maintenance

- Check that the drilling rig or soil-coring rig is in working order.
- Check that the borehole is grouted to the ground surface at the completion of drilling and sampling.

STANDARD OPERATING PROCEDURE

Installation of Shallow Monitoring Wells

I. Purpose and Scope

The purpose of this guideline is to describe methods for drilling and installation of shallow monitoring wells and piezometers in unconsolidated or poorly consolidated materials using hollow stem augers, air rotary, or mud rotary. Installing monitoring wells in unconsolidated materials using sonic drilling is discussed in SOP *Installation of Monitoring Wells Using Sonic Drilling.* Methods for drilling and installing bedrock monitoring wells and deep, surface-cased wells in unconsolidated materials are presented in SOPs *Installation of Bedrock Monitoring Wells* and *Installation of Surface-Cased Monitoring Wells,* respectively.

II. Equipment and Materials

Drilling

- Drilling rig (hollow stem auger, air rotary or mud rotary) and associated tools and equipment

Well Riser/Screen and Associated Materials

- Polyvinyl chloride (PVC), Schedule 40, minimum 2-inch ID, flush-threaded riser; alternatively, stainless-steel riser
- PVC, Schedule 40, minimum 2-inch ID, flush-threaded, factory slotted screen; alternatively, stainless-steel screen
- PVC bottom cap, threaded to match the well screen; alternatively, stainless steel
- PVC or stainless-steel centering guides (if used)
- Above-grade well completion: PVC well cap, threaded or push-on type, vented
- Flush-mount well completion: PVC well cap, locking, leak-proof seal
- Stainless steel to be used as appropriate

Sand

- Clean silica sand, provided in factory-sealed bags, well-rounded, containing no organic material, anhydrite, gypsum, mica, or calcareous material; primary (coarse – e.g., Morie #1) filter pack, and secondary (fine sand seal) filter pack. Grain size determined based on sediments observed during drilling.

Bentonite

- Pure, additive-free bentonite pellets or chips
- Pure, additive-free powdered bentonite
- Coated bentonite pellets; coating must biodegrade within 7 days
- Cement-Bentonite Grout: proportion of 6 to 8 gallons of water per 94-pound bag of Portland cement; 3 to 6 pounds of bentonite added per bag of cement to reduce shrinkage.

Protective Casing

- Above-grade well completion: 6-inch minimum ID black iron steel pipe with locking cover, diameter at least 2 inches greater than the well casing, painted with epoxy paint for rust protection; heavy duty lock; protective posts if appropriate
- Flush-mount well completion: Morrison 9-inch or 12-inch 519 manhole cover, or equivalent; rubber seal to prevent leakage; locking cover inside of road box

Well Development

- Surge block
- Well-development pump and associated equipment
- Calibrated meters to ensure pH, temperature, specific conductance, ORP, and dissolved oxygen of development water
- Containers (e.g., DOT-approved 55-gallon drums) for water produced from well.

III. Procedures and Guidelines

A. Drilling Method

Typically, continuous-flight hollow-stem augers with a minimum 4.25-inch inside diameter (ID) will be used to drill shallow monitoring well boreholes for 2-inch diameter monitoring wells. Alternatively, air or mud rotary may be used.

The bit of the auger is placed at the ground surface and then turned with the drilling rig. To collect split spoon samples, the auger is advanced to the top of the sampling depth, and the split-spoon sample is collected from below the auger head. The split spoon is advanced through repeated blows from a 140- or 300-pound hammer dropped from a height of 30 inches. Thin-walled tube samplers are advanced by pressing down on the rods with the weight of the drilling rig. Split-spoon samples may be collected at selected intervals for chemical analysis and/or lithologic classification. Soil sampling procedures are detailed in SOPs *Soil Boring Sampling – Split Spoons* and *Soil Sampling*.

The use of water to assist in hollow-stem auger drilling for monitoring well installation will be avoided, unless required for such conditions as running sands.

Hollow-stem augers, drilling bits, rods, split-spoon samplers, and other downhole drilling tools will be properly decontaminated prior to the initiation of drilling activities and between each borehole location. Split-spoon samplers and other downhole soil sampling equipment will also be properly decontaminated before and after each use. SOP *Decontamination of Drill Rigs and Equipment* details proper decontamination procedures.

Drill cuttings and decontamination fluids generated during well drilling activities will be contained according to the procedures detailed in the SOP *Disposal of Waste Fluids and Solids* and the Investigation Derived Waste Management Plan (IDWMP).

Air or mud rotary drilling may be used instead of hollow-stem augers. The use of added mud should be kept to a minimum.

B. Monitoring-Well Installation

Shallow monitoring wells will be constructed inside the hollow-stem augers, once the borehole has been advanced to the desired depth, or in the mudded borehole once the drilling rods have been withdrawn. If the borehole has been drilled to a depth greater than that at which the well is to be set, the borehole will be backfilled with bentonite pellets or chips or a bentonite-cement slurry to a depth approximately 1 foot below the intended well depth. Approximately 1 foot of clean sand will be placed on top of the bentonite to return the borehole to the proper depth for well installation.

The appropriate lengths of well screen, nominally 10 feet (with bottom cap), and casing will be joined watertight and lowered inside the augers to the bottom of the borehole. Centering guides, if used, will be placed at the bottom of the screen and above the interval in which the bentonite seal is placed.

Selection of the filter pack and well screen intervals for the shallow monitoring wells shall be made in the field.

A primary sand pack consisting of clean Morie No. 00 (or DSI No.1) silica sand for 10-slot screen and Morie No. 01 (or DSI No.2) for 20-slot screen silica sand will be placed around the well screen. The sand will be placed into the borehole at a uniform rate, in a manner that will allow even placement of the sand pack. The augers will be raised gradually during sand pack installation to avoid caving of the borehole wall; at no time will the augers be raised higher than the top of the sand pack during installation. During placement of the sand, the position of the top of the sand will be continuously sounded. The primary sand pack will be extended from the bottom of the borehole to a minimum height of 2 feet above the top of the well screen. A secondary, finer-grained (fine sand seal), sand pack will be installed for a minimum of 1 foot above the coarse sand pack. Heights of the coarse and fine sand packs and bentonite seal may be modified in the field to account for a shallow water table and a small saturated thickness of the surficial aquifer.

A bentonite seal at least 2 feet thick will be placed above the sand pack. The seal will be placed into the borehole in a manner that will prevent bridging. The position of the top of the bentonite seal will be verified using a weighted tape measure. If all or a portion of the bentonite seal is above the water table, clean water will be added to hydrate the bentonite. A hydration period of at least 30 minutes will be required following installation of the bentonite seal.

Above the bentonite seal, an annular seal of cement-bentonite grout will be placed. The cement-bentonite grout will be installed continuously in one operation from the bottom of the space to be grouted to the ground surface through a tremie pipe. The tremie pipe must be plugged at the bottom and have small openings along the sides of the bottom 1-foot length of pipe. This will allow the grout to diffuse laterally into the borehole and not disturb the bentonite pellet seal.

C. Well Completion

For monitoring wells that will be completed above-grade, a locking steel protective casing set in a concrete pad will be installed. The steel protective casing will extend at least 3 feet into the ground and 2 feet above ground but should not penetrate the bentonite seal. The concrete pad will be square, approximately 2 feet per side (unless otherwise specified in the project plans), and poured into wooden forms. The concrete will be sloped away from the protective casing.

Guard posts may be installed in high-traffic areas for additional protection. Four steel guard posts will be installed around the protective casing Guard posts would be concrete-filled, at least 2 inches in diameter, and would extend at least 2 feet into the ground and 3 feet above the ground. The protective casing and guard posts will be painted with an epoxy paint to prevent rust.

For monitoring wells with flush-mount completions, Morrison 9-inch or 12-inch 519 manhole cover or equivalent, with a rubber-sealed cover and drain will be installed. The top of the manhole cover will be positioned approximately 1 inch above grade. A square concrete pad, approximately 2 feet per side (unless otherwise specified in the project plans), will be installed as a concrete collar surrounding the road box cover, and will slope uniformly downward to the adjacent grade. The road box and installation thereof will be of sufficient strength to withstand normal vehicular traffic.

Concrete pads installed at all wells will be a minimum of 6 inches below grade. The concrete pad will be 12 inches thick at the center and taper to 6-inch thick at the edge. The surface of the pad should slope away from the protective casing to prevent water from pooling around the casing.

Protective casing, guard posts, and flush mounts will be installed into this concrete.

Each well will be properly labeled on the exterior of the locking cap or protective casing with a metal stamp indicating the permanent well number.

D. Well Development

Well development will be accomplished using a combination of surging throughout the well screen and pumping, until the physical and chemical parameters of the discharge water that are measured in the field have stabilized and the turbidity of the discharge water is substantially reduced. Fine-grained materials in the surficial aquifer at the site may not allow low turbidity results to be achieved.

The surging apparatus will include a surge block. Well development will begin by surging the well screen, starting at the bottom of the screen and proceeding upwards, throughout the screened zone. Following surging, the well will be pumped to remove the fine materials that have been drawn into the well. During pumping, measurements of pH, temperature, and specific conductance will be recorded.

Development will continue by alternately surging and pumping until the discharge water is free from sand and silt, the turbidity is substantially reduced, and the pH, temperature, and specific conductance have stabilized at regional background levels, based on historical data. Development will continue for a minimum of 30 minutes and until the water removed from the well is as clear of turbidity as practicable.

Well development equipment will be decontaminated prior to initial use and after the development of each well. Decontamination procedures are detailed in SOP *Decontamination of Personnel and Equipment*. Water generated during well development will be contained and managed as detailed in the SOP *Disposal of Waste Fluids and Solids* and the Investigation Derived Waste Management Plan.

IV. Attachments

Schematic diagram of shallow monitoring-well construction (MWSingleDiag.xls)

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

I. Purpose and Scope

The purpose of this procedure is to provide a general guideline for using a water quality parameter meter (e.g., Horiba® U-22 or YSI) for field measurements of pH, specific conductance, turbidity, dissolved oxygen, oxidation-reduction potential (ORP), and temperature of aqueous samples. The YSI instrument does not measure turbidity. A separate turbidity meter (i.e., Hanna Turbidity Meter) will need to be used in conjunction with the YSI meter. The operator's manual should be consulted for detailed operating procedures.

II. Equipment and Materials

- Water Quality Parameter Meter such as a Horiba® U-22 Water Quality Monitoring System or YSI with flow-though cell
- Auto-Calibration Standard Solution (provided by rental company)
- Distilled water in squirt bottle

III. Procedures and Guidelines

A. Parameters and Specifications:

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

B. Calibration:

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

Horiba U22 Calibration procedure:

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

YSI Calibration procedure:

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

A. Conductivity Calibration:

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

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

6) Carefully immerse the sensor end of the probe module into the solution.
7) Gently rotate and/or move the probe module up and down to remove any bubbles from the conductivity cell.

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

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

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

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

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

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

B. Dissolved Oxygen Calibration:

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

1) Go to the calibrate screen as described in Section

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

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

   NOTE: Be sure to completely immerse all the sensors.

8) Use the keypad to enter the known DO concentration of the water.
9) Press **Enter**. The Dissolved Oxygen mg/L Calibration Screen is displayed.
10) Stir the water with a stir bar, or by rapidly moving the probe module, to provide fresh sample to the DO sensor.
11) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

12) Observe the DO mg/L reading, when the reading is stable (shows no significant change for approximately 30 seconds), press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.
13) Press **Enter**. This returns you to the DO calibration screen.
14) Press **Escape** to return to the calibrate menu.
15) Rinse the probe module and sensors in tap or purified water and dry.

C. pH Calibration:

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

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

NOTE: The sensor must be completely immersed. Using the recommended volumes from Table 6.1 Calibration Volumes, should ensure that the sensor is covered.

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

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

10) Use the keypad to enter the calibration value of the buffer you are using **at the current temperature**.

    NOTE: pH vs. temperature values are printed on the labels of all YSI pH buffers.

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

D. ORP Calibration:

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

    NOTE: Before proceeding, ensure that the sensor is as dry as possible. Ideally, rinse the ORP sensor with a small amount of solution that can be discarded. Be certain that you avoid cross-contamination with other solutions.

5) Carefully immerse the sensor end of the probe module into the solution.
6) Gently rotate and/or move the probe module up and down to remove any bubbles from the ORP sensor.

    NOTE: The sensor must be completely immersed.

7) Screw the transport/calibration cup on the threaded end of the probe module and securely tighten.
8) Use the keypad to enter the correct value of the calibration solution you are using at the current temperature.
9) Press **Enter**. The ORP calibration screen is displayed.

10) Allow at least one minute for temperature equilibration before proceeding. The current values of all enabled sensors will appear on the screen and will change with time as they stabilize.

11) Observe the reading under ORP, when the reading shows no significant change for approximately 30 seconds, press **Enter**. The screen will indicate that the calibration has been accepted and prompt you to press **Enter** again to Continue.

12) Press **Enter**. This returns you to the Calibrate Screen.

13) Rinse the probe module and sensors in tap or purified water and dry. Record the calibration data (e.g. time, instrument ID, solution lot number and expiration date, final calibrated readings, and solution temperature in the field logbook.

C. Sample Measurement:

Horiba U22 measurement procedure:

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

YSI measurement procedure:

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

IV. Key Checks and Preventive Maintenance

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

V. References

YSI 556 Multi Probe System Operator Manual

STANDARD OPERATING PROCEDURE

Low-Flow Groundwater Sampling from Monitoring Wells

I. Purpose and Scope

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

II. Equipment and Materials

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

III. Procedures and Guidelines

A. Setup and Purging

1. Obtain information on well location, diameter(s), depth, and screen interval(s), and the method for disposal of purged water.

2. Calibrate instruments according to manufacturer's instructions.

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

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

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

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

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

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

9. If using a generator, locate it 30 feet downwind from the well to avoid exhaust fumes contaminating the samples.

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

11. The water level should be monitored during purging, and, ideally, the purge rate should equal the well recharge rate so that there is little or no drawdown in the well (i.e., less than 0.3-foot). The water level should stabilize for the specific purge rate. There should be at least 1 foot of water over the pump intake so there is no risk of the pump suction being broken, or entrainment of air in the sample. Record adjustments in the purge rate and changes in depth to water in the logbook. Purge rates should, if needed, be decreased to the minimum capabilities of the pump (0.1- to 0.2-liter per minute) to avoid affecting well drawdown.

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

- pH: within 0.1 pH units
- Specific conductance: within 3 percent
- Dissolved oxygen: within 10 percent
- Turbidity: within 10 percent for values greater than 5 NTU; if 3 turbidity values are less than 5 NTU, consider the values as stabilized
- ORP: within 10 mV
- Temperature: within 3 percent

B. Sample Collection

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

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

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

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

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

1. The cap is removed from the sample bottle, and the bottle is tilted slightly.

2. The sample is slowly poured from the bailer or discharged from the pump so that it runs down the inside of the sample bottle with a minimum of splashing. The pumping rate should be reduced to approximately 100 ml per minute when sampling VOCs.

3. Inorganics, including metals, may be collected and preserved in the filtered form as well as the unfiltered form. Disposable in-line filters (0.45 micron filter), connected to the end of the sample tubing,, are typically used for field filtration. Samples are field filtered as the water is being placed into the sample container. If a bailer is used, filtration may be driven by a peristaltic pump.

4. Adequate space is left in the bottle to allow for expansion, except for VOC vials, which are filled to the top with a positive meniscus.

5. The bottle is capped and clearly labeled.

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

7. Nondedicated equipment is cleaned and decontaminated in accordance with the *Decontamination of Personnel and Equipment* SOP.

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

1. Sample identification (site name, location, and project number; sample name/ number and location; sample type and matrix; time and date; sampler's identity)

2. Sample source and source description

3. Field observations and measurements (appearance, volatile screening, field chemistry, sampling method), volume of water purged prior to sampling, number of well volumes purged, and field parameter measurements

4. Sample disposition (preservative; laboratory name, date and time sent; laboratory sample number, chain-of-custody number, sample bottle lot number)

5. Additional remarks

C. Additional remarks

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

2. Disposable tubing is disposed of with PPE and other site trash.

IV. Attachments

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

V. Key Checks and Preventative Maintenance

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

- The highest purging rate should not exceed 1 liter per minute. This is to keep the drawdown minimized.

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

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

White Paper on Low-Flow Sampling

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

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

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

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

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

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

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

STANDARD OPERATING PROCEDURE

Decontamination of Personnel and Equipment

I. Purpose

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

II. Scope

This is a general description of decontamination procedures.

III. Equipment and Materials

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

IV. Procedures and Guidelines

A. PERSONNEL DECONTAMINATION

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

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

B. SAMPLING EQUIPMENT DECONTAMINATION—GROUNDWATER SAMPLING PUMPS

Sampling pumps are decontaminated after each use as follows.

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

C. SAMPLING EQUIPMENT DECONTAMINATION—OTHER EQUIPMENT

Reusable sampling equipment is decontaminated after each use as follows.

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

D. HEALTH AND SAFETY MONITORING EQUIPMENT DECONTAMINATION

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

E. SAMPLE CONTAINER DECONTAMINATION

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

1. Wipe container with a paper towel dampened with Liquinox® solution or immerse in the solution AFTER THE CONTAINERS HAVE BEEN SEALED. Repeat the above steps using potable water.

2. Dispose of all used paper towels in a DOT-approved 55-gallon drum or with solid waste in garbage bags, dependent on Facility/ project requirements.

F. HEAVY EQUIPMENT AND TOOLS

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

1. Set up a decontamination pad in area designated by the Facility

2. Steam clean heavy equipment until no visible signs of dirt are observed. This may require wire or stiff brushes to dislodge dirt from some areas.

V. Attachments

None.

VI. Key Checks and Items

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

Decontamination of Drilling Rigs and Equipment

I. Purpose and Scope

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

II. Equipment and Materials

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

III. Procedures and Guidelines

A. Drilling Rigs and Monitoring Well Materials

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

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

B. Downhole Drilling Tools

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

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

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

C. Field Analytical Equipment

1. Water Level Indicators

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

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

2. Probes

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

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

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

Disposal of Waste Fluids and Solids

I. Purpose and Scope

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

II. Equipment and Materials

A. Fluids

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

B. Solids

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

III. Procedures and Guidelines

A. Methodology

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

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

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

B. Labels

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

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

C. Fluids

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

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

D. Solids

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

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

E. Storage and Disposal

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

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

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

IV. Attachments

None.

V. Key Checks and Preventative Maintenance

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

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

Packaging and Shipping Procedures for Low-Concentration Samples

I. Purpose and Scope

The purpose of this guideline is to describe the packaging and shipping of low-concentration samples of various media to a laboratory for analysis.

II. Scope

The guideline only discusses the packaging and shipping of samples that are anticipated to have low concentrations of chemical constituents. Whether or not samples should be classified as low-concentration or otherwise will depend upon the site history, observation of the samples in the field, odor, and photoionization-detector readings.

If the site is known to have produced high-concentration samples in the past or the sampler suspects that high concentrations of contaminants might be present in the samples, then the sampler should conservatively assume that the samples cannot be classified as low-concentration. Samples that are anticipated to have medium to high concentrations of constituents should be packaged and shipped accordingly.

If warranted, procedures for dangerous-goods shipping may be implemented. Dangerous goods and hazardous materials pose an unreasonable risk to health, safety, or property during transportation without special handling. As a result only employees who are trained under CH2M HILL Dangerous Goods Shipping course may ship or transport dangerous goods. Employees should utilize the HAZMAT ShipRight tool on the Virtual Office and/or contact a designated CH2M HILL HazMat advisor with questions.

III. Equipment and Materials

- Coolers
- Clear tape
- "This Side Up" labels
- "Fragile" labels
- Vermiculite
- Ziplock bags or bubble wrap
- Ice
- Chain-of-Custody form (completed)
- Custody seals

IV. Procedures and Guidelines

Low-Concentration Samples

A. Prepare coolers for shipment:

- Tape drains shut.
- Affix "This Side Up" labels on all four sides and "Fragile" labels on at least two sides of each cooler.
- Place mailing label with laboratory address on top of coolers.
- Fill bottom of coolers with about 3 inches of vermiculite or absorbent pads.

B. Arrange decontaminated sample containers in groups by sample number. Consolidate VOC samples into one cooler to minimize the need for trip blanks.

C. Affix appropriate adhesive sample labels to each container. Protect with clear label protection tape.

D. Seal each sample bottle within a separate ziplock plastic bag or bubble wrap, if available. Tape the bag around bottle. Sample label should be visible through the bag.

E. Arrange sample bottles in coolers so that they do not touch.

F. If ice is required to preserve the samples, cubes should be repackaged in zip-lock bags and placed on and around the containers.

G. Fill remaining spaces with vermiculite or absorbent pads.

H. Complete and sign chain-of-custody form (or obtain signature) and indicate the time and date it was relinquished to Federal Express or the courier.

J Close lid and latch.

K. Carefully peel custody seals from backings and place intact over lid openings (right front and left back). Cover seals with clear protection tape.

L. Tape cooler shut on both ends, making several complete revolutions with strapping tape. Cover custody seals with tape to avoid seals being able to be peeled from the cooler.

M. Relinquish to Federal Express or to a courier arranged with the laboratory. Place airbill receipt inside the mailing envelope and send to the sample documentation coordinator along with the other documentation.

Medium- and High-Concentration Samples:

Medium- and high-concentration samples are packaged using the same techniques used to package low-concentration samples, with potential additional restrictions. If applicable, the sample handler must refer to instructions associated with the shipping of dangerous goods for the necessary procedures for shipping by Federal Express or other overnight carrier. If warranted, procedures for dangerous-goods shipping may be implemented. Dangerous goods and hazardous materials pose an unreasonable risk to health, safety, or property during transportation without special handling. As a result only employees who are trained under CH2M HILL Dangerous Goods Shipping course may ship or transport dangerous goods. Employees should utilize the HAZMAT ShipRight tool on the Virtual Office and/or contact a designated CH2M HILL HazMat advisor with questions.

V. Attachments

None.

VI. Key Checks and Items

- Be sure laboratory address is correct on the mailing label
- Pack sample bottles carefully, with adequate vermiculite or other packaging and without allowing bottles to touch
- Be sure there is adequate ice
- Include chain-of-custody form
- Include custody seals

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.

Click Here For Attachments

Explosives Usage and Munitions Response (MR) Enterprise Standard Operating Procedure HSE -610

1.0 Applicability and Scope

1.1 Applicability

This Standard Operating Procedure (SOP) applies to:

(1) CH2M HILL employees who enter areas known or suspected of having munitions,

(2) Areas where explosives are used for construction or demolition purposes, and

(3) Managers who may be responsible for oversight of a subcontractor's explosives usage, MR operations, or Controlled Detonation Chamber (CDC) operations.

Explosives usage or MR operations may be conducted on active, inactive, closed, transferring, or transferred ranges; former battlefields; disposal sites; munitions manufacturing and storage sites; and construction sites.

1.2 Scope

This SOP provides information regarding the spectrum of hazards and issues to be addressed during each phase of a project associated with operations involving the use of explosives. Hazardous situations addressed in this SOP include exposure to explosives used for construction or demolition work; munitions and explosives of concern (MEC), which include unexploded ordnance (UXO), discarded military munitions (DMM), and material potentially presenting an explosive hazard (MPPEH); chemical warfare materiel (CWM), or munitions constituents (MC) contaminated soil and groundwater; munitions demilitarization operations; Controlled Detonation Chamber (CDC) operations; and operations to locate, identify, remove, and dispose of munitions.

CH2M HILL employees who enter areas where explosives may be encountered or used must take precautions to avoid these hazards and be aware of associated safe work practices.

As described in SOP HSE-215, Contracts, Subcontracts, & HSE Management Practices, responsibilities for health, safety, and environmental (HS&E) protection are expressly defined through subcontract terms and conditions. CH2M HILL's HS&E practices in the field are determined on the basis of these defined responsibilities. Consistent with HSE -215, the subcontractor must determine how to operate safely, comply with applicable HS&E regulations and industry standards, and correct any deficiencies.

1.3 Regulatory Review

Projects involving the use of explosives are often complex (may require the acquisition, receipt, storage, and use of explosives to include insurance, permits/license, public safety, etc.) and have a myriad of regulatory requirements to ensure safety. A brief description of the major requirements follows:

U.S. Department of Defense (DOD) Ammunition and Explosives Safety Standards, DOD 6055.9-STD, establishes uniform safety standards that apply to ammunition and explosives, to associated personnel and property, and to unrelated personnel and property exposed to the potential damaging effects of an accident involving ammunition and explosives during their development, manufacturing, testing, transportation, handling, storage, maintenance, de-militarization, and disposal. Additional regulatory requirements are: Title 18 U. S. Code, 842, Safe Explosives Act, 27 CFR Part 555.1 Explosives, 29 CFR 1910.109 Explosives and Blasting Agents, National Fire Protection Association 495 Explosive Materials Code, 49 CFR Parts 100–199, Hazardous Materials Transportation.

The U.S. Environmental Protection Agency (EPA) regulates the disposal of military munitions, and of waste that contains military munitions, through the Military Munitions Rule (MMR) (62 Federal Register [Fed. Reg.] 6621, February 12, 1997; 40 Code of Federal Regulations [CFR] Part 260 et seq.) under authority of the Resource Conservation and Recovery Act (RCRA). The rule has two functions: (1) it identifies when conventional and chemical military munitions become a solid waste, and (2) it provides criteria for storing and transporting such waste, including a conditional exemption if the munitions are managed under DOD rules.

This SOP incorporates by reference the guidelines and requirements for MR operations that are published by the U.S. Army Corps of Engineers (USACE) Engineering Support Center, Huntsville, Alabama. These are accepted industry standards, similar to voluntary consensus standards published by such organizations as the National Fire Protection Association (NFPA) and the American National Standards Institute (ANSI).

2.0 Project Planning

2.1 Planning Requirements

Compliance with the applicable governing laws and regulations is the responsibility of the Project Manager. The Project Manager will contact the MR Operations Manager, or in his absence the MR Safety/Quality Officer or the Munitions Response Market Segment Director, prior to and post MR (paragraph 17) of the ORE approval and subsequent GO/NO GO decision for determination of applicable governing laws and regulations and to assist with planning and executing support for such activities as blasting operations, hazardous toxic radiological waste (HTRW) support, construction support, MR actions, handling of CWM or explosive-contaminated soils, and munitions demilitarization. The following types of support may be needed for MR operations:

- For on-site visits with known or suspected MEC, an Abbreviated Accident Prevention Plan (AAPP) (See **Attachment 1**) must be prepared. This AAPP is to be used only for non-intrusive site visits, and it must be approved by the MR Safety/Quality Officer, or in his absence either the MR Operations Manager or MR Market Segment Director, before the field visit starts. All team members must read and comply with the AAPP and attend the safety briefings. The UXO Safety Officer (UXOSO) shall ensure that the Safety Briefing Checklist and the Plan Acceptance forms are filled out before the site visit begins.

- On an HTRW site with known or suspected MEC, MEC support involves implementing anomaly avoidance techniques to avoid any potential surface MEC and any subsurface anomalies. A Site Safety & Health Plan (SSHP) must be prepared. This SSHP is to be used only for non-intrusive anomaly avoidance activities, and it must be approved by the MR Safety/Quality Officer, or in his absence the MR Operations Manager or the MR Market Segment Director prior to the start of fieldwork. All team members must read and comply with the SSHP and attend the safety briefings. The UXOSO shall ensure that the Safety Briefing Checklist and Plan Acceptance Form are filled out prior to the start of the site work.
- On a construction site with known or suspected MEC, support must be provided by qualified UXO personnel during construction activities. The level of MEC support required depends on the probability of encountering MEC, determined on a project-by-project basis. This will be identified during the MR (paragraph 17) of the ORE.
- MR actions in which the intent is to locate, identify, excavate, remove, and dispose of MEC may require a Senior UXO Supervisor, UXO Safety Officer, and UXO Quality Control Specialist, to oversee UXO contractor teams performing operations.
- On an MR site that has MC contamination of soil or groundwater, MEC support may include both anomaly avoidance techniques and MEC construction support for excavating and/or treating MC-contaminated soil and groundwater.
- On munitions demilitarization projects, MEC support is required to identify, handle, disassemble, process, certify, transport, and treat or dispose of munitions components.
- On projects where explosives waste is transported or disposed of offsite, the MR Operations Manager and the BG Environmental Compliance Coordinator (ECC) may assist in identifying the applicable regulations and permits required.
- On projects where munitions debris (MD), material potentially presenting an explosive hazard (MPPEH), or inert munitions is recovered and processed for disposal as scrap, the MR Operations Manager and the BG ECC may determine whether treatment and certification is required, along with any permitting requirements.
- For drilling activities at project sites suspected of MEC contamination, the UXO team shall conduct a reconnaissance and MEC avoidance to provide clear access routes to each site before drilling crews enter the area. Down hole avoidance support shall be conducted at intervals every one foot until the depth that was determined during the MR ORE was reached. The procedures listed in HSE-204, *Drilling*, apply and shall be implemented.
- For excavation activities at project sites suspected of MEC contamination, the UXO team shall conduct a reconnaissance and MEC avoidance to provide clear access routes to

each site before excavation crews enter the area. The procedures listed in HSE-307, *Excavations*, apply and shall be implemented.

- Safety and quality control (QC) audits shall be included in developing cost estimates for any MR or explosives usage project that will last more then two weeks.
- On projects that include intrusive activities to investigate MEC or use of explosives (blasting), an Explosive Safety Submission (ESS), an Explosive Siting Plan (ESP), and an Explosive Management Plan (EMP) may be required. The MR Operations Manager, or in his absence the MR Safety/Quality Officer or MR Market Segment Director, shall assist in evaluating project requirements and coordinate with others as appropriate.

The project UXOQCS or in his/her absence, one the following, MR Program Quality Manager, MR Safety/Quality Officer or the MR Market Segment Director, shall verify subcontractor training, personnel qualifications, and current medical examinations prior to the start of field operations. Any identified shortfalls in qualifications should be reported to the MR Operations Manager or in his absence to the MR Safety/Quality Officer or the Market Segment Director for resolution.

2.2 Opportunity and Risk Evaluation (ORE)

Every project or task involving the usage of explosives or a Munitions Response (MR) requires completion of the Munitions Response ORE form in **Attachment 2**. The most current form and assistance in filling out the form can be obtained from the MR Safety/Quality Officer, MR Operations Manager, or MR Market Segment Director. This document is a living form and should be updated as a project is developed and executed or upon change of scope of work (SOW), identification of previously unknown hazards, etc. Final acceptance of the MR ORE is done by the MR Safety/Quality Officer. Upon acceptance of the MR ORE, the Project Delivery Team (PDT) is required to perform the Go/No Go decisions making process per the ESBG Authority Matrix.

2.3 Alcohol, Tobacco, Firearms, and Explosives (ATF&E) Background Investigation

The “Safe Explosives Act of 2002” requires the employer (CH2M HILL) to submit to ATF&E identifying information, fingerprints, and photographs for all "Responsible Persons" and "Possessors of Explosives."

All personnel designated as Responsible Persons or Possessors of Explosives involved in explosives usage and MR projects must provide a 2-inch by 2-inch color picture and an ATF Form 5400.28 filled out for submission by the ATF&E License Holder (contact MR Operations for assistance) who will forward them to ATF&E so that a background investigation can be conducted to establish eligibility to work with explosives.

Under the "Safe Explosives Act," a "Responsible Person" and a "Possessor of Explosives" are defined as follows:

Responsible Person: An individual who has the power to direct the management and policies of the applicant pertaining to explosive materials. Generally the term includes partners, sole proprietors, project managers, site managers, corporate officers and directors, and majority shareholders.

Possessor of Explosives: An individual who has actual physical possession or constructive possession, which means the person has dominion or control over explosives. For example, persons who are physically handling explosive materials would be considered to be possessors of explosives. This would include employees who handle explosive materials in order to ship, transport, or sell them; and employees, such as blasters, who actually use explosive materials. Other examples of possessors include a supervisor at a construction site who keeps keys for magazines in which explosives are stored, or who directs the use of explosive materials by other employees; and an employee of a licensee or permittee transporting explosive materials from a licensed distributor to a purchaser.

Assistance in filling out required forms can be obtained from the MR Operations Manager, or in his absence the MR Safety Officer or the MR Market Segment Director. Submission of completed forms to ATF&E is the responsibility of the ATF&E License Holder. Upon submission of the required forms "responsible persons and possessors of explosives" may execute their duties pending completion of the background investigation.

ATF&E will notify employers in writing of the result of each background check and will supply the "responsible person" or "possessor of explosives" with a "Letter of Clearance" where appropriate. The custodian of the ATF&E records will request a copy of this certificate from the employee.

2.4 Training Requirements

2.4.1 MR Projects

CH2M HILL employees and subcontractors who work on projects that involve MR must complete the following training:

- A one-time, 40-hour Hazardous Waste Operations and Emergency Response course, and a minimum of three days' actual field experience under the direct supervision of a trained supervisor as specified in 29 CFR §1910.120(e).
- An annual 8-hour hazardous waste refresher course, as specified in 29 CFR §1910.120(e) (8).
- Hazardous waste supervisory training (required for managers and supervisors only) as specified in 29 CFR §1910.120(e)(4).

All UXO technicians must be graduates of one of the following:

- U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD;
- U.S. Naval Explosive Ordnance Disposal (EOD) School, Indian Head, MD;
- U.S. Naval EOD School, Eglin Air Force Base (AFB), FL;
- EOD Assistants Course, Redstone Arsenal, AL;
- EOD Assistant Course, Eglin AFB; or
- An equivalent course as identified in Department of Defense Explosives Safety Board (DDESB) Technical Publication (TP) 18

The project UXOQCS or in his/her absence the MR Operations Manager, MR Safety/Quality Officer or the MR Market Segment Director, must review and accept subcontractor personnel qualifications.

2.4.2 Commercial Blaster Requirements

Commercial blasting is most often done in support of construction projects to remove or reduce obstacles that interfere with the construction of new roads, bridges, tunnels, harbors, or other facilities.

In order to be qualified as a “Blaster,” the individual shall be able to understand and give written and oral orders; be in good physical condition and not be addicted to narcotics, intoxicants, or similar types of drugs; and be qualified by reason of training, knowledge, or experience in the field of transporting, storing, handling, and use of explosives, and have a working knowledge of state and local laws and regulations that pertain to explosives. A “Blaster” will be required to furnish satisfactory evidence of competency in handling explosives and performing in a safe manner the type of blasting that will be required. A Blaster must also be knowledgeable and competent in the use of each type of blasting method used.

Depending on the type and location of work performed, personnel that transport explosives may need to have a commercial driver’s license (CDL) with a hazardous material endorsement in accordance with Department of Transportation Requirements specified in 49 CFR.

The following definitions provide an overview the types of explosives which may be used in commercial blasting:

Explosives -- any chemical compound, mixture, or device, the primary or common purpose of which is to function by explosion, i.e., with substantially instantaneous release of gas and heat, unless such compound, mixture, or device is otherwise specifically classified by the U.S. Department of Transportation; see 49 CFR Chapter I. The term "explosives" shall include all material which is classified as Class A, Class B, and Class C explosives by the U.S. Department of Transportation, and includes, but is not limited to dynamite, black powder, pellet powders, initiating explosives, blasting caps, electric blasting caps, safety fuse, fuse lighters, fuse igniters, squibs, cordeau detonant fuse, instantaneous fuse, igniter cord, igniters, small arms ammunition, small arms ammunition primers, smokeless propellant, cartridges for propellant-actuated power devices, and cartridges for industrial guns. Commercial explosives are those explosives which are intended to be used in commercial or industrial operations.

(i) ***Class A explosives***. Possessing, detonating, or otherwise having maximum hazard, such as dynamite, nitroglycerin, picric acid, lead azide, fulminate of mercury, black powder, blasting caps, and detonating primers.

(ii) ***Class B explosives***. Possessing flammable hazard, such as propellant explosives (including some smokeless propellants), photographic flash powders, and some special fireworks.

(iii) ***Class C explosives***. Includes certain types of manufactured articles which contain Class A or Class B explosives, or both, as components but in restricted quantities.

2.5 Medical Surveillance Requirements

All CH2M HILL employees who perform field work on MR sites must participate in a medical monitoring program in accordance with 29 CFR 1910.120 and HSE-113, *Medical Monitoring*.

Employees who terminate employment and who have performed field work at MR project sites may be required to undergo an exit examination.

Subcontractors are responsible for ensuring that their employees are enrolled in a medical surveillance or monitoring program that meets the requirements of 29 CFR 1910.120.

2.6 Drug Free Workplace Requirements

CH2M HILL employees who perform or oversee MR operations are subject to the provisions of HSE-105, *Drug-Free Workplace*.

All CH2M HILL employees assigned toto MR projects are subject to the provisions of HSE-105, Drug-Free Workplace. Subcontractors are responsible for ensuring that their employees who perform MR operations on CH2M HILL projects are on a drug abuse surveillance program that meets the requirements of HSE-105.

2.7 Competent Person Requirements

2.7.1 Munitions Response

A competent person may be a Senior UXO Supervisor, UXO Safety Officer, UXO Quality Control Specialist, or UXO Technician III. The competent person must meet the following minimum qualifications:

- Be a graduate of one of the schools and courses listed for all UXO technicians in Section 2.4.1 above and meet the requirements of DDESB TP-18,
- Have at least 8 years of combined active-duty military EOD experience and contractor UXO experience, and
- Have experience in MR operations and supervision of personnel.

The MR Operations Manager, the MR Market Segment Director, and the MR Safety/Quality Officer will compose the Ammunition & Explosive Personnel Qualification and Certification Board for employees of CH2M HILL. This Board will review individual qualifications and experiences for determining who will be allowed to perform those duties and assignments associated with SUXOS, UXOQC, UXOSO, and CDC Chamber Operator. Project managers are required to notify in writing, the MR Safety/Quality Officer of any CH2M HILL UXO Technician assignments requiring service related documented of qualifications.

2.7.2 Blasting

Blasting subcontractors are responsible for providing a competent person to oversee blasting operations. A competent person may be a state licensed blaster. The competent person must be qualified through a license or permit issued by a state or local jurisdiction based on testing, extensive knowledge, training, and experience with an ability to solve or resolve problems related to blasting, and must meet the following requirements:

- Able to understand and give written and oral orders.
- In good physical condition and not be addicted to narcotics, intoxicants, or similar types of drugs.
- Required to furnish satisfactory evidence of competency in handling explosives and performing in a safe manner the type of blasting that will be required.
- Knowledgeable and competent in the use of each type of blasting method used.

2.8 Safety Equipment

Subcontractors are responsible for providing all necessary personal protective equipment (PPE) for their employees. CH2M HILL will provide PPE only for its own employees. Other safety equipment will be provided as delineated in the subcontract and documents referenced by the subcontract. The MR Safety Officer, or in his absence the MR Operations Manager or the MR Market Segment Director, must review subcontractor work plans and site-specific HS&E plans to ensure that appropriate safety equipment has been included to meet the requirements of the scope of work (SOW).

Personnel who will be handling explosives will not wear outer or inner garments having static electricity-generating characteristics. These include clothing made of 100 percent polyester, nylon, silk, and wool, which are all highly static producing.

Protective shoes worn by personnel performing explosives operations should be constructed of nonferrous materials (e.g., fiberglass) to prevent interference with sensitive geophysical instruments.

UXO Technicians are required to wear hard hats when an overhead hazard exists or when specified in the site-specific HS&E plan. Hard hats should *not* be worn, however, when investigating suspect MEC. A hard hat can create an unsafe condition by falling off the technician's head at a critical moment. Also, if a MEC is accidentally detonated (the worst-case accident scenario), the hard hat will not protect the technician from fragments and may worsen the injury by reflecting fragments into the head of the technician. This is consistent with safety guidance from the Corps of Engineers, Huntsville Center, Military Munitions Center of Expertise (MM-CX).

2.9 Subcontractor Selection

Subcontractors are selected based on their past performance in working for CH2M HILL, safety record, experience, and compliance with federal, state, and local jurisdiction licensing and permitting.

Additional criteria may be developed, depending upon the specific SOW requirements for the subcontractor. When oversight is required by HSE-215, the CH2M HILL MR Safety/Quality Officer, or in his absence the MR Operations Manager or MR Market Segment Director, shall use these developed criteria to review the explosives procedures submitted by the subcontractor.

3.0 Definitions

Please see **Attachment 3** for definitions.

4.0 Project Execution

4.1 Safe Work Practices

Management is responsible to control and eliminate unsafe work conditions through training and engineering out the hazard. The requirements of this section are to be followed by all personnel where explosives are used, regardless of the company performing the operations. These requirements also pertain to subcontractor personnel.

4.2 MR Operations

On MR project sites, the MR Operations Manager will be contacted to establish requirements.

4.3 Regulations and Industry Standards

As described in HSE-215, the MR Safety Officer/Quality or UXOQCS may be required to oversee a subcontractor's field activities. Subcontractors retain control over their practices, and CH2M HILL's oversight does not relieve them of their own responsibility for effective implementation and enforcement of HS&E requirements. The following subsections provide the minimum regulatory and industry standards for operations.

The Military Munitions Response Program (MMRP) is a maturing program with different levels of regulatory oversight within each service component. Unless a service component has issued written regulations/guidance for execution of MR actions, then the default regulations/guidance followed will be those issued by the Department of Defense Explosive Safety Board (DDESB) and the U.S. Army Corps of Engineers. For commercial blasting operations, the following guidelines shall apply: ATF&E federal explosive laws and regulations (ATF P5400.7); ANSI A10.7, Safety Requirements for Transportation, Storage, Handling and Use of Explosives; and NFPA 495, Explosive Material Code.

4.3.1 General Safety Concerns and Procedures

Operations, including site visits, shall not be conducted until a complete plan for the site is prepared and approval for use is given by the CH2M HILL MR Safety/Quality Officer, MR Operations Manager, or MR Market Segment Director. These plans will be based upon the cardinal rule of explosive safety which is to limit exposure to the minimum number of personnel, for the minimum amount of time, to the least amount of explosives hazards consistent with safe and efficient operations.

Only UXO-qualified personnel shall perform MEC procedures. Non-UXO personnel may be used to perform MEC-related procedures when supervised by a UXO Technician III. All personnel engaged in field operations shall be thoroughly trained and capable of recognizing the specific hazards of the procedures being performed. To ensure that these procedures are performed to standards, all field personnel shall be under the direct supervision of a UXO Technician III or a Senior UXO Supervisor (SUXOS).

4.3.2 Explosives Safety Precautions

Comply with the cardinal rule for explosives safety: expose the minimum number of people to the minimum amount of explosives for the minimum amount of time. Project-specific explosives safety precautions shall be developed prior to field activities and included in Work Plans and Health & Safety Plans that must be reviewed and approved by the MR Safety/Quality Officer and the MR Operations Manager, or in their absence the MR Market Segment Director.

4.3.3 Recognize, Retreat, and Report MEC

Any CH2M HILL project located on a present or former Department of Defense (DOD) facility, even if it is now under the control of a city, state, or private owner, should plan on the potential to encounter MEC/MPPEH. A contingency plan developed during pre-mobilization that addresses the three Rs of MEC/MPPEH (recognize the potential hazard, retreat upwind a safe distance, and report in accordance with approved plans) will lesson the impact to the project and enhance employee safety if MEC/MPPEH is encountered. Assistance in developing this contingency plan should be obtained from the MR Safety/Quality Officer, or in his absence the MR Operations Manager or the MR Market Segment Director.

4.3.4 Explosives Management

Management of explosives material under the "Safe Explosives Act of 2002" implements stringent requirements that must be followed. Management of explosives is a process that, if in compliance with federal, state, and local jurisdiction, will reduce, control, or eliminate civil and criminal penalties, disciplinary actions, and potential risk to personnel, the public, and the environment. Details of explosives management are developed on a site-specific basis and included in a site-specific Explosives Management Plan (EMP). These details are based on federal, state, and local jurisdiction requirements and on contractual specifications by the client.

4.3.5 Explosives Security

Security of explosives will conform to the requirements set forth by federal, state, and local jurisdictions. Provisions for explosives security during interstate or intrastate shipment will be performed by transportation vendors. Project site and overnight explosives security will conform to 49 CFR 171-173, transportation security requirements. Details of explosives security requirements are included in the EMP for each project.

4.3.6 Controlled Detonation Chamber Operations

A Controlled Detonation Chamber (CDC) is capable of repeated controlled detonations of a suite of energetic materials that are currently demilitarized by open burn/open detonation (OB/OD). An MR ORE is required on CDC projects. On CDC projects, the MR Operations Manager will be contacted to establish requirements.

4.3.7 Explosive Waste Disposal

When used or fired munitions are managed off range (i.e., transported off range and stored, reclaimed, treated, or disposed) or disposed of on range (i.e., buried without treatment), it is subject to regulation as a solid waste under RCRA. This means it may also be subject to regulation as a hazardous waste. Also, munitions that land off range and are not promptly retrieved are solid wastes. Table 4-1 describes how solid wastes may be characterized as hazardous in these situations. All characterization must be based on field observations by qualified MR personnel who are trained to properly identify waste munitions items and meet the requirements for an emergency response expert under RCRA. In the event that the explosive waste is regulated as hazardous waste, refer to SOP HSE-409, Waste Management: Hazardous Waste for RCRA hazardous waste management requirements.

TABLE 4-1
Waste Characterization

Item	Characterization	Waste Code
Uncontaminated metal debris	If visual inspection determines that the item does not contain waste residue, then waste is non-hazardous scrap metal excluded from RCRA regulation under 40 CFR §261.6(a)(3). Waste may be subject to further incineration and certification requirements.	None
Contaminated metal debris	If visual inspection determines that the item contains hazardous waste residue, then manage it as potential hazardous waste.	Potential D003 and/or D008
Munitions less than 0.50 caliber	Small-arms ammunition is not considered reactive hazardous waste in accordance with EPA policy (November 30, 1984 Memorandum, John Skinner, OSWER Director).	None
Munitions greater than 0.50 caliber	Untreated MEC is presumed to be reactive hazardous waste using generator knowledge under 40 CFR §261.23.	D003

4.3.8 Forms and Permits

(1) **Type-20 Manufacturer of High Explosives License/Permit** issued by the ATF&E is required to purchase, store, and use high explosives including on-site use of binary explosives in support of MR operations, construction projects, and demolition and deactivation (D&D) projects. The following must be done prior to execution of field activities:

- Explosives will not be ordered, shipped, stored, or used by CH2M HILL without the review and approval of the ATF&E License Holder.
- The ATF&E License Holder must review and approve all Explosive Siting Plans (ESPs) and Explosives Management Plans (EMPs) to ensure compliance with ATF&E regulations.
- Following compliance with the above, the ATF&E License Holder will provide procurement/contracting with a certified copy of our Type 20 license and the authorization letter (responsible persons & possessors of explosives) to procure explosives.
- Written authorization designating the "Responsible Persons" and "Possessors of Explosives" who can order, receive, store, and use explosives must be provided by the ATF&E License Holder to explosives supplier.
- A copy of the CH2M HILL ATF&E Type 20 Manufacturer of High Explosives license must be posted on the project site.

- A copy of the ESP must be provided through the ATF&E License Holder to the ATF&E Office that inspects the CH2M HILL records and to the nearest ATF&E Office to the project site.

Additional details are provided in **Attachment 4**, Explosives Management Check List, including required records that must be forwarded to the CH2M HILL ATF&E Type 20 License Holder upon completion of work.

(2) State and local explosives permits may be required for CH2M HILL and individuals to purchase, store, and use explosives in support of MR operations, CDC operations, construction projects, and D&D projects. In addition there may be local requirements to notify law enforcement or fire department agencies when establishing explosives storage.

5.0 Attachments

The following attachments are located within the SOP.

Attachment 1 Abbreviated Site Safety and Health Plan (ASSHP)

Attachment 2 Opportunity Risk Evaluation (ORE)

Attachment 3 Glossary, Acronyms, and Abbreviations

Attachment 4 Explosives Management Check List

6.0 Revision Log

Revision	Date	Description	Prepared By	Approved By
1	9/27/06	Updated to Standard Operating Procedure	Dan Young	R Keith Christopher

CH2MHILL

Explosives Usage and Munitions Response (MR)
Standard Operating Procedure HSE-610

Attachment 1: Abbreviated Accident Protection Plan (AAPP)

For:

Site name ______________________________

Site location ______________________________

Purpose of visit ______________________________

AAPP prepared by ______________________________

Office ______________________________

Address ______________________________

Telephone ______________________________

Date prepared ______________________________

Signature and date ______________________________

AAPP reviewed and approved by:

Safety office: ______________________________ Date: __________

NOTE: This AAPP is to be used only for non- intrusive site visits or for intrusive activities (e.g. geophysical prove-outs) where anomaly avoidance is to be performed prior to intrusive activity. All team members must read and comply with this AAPP and attend the safety briefings. The UXO escort shall ensure that the Safety Briefing Checklist and Plan Acceptance Form are filled out prior to the start of the site visit.

I. Site Description and Previous Investigation

A. Site Description

- **Size: _______ acres**
- **Present usage:**

( ) Military	( ) Recreational	( ) Other
( ) Residential	( ) Commercial	( )________________
( ) Natural area	( ) Industrial	( ) ________________
( ) Agricultural	( ) Landfill	( ) ________________
( ) Secured	( ) Active	( ) Unknown

( ) Unsecured ( ) Inactive

B. Past Uses

All members of the site visit team have been provided with a copy of the ASR.

Yes No –

C. Surrounding Population

( ) Rural	( ) Residential (outside base fence)	( ) Other (specify)
( ) Urban	( ) Industrial	( ) ________________
	( ) Commercial	( ) ________________

D. Previous Sampling and Investigation Results

1. MEC Encountered within anticipated boundaries of site

2. Samples (air, water, soil, and/or vegetation)

Chemical	Concentration	Medium	Location

II. Description of On-Site Activities

( ) Walk-through	( ) Drive-through	( ) Other
( ) On-road	( ) Off-road	( )________________
( ) On-path	( ) Off-path	( ) ________________
( ) Other	( ) Other	( ) ________________

III. Site Personnel and Responsibilities

Project Manager –

Office ________________________________

Address ________________________________

Phone ______

Responsibilities ______

Team Leader –

Office ______

Address ______

Phone ______

Responsibilities Responsible for documenting site visit.

UXO Safety Officer –

Office ______

Address ______

Phone ______

Responsibilities Responsible for all aspects of site safety during operations covered under this AAPP

IV. Hazard Analysis

A. Safety and Health Hazards Anticipated

( ) Chemical (be specific and include warning signs and symptoms of overexposure)

( ) Munitions (specify)

( ) Heat stress	( ) Cold stress	( ) Tripping hazard
( ) Noise	( ) Electrical	( ) Falling objects
( ) Foot hazard	( ) Biological	( ) Overhead hazard
( ) Radiological	( ) Confined space	( ) Water hazard
( ) Explosive	( ) Climbing hazard	( ) Sunburn
( ) Flammable	( ) Other	

B. Overall Hazard Evaluation

( ) High   ( ) Moderate   ( ) Low   ( ) Unknown

Justification

V. Accident Prevention

A. General Precautions

Before the on-site visit, all team members are required to read this AAPP and sign the form acknowledging that they have read and will comply with it. In addition, the UXO Safety Officer (escort) - shall hold a brief tailgate meeting in which site-specific topics regarding the day's activities are discussed. The buddy system shall be enforced at all times. If unanticipated hazardous conditions arise, team members are to stop work, leave the immediate area, and notify the UXO Safety Officer.

VI. Standard Operation Safety Procedures, Engineering Controls, and Work Practices

A. Site Rules and Prohibitions

At any sign of unanticipated hazardous conditions, stop tasks, leave the immediate area, and notify the UXO Safety Officer. Smoking, eating, and drinking are allowed in designated areas only.

B. Material-Handling Procedures

Do not handle.

C. Drum-Handling Procedures

Do not handle.

D. Confined Space Entry

Do not enter.

E. Ignition Source and Electrical Protection

Smoke in designated areas only. Team members are not to carry matches or lighters into the site.

F. Spill Containment

N/A

G. Excavation Safety

N/A

H. Illumination

Work during daylight hours only.

I. Sanitation

Use existing sanitary facilities.

J. Buddy System

Two persons shall be on site maintaining constant contact with each other; this shall be adhered to at all times.

K. Engineering Controls

N/A

L. Heat Stress

Dress appropriately, take sufficient breaks, and drink plenty of fluids. Watch for signs and symptoms of heat stress.

M. Poisonous Snakes or Insects

(1) Do NOT handle any snakes even those that appear to be dead.

(2) Avoid areas of limited visibility such as tall grass or heavy vegetation.

(3) Roll sleeves down and use insect repellant.

N. Material Potentially Presenting an Explosive hazard (MPPEH).

1. General Information

a. The cardinal principle to be observed involving explosives, ammunition, severe fire hazards, or toxic materials is to limit the exposure of a minimum number of personnel, for the minimum amount of time, to a minimum amount of hazardous material, consistent with a safe and efficient operation.

b. The age or condition of an munition does not decrease its effectiveness. MPPEH that has been exposed to the elements for extended periods of time becomes more sensitive to shock, movement, and friction because the stabilizing agent in the explosive may be degraded.

c. When chemical agents may be present, further precautions are necessary. If the munitions item has green markings, leave the area immediately, since it may contain a chemical filler.

d. Consider MPPEH that has been exposed to fire as extremely hazardous. Chemical and physical changes may have occurred to the contents which render it more sensitive than it was in its original state.

2. On-Site Instructions

a. DO NOT touch or move MPPEH regardless of the marking or apparent condition.

b. DO NOT visit an MPPEH site if an electrical storm is occurring or approaching. If a storm approaches during a site visit, leave the site immediately and seek shelter.

c. DO NOT use radio or cellular phones in the vicinity of suspected MPPEH.

d. DO NOT walk across an area where the ground cannot be seen. If dead vegetation or animals are observed, leave the area immediately due to the potential of contamination by a chemical agent.

e. DO NOT drive a vehicle into a suspected MPPEH area; use clearly marked lanes.

f. DO NOT carry matches, cigarettes, lighters, or other flame-producing devices into an MPPEH site.

g. DO NOT rely on color code for positive identification of munitions or their contents.

h. Always assume that MPPEH contains a live charge until it can be determined otherwise.

3. Specific Actions upon Locating MPPEH

a. DO NOT touch, move, or jar MPPEH regardless of its apparent condition.

b. The UXO Safety Officer may approach the item cautiously; take photographs and a full description. Take notes of the markings or any other identifiers.

c. DO NOT be misled by markings on the item stating “practice bomb,” “dummy,” or “inert.” Even practice bombs have explosive charges that are used to mark or spot the point of impact; or the item could be miss-marked.

d. DO NOT roll the item over or scrape the item to identify the markings.

e. The location of any MPPEH found during site investigation should be clearly marked so it can be easily located and avoided.

f. Notify PM upon location of any MPPEH. See Section VIII for phone number.

O. Other

Specify: ____

VII. Site Control and Communications

A. Site Map

Attach copy.

B. Site Work Zones

N/A

C. Buddy System

To be adhered to at all times.

D. Communications

1. On Site

Use verbal communications among team members to communicate to each other on site. If this communication is not possible, develop and use hand signals. Here are some examples:

Hand gripping throat:	"Breathing problems, can't breathe."
Thumbs up:	"OK, I'm all right, I understand."
Thumbs down:	"No, negative."
Hand(s) on top of head:	"Need assistance."
Grab buddy's wrist:	"Evacuate site now, no questions."
One long horn blast:	"Evacuate site to assembly point."
Two short horn blasts:	"Condition under control, return to site."

2. Off Site

Off-site communications shall be established on every site. Communications may be established by using an on-site cellular phone or by locating the nearest public or private phone that may be readily accessed. Mark the appropriate box:

( ) Cellular phone
( ) Public or private phone
( ) Other: ________________

3. Emergency Signals

In the case of small groups, a verbal signal for emergencies shall suffice. The emergency signal for large groups (i.e., air horn) should be incorporated at the discretion of the UXO Safety Officer. Mark the appropriate box:

( ) Verbal
( ) Nonverbal (specify) ____

VIII. Emergency Response

A. Alert Procedures

Team members are to be alert to the hazards associated with the site at all times. If an unanticipated hazardous condition arises, stop work, evacuate the immediate area, and notify the UXO Safety Officer. Practice MEC avoidance. If a suspected MEC is encountered during field activities, the team leader will contact local authorities and USACE Project Manager. The local authorities will contact military EOD. The suspected item will be marked with colored tape (or equivalent) by on-site UXO Safety Officer (escort).

B. First Aid

A first aid kit and emergency eyewash (as applicable) will be located in the UXO Safety Officer's field car. If qualified persons (i.e., a fire department, medical facility, or physician) are not accessible within five minutes of the site, at least one team member shall be qualified to administer first aid and cardiopulmonary resuscitation (CPR).

C. Emergency Telephone Numbers

1. Medical Facility
2. Fire Department

   ____

3. Police Department

   ____

4. Poison Control Center:

   (800) 222-1222

5. Local EOD

   ____

6. Project Manager(s)

   ____

D. Hospital and Medical Facility Information

Route to hospital: (Attach a map with the route to the hospital marked; if a map is not available, then provide clear, written instructions.)

IX. Monitoring Equipment and Procedures

A. Exposure Monitoring

For non-intrusive on-site activities such as site visits, air monitoring is typically not required. However, if the site situation dictates the need for monitoring, then complete the following information on a separate page and attach the page to this AAPP.

Monitoring equipment to be utilized

Documentation of equipment calibration and results

Action levels

B. Heat and Cold Stress Monitoring

If heat stress monitoring is necessary, the monitoring criteria published in Chapter 8 of *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities* (NIOSH/OSHA/USCG/EPA, October 1985) shall be followed. If cold stress monitoring is necessary, it shall be conducted in accordance with the most current American Conference of Governmental Industrial Hygienists (ACGIH) cold stress standard.

X. Personal Protective Equipment

A. General

Typically, for non-intrusive site visits, Level D PPE is required. Hard hats shall be worn if an overhead hazard exists, safety shoes if a foot hazard exists, and safety glasses if an eye hazard exists. If a higher level of protection is to be used initially or as a contingency, attach a brief discussion.

B. Non-intrusive Site Visit

Level of Protection

Initial:	( ) C	( ) D	( ) Modified (specify)
Contingency:	( ) C	( ) D	( ) Modified (specify)
	( ) Evacuate site if higher level of protection is needed.		

XI. Decontamination Procedures

If decontamination is required, attach an additional sheet with the requirements.

Decontamination procedures are not anticipated for this site investigation. Team members are cautioned not to walk, kneel, or sit on any surface with potential leaks, spills, or contamination.

XII. Training

All site personnel shall have completed the training required by EM 385-1-1 and 29 CFR §1910.120 (e). The Project Manager shall ensure, and the UXO Safety Officer shall verify, that all on-site persons have completed appropriate training prior to submitting the plan to the safety office for review. Additionally, the UXO Safety Officer shall inform personnel, before they enter the site, of any potential site-specific hazards and procedures.

XIII. Medical Surveillance Program

The Project Manager shall ensure, and the UXO Safety Officer shall verify, that all on-site personnel are in the Medical Surveillance Program meeting the requirements of 29 CFR §1910.120.

XIV. Logs, Reports, and Recordkeeping

A Site Log will be maintained by the team leader. This record will include historical data, personnel authorized to visit the site, all records, standard operating procedures, the AAPP submitted, any air monitoring logs, SOPs, and attachments to plans. All logs are to be maintained and available for inspection.

XV. General

The number of persons visiting the site shall be held to a minimum. No more than 8 people per UXO Safety Officer shall be allowed on-site. The more persons on site, the greater the potential for an accident. The UXO Safety Officer may modify this AAPP if site conditions warrant it and if it does not risk the safety and health of the team members. This modification shall be coordinated with the team members, and the UXO Safety Officer shall notify PM of the change as the situation allows.

XVI. Natural Resources

The following is a list of threatened and endangered species:

Safety Briefing Checklist
(Check subjects discussed)

Location: ______________________________ Date: ______________________________

General Information

Purpose of visit: ______________________________

Identify key site personnel: ______________________________

Training and medical requirements: ______________________________

Specific Information

Site description and past uses: ______________________________

Results of previous studies: ______________________________

Potential site hazards: ______________________________

MEC safety procedures: ______________________________

Site SOPs: ______________________________

Site control and communications: ______________________________

( ) Emergency Hand Signals

Emergency Response: ______________________________

( ) Location of First Aid Kit

( ) Emergency Phone Numbers and Location

( ) Location of Nearest Medical Facility and Location of Map to Facility

PPE and Decontamination: ______________________________

Note: Stress the following during the briefings: If an unanticipated hazardous condition arises, stop work, evacuate the immediate area, and notify the UXO Safety Officer.

Plan Acceptance Form:
Abbreviated Accident Prevention Plan

For:

I have read and agree to abide by the contents of this Abbreviated Accident Prevention Plan and I have attended the Safety Briefing for the aforementioned site.

Name (printed)	Office	Signature	Date

Person presenting the safety briefing:

Signature Date

Equipment List

(The following items may be necessary to support the site visit)

1. Boots or sturdy leather work shoes.
2. First aid kit.
3. Sun screen lotion.
4. Bug and/or insect repellant.
5. Rain / cold weather protection.
6. Potable water.

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Explosives Usage and Munitions Response (MR)
Standard Operating Procedure HSE-610

Attachment 2: Opportunity Risk Evaluation (ORE)

1.0 Projects Involving or Potentially Involving the Use of Explosives, Materials Potentially Presenting an Explosive Hazard (MPPEH), Munitions and Explosives of Concern (MEC) and Related Activity.

Administrative Information

Project Name:
Project Number:
Project Location: (Address, City, State, Zip Code, Country)
Address:
City:
State:
Zip Code:
Country:
Project Manager - CH2M HILL:
Contracting Organization:
Client Organization:
☐Department of Defense
☐Department of State
☐Department of Energy
☐Department of Interior
☐Other
Client Organization Name:
Contract Type
☐ Time and Materials (T&M)
☐ Cost Plus (CP)
☐ Firm Fixed Price (FFP)
☐ Target Cost Incentive Fee (TCIF)
☐ Guaranteed Fixed Price with Insurance (GFPI)
☐ Performance Based Acquisition (PBA)
☐ Other

)

Brief Outline of the Scope of Work.

Number and Type of MR Personnel Needed to Support Project.

Any point value of 3, 4 or 5 in Sections A, B, C or D requires that you provide a risk management strategy as indicated. If unable to do so, you may wait until the formal MR ORE is conducted, then add the agreed to strategy at that time. Examples of strategies include, engineering controls, contractual protections, procedures, insurance and bonding, etc.

Level of effort should include MR Group Safety/Quality Control Audits for project over two weeks in field.

If you are unsure of which answer to use, leave blank and the question will be evaluated at length during the MR ORE process.

Upon completion of this form, email to those identified and schedule a telephonic conference call with them to review this document.

Part A:

Common Questions for Explosives Usage, Munitions Response (MR) and Controlled Detonation Chamber (CDC) Projects

Scoring Criteria

0 = none, 1 - 2 = Low Risk 3 Moderate Risk 4 - 5 High Risk

17.A1 Type of Reactive Materials?

Project Risk Category?	Check (x)	Point Value
Small Arms (<.50 cal) Ammunition	☐	0
Commercial Explosives	☐	3
Military Explosives/Energetics (bulk)	☐	3
CWM or CWA	☐	5
Munitions and Explosives of Concern (MEC)	☐	5
Pyrotechnics (including fire-works, etc.)	☐	5

RISK MANAGEMENT STRATEGY:

17.A2 Client – End Land Use

Which factor best describes the project end land use?	Check (x)	Point Value
Like Use -	☐	0
Not Yet Determined -	☐	1
Limited Public Access - livestock grazing/wildlife preserve/historic area	☐	2
Public Access - Farming/Agriculture	☐	3
Unrestricted – Commercial	☐	4
Unrestricted – Residential	☐	5

RISK MANAGEMENT STRATEGY:

17.A3 Chemical Warfare Material (CWM)

Which factor best describes this risk factor?	Check (x)	Point Value
None	☐	0
No-specific reference - but possible	☐	3
CW Agents Known or Suspected	☐	5
CW Munitions Known or Suspected	☐	5

RISK MANAGEMENT STRATEGY:

)

17.A4 Who will write the Work & Safety Plans?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
CH2M HILL (Who in CH2M HILL ?)	☐	1
Don't Know	☐	3
Client / Subcontractor	☐	5

RISK MANAGEMENT STRATEGY:

17.A5 Does Client acknowledge that it will retain ownership of, and responsibility for MEC & recovered items ?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Yes.	☐	1
Don't Know	☐	3
No.	☐	5

RISK MANAGEMENT STRATEGY:

17.A6 Does the Project Delivery Team have a history of successful execution of this type of project?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Yes.	☐	1
Don't Know?	☐	3
No.	☐	5

RISK MANAGEMENT STRATEGY:

17.A7 Is the Client responsible for obtaining necessary permits such as utility locator, state authorizations, rights of entry, etc.?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Yes.	☐	1
Don't Know	☐	3
No.	☐	5

RISK MANAGEMENT STRATEGY:

17.A8 Will there be a range debris, munition debris, etc., recovery effort?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
No	☐	1
Don't Know	☐	3
Yes	☐	5

RISK MANAGEMENT STRATEGY:

17. A9 Will CH2M HILL subcontract MR or explosive operational actions?

Which factor best describes this risk factor?	Check (x)	Point Value
No	☐	0
Munitions Response Master Services Agreement (MSA)	☐	1
Don't Know	☐	3
Yes	☐	5

RISK MANAGEMENT STRATEGY:

17.A10 For "removal" activities, will "blow-in-place" (BIP) be permitted?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
No.	☐	1
Don't Know	☐	3
Yes	☐	5

RISK MANAGEMENT STRATEGY:

17.A11 Is CH2M HILL responsible for the preparation of client-owned solid waste and hazwaste? (with Client's manifest)?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
No	☐	1
Don't Know	☐	3
Yes	☐	5

RISK MANAGEMENT STRATEGY:

)

17.A12 Will we need to order explosives for this project? Who will initiate the order?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Government Furnished	☐	1
CH2M HILL	☐	3
UXO Contractor	☐	5

RISK MANAGEMENT STRATEGY:

17.A13 Is explosives storage required and/or available on site? If yes, who provides?

Which factor best describes this risk factor?	Check (x)	Point Value
Government Provided	☐	0
CH2M HILL	☐	2
UXO Subcontractor	☐	3
Unknown	☐	5

RISK MANAGEMENT STRATEGY:

17.A14 Could weather conditions effect this project?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
No	☐	1
Don't Know	☐	3
Yes.	☐	5

RISK MANAGEMENT STRATEGY:

17.A15 Is geophysical investigation required on this project?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Geophysical Prove Out required?	☐	3
Geophysical System Verification?	☐	5
	☐	

RISK MANAGEMENT STRATEGY:

17.A16 Are there public transportation routes, airport, mariners operations, rail roads, etc., within 2000 ft. to the site? If so, provide distances in feet.

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
No	☐	1
Don't Know	☐	3
Yes	☐	5

RISK MANAGEMENT STRATEGY:

17.A17 Are two types of communications available on this project site? Both will need to be added to the Safety Plan and exercised prior to each day activity.

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Yes	☐	1
Don't Know	☐	3
No	☐	5

RISK MANAGEMENT STRATEGY:

17.A18 Are there emergency response services in close (5 minutes) proximity to project site (e.g., fire, hospital)?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Yes.	☐	1
Don't Know	☐	3
No.	☐	5

RISK MANAGEMENT STRATEGY:

17.A19 Are there sensitive environment issues that need to be considered? Training of the UXO Technicians may be required.

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
No	☐	1
Don't Know	☐	3
Yes	☐	5

RISK MANAGEMENT STRATEGY:

PART B:

Explosives Usage Project Questions

17.B1 Source of explosives

Which factor best describes the source?	Check (x)
Vendor - Authorized ATF&E Dealer	☐
Government Furnished	☐
Client Furnished	☐
Subcontractor Provided	☐
Transferred from another CH2M HILL project	☐

RISK MANAGEMENT STRATEGY:

17.B2 Explosive operations general RISK requirements/concerns

Which factors apply to regulatory conformance risk factor?	Check (x)
State Blasting License (Individual)	☐
State Blasting License (Corporation)	☐
State Explosive Storage Permit (Fire Marshal Inspection)	☐
Vehicle Inspection (state of registration) for hazard materials transportation	☐
Hazard Materials License (federal and or state)	☐
Operator – Commercial Drivers License with Hazmat Endorsement	☐
Airport/flight paths – Notice to Airmen (NOTAM) – Airspace	☐
Navigable Waterways – Notice to Mariners (NOTM)	☐
Power lines/ Radar/ Microwave tower/Antenna – Electro Magnetic Radiation Hazards	☐
Military - training corridor/area/test area/research and development area	☐
Need to establish a Temporary Open Detonation Area	☐
Need to establish an Explosive Holding Area	☐
Need to establish an Explosive Inspection Area for MPPEH/MDAS	☐
Need to establish a storage area for MEC	☐
Need to establish a storage area for MPPEH	☐

RISK MANAGEMENT STRATEGY:

)

17.B3 Explosive Storage Risk Factors

Which factor best describes this risk factor - Magazine Condition?	Check (x)	Check (x)
Not Applicable.	☐	0
Fire Inspector Permit/electrical grounding tests, ventilator and doors and locks and hasps IAW NFPA Code 495	☐	1
Do Not Know	☐	3
Unknown construction (material, etc.)	☐	5

RISK MANAGEMENT STRATEGY:

17.B4 Explosive Transportation

Which factor best describes this risk factor?	Check (x)	Check (x)
Not Applicable.	☐	0
Within project area – private roads	☐	1
Public Roads	☐	3
Federal Roads (interstate - DOT) or over water (USCG)	☐	5

RISK MANAGEMENT STRATEGY:

17.B5 Explosive Security

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Provided by Military	☐	1
Provided by Others	☐	3
Don't Know	☐	3
Provided by CH2M HILL	☐	5

RISK MANAGEMENT STRATEGY:

17.B6 Is underwater work required?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
No	☐	1
Don't Know	☐	3
Yes	☐	5

RISK MANAGEMENT STRATEGY:

PART C:

Munitions Response Project Questions

17.C1 Type of Munitions Response (MR) project.

Which factor best describes this risk factor?	Check (x)	Point Value
Desk top studies – no site visit	☐	0
Escort and/or Avoidance Activities – (site visit, reconnaissance, sediment sampling, develop wells, perform O&M, land survey, area preparation, design work, etc.)	☐	1
Construction Support – Direct Push, Trenching, Excavation, Soil Sifting, Insitu-treatment, Demolition, Land Clearing/grubbing etc.)	☐	2
Demilitarization/ MPPEH/ Blasting/	☐	3
Removal Action	☐	4
Demining, Improvised Explosive Devices (IED)	☐	5

RISK MANAGEMENT STRATEGY:

17.C2 Is "over water" (on boat, bridge, etc.) work required?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
No	☐	1
Unknown	☐	3
Yes	☐	5

RISK MANAGEMENT STRATEGY:

17.C3 Type of Munitions Constituents (MC) contaminated soil and/or groundwater

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Low concentrations of explosives measured in ppb/ppm.	☐	1
High Concentrations of explosives measured in ppb/ppm.	☐	2
High Concentrations of explosives measured in ppb/ppm - No explosive hazard.	☐	3
Soil with 5% to 10% Energetic Material by Weight - Initiation Hazard.	☐	4
Soil with >10% Energetic Material by Weight - Explosive Hazard.	☐	5

RISK MANAGEMENT STRATEGY:

17.C4 Type of munitions demilitarization.

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Discarded Military Munitions (DMM).	☐	1
MEC Unfuzed.	☐	2
MEC Fuzed (BIP)	☐	3
MD	☐	4
Deteriorated material.	☐	5

RISK MANAGEMENT STRATEGY:

17.C5 Are we to submit an Explosives Siting Plan (ESP), Explosive Safety Submission (ESS) for the Client? (CSS for RCWM).

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
No	☐	1
Don't Know	☐	3
Yes	☐	5

RISK MANAGEMENT STRATEGY:

17.C6 Is the Munitions Response Area (MRA) secured?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Yes	☐	1
Don't Know	☐	3
No	☐	5

RISK MANAGEMENT STRATEGY:

17.C7 Self Performance?

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	**0**
Avoidance Support	☐	**0**
Vegetation Removal	☐	**1**
Geophysical Survey	☐	**2**
Investigaton/MPPEH Processing	☐	**3**
Removal	☐	**4**
Demolition	☐	**5**

RISK MANAGEMENT STRATEGY:

PART D:

Controlled Detonation Chamber (CDC) Project Questions

17.D1 Type of MEC Hazard

Which factor best describes this risk factor?	Check (x)	Point Value
Small Arms Ammunition < 0.50 cal.	☐	0
Demilitarization	☐	1
MEC/MPPEH/Bulk Explosives	☐	3
Fireworks/pyrotechnics	☐	4
Chemical Warfare Materiel (CWM)	☐	5

RISK MANAGEMENT STRATEGY:

17.D2 Quality and Completeness of Inventory

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Inspection and Verification by CH2M HILL.	☐	1
Inspection/Certification/Verification by Others	☐	3
Client Statement.	☐	5

RISK MANAGEMENT STRATEGY:

17.D3 MEC/MPPEH

Which factor best describes this risk factor?	Check (x)	Point Value
Not Applicable.	☐	0
Meets CDC ESS limitations	☐	1
CWM	☐	3
Munitions requiring disassembly (i.e., water cutting, etc.)	☐	5

RISK MANAGEMENT STRATEGY:

17.D4 Will CH2M HILL provide CDC operator services?		
Which factor best describes this risk factor?	**Check (x)**	**Point Value**
Not Applicable.	☐	0
Yes.	☐	1
Don't Know	☐	3
No.	☐	5
RISK MANAGEMENT STRATEGY:		

17.D5 If CDC leased to Owner, will CH2M HILL train Client operators?		
Which factor best describes this risk factor?	**Check (x)**	**Point Value**
Not Applicable.	☐	0
Yes.	☐	1
Don't Know	☐	3
No.	☐	5
RISK MANAGEMENT STRATEGY:		

17.D6 Will Owner accept CH2M HILL rejection of MEC deemed unsuitable for CDC destruction?		
Which factor best describes this risk factor?	**Check (x)**	**Point Value**
Not Applicable.	☐	0
Yes.	☐	1
Don't Know	☐	3
No.	☐	5
RISK MANAGEMENT STRATEGY:		

17.D7 Are all items of type, size and condition previously destroyed in CDC?		
Which factor best describes this risk factor?	**Check (x)**	**Point Value**
Not Applicable.	☐	0
Yes.	☐	1
Don't Know	☐	3
No.	☐	5
RISK MANAGEMENT STRATEGY:		

Attachment 3: Glossary, Acronyms, and Abbreviations

Active munitions inventory (or stockpile): The supply of chemical and conventional military munitions that is available for issue and use for combat, training, demonstrations, research, development, testing, or evaluation. (See **munitions stockpile** and **demilitarization inventory**.)

Active range: An operational military range that is currently in service and being regularly used for training, demonstrations, research, development, testing, or evaluation.

AEDA: ammunition, explosives, and dangerous articles.

Anomaly avoidance: Techniques employed by EOD or UXO personnel at sites with known or suspected MEC to avoid any potential surface MEC or subsurface anomalies. This usually occurs at mixed-hazard sites when HTRW investigations must occur before an MEC removal action is executed. Intrusive anomaly investigations are not authorized during MEC avoidance operations.

Anomaly: Any item that is seen as a subsurface irregularity after geophysical investigation. This irregularity should deviate from the expected subsurface ferrous and nonferrous material at a site.

AP: armor piercing: Munitions that may or may not contain HE and are designed to penetrate hard targets.

APERS: antipersonnel munitions: May be loaded with high explosives or incendiary fillers and are designed to kill, wound, or obstruct personnel.

APT: armor-piercing tracer: Munitions, designed to penetrate hard targets, that contain a pyrotechnic element that produces bright light and/or smoke to aid in visual tracking of the munitions in flight.

ATV: all-terrain vehicle.

Authorized Visitors: Government or contractor personnel conducting project or mission related functions, e.g., Quality Assurance Representatives (QAR's) safety and quality inspectors (including geophysicists performing quality assurance functions) and project management. Authorized visitors must be escorted while in the EZ and be approved for entry into the EZ. No more than two visitors will be permitted in the EZ at any one time.

BD: base detonating: Impact fuze designed to function when the projectile comes in contact with the surface of the target. The fuze is located in the base or tail of the munitions.

bgs: below ground surface.

BRAC: Base Realignment and Closure.

CAD: cartridge-actuated device: An explosive device designed to produce gas pressure to expel or eject an item.

Cal: caliber: The diameter of a projectile or the bore of a weapon (i.e., .50-cal, 3-inch, 90-millimeter).

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act.

Chemical Warfare Materiel (CWM): An item configured as ammunition, containing a chemical substance intended to kill, seriously injure, or incapacitate a person through its physiological effects. Also includes V- and G-series nerve agents, H-series blister agent, and lewisite in other-than-munitions configurations. Due to their hazards, prevalence, and military-unique application, chemical agent identification sets (CAIS) are also considered CWM. CWM does not include riot control agents, chemical herbicides, smoke- and flame-producing items, or soil, water, debris, or other media contaminated with a chemical agent.

Closed range: A military range that has either been taken out of service as a range and has been put to new uses that are incompatible with range activities, or that is no longer considered to be a potential range area. A closed range is still under the control of a DOD component.

Construction support: Support provided by qualified UXO personnel during construction activities at potential MR sites to ensure the safety of construction personnel from the harmful effects of MEC. When it is determined that the probability of encountering MEC is low (current or previous land use leads to a determination that MEC may be present), a two-person UXO team will stand by in case the construction contractor encounters a suspected MEC. When it is determined that the probability of encountering a MEC is moderate to high (current or previous land use leads to a determination that MEC was employed or disposed of in the parcel of concern, e.g., open burn and open detonation areas), UXO teams are required to conduct subsurface MEC clearance for the known construction footprint, either in conjunction with the construction contractor or before construction.

Controlled Detonation Chamber (CDC): The CDC is a system for controlled detonation of MEC and MEC-related materials. It is capable of repeated controlled detonations of a suite of energetic materials that are currently demilitarized by OB/OD. This offers the DOD an alternative to OB/OD while at the same time increasing throughput, efficiency, and safety and controlling air, soil, water, and noise pollution. The CDC system meets all state and federal air discharge regulations.

CQC: Contractor Quality Control.

CTT: closed, transferring, and transferred (refers to a subset of military ranges).

DAC: Defense Ammunition Center.

DDESB: Department of Defense Explosives Safety Board.

DERP: Defense Environmental Restoration Program.

Demilitarization ("demil"): The process that removes the military characteristics from unused munitions that are either unsuitable for continued storage, excess to DOD needs, or about to be released from DOD control. Demilitarization applies equally to munitions in unserviceable or serviceable condition. Used (i.e., fired) munitions items also sometimes undergo demilitarization. There are many demilitarization methods, such as recovery, recycling, remanufacture, disassembly, reclamation, mutilation, alteration, melting, burning, detonating, destruction, treatment, and disposal. Methods involving R3 currently constitute approximately two-thirds of the DOD demilitarization programs.

Demilitarization (demil) inventory: The demilitarization inventory consists of excess, obsolete, and unserviceable munitions. Munitions are moved from the active inventory to the demilitarization inventory after it is determined that they are not economically repairable, they are obsolete, or they are excess to DOD needs and cannot be sold under the Foreign Military Sales program. (Also see **active munitions inventory** and **munitions stockpile**.)

DENIX: Defense Environmental Network and Information Exchange.

Department of Defense Components: The Office of the Secretary of Defense, the Military Departments and Services, the Joint Staff, the Unified and Specified Combatant Commands, the Defense Agencies, the DOD Field Activities, and the National Guard.

Department of Defense Explosives Safety Board (DDESB): A Joint Service board comprising a chairperson, voting representatives from each of the Armed Services, and a permanent military and civilian secretariat to perform operational and administrative functions. The DDESB provides impartial and objective advice to the Secretary of Defense and DOD components on explosives safety matters. (See DOD 6055.9-STD for a detailed assignment of DDESB functions.)

DGPS: differential global positioning system.

Discarded Military Munitions (DMM): Military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations. (10 U.S.C. 2710(e)(2))

DLA: Defense Logistics Agency.

DMM: discarded military munitions.

DOD: U.S. Department of Defense.

DODD: Department of Defense Directive.

DODIG: Department of Defense Inspector General.

DOI: U.S. Department of Interior.

DRMO: Defense Reutilization and Marketing Office.

DRMS: Defense Reutilization and Marketing Service.

EBS: environmental baseline survey.

Emergency Response (to munitions- or explosives-related or UXO emergencies): An immediate response by explosives and munitions emergency response personnel (i.e., DOD EOD personnel) to control, mitigate, or eliminate the actual or potential threat encountered during an explosives or munitions emergency. The response action may include in-place or on-site render-safe procedures, treatment, or destruction of the explosives or munitions or their transport to another location where these operations may be conducted. (See 40 CFR Part 260 et seq., the Military Munitions Rule.)

Energetic material: A component or item of ammunition that is designed to produce the necessary energy required for ignition, propulsion, detonation, fire, or smoke, thus enabling the item to function. Also a material (e.g., corrosive or oxidizer) that is inherently dangerous and capable of causing serious damage and that requires regulated handling to avoid accidents in connection with its existence and use.

EOD: Explosive Ordnance Disposal.

EPA: U.S. Environmental Protection Agency.

EPCRA: Emergency Planning and Community Right-to-Know Act.

ERGM: extended-range guided munitions.

ESCA: Environmental Services Cooperative Agreement.

ESOH: Environmental, Safety, and Occupational Health.

ESOHPB: Environmental, Safety, and Occupational Health Policy Board.

Essential personnel. Personnel whose duties require them to remain within an ESQD arc for one or more of the following reasons:

a. Government and project personnel necessary for the safe and efficient completion of field operations conducted in an EZ. This is limited to: contractor work teams members including the Unexploded Ordnance (UXO) Safety Officer (UXOSO), UXO Quality Control Specialist, Senior UXO Supervisor and a USACE Ordnance and Explosives (OE) Safety specialist.

b. Personnel not UXO qualified must be identified in the work plan by name and/or position.

ESTCP: Environmental Security Technology Certification Program.

Exclusion Zone (EZ): A safety zone established around an MR work area. Only project personnel and authorized, escorted visitors are allowed within the EZ. Examples of EZs are safety zones around MEC-intrusive activities and safety zones where MEC is intentionally detonated. (See DDESB-KO, 27 January 1990.)

Explosive Equivalent. The amount of a standard explosive which, when detonated, will produce a blast effect comparable to that which results at the same distance from the detonation or explosion of a given amount of the material for which performance is being evaluated. It is usually expressed as a percentage of the total net weight of all reactive materials contained in the item or system. For the purpose of this manual, TNT is used for comparison.

Explosive Ordnance Disposal (EOD): Includes detecting, identifying, field evaluating, rendering safe, and final disposing of MEC.

Explosive Ordnance Disposal (EOD) Personnel: Military members who have graduated from the Naval School, EOD. They have received highly specialized training to provide time-critical MEC hazard mitigation services during both peacetime and wartime. EOD personnel are trained and equipped to perform render-safe procedures (RSP) on nuclear, biological, chemical, conventional, and improvised explosive devices. (Note that EOD personnel are distinguished from UXO Technicians, who are civilian contractor or government personnel with specialized training and qualifications in the long-term remediation of MEC.)

Explosive Safety Quantity Distance (ESQD): The prescribed minimum distance between sites storing or handling hazard Class 1 explosive material and specified exposures (i.e., inhabited buildings, public highways, public railways, other storage or handling facilities, or ships, aircraft, etc.) to afford an acceptable degree of protection and safety to the specified exposure. The size of the ESQD arc is proportional to the NEW present.

Explosive Safety Submission (ESS): The document that serves as the specifications for conducting work activities at the project. The ESS details the scope of the project, the planned work activities, potential hazards, and the methods for their control.

Explosive Siting Plan (ESP): The document that serves as a DDESB Permit approving the site-specific storage locations, quantities, and safe distances for explosive operations.

Explosive soil: Mixtures of explosives in soil, sand, clay, or other solid media at concentrations such that the mixture itself is explosive. The following also defines an explosive soil: The concentration of a particular explosive in soil necessary to present an explosion hazard depends on whether an explosive is classified as "primary" or "secondary." Primary explosives are those extremely sensitive explosives (or mixtures thereof) that are used in primers, detonators, and blasting caps. They are easily detonated by heat, sparks, impact, or friction. Examples of primary explosives include lead azide, lead styphnate, and mercury fulminate. Secondary explosives are bursting and boostering explosives (i.e., they are used as the main bursting charge or as the booster that sets off the main bursting charge). Secondary explosives are much less sensitive than primary explosives. Soil containing 10 percent or more by weight of any mixture of secondary explosives is considered "explosive soil." Soil containing propellants (as opposed to primary or secondary high explosives) may also present explosion hazards.

°F: degrees Fahrenheit.

FAR: Federal Acquisition Regulations.

FFA: Federal Facilities Agreement.

FFCA: Federal Facilities Compliance Act.

FOST: finding of suitability to transfer.

Frag: fragment or fragmentation: Munitions material projected away from the point of detonation at a high velocity.

Free from explosive hazard: Material that has been inspected for explosives and determined not to present a danger of explosion or combustion from explosive or energetic materiel.

FUDS: formerly used defense site.

GIS: geographic information system.

GPS: global positioning system.

Hazardous waste: A solid waste that meets the following criteria: (1) is or contains a hazardous waste listed in 40 CFR Part 261, or (2) exhibits characteristics of ignitability, corrosivity, reactivity, and/or toxicity. (Refer to 40 CFR § 261.3 for further explanation.)

HE: high explosive: Explosive that normally detonates rather than burns.

HEAT: high-explosive antitank: Munitions designed to defeat armor by the use of a shaped charge.

HEI: high-explosive incendiary: High-explosive-filled munitions with additional ingredients to give a fire-producing effect.

HQMC: Headquarters, U.S. Marine Corps.

ICM: improved conventional munition.

Impact area: The identified area within a range intended to capture or contain ammunition, munitions, or explosives and resulting debris, fragments, and components from various weapon system employments. In simple terms, normally the target area where live-fire rounds or bombs impact the earth.

Improved Conventional Munition (ICM): ICMs or submunitions, cluster bombs, and cargo rounds are considered sensitive-fuzed munitions and require special authority to enter contaminated areas.

Inactive range: An operational military range that is not currently being used but is still under military control, and which the military both considers to be a potential range area and has not put to a new use that is incompatible with range activities. A potential range area is defined as meeting one of three criteria:

(1) Mobilization and force projection: ranges that are held by a DOD component for the purpose of preparing individuals and units for worldwide deployment, redeployments, or demobilization in response to war, stability, and support operations or projected training requirements that would exceed current active range capabilities;

(2) Force structure: ranges held as inactive during realignment, reorganization, stationing, or reequipping of units projected to use these ranges under new training requirements; or

(3) Future: ranges that are held by DOD components for future use in support of National Security Policy or DOD component doctrine that ensures the capability to produce, establish, and maintain conditions needed for operational success.

Inhabited Building Distance (IBD): The minimum distance permitted between an inhabited building and an ammunition or explosives location for the protection of administration, quarters, industrial, and other similar areas within a naval shore establishment. Inhabited building distances shall be provided between ammunition or explosives locations and the boundary of a shore establishment of the nearest point beyond the boundary where such inhabited structures could be erected.

Integrated Training Area Management (ITAM): A U.S. Army program designed to improve range conditions by inventorying and monitoring land conditions, determining carrying capacity of the land in terms of the training requirements, and providing for land rehabilitation and maintenance measures.

Intentional detonation: An intentional detonation is a planned, controlled detonation.

Intrusive activity: An activity that involves or results in the penetration of the ground surface at an area known or suspected to contain MEC. Intrusive activities can be of an investigative or removal action nature.

IR: Installation Restoration.

ITAM: Integrated Training Area Management (a U.S. Army program).

JOCG: Joint Ordnance Commanders Group.

JUXOCO: Joint UXO Coordination Office.

MDAS: MPPEH that has been assessed and documented as not presenting an explosive hazard and for which the chain of custody has been established and maintained. This material is no longer considered to be MPPEH.

MDEH: MPPEH that has been assessed and documented as to the explosive hazards the material is known or suspected to present and for which hthge chain of custody has been established and maintained. This material is no longer considered to be MPPEH.

Material that Potentially Presenting an Explosive Hazard (MPPEH): Military munitions, including: their components; munitions packaging material; residues from research, development, testing, and evaluation (RDT&E), production, use (to include range scrap), operational and quality testing, or demilitarization of munitions; or any other materials, equipment, or facilities potentially contaminated with explosives. MPPEH includes both end items and residues derived from processing end-items within United Nations Organization (UNO) Hazard Class (HC). It also includes munitions-related items, pieces, models, training aids, etc., that are suspected but not confirmed to be wholly inert.

Maximum Credible Event (MCE): The worst single event that could occur at any time with maximum release of a chemical agent from a munition, container, or process as a result of an unintended, unplanned, or accidental occurrence.

MEC: munitions and explosives of concern. Distinguishes specific categories of military munitions that may pose unique explosives safety risks means: (A) Unexploded Ordnance (UXO), (B) Discarded military munitions (DMM), (C) Munitions Constituents (MC).

MIL SPECS/STDS: military specifications and standards.

Military Munitions (MM): All ammunition products and components produced or used by or for the DOD or the U.S. Armed Services for national defense and security, including military munitions under the control of the DOD, the U.S. Coast Guard, the U.S. DOE, and the National Guard. The term includes confined gaseous, liquid, and solid propellants, explosives, pyrotechnics, chemical and riot control agents, smokes, and incendiaries used by DOD components, including bulk explosives and chemical warfare agents, chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, demolition charges, and devices and components thereof. It does not include: wholly inert items; improvised explosive devices; and nuclear weapons, devices, and components thereof. However, it does include nonnuclear components of nuclear devices, managed under DOE's nuclear weapons program after all required sanitation operations under the Atomic Energy Act of 1954, as amended, have been completed.

Military Range: A designated land or water area set aside, managed, and used to conduct research on, develop, test, and evaluate military munitions and explosives, or weapon systems, or to train military personnel in their use and handling. Ranges include firing lines and positions, maneuver areas, test pads, detonation pads, impact areas, and buffer zones with restricted access and exclusionary areas.

MLLW: mean lower low water.

Most Probable Event (MPE): The most likely event, as a result of an accidental, unplanned, or unintended detonation of an item of munitions, that could occur during MR activities. The event must be realistic, with reasonable probability of occurrence.

MPPEH: munitions that potentially presenting an explosive hazard.

MT: Mechanical time: fuzes designed usually for airburst. MT fuzes are located in the nose of the munition.

Munitions and Explosives of Concern (MEC): Military munitions that are UXO or have been abandoned, as defined in the EPA Munitions Rule. Also includes soil, facilities, equipment, or other materials contaminated with a high enough concentration of explosives that it presents an explosive hazard.

Munitions Constituents (MC): Any materials originating from military munitions, including explosive and/or non-explosive materials, and emission, degradation, or breakdown products. [The following additional explanation is offered for purposes of this SOP: Munitions constituents are the substances or chemical residues that result from the proper functioning or use of munitions (e.g., residues created and remaining in the soil, water, or air from the burning or explosion of energetic material) or that are present in MEC. Such constituents may or may not present an immediate risk of acute physical injury from fire or explosion resulting from accidental or unintentional detonation or ignition of MEC or energetic materials. Similarly, such constituents may or may not result in environmental contamination requiring a response (i.e., response action).]

Munitions Debris (MD): Metal fragments resulting from the intended use of munitions or detonations.

Munition with the Greatest Fragmentation Distance (MGFD). The munition with the greatest fragment distance that is reasonably expected (based on research or characterization) to be encountered in any particular munition response area (MRA) or munitions response site (MRS).

Munitions Response Area (MRA): Any area on a defense site that is known or suspected to contain UXO, DMM, or MC. Examples include former ranges and munitions burial areas. A munitions response area is comprised of one or more munitions response sites.

Munitions Response Site (MRS): A discrete location within a MRA that is known to require a munitions response.

Munitions Rule Implementation Policy: Detailed guidance and procedures issued by the Services that explains how DOD will implement and comply with the EPA Military Munitions Rule.

Munitions stockpile: Munitions in the active and demilitarization inventories as well as unused waste munitions as defined in the EPA's Military Munitions Rule (MMR). (See **active munitions inventory** and **demilitarization inventory**.)

Munitions: see **military munitions**.

Net Explosive Weight (NEW): The actual weight of explosive mixture or compound including the TNT equivalent of other energetic material which is used in the determination of explosive limits and ESQD arcs.

Non-stockpile Chemical Warfare Materiel: CWM (defined above) that is not included in the chemical stockpile. Non-stockpile CWM is divided into five categories: (1) buried CWM; (2) recovered chemical weapons (items recovered during range clearing operations, from chemical burial sites, and from research and development testing); (3) former chemical weapon production facilities; (4) binary chemical weapons; and (5) miscellaneous CWM (unfilled munitions and devices and equipment specially designed for use directly in connection with employment of chemical weapons).

OB: open burn.

OCR: Office(s) of Collateral Responsibility.

OD: open detonation.

ODEP: Office of Defense Environmental Programs.

ODUSD (I&E): Office of the Deputy Under Secretary of Defense (Installations and Environment).

OE Safety Specialist: a USACE employee involved in the execution, supervision, or oversight of munitions-related activities inside the exclusion zone who has graduated from the U.S. Naval EOD School, Indian Head, MD. An OE Safety Specialist shall be on-site each day during intrusive and MEC destruction activities. The OE Safety Specialist is on-site to ensure that the contractor establishes the appropriate daily safety routines at the beginning of UXO field operations, to perform quality assurance oversight, to verify contractor employee UXO qualifications, to advise the contractor on UXO procedures, to coordinate with the PM, and to facilitate EOD response when needed.

OEESCM: Operational and Environmental Executive Steering Committee for Munitions.

Open Burn (OB): A controlled open-air process by which excess, unserviceable, and obsolete munitions are destroyed to eliminate their inherent explosives safety hazards. DOD OB units contain the munitions with pans or pads to minimize environmental contamination. DOD OB units are permitted as "miscellaneous units" in EPA's environmental permitting process.

Open Detonation (OD): A process used for the treatment of unserviceable, obsolete, and/or waste munitions whereby an explosive donor charge initiates the munitions to be detonated. Although surface detonations can be performed under certain circumstances, most munitions are treated in 4- to 6-foot-deep pits for safety purposes. Most OD sites are permitted as miscellaneous units as part of the EPA environmental permitting process. DOD's units are generally permitted as combined OB/OD facilities.

Operational range: A military range that is currently under military control and management; includes both active ranges (currently in service or use) and inactive ranges (not in current use or service).

OPR: Office(s) of Primary Responsibility.

OSD: Office of the Secretary of Defense.

OU: Operable Unit.

OUSD (AT&L): Office of the Under Secretary of Defense (Acquisition, Technology, and Logistics).

PD: point detonating: impact fuze, designed to function when the projectile comes in contact with the surface of a target; located in the nose of the munition.

Potential Explosion Site (PES): The location of a quantity of explosives that will create a blast, fragment, thermal, and/or debris hazard in event of an accidental explosion of its contents. Quantity limits for ammunition/explosives at a PES are determined by the distance to an exposed site.

POL: petroleum, oil, and lubricants.

PPE: personal protective equipment.

Primer: Small, sensitive explosive component used as the first element in the explosive train.

Proj: projo or projectile: A weapon that is projected through a tube or barrel into the air toward a target.

PSE: preliminary source evaluation.

PTT: powder train time fuse: Fuses designed usually for airburst, normally used with illumination rounds to light up the battlefield.

QA: quality assurance.

QC: quality control.

Quantity-Distance (Q-D): the quantity of explosives material and distance separations that provide defined types of protection. These relationships are based on levels of risk considered acceptable for the stipulated exposures and are tabulated in the appropriate Q-D tables provided in DOD 6055.9-STD. Separation distances are not absolute safe distances but are relative protective safe distances. Greater distances than those shown in the Q-D tables shall be used whenever possible.

R&D: research and development.

RAB: Restoration Advisory Board.

RAC: Remedial Action Contract.

Range clearance: An operation or procedure conducted to remove and properly dispose of munitions or munitions fragments. (e.g., MEC, "duds," etc.). Several types or degrees of clearance may be conducted (e.g., surface clearance based on visual inspection of the surface; shallow clearance where an area is systematically swept with detectors—normally to a depth of 20-24 inches; etc.) Range clearance, though technically applicable to any range category (closed, transferred, active, etc.) is often considered as occurring only at active, operational ranges. Clearance operations at these active ranges are normally conducted as part of range maintenance activities to maintain or enhance operational safety conditions at the range facility. Even though it is possible for MEC to cause environmental contamination (pollution of soil, surface water, groundwater, etc., from the chemical constituents present in munitions), range clearance is focused on removing and safely disposing of munitions items or fragments—not the removal or treatment of any chemical residues or constituents from the munitions or associated environmental contamination. Cleanup of environmental contamination or pollution is normally achieved by removal or remedial actions.

Range: see **military range**.

RCRA: Resource Conservation and Recovery Act.

RCWM: recovered chemical warfare material.

RDT&E: research, development, test, and evaluation.

Regional Environmental Coordinator (REC): A senior military officer or DOD civilian assigned to one of ten EPA regions who is responsible for the dissemination of information and coordination of environmental matters and public affairs among military installations and environmental regulatory organizations within their respective region. RECs have a liaison role and fully adhere to the Services' chain of command.

Remedial Action/RRemoval Action process: Longer-term activities that complete the cleanup of contamination (or a contaminated site or location) if a removal action has not achieved or cannot achieve the required degree of cleanup for the contamination problem. A distinction is sometimes made between the control or cleanup measures to be implemented, which are called "remedial actions," and the identification, evaluation, decision-making, and design and construction steps required to implement the control measures. These steps collectively are called the "remedial action process."

Removal Action(s): Relatively quick actions designed to address imminent threats to human health and the environment posed by releases or spills of hazardous substances. Removals should satisfy one or more of the following tests:

(1) **Imminent threat:** the site or situation poses an imminent threat to public health.

(2) **Source control:** the removal action either removes the source of contamination off-site or effectively contains it on-site so that continuing releases to the environment are prevented or reduced.

(3) **Access limitation:** the removal action substantially reduces the possibility of human exposure to hazardous substances. The EPA has categorized removal actions as emergency, time-critical, and non-time-critical. Each of these categories possesses its own criteria and procedural requirements.

Resource recovery and recycling (R3): Technologies and processes used by DOD to demilitarize military munitions. These include reuse, sale "as is" (e.g., Foreign Military Sales), conversion to a commercial product for sale or industrial use, or disassembly, modification, and partial or whole use for a military application.

Response(s) or Response Action(s): Responses or response actions are broadly defined in environmental law and regulations as any scientific or engineering investigation, evaluation, decision-making, design, or implementation step taken in response to (i.e., to clean up) a release or spill of hazardous substances. Removals and remedial actions (or remedial action processes) are subcategories of response actions. Procedural requirements (established in environmental regulations) for these two types of actions differ substantially, but their definitions are almost as broad as for "responses," allowing the terms to be used almost interchangeably. The various terms are best defined by the procedural requirements imposed on them by the applicable environmental regulations.

RI/FS: remedial investigation/feasibility study.

ROD: Record of Decision.

Senior UXO Supervisor (SUXOS): Supervises all contractor on-site UXO activities. This individual must be a graduate of the U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD, or the U.S. Naval EOD School, Indian Head, MD. Must have at least 10 years of combined active-duty military EOD and contractor UXO experience, to include at least 5 years in supervisory positions.

SERDP: Strategic Environmental Research and Development Program.

SHPO: State Historic Preservation Officer.

Single Manager for Conventional Ammunition (SMCA): A DOD executive agent responsibility performed by the U.S. Army Operations Support Command. The Secretary of the Army is DOD's SMCA. The U.S. Army OSC is the day-to-day operator of the SMCA and serves as the central program manager for the execution of most of DOD's demilitarization requirements. The objectives and responsibilities of the SMCA can be found in DOD Directive 5160.65.

Sustainable Range Management: Management of a military range in a manner that supports national security objectives and maintains the operational readiness of the Armed Forces and ensures the long-term viability of the range while protecting human health and the environment. [The following additional explanation is offered for purposes of this SOP:

A comprehensive DOD approach that develops and implements the policies, plans, practices, and procedures necessary to achieve sustainable ranges. Sustainable ranges are managed and operated in a manner that supports their long-term viability and utility to meet the national defense mission. Sustainable ranges will implement the planning, management, coordination, and public outreach necessary to ensure viable continuity of test and training operations and long-term coexistence with neighboring communities and natural ecosystems.]

Sustainable use: Actions taken to ensure that ranges maintain the ability to conduct training, research, development, testing, and evaluation of munitions in support of the national defense mission while minimizing adverse effects to human health and the environment.

SUXOS: Senior UXO Supervisor.

SWMU: solid waste management unit.

TNT equivalent: Considering the peak overpressure produced by detonation of a given weight of TNT as 100 percent, the TNT equivalency of an explosive is the amount of overpressure produced by detonation of an identical quantity of propellant under comparable conditions, expressed as a percentage.

Transferred range: A military range that is no longer under the control of a DOD component and has been leased, transferred, or returned to another entity (including other federal, non-DOD entities) for use.

Transferring range: A military range that is proposed to be leased or transferred from DOD to another entity or disposed of by conveying title to a non-federal entity. An active range will not be considered a "transferring range" until the transfer is imminent.

TRI: Toxic Release Inventory (required by the EPCRA).

Unexploded ordnance (UXO): Military munitions that have been primed, fuzed, armed, or otherwise prepared for use and that have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installation, personnel, or materiel and that remain unexploded by malfunction, design, or any other cause. UXO presents an immediate risk of acute physical injury from fire or explosion resulting from accidental or unintentional detonation.

Unintentional detonation: A detonation not planned in advance.

USACE: U.S. Army Corps of Engineers.

Used or fired military munitions: Those military munitions that meet the following criteria: (1) have been primed, fuzed, armed, or otherwise prepared for use, and have been fired, dropped, launched, projected, placed, or otherwise used; (2) munitions fragments, (e.g., shrapnel, casings, fins, and other components, to include arming wires and pins) that result from the use of military munitions; or (3) malfunctions or misfires (e.g., fail to properly fire or detonate).

USFWS: U.S. Fish and Wildlife Service.

USGS: U.S. Geological Survey.

UST: underground storage tank.

UTM: Universal Transverse Mercator.

UXO: unexploded ordnance.

UXO personnel: Contractor personnel who have completed specialized military training in EOD methods and have satisfactorily performed the EOD function while serving in the military. Various grades and contract positions are established based on skills and experience.

UXO Quality Control Specialist (UXOQCS): Contractor personnel with the responsibility of enforcing the contractor's Quality Control Program for all MR-related evolutions; conducting quality control inspections of all UXO and explosives operations for compliance with established procedures; and directing and approving all corrective actions to ensure that all MR-related work complies with contractual requirements.

UXO Safety Officer (UXOSO): Contractor personnel with the responsibility of enforcing the contractor's SSHP. This individual must, therefore, be in the field whenever possible to observe operations. Must have the same minimum qualifications as the UXO Technician III. In addition, must have the specific training, knowledge, and experience necessary to implement the SSHP and verify compliance with applicable safety and health requirements.

UXO Technician II: must be a graduate of the U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD; the U.S. Naval EOD School, Indian Head, MD; U.S. Naval EOD School, Eglin AFB, FL; or a DOD-equivalent certified course. Must have a minimum of five years of military EOD or contractor UXO experience.

UXO Technician III: supervises a UXO team. Must be a graduate of the U.S. Army Bomb Disposal School, Aberdeen Proving Ground, MD; the U.S. Naval EOD School, Indian Head, MD; U.S. Naval EOD School, Eglin AFB, FL; or a DOD-equivalent certified course. This individual must have a minimum of ten years of military EOD or contractor UXO experience.

UXO: unexploded ordnance.

UXOQCS: UXO Quality Control Specialist.

UXOSO: UXO Safety Officer.

Waste Military Munitions: A military munition that is a solid waste per 40 CFR §266.202. Such a waste military munition may also be a hazardous waste if it meets the definition found in 40 CFR §261.3. Waste munitions are hazardous wastes when they exhibit the hazardous waste characteristic of ignitability, corrosivity, reactivity, or toxicity, or are listed as hazardous wastes.

WP: white phosphorus: A screening smoke that burns on contact with air and can be used as an incendiary.

CH2MHILL

Explosives Usage and Munitions Response (MR)
Standard Operating Procedure HSE-610

Attachment 4: Explosives Management Check List

Date	Check List Item	PM Date Completed	MR Ops Review Date	MR QC NTP Date
	Contract Terms and Conditions			N/A
	Scope of Work			N/A
	Completed: Opportunity Risk Evaluation (ORE), Paragraph 17 MR Projects and CDC Projects			
	Explosive Management Plan (*)			
	Explosive Siting Plan (*)			
	Obtain State/local (if required) Explosive Permit* for CH2M HILL to use high explosives within the state and or local jurisdiction.			
	Obtain State/local (if required) Permit* for CH2M HILL to site explosives magazine within the state and or local jurisdiction.			
	Identify CH2M HILL HILL HILL licensed Blaster* (if self-performing)			
	CH2M HILL ATF&E “Request to Order Explosives” form for Review and obtain authorization signature of ATF Permittee			
	Original signature of ATF&E Type 20 Explosives Manufacture License* from CH2M HILL License Holder			
	“Authorization Letter*” identifying “Responsible Persons” and “Possessor of Explosives” that are authorized to order, receive, store, and use explosives under the CH2M HILL ATF&E Type 20 Explosives Manufacturer License			
	Vender Identified by contracting (If sole source - justification is required)			N/A
	Vender required to provide a copy of their ATF&E License* to CH2M HILL ATF&E files			
STOP!!! MANDATORY MUNITIONS RESPONSE QC CHECK				
	Purchase Order* provided to vender with a copy of ATF&E Type 20 Manufacturer of High Explosives License, with endorsement			

Date	Check List Item	PM Date Completed	MR Ops Review Date	MR QC NTP Date
	Purchase Order* provided to vender with Authorization Letter for Responsible Persons and Employee Possessor of Explosives			
	Award the purchase order to the selected vender - - Hold authorization for Vendor to ship explosives			
	Notify Vendor of CH2M Possessor of Explosives authorized to receive explosives at the project site, telephone number and address of receiving location			
	Vender accepts purchase order and holds for contracting release of explosives shipment			
	Vender identifies carrier and provides a shipment schedule with copy of manifest* to CH2M HILL contracting and contracting notifies the Project Manager			
	Establish Explosives Storage Area (Security, Lightening Protection, Grounding)			
	Schedule State and or local jurisdiction site inspection for “Explosive Storage” (Magazines) if required.			
	Magazine storage area inspected and approved* for storage by local jurisdictions (if required).			
	CH2M HILL contracting notifies vender to release explosives shipment			
	Notify ATF&E servicing office for CH2M HILL ATF&E License*, local ATF&E office*, and local jurisdictions* of storage of explosives and provide an Explosives Siting Plan that includes ATF Form 5400.13/5400.16, Explosives Storage Magazine Description Worksheet* (as required).			
	Post CH2M HILL ATF&E Type 20 License on the project site			
	CH2M HILL “Responsible Person” or Possessor of Explosives” person receives shipment (presents identification to transporter, verifies manifest, and inventories shipment to ensure accuracy between purchase order and manifest. Discrepancies should be resolved IAW the project Explosive Management Plan)			
	Explosive materials are properly inventoried (date shift codes, acquisition dealer, license address, POC), and stored IAW project Explosives Management Plan			
	Material Safety Data Sheets (MSDS) for explosives materials are on-site			

Date	Check List Item	PM Date Completed	MR Ops Review Date	MR QC NTP Date
	Magazine Data Cards (Daily Summary of Magazine Transactions*) are completed and maintained IAW project Explosives Management Plan			
	Magazine has two mortise type 5 (or equivalent) pin high security locks			
	Security Checks conducted a minimum of every 72 hours and documented or IAW work plan approved methods*			
	Responsible person or possessor of explosives has control of keys to magazines (IAW local procedures).			
	Daily Usage (Shot) Log* maintained for expenditure of explosive materials including target materials			
	Weekly inventories of all explosives materials conducted and documented*			
	PM to notify local jurisdictions and ATF&E offices when explosives materials are no longer being stored*			
	*Project Manager to provide to the ATF&E License Holder completed purchase orders, manifest documents, inventories, magazine data cards, usage logs, and any other associated information for ordering, storage and use of explosives material along with an end user certification that all explosives materials have been accounted for.			
	MR Safety Officer shall conduct a quality control audit of the project explosives management plan with ATF&E requirements and report on the conformance of the Project Manager & License Holder.			
	* Indicates documents that upon completion of project will be forwarded to the License Holder and copy to Safety Office			

REQUEST to ORDER EXPLOSIVES		
Instructions: Enter information for the procurement of one (1) Explosive Class/Product Trade Name per request form.		
Block 1.	Block 2.	Block 3.
Project Name	Project Number	Date of Request mm/dd/yyyy
Block 4.	Block 5.	Block 6.
Project Manager (First, Middle, Last)	Office Location/Symbol	Project Manager Telephone Number
Block 7.	Block 8.	Block 9.
Delivery Date mm/dd/yyyy	Delivery Address	Delivery Telephone Number
Street		Block 10.
City		Receiving Person (First, Middle, Last)
County/province		
State		Block 11.
Postal Code		Receiving Person Telephone Number
Country		
Block 12.	Block 13.	Block 14.
Vendor/Supplier/Organization	Vendor ATF License	Vendor ATF License
Block 15.	Block 16.	Block 17.
Vendor/Supplier/Organization		Vendor Telephone Number
Street		
City		Block 18.
County/province		Vendor Point of Contact Person
State		
Postal Code		Primary Tel. #:
Country		2nd Tel.#:
Block 19.	Block 20.	Block 21.
Product Trade Name	Product Unit of Issue (EA, LB, FT, RL,BX)	Product Quantity Requested (Number)
Block 22.	Block 23.	Block 24.
Vendor Lot Number	Vendor Date Shift Code	Vendor MSDS Product Name
Block 25.	Block 26.	Block 27.
DOT EX Number	UN Number	DOT Hazard Class/Division
Block 28.	Block 29.	Block 30.
Estimated Product Cost	Estimated Shipping Cost	Estimated Total Cost
AUTHORIZATION FOR PURCHASING TO ORDER EXPLOSIVES		
ATF Licensee Signature		
Date		

SOP UXO Contacts

Name	Title	Office
Ben Redmond	MR Market Segment Director	KNV
George DeMetropolis	MR Western Region MR Market Segment Manager	SDO
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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
- Personal Protective Equipment as specified by the Health and Safety Plan

IV. Procedures and Guidelines

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

5. Fill all sample containers, beginning with the containers for VOC analysis, using a decontaminated or dedicated sampling implement. For the VOC samples, place the sample into a pre-preserved VOA vial or direct sample container such as an **En Core**® sampler and seal the cap tightly. Ideally, the operation should be completed in one minute. Label the vials and place on ice for shipment to the laboratory.

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

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

V. Key Checks and Items

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

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

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

Attachment 2
Data Management Guidelines

Version 1

Navy CLEAN
Data Management Plan

Prepared for

Navy CLEAN & Joint Venture Programs

June 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. The various steps in the flow process are numbered 1 to 26. Figure P-2 presents, in more detail, the tools used in each step of the process.

Appendix B contains a data flow diagram that outlines the tools that used to help collect data for all program and project activities. 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

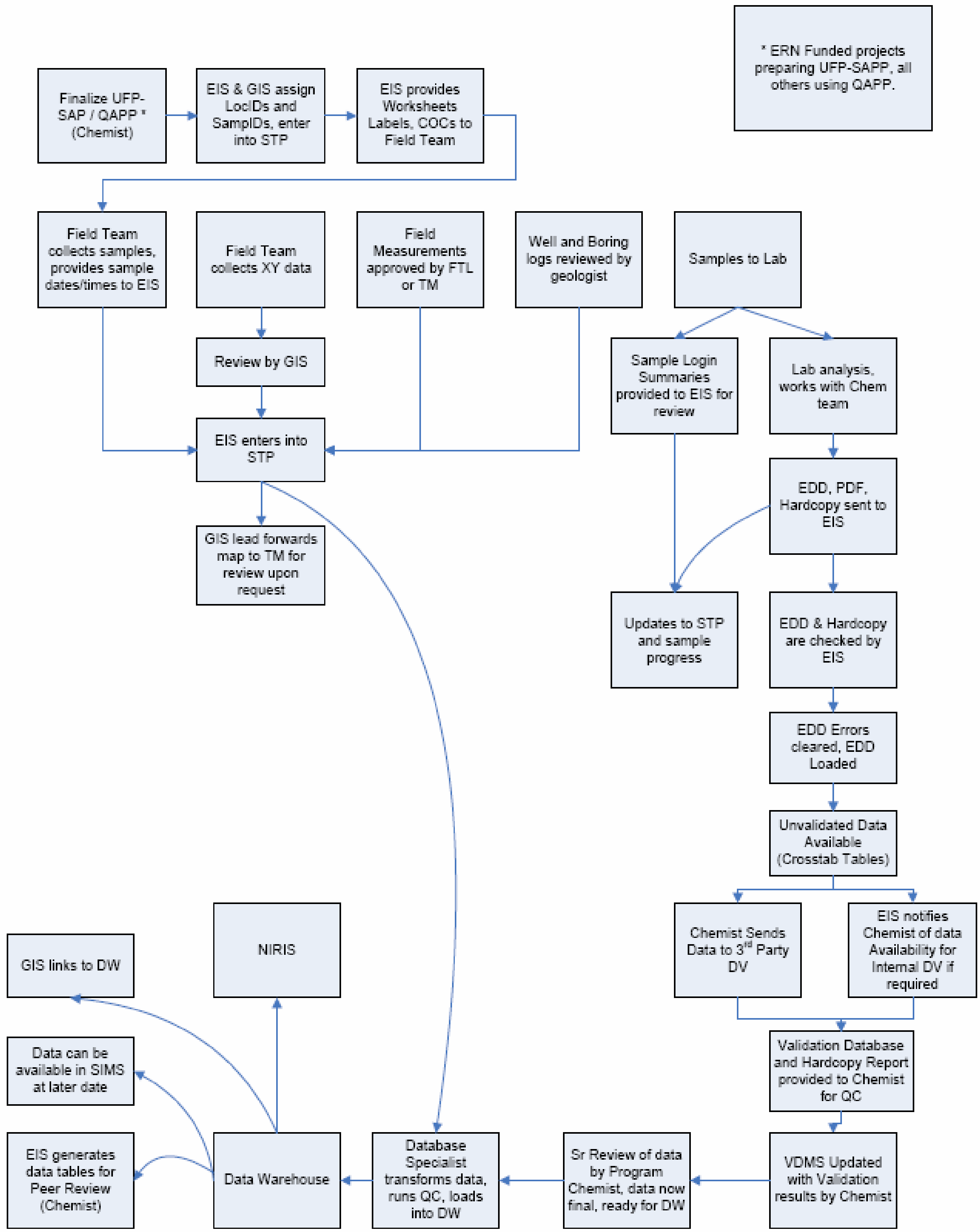

FIGURE P-1
ENVIRONMENTAL DATA MANAGEMENT WORKFLOW PROCESS

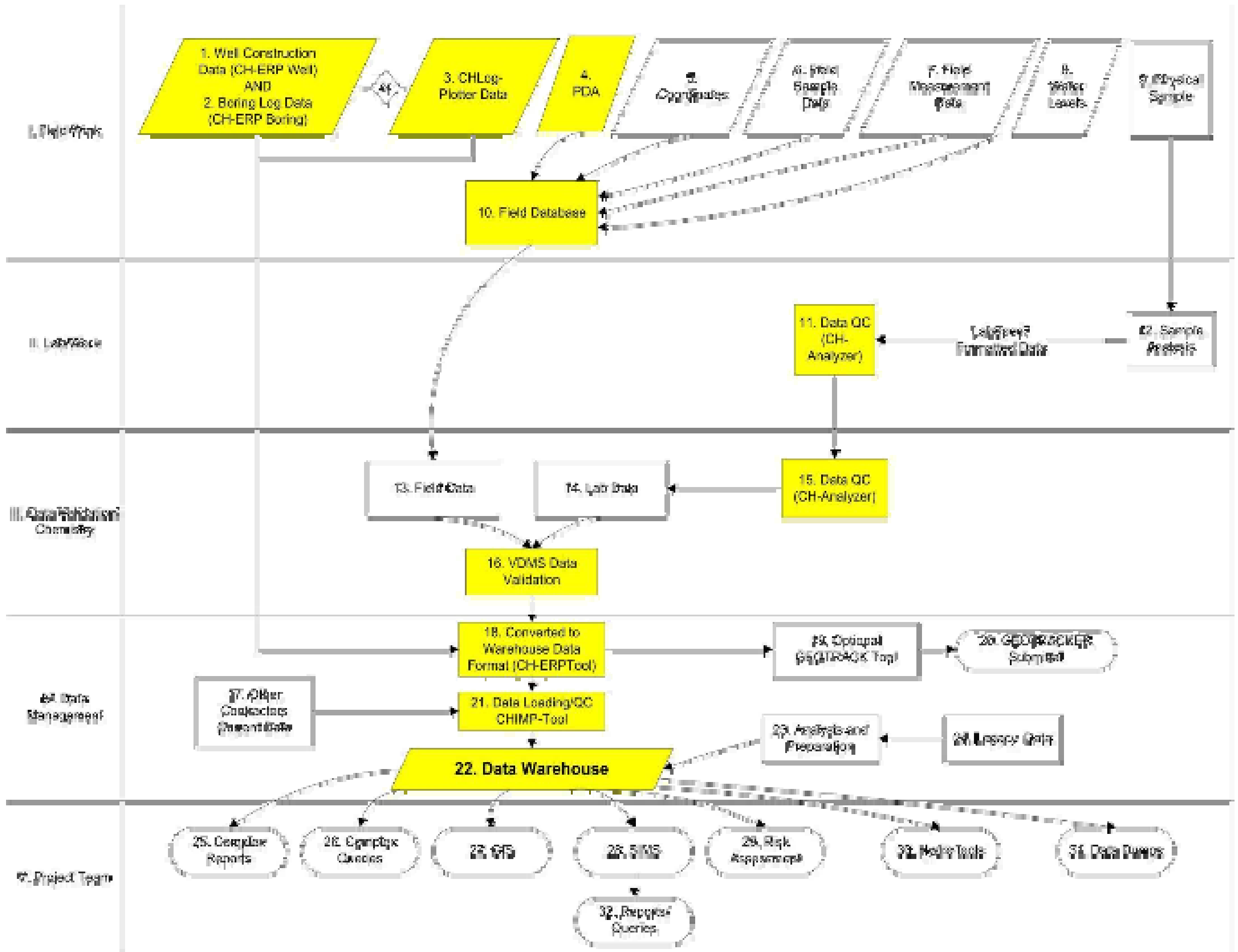

FIGURE P-2
DBMS PROCESS

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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
DMP	Data Management Plan
EDD	electronic data deliverable
EDM	Environmental Data Management
EIS	Environmental Information Specialist
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	Naval Installation Restoration Information Solution 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
PGDB	personal geodatabase
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 and Objective

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.

The EMS objectives critical to the success of the DMP are as follows:

- **Standardize and facilitate data collection.** Use standard field forms 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 the ability to capture electronic field data directly or indirectly.** 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.
- **Minimize the uncertainties associated with the data.** Implement quality assurance (QA) and quality control (QC) measures to provide accurate representation of all data collected and 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.
- **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.

- **Provide end-users with tools to gain access to the data.** 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.

1.2 Scope of the Data Management Plan

The scope of the data management activities addressed by this plan includes the following:

- Definition of staff roles and responsibilities (Appendix A).
- Flow diagrams illustrating how environmental data are collected, reviewed, and entered into the DBMS (Appendix B)
- SOPs (Appendix C).
- Description and use of data outputs (Appendix D).
- 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 for hard copy and electronic project documentation.

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 environmental, data, GIS, and EMS resources. The EDM team is responsible for all aspects of planning, execution, and reporting environmental 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. Checklist_VDMS-DM-Process_20090615 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 EMS Team Lead	John Kochanowski 5700 Cleveland Street Suite 101 Virginia Beach, VA 23462	757-671-6227	757-497-6885	jkochanowski@ch2m.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
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
Database Specialist (DBS)	Bhavana Reddy 15010 Conference Center Dr. Suite 200 Chantilly, VA 20151	703- 462-3784	703- 376-5010	breddy@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
Program Data Management Lead (PDL)	Chelsea Leigh 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6208	773-695-1378	cleigh@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)	Kyle Block 25 New Chardon Street. Suite 300 Boston, MA 02114	617-626-7013		kblock@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@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
GIS Analyst (GA)	Blake Hathaway 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6230	757-497-6885	bhathawa@ch2m.com
GIS Analyst (GA)	Mary Beth Artese 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6228	757-497-6885	martese@ch2m.com
GIS Analyst (GA)	Mark Unwin 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6261	757-497-6885	munwin@ch2m.com
GIS Analyst (GA)	Chris Bowman 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6276	757-497-6885	cbowman@ch2m.com
GIS Analyst (GA)	Matt Rissing 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6243	757-497-6885	mrissing@ch2m.com
GIS Analyst (GA)	Forrest Cain 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6271	757-497-6885	fcain@ch2m.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:

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.

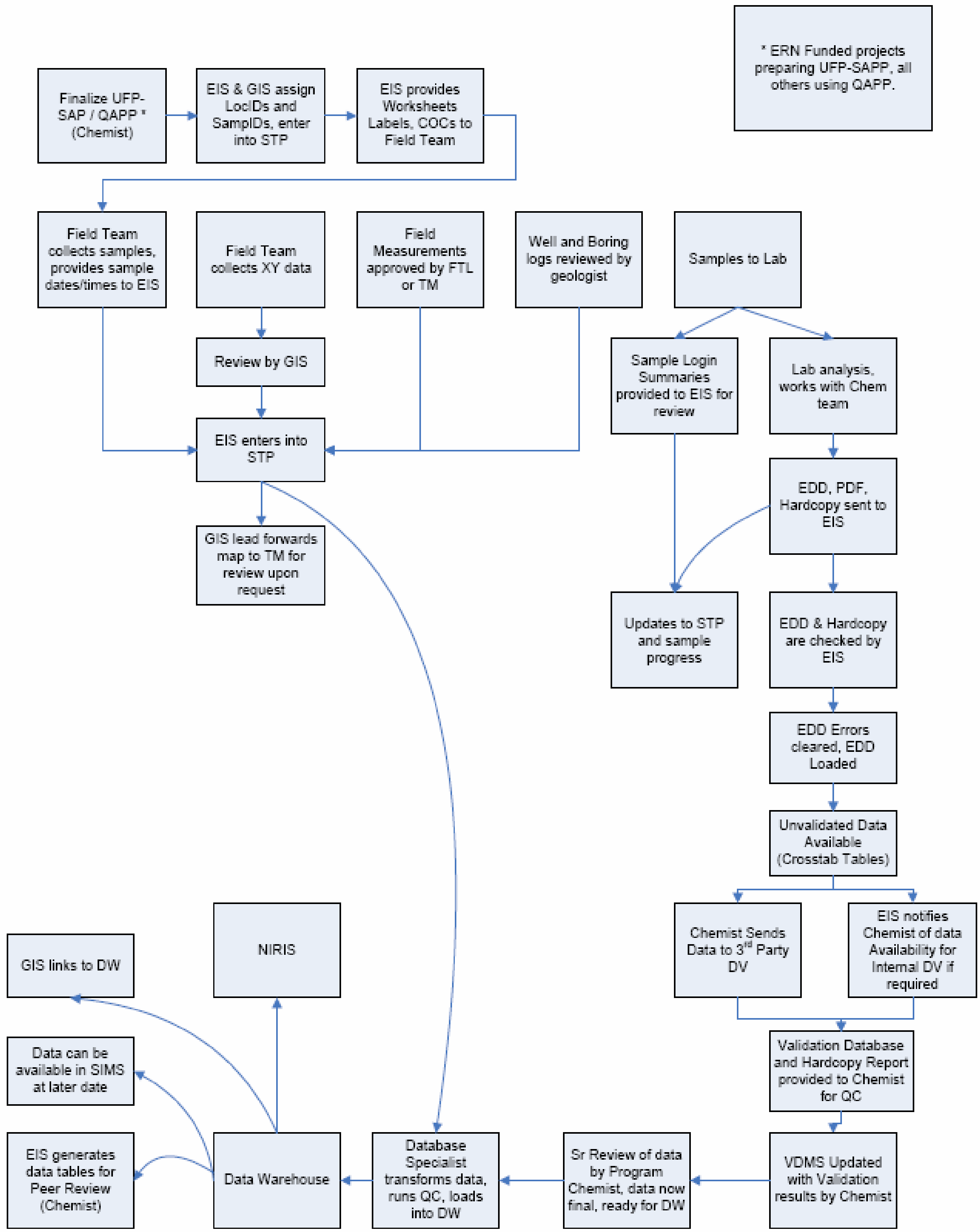


FIGURE 1
ENVIRONMENTAL DATA MANAGEMENT WORKFLOW PROCESS

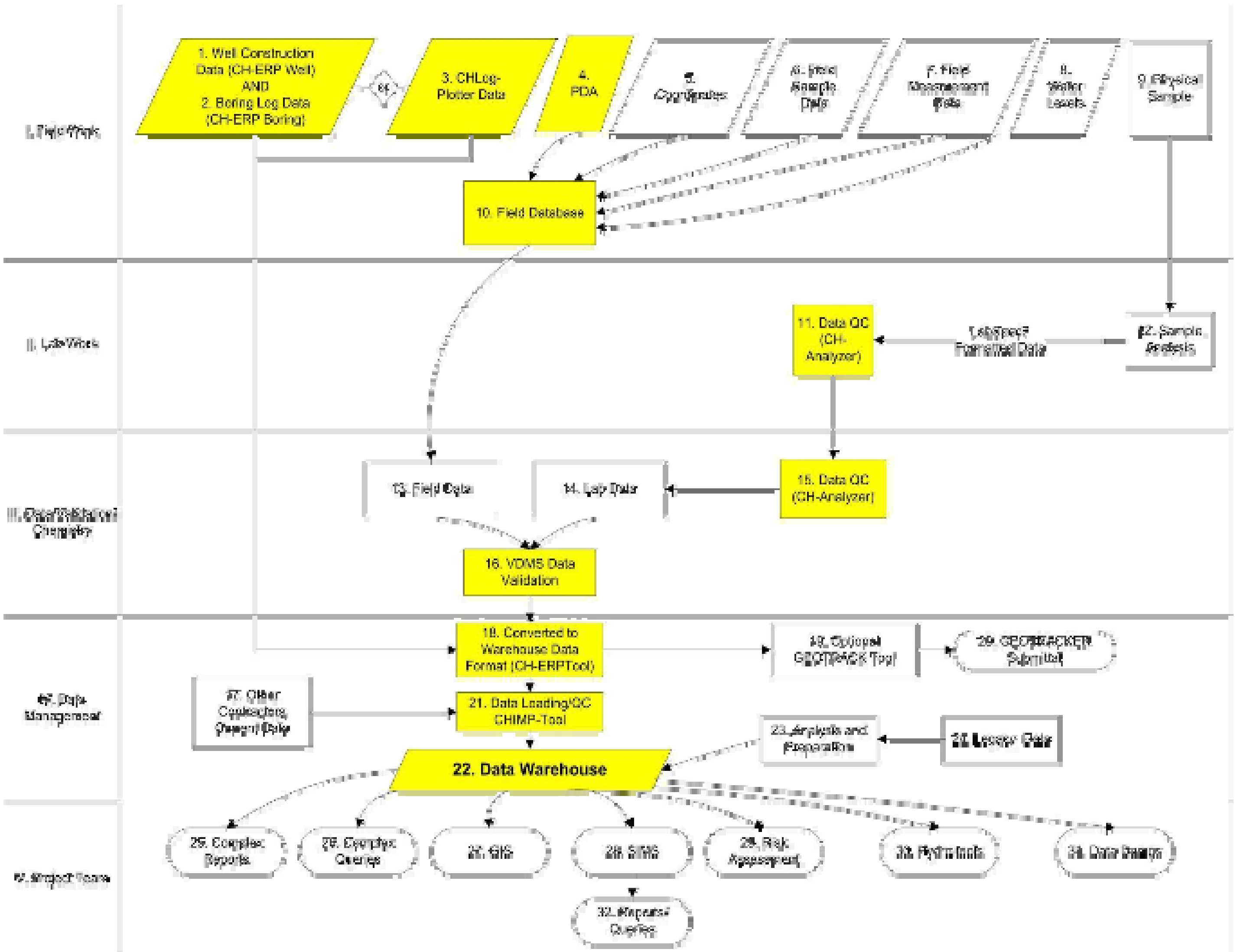


FIGURE 2
DBMS PROCESS

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 EMS Team Lead (EMS Lead) works with 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 Program Data Management Lead (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, 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.

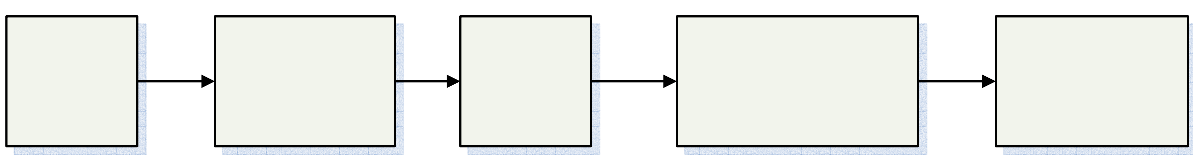


FIGURE 3
PROJECT PLANNING

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 VDMS and the Data Warehouse combined, 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 uniqueness, a key field or fields will be identified for each data record. Key fields define the record as unique. 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.

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.

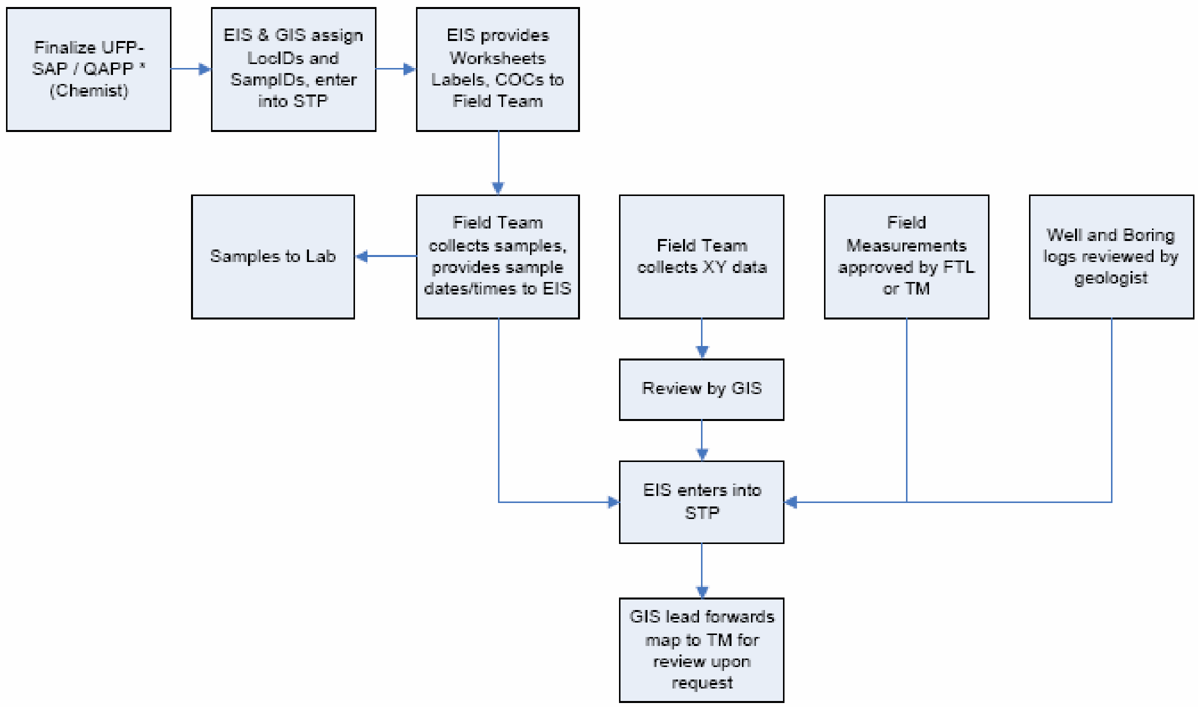


FIGURE 4
FIELD SAMPLING

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.

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 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.

Navy Clean		
First Segment	**Second Segment**	
Facility, Site Number	Station Type	Station Number, Modifier
AA,ANN	AA	NNN$_A$
Notes: "A"= alphabetic "N"= numeric		

<u>Facility:</u>

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

<u>Site/AOC/SWMU Number – Sequential Number:</u>

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)

<u>QC and IDW Stations</u>
Site ID (First Segment) followed by –QC or -IDW

<u>Station Type:</u>

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

<u>Station Number:</u>
Sequential Station Number (i.e., 01, 02, 03…)

<u>Modifier (used selectively):</u>
D = Deep monitoring well
S = Shallow monitoring well

<u>Example Station IDs</u>:

<u>YS01-DP02</u> = Direct push soil location #2 at Yorktown Naval Weapons Station Site 1
<u>CHR05-MW02S</u> = Shallow monitoring well location 2, at the Cheatham Annex facility, Range 5.
<u>NMBKL-SD02</u> = Background sediment location #2 located outside of NNMC
<u>CHBS03-SO05</u> = Soil location #5, located in reference area outside of Site 3 in Cherry Point
<u>VEW04-QC</u> = QC Station at East Vieques SWMU-4
<u>CAA08-IDW</u> = 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

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 (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 (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 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.

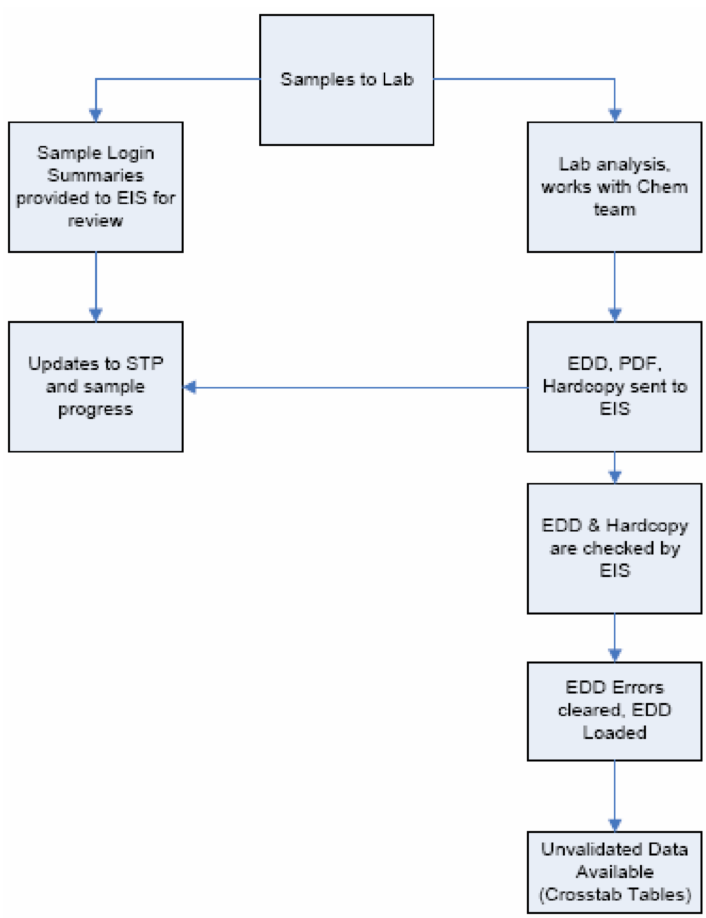


FIGURE 5
LABORATORY ANALYSIS

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 RDE 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 3rd 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, 3rd 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. Data in the warehouse are accessible through Site Information Management System (SIMS), a Web-based GIS application that allows users to query the data through a graphical interface and the XTabReports Tool.

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 that installation's 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)

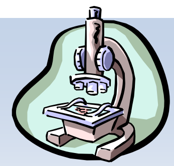
Step 2B

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 Environmental Database (EnDat)
- (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

List of Standard Operating Procedures

Checklist - EIS Project Start-up Questions

Checklist - EIS QC for Unvalidated Data

Checklist - Generating RDE Tables

Checklist - Historic Data Cleanup

Checklist - VDMS DM Process

SOP-103 - Sample Tracking Program

SOP-107 - CH-Analyzer

SOP-109 - VDMS Validation

SOP-113 - CHERP Tool

SOP-114 - CHIMPTool

SOP-115 - VDMS Importing

SOP-126 - XTab Reports Tool

SOP - Access To NIRIS

SOP - Cherry Point Exceedance Formatting Wizard

SOP - Corrections To File

SOP - Data Archiving Procedures

SOP - Data Shipping

SOP - NEDD Creator Tool

Attachment 3
DoD Environmental Laboratory Accreditation Program Certification

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

ENVIRONMENTAL CONSERVATION LABORATORIES - JACKSONVILLE

Jacksonville, FL

for technical competence in the field of

Environmental Testing

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

Presented this 29th day of March 2010.

President & CEO
For the Accreditation Council
Certificate Number 3000.02
Valid to April 30, 2012

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

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

ENVIRONMENTAL CONSERVATION LABORATORIES - ORLANDO

Orlando, FL

for technical competence in the field of

Environmental Testing

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

Presented this 29h day of March 2010.

President & CEO
For the Accreditation Council
Certificate Number 3000.01
Valid to March 31, 2012

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

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

GEL LABORATORIES, LLC

Charleston, SC

for technical competence in the field of

Environmental Testing

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

Presented this 23rd day of October 2009.

President & CEO
For the Accreditation Council
Certificate Number 2567.01
Valid to June 30, 2011

AMERICAN ASSOCIATION FOR LABORATORY ACCREDITATION
CORPORATE SEAL 1978
DISTRICT OF COLUMBIA
A2LA

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

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

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

ENVIRONMENTAL

Valid To: June 30, 2011 Certificate Number: 2567.01

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

	Preparation SOP	Analytical SOP
Alpha Spectrometry: Alpha: Am-241, Am-243, Cf-252, Cm-242, Cm-243/244, Cm-245/246, Np-237, Po-208, Po-209, Po-210, Pu-236, Pu-238, Pu-239/240, Pu-242, Pu-244, Th-228, Th-229, Th-230, Th-232, U-232, U-233/234, U-235/236, U-238	GL-RAD-A-011, GL-RAD-A-016, GL-RAD-A-032, GL-RAD-A-036, GL-RAD-A-038, GL-RAD-A-043, GL-RAD-A-045	GL-RAD-I-009
Radon Emanation: Ra-226	GL-RAD-A-008, GL-RAD-A-028	GL-RAD-I-007
Gamma Spectrometry: Gamma: 46 to 1836 keV, I-129, I-131, Ni-59	GL-RAD-A-006, GL-RAD-A-013, GL-RAD-A-022	GL-RAD-I-001

	Preparation SOP	Analytical SOP
Kinetic Phosphorescence Analyzer Total Uranium	GL-RAD-A-023	GL-RAD-B-018
Gas Flow Proportional Counting: Beta: Cl-36, I-131, Pb-210, Ra-228, Sr-89, Sr-90, Total Radium	GL-RAD-A-004, GL-RAD-A-009, GL-RAD-A-010, GL-RAD-A-017, GL-RAD-A-018, GL-RAD-A-029, GL-RAD-A-030, GL-RAD-A-033	GL-RAD-I-006, GL-RAD-I-015, GL-RAD-I-016
Gross Alpha/Gross Beta:	GL-RAD-A-001, GL-RAD-A-001B, GL-RAD-A-001C	GL-RAD-I-006, GL-RAD-I-015, GL-RAD-I-016
48 hour Gross Alpha	GL-RAD-A-047	GL-RAD-I-006, GL-RAD-I-015, GL-RAD-I-016
Liquid Scintillation Spectrometry: Beta: C-14, Ca-45, Fe-55, H-3, Ni-63, P-32, Pm-147, Pu-241, S-35, Se-79, Tc-99 Alpha: Rn-222	GL-RAD-A-002, GL-RAD-A-003, GL-RAD-A-005, GL-RAD-A-007, GL-RAD-A-019, GL-RAD-A-020, GL-RAD-A-022, GL-RAD-A-031, GL-RAD-A-035, GL-RAD-A-040, GL-RAD-A-048, GL-RAD-A-049, GL-RAD-A-050	GL-RAD-I-004, GL-RAD-I-014, GL-RAD-I-017
ICP-MS Uranium Isotopes Tc-99	 GL-MA-E-008 GL-RAD-A-005	 GL-MA-E-014 GL-RAD-B-034

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

Testing Technologies

Atomic Absorption/ICP-AES Spectrometry, ICP/MS, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Gravimetry, High Performance Liquid Chromatography, Ion Chromatography, Methylene Blue Active Substances, Misc.- Electronic Probes (pH, O_2), Oxygen Demand, Hazardous Waste Characteristics Tests, Spectrophotometry (Visible), Spectrophotometry (Automated), IR Spectrometry, Titrimetry, Total Organic Carbon, Total Organic Halide, Turbidity, Liquid Chromatography/Mass Spectrometer/Mass Spectrometer and Various Radiochemistry Techniques

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
Metals		
Aluminum	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Antimony	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Arsenic	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Barium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Beryllium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Boron	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Cadmium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Calcium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Chromium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Cobalt	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Copper	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Iron	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Lead	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Lithium	EPA 6020/6020A	EPA 6020/6020A
Magnesium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Manganese	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Mercury	EPA 1631E/7470/7470A/245.1	EPA 7470/7470A/7471A/7471B
Molybdenum	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Nickel	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Phosphorous	EPA 6020/6020A	EPA 6010B/6010C/6020/6020A
Potassium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Selenium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Silicon[1]	EPA 6010B/6010C modified	EPA 6010B/6010C modified
Silica as SiO2	EPA 6010B/6010C	EPA 6010B/6010C
Silver	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Sodium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Strontium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Thallium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Tin	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Titanium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Tungsten	----------	EPA 6020/6020A
Vanadium	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Zinc	EPA 6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
General Chemistry		
Acidity	SM 2310 B/EPA 305.1	----------
Adsorbable Organic Halogens (AOX)	EPA 1650	----------
Alkalinity	SM 2320B/EPA 310.1	----------

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
Ammenable Cyanide	EPA 9012A/9012B/EPA 335.1	EPA 9012A/9012B
Ammonia Nitrogen	EPA 350.1	----------
Biochemical oxygen demand	SM 5210 B/EPA 405.1	----------
Bromide	EPA 9056A/EPA 300.0	EPA 9056A[3]
Carbonaceous BOD	SM 5210 B	----------
Chemical Oxygen Demand (COD)	EPA 410.4	----------
Chloride	EPA 9056A/EPA 300.0	EPA 9056A[3]
Chlorine (residual)	SM 4500Cl-G/EPA 330.5	----------
Chromium VI	EPA 7196A/SM 3500Cr-B	EPA 7196A
Color	SM 2120B/EPA 110.2	----------
Corrosivity toward Steel	----------	EPA 1110/1110A
Cyanide	EPA 9012A/9012B/335.3/335.4	EPA 9012A/9012B
Density	----------	ASTM D 5057
Extractable Organic Halides (EOX)	----------	EPA 9023
Filterable residue	SM 2540C	----------
Fluoride	EPA 9056A/EPA 300.0	EPA 9056A[3]
Ignitability	EPA 1010/1020A/1020B	EPA 1010/1020A/1020B
Hardness	SM 2340B/SM2340C/ EPA 130.2	----------
Kjeldahl Nitrogen	EPA 351.2	----------
MBAS/Surfactants	SM 5540C/EPA 425.1	----------
Moisture Determination	----------	ASTM D-2216 (M)
Nitrate (as N)	EPA 9056A/EPA 300.0	EPA 9056A[3]
Nitrate-nitrite (as N)	EPA 9056A/EPA 300.0	EPA 9056A[3]
Nitrite (as N)	EPA 9056A/EPA 300.0	EPA 9056A[3]
Nonfilterable residue	SM 2540D	----------
Oil & Grease	EPA 1664A	EPA 1664A
Organic Nitrogen	TKN – Ammonia EPA 351.2 – EPA 350.1	----------
Orthophosphate (as P)	EPA 9056A/EPA 300.0	EPA 9056A[3]
Paint Filter Liquids Test	----------	EPA 9095A/9095B
Perchlorate	EPA 314.0/6850	EPA 6850
pH	SM 4500-H^+ B/ EPA 9040B /9040C/9041A/ EPA 150.1	EPA 9040B/9040C/9045C/9045D
Reactive Cyanide	Sec 7.3.3 SW846	Sec 7.3.3 SW846
Reactive Sulfide	Sec 7.3.4 SW846	Sec 7.3.4 SW846
Residue-Volatile	SM 2540E/EPA 160.4	----------
Residue-Settleable	SM 2540F	----------
Specific conductance	EPA 9050A/EPA 120.1	----------
Sulfate	EPA 9056A/EPA 300.0	EPA 9056A[3]
Sulfite	SM 4500-SO3 B	----------
Sulfide	EPA 9030B/9034	EPA 9030B/9034
Temperature	EPA 170.1	EPA 170.1
Total, fixed, and volatile residue	SM 2540G	----------
Total Nitrate-Nitrite	EPA 353.2	----------
Total Organic Carbon (TOC)	EPA 9060/9060A/ SM 5310D/415.1	EPA 9060/9060A[2]

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
Total Organic Halides (TOX)	EPA 9020B	EPA 9020B[2]
Total Petroleum Hydrocarbons	EPA 1664A	EPA 1664A
Total Phenolics	EPA 9066/EPA 420.4	----------
Total Phosphorous	EPA 365.4	----------
Total residue	SM 2540B	----------
Turbidity	EPA 180.1/SM 2130	EPA 180.1/SM 2130
Organic Analytes		
1,2-Dibromo-3-chloropropane (DBCP)	EPA 8011/8260B	EPA 8260B
1,2 Dibromoethane (EDB)	EPA 8011/8260B	EPA 8260B
Purgeable Organics (Volatiles)		
Acetone	EPA 8260B	EPA 8260B
Acetonitrile	EPA 8260B	EPA 8260B
Acrolein (Propenal)	EPA 8260B	EPA 8260B
Acrylonitrile	EPA 8260B	EPA 8260B
Allyl Chloride	EPA 8260B	EPA 8260B
Benzene	EPA 8260B	EPA 8260B
Benzyl chloride	EPA 8260B	EPA 8260B
Bromobenzene	EPA 8260B	EPA 8260B
Bromochloromethane	EPA 8260B	EPA 8260B
Bromodichloromethane	EPA 8260B	EPA 8260B
Bromoform	EPA 8260B	EPA 8260B
Bromomethane	EPA 8260B	EPA 8260B
2-Butanone (Methyl Ethyl Ketone)	EPA 8015B/8015C/8260B	EPA 8260B
n-Butyl alcohol	EPA 8015B/8015C/8260B	EPA 8260B
n-Butylbenzene	EPA 8260B	EPA 8260B
Sec-Butylbenzene	EPA 8260B	EPA 8260B
Tert-Butylbenzene	EPA 8260B	EPA 8260B
Carbon disulfide	EPA 8260B	EPA 8260B
Carbon tetrachloride	EPA 8260B	EPA 8260B
Chlorobenzene	EPA 8260B	EPA 8260B
Chloroethane	EPA 8260B	EPA 8260B
2-Chloroethyl vinyl ether	EPA 8260B	EPA 8260B
Chloroform	EPA 8260B	EPA 8260B
Chloromethane	EPA 8260B	EPA 8260B
Chloroprene	EPA 8260B	EPA 8260B
2-Chlorotoluene	EPA 8260B	EPA 8260B
4-Chlorotoluene	EPA 8260B	EPA 8260B
Dibromochloromethane	EPA 8260B	EPA 8260B
Dibromomethane	EPA 8260B	EPA 8260B
1,2-Dichlorobenzene	EPA 8260/8270C/8270D	EPA 8260/8270C/8270D
1,3-Dichlorobenzene	EPA 8260/8270C/8270D	EPA 8260/8270C/8270D
1,4-Dichlorobenzene	EPA 8260/8270C/8270D	EPA 8260/8270C/8270D
Dichlorodifluoromethane	EPA 8260B	EPA 8260B
1,1-Dichloroethane	EPA 8260B	EPA 8260B
1,2-Dichloroethane	EPA 8260B	EPA 8260B
1,1-Dichloroethene	EPA 8260B	EPA 8260B
cis-1,2-Dichloroethene	EPA 8260B	EPA 8260B

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
trans-1,2-Dichloroethene	EPA 8260B	EPA 8260B
1,2-Dichloropropane	EPA 8260B	EPA 8260B
1,3-Dichloropropane	EPA 8260B	EPA 8260B
2,2-Dichloropropane	EPA 8260B	EPA 8260B
1,1-Dichloropropene	EPA 8260B	EPA 8260B
cis-1,3-Dichloropropene	EPA 8260B	EPA 8260B
trans-1,3-Dichloropropene	EPA 8260B	EPA 8260B
cis-1,4-Dichloro-2-butene	EPA 8260B	EPA 8260B
trans-1,4-Dichloro-2-butene	EPA 8260B	EPA 8260B
Diethyl ether	EPA 8260B	EPA 8260B
1,4-Dioxane	EPA 8260B	EPA 8260B
Ethyl Acetate	EPA 8015B/8015C/8260B	EPA 8015B/8015C/8260B
Ethyl Benzene	EPA 8260B	EPA 8260B
Ethyl methacrylate	EPA 8260B	EPA 8260B
2-Hexanone	EPA 8260B	EPA 8260B
Hexachlorobutadiene	EPA 8260/8270C/8270D	EPA 8260/8270C/8270D
Isopropylbenzene	EPA 8260B	EPA 8260B
4-Isopropyltoluene	EPA 8260B	EPA 8260B
Iodomethane	EPA 8260B	EPA 8260B
Isobutyl Alcohol	EPA 8015B/8015C/8260B	EPA 8260B
Methacrylonitrile	EPA 8260B	EPA 8260B
Methylene chloride	EPA 8260B	EPA 8260B
Methyl methyacrylate	EPA 8260B	EPA 8260B
4-Methyl-2-pentanone	EPA 8260B	EPA 8260B
Methyl tert butyl ether (MTBE)	EPA 8260B	EPA 8260B
Naphthalene	EPA 8260B/8270C/8270D/8310	EPA 8260B/8270C/8270D/8310
2-Nitropropane	EPA 8260B	EPA 8260B
n-Propylbenzene	EPA 8260B	EPA 8260B
Pentachloroethane	EPA 8260B	EPA 8260B
Propionitrile	EPA 8260B	EPA 8260B
Styrene	EPA 8260B	EPA 8260B
1,1,1,2-Tetrachloroethane	EPA 8260B	EPA 8260B
1,1,2,2-Tetrachloroethane	EPA 8260B	EPA 8260B
Tetrachloroethene	EPA 8260B	EPA 8260B
Toluene	EPA 8260B	EPA 8260B
1,1,1-Trichloroethane	EPA 8260B	EPA 8260B
1,1,2-Trichloroethane	EPA 8260B	EPA 8260B
Trichloroethene	EPA 8260B	EPA 8260B
Trichlorofluoromethane	EPA 8260B	EPA 8260B
1,2,3-Trichlorobenzene	EPA 8260B	EPA 8260B
1,2,3-Trichloropropane	EPA 8260B	EPA 8260B
1,2,4-Trichlorobenzene	EPA 8260B/8270C/8270D	EPA 8260B/8270C/8270D
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 8260B	----------
1,2,4-Trimethylbenzene	EPA 8260B	EPA 8260B
1,3,5-Trimethylbenzene	EPA 8260B	EPA 8260B
Trihalomethanes	EPA 8260B	EPA 8260B
Vinyl acetate	EPA 8260B	EPA 8260B
Vinyl chloride	EPA 8260B	EPA 8260B
Xylenes, total	EPA 8260B	EPA 8260B
o-Xylene	EPA 8260B	EPA 8260B

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
m+p-Xylene	EPA 8260B	EPA 8260B
Semivolatile Compounds		
Acenaphthene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Acenaphthylene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Acetophenone	EPA 8270C/8270D	EPA 8270C/8270D
2-Acetylaminofluorene	EPA 8270C/8270D	EPA 8270C/8270D
4-Aminobiphenyl	EPA 8270C/8270D	EPA 8270C/8270D
Aniline	EPA 8270C/8270D	EPA 8270C/8270D
Anthracene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Aramite	EPA 8270C/8270D	EPA 8270C/8270D
Atrazine	EPA 8270C/8270D	EPA 8270C/8270D
Benzidine	EPA 8270C/8270D	EPA 8270C/8270D
Benzoic acid	EPA 8270C/8270D	EPA 8270C/8270D
Benzo (a) anthracene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Benzo (b) fluoranthene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Benzo (k) fluoranthene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Benzo (ghi) perylene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Benzo (a) pyrene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
p-Benzoquinone	EPA 8270C/8270D	EPA 8270C/8270D
Benzyl alcohol	EPA 8270C/8270D	EPA 8270C/8270D
Bis (2-chloroethoxy) methane	EPA 8270C/8270D	EPA 8270C/8270D
Bis (2-chloroethyl) ether	EPA 8270C/8270D	EPA 8270C/8270D
Bis (2-chloroisopropyl) ether	EPA 8270C/8270D	EPA 8270C/8270D
Bis (2-ethylhexyl) phthalate	EPA 8270C/8270D	EPA 8270C/8270D
4-Bromophenyl phenyl ether	EPA 8270C/8270D	EPA 8270C/8270D
Butyl benzyl phthalate	EPA 8270C/8270D	EPA 8270C/8270D
Carbazole	EPA 8270C/8270D	EPA 8270C/8270D
4-Chloroaniline	EPA 8270C/8270D	EPA 8270C/8270D
Chlorobenzilate	EPA 8270C/8270D	EPA 8270C/8270D
4-Chloro-3-methylphenol	EPA 8270C/8270D	EPA 8270C/8270D
2-Chloronaphthalene	EPA 8270C/8270D	EPA 8270C/8270D
2-Chlorophenol	EPA 8270C/8270D	EPA 8270C/8270D
4-Chlorophenyl phenyl ether	EPA 8270C/8270D	EPA 8270C/8270D
Chrysene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
n-Decane	EPA 625	----------
Diallate	EPA 8270C/8270D	EPA 8270C/8270D
Dibenzo (a,h) anthracene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Dibenzofuran	EPA 8270C/8270D	EPA 8270C/8270D
Dibenzo (a,e) pyrene	EPA 8270C/8270D	EPA 8270C/8270D
1,2-Dichlorobenzene	EPA 8260B/8270C/8270D	EPA 8260B/8270C/8270D
1,3-Dichlorobenzene	EPA 8260B/8270C/8270D	EPA 8260B/8270C/8270D
1,4-Dichlorobenzene	EPA 8260B/8270C/8270D	EPA 8260B/8270C/8270D
3,3'-Dichlorobenzidine	EPA 8270C/8270D	EPA 8270C/8270D
2,4-Dichlorophenol	EPA 8270C/8270D	EPA 8270C/8270D
2,6-Dichlorophenol	EPA 8270C/8270D	EPA 8270C/8270D
3,3'-Dimethylbenzidine	EPA 8270C/8270D	EPA 8270C/8270D
Diethyl phthalate	EPA 8270C/8270D	EPA 8270C/8270D
Dimethoate	EPA 8270C/8270D	EPA 8270C/8270D
1,3-Dinitrobenzene	EPA 8270C/8270D/8330/8330B	EPA 8270C/8270D/8330/8330B
1,4-Dinitrobenzene	EPA 8270C/8270D	EPA 8270C/8270D

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
Disulfoton	EPA 8270C/8270D	EPA 8270C/8270D
p-Dimethylaminoazobenzene	EPA 8270C/8270D	EPA 8270C/8270D
7,12-Dimethylbenz(a)anthracene	EPA 8270C/8270D	EPA 8270C/8270D
Alpha-,alpha-Dimethylphenethylamine	EPA 8270C/8270D	EPA 8270C/8270D
2,4-Dimethylphenol	EPA 8270C/8270D	EPA 8270C/8270D
Dimethyl phthalate	EPA 8270C/8270D	EPA 8270C/8270D
Di-n-butyl phthalate	EPA 8270C/8270D	EPA 8270C/8270D
Di-n-octyl phthalate	EPA 8270C/8270D	EPA 8270C/8270D
2,4-Dinitrophenol	EPA 8270C/8270D	EPA 8270C/8270D
2,4-Dinitrotoluene	EPA 8270/8330/8330B	EPA 8270/8330/8330B
2,6-Dinitrotoluene	EPA 8270/8330/8330B	EPA 8270/8330/8330B
Diphenylamine	EPA 8270C/8270D	EPA 8270C/8270D
1,2-Diphenylhydrazine	EPA 8270C/8270D	EPA 8270C/8270D
Ethyl methanesulfonate	EPA 8270C/8270D	EPA 8270C/8270D
Famphur	EPA 8270C/8270D	EPA 8270C/8270D
Fluoroanthene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Fluorene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Hexachlorobenzene	EPA 8270C/8270D	EPA 8270C/8270D
Hexachlorobutadiene	EPA 8260B/8270C/8270D	EPA 8260B/8270C/8270D
Hexachlorophene	EPA 8270C/8270D	EPA 8270C/8270D
Hexachloropropene	EPA 8270C/8270D	EPA 8270C/8270D
Hexachlorocyclopentadiene	EPA 8270C/8270D	EPA 8270C/8270D
Hexachloroethane	EPA 8270C/8270D	EPA 8270C/8270D
Indeno (1,2,3-cd) pyrene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Isodrin	EPA 8270C/8270D	EPA 8270C/8270D
Isophorone	EPA 8270C/8270D	EPA 8270C/8270D
Isosafrole	EPA 8270C/8270D	EPA 8270C/8270D
Kepone	EPA 8270C/8270D	EPA 8270C/8270D
Methapyrilene	EPA 8270C/8270D	EPA 8270C/8270D
3-Methylcholanthrene	EPA 8270C/8270D	EPA 8270C/8270D
2-Methyl-4,6-Dinitrophenol	EPA 8270C/8270D	EPA 8270C/8270D
Methyl methanesulfonate	EPA 8270C/8270D	EPA 8270C/8270D
1-Methylnaphthalene	EPA 8270C/8270D	EPA 8270C/8270D
2-Methylnaphthalene	EPA 8270C/8270D	EPA 8270C/8270D
Methyl Parathion	EPA 8270C/8270D	EPA 8270C/8270D
2-Methylphenol (o-cresol)	EPA 8270C/8270D	EPA 8270C/8270D
3/4-Methylphenols(m/p cresols)	EPA 8270C/8270D	EPA 8270C/8270D
Naphthalene	EPA 8260B/8270C/8270D/8310	EPA8260B/8270C/8270D/8310
1,4-Naphthoquinone	EPA 8270C/8270D	----------
1-Naphthylamine	EPA 8270C/8270D	EPA 8270C/8270D
2-Naphthylamine	EPA 8270C/8270D	EPA 8270C/8270D
2-Nitroaniline	EPA 8270C/8270D	EPA 8270C/8270D
3-Nitroaniline	EPA 8270C/8270D	EPA 8270C/8270D
4-Nitroaniline	EPA 8270C/8270D	EPA 8270C/8270D
Nitrobenzene	EPA 8270C/8270D/8330/8330B	EPA 8270C/8270D/8330/8330B
5-Nitro-o-toluidine	EPA 8270C/8270D	EPA 8270C/8270D
2-Nitrophenol	EPA 8270C/8270D	EPA 8270C/8270D
4-Nitrophenol	EPA 8270C/8270D	EPA 8270C/8270D
Nitroquinoline-1-oxide	EPA 8270C/8270D	EPA 8270C/8270D

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
N-Nitrosodietheylamine	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosodimethylamine	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosodi-n-butylamine	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosodi-n-propylamine	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosodiphenylamine	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosodimethylethylamine	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosomorpholine	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosopiperidine	EPA 8270C/8270D	EPA 8270C/8270D
N-Nitrosopyrrolidine	EPA 8270C/8270D	EPA 8270C/8270D
n-Octadecane	----------	EPA 8270C/8270D
o,o,o-Triethyl phosphorothioate	EPA 8270C/8270D	EPA 8270C/8270D
o-Toluidine	EPA 8270C/8270D	EPA 8270C/8270D
Parathion, ethyl	EPA 8270C/8270D	EPA 8270C/8270D
Pentachlorobenzene	EPA 8270C/8270D	EPA 8270C/8270D
Pentachloronitrobenzene	EPA 8270C/8270D	EPA 8270C/8270D
Pentachlorophenol	EPA 8270C/8270D/8151A	EPA 8270C/8270D/8151A
Phenacetin	EPA 8270C/8270D	EPA 8270C/8270D
Phenanthrene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Phenol	EPA 8270C/8270D	EPA 8270C/8270D
1,4-Phenylenediamine	EPA 8270C/8270D	----------
Phorate	EPA 8270C/8270D	EPA 8270C/8270D
2-Picoline (2-Methylpyridine)	EPA 8270C/8270D	EPA 8270C/8270D
Pronamide (Kerb)	EPA 8270C/8270D	EPA 8270C/8270D
Pyrene	EPA 8270C/8270D/8310	EPA 8270C/8270D/8310
Pyridine	EPA 8270C/8270D	EPA 8270C/8270D
Safrole	EPA 8270C/8270D	EPA 8270C/8270D
Sulfotepp	EPA 8270C/8270D	EPA 8270C/8270D
1,2,4,5-Tetrachlorobenzene	EPA 8270C/8270D	EPA 8270C/8270D
2,3,4,6-Tetrachlorophenol	EPA 8270C/8270D	EPA 8270C/8270D
Thionazin (Zinophos)	EPA 8270C/8270D	EPA 8270C/8270D
1,2,4-Trichlorobenzene	EPA 8260B/8270C/8270D	EPA 8260B/8270C/8270D
2,4,5-Trichlorophenol	EPA 8270C/8270D	EPA 8270C/8270D
2,4,6-Trichlorophenol	EPA 8270C/8270D	EPA 8270C/8270D
1,3,5-Trinitrobenzene	EPA 8270C/8270D/8330/8330B	EPA 8270C/8270D/8330/8330B
Pesticides & PCBs		
Aldrin	EPA 8081A/8081B	EPA 8081A/8081B
alpha-BHC	EPA 8081A/8081B	EPA 8081A/8081B
alpha-Chlordane	EPA 8081A/8081B	EPA 8081A/8081B
beta-BHC	EPA 8081A/8081B	EPA 8081A/8081B
Chlordane (technical)	EPA 8081A/8081B	EPA 8081A/8081B
delta-BHC	EPA 8081A/8081B	EPA 8081A/8081B
gamma-BHC	EPA 8081A/8081B	EPA 8081A/8081B
gamma-Chlordane	EPA 8081A/8081B	EPA 8081A/8081B
4,4’-DDD	EPA 8081A/8081B	EPA 8081A/8081B
4,4’-DDE	EPA 8081A/8081B	EPA 8081A/8081B
4,4’,-DDT	EPA 8081A/8081B	EPA 8081A/8081B
Dieldrin	EPA 8081A/8081B	EPA 8081A/8081B
Endosulfan I	EPA 8081A/8081B	EPA 8081A/8081B
Endosulfan II	EPA 8081A/8081B	EPA 8081A/8081B

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
Endonsulfan sulfate	EPA 8081A/8081B	EPA 8081A/8081B
Endrin	EPA 8081A/8081B	EPA 8081A/8081B
Endrin aldehyde	EPA 8081A/8081B	EPA 8081A/8081B
Endrin ketone	EPA 8081A/8081B	EPA 8081A/8081B
Heptachlor	EPA 8081A/8081B	EPA 8081A/8081B
Heptachlor epoxide	EPA 8081A/8081B	EPA 8081A/8081B
Methoxychlor	EPA 8081A/8081B	EPA 8081A/8081B
Toxaphene	EPA 8081A/8081B	EPA 8081A/8081B
PCB-1016 (Aroclor)	EPA 8082/8082A	EPA 8082/8082A
PCB-1221	EPA 8082/8082A	EPA 8082/8082A
PCB-1232	EPA 8082/8082A	EPA 8082/8082A
PCB-1242	EPA 8082/8082A	EPA 8082/8082A
PCB-1248	EPA 8082/8082A	EPA 8082/8082A
PCB-1254	EPA 8082/8082A	EPA 8082/8082A
PCB-1260	EPA 8082/8082A	EPA 8082/8082A
PCB-1262	EPA 8082/8082A	EPA 8082/8082A
PCB-1268	EPA 8082/8082A	EPA 8082/8082A
Total Aroclors	EPA 8082/8082A	EPA 8082/8082A
FID Compounds		
Ethyl acetate	EPA 8015B/8015C/8260B	EPA 8015B/8015C/8260B
Ethylene Glycol	EPA 8015B/8015C	EPA 8015B/8015C
Isobutyl Alcohol	EPA 8015B/8015C/8260B	EPA 8260B
Isopropyl Alcohol (2-Propanol)	EPA 8015B/8015C	----------
Methanol	EPA 8015B/8015C	EPA 8015B/8015C
Diesel Range Organics (DRO)	EPA 8015B/8015C/CA-LUFT/ CT-ETPH	EPA 8015B/8015C/CA-LUFT/ CT-ETPH
Gas Range Organics (GRO)	EPA 8015B/8015C/CA-LUFT	EPA 8015B/8015C/CA-LUFT
Herbicides		
2,4-D	EPA 8151A	EPA 8151A
2,4-DB	EPA 8151A	EPA 8151A
Dalapon	EPA 8151A	EPA 8151A
Dicamba	EPA 8151A	EPA 8151A
Dichloroprop	EPA 8151A	EPA 8151A
Dinoseb	EPA 8151A	EPA 8151A
MCPA	EPA 8151A	EPA 8151A
MCPP	EPA 8151A	EPA 8151A
2,4,5-T	EPA 8151A	EPA 8151A
2,4,5-TP (Silvex)	EPA 8151A	EPA 8151A
Pentachlorophenol	EPA 8151A	EPA 8151A
Nitrosamines, Nitroaromatics		
1,3-Dinitrobenzene	EPA 8270C/8270D/8330/8330B	EPA 8270C/8270D/8330/8330B
2,4-Dinitrotoluene	EPA 8270C/8270D/8330/8330B	EPA 8270C/8270D/8330/8330B
2,6-Dinitrotoluene	EPA 8270C/8270D/8330/8330B	EPA 8270C/8270D/8330/8330B
2,4,6-Trinitrotoluene	EPA 8330/8330B	EPA 8330/8330B
2-Amino-4,6-Dinitrotoluene	EPA 8330/8330B	EPA 8330/8330B
2-Nitrotoluene	EPA 8330/8330B	EPA 8330/8330B
3-Nitrotoluene	EPA 8330/8330B	EPA 8330/8330B
4-Amino-2,6-Dinitrotoluene	EPA 8330/8330B	EPA 8330/8330B

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Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
4-Nitrotoluene	EPA 8330/8330B	EPA 8330/8330B
Nitrobenzene	EPA 8270C/8270D/8330/8330B	EPA 8270C/8270D/8330/8330B
Nitroglycerine	EPA 8330/8330B	EPA 8330/8330B
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330/8330B	EPA 8330/8330B
Pentaerythritoltetranitrate (PETN)	EPA 8330/8330B	EPA 8330/8330B
hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	EPA 8330/8330B	EPA 8330/8330B
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	EPA 8330/8330B	EPA 8330/8330B
Radiochemistry		
Barium 133	DOE 4.5.2.3	DOE 4.5.2.3
Cesium 134	DOE 4.5.2.3/EPA 901.1	DOE 4.5.2.3
Cesium 137	DOE 4.5.2.3/EPA 901.1	DOE 4.5.2.3
Cobalt-60	DOE 4.5.2.3/EPA 901.1	DOE 4.5.2.3
Gamma Emitters	DOE 4.5.2.3/EPA 901.1	DOE 4.5.2.3
Gross Alpha	EPA 900.0/9310	EPA 9310
Gross Beta	EPA 900.0/9310	EPA 9310
Radioactive Iodine	DOE 4.5.2.3/EPA 901.1/902.0	DOE 4.5.2.3
Radium-226	EPA 903.1/DOE Ra-04	DOE Ra-04
Radium-228	EPA 904.0/9320/DOE 4.5.2.3	DOE 4.5.2.3/EPA9320
Total Radium	EPA 9315	EPA 9315
Radon	SM7500 Rn-B	----------
Strontium-89	EPA 905.0	DOE Sr-01
Strontium-90	EPA 905.0/DOE Sr-02	DOE Sr-02
Thorium	DOE 4.5.5	DOE 4.5.5
Tritium	EPA 906.0	----------
Uranium	ASTM D5174-02/D5174-97/DOE U-02/EPA 6020/6020A	DOE U-02/EPA 6020/6020A
Zinc-65	EPA 901.1/DOE 4.5.2.3	DOE 4.5.2.3
Preparatory and Clean-up Methods		
Toxicity Characteristic Leaching Procedure (Inorganics, Extractable Organics, Volatile Organics)	----------	EPA 1311
Synthetic Preparation Leaching Procedure	----------	EPA 1312
Waste Extraction Test (W.E.T.)	----------	CCR Chapter 11, Article 5, Appendix II
Anion Preparation	----------	EPA 9056A[3]
Cyanide Distillation	EPA 9010B/9010C	EPA 9010B/9010C[3]
Sulfide Distillation	EPA 9030B	EPA 9030B
Metals Digestion	EPA 200.2, 3005A, 3010A	EPA 3050B
Alkaline Digestion for Hexavalent Chromium	----------	EPA 3060A
Bomb Preparation for Solid Waste	----------	EPA 5050

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
Mercury Preparation	EPA 7470/7470A	EPA 7471A/7471B
Separatory Funnel Liquid-Liquid Extraction	EPA 3510C	----------
Continuous Liquid-Liquid Extraction	EPA 3520C	----------
Solid Phase Extraction	EPA 3535A	----------
Automated Soxhlet Extraction	----------	EPA 3541
Ultrasonic Extraction	----------	EPA 3550C
Waste Dilution	----------	EPA 3580A
Waste Dilution for Volatile Organics	----------	EPA 3585
Purge and Trap for Volatile Organics	EPA 5030A/5030B/5030C	EPA 5035/5035A
Alumina Clean-up	----------	EPA 3610B/3611B
Florisil Clean-up	----------	EPA 3620B/3620C
Silica Gel Clean-up	----------	EPA 3630C
Gel Permeation Clean-up	----------	EPA 3640A
Sulfur Clean-up	----------	EPA 3660B
Sulfuric Acid/Permanganate Clean-up	----------	EPA 3665A

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

	Preparation SOP	Analytical SOP
Bioassy Analysis		
Alpha Spectrometry: Alpha: Am-241, Cm-242, Cm-243/244, Cm 245/246,Cf-252, Np-237, Po-208, Po- 209, Po-210, Pu-236, Pu-238, Pu-239/240, Pu-242, Pu-244, Th-228, Th-229, Th-230, Th-232, U-232, U-233/234, U-235/236, U-238	GL-RAD-B-001, GL-RAD-B-002, GL-RAD-B-003, GL-RAD-B-010, GL-RAD-B-012, GL-RAD-B-013, GL-RAD-B-017	GL-RAD-B-009
Liquid Scintillation Spectrometry: C-14, Gross Alpha, H-3, Ni-63, Pu-241, Tc-99	GL-RAD-B-001, GL-RAD-B-008, GL-RAD-B-011, GL-RAD-B-012, GL-RAD-B-013, GL-RAD-B-016, GL-RAD-B-020, GL-RAD-B-023	GL-RAD-I-004, GL-RAD-I-014, GL-RAD-I-017
Gas Flow Proportional Counting: Beta: Sr-90	GL-RAD-B-001	GL-RAD-I-006, GL-RAD-I-015, GL-RAD-I-016

	Preparation SOP	Analytical SOP
Bioassy Analysis		
Gross Alpha/Gross Beta:	GL-RAD-B-022	GL-RAD-I-006
Kinetic Phosphorescence Analyzer Total Uranium	GL-RAD-B-019	GL-RAD-B-018
Radon Emanation: Ra-226	GL-RAD-B-002	GL-RAD-I-007
Refractometer Specific Gravity	GL-RAD-B-027	GL-RAD-B-027
ICP-MS Uranium Isotopes	GL-RAD-B-035	GL-RAD-B-027
Gamma Spectrometry: Gamma: Ni-59, 46 to 1836 keV	GL-RAD-B-020, GL-RAD-A-013	GL-RAD-I-001

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

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

1 - Calculated from silica determination

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

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

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

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ENVIRONMENTAL

Valid To: March 31, 2012 Certificate Number: 3000.01

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

Testing Technologies

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

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Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Sodium	EPA 6020A/200.8	EPA 6020A
Thallium	EPA 6020A/200.8	EPA 6020A
Tin	EPA 6020A/200.8	EPA 6020A
Titanium	EPA 6020A/200.8	EPA 6020A
Vanadium	EPA 6020A/200.8	EPA 6020A
Zinc	EPA 6020A/200.8	EPA 6020A
Microbiology		
Total Coliforms	SM 9222B	----------------------------------
Fecal Coliforms	SM 9222D	----------------------------------
General Chemistry		
Acidity, as $CaC0_3$	EPA 305.1/SM 2310 B (4A)	----------------------------------
Alkalinity as $CaC0_3$	EPA 310.1/SM 2320 B	EPA 310.1/SM 2320 B
Alkalinity as $CaC0_4$	EPA 310.2	EPA 310.2
Ammonia as N	----------------------------------	EPA 350.1
Biochemical oxygen demand	EPA 405.1/SM 5210 B	----------------------------------
Bromide	EPA 300.0/9056A	EPA 9056A
Carbonaceous BOD (CBOD)	SM 5210 B	----------------------------------
Chemical oxygen demand	EPA 410.4	----------------------------------
Chloride	EPA 300.0/9056A	EPA 9056A
Chromium VI	EPA 7196/ SM 3500-Cr D	EPA 7196
Conductivity	EPA 120.1	----------------------------------
Cyanide	EPA 335.2/SM 4500-CN E	EPA 9014
Ferric iron (calculated)	SM 3500-Fe D	----------------------------------
Ferrous iron	SM 3500-Fe D	----------------------------------
Fluoride	EPA 300.0/9056A	EPA 9056A
Hardness	EPA 130.2/SM 2340 C	----------------------------------
Kjeldahl nitrogen -total	EPA 351.2	EPA351.2
Nitrate as N	EPA 300.0/353.1/9056A	EPA 353.1/9056A
Nitrate-nitrite	EPA 300.0/353.1/9056A	EPA 353.1/9056A
Nitrite as N	EPA 300.0/354.1/9056A/SM 4500-NO_2 B	EPA 9056A/ SM 4500-NO_2 B
Organic nitrogen	EPA 351.2/350.1	EPA 351.2/350.1
Orthophosphate as P	EPA 365.1	----------------------------------
Orthophosphate as P	EPA 365.3	----------------------------------
pH	EPA 150.1/9040C/SM 4500-H^+-B	EPA 9040C
Phosphorus, total	EPA 365.4	EPA 365.4
Residue-filterable (TDS)	SM 2540 C	----------------------------------
Residue-nonfilterable (TSS)	SM 2540 D	----------------------------------
Residue-total	SM 2540 B/SM 2540 G/EPA 160.3	SM 2540G/EPA 160.3
Residue-volatile	EPA 160.4	EPA 160.4
Sulfate	EPA 300.0/9056A	EPA 9056A
Sulfide	EPA 376.1/SM 4500-S E	----------------------------------
Surfactants -MBAS	SM 5540 C	----------------------------------
Total nitrate-nitrite	EPA 9056 A/SM 4500-$N0_3$ H	EPA 9056 A/SM 4500-$N0_3$ H
Total cyanide	EPA 9014	EPA 9014
Total nitrogen	TKN + Total nitrate-nitrite	TKN + Total nitrate-nitrite
Total Organic Carbon	EPA 9060A/SM 5310B	TOC Walkley Black
Total phenolics	EPA 420.1	EPA 420.1
Total, fixed, and volatile residue	SM 2540 G	SM 2540 G
Turbidity	EPA 180.1	----------------------------------

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
Un-ionized ammonia	DEP SOP 10/03/83	DEP SOP 10/03/83
Extractable Organics		
1,2,4-Trichlorobenzene	EPA 8270D/625	EPA 8270D
1,2,4,5-Tetrachlorobenzene	EPA 8270D/625	EPA 8270D
1,2-Dichlorobenzene	EPA 8270D/625	EPA 8270D
1,3-Dichlorobenzene	EPA 8270D/625	EPA 8270D
1,4-Dichlorobenzene	EPA 8270D/625	EPA 8270D
2,3,4,6-Tetrachlorophenol	EPA 8270D/625	EPA 8270D
2,4,5-Trichlorophenol	EPA 8270D/625	EPA 8270D
2,4,6-Trichlorophenol	EPA 8270D/625	EPA 8270D
2,4-Dichlorophenol	EPA 8270D/625	EPA 8270D
2,4-Dimethylphenol	EPA 8270D/625	EPA 8270D
2,4-Dinitrophenol	EPA 8270D/625	EPA 8270D
2,4-Dinitrotoluene (2,4-DNT)	EPA 8270D/625/ Scan-Sim	EPA 8270D
2,6-Dinitrotoluene (2,6-DNT)	EPA 8270D/625	EPA 8270D
2-Chloronaphthalene	EPA 8270D/625	EPA 8270D
2-Chlorophenol	EPA 8270D/625	EPA 8270D
2·Methyl-4,6-dinitrophenol	EPA 8270D/625	EPA 8270D
2-Methylnaphthalene	EPA 8270D/625	EPA 8270D
2-Methylphenol (o-Cresol)	EPA 8270D/625	EPA 8270D
2-Nitroaniline	EPA 8270D/625	EPA 8270D
2-Nitrophenol	EPA 8270D/625	EPA 8270D
3,3'-Dichlorobenzidine	EPA 8270D/625	EPA 8270D
3/4-Methylphenols (m/p-Cresols)	EPA 8270D/625	EPA 8270D
3-Nitroaniline	EPA 8270D/625	EPA 8270D
4-Bromophenyl phenyl ether	EPA 8270D/625	EPA 8270D
4-Chloro-3-methylphenol	EPA 8270D/625	EPA 8270D
4-Chloroaniline	EPA 8270D/625	EPA 8270D
4-Chlorophenyl phenyl ether	EPA 8270D/625	EPA 8270D
4-Nitrophenol	EPA 8270D/625	EPA 8270D
Acenaphthene	EPA 8270D/625	EPA 8270D
Acenaphthylene	EPA 8270D/625	EPA 8270D
4-Melhylphenol (p-Cresol)	EPA 8270D/625	EPA 8270D
4-Nitroaniline	EPA 8270D/625	EPA 8270D
Acetophenone	EPA 8270D/625	EPA 8270D
Anthracene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Atrazine	EPA 8270D/625	EPA 8270D
Benzaldehyde	EPA 8270D/625	EPA 8270D
Benzidine	EPA 8270D/625/ Scan-Sim	EPA 8270D
Benzo(a)anthracene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Benzo(a)pyrene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Benzo(b)fluoranthene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Benzo(g,h,i)perylene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Benzo(k)fluoranthene	EPA 8270D/625/ Scan-Sim	EPA 8270D
1,1-Biphenyl	EPA 8270D/625	EPA 8270D
bis(2-Chloroethoxy) methane	EPA 8270D/625	EPA 8270D
bis(2-Chloroethyl) ether	EPA 8270D/625	EPA 8270D
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane))	EPA 8270D/625	EPA 8270D
bis(2-Ethylhexyl) phthalate (DEHP)	EPA 8270D/625	EPA 8270D

Analyte / Parameter	**Non-Potable Water**	**Solid Hazardous Waste**
Butyl benzyl phthalate	EPA 8270D/625	EPA 8270D
Caprolactam	EPA 8270D/625	EPA 8270D
Carbazole	EPA 8270D/625	EPA 8270D
Chrysene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Dibenz(a,h)anthracene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Dibenzofuran	EPA 8270D/625	EPA 8270D
Diethyl phthalate	EPA 8270D/625	EPA 8270D
Dimethyl phthalate	EPA 8270D/625/ Scan-Sim	EPA 8270D
Di-n-butyl phthalate	EPA 8270D/625	EPA 8270D
Di-n-octyl phthalate	EPA 8270D/625	EPA 8270D
Fluoranthene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Fluorene	EPA 8270D/625	EPA 8270D
Hexachlorobenzene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Hexachlorobutadiene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Hexachlorocyclopentadiene	EPA 8270D/625	EPA 8270D
Hexachloroethane	EPA 8270D/625	EPA 8270D
Indeno(1,2,3-cd)pyrene	EPA 8270D/625/ Scan-Sim	EPA 8270D
Isodrin	EPA 8270D/625	EPA 8270D
Isophorone	EPA 8270D/625	EPA 8270D
Naphthalene	EPA 8270D/625	EPA 8270D
Nitrobenzene	EPA 8270D/625	EPA 8270D
n-Nitrosodi-n-propylamine	EPA 8270D/625	EPA 8270D
n-Nitrosodiphenylamine	EPA 8270D/625	EPA 8270D
Pentachlorophenol	EPA 8270D/625/ Scan-Sim	EPA 8270D
Phenanthrene	EPA 8270D/625	EPA 8270D
Phenol	EPA 8270D/625	EPA 8270D
Pyrene	EPA 8270D/625	EPA 8270D
Total Petroleum Hydrocarbons (TPH)	FL·PRO	FL·PRO
<u>Volatile Organics</u>		
1,1,1,2-Tetrachloroethane	EPA 8260B/624	EPA 8260B
1,1,1-Trichloroethane	EPA 8260B/624	EPA 8260B
1,1,2,2-Tetrachloroethane	EPA 8260B/624	EPA 8260B
1,1,2-Trichloro-1,2,2-trifluoroethane	EPA 8260B/624	EPA 8260B
1,1,2-Trichloroethane	EPA 8260B/624	EPA 8260B
1,1-Dichloroethane	EPA 8260B/624	EPA 8260B
1,1-Dichloroethene	EPA 8260B/624	EPA 8260B
1,1-Dichloropropene	EPA 8260B/624	EPA 8260B
1,2,3-Trichlorobenzene	EPA 504.1/8260B/624	EPA 8260B
1,2,3-Trichloropropane	EPA 8260B/624	EPA 8260B
1,2,4-Trichlorobenzene	EPA 8260B/624	EPA 8260B
1,2,4-Trimethylbenzene	EPA 8260B/624	EPA 8260B
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504 /504.1/8011/8260B	EPA 8260B
1,2-Dibromoethane (EDB, Ethylene dibromide)	EPA 504 /504.1/8011/8260B	EPA 8260B
1,2-Dichlorobenzene	EPA 8260B/624	EPA 8260B
1,2-Dichloroethane	EPA 8260B/624	EPA 8260B
1,2-Dichloropropane	EPA 8260B/624	EPA 8260B
1,3,5-Trimethylbenzene	EPA 8260B/624	EPA 8260B

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

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

Analyte / Parameter	Non-Potable Water	Solid Hazardous Waste
delta-BHC	EPA 8081B/608	EPA 8081B
Demeton-o	EPA 8141B/614	EPA 8141B
Demeton-s	EPA 8141B/614	EPA 8141B
Diazinon	EPA 8141B/614	EPA 8141B
Dicamba	EPA 8151A/615	EPA 8151A
Dichlorofenthion	EPA 8141B/614	EPA 8141B
Dichloroprop (Dichlorprop)	EPA 8151A/615	EPA 8151A
Dlchlorovos (DDVP, Dichtorvos)	EPA 8141B/614	EPA 8141B
Dieldrin	EPA 8081B/608	EPA 8081B
Dimethoate	EPA 8141B/614	EPA 8141B
Dinoseb (2-sec-buty1-4 ,6-dinilrophenol, DNB P)	EPA 8151A/615	EPA 8151A
Disulfoton	EPA 8141B/614	EPA 8141B
Endosulfan I	EPA 8081B/608	EPA 8081B
Endosulfan II	EPA 8081B/608	EPA 8081B
Endosulfan sulfate	EPA 8081B/608	EPA 8081B
Endrin	EPA 8081B/608	EPA 8081B
Endrin aldehyde	EPA 8081B/608	EPA 8081B
Endrin ketone	EPA 8081B/608	EPA 8081B
EPN	EPA 8141B/614	EPA 8141B
Ethion	EPA 8141B/614	EPA 8141B
Ethoprop	EPA 8141B/614	EPA 8141B
fensulfothion	EPA 8141B/614	EPA 8141B
fenthion	EPA 8141B/614	EPA 8141B
gamma-BHC (Lindane, gamma-Hexachlorocyclohexane)	EPA 8081B/608	EPA 8081B
gamma-Chlordane	EPA 8081B/608	EPA 8081B
Heptachlor	EPA 8081B/608	EPA 8081B
Heptachlor epoxide	EPA 8081B/608	EPA 8081B
Isodrin	EPA 8081B/608	EPA 8081B
Malathion	EPA 8141B/614	EPA 8141B
MCPA	EPA 8151A/615	EPA 8151A
Merphos	EPA 8141B/614	EPA 8141B
Methoxychlor	EPA 8081B/608	EPA 8081B
Methyl parathion (Parathion. methyl)	EPA 8141B/614	EPA 8141B
Mevinphos	EPA 8141B/614	EPA 8141B
Mirex	EPA 8081B/608	EPA 8081B
Monocrotophos	EPA 8141B/614	EPA 8141B
Naled	EPA 8141B/614	EPA 8141B
Parathion, ethyl	EPA 8141B/614	EPA 8141B
Pentachlorophenol	EPA 8151A/615	EPA 8151A
Phorate	EPA 8141B/614	EPA 8141B
Picloram	EPA 8151A/615	EPA 8151A
Ronnel	EPA 8141B/614	EPA 8141B
Silvex (2A.5-TP)	EPA 8151B/615	EPA 8151B
Stirofos	EPA 8141B/614	EPA 8141B
Sulfotepp	EPA 8141B/614	EPA 8141B
Tetraethyl pyrophosphate (TEPP)	EPA 8141B/614	EPA 8141B
Tokuthion (Prothiophos)	EPA 8141B/614	EPA 8141B
Toxaphene (Chlorinated camphene)	EPA 8081B/608	EPA 8081B
Trichloronate	EPA 8141B/614	EPA 8141B

Preparation Methods

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

SCOPE OF ACCREDITATION TO ISO/IEC 17025-2005

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ENVIRONMENTAL

Valid To: April 30, 2012 Certificate Number: 3000.02

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

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

Peter Mhyer

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

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
Vinyl chloride	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Xylene (total)	EPA 624, 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
1,1,1,2-Tetrachloroethane	EPA 8260B	EPA 8260B	---------------------------
1,1-Dichloropropene	EPA 8260B	EPA 8260B	---------------------------
1,2,3-Trichlorobenzene	EPA 8260B	EPA 8260B	---------------------------
1,2,3-Trichloropropane	EPA 8260B	EPA 8260B	---------------------------
1,2,4-Trichlorobenzene	EPA 625, 8260B, 8270D	EPA 8260B, 8270D	EPA TO-14A, EPA TO-15
1,2,4-Trimethylbenzene	EPA 8260B	EPA 8260B	EPA TO-14A
1,3,5-Trimethylbenzene	EPA 8260B	EPA 8260B	EPA TO-14A
1,3-Dichloropropane	EPA 8260B	EPA 8260B	---------------------------
2,2-Dichloropropane	EPA 8260B	EPA 8260B	---------------------------
2-Butanone (Methyl ethyl ketone,MEK)	EPA 8015, 8260B	EPA 8260B	EPA TO-15
2-Chlorotoluene	EPA 8260B	EPA 8260B	NA
2-Hexanone	EPA 8260B	EPA 8260B	ENCO VGCMS-07
4-Chlorotoluene	EPA 8260B	EPA 8260B	---------------------------
4-Methyl-2-pentanone (MIBK)	EPA 8015C , 8260B	EPA 8260B	EPA TO-15
Acetone	EPA 8260B	EPA 8260B	---------------------------
Acetonitrile	EPA 8260B	EPA 8260B	---------------------------
Allyl chloride (3-Chloropropene)	EPA 8260B	EPA 8260B	EPA TO-15
Bromobenzene	EPA 8260B	EPA 8260B	---------------------------
Bromochloromethane	EPA 8260B	EPA 8260B	---------------------------
Carbon disulfide	EPA 8260B	EPA 8260B	EPA TO-15
Chloroprene	EPA 8260B	EPA 8260B	---------------------------
cis-1,2-Dichloroethylene	EPA 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
Dibromomethane	EPA 8260B	EPA 8260B	---------------------------
Dichlorodifluoromethane	EPA 8260B	EPA 8260B	EPA TO-14A
Ethanol	EPA 8015, 8260B	EPA 8260B	---------------------------
Hexachlorobutadiene	EPA 625, 8260B, 8270D	EPA 8260, 8270	EPA TO-14A, EPA TO-15
Isopropylbenzene	EPA 8260B	EPA 8260B	---------------------------
Methacrylonitrile	EPA 8260B	EPA 8260B	---------------------------
Methyl methacrylate	EPA 8260B	EPA 8260B	---------------------------
Methyl tert-butyl ether (MTBE)	EPA 8260B	EPA 8260B	EPA TO-15
m-Xylene	EPA 8260B	EPA 8260B	---------------------------
Naphthalene	EPA 625, 8260B, 8270D, 8270D PAHSIM	EPA 8260B, 8270D, 8270D PAHSIM	---------------------------
n-Butyl benzene	EPA 8260B	EPA 8260B	---------------------------
n-Propyl benzene	EPA 8260B	EPA 8260B	---------------------------
o-Xylene	EPA 8260B	EPA 8260B	---------------------------
p-Isopropyltoluene	EPA 8260B	EPA 8260B	---------------------------
Propionitrile (Ethyl cyanide)	EPA 8260B	EPA 8260B	---------------------------
p-Xylene	EPA 8260B	EPA 8260B	---------------------------
sec-Butylbenzene	EPA 8260B	EPA 8260B	---------------------------
Styrene	EPA 8260B	EPA 8260B	EPA TO-14A, EPA TO-15
tert-Butylbenzene	EPA 8260B	EPA 8260B	---------------------------
trans-1,4-Dichloro-2-butene	EPA 8260B	EPA 8260B	---------------------------
Vinyl acetate	EPA 8260B	EPA 8260B	EPA TO-15
4,4'-DDD	EPA 608, 8081B	EPA 8081B	---------------------------
4,4'-DDE	EPA 608, 8081B	EPA 8081B	---------------------------

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

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
2,4,5-T	EPA 615, 8151A	EPA 8151A	---------------------------
2,4-DB	EPA 615, 8151A	EPA 8151A	---------------------------
Bentazon	EPA 615, 8151A	EPA 8151A	---------------------------
Picloram	EPA 615, 8151A	EPA 8151A	---------------------------
Dinoseb	EPA 615, 625, 8151A, 8270D	EPA 8151A, 8270D	---------------------------
Dacthal	EPA 615, EPA 8151A	EPA 8151A	---------------------------
Acifluorfen	EPA 615, EPA 8151A	EPA 8151A	---------------------------
2,4-DCAA	EPA 615, EPA 8151A	EPA 8151A	---------------------------
Total coliforms	SM 9222B	---------------------------	---------------------------
Fecal coliforms	SM 9222D	---------------------------	---------------------------
Aluminum	EPA 200.7, 6010C	EPA 6010C	---------------------------
Antimony	EPA 200.7, 6010C	EPA 6010C	---------------------------
Arsenic	EPA 200.7, 6010C	EPA 6010C	---------------------------
Barium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Beryllium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Boron	EPA 200.7, 6010C	EPA 6010C	---------------------------
Cadmium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Calcium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Chromium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Cobalt	EPA 200.7, 6010C	EPA 6010C	---------------------------
Copper	EPA 200.7, 6010C	EPA 6010C	---------------------------
Hardness (calc.)	EPA 200.7, SM2340B	---------------------------	---------------------------
Iron	EPA 200.7, 6010C, SM 18 3500-Fe D	EPA 6010C	---------------------------
Lead	EPA 200.7, 6010C	EPA 6010C	---------------------------
Lithium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Magnesium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Manganese	EPA 200.7, 6010C	EPA 6010C	---------------------------
Molybdenum	EPA 200.7, 6010C	EPA 6010C	---------------------------
Nickel	EPA 200.7, 6010C	EPA 6010C	---------------------------
Potassium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Selenium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Silver	EPA 200.7, 6010C	EPA 6010C	---------------------------
Sodium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Strontium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Thallium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Tin	EPA 200.7, 6010C	EPA 6010C	---------------------------
Titanium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Vanadium	EPA 200.7, 6010C	EPA 6010C	---------------------------
Zinc	EPA 200.7, 6010C	EPA 6010C	---------------------------
Mercury	EPA 245.1, 7470	EPA 7471	---------------------------
Sulfate	ASTM D516-90	---------------------------	---------------------------
Ignitability	EPA 1010	EPA 1010, EPA 1030	---------------------------
Conductivity	EPA 120.1, SM 18 2510B	---------------------------	---------------------------
Oil & Grease (HEM)	EPA 1664A	EPA 9071B	---------------------------
Total Petroleum Hydrocarbons (TPH) (HEM-SGT)	EPA 1664A	---------------------------	---------------------------
Turbidity	EPA 180.1, SM 18 2130B	---------------------------	---------------------------
Orthophosphate as P	EPA 365.3	---------------------------	---------------------------
Color	SM 2120B	---------------------------	---------------------------
Alkalinity as CaC03	SM 2320B	---------------------------	---------------------------

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
Hardness	SM 2340C	---------------------------	---------------------------
Residue-nonfilterable (TSS)	SM 2540D	---------------------------	---------------------------
Residue-total	SM 2540B	---------------------------	---------------------------
Residue-filterable (TDS)	SM 2540C	---------------------------	---------------------------
Chromium VI	SM 3500-Cr D(18th/19th Ed.)/UV-VIS	---------------------------	---------------------------
Chloride	SM 4500-Cl C	---------------------------	---------------------------
Total residual chlorine	SM 4500-Cl G	---------------------------	---------------------------
pH	SM 18 4500-H+-B, EPA 9040	EPA 9040, 9045	---------------------------
Nitrite	SM 4500-NO_2 B	---------------------------	---------------------------
Biochemical oxygen demand	SM 5210B	---------------------------	---------------------------
Carbonaceous BOD(CBOD)	SM 5210B	---------------------------	---------------------------
Chemical oxygen demand	SM 5220D, EPA 410.4	---------------------------	---------------------------
Total Organic Carbon	SM 18 5310B, EPA 9060	---------------------------	---------------------------
Total Petroleum Hydrocarbons (TPH)	FL-PRO	FL-PRO	---------------------------
Carbon dioxide	RSK-175	---------------------------	---------------------------
Ethane	RSK-175	---------------------------	---------------------------
Ethylene	RSK-175	---------------------------	---------------------------
Methane	RSK-175	---------------------------	---------------------------
2,4,6-Trichlorophenol	EPA 625, 8270D	EPA 8270D	---------------------------
2,4-Dichlorophenol	EPA 625, 8270D	EPA 8270D	---------------------------
2,4-Dimethylphenol	EPA 625, 8270D	EPA 8270D	---------------------------
2,4-Dinitrophenol	EPA 625, 8270D	EPA 8270D	---------------------------
2,4-Dinitrotoluene (2,4-DNT)	EPA 625, 8270D	EPA 8270D	---------------------------
2,6-Dinitrotoluene (2,6-DNT)	EPA 625, 8270D	EPA 8270D	---------------------------
2-Chloronaphthalene	EPA 625, 8270D	EPA 8270D	---------------------------
2-Chlorophenol	EPA 625, 8270D	EPA 8270D	---------------------------
2-Methyl-4,6-dinitrophenol	EPA 625, 8270D	EPA 8270D	---------------------------
2-Nitrophenol	EPA 625, 8270D	EPA 8270D	---------------------------
3,3'-Dichlorobenzidine	EPA 625, 8270D	EPA 8270D	---------------------------
4-Bromophenyl phenylether	EPA 625, 8270D	EPA 8270D	---------------------------
4-Chloro-3-methylphenol	EPA 625, 8270D	EPA 8270D	---------------------------
4-Chlorophenyl phenylether	EPA 625, 8270D	EPA 8270D	---------------------------
Acenaphthene	EPA 625, 8270D	EPA 8270D	---------------------------
Acenaphthylene	EPA 625, 8270D	EPA 8270D	---------------------------
Aniline	EPA 625, 8270D	EPA 8270D	---------------------------
Anthracene	EPA 625, 8270D	EPA 8270D	---------------------------
Benzidine	EPA 625, 8270D	EPA 8270D	---------------------------
Benzo(a)anthracene	EPA 625, 8270D	EPA 8270D	---------------------------
Benzo(a)pyrene	EPA 625, 8270D	EPA 8270D	---------------------------
Benzo(b)fluoranthene	EPA 625, 8270D	EPA 8270D	---------------------------
Benzo(g,h,i)perylene	EPA 625, 8270D	EPA 8270D	---------------------------
Benzo(k)fluoranthene	EPA 625, 8270D	EPA 8270D	---------------------------
bis(2-Chloroethoxy)methane	EPA 625, 8270D	EPA 8270D	---------------------------
bis(2-Chloroethyl) ether	EPA 625, 8270D	EPA 8270D	---------------------------

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
bis(2-Chloroisopropyl) ether (2,2'-Oxybis(1-chloropropane)	EPA 625, 8270D	EPA 8270D	---------------------------
bis(2-Ethylhexyl) phthalate(DEHP)	EPA 625, 8270D	EPA 8270D	---------------------------
Butylbenzylphthalate	EPA 625, 8270D	EPA 8270D	---------------------------
Chrysene	EPA 625, 8270D	EPA 8270D	---------------------------
Dibenzo(a,h)anthracene	EPA 625, 8270D	EPA 8270D	---------------------------
Diethyl phthalate	EPA 625, 8270D	EPA 8270D	---------------------------
Dimethyl phthalate	EPA 625, 8270D	EPA 8270D	---------------------------
Di-n-butyl phthalate	EPA 625, 8270D	EPA 8270D	---------------------------
Di-n-octyl phthalate	EPA 625, 8270D	EPA 8270D	---------------------------
Fluoranthene	EPA 625, 8270D	EPA 8270D	---------------------------
Fluorene	EPA 625, 8270D	EPA 8270D	---------------------------
Hexachlorobenzene	EPA 625, 8270D	EPA 8270D	---------------------------
Hexachlorocyclopentadiene	EPA 625, 8270D	EPA 8270D	---------------------------
Hexachloroethane	EPA 625, 8270D	EPA 8270D	---------------------------
Indeno(1,2,3-cd)pyrene	EPA 625, 8270D	EPA 8270D	---------------------------
Isophorone	EPA 625, 8270D	EPA 8270D	---------------------------
Nitrobenzene	EPA 625, 8270D	EPA 8270D	---------------------------
n-Nitrosodimethylamine	EPA 625, 8270D	EPA 8270D	---------------------------
n-Nitrosodi-n-propylamine	EPA 625, 8270D	EPA 8270D	---------------------------
n-Nitrosodiphenylamine	EPA 625, 8270D	EPA 8270D	---------------------------
Phenanthrene	EPA 625, 8270D	EPA 8270D	---------------------------
Phenol	EPA 625, 8270D	EPA 8270D	---------------------------
Pyrene	EPA 625, 8270D	EPA 8270D	---------------------------
Pyridine	EPA 625, 8270D	EPA 8270D	---------------------------
1,1-Biphenyl	EPA 8270D	EPA 8270D	---------------------------
1,2,4,5-Tetrachlorobenzene	EPA 8270D	EPA 8270D	---------------------------
1,2-Diphenylhydrazine	EPA 8270D	EPA 8270D	---------------------------
1,3,5-Trinitrobenzene (1,3,5-TNB)	EPA 8270D	EPA 8270D	---------------------------
1,3-Dinitrobenzene (1,3-DNB)	EPA 8270D	EPA 8270D	---------------------------
1,4-Naphthoquinone	EPA 8270D	EPA 8270D	---------------------------
1,4-Phenylenediamine	EPA 8270D	EPA 8270D	---------------------------
1-Methylnaphthalene	EPA 8270D	EPA 8270D	---------------------------
1-Naphthylamine	EPA 8270D	EPA 8270D	---------------------------
2,3,4,6-Tetrachlorophenol	EPA 8270D	EPA 8270D	---------------------------
2,4,5-Trichlorophenol	EPA 8270D	EPA 8270D	---------------------------
2,6-Dichlorophenol	EPA 8270D	EPA 8270D	---------------------------
2-Acetylaminofluorene	EPA 8270D	EPA 8270D	---------------------------
2-Methylnaphthalene	EPA 8270D	EPA 8270D	---------------------------
2-Methylphenol (o-Cresol)	EPA 8270D	EPA 8270D	---------------------------
2-Naphthylamine	EPA 8270D	EPA 8270D	---------------------------
2-Nitroaniline	EPA 8270D	EPA 8270D	---------------------------
2-Picoline (2-Methylpyridine)	EPA 8270D	EPA 8270D	---------------------------
3,3'-Dimethylbenzidine	EPA 8270D	EPA 8270D	---------------------------
3-Methylcholanthrene	EPA 8270D	EPA 8270D	---------------------------
3-Methylphenol (m-Cresol)	EPA 8270D	EPA 8270D	---------------------------
3-Nitroaniline	EPA 8270D	EPA 8270D	---------------------------

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
4-Aminobiphenyl	EPA 8270D	EPA 8270D	---------------------------
4-Chloroaniline	EPA 8270D	EPA 8270D	---------------------------
4-Dimethyl aminoazobenzene	EPA 8270D	EPA 8270D	---------------------------
4-Methylphenol (p-Cresol)	EPA 8270D	EPA 8270D	---------------------------
4-Nitroaniline	EPA 8270D	EPA 8270D	---------------------------
4-Nitroquinoline-n-oxide	EPA 8270D	EPA 8270D	---------------------------
5-Nitro-o-toluidine	EPA 8270D	EPA 8270D	---------------------------
7,12-Dimethylbenz(a)anthracene	EPA 8270D	EPA 8270D	---------------------------
a-a-Dimethylphenethylamine	EPA 8270D	EPA 8270D	---------------------------
Acetophenone	EPA 8270D	EPA 8270D	---------------------------
Aramite	EPA 8270D	EPA 8270D	---------------------------
Atrazine	EPA 8270D	EPA 8270D	---------------------------
Benzaldehyde	EPA 8270D	EPA 8270D	---------------------------
Benzoic acid	EPA 8270D	EPA 8270D	---------------------------
Benzyl alcohol	EPA 8270D	EPA 8270D	---------------------------
Caprolactam	EPA 8270D	EPA 8270D	---------------------------
Carbazole	EPA 8270D	EPA 8270D	---------------------------
Chlorobenzilate	EPA 8270D	EPA 8270D	---------------------------
Cresol, Total	EPA 8270D	EPA 8270D	---------------------------
Diallate	EPA 8270D	EPA 8270D	---------------------------
Dibenzo(a,h)pyrene	EPA 8270D	EPA 8270D	---------------------------
Dibenzofuran	EPA 8270D	EPA 8270D	---------------------------
Dimethoate	EPA 8270D	EPA 8270D	---------------------------
Diphenylamine	EPA 8270D	EPA 8270D	---------------------------
Disulfoton	EPA 8270D	EPA 8270D	---------------------------
DPH (as Azobenzene)	EPA 8270D	EPA 8270D	---------------------------
Ethyl methanesulfonate	EPA 8270D	EPA 8270D	---------------------------
Famphur	EPA 8270D	EPA 8270D	---------------------------
Hexachlorophene	EPA 8270D	EPA 8270D	---------------------------
Hexachloropropene	EPA 8270D	EPA 8270D	---------------------------
Isosafrole	EPA 8270D	EPA 8270D	---------------------------
Methapyrilene	EPA 8270D	EPA 8270D	---------------------------
Methyl methane sulfonate	EPA 8270D	EPA 8270D	---------------------------
Methyl parathion (Parathion,methyl)	EPA 8270D	EPA 8270D	---------------------------
Nitroquinoline-1-oxide	EPA 8270D	EPA 8270D	---------------------------
n-Nitrosodiethylamine	EPA 8270D	EPA 8270D	---------------------------
n-Nitroso-di-n-butylamine	EPA 8270D	EPA 8270D	---------------------------
n-Nitrosomethylethylamine	EPA 8270D	EPA 8270D	---------------------------
n-Nitrosomorpholine	EPA 8270D	EPA 8270D	---------------------------
n-Nitrosopiperidine	EPA 8270D	EPA 8270D	---------------------------
n-Nitrosopyrrolidine	EPA 8270D	EPA 8270D	---------------------------
o-Toluidine	EPA 8270D	EPA 8270D	---------------------------
Pentachlorobenzene	EPA 8270D	EPA 8270D	---------------------------
Pentachloroethane	EPA 8270D	EPA 8270D	---------------------------
Pentachloronitrobenzene	EPA 8270D	EPA 8270D	---------------------------
Phenacetin	EPA 8270D	EPA 8270D	---------------------------
Pronamide (Kerb)	EPA 8270D	EPA 8270D	---------------------------
Safrole	EPA 8270D	EPA 8270D	---------------------------

Parameter/Analyte	Non-Potable Water	Solid Hazardous Waste	Air
C9-C18 Aliphatic Hydrocarbons	MAEPH	MAEPH	---------------------------
C19-C36 Aliphatic Hydrocarbons	MAEPH	MAEPH	---------------------------
C11-C22 Aromatic Hydrocarbons	MAEPH	MAEPH	---------------------------
Diesel Range Organics (DRO)	EPA 8015	EPA 8015	---------------------------
2-Methylnaphthalene	EPA 8270	EPA 8270	---------------------------
4-Methylphenol (p-Cresol)	EPA 8270	EPA 8270	---------------------------
Toxicity Characteristic Leaching Procedure (TCLP)	EPA 1311	EPA 1311	---------------------------
Synthetic Precipitation Leaching Procedure (SPLP)	EPA 1312	EPA 1312	---------------------------
Corrosivity (pH)	NA	EPA 9040	---------------------------
Paint Filter Liquids Test	NA	EPA 9095	---------------------------
Diethyl ether	EPA 8260	EPA 8260	---------------------------
Ethyl methacrylate	EPA 8260	EPA 8260	---------------------------
Iodomethane (Methyl iodide)	EPA 8260	EPA 8260	---------------------------
Methyl cyclohexane	EPA 8260	EPA 8260	---------------------------
Methyl acetate	EPA 8260	EPA 8260	---------------------------
Isopropyl ether	EPA 8260	EPA 8260	---------------------------

Analytical Method	Prep Method			
	Soil	Water	Air	Waste
EPA 8260B	EPA 5035	EPA 5030B	----------------	EPA 5035
EPA 624	---------------------	EPA 5030B	----------------	---------------------
EPA 625	---------------------	EPA 3510C	----------------	---------------------
EPA 8270D	EPA 3545A	EPA 3510C	----------------	EPA 3580A
EPA 200.7	---------------------	EPA 200.7	----------------	---------------------
EPA 6010C	EPA 3050B	EPA 3005A	----------------	EPA 3050B
EPA 608	---------------------	EPA 3510C	----------------	---------------------
EPA 8081B	EPA 3545A	EPA 3510C	----------------	EPA 3580A
EPA 8082A	EPA 3545A	EPA 3510C	----------------	EPA 3580A
EPA 615	---------------------	EPA 615	----------------	---------------------
EPA 8151A	EPA 8151A	EPA 8151	----------------	EPA 8151A
MA VPH, May 2004 Revision 1.1	EPA 5035	EPA 5030B	----------------	---------------------
MA EPH, May 2004 Revision 1.1	EPA 3545A	EPA 3510C	----------------	---------------------
FLPRO	EPA 3545A	EPA 3510C	----------------	---------------------
8015C – GRO	EPA 5035	EPA 5030B	----------------	---------------------
8015C – DRO	EPA 3545A	EPA 3510C	----------------	---------------------
TO14A	---------------------	-------------------	TO14A	---------------------
TO15	---------------------	-------------------	TO15	---------------------
SPLP	EPA 1312	EPA 1312	----------------	EPA 1312
TCLP	EPA 1311	EPA 1311	----------------	EPA 1311