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FINAL SAMPLING AND ANALYSIS PLAN REMEDIAL INVESTIGATION FOR MILITARY MUNITIONS RESPONSE PROGRAM SITE UNEXPLODED ORDNANCE 6 (UXO6) FORMER FORTIFIED BEACH ASSAULT AREA OPERABLE UNIT 24 (OU24) MCB CAMP LEJEUNE NC
6/1/2012
CH2M HILL

Naval Facilities Engineering Command

Final

Sampling and Analysis Plan Remedial Investigation for Military Munitions Response Program Site Unexploded Ordnance (UXO)-06 - Former Fortified Beach Assault Area (ASR #2.65)/Operable Unit 24

Marine Corps Installations East-
Marine Corps Base Camp Lejeune
Jacksonville, North Carolina
June 2012

Contract No. N62470-11-D-8012 | CTO-WE12

prepared by CH2MHILL.

SAP Worksheet #1: Title and Approval Page

Final

Sampling and Analysis Plan
Remedial Investigation for Military Munitions Response Program Site Unexploded Ordnance (UXO)-06 - Former Fortified Beach Assault Area (ASR #2.65)/Operable Unit 24

Marine Corps Installation East- Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Contract N62470-11-D-8012
CTO-WE12

June 2012

Prepared for:

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

Prepared under:

NAVFAC CLEAN 8012 Program

Prepared by:

CH2MHILL

Charlotte, North Carolina

NORTH CAROLINA
PROFESSIONAL
SEAL
038950
ENGINEER
THOMAS M. ROTH

6/22/2012

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Review Signature:

June 6, 2012

Lael-Ruth Feist, P.E. — Date
CH2M HILL – Project Manager

Thomas M. Roth
Digitally signed by Thomas M. Roth
DN: cn=Thomas M. Roth, o=CH2M HILL, Inc., ou=ESBG, email=tom.roth@ch2m.com, c=US
Date: 2012.06.04 17:05:00 -04'00'

Thomas M. Roth, P.E. — Date
CH2M HILL – Senior Technical Consultant

6/6/12

Chris Bozzini — Date
CH2M HILL – Activity Quality Manager

Approval Signature:

Date
NAVFAC Atlantic – Chemist/QA Officer

Other Approval Signature:

06-06-2012

Dave Cleland — Date
NAVFAC Mid-Atlantic – Remedial Project Manager

6/6/2012

Gena Townsend — Date
USEPA Region 4 – Remedial Project Manager

6/06/12

Randy McElveen — Date
NCDENR – Remedial Project Manager

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Executive Summary

This document presents the plan for the remedial investigation (RI) at Site Unexploded Ordnance (UXO)-06, Former Fortified Beach Assault Area (ASR#2.65)/Operable Unit 24, herein referred to as Site UXO-06, located at Marine Corps Installations East- Marine Corps BaseCamp Lejeune (MCIEAST-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) 8012 Contract N62470-11-D-8012, Contract Task Order WE12 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 MCIEAST-MCB CamLej.

Environmental Conservation Laboratories, Jacksonville, Florida, as well as GEL Laboratories, Charleston, South Carolina will be responsible for analyzing environmental samples from Site UXO-06. 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 Site-Specific Work Plan Addendum for RI at Site UXO-06 (CH2M HILL, 2011a) describes the field plan to define the nature and extent of MEC contamination associated with historical munitions use at Site UXO-06. This SAP is Appendix D to the Site-Specific Work Plan Addendum. Field activities to be conducted during the RI include surveying, vegetation clearance, digital geophysical mapping, intrusive investigation, and, if warranted, environmental characterization sampling. Because previous sampling within Site UXO-06 indicated no unacceptable risk to human health or ecological receptors where there was a high frequency of MEC/MPPEH discovery, environmental characterization activities described in this SAP in the remaining area of Site UXO-06 and in the vicinity of its boundaries is limited. Environmental characterization sampling activities will be required only if MEC/MPPEH items with exposed fillers are identified or MEC items are disposed via controlled detonation onsite.

If one or more of these conditions is met and environmental characterization sampling is therefore triggered, the objective of this SAP will be to assess the absence or presence of munitions constituents (MC) within the investigation area. This objective will be achieved through sampling and analysis of environmental media for MC explosives residues including pentaerythritol tetranitrate [PETN] and nitroglycerin and perchlorate. In addition, Target Analyte List [TAL] metals will be analyzed in post-detonation samples. Analytical results will be incorporated into human health and ecological risk screenings, followed by human health risk assessment (HHRA) and baseline ecological risk assessment (BERA) if necessary.

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/Site-specific Health and Safety Plan (APP/SSHSP) is **Appendix A of the Work Plan**. Upon approval of this Draft UFP-SAP, the field effort will be scheduled and executed, including sampling activities as appropriate.

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SAP Worksheets

Figures

Attachments

Acronyms and Abbreviations

ABP	agent breakdown product
AHA	activity hazard analysis
AM	Activity Manager
APP	accident prevention plan
AQM	Activity Quality Manager
ASR	archive search report
ASTM	American Society for Testing and Materials
BERA	baseline ecological risk assessment
bgs	below ground surface
BIP	blow-in-place
BTV	background threshold value
C°	Celsius
CA	corrective action
CCV	continuing calibration verification
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	contaminant of concern
COPC	constituent of potential concern
CS	chlorobenzylidenemaloonitrile
CSM	conceptual site model
CTO	Contract Task Order
DDT	dichlorodiphenyltrichloroethane
DGM	digital geophysical mapping
DL	detection limit
DMM	discarded military munitions
DO	dissolved oxygen
DoD	Department of Defense
DPT	direct push technology
DQI	data quality indicator
DQO	data quality objective
DU	decision unit
DV	data validation
EDD	electronic data deliverable
ELAP	Environmental Laboratory Accreditation Program
EMD	Environmental Management Division
ERA	Ecological Risk Assessor
ERO	diesel range organic
ft/ft	feet per foot
FTL	field team leader
GPS	Global Positioning System
GRO	gasoline range organic
GW	groundwater

H&S	health & safety
HHRA	Human Health Risk Assessor
HSP	health and safety plan
ICAL	initial calibration
ICP	Inductively Coupled Plasma
ICS	interference check solutions
ICV	initial calibration verification
IDW	investigation-derived waste
IS	incremental sampling
IS	internal standard
LCS	laboratory control sample
LIMS	Laboratory Information Management Systems
LOD	limit of detection
LODV	limit of detection verification
LOQ	limit of quantitation
mg/kg	milligrams per kilogram
µg/kg	micrograms per kilogram
µg/l	micrograms per liter
MC	munitions constituents
MCIEAST-MCB CamLej	Marine Corps Installations East- Marine Corps Base Camp Lejeune
MD	munitions debris
MDL	method detection limit
MEC	munitions and explosives of concern
mm	millimeter
MPPEH	material potentially presenting an explosive hazard
MQO	measurement quality objectives
MS/MSD	matrix spike/matrix spike duplicate
mV	millivolt
NAVFAC	Naval Facilities Engineering Command, Mid-Atlantic
NC SSL	North Carolina Soil Screening Level
NCAC	North Carolina Administrative Code
NCDENR	North Carolina Department of Environment and Natural Resources
NCGWQS	North Carolina Water Quality Standards for Groundwater
NIRIS	Naval Installation Restoration Information Solution
NRWQC	National Recommended Water Quality Criteria
ONWASA	Onslow County Water and Sewer Authority
ORP	oxidation reduction potential
ORR	Operational Readiness Review
PA/SI	preliminary assessment/site investigation
PAL	project action limit
PC	project chemist
PE	Professional Engineer
PETN	pentaerythritol tetranitrate
PG	Professional Geologist
PM	Project Manager
POC	point of contact
PQL	project quantitation limit

PQO	project quality objective
PRG	Preliminary Remediation Goal
PS	post spike
PVC	polyvinyl chloride
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
RSL	Regional Screening Level
SAP	sampling and analysis plan
SB	subsurface soil
SBO	Safe Behavior Observation
SD	sediment
SOP	standard operating procedure
SS	surface soil
SS HSP	Site Specific Health & Safety Plan
SSC	site safety coordinator
SSL	soil screening level
SVOC	semivolatile organic compounds
SW	surface water
TAL	target analyte list
TBD	to be determined
TCL	target compound list
TOC	total organic carbon
TPH	total petroleum hydrocarbon
UFP	Uniform Federal Policy
USACE	United States Army Corps of Engineers
USEPA	United States Environmental Protection Agency
UST	underground storage tank
UXO	unexploded ordnance
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-06

Operable Unit: N/A

Contractor Name: CH2M HILL

Contract Number: N62470-11-D-8012

Contract Title: Navy Comprehensive Long-Term Environmental Action Navy (CLEAN) 8012

Work Assignment Number (optional): Contract Task Order (CTO) WE12

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 dates of scoping sessions that were held:

Scoping Session	**Date**
Partnering Session	November 16, 2011
5. List dates and titles of any SAP documents written for previous site work that are relevant to the current investigation.

   Not applicable
6. 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
   - MCIEAST-MCB CamLej – site owner
7. Lead organization: U.S. Department of Navy – Lead Agency
8. 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	MCIEAST-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	RPM	NCDENR	(919) 707-8341	randy.mcelveen@ncdenr.gov
Matt Louth	Activity Manager (AM)	CH2M HILL	(757) 671-6240	matt.louth@ch2m.com
Chris Bozzini	Activity Quality Manager (AQM)	CH2M HILL	(704) 544-5163	chris.bozzini@ch2m.com
Tom Roth	Senior Technical Consultant	CH2M HILL	(404) 474-7640	tom.roth@ch2m.com
Teg Williams	Subject Matter Expert	CH2M HILL	(704) 543-3297	tegwyn.williams@ch2m.com
Tamir Klaff	Senior Geophysicist	CH2M HILL	(202) 596-1199	tamir.klaff@ch2m.com
Lael Feist	Project Manager (PM)	CH2M HILL	(256) 529-7671	laelruth.feist@ch2m.com
Brett Doerr	UFP-SAP Reviewer	CH2M HILL	(757) 671-6219	brett.doerr@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		

SAP Worksheet #3: Distribution List (continued)

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
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
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
Doug Weaver	Data Validator	EDS	(757) 564-0090	dweaver.env-data.com

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	MCIEAST-MCB CamLej/ EMD	(910) 451-9386			
Nick Schultz	MCIEAST-MCB CamLej/ EMD	(910) 451-9114			
Matt Louth	CH2M HILL/ AM	(757) 671-6240			
Chris Bozzini	CH2M HILL/AQM	(704) 544-5163			
Brett Doerr	CH2M HILL / Navy CLEAN Program UFP-SAP Reviewer	(757) 671-6219			
Tom Roth	CH2M HILL/ Senior Technical Consultant	(404) 474-7640			
Teg Williams	CH2M HILL/ Subject Matter Expert	(704) 543-3297			
Tamir Klaff	CH2M HILL/ Senior Geophysicist	(202) 596-1199			
Lael Feist	CH2M HILL/PM	(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/Laboratory PM	(407) 826-5314			
Lori Mangram	ENCO/Laboratory QAO	(407) 826-5314			
Ann Skradski	GEL/ Laboratory PM	(843) 556-8171			
Robert Pullano	GEL/Laboratory QAO	(843) 556-8171			
Doug Weaver	Environmental Data Services, Inc. (EDS) /Data Validator	(757) 564-0090			

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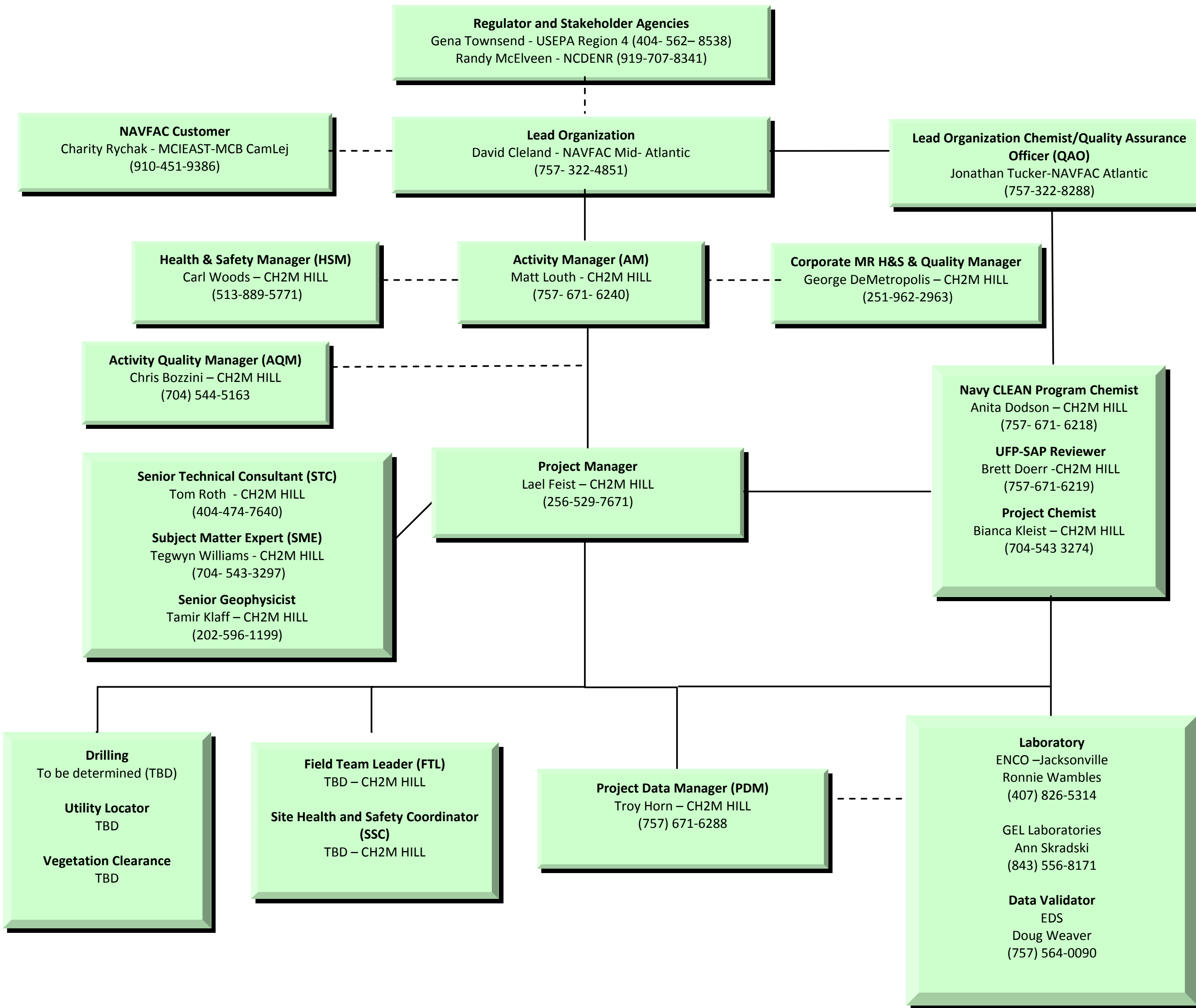
SAP Worksheet #5: Project Organizational Chart



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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	Randy McElveen	randy.mcelveen@ncdenr.gov (919) 707-8341	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 STCs/SMEs	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	Lael Feist	laelruth.feist@ch2m.com	All information and materials about the project will be forwarded to the Navy NTR/RPM, AM, and Senior Consultants as necessary. POC for field sampling team. Responsible for field team members’ and subcontractors adherence to work plan.

SAP Worksheet #6: Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure, Pathway, etc.
Health and Safety (H&S)	CH2M HILL SSC	TBD		Responsible for the adherence of team members to the site safety requirements described in the Site Specific Health and Safety Plan (SSHSP). 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. The PC will inform the PM immediately, who in turn will inform the Navy NTR/RPM.
Reporting Data Validation Issues	Data Validation (DV) PM	Doug Weaver	dweaver@env-data.com (757) 564-0090	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	MCIEAST-MCB CamLej	Oversees project
Nick Shultz	Environmental Engineer, Base Environmental Management Division	MCIEAST-MCB CamLej	Oversees project
Gena Townsend	USEPA RPM	USEPA	USEPA POC
Randy McElveen	NCDENR RPM	NCDENR	NCDENR POC
Matt Louth, PG	Activity Manager	CH2M HILL	Oversees project activities
Chris Bozzini	Activity Quality Manager	CH2M HILL	Oversees project quality
Brett Doerr	Navy CLEAN Program UFP-SAP Reviewer	CH2M HILL	Navy CLEAN Program UFP-SAP Reviewer
Tom Roth, PE	Senior Technical Consultant	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	Subject Matter Expert	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
Lael Feist, PE	Project Manager	CH2M HILL	Manages Project and coordinates project tasks and project staff
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
Doug Weaver	Data Validator	EDS	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: Remedial Investigation, Site UXO-06	
Projected Date(s) of Sampling: April-May 2012	**Site Name:**UXO-06 CamLej
PM: Lael Feist	**Site Location:** CamLej, Jacksonville, North Carolina

Dates of Session: November 16, 2011

Scoping Session Purpose: The purpose of the scoping session was to present the Site UXO-06 (ASR#2.65) 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
Nick Schultz	RPM	EMD EMC CamLej	910-451-9114	nicholas.a.schultz@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
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 Activity Quality Manager	CH2M HILL	704-544-5163	chris.bozzini@ch2m.com	Activity Quality Manager for CamLej projects

Comments/Decisions:

Consensus: The Team agrees with the RI approach for Site UXO-06 to further define the nature and extent of MEC/MPPEH by conducting at least 3.3% DGM and 100% intrusive investigation within undeveloped areas of the site not previously investigated and along the current site boundaries. Environmental sampling will be conducted for MC analysis if MEC/MPPEH items with exposed fillers are identified or controlled detonation of MEC/MPPEH is conducted.

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 DGM, intrusive investigation, and environmental sampling for MC (if MEC/MPPEH items with exposed fillers are identified or detonation of MEC/MPPEH is conducted) for the RI of Site UXO-6 is acceptable. The Team will receive and comment on the Work Plan and UFP-SAP.

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SAP Worksheet #10: Problem Definition

The Site-Specific Work Plan Addendum for RI at Site UXO-06 (CH2M HILL, 2011a) describes the field plan to define the nature and extent of MEC contamination associated with historical munitions use at Site UXO-06. This SAP is Appendix D to the Site-Specific Work Plan Addendum.

The objective of this SAP is to define the nature and extent of contamination by MEC and MC associated with Site UXO-06. DGM and analog electromagnetic detector survey, intrusive investigation of anomalies selected as potentially representing subsurface MEC, and environmental characterization sampling (if warranted) will be performed in uninvestigated portions of Site UXO-06 and in areas in the vicinity of Site UXO-06.

Because previous sampling within Site UXO-06 indicated no unacceptable risk to human health or ecological receptors where there was a high frequency of MEC/MPPEH discovery, environmental characterization activities, as described in this SAP, in the remaining area of Site UXO-06 and in the vicinity of its boundaries are limited. Further environmental characterization sampling will be conducted only if MEC/MPPEH items with exposed fillers are identified or if MEC items are disposed onsite by controlled detonation.

If either of these conditions is met and environmental characterization sampling is conducted, an additional objective of this SAP will be to assess the presence or absence of munitions constituents (MC) at locations where MEC/MPPEH items with exposed fillers are identified or MEC items are detonated. This objective will be achieved through sampling and analysis of environmental media for MC (explosives residues including pentaerythritol tetranitrate [PETN] and nitroglycerin and perchlorate; in addition, Target Analyte List [TAL] metals will be analyzed in post-detonation samples. (Samples collected where MEC/MPPEH items with exposed fillers are identified will not be sampled for Target Analyte List [TAL] metals on the basis that metals are contributed by munitions casings. In addition previous sampling at Site UXO-06 where MEC/MPPEH were identified have not identified unacceptable risk to human health or ecological receptors.) Analytical results will be incorporated into human health and ecological risk screenings, followed by human health risk assessment (HHRA) and baseline ecological risk assessment (BERA) if necessary.

Site Background and History

Site UXO-06 (ASR #2.65) is located in the Mainside of MCIEAST-MCB CamLej and is approximately 177 acres in size as shown on **Figure 10-1**. The investigation area is an approximately 206-acre area that includes previously uninvestigated areas in the northwest and southeast portion of Site UXO-06 and areas outside the Site UXO-06 boundaries as shown on **Figure 10-2**. The southern boundary of the investigation area is formed by an active operational area that is not subject to closeout.

The investigation area is located south of McHugh Boulevard and west of Sneads Ferry Road. The portion of the investigation area north of Gonzalez Boulevard, which crosses through Site UXO-06, is mostly developed, while the portion of the investigation area south of Gonzalez Boulevard is largely undeveloped. The developed portion consists of buildings, roads, and parking areas with some wooded areas near drainages. The undeveloped section south of Gonzalez Boulevard consists of wooded areas, ponds, streams, wetlands, and a 51-acre active borrow pit which is used for on-base construction fill material. The borrow pit is currently planned for expansion over approximately 54 additional acres as shown on **Figure 10-2**.

Site UXO-06 was used from 1953 until 1977 as a training area for fortified beach assault and assault of fortified positions. All fire was directed away from service roads and main thoroughfares. During initial site operations from 1953 to 1970, the range was authorized to use blank small arms, demolitions, practice rockets, flame throwers, smoke grenades and pyrotechnics (USACE, 2001). From 1970 until range closure in 1977, the range was authorized to use blank small arms, 3.5-inch practice rockets, thickened and unthickened fuel, half pound demolitions, practice rifle grenades, and smoke and white phosphorus hand grenades (USACE, 2001). The potential hazards at this former range are posed by MEC in the form of UXO and discarded military munitions

SAP Worksheet #10: Problem Definition (continued)

(DMM), and MC. Potential MEC would be primarily located at the surface, but over the years, construction and other ground movement may have caused the MEC to become buried to an unknown depth. Burial and intentional discard of munitions may have also occurred.

The investigation area is partially undeveloped. There is no fencing or other access restrictions to the site. The investigation area is accessible to anyone with Base access.

Previous Site Investigations

Table 10-1 summarizes the historical investigations at Site UXO-06. **Figure 10-3** presents the investigation areas for the SI in the MILCON area, the focused PA/SI along the sewer easement, and the focused SI in the borrow pit expansion area. **Figure 10-4** presents all previous environmental characterization sampling locations.

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. If additional sampling and analysis of environmental media is performed where MEC/MPPEH is found during the RI field effort, the existing conceptual site model (CSM) will be revised and the exposure pathways, discussed below, will be evaluated using the environmental data.

Physical Characteristics

The investigation area consists of unpaved areas within developed areas near Gonzales and McHugh Boulevards. South of Gonzales Boulevard, the investigation area is wooded. Regional topography and drainage at MCIEAST-MCB CamLej is discussed in the MCIEAST-MCB CamLej Master Project Plans (CH2M HILL, 2009), referred as the Master Plans herein. The investigation area is generally typical of the North Carolina Coastal Plain. Except for the borrow pit area, where topographic relief is approximately 40 feet, the site topography varies from 0-25 feet above sea level. The investigation area is relatively flat near the developed areas surrounding Gonzales Boulevard, with local depressions near Cowhead Creek and an existing unnamed tributary. Surface runoff generally flows south and southwest towards these water bodies or directly into French's Creek located on the southern boundary of the investigation area. Cowhead Creek and its tributary also discharge into French's Creek, a tributary of the New River.

SAP Worksheet #10: Problem Definition (continued)

TABLE 10-1
Previous Investigations at Site UXO-06

Investigation and Location within UXO-06	Year	Media Investigated	Purpose of Investigation	Target Analytes	Activities	MEC	Results and Conclusions
Focused Site Inspection (MILCON Area)	2006	Surface and subsurface soil, groundwater	Identify and remove MEC hazards that would impede construction, identify MC risks to human health	Explosives residues, TCL VOCs, SVOCs, pesticides, PCBs, herbicides, Total petroleum hydrocarbons (TPH), TAL metals	DGM over 100% of the 4.4-acre area Intrusive investigation of selected anomalies Collection of 20 surface soil (0-6 inches) and 20 subsurface soil samples (5-12 feet bgs) Installation of five temporary monitoring wells (10-40 feet bgs)	One M29 series 3.5-inch practice rocket, one M18 colored smoke hand grenade with M201A1 fuze, one MK13 MOD-0 Marine Hand Signal Flare	Potential human health Chemicals of Potential Concern (COPCs) in soil: arsenic, iron, vanadium; in groundwater dissolved iron, dissolved manganese Potential ecological COPCs in soil: dieldrin, endrin, aluminum, chromium, iron, manganese, vanadium, TPH In soil, dieldrin and iron exceeded NCSSLs In groundwater, bis-(2-Ethylhexyl)phthalate, dissolved iron, dissolved manganese exceeded NC2LGWs
Focused Preliminary Assessment/Site Inspection (Arcadis and Zapata for Onslow County Water and Sewer Authority)	2007	Subsurface soil, groundwater	Identify and remove MEC hazards that would impede construction along sewer easement, identify and mitigate MC risks to human health	Explosives residues, perchlorate, cyanide, TCL VOCs, SVOCs, pesticides, PCBs, herbicides, TAL metals, TPH, total organic carbon, total organic halogens	100% DGM of the proposed easement Intrusive investigation Collection of 42 subsurface soil samples (3-7feet bgs) Installation of two temporary monitoring wells to 8 feet bgs.	None, two MPPEH items encountered (M29 3.5-inch practice rocket, M22 smoke rifle grenade, expended)	In subsurface soil, arsenic and vanadium exceeded USEPA Region 9 PRGs and NCSSLs Metals detected above USEPA Tap Water PRGs and NCGWQS were attributed to suspended solids Concluded that site media did not pose an unacceptable risk to construction workers
Preliminary Assessment/Site Inspection, Site UXO-06	2007-2008	Surface and subsurface soil, surface water, sediment, and groundwater	Gather geophysical data along transects covering 10% of Site UXO-06 as a preliminary step in assessing the nature and extent of potential subsurface MEC. Evaluate potential presence and nature of impact to environmental media from historical munitions use.	Explosives residues; perchlorate; TAL metals, TCL VOCs, SVOCs, pesticides, TPH DRO and GRO	DGM along transects covering 10% of Site UXO-06 Intrusive investigation Collection of 3 incremental surface soil samples and48 TR-02-1 surface soil samples (0-2 inches bgs),25 discrete surface soils samples (0-6 inches bgs), 25 subsurface soil samples (up to 8 ft bgs), 7 surface water samples, 7 sediment samples, 17 groundwater samples (from 8-20 feet bgs).	None. 297 MPPEH items identified, including four burial pits of MPPEH.	In surface soil, aluminum, arsenic, chromium, iron, manganese, and thallium exceeded at least one regulatory standard and base background. The SVOC pentachlorophenol and the pesticide dieldrin exceeded NCSSLs in surface soil. In subsurface soil, aluminum, arsenic, iron, and manganese exceeded at least one regulatory standard and base background. The VOC methylene chloride exceeded the NCSSL in subsurface soil. In surface water, aluminum, beryllium, chromium, iron, thallium, vanadium, the SVOC bis(2-ethylhexyl)phthalate, and pesticides DDT and dieldrin exceeded at least one regulatory standard. In sediment, aluminum and arsenic exceeded at least one regulatory standard. In groundwater, total metals antimony, arsenic, chromium, cobalt, iron, manganese, and thallium exceeded at least one regulatory standard and base background; and dissolved iron and manganese exceeded base background and at least one regulatory standard. (In March 2011 dissolved iron and manganese were not detected in three permanent wells installed in proximity to three former temporary well locations). The VOC methylene chloride and SVOC bis(2-ethylhexyl)phthalate exceeded at least one regulatory standard. No unacceptable risk to human health or ecological receptors was identified. No further sampling for MC was recommended.
Focused Site Inspection for Site UXO-06 Base Borrow Pit Expansion	2008-2010	Surface and subsurface soil samples	100% clearance of MEC over the 54-acre borrow pit expansion area, environmental characterization sampling to characterize any existing risks posed by MC in soil	Explosives residues (including PETN and nitroglycerin), perchlorate, TAL metals	100% DGM of borrow pit expansion area Intrusive investigation Collection of Two surface soil (0-6 inches bgs), three subsurface soil samples (from 8 to 22 feet bgs), 2 post-detonation soil samples	One 3.5inch HEAT Rocket, M28A2; one Rifle Grenade, M20A1; one MKI illuminating hand grenade	In surface soil, aluminum arsenic, chromium, and iron exceeded at least one regulatory standard and base background 2,4,6-trinitrotoluene and RDX were detected above the adjusted USEPA Residential Soil RSLs in one post-detonation sample. Human health screening for the Phase I1A Borrow Pit indicated there would be no unacceptable human health risks associated with exposure to soil by any of the potential receptors. Human health and the ecological risk screenings conducted for the Phase 1 borrow pit expansion area concluded that soil does not pose any unacceptable risk above background levels to human health or ecological receptors; therefore, no further evaluation of soil was recommended in the Phase 1 borrow pit expansion area.

DRO- diesel range organics
GRO- gasoline range organics
NC2LGW- North Carolina Groundwater Quality Standards, Groundwater
NCQWQS- North Carolina Groundwater Quality Standards
NCSSLs- North Carolina Soil Screening Levels
PCBs - polychlorinated biphenyls
PETN- pentaerythritol tetranitrate
PRGs- preliminary remediation goals
SVOC- semivolatile organic compound
TAL - Target Analyte List
TCL – Target Compound List
TPH- total petroleum hydrocarbons
VOCs- volatile organic compounds

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SAP Worksheet #10: Problem Definition (continued)

The geology underlying Site UXO-06 consist of layered laterally-discontinuous fine grained soil, consistent with the Tidewater region of the Atlantic Coastal Plain Physiographic Province. The soil is of marine and non-marine sources, ranging in age from early Cretaceous to Holocene. Soil consists of layered interfingered beds and lenses of sands, silts, clays, calcareous clays, shell beds, sandstone, and limestone that were deposited over pre-Cretaceous crystalline bedrock.

Site-specific hydrogeological information was derived from the installation of 14 shallow temporary monitoring wells within Site UXO-06. Groundwater is present approximately 5-10 feet bgs, and discharges to the surface in the borrow pit area, east of the Site UXO-06 boundary (**Figure 10-5**). The potentiometric surface suggests that groundwater west of the unnamed north-south tributary that bisects Site UXO-06 flows towards the south/southwest. Groundwater east of this tributary generally flows to the south/southeast towards Cowhead Creek. All groundwater flow in the surficial aquifer at Site UXO-06 appears to flow towards tributaries to French's Creek. Horizontal hydraulic gradients calculated from the surficial potentiometric surface ranges from 0.0001 feet per foot (ft/ft) to 0.0033 ft/ft) within Site UXO-06.

Potential Sources of Release

Potential source areas of MEC contamination are expected to be located in areas of historical munitions use. Based on previous investigations, the highest density of MEC/MPPEH has been located in the southeast corner of Site UXO-06 (**Figure 10-6**). However, isolated MEC items were also found in the MILCON area near Gonzalez Boulevard, and MPPEH has been found in the vicinity of the northeast, south, and southwest boundaries of Site UXO-06.The extent of MEC has not been assessed beyond the Site UXO-06 boundary as established by ASR #2.65.

MEC may be present on the surface or in the subsurface. Based on burial pits found within Site UXO-06, items may be found up to 6 feet bgs. The primary source of MEC contamination at this site is assumed to be from intentional disposal random discards or historical impact areas. A potential secondary source of contamination may be environmental media potentially contaminated by MC associated with MEC. MEC with exposed filler may have the potential to release explosives residues (including PETN and nitroglycerine) and perchlorate. Detonation of MEC/MPPEH may release explosives residues (including PETN and nitroglycerine) and perchlorate, and TAL metals (including mercury). In past investigations, aluminum, arsenic, chromium, cobalt, iron, manganese, thallium, vanadium have been detected above regulatory standards in site media, but did not present unacceptable risks to human health or environmental receptors.

Fate and Transport

A transport pathway describes the mechanisms whereby site-related constituents, once released, may be transported from a source area to exposure media (such as surface soil) where receptor exposures may occur. Explosives residues, and perchlorate may be present on the ground surface and in the shallow subsurface soils and could potentially be transported into surface water bodies and underlying sediments. Surface MC could potentially become dissolved by precipitation and, along with subsurface MC, could subsequently leach through the vadose zone until reaching the water table. Thereafter, the dissolved MC 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.

The origin of the MC would be from munitions use or discard of munitions in the investigation area 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.

SAP Worksheet #10: Problem Definition (continued)

The primary mechanisms for transport of constituents from the potential source areas include:

- Direct deposition of munitions on the ground surface and/or burial in the subsurface via filling, disposal operations, random discards, or firing (impact areas)
- Transportation or migration of munitions items by erosion, soil disturbance or souvenir hunters/collectors
- Transport of contaminated soil particulates via overland surface runoff to downgradient terrestrial areas and/or surface water bodies
- Transport of contaminated soil particulates via wind or soil disturbing activities to surrounding terrestrial areas and/or surface water bodies
- Leaching of chemicals from surface/subsurface soils into groundwater via infiltrating precipitation (and potential discharge of contaminated groundwater into downgradient surface water bodies)
- Uptake by biota from soil, surface water, and sediment and trophic transfer to upper trophic level receptors

Potential Receptors

Potential current receptors include visitors/trespassers and occasional site workers (who sporadically excavate loads of soil from the borrow pit expansion area). The current visitors/trespassers may come in contact with surface soil, surface water, and sediment. Exposure routes may include incidental ingestion of and dermal contact with the surface soil, inhalation of particulate emissions from the surface soil, and incidental ingestion of and dermal contact with surface water and sediment.

Potential future receptors who could be exposed to soil include the current receptors (visitors, trespassers, and occasional site workers), and if the site is developed for future use, future residents, construction workers, or site workers. Future receptors could be exposed to surface and subsurface soil if future residential houses or industrial buildings or underground utilities are constructed and the soil is re-worked, mixing the subsurface soil with the surface soil. If building at the site is permitted, exposure routes for future exposure to soil are the same as those for current exposure to surface soil. Future farming, hunting, or fishing at the site could result in exposure to MC through ingestion of vegetation, game, and fish.

Potable water supplies for MCIEAST-MCB CamLej and the surrounding residential area are provided by water supply wells that pump groundwater from the Castle Hayne aquifer; therefore, there is no current exposure to shallow groundwater at Site UXO-06 via drinking water supplies. Although freshwater is present within the surficial, Castle Hayne, Beaufort, and Peedee aquifers, all of which are located below MCIEAST-MCB CamLej, only the Castle Hayne aquifer is used by MCIEAST-MCB CamLej as a water supply source (Cardinell, Berg, and Lloyd, 1993). There are no active water supply wells within a 1,000-foot radius of Site UXO-06. The groundwater use patterns are already established for the Base and area around Site UXO-06; thus, use of site groundwater for industrial or residential purposes is unlikely. However, state and federal governing policies assume that underground fresh water resources are potable and should be aimed to be maintained as such. Therefore, a potable use scenario is considered a potential exposure scenario. It is assumed if future residential development of the site or areas near the site occurs, the residents could use the groundwater as a potable water supply. The residents could be exposed through ingestion, dermal contact, and inhalation while bathing. It is also assumed that the groundwater could be used as a future potable water supply for the base, resulting in exposure to future industrial workers through incidental ingestion. Additionally, due to the groundwater depth (from 5 to 10 feet bgs), construction workers could be exposed to the groundwater through inhalation and dermal contact in an excavation during construction activities. Borrow pit workers may be exposed to groundwater via dermal contact, ingestion, and inhalation where groundwater discharges to the borrow pit.

SAP Worksheet #10: Problem Definition (continued)

Because VOCs were not identified as presenting unacceptable risk to human health or ecological receptors, vapor intrusion into current or future buildings is not considered an exposure pathway of concern.

Based on the habitats and biota present, there are potentially complete exposure pathways for terrestrial and semi-aquatic receptors (e.g., plants, invertebrates, birds and mammals) using the habitats within and adjacent to this site (i.e., exposure to contaminated surface soil, surface water, and sediment).

Problem Definition

The nature and extent of MEC/MPPEH associated with munitions use has not been sufficiently defined in the southeast corner of Site UXO-06, and where MPPEH and MD has been found adjacent to the site boundaries. Areas surrounding Site UXO-06 have not been accessed for MEC/MPPEH or MC impact. If MEC items with exposed fillers are identified in the planned investigation area, it is possible release(s) of MC have occurred that pose a potentially unacceptable risk to human health and/or ecological receptors; therefore, further assessment is warranted. Previous investigations of soil, groundwater, surface water and sediment within Site UXO-06, where MEC/MPPEH items were found at high frequencies, did not indicate that MC posed any unacceptable risk to human health or ecological receptors. As a result, environmental characterization sampling during the RI will only be performed if MEC/MPPEH items with exposed fillers are identified or if MEC items are disposed via controlled detonation onsite.

If MEC/MPPEH is identified, the environmental questions and problems to be addressed by the investigation are:

1. **Are geophysical anomalies representing potential MEC present at the site**?

   To address this question, a DGM survey using a Geonics EM61-MK2 will be conducted over approximately 9.9 acres of 4-foot wide transects at the site **(Figure 10-7).** DGM survey results will be compared to a threshold response determined by the geophysical systems verification at the site, described in Appendix by of the Work Plan Addendum. DGM survey results exceeding the threshold response will be identified as anomalies. In areas inaccessible to DGM equipment, handheld metal detectors (Schonstedt GA-52Cx or equivalent) will be used to detect anomalies; all detected anomalies will be subsequently investigated in a “mag and dig” operation.

2. **Have there been releases of MC to soils?**

   If MEC/MPPEH is found with exposed filler, one discrete or TR-02-1 sample will be collected. (The sampling methodology will be based on the visible extent of filler. If a 1-meter × 1-meter area or most of a 1-meter × 1-meter area appears impacted, a TR-02-1 sample would be appropriate; otherwise a discrete a discrete sample will be collected.)

   Surface soil samples will be collected at depths of 0 to 2 inches bgs. If the TR-02-1 sampling method is employed, the surface soil sampling location will be defined as an area 1 meter × 1 meter in size. A minimum of 30 sample increments will be collected from random locations within each 1-meter × 1-meter sampling location. Discrete samples will be collected as grab samples.

   If detected analytes exceed regulatory screening criteria and base background threshold values in surface soil, subsurface soil samples will be collected at the locations of the sample exceedance(s) during a separate sampling event. In this case, subsurface soil samples will be collected from unsaturated soil immediately above the water table (estimated at 5-10 feet bgs).

   If MEC/ MPPEH is identified and detonated onsite, surface soil samples will be collected at locations where controlled detonations/blow-in-place (BIP) operations are conducted.

SAP Worksheet #10: Problem Definition (continued)

Two post-detonation soil samples will be collected at each location where MEC/MPPEH disposal by detonation is performed. Composite surface soil samples will be collected from the center of the detonation using the TR-02-1 sampling approach. The IS method will be utilized to collect a sample of soil ejected from the crater. The DU for the post-detonation sample collected outside the crater (outside the 3-foot × 3 foot TR-02-01 sampling area) will be roughly circular and centered upon the crater, with a radius of up to 5 feet to encompass the visible ejecta pattern.

Soil samples will be analyzed for explosives residues (including PETN and nitroglycerine), perchlorate, and TAL metals (including mercury).

<u>Have there been releases of MC to groundwater</u>? This question will be addressed by collecting and analyzing groundwater samples at the locations, if any, where surface soil sample analytical results exceed both regulatory screening criteria and base background \threshold values. Groundwater monitoring wells will be installed via hollow stem auger and will be installed to bracket the water table. Groundwater samples will be collected from newly installed wells.

If new groundwater monitoring wells are installed, groundwater samples will be also be collected from three existing permanent monitoring wells (MR06-MW01 through MR06-MW03).

Groundwater samples will be analyzed for explosives residues (including PETN and nitroglycerine) and perchlorate

3. **<u>Have there been releases of MC to surface water</u>?** For each location where surface soil sample analytical results exceed both regulatory screening criteria and base background threshold values that has adjacent or downgradient surface water (unnamed tributaries of Cowhead Creek, Cowhead Creek, and any wetlands), surface water samples will be collected to assess potential MC releases to surface water. Topography and distances between surface water and surface soil sampling locations will be evaluated to determine the need for surface water sampling. Samples will be collected as grab samples first from downstream locations and then from upstream locations. Surface water samples will be analyzed for explosives residues (including PETN and nitroglycerine) and perchlorate.

4. **<u>Have there been releases of MC to sediment</u>?** This question will be addressed by collecting and analyzing one sediment sample co-located with each of the surface water samples described above. Sediment samples will be collected as grab samples after the surface water samples are collected. Sediment samples will be analyzed for explosives residues (including PETN and nitroglycerine)and perchlorate.

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

   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 #11: Project Quality Objectives/Systematic Planning Process Statements

This section presents the project quality objectives for the RI at Site UXO-06.

Who will use the data?

The data will be used to evaluate explosives residues and perchlorate impacts to environmental media from munitions used and possibly discarded in the investigation area. The data will be also be used to determine whether a remedial/removal action for the potential releases of MC is required and, if so, to develop and evaluate effective remedial/removal alternatives. Data from post-detonation sampling will be used to determine whether soil at controlled detonation areas will require disposal as investigation derived waste.

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:

Surface and subsurface Soil

Surface and subsurface soil analytical results will be compared to the NCDENR Soil Screening Levels (SSLs) (NCDENR, 2010a), the adjusted USEPA RSLs for industrial and residential soil (USEPA, 2011), USEPA Ecological Soil Screening Levels (USEPA, 2009a), USEPA Region 4 ecological screening values (USEPA, 2001), and background threshold values (BTVs) for combined soil types (CH2M HILL, 2011c).

Groundwater

The groundwater results will be compared to the NCGWQS (NCDENR, 2010b), USEPA Adjusted Tap Water RSLs (USEPA, 2011), NRWQC for aquatic organisms (USEPA, 2009b), USEPA Region 4 ecological screening values (USEPA, 2001), and two times the mean MCIEAST-MCB CamLej background groundwater concentrations (Baker, 2002).

Surface water

Surface water samples will be compared to the NCAC 02B Surface Water Standards (NC 2B) for human health and water supply (NCDENR, 2007b), the USEPA Tap Water RSLs (USEPA, 2011), and the NRWQC for Human Health (organisms and water + organisms criteria) (USEPA, 2006), NRWQC for aquatic organisms (USEPA, 2009b), and USEPA Region 4 ecological screening values (USEPA, 2001).

Sediment

The sediment results will be compared to the adjusted USEPA RSLs for industrial and residential soil (USEPA, 2011) and USEPA Region 4 ecological screening values (USEPA, 2001).

DGM

DGM survey results will be compared to a threshold response determined by geophysical system verification at the site. This threshold will be chosen based on the lowest amplitude at which a metallic item can be positively distinguished from signal noise using the EM61-MK2 instrumentation at the site.

What will the data be used for?

- DGM and intrusive investigation data will be used to define the nature and extent of MEC contamination associated with Site UXO-06.
- Sample analytical results will be used to evaluate the presence or absence of MC in the investigation area and evaluate human health and ecological risks posed by MC through risk screenings, and HHRA and BERA (if necessary, based on the results of the risk screenings).

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

What types of data are needed?

- DGM will be conducted on 130,928 linear feet of 4-foot wide transects over the investigation area to assess the density of geophysical anomalies representing potential subsurface MEC **(Figure 10-7)**.
- Intrusive investigation of all anomalies selected as representing potential subsurface MEC will be conducted to visually identify geophysical anomalies indicated by DGM survey and ”mag and dig” operations (for areas inaccessible to DGM equipment); results of the excavation will aid in determining locations for soil and groundwater samples.
- **Worksheet #10** defines the sample media and target analyte list to be used during this investigation of Site UXO-06. The target analyte list includes explosives residues (including PETN and nitroglycerin) and perchlorate, and TAL metals (including mercury)(only for locations where MEC/MPPEH is detonated during the investigation).
- Water quality parameters, including field testing for pH, conductivity, oxidation-reduction potential (ORP), dissolved oxygen (DO), temperature, and turbidity, will be measured during the purging of the monitoring wells and sampling of surface water.
- Lithologic logging of soil cuttings will be conducted during drilling operations. The logging activities will provide data to 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, new 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.

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. Note that for some analytes non-detects will be reported at quantitative values greater than the PAL because the laboratory’s limit of detection (LOD) is greater than the PAL; such instances are indicated by shading on **Worksheet #15**. If any specific analyte is nondetect the analyte will be considered not present, including cases where the LOD is greater than the PAL.
- Visual observations (soil saturation, staining etc.) will be used to determine appropriate well screen placement for groundwater sampling; soil saturation aids in the selection of subsurface soil sampling intervals, which will be located just above the water table.
- 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 in accordance with the CH2M HILL “Installation of Shallow Monitoring Wells SOP” **(Attachment 2**). Groundwater samples will be collected from newly installed wells and three existing permanent monitoring wells (MR06-MW01, MR06-MW02, and MR06-MW03).

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

In addition to correct installation procedures, groundwater monitoring wells 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: constant
- pH: within 0.1 pH units
- Specific conductance: within 3 percent
- Turbidity: less than 10 NTU, or as low as practicable
- Groundwater sampling procedures for Site UXO-06 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.

How much data should be collected?

- DGM and “mag and dig” data will be collected over 130,928 linear feet of 4-foot wide transects (9.9 acres) over the investigation area.
- For environmental sampling this question will be answered by the following. The number of samples and rationale are provided in **Worksheet #17**:
  - **Surface soil:** one surface soil sample will be collected from each location where MEC/MPPEH with exposed filler is identified to assess potential contamination at the location. Surface soil samples will be analyzed for explosives residues (including PETN and nitroglycerin) and perchlorate.
  - **Subsurface soil:** one subsurface soil sample will be collected from each location where surface soil sample analytical results exceed both regulatory screening criteria and base background threshold values to assess potential contamination at the location. Subsurface soil samples will be analyzed for explosives residues (including PETN and nitroglycerin) and perchlorate.
  - **Groundwater:** One groundwater monitoring well will be installed at each location where surface soil sample analytical results exceed regulatory screening criteria and base background threshold values. Groundwater samples will be also collected from the existing (3) and new monitoring wells and analyzed for explosives residues (including PETN and nitroglycerin) andperchlorate.
  - **Surface water and sediment:** One surface water sample and one sediment sample will be collected from each location where surface water (such as unnamed tributaries of Cowhead Creek, Cowhead Creek, and any wetlands) is adjacent or downgradient of surface soil sample analytical results that exceed both regulatory screening criteria and base background threshold values. Sediment and surface water samples will be analyzed for explosives residues (including PETN and nitroglycerin) andperchlorate.

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

- The environmental samples will be collected within the boundary of the investigation area as determined by MEC/MPPEH discoveries. Proposed DGM and “mag and dig” transects are shown on **Figure 10-7**.
- The proposed investigation will be conducted in April-May 2012.
- The DGM, “mag and dig” survey, and 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?

- DGM and "mag and dig" activities will be conducted by qualified subcontractors and supervised by CH2M HILL geophysicists and UXO technicians.
- Intrusive investigation of anomalies will be conducted by qualified subcontractors and supervised by CH2M HILL UXO technicians.
- 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 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.

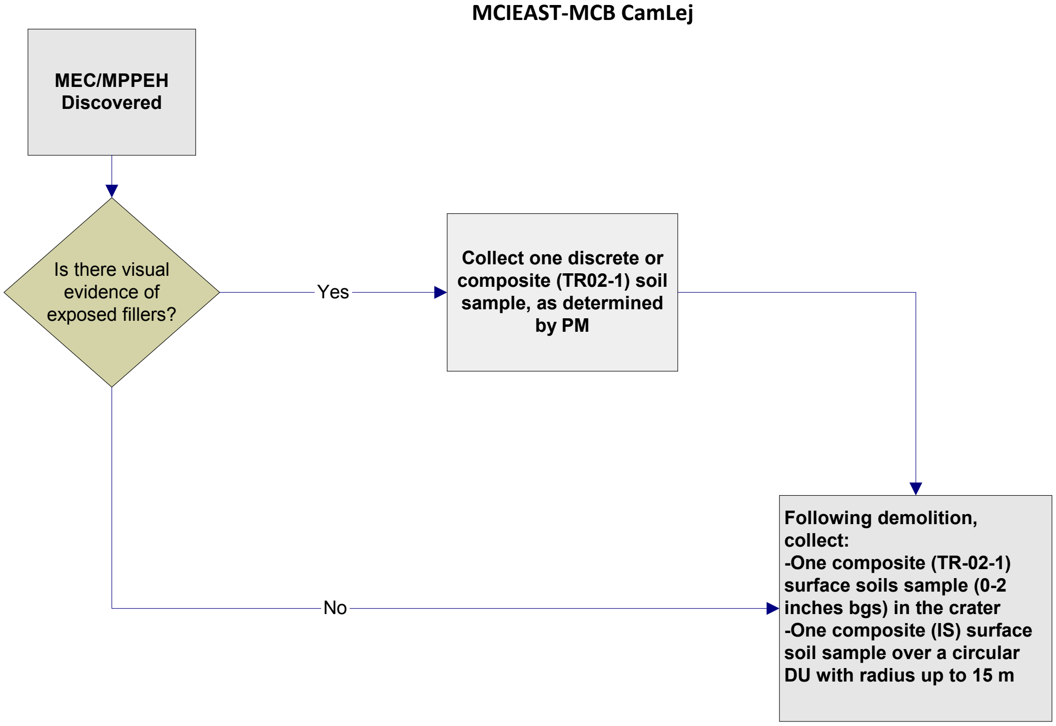
Project quality objectives listed in the form of if/then qualitative and quantitative statements.

The decision analysis process depicted on **Figure 11-1** and **Figure 11-2** represents the project quality objectives (PQOs) for initial surface soil sample collection and additional sample collection at the site. **Figure 11-3** represents the PQOs for the environmental media sample data collected at the site. The general objective of the decision analysis process is to assess environmental impacts, if present, resulting from munitions use within the investigation area surrounding site UXO-06. If environmental media are impacted by MC, the process will evaluate whether MC poses unacceptable risk to human health or ecological receptors.

Additional PQOs related to the analysis of DGM data are presented on **Figure 11-4**. If results from the DGM activities indicate anomalies above the lowest amplitude at which a metallic item can be positively distinguished from signal noise, then a MEC intrusive investigation will be recommended. As noted above, this threshold will be determined by Geophysical System Verification at the site.

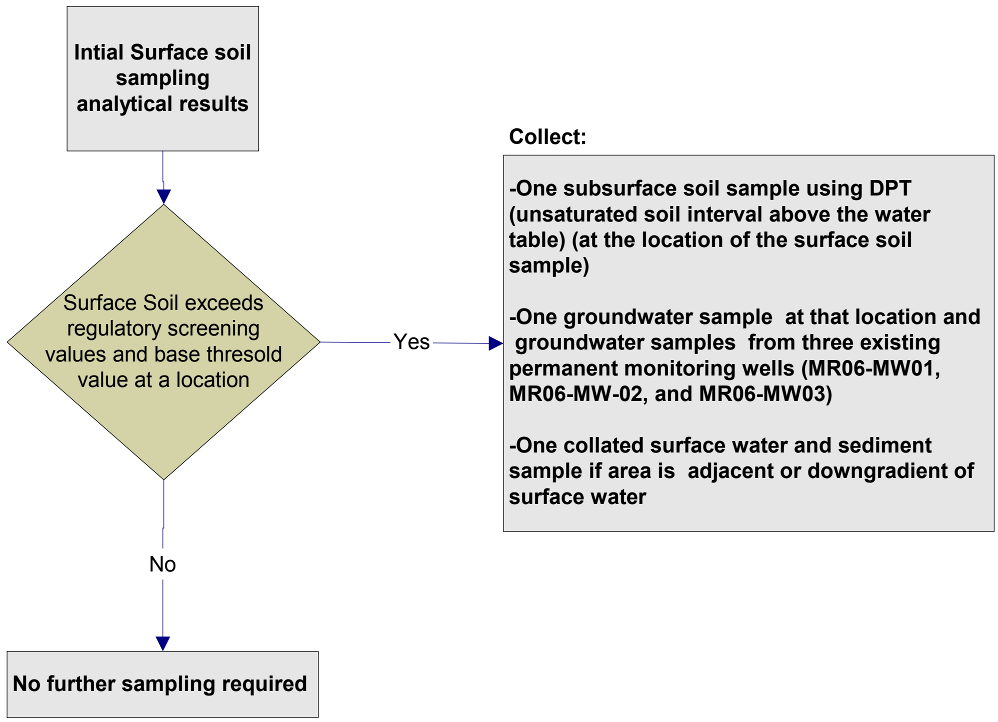
SAP Worksheet #11: Project Quality Objectives/Systematic Planning Process Statements (continued)

Figure 11-1
Project Quality Objectives Decision Flow Chart - Surface Soil Sample Collection
Contract Task Order WE12, Site UXO-06,
MCIEAST-MCB CamLej



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

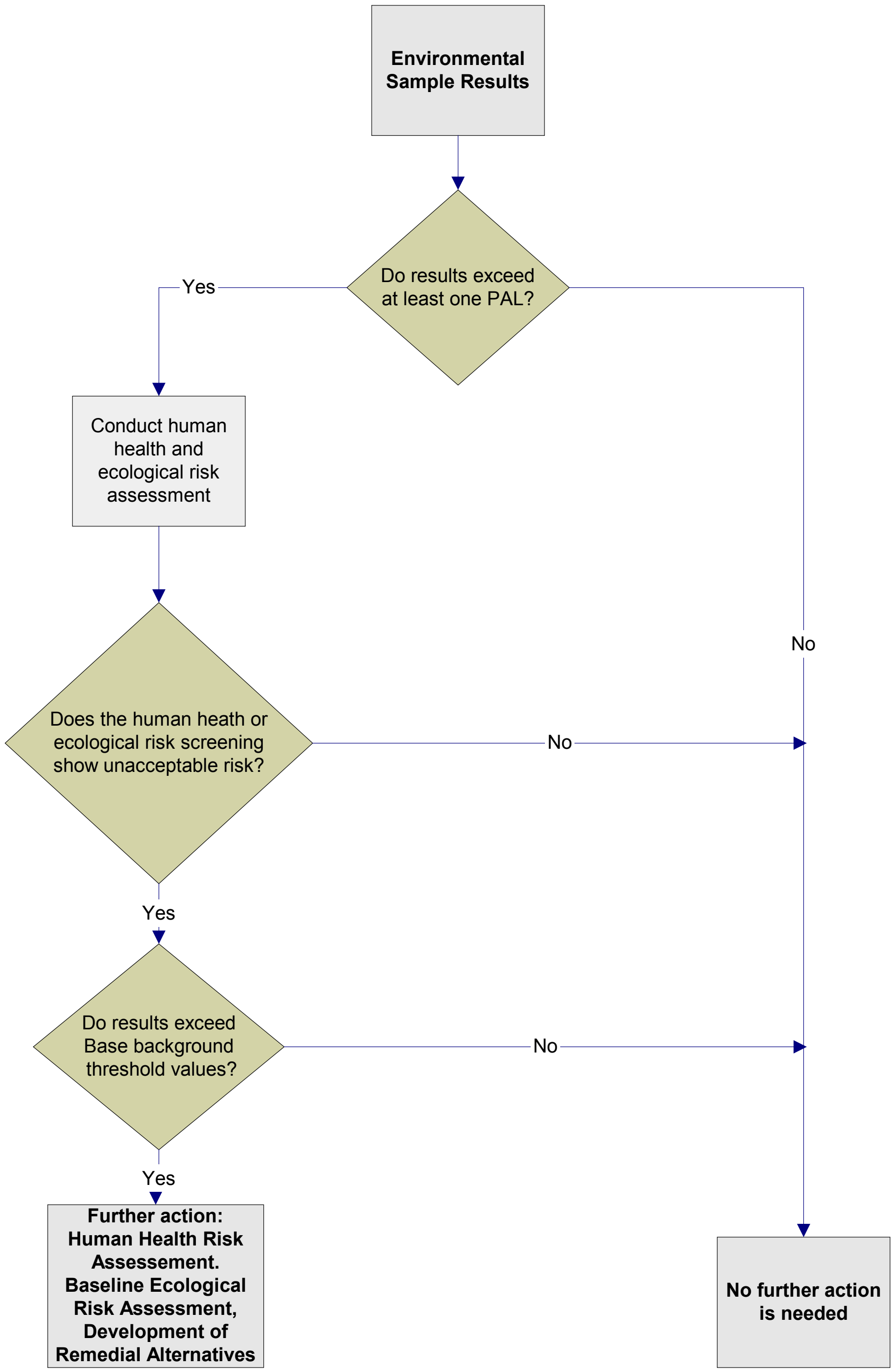
Figure 11-2
Project Quality Objectives Decision Flow Chart- Additional Sample Collection
Contract Task Order WE12, Site UXO-06,
MCIEAST-MCB CamLej



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

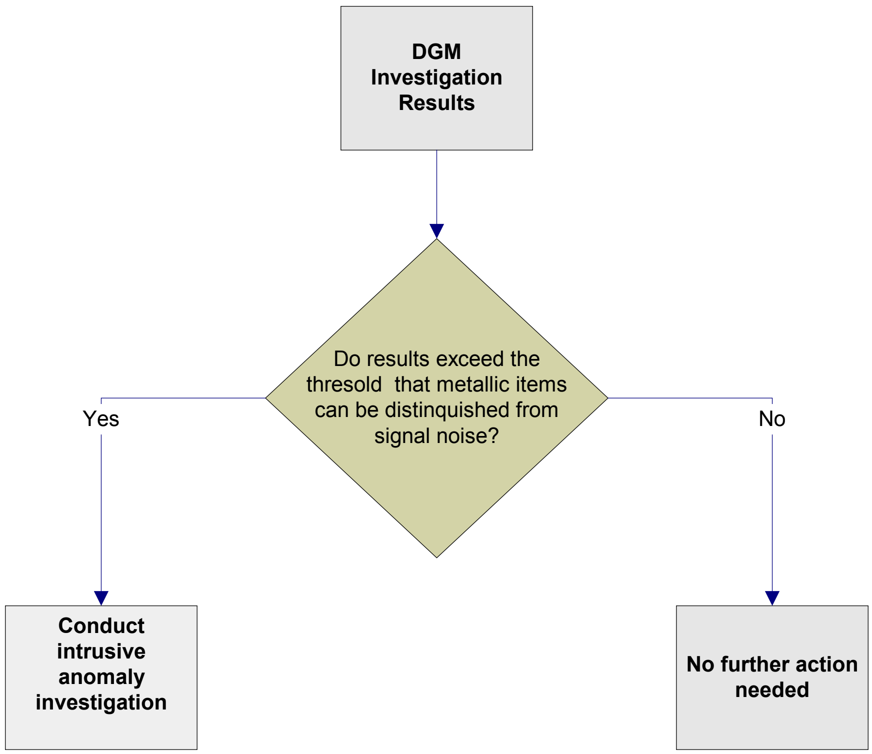
Figure 11-3

**Project Quality Objectives Decision Flow Chart-Sample Data
Contract Task Order WE12, Site UXO-06,
MCIEAST-MCB CamLej**



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

Figure 11-4
Project Quality Objectives Decision Flow Chart-DGM
Contract Task Order WE12, Site UXO-06
MCIEAST-MCB CamLej



SAP Worksheet #12-1: Field Quality Control Samples

Matrix: Surface Soil, Subsurface Soil, and Sediment

Analytical Group: Explosives Residues including PETN and Nitroglycerin

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 Residues including PETN and Nitroglycerin	One per 10 field samples	Precision	Relative Percent Difference (RPD) ≤30%	S & A
Equipment Rinsate 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

Matrix: Surface Soil, Subsurface Soil, and Sediment

Analytical Group: Perchlorate

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	Perchlorate	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 #12-3: Field Quality Control Samples

Matrix: Surface Soil (Post-detonation samples)

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	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 #12-4: Field Quality Control Samples

Matrix: Groundwater and Surface Water

Analytical Group: Explosives Residues including PETN and Nitroglycerin

Concentration Level: Low

QC Sample1	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 Residues including PETN and Nitroglycerin	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 #12-5: Field Quality Control Samples

Matrix: Groundwater and Surface Water

Analytical Group: Perchlorate

Concentration Level: Low

QC Sample1	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	Perchlorate	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

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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
2007 Archival Report	CH2M HILL, *Archival Records Search Report, Site UXO-06, Former Fortified Beach Assault Area*	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 4-45 years old and may not be representative of current conditions
2007 Focused SI MILCON Area	CH2M HILL, *Focused Site Inspection Report, Site UXO-06 MILCON Area*	CH2M HILL DGM, intrusive investigation results, surface and subsurface soil 2006	Planning and Sample Location Selection	Data is limited to a 4.4 acre portion of the site
2007 Focused PA/SI, AOC #3, Proposed Force Main Easement	Arcadis, *Focused PA/SI, AOC #3, Proposed Force Main Easement near MMRP Site UXO-06 (Fortified Beach Assault Area)*	Arcadis DGM, intrusive investigation results, subsurface soil and groundwater data 2007	Planning and Sample Location Selection	Data is limited to sewer line easement
2011 PA/SI Report	CH2M HILL, Preliminary Assessment/Site Inspection Report MMRP Site UXO-06, Former Fortified Beach Assault Area, ASR #2.65	CH2M HILL DGM, intrusive investigation results, soil, and groundwater data 2007-2011	Planning and Sample Location Selection	Data is limited to TAL metals, explosives (including PETN and nitroglycerin), and perchlorate over 177 acres within the Site UXO-06 MRS.

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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 SOPs and the 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 of **the RI Work Plan Addendum** 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, SSHSP, 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

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 SSHSP by all site personnel. Additional meetings will occur as needed, as new personnel, visitors, and/or subcontractors arrive at the site.

Buried Utility Clearance

Prior to initiation of intrusive activities, all buried utilities will be identified within a 20-foot radius of each subsurface sampling location.

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

Land Surveying

Land surveying services will be conducted in accordance with Section 7.4 of the Master Plans. The surveying services will be completed under three mobilizations:

- **Phase 1** will consist of 1)an initial control survey with installation of semi-permanent or permanent benchmarks, if needed; 2) a survey of the designated new investigation area boundary (**Figure 14-1)**; this survey will delineate the extent of the investigation areas and will also designate the areas that will be subjected to vegetation clearing for the DGM effort; 3) a survey of the transects for the vegetation clearance subcontractor. A total of approximately 39,907 linear met**ers of trans**ects (1-meter wide) (both DGM transects and "mag and dig" transects) will be marked in the investigation area.
- **Phase 2** will consist of a survey of points for the DGM instrument verification strip (IVS) and a survey of QC seed item locations.
- **Phase 3** will be a survey of the horizonta**l coord**inates, top of casing elevation, and ground surface elevation of permanent monitoring wells, if installed, and environmental characterization sampling locations in areas where the GPS unit cannot get a clear signal, such as in densely vegetated areas.

MEC anomaly avoidance will be practiced as described in SSHSP in the **RI Work Plan Addendum**. UXO Technicians will escort surveying personnel while onsite, and will clear all locations where stakes are driven.

Vegetation Clearance

Vegetation clearance will be conducted to facilitate access for DGM and environmental characterization sampling, if needed. Vegetation less than 3 inches in diameter will be removed to within approximately 6 inches of the ground surface to aid the intrusive investigations and provide access for environmental characterization sampling. Vegetation clearing will be accomplished using a combination of mechanical and manual methods, depending on site conditions. Mechanical removal may include use of chain saws, brush cutters, and grinders, while manual removal may include use loppers, hand saws, or similar hand tools. Felled brush and trees will be left on the site. Trees, if any, greater than 3 inches in diameter will not be removed without prior Base approval. Overhanging vines and protruding branches that could interfere with the safe and effective performance of investigation activities will also be removed.

UXO technicians will conduct MEC avoidance activities in the vegetation removal areas according to the MEC avoidance procedures included in the **RI Work Plan Addendum**.

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 RI Work Plan Addendum**).

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.

Geophysical System Verification (GSV) Plan

A GSV will be performed as part of the process for validating the instruments to be utilized during the DGM activities. The GSV is a physics-based presumptively selected technology process in which signal strength and sensor performance are compared to known response curves of industry standard objects (ISOs) to verify DGM systems prior to and during site surveys. The GSV process is designed to perform initial verification of the DGM system using an IVS followed by a blind seeding program for continued verification throughout the field operations. A GSV Plan is provided as Appendix B to the Site-Specific Work Plan Addendum that provides details of the equipment, approach, methods, operational procedures and quality control to be used in performing the GSV for Site UXO-06 DGM activities.

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

Geophysical Investigation Plan (GIP)

DGM will be conducted at Site UXO-06 over approximately 9.9 acres, representing approximately 4.8% of the 206-acre investigation area. DGM will be conducted using a single coil Geonics EM61-MK2 instrument to map geophysical anomalies that represent potential subsurface MEC within the subject site. In areas where DGM cannot be conducted due to site conditions (i.e., areas with rough terrain or dense vegetation), handheld metal detectors (Schonstedt GA-52Cx or equivalent) will be used to locate anomalies.

The EM61-MK2 is a high-resolution time-domain electromagnetic instrument designed to detect, with high spatial resolution, shallow ferrous and non-ferrous metallic objects. Site UXO-06 will be subjected to DGM surveys using regularly spaced transects across the site. The centerline of each transect will be spaced approximately every 32 feet (in portions of the site likely to be developed in the future) and 109 feet across remaining portions of the site (**Figure 14-1**). The locations and actual acreages surveyed will be based on field conditions, including presence of utilities and other cultural features that may interfere with the collection of DGM data. Each transect will be approximately 4 feet wide, and will require one pass by the DGM crew in each transect to ensure 4.8 percent of the investigation area is being covered.

The GIP provided in Appendix C of the Site-Specific Work Plan Addendum provides details of the equipment, approach, methods, operational procedures and QC to be used in performing the geophysical investigation at the UXO-06. Quality Control at Site UXO-06 will consist of one seed item being placed emplaced approximately every 10,000 feet of transect. Based on the estimated linear footage, fourteen seed items will be emplaced within transects and professionally surveyed before the DGM subcontractor arrives onsite. The seed items will consist of ISOs with known responses for the EM61-MK2 (see EM61-MK2 Response of Three Munitions Surrogates, NRL/MR/6110--09-9183, March 12, 2009).

Prior to commencing the DGM survey, the selected geophysical equipment and survey methodologies will be demonstrated as meeting project data quality objectives. Geophysical system verification (GSV) will be performed as part of the process for validating the instruments to be utilized during the DGM activities. The GSV process is designed to perform initial verification of the DGM system using an instrument verification strip (IVS) followed by a blind seeding program for continued verification throughout the field operations.

Approximately 4.8 percent of the investigation area will be subjected to DGM surveys. DGM activities may be limited in some areas of the site due to utility easements, including natural gas and overhead power lines.

Environmental Site Sampling

- Anomaly avoidance will be practiced during all sampling activities as described in the **RI Work Plan Addendum**.
- Surface Soil Sampling
  - Soil samples will be collected at locations where MEC/MPPEH with exposed fillers are found. Exposed fillers may have leached into adjacent soil. Upon consultation with the CH2M HILL project manager, one grab sample or TR-02-1 sample will be collected for each occurrence, based on the visible extent of exposed filler.
  - TR-02-1 approach (Thiboutot et al., 2002) samples will be collected at depths of 0 to 2 inches bgs. Each sampling location will be defined as an area 1 meter × 1 meter in size. Coordinates of the sampling locations will be based on the center of the sampling area and will be logged by GPS. Soil samples will be collected by compositing a minimum of 30 sample increments from random locations within each 1-meter × 1-meter sampling location. The sample increments will be approximately equal in the amount of soil, which will be collected from depths of 0 to 2 inches bgs. 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 MPP (CH2M HILL, 2008a) prior to being transferred to the appropriate sample containers.

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

- Subsurface Soil Sampling
  - For each location where surface soil sample analytical results exceed regulatory screening criteria and base background threshold values, a subsurface soil sample will be collected.
  - Subsurface soil samples will be collected in accordance with the *Direct Push Soil Sample Collection* SOP in Appendix C of the MRP MPP (CH2M HILL, 2008a). The samples will be collected from unsaturated soil immediately above the water table (estimated at 5 to 17 feet bgs).
  - Soil cores will be classified according to American Society for Testing and Materials (ASTM) Standard D2488-69, *Description of Soils (Visual-Manual Procedure).* Soil descriptions will comply with the Unified Soil Classification System.
  - At the start of each borehole, a UXO technician will hand auger to a depth of 5 feet bgs, checking the borehole with a down hole magnetometer at 1-foot increments. If the water table is encountered at a depth less than 5 feet bgs, subsurface soil samples will be collected with a hand auger.
- Monitoring Well Installation
  - If soil sample analytical results exceed regulatory screening criteria and base background threshold values at locations within the investigation area, permanent groundwater monitoring wells will be installed to assess shallow groundwater at these locations. Groundwater monitoring wells will be installed via hollow stem auger**.** Each well will consist of 2-inch inner diameter polyvinyl chloride (PVC) well casing, with a 10-foot section of 0.010-inch machine-slotted well screen. Optimally, the static groundwater table will intersect 1 to 2 feet below the top of the screen of each monitoring well so that 8 to 9 feet of the screen is below the water. The screen will be connected to a new, threaded, flush-jointed, PVC riser casing with the O-rings removed prior to assembly. Each well will be completed with a flush-mounted, traffic-rated well monument and locking well cap. The wells will be constructed in accordance with *Installation of Shallow Monitoring Wells* SOP listed in **Worksheet #21**.
  - The monitoring wells will be developed by the drilling subcontractor to reduce turbidity and allowed to equilibrate to ambient aquifer conditions before static groundwater elevation measurements and environmental groundwater sampling activities begin.
  - Static groundwater elevations will be measured prior to initiating groundwater sampling at any monitoring well. The static water levels will be measured using an electronic water level indicator. The depth from the top of casing to fluid level will be recorded to the nearest 0.01 foot. The indicator will be decontaminated after use in each well.
- Groundwater Sampling
  - Groundwater samples will include samples from newly installed wells and three permanent monitoring wells onsite.
  - 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" listed in **Worksheet #21**.
  - All groundwater samples will be collected by placing the sample tubing or pump intake in the middle of the water column.

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

  - All groundwater samples will be collected by placing the sample tubing or pump intake in the middle of the water column. The water quality parameters (WQPs), including specific conductance, pH, turbidity, temperature, DO, and ORP will be measured and recorded (approximately every 5 minutes) before sampling. Sampling will begin when WQPs have stabilized as specified in the Low-Flow Groundwater Sampling from Monitoring Wells SOP in Appendix C of the Master Plans (CH2M HILL, 2008a) and at least one well volume has been purged, while minimizing the elapsed time since stabilization. Depth to water, WQPs, and total well depth measurements will be recorded in the field logbook.

- Surface Water and Sediment Sampling
  - For each location where surface soil sample analytical results exceed regulatory screening criteria and base background threshold values, and surface water is adjacent or downgradient of such locations, one set of co-located surface water and sediment samples will be collected. Samples will be collected first from downstream locations and then from upstream locations. Sediment samples will be collected at the same locations as the surface water samples after the surface water samples are collected in accordance with the SOPs listed in **Worksheet #21**.
  - Actual surface water and sediment sample location coordinates will be determined using a hand-held GPS in the field. All coordinates will be recorded in the field logbook.
- Post-detonation Soil Sampling
  - Soil samples will be collected at locations where controlled detonations/BIP operations are conducted. 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.
  - The surface soil sample from the crater will be collected using the TR-02-1 approach described in the United States Army Corps of Engineers (USACE) Technical Report ERDC/CRREL TR-02-1, *Guide for Characterization of Sites Contaminated with Energetic Materials* (Thiboutot, et al., 2002). Each sampling location will be defined as an area measuring 1 meter × 1 meter. Coordinates of the sampling locations will be based on the center of the sampling area. Soil samples will be collected by compositing a minimum of 30 sample increments from random locations within each 1-meter × 1-meter sampling location. The sample increments will be approximately equal in the amount of soil, which will be collected from depths of 0 to 2 inches bgs. The sample increments at each location will be composited into a single sample following the *Homogenization of Soil and Sediment Samples* SOP listed in **Worksheet #21**.
  - One surface soil sample will be collected outside the crater utilizing the IS method. The DU for the post-detonation sample collected outside the crater (outside the 1-meter × 1-meter TR-02-01 sampling area) will be roughly circular and centered upon the crater, with a radius of up to 15 meters to encompass the visible ejecta pattern. The maximum radius of 15 meters is based on work conducted by the U.S. Army Engineer Research and Development Center entitled "Explosive Residues from Blow-in-Place Detonations of Artillery Munitions"(Pennington, et al., 2008). At least 30 aliquots of soil will be collected from 0 to 2 inches bgs and homogenized in accordance with the At least 30 aliquots of soil will be collected from 0 to 2 inches bgs and homogenized in accordance with the *Homogenization of Soil and Sediment Samples* SOP listed in **Worksheet #21**.
  - The coordinates of the sampling locations will be logged by handheld GPS.

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

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. Anticipated IDW includes soil cuttings, waste groundwater, and decontamination fluids. Based upon the previous investigations conducted at Site UXO-06, soil IDW generated at this site is not suspected to be from a known contaminant source area. Therefore, soil cuttings will be spread on the ground and around the sampling location. Waste groundwater and decontamination fluids generated during the field activities will be properly containerized in labeled 55-gallon drums and disposed of at a certified offsite disposal facility.IDW will be managed in accordance with the Waste Management Plan.
- The 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 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.

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.

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

- 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.

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

Matrix: Surface Soil and Subsurface Soil

Analytical Group: Explosives Residues including PETN and Nitroglycerin

Analyte	CAS Number	Project Action Limit[1] (ug/kg)	Project Action Limit Reference	Project Quantitation Limit Goal[2] (ug/kg)	Laboratory-specific		
					LOQ (ug/kg)	LOD (ug/kg)	DL (ug/kg)
1,3,5-Trinitrobenzene	99-35-4	220000	RSL Residential for Soil	110000	500	300	150
1,3-Dinitrobenzene	99-65-0	610	RSL Residential for Soil	305	500	300	150
2,4,6-Trinitrotoluene	118-96-7	3600	RSL Residential for Soil	1800	500	300	150
2,4-Dinitrotoluene	121-14-2	1600	RSL Residential for Soil	800	500	300	150
2,6-Dinitrotoluene	606-20-2	6100	RSL Residential for Soil	3050	500	300	150
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	500	300	150
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	300	150
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	150
Nitrobenzene	98-95-3	4800	RSL Residential for Soil	2400	500	300	150
Nitroglycerin	55-63-0	610	RSL Residential for Soil	305	2000	1000	500
PETN	78-11-5	12000	RSL Residential for Soil	6000	1000	500	250
RDX	121-82-4	5600	RSL Residential for Soil	2800	500	300	150
Tetryl	479-45-8	24000	RSL Residential for Soil	12000	500	300	150

[1] Project Action Limits (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, May 2011.

Shading represents cases where the PQL goal is lower than the laboratory LOD. Refer to **Worksheet #11**, "How 'good' does the data need to be…' for a discussion of how data will be treated in instances where the PQL goal is lower than the laboratory LOD.

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

Matrix: Surface Soil and Subsurface Soil

Analytical Group: Perchlorate

Analyte	CAS Number	Project Action Limit[1] (ug/kg)	Project Action Limit Reference	Project Quantitation Limit Goal[2] (ug/kg)	Laboratory-specific		
					LOQ (ug/kg)	LOD (ug/kg)	DL (ug/kg)
Perchlorate	14797-73-0	5500	RSL Residential for Soil	2750	1	5	2.5

[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, May 2011.

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

Matrix: Surface Soil (Post-detonation samples)
Analytical Group: TAL Metals (including Mercury)

Analyte	CAS Number	Project Action Limit[1] (mg/kg)	Project Action Limit Reference	Project Quantitation Limit Goal[2] (mg/kg)	Laboratory-specific LOQs (mg/kg)	Laboratory-specific LODs (mg/kg)	Laboratory-specific DLs (mg/kg)
Aluminum	7429-90-5	12800	Base BTV	2874	10.0	5.00	1.90
Antimony	7440-36-0	1.87	Base BTV	0.223	2.00	1.00	0.190
Arsenic	7440-38-2	1.17	Base BTV	0.195	2.00	1.00	0.260
Barium	7440-39-3	36.7	Base BTV	7.25	0.500	0.250	0.0110
Beryllium	7440-41-7	0.195	Base BTV	0.0515	0.0500	0.0250	0.00610
Cadmium	7440-43-9	0.2	Base BTV	0.165	0.100	0.0500	0.0140
Calcium	7440-70-2	8470	Base BTV	3180	25.0	6.25	1.90
Chromium	7440-47-3	17.4	Base BTV	0.145	0.500	0.250	0.0290
Cobalt	7440-48-4	0.414	Base BTV	0.147	0.500	0.250	0.0230
Copper	7440-50-8	17.1	Base BTV	2.415	0.500	0.250	0.0760
Iron	7439-89-6	7210	Base BTV	75	10.0	5.00	1.50
Lead	7439-92-1	27.5	Base BTV	6.15	1.00	0.500	0.100
Magnesium	7439-95-4	904	Base BTV	119	25.0	6.25	1.80
Manganese	7439-96-5	37	Base BTV	6.85	1.00	0.500	0.0260
Mercury	7439-97-6	0.161	Base BTV	0.04	0.0480	0.0240	0.0110
Nickel	7440-02-0	3.11	Base BTV	0.605	0.500	0.250	0.0200
Potassium	7440-09-7	359	Base BTV	58	50.0	25.0	4.10
Selenium	7782-49-2	1.59	Base BTV	0.2815	2.00	1.00	0.310
Silver	7440-22-4	0.354	Base BTV	0.07	0.500	0.250	0.0590
Sodium	7440-23-5	250	Base BTV	40.45	25.0	6.25	2.70
Thallium	7440-28-0	0.078	RSL Residential for Soil	0.039	1.00	0.500	0.140
Vanadium	7440-62-2	17.6	Base BTV	3	1.00	0.250	0.0460
Zinc	7440-66-6	28.6	Base BTV	5.4	1.00	0.500	0.190

[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 Threshold Values (BTVs) are for combined soil types from the Expanded Soil Background Study Report, MCIEAST-MCB CamLej, August 2011.

Residential Soil RSL values were adjusted from the USEPA Regional Screening Levels Table, May 2011.

Shading represents cases where the PQL goal is lower than the laboratory LOD. Refer to **Worksheet #11**, "How 'good' does the data need to be…' for a discussion of how data will be treated in instances where the PQL goal is lower than the laboratory LOD.

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

Matrix: Sediment

Analytical Group: Explosives Residues including PETN and Nitroglycerin

Analyte	CAS Number	Project Action Limit[1] (ug/kg)	Project Action Limit Reference	Project Quantitation Limit Goal[2] (ug/kg)	Laboratory-specific		
					LOQ (ug/kg)	LOD (ug/kg)	DL (ug/kg)
1,3,5-Trinitrobenzene	99-35-4	220000	RSL Residential for Soil	110000	500	300	150
1,3-Dinitrobenzene	99-65-0	610	RSL Residential for Soil	305	500	300	150
2,4,6-Trinitrotoluene	118-96-7	3600	RSL Residential for Soil	1800	500	300	150
2,4-Dinitrotoluene	121-14-2	1600	RSL Residential for Soil	800	500	300	150
2,6-Dinitrotoluene	606-20-2	6100	RSL Residential for Soil	3050	500	300	150
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	500	300	150
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	300	150
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	150
Nitrobenzene	98-95-3	4800	RSL Residential for Soil	2400	500	300	150
Nitroglycerin	55-63-0	610	RSL Residential for Soil	305	2000	1000	500
PETN	78-11-5	12000	RSL Residential for Soil	6000	1000	500	250
RDX	121-82-4	5600	RSL Residential for Soil	2800	500	300	150
Tetryl	479-45-8	24000	RSL Residential for Soil	12000	500	300	150

[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, May 2011.

Shading represents cases where the PQL goal is lower than the laboratory LOD. Refer to **Worksheet #11**, "How 'good' does the data need to be…' for a discussion of how data will be treated in instances where the PQL goal is lower than the laboratory LOD.

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

Matrix: Sediment

Analytical Group: Perchlorate

Analyte	CAS Number	Project Action Limit[1] (ug/kg)	Project Action Limit Reference	Project Quantitation Limit Goal[2] (ug/kg)	Laboratory-specific		
					LOQ (ug/kg)	LOD (ug/kg)	DL (ug/kg)
Perchlorate	14797-73-0	5500	RSL Residential for Soil	2750	1	5	2.5

[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, May 2011.

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

Matrix: Groundwater

Analytical Group: Explosives Residues including PETN and Nitroglycerin

Analyte	CAS Number	Project Action Limit[1] (ug/l)	Project Action Limit Reference	Project Quantitation Limit Goal[2] (ug/l)	Laboratory-specific		
					LOQ (ug/l)	LOD (ug/l)	DL (ug/l)
1,3,5-Trinitrobenzene	99-35-4	110	RSL Tapwater	55	0.325	0.208	0.104
1,3-Dinitrobenzene	99-65-0	0.37	RSL Tapwater	0.185	0.325	0.208	0.104
2,4,6-Trinitrotoluene	118-96-7	1.8	RSL Tapwater	0.9	0.325	0.208	0.104
2,4-Dinitrotoluene	121-14-2	0.22	RSL Tapwater	0.11	0.325	0.208	0.104
2,6-Dinitrotoluene	606-20-2	3.7	RSL Tapwater	1.85	0.325	0.208	0.104
2-Amino-4,6-dinitrotoluene	35572-78-2	7.3	RSL Tapwater	3.65	0.325	0.208	0.104
2-Nitrotoluene	88-72-2	0.31	RSL Tapwater	0.155	0.325	0.213	0.107
3-Nitrotoluene	99-08-1	0.37	RSL Tapwater	0.185	0.325	0.208	0.104
4-Amino-2,6-dinitrotoluene	19406-51-0	7.3	RSL Tapwater	3.65	0.325	0.208	0.104
4-Nitrotoluene	99-99-0	4.2	RSL Tapwater	2.1	0.65	0.39	0.195
HMX	2691-41-0	180	RSL Tapwater	90	0.325	0.208	0.104
Nitrobenzene	98-95-3	0.12	RSL Tapwater	0.06	0.325	0.208	0.104
Nitroglycerin	55-63-0	0.37	RSL Tapwater	0.185	0.65	0.43	0.216
PETN	78-11-5	7.3	RSL Tapwater	3.65	0.65	0.26	0.13
RDX	121-82-4	0.61	RSL Tapwater	0.305	0.325	0.208	0.104
Tetryl	479-45-8	15	RSL Tapwater	7.5	0.65	0.208	0.104

[1] PALs were developed to be protective of human health and the environment.

[2] PQL Goals are half of the PAL.

RSL Tapwater values were adjusted from the USEPA Regional Screening Levels Table, May 2011. The RSLs are more stringent than the NCGWQS.

Shading represents cases where the PQL goal is lower than the laboratory LOD. Refer to **Worksheet #11**, "How 'good' does the data need to be…' for a discussion of how data will be treated in instances where the PQL goal is lower than the laboratory LOD.

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

Matrix: Groundwater

Analytical Group: Perchlorate

Analyte	CAS Number	Project Action Limit[1] (ug/l)	Project Action Limit Reference	Project Quantitation Limit Goal[2] (ug/l)	Laboratory-specific		
					LOQ (ug/l)	LOD (ug/l)	DL (ug/l)
Perchlorate	14797-73-0	2.6	RSL Tapwater	1.3	0.65	0.26	0.13

[1] PALs were developed to be protective of human health and the environment.

[2] PQL Goals are half of the PAL.

RSL Tapwater value was adjusted from the USEPA Regional Screening Levels Table, May 2011. The RSLs are more stringent than the NCGWQS.

Shading represents cases where the PQL goal is lower than the laboratory LOD. Refer to **Worksheet #11**, "How 'good' does the data need to be…' for a discussion of how data will be treated in instances where the PQL goal is lower than the laboratory LOD.

SAP Worksheet #15-8: Reference Limits and Evaluation Tables

Matrix: Surface Water

Analytical Group: Explosives Residues including PETN and Nitroglycerin

Analyte	CAS Number	Project Action Limit[1] (ug/l)	Project Action Limit Reference	Project Quantitation Limit Goal[2] (ug/l)	Laboratory-specific		
					LOQ (ug/l)	LOD (ug/l)	DL (ug/l)
1,3,5-Trinitrobenzene	99-35-4	110	RSL Tapwater	55	0.325	0.208	0.104
1,3-Dinitrobenzene	99-65-0	0.37	RSL Tapwater	0.185	0.325	0.208	0.104
2,4,6-Trinitrotoluene	118-96-7	1.8	RSL Tapwater	0.9	0.325	0.208	0.104
2,4-Dinitrotoluene	121-14-2	0.22	RSL Tapwater	0.11	0.325	0.208	0.104
2,6-Dinitrotoluene	606-20-2	3.7	RSL Tapwater	1.85	0.325	0.208	0.104
2-Amino-4,6-dinitrotoluene	35572-78-2	7.3	RSL Tapwater	3.65	0.325	0.208	0.104
2-Nitrotoluene	88-72-2	0.31	RSL Tapwater	0.155	0.325	0.213	0.107
3-Nitrotoluene	99-08-1	0.37	RSL Tapwater	0.185	0.325	0.208	0.104
4-Amino-2,6-dinitrotoluene	19406-51-0	7.3	RSL Tapwater	3.65	0.325	0.208	0.104
4-Nitrotoluene	99-99-0	4.2	RSL Tapwater	2.1	0.65	0.39	0.195
HMX	2691-41-0	180	RSL Tapwater	90	0.325	0.208	0.104
Nitrobenzene	98-95-3	0.12	RSL Tapwater	0.06	0.325	0.208	0.104
Nitroglycerin	55-63-0	0.37	RSL Tapwater	0.185	0.65	0.43	0.216
PETN	78-11-5	7.3	RSL Tapwater	3.65	0.65	0.26	0.13
RDX	121-82-4	0.61	RSL Tapwater	0.305	0.325	0.208	0.104
Tetryl	479-45-8	15	RSL Tapwater	7.5	0.65	0.208	0.104

[1] PALs were developed to be protective of human health and the environment.

[2] PQL Goals are half of the PAL.

RSL Tapwater values were adjusted from the USEPA Regional Screening Levels Table, May 2011. The RSLs are more stringent than the NCGWQS.

Shading represents cases where the PQL goal is lower than the laboratory LOD. Refer to **Worksheet #11**, "How 'good' does the data need to be…' for a discussion of how data will be treated in instances where the PQL goal is lower than the laboratory LOD.

SAP Worksheet #15-9: Reference Limits and Evaluation Tables

Matrix: Surface Water

Analytical Group: Perchlorate

Analyte	CAS Number	Project Action Limit[1] (ug/l)	Project Action Limit Reference	Project Quantitation Limit Goal[2] (ug/l)	Laboratory-specific		
					LOQ (ug/l)	LOD (ug/l)	DL (ug/l)
Perchlorate	14797-73-0	2.6	RSL Tapwater	1.3	0.65	0.26	0.13

[1] PALs were developed to be protective of human health and the environment.

[2] PQL Goals are half of the PAL.

RSL Tapwater values were adjusted from the USEPA Regional Screening Levels Table, May 2011. The RSLs are more stringent than the NCGWQS.

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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		
UFP-SAP preparation	CH2M HILL	7/18/11	1/9/12	Draft UFP SAP	1/13/12
UFP-SAP reviewed by Navy	Navy	3/1/12	4/18/12	Comments	
UFP-SAP – address Navy comments	CH2M HILL	4/19/12	4/20/12	Draft UFP SAP	4/20/12
UFP-SAP Review and Approval by Regulatory Agencies	NC DENR, USEPA Region 4	4/23/12	5/30/12	Comments	
Comment resolution	Navy, CH2M HILL	5/31/12	6/14/12	Final UFP SAP	6/14/12
Final acceptance	Navy, NC DENR, USEPA Region 4	6/15/12	6/15/12	Final UFP SAP	6/15/12
Subcontracting	CH2M HILL	12/1/11	3/16/12	Subcontractor Contracts	
Vegetation, Utility Clearance, and Survey	Subcontractors w/ CH2M HILL	5/21/12	7/27/12	Vegetation and Utility Clearance	
Digital Geophysical Mapping	Subcontractor w/ CH2M HILL	6/26/12	7/16/12	Digital Geophysical Mapping	
Mag and Dig and Intrusive Anomaly Investigation	Subcontractor w/ CH2M HILL	7/17/12	8/22/12	Anomaly Investigation	
Field Sampling Activities	CH2M HILL, Subcontractor for drilling/well installation	8/22/12	9/10/12	Environ. Samples	
Laboratory analyses and data validation	CH2M HILL	9/11/12	10/12/12	Analytical and DV Reports	10/12/12
Data management and report preparation	CH2M HILL	10/15/12	1/31/13	Draft RI Report	1/31/13

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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 RI. Environmental characterization sampling is performed to assess contamination by MC, if present.

The investigation area was determined based on historical information and the results of the previous and ongoing investigations. Because the area was used for beach assault maneuvers it is possible that munitions may have been used beyond UXO-06 boundaries as established by the ASR. The results of the PA/SI indicate MPPEH has been found up to this boundary. A portion of the area within the Site UXO-06 boundary was not subject to DGM and intrusive investigation and environmental characterization sampling, because it was inaccessible to DGM equipment. This area will be investigated using handheld metal detectors (Schonstedt GA-52Cx or equivalent).

Sample Matrices: Sampling matrices will be determined in the field based on the identification of MEC/MPPEH, as follows. Surface soil will be collected at locations where MEC/MPPEH with exposed fillers are observed and at locations where MEC/MPPEH is detonated (during this investigation) to assess potential releases of MC to soil. If surface soil sample analytical results exceed regulatory screening criteria and base background threshold values at locations where MEC/MPPEH with exposed fillers are observed, subsurface soil, surface water/sediment (if adjacent or downgradient of the area), and groundwater samples will also be collected, to assess the presence of potential contamination by MC in site media.

Analytical Groups: The target analytical groups for Site UXO-06 will be explosives residues including PETN and nitroglycerine) and perchlorate for all samples, and additionally TAL metals (including mercury) for post-detonation samples. The rationale for selection of target analytical groups for sampling where MEC/MPPEH with visible signs of exposed filler was based on explosive fillers of munitions used onsite. The rationale for the selection of target analytical groups for post-detonation sampling was based on the use of munitions onsite, including explosive fillers and munitions casings.

Site Sample Numbers and Locations: The sampling approach, the number of samples per matrix, the analytical groups, and the relevant concentration action levels are discussed in **Worksheets #10, #11, #14** and **#15**. Sampling locations will be determined in the field, based on the identification of areas of MEC/MPPEH.

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 to identify the presence of potential environmental impacts, the assessment activities will not evaluate seasonal influences.

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

Site	Matrix	Sample Location	Screening Interval	Sample ID[1]	Sampling SOP Reference	Analytical Group		
						Explosives Residues including PETN and Nitroglycerin	Perchlorate	TAL Metals (including Mercury) (SW846 6010C, 6020C & 7470A/ 7471B
Surface Soil								
UXO-06	SS	MR06-SS88	0-2" bgs	MR06-SS88-YYQ	See Worksheet #21	X	X	
UXO-06	SS	MR06-SS89	0-2"bgs	MR06-SS89-YYQ		X	X	
UXO-06	SS	MR06-SS90	0-2"bgs	MR06-SS90-YYQ		X	X	
UXO-06	SS	MR06-SS91	0-2"bgs	MR06-SS91-YYQ		X	X	
UXO-06	SS	MR06-SS92	0-2"bgs	MR06-SS92-YYQ		X	X	
UXO-06	SS	MR06-SS92	0-2"bgs	MR06-SS92D-YYQ		X	X	
UXO-06 QA/QC - MS/MSD[2]	SS	MR06-SS88	0-2" bgs	MR06-SS88-11C-MS		X	X	
UXO-06 QA/QC - MS/MSD[2]	SS	MR06-SS88	0-2" bgs	MR06-SS88-11C-SD		X	X	
UXO-06	SS	MR06-SS88		MR06-SS88-IC-YYQ / MR06-SS88-OC-YYQ		X	X	X
UXO-06	SS	MR06-SS89		MR06-SS89-IC-YYQ / MR06-SS89-OC-YYQ		X	X	X
UXO-06	SS	MR06-SS90		MR06-SS90-IC-YYQ / MR06-SS90-OC-YYQ		X	X	X
UXO-06	SS	MR06-SS91		MR06-SS91-IC-YYQ / MR06-SS91-OC-YYQ		X	X	X
UXO-06	SS	MR06-SS92		MR06-SS92-IC-YYQ / MR06-SS92-OC-YYQ		X	X	X
UXO-06	SS	MR06-SS92		MR06-SS92D-IC-YYQ / MR06-SS92D-OC-YYQ		X	X	X

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

Site	Matrix	Sample Location	Screening Interval	Sample ID[1]	Sampling SOP Reference	Analytical Group		
						Explosives Residues including PETN and Nitroglycerin	Perchlorate	TAL Metals (including Mercury) (SW846 6010C, 6020C & 7470A/ 7471B
Subsurface Soil								
UXO-06	SB	MR06-IS68	approx. 5' bgs	MR06-IS68-YYQ	See Worksheet #21	X	X	
UXO-06	SB	MR06-IS69	Approx. 5' bgs	MR06-IS69-YYQ		X	X	
UXO-06	SB	MR06-IS70	Approx. 5' bgs	MR06-IS70-YYQ		X	X	
UXO-06	SB	MR06-IS71	Approx. 5' bgs	MR06-IS71-YYQ		X	X	
UXO-06	SB	MR06-IS72	Approx. 5' bgs	MR06-IS72-YYQ		X	X	
UXO-06 QA/QC - Duplicate[2]	*SB*	*MR06-IS68*	approx. 5' bgs	*MR06-IS68D-YYQ*		*X*	X	
UXO-06 QA/QC - MS/MSD[2]	SB	MR06-IS72	approx. 5' bgs	MR06-IS72-YYQ-MS		X	X	
UXO-06 QA/QC - MS/MSD[2]	SB	MR06-IS72	approx. 5' bgs	MR06-IS72-YYQ-SD		X	X	

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

Site	Matrix	Sample Location	Screening Interval	Sample ID[1]	Sampling SOP Reference	Explosives Residues including PETN and Nitroglycerin	Perchlorate	TAL Metals (including Mercury) (SW846 6010C, 6020C & 7470A/ 7471B
Groundwater								
UXO-06	GW	MR06-MW04	approx. 5' bgs	MR06-MW04-YYQ	See Worksheet #21	X	X	
UXO-06	GW	MR06-MW05	Approx. 5' bgs	MR06-MW05-YYQ		X	X	
UXO-06	GW	MR06-MW06	Approx. 5' bgs	MR06-MW06-YYQ		X	X	
UXO-06	GW	MR06-MW07	Approx. 5' bgs	MR06-MW07-YYQ		X	X	
UXO-06	GW	MR06-MW08	Approx. 5' bgs	MR06-MW08-YYQ		X	X	
UXO-06 QA/QC – Duplicate	GW	*MR06-MW04*	approx. 5' bgs	*MR06-MW04D-YYQ*		*X*	X	
UXO-06 QA/QC - MS/MSD	GW	MR06-MW08	approx. 5' bgs	MR06-MW08-YYQ-MS		X	X	
UXO-06 QA/QC - MS/MSD	GS	MR06-MW08	approx. 5' bgs	MR06-MW08-YYQ-SD		X	X	
UXO-06	SW	MR06-SW10		MR06-SW10-YYQ	See Worksheet #21	X	X	
UXO-06	SW	MR06-SW11		MR06-SW11-YYQ		X	X	
UXO-06	SW	MR06-SW12		MR06-SW12-YYQ		X	X	
UXO-06	SW	MR06-SW13		MR06-SW13-YYQ		X	X	
UXO-06	SW	MR06-SW14		MR06-SW14-YYQ		X	X	
UXO-06 QA/QC - Duplicate	SW	*MR06-SW10*		*MR06-SW10D-YYQ*		*X*	X	
UXO-06 QA/QC - MS/MSD	SW	MR06-SW14		MR06-SW14-YYQ-MS		X	X	
UXO-06 QA/QC - MS/MSD	SW	MR06-SW14		MR06-SW14-YYQ-SD		X	X	

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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
Surface Soil, Subsurface Soil, and Sediment	Explosives Residues including PETN and Nitroglycerin	SW846 8330B / 107, 126	4oz. glass jar	1 – 2 kg	Cool to 0-6°C	14 days to prep; 40 days to analysis
	Perchlorate	SW846 6850 / 116	One (1) 4oz. plastic or glass wide-mouth jar	20g	Cool to 0-6°C	28 days (for prep and analysis)
Surface Soil (Post-detonation samples)	TAL Metals (including Mercury)	SW-846 6010C and 7471B / EXMT-09, MET-05, MET-16	One (1) 4oz. glass jar	10g	Cool to 0-6°C	180 days; 28 days Mercury
Groundwater and Surface Water	Explosives Residues including PETN and Nitroglycerin	SW846 8330B / 126	One (1) 1L glass bottle	1L	Cool to 0-6°C	7 days to prep; 40 days to analysis
	Perchlorate	SW846 6850 / 116	One (1) 125mL plastic or glass bottle	100mL	Cool to 0-6°C	28 days (for prep and analysis)

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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
[1]Environmental Characterization Samples							
Surface Soil	Explosives Residues (including PETN and Nitroglycerin)	5	1	1/1	1	1	10
	Perchlorate	5	1	1/1	1	1	10
Surface Soil (Post-detonation samples)	TAL Metals (including Mercury)	5	1	1/1	1	1	10
Subsurface Soil	Explosives Residues (including PETN and Nitroglycerin)	5	1	1/1	1	2	11
	Perchlorate	5	1	1/1	1	2	11
Sediment	Explosives Residues (including PETN and Nitroglycerin)	5	1	1/1	1	1	10
	Perchlorate	5	1	1/1	1	1	10
Groundwater	Explosives Residues (including PETN and Nitroglycerin)	5	1	1/1	1	2	11
	Perchlorate	5	1	1/1	1	2	11
Surface Water	Explosives Residues (including PETN and Nitroglycerin)	5	1	1/1	1	1	10
	Perchlorate	5	1	1/1	1	1	10

[1]The sample counts listed in the table are estimates and may vary. Samples will only be collected if areas of MEC/MPPEH are found.

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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-003	Shallow Soil Sampling, rev 5/2011		Stainless Steel Spoon and Bowls		
SOP-004	Sediment Sampling, rev. 5/2011		Stainless Steel Spoon and Bowls		
SOP-005	Homogenization of Soil and Sediment Samples, rev 5/2011		Stainless Steel Spoon and Bowls		
SOP-006	Soil Boring and Abandonment, rev. 5/2011		Drill rig		
SOP-007	Installation of Shallow Monitoring Wells, rev. 5/2011		Drill rig	Yes	Monitoring Well Installation through HSA drilling techniques
SOP-008	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-009	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-010	Decontamination of Personnel and Equipment, rev. 5/2011		Reusable sampling equip.	No	
SOP-011	Decontamination of Drilling Rigs and Equipment, rev. 5/2011		Steam cleaner and decon pad		
SOP-012	Disposal of Waste Solids and Fluids, rev. 5/2011		5-gallon buckets with on-base disposal		
SOP-013	Equipment Blank and Field Blank Preparation, rev. 5/2011		Lab provided blank liquid and sample bottles		
SOP-014	Packaging and Shipping Procedures for Low-Concentration Samples, rev. 5/2011		Lab supplied coolers		
SOP-015	Chain-of-Custody, rev. 5/2011		Chain-of-Custody Form		
SOP-016	UXO Contacts		Staff Form		
SOP-017	DPT Soil Sample Collection 5/2011		Direct-push rig		
SOP-018	GPS		Trimble GPS Unit		

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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)
LOGIN-03	Receiving Samples, Revision No. 10 (1/23/2010)	04/20/2011	NA	All	NA	ENCO – Jacksonville	None	N
ADMIN-14	Waste Disposal and Characterization, Revision No. 5 (12/1/2009)	*04/22/2011*	NA	All	NA	ENCO – Jacksonville	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
MET-05	Metals Analysis using ICP-AES (Rev. 7, Effective Date 11/30/2009)	5/17/2011	Definitive	Solid Metals	ICP	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
GL-SR-E-001	Sample Acceptance Policy, Sample Login and Storage, Revision No. 32 (March 2011)	--	NA	All	NA	GEL Laboratories	None	N
GL-LB-G-001	Laboratory Waste Management Plan, Revision No. 19 (Feb 2011)	--	NA	All	NA	GEL Laboratories	None	N
116	Definitive Low Level Perchlorate Analysis Utilizing Liquid Chromatography/Mass Spectrometry (LC/MS/MS) by EPA Method 6850 Modified (6850M), Revision 7 (Oct2010)	--	Definitive	Solid and Aqueous Perchlorate	LC/MS/MS	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	HPLC	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

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SAP Worksheet #24-1: Analytical Instrument Calibration Table

Instrument[1]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
HPLC (SW846 8330B)	Mass Calibration/ Tune	Prior to ICAL and after any mass calibration or maintenance is performed. Tune check on daily basis.	Acceptance criteria outlined in laboratory SOP.	Perform mass calibration and reanalyze standard	Analyst	126
	Initial calibration (minimum of 5 calibration standards to establish linearity at method set-up and after major maintenance) Re-analyze the lowest calibration standard once linearity has been established.	Prior to sample analysis.	The apparent signal-to-noise ratio at the RL must be at least 1:5. If linear regression is used, r >/=0.995. If using internal standardization, RSD <15%	Correct the problem, then repeat ICAL		
	Initial calibration verification (ICV)	Immediately following the ICAL	All target analytes and surrogates within +/- 20% of the true value	Correct the problem and verify second source standard. Re-analyze ICV. If that fails, correct problem and repeat ICAL		
	Continuing calibration verification standard (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 the problem and re-analyze the CCV. If that fails, then repeat ICAL. Re-analyze all samples since the last successful calibration verification.		
	Calibration blanks (ICB/CCB)	Before beginning sample analysis, after the ICAL, after every 10 samples and at the end of the analysis sequence.	No analytes detected > LOD	Correct the problem. Reprep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.		

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

SAP Worksheet #24-2: Analytical Instrument Calibration Table

Instrument[1]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
LC/MS/MS (SW846 6850)	Tuning/Mass Calibration	Prior to ICAL and after any mass calibration or maintenance is performed	Acceptance criteria outlined in laboratory SOP	Perform mass calibration and reanalyze standard	Analyst	116
	Initial calibration (minimum of 5 calibration standards to establish linearity at method set-up and after major maintenance).	As needed (laboratory calibrates daily before sample analysis begins)	r >/= 0.995 or RSD </= 20% The concentration corresponding to the absolute value of the calibration curve's Y-intercept must be </= LOD	Correct the problem, then repeat ICAL		
	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 calibration.		
	Continuing calibration verification (CCV)	Analysis of midpoint standard after every 10 field samples and at the end of the analysis sequence. 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 repeat CCV. If that fails, reanalyze all samples since the last successful calibration verification.		
	Calibration blanks (ICB/CCB)	Before beginning sample analysis, after the ICAL, and after every 10 samples and at the end of the analysis sequence.	No analytes detected >LOD	Correct the problem. Reprep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.		
LC/MS/MS (SW846 6850)	Limit of detection verification standard (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 the 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.	Analyst	116

[1] 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.

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

SAP Worksheet #24-3: Analytical Instrument Calibration Table

Instrument[1]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
CVAA (SW846 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]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.

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

SAP Worksheet #24-4: Analytical Instrument Calibration Table

Instrument[1]	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference[2]
ICP-AES (SW846 6010C)	ICAL -minimum one high standard and a calibration blank for all analytes	Daily ICAL prior to sample analysis.	More than one calibration standard is used, r≥ 0.995.	Correct problem, then repeat ICAL.	Analyst	MET-05
	Second Source Calibration Verification (ICV)	Once after each ICAL, prior to beginning a sample run.	Value of second source for all analytes within ± 10% of true value.	Verify second source standard. Rerun second source verification. If that fails, correct problem and repeat ICAL.		
	Continuing Calibration Verification (CCV)	After every 10 field samples and at the end of the analysis sequence.	All analytes within ± 10% of true value.	Correct problem, rerun calibration verification. If that fails, then repeat ICAL. Reanalyze all samples since the last successful calibration verification.		
	Low-level calibration check standard	Daily, after one-point ICAL. If multipoint curve is used, the low level calibration check is not necessary.	Within ± 20% of true value.	Correct problem, then reanalyze.		
	Calibration blank	Before beginning a sample run, after every 10 samples, and at end of the analysis sequence.	No analytes detected > LOD.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.		

[1]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.

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

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

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
HPLC and LC/MS/MS (SW846 8330B and SW846 6850)	Check solvent levels, pump, and lines. Check syringe.	Explosives and Perchlorate	Instrument performance and sensitivity	Daily	Acceptable instrument quality control and sensitivity.	Fill solvent reservoirs, prime pump and lines. Calibrate syringe placement.	Analyst	126 and 116
CVAA (SW846 7471B)	Replace disposables, flush lines.	Sensitivity check	Instrument performance and sensitivity.	Daily or as needed.	CCV pass criteria.	Recalibrate.	Analyst	MET-03 and MET-16
	Clean lens.	Sensitivity check	Instrument performance and sensitivity.	Daily or as needed.	Method Blank pass criteria.	Recalibrate.		
	Replace pump tubing.	Flow Rate Check	Instrument performance and sensitivity.	As needed.	Monitor flow rate for variation.	Replace windings, recalibrate and re-analyze.		
	Replace disposables, flush lines.	Sensitivity check	Instrument performance and sensitivity.	Daily or as needed.	CCV pass criteria.	Recalibrate.	Analyst	MET-03 and MET-16
	Clean lens.	Sensitivity check	Instrument performance and sensitivity.	Daily or as needed.	Method Blank pass criteria.	Recalibrate.		
	Replace pump tubing.	Flow Rate Check	Instrument performance and sensitivity.	As needed.	Monitor flow rate for variation.	Replace windings, recalibrate and re-analyze.		

SAP Worksheet #25: Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table (continued)

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
ICP-AES (SW846 6010C)	Change tubing	None	None	Every other run	None	None	Analyst	MET-05
	Clean air filter	Inspect air filters	Visual	Monthly	Air Filters are clean	Clean, replace air filters		
	Clean lenses	Inspect lenses for cleanliness	Visual	As needed.	Lenses are clean	None		
	Clean injector	Inspect injector for cleanliness	Visual	As needed.	verify injector is clean	None		

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-Jacksonville and GEL Labs
Sample Custody and Storage (Personnel/Organization): Sample Custody Personnel / ENCO-Jacksonville and GEL Labs
Sample Preparation (Personnel/Organization): Sample Preparation Personnel / ENCO-Jacksonville and GEL Labs
Sample Determinative Analysis (Personnel/Organization): Analysts / 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-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 a listing of CH2M HILL SOPs containing sample custody guidance. The CH2M HILL field team will ship all samples directly to the laboratory performing the analysis (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, Subsurface Soil, and Sediment

Analytical Group: Explosives Residues including PETN and Nitroglycerin

Analytical Method / SOP Reference: SW846 8330B / 126

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 laboratory control sample (LCS) must demonstrate the laboratory's ability to meet the project's Measurement Quality Objectives (MQOs). 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	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 #28-1A**.
Matrix Spike	One per preparatory batch per matrix.	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. 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 #28-1A**.
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.

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SAP Worksheet #28-1A: 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 #28-2: Laboratory QC Samples Table

Matrix: Surface Soil, Subsurface Soil, and Sediment

Analytical Group: Perchlorate

Analytical Method / SOP Reference: SW846 6850 / 116

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 #28-2: Laboratory QC Samples Table (continued)

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
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.

SAP Worksheet #28-2: Laboratory QC Samples Table (continued)

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
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, interference is 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.

SAP Worksheet #28-3: Laboratory QC Samples Table

Matrix: Surface Soil (Post-detonation samples)

Analytical Group: Mercury

Analytical Method / SOP Reference: SW846 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 target analytes > 1/2 LOQ and >1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater).	Correct problem; then repeat. If the method blank still fails; re-prep and re-analyze all samples processed with contaminated blank.	Analyst	Bias/Contamination	No target analytes > 1/2 LOQ.
LCS		% Recovery = 80% - 120%	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch.		Precision and Accuracy/ Bias	% Recovery = 80% - 120%
MS		Same as LCS.	Examine the project specific DQOs. In absence of project specific instruction, flag the data		Precision and Accuracy/ Bias	Same as QC Acceptance Limits.
MSD		Same as LCS and RPD ≤ 20%.	Same as MS		Precision and Accuracy/ Bias	

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

SAP Worksheet #28-4: Laboratory QC Samples Table

Matrix: Groundwater and Surface Water

Analytical Group: Explosives Residues including PETN and Nitroglycerin

Analytical Method / SOP Reference: SW846 8330 / 126

QC Sample1	Frequency/Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank		Target analytes must be < ½ LOQ or < 1/10 the concentration found in the sample or < 1/10th the regulatory limit. Blank results must not otherwise affect sample results.	Correct the problem, then see Department of Defense (DoD) Quality Standards Manual (QSM) v4.1 Box D-1.If required, reprep and reanalyze the method blank and all samples processed with the contaminated blank.		Contamination/ Bias	Target analytes must be < ½ LOQ or < 1/10 the concentration found in the sample or < 1/10th the regulatory limit. Blank results must not otherwise affect sample results.
LCS	One is performed for each batch of up to 20 samples.	Contains all target analytes. Percent recoveries must meet the control limits listed in **Worksheet #28-5A**.	Re-prepare and analyze all associated samples if holding time remains. Discuss qualification with client.	Analyst/ Laboratory Area Supervisor	Accuracy/ Bias	Contains all target analytes. Percent recoveries must meet the control limits listed in **Worksheet #28-5A**.
MS/MSD		Contains all target analytes. For matrix evaluation only. Percent recoveries must meet the LCS limits. Relative Percent Difference (RPD) <30%	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.		Precision / Accuracy / Bias	Contains all target analytes. For matrix evaluation only. Percent recoveries must meet the LCS limits. Relative Percent Difference (RPD) <30%
Confirmation of positive results	All positive results must be confirmed on second column	Calibration and QC criteria same as for initial or primary column analysis; Results between two columns RPD ≤ 40%	Narrate and qualify the results		Accuracy	Calibration and QC criteria same as for initial or primary column analysis; Results between two columns RPD ≤ 40%

SAP Worksheet #28-4: 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
Surrogates	All field and QC samples.	1-chloro-3-nitrobenzene 40%-145%	Re-prepare and reanalyze all failed samples in the associated preparatory batch for confirmation of matrix interference.		Accuracy / Bias	1-chloro-3-nitrobenzene 40%-145%

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

SAP Worksheet #28-4A: Laboratory QC Samples Table - LCS Recovery Limits

Analyte	CAS Number	LCS Recovery Limits (%R)
1,3,5-Trinitrobenzene	99-35-4	69 - 114
1,3-Dinitrobenzene	99-65-0	77 - 109
2,4,6-Trinitrotoluene	118-96-7	70 - 126
2,4-Dinitrotoluene	121-14-2	76 - 117
2,6-Dinitrotoluene	606-20-2	78 - 109
2-Amino-4,6-dinitrotoluene	35572-78-2	70 - 125
2-Nitrotoluene	88-72-2	59 - 113
3-Nitrotoluene	99-08-1	58 - 114
4-Amino-2,6-dinitrotoluene	19406-51-0	68 - 126
4-Nitrotoluene	99-99-0	60 - 120
HMX	2691-41-0	55 - 120
Nitrobenzene	98-95-3	63 – 110
Nitroglycerin	55-63-0	45 - 134
Pentaerythritol tetranitrate (PETN)	78-11-5	56 - 139
RDX	121-82-4	65 - 132
Tetryl	479-45-8	59 - 123

SAP Worksheet #28-5: Laboratory QC Samples Table

Matrix: Groundwater and Surface Water
Analytical Group: Perchlorate
Analytical Method / SOP Reference: SW846 6850 / 116

QC Sample[1]	Frequency / Number	Method/SOP QC Acceptance Limits	CA	Person(s) Responsible for CA	Data Quality Indicator (DQI)	Measurement Performance Criteria
Isotope ratio	Each sample, QC sample, and standard	Monitor for either the parent ion at masses 99/101 or the daughter ion at masses 83/85. Must fall within 2.3 - 3.8	Re-extract using cleanup procedures or alternate techniques to confirm the presence of perchlorate such as post spikes or dilutions to reduce interference.	Analyst, Laboratory Supervisor	Precision / Accuracy / Bias	Monitor for either the parent ion at masses 99/101 or the daughter ion at masses 83/85. Must fall within 2.3 - 3.8
IS	One per sample	Relative retention times for internal standard must be 0.98-1.02 and the responses within ± 50% of the average response of the initial calibration (ICAL).	Reanalyze samples at increasing dilutions until the ± 50% criteria can be met			Relative retention times for internal standard must be 0.98-1.02 and the responses within ± 50% of the average response of the initial calibration (ICAL).
Lab reagent blank	One per batch of 20 or less	Target analytes must be < ½ LOQ or <1/10 the concentration found in the sample or <1/10th the regulatory limit.	Re-clean, retest, re-extract, reanalyze, and/or qualify data		Bias / Contamination	Target analytes must be < ½ LOQ or <1/10 the concentration found in the sample or <1/10th the regulatory limit.
Method blank			Re-clean, retest, re-extract, reanalyze, and/or qualify data			
LCS		Percent recoveries must meet control limits 80%-120%	Evaluate and re-prepare/ reanalyze the LCS and associated samples.		Precision / Accuracy / Bias	Percent recoveries must meet control limits 80%-120%
MS/MSD		Percent recoveries must meet control limits 80%-120% and RPD of 15	Examine results of LCS. If both the LCS and MS/MSD are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.			Percent recoveries must meet control limits 80%-120% and RPD of 15

[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 (Post-detonation samples)

Analytical Group: TAL Metals

Analytical Method / SOP Reference: SW846 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 > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct problem; then repeat. If the method blank still fails; redigest and analyze all affected samples.	Analyst	Bias/ Contamination	No analytes detected > ½ LOQ and > 1/10 the amount measured in any sample or 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.
Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analyte detected > LOD.	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.		Bias/ Contamination	No analyte detected > LOD.
Interference Check (ICS)	At the beginning of an analytical run.	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are verified trace impurity from one of the spiked analytes); ICS-AB: Within ± 20% of true value.	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze all samples.		Bias/ Contamination	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD (unless they are verified trace impurity from one of the spiked analytes); ICS-AB: Within ± 20% of true value.
LCS	One per preparatory batch.	% Recovery = 80% - 120%	Correct problem, then reprep and reanalyze the LCS and all samples in the associated preparatory batch for failed analytes. If reanalysis cannot be performed, data must be qualified and explained in a case narrative.	Analyst	Precision and Accuracy/Bias	% Recovery = 80% - 120%
MS	One per preparatory batch.	Same as LCS.	Perform a dilution test and/or post spike to evaluate matrix effects.		Precision and Accuracy/Bias	Same as LCS.
MSD		Same as LCS and RPD ≤ 20%.	Perform a dilution test and/or post spike to evaluate matrix effects.		Precision and Accuracy/Bias	Same as LCS and RPD ≤ 20%.
Dilution Test		Recovery within ±10% of true value.	Perform post spike.		Precision and Accuracy/Bias	Recovery within ±10% of true value.
Post Spike (PS)	When dilution test fails or analyte concentration for all samples < 50x LOD.	Recovery within ± 25% of true value.	If dilution test recovers outside of QC acceptance limits but post spike meets QC acceptance criteria, matrix effects are not confirmed, reprep and reanalyze sample.		Precision and Accuracy/Bias	Recovery within ± 25% of true value.
Internal Standard (IS)	Spiked in every sample.	IS intensity within 30-120% of intensity of IS in ICAL.	Re-analyze sample at 5X dilution with the addition of appropriate amounts of IS.		Precision and Accuracy	IS intensity within 30-120% of intensity of IS in ICAL.

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

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]
Surface Soil, Subsurface Soil, and Sediment	Explosives Residues including PETN and Nitroglycerin	Refer to **Worksheet #18**	Refer to **Worksheet #23**	28 Calendar Days	GEL Laboratories Ann Skradski 2040 Savage Road Charleston, SC (843)-566-8171	TBD
	Perchlorate					
Groundwater and Surface Water	Explosives Residues including PETN and Nitroglycerin					
	Perchlorate					
Surface Soil(Post-detonation samples)	TAL Metals (including Mercury)				ENCO – Jacksonville Ronnie Wambles 4810 Executive Park Court #110 Jacksonville, FL 32216 (904)-296-3007	

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	Lael Feist Project Manager / CH2M HILL	Field Team Leader / CH2M HILL	Lael Feist Project Manager / CH2M HILL	Lael Feist 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: ____________________

____

____

____

Sequence of Corrective Action (CA): **(including date implemented, action planned and personnel/data affected)** ____________________

____

____

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____

____

____

____

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 colspan="2">Project:</td><td>Observer:</td><td>Date:</td></tr>
<tr><td>Position/Title of worker observed:</td><td></td><td colspan="2">Background Information/comments:</td></tr>
<tr><td>Task/Observation Observed:</td><td colspan="3"></td></tr>
</table>

- ❖ 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

<table>
<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	Lael Feist 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: Lael Feist / 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 PDM: Troy Horn/ 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: Lael Feist / 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, 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: Lael Feist 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: Lael Feist / 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: Doug Weaver/EDS
IIb	QC Results	Verify that QC samples were run and compliant with limits established in the UFP-SAP.	DV: Doug Weaver/EDS
IIb	Project Quantitation Limits (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.	DV: Doug Weaver/EDS

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

<table>
<tr><th>Step IIa / IIb</th><th>Matrix</th><th>Analytical Group</th><th>Validation Criteria</th><th>Data Validator</th></tr>
<tr><td rowspan="7">IIa and IIb</td><td rowspan="2">Surface Soil</td><td>Explosives Residues including PETN and Nitroglycerin</td><td rowspan="7">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.</td><td rowspan="7">TBD</td></tr>
<tr><td>Perchlorate</td></tr>
<tr><td>Surface Soil (Post-detonation samples)</td><td>TAL Metals (including Mercury)</td></tr>
<tr><td rowspan="2">Subsurface Soil, and Sediment</td><td>Explosives Residues including PETN and Nitroglycerin</td></tr>
<tr><td>Perchlorate</td></tr>
<tr><td rowspan="2">Groundwater and Surface Water</td><td>Explosives Residues including PETN and Nitroglycerin</td></tr>
<tr><td>Perchlorate</td></tr>
</table>

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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.

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 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.

SAP Worksheet #37: Usability Assessment (continued)

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

The following will be prepared by CH2M HILL and presented to and submitted to the MCIEAST-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. Data qualifiers will be reflected in the tables and discussed in the data quality evaluation.
- 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 MCIEAST-MCB CamLej Partnering Team as a whole will assess the usability of the data.

Figures

\\aphrodite\proj\USNavFacEngCom\CampLejeune\MapFiles\UXO_06\RI\Figure_1_1_BaseLocationMap.mxd

Legend

- Highways
- UXO-06 Site Boundary
- Installation Boundary

N

0 7,500 15,000 30,000 Feet

1 inch = 15,000 feet

Figure 1-1
Location Map
Site UXO-06 Former Fortified Beach Assault Area
RI Work Plan
MCB CamLej
North Carolina

CH2MHILL

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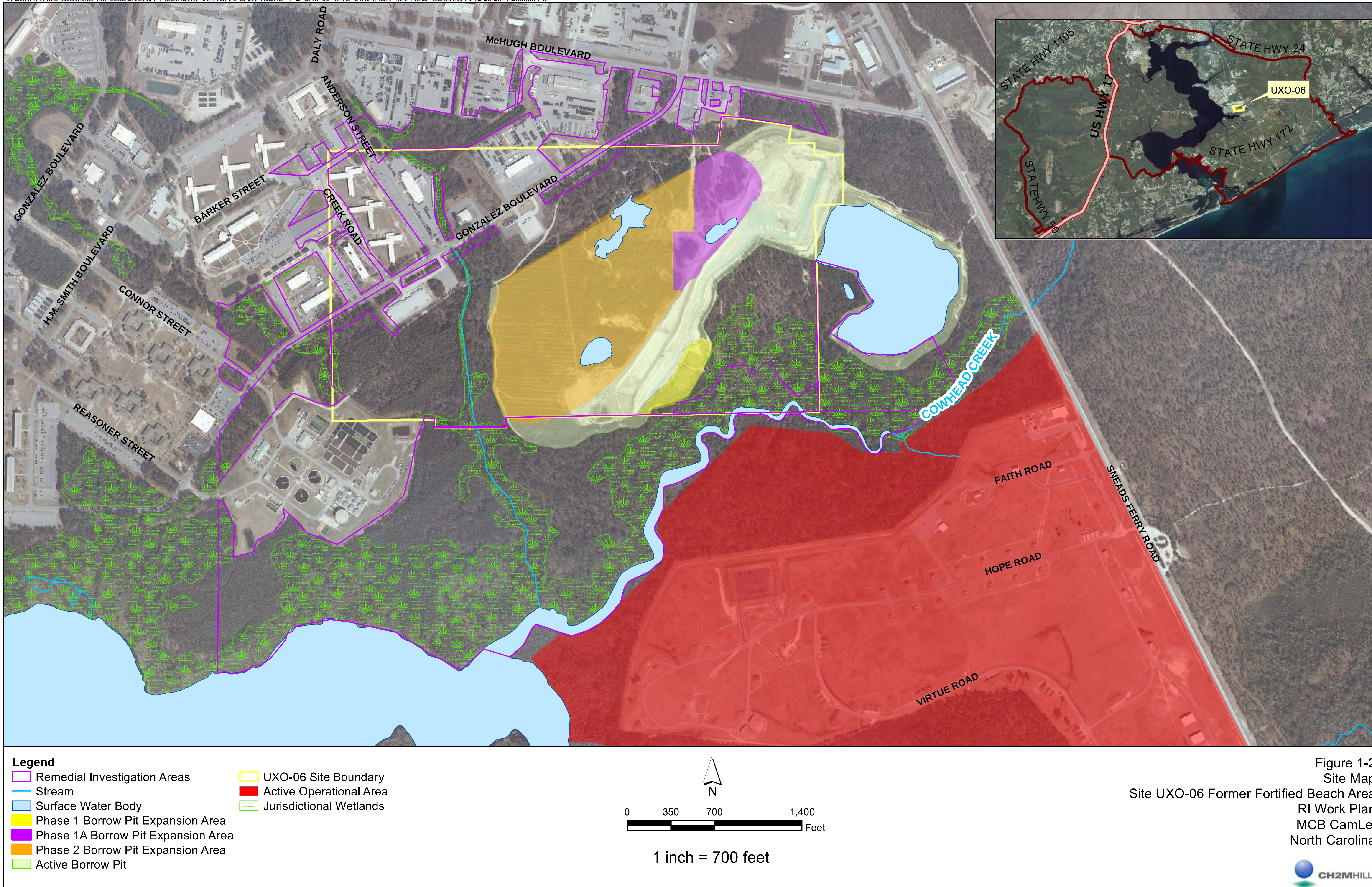

Figure 1-2
Site Map
Site UXO-06 Former Fortified Beach Area
RI Work Plan
MCB CamLej
North Carolina

CH2MHILL

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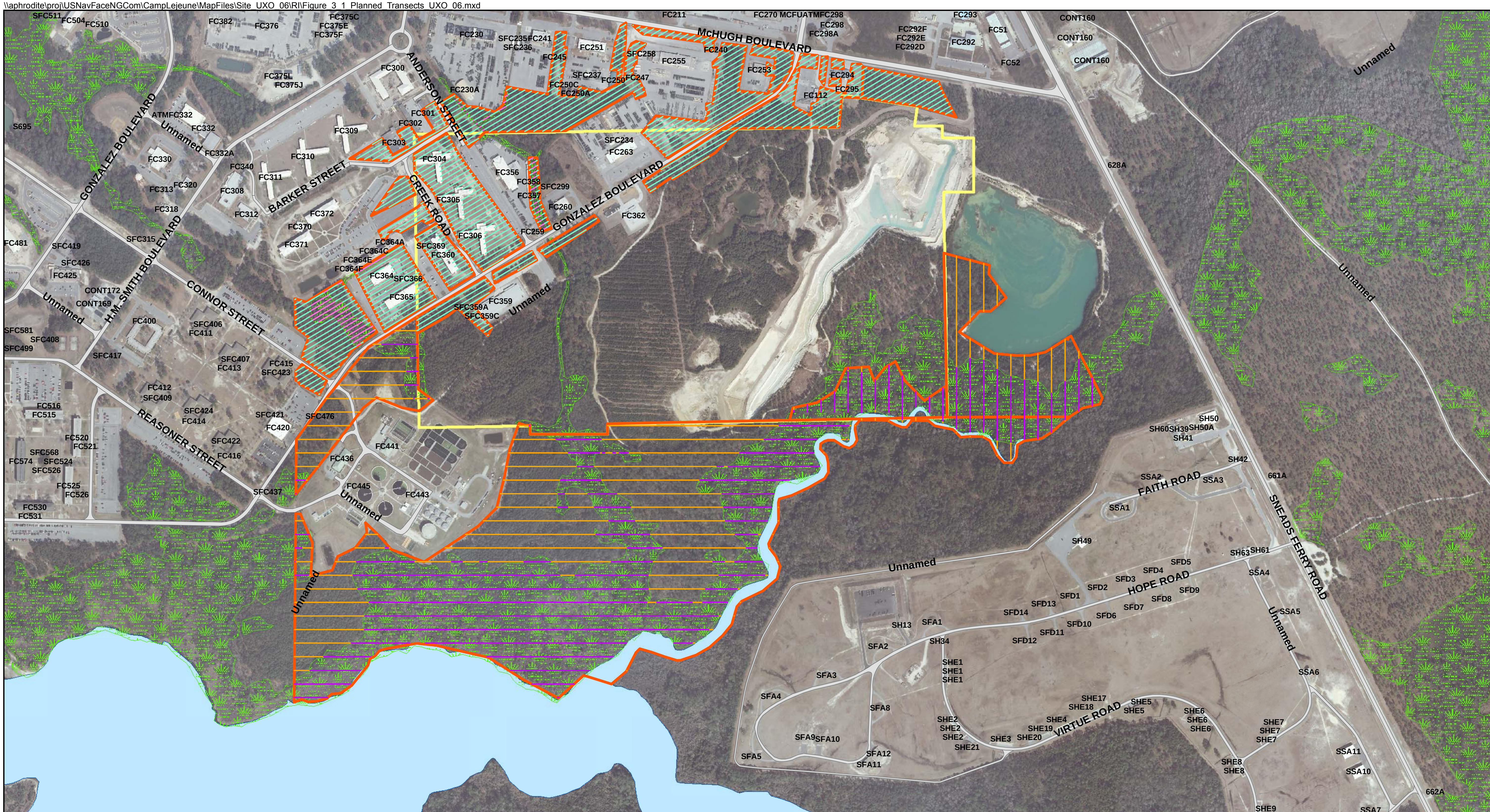

Legend

- 10% Coverage Planned Transects (Outside Wetland 64,892ft)
- 10% Coverage Planned Transects (Inside Wetland 3,836ft)
- 3.3% Coverage Planned Transects (Outside Wetland 28,058ft)
- 3.3% Coverage Planned Transects (Inside Wetland 34,142ft)
- Investigation Area (205.9 Acres)
- Road
- Jurisdictional Wetland Area
- Surface Water Course Area
- UXO-06 Site Boundary (ASR #2.65)

N

0 350 700 1,400 Feet

1 inch = 700 feet

Figure 1-3
Planned Transects
MRP Site UXO-06 Former Fortified Beach Assault Area
RI Work Plan
MCB CamLej
North Carolina

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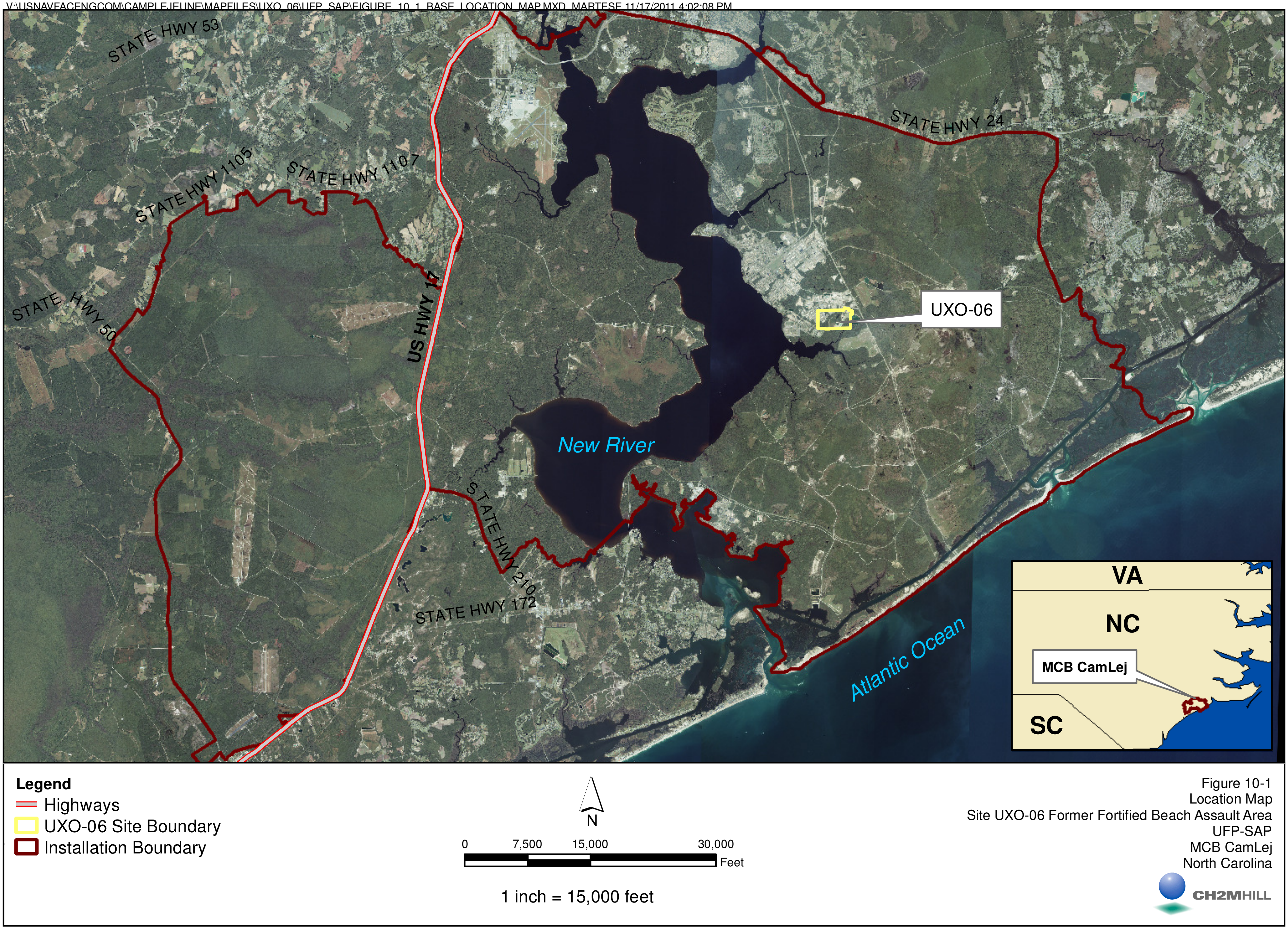

Figure 10-1
Location Map
Site UXO-06 Former Fortified Beach Assault Area
UFP-SAP
MCB CamLej
North Carolina

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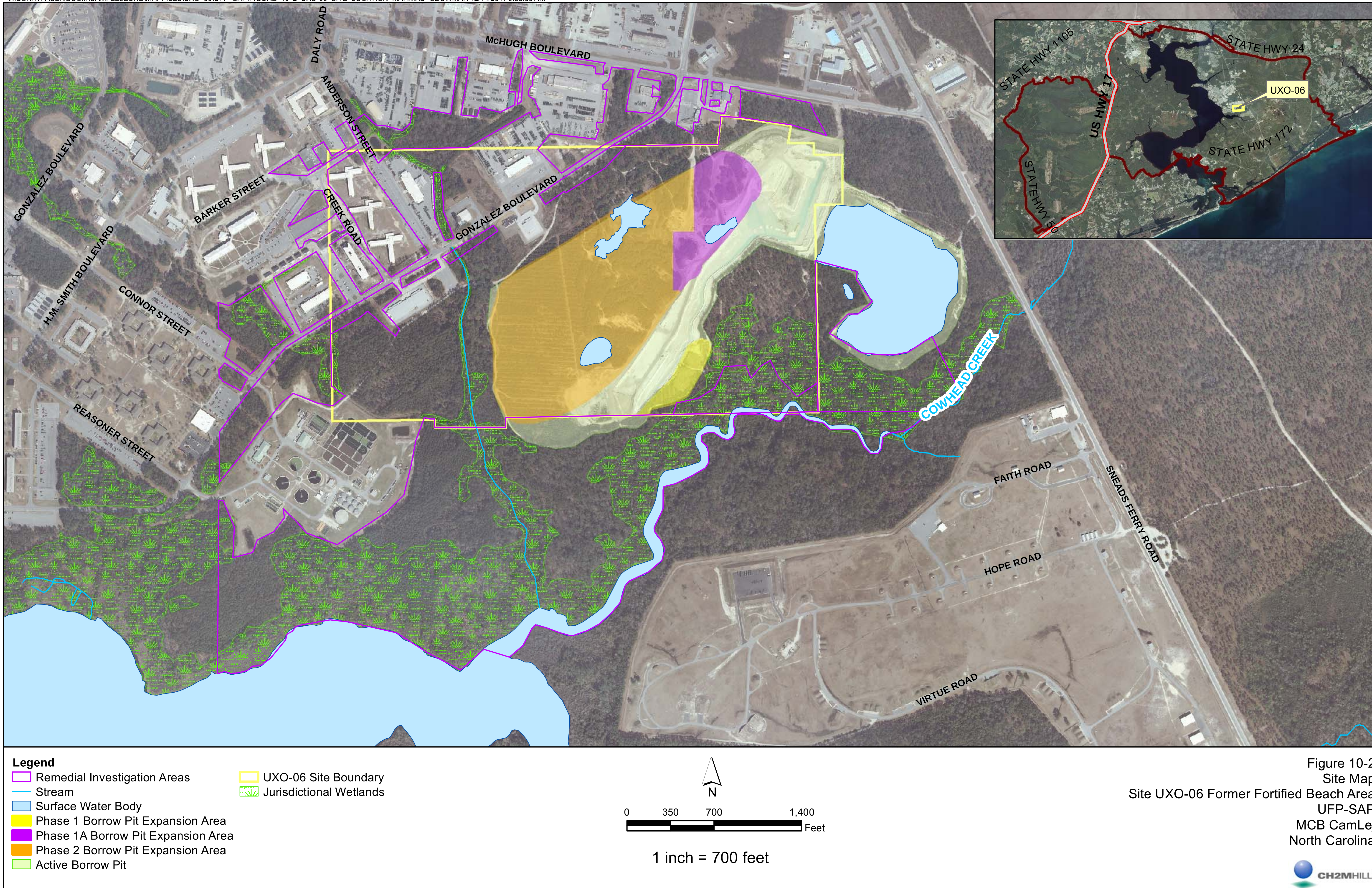

Figure 10-2
Site Map
Site UXO-06 Former Fortified Beach Area
UFP-SAP
MCB CamLej
North Carolina

CH2MHILL

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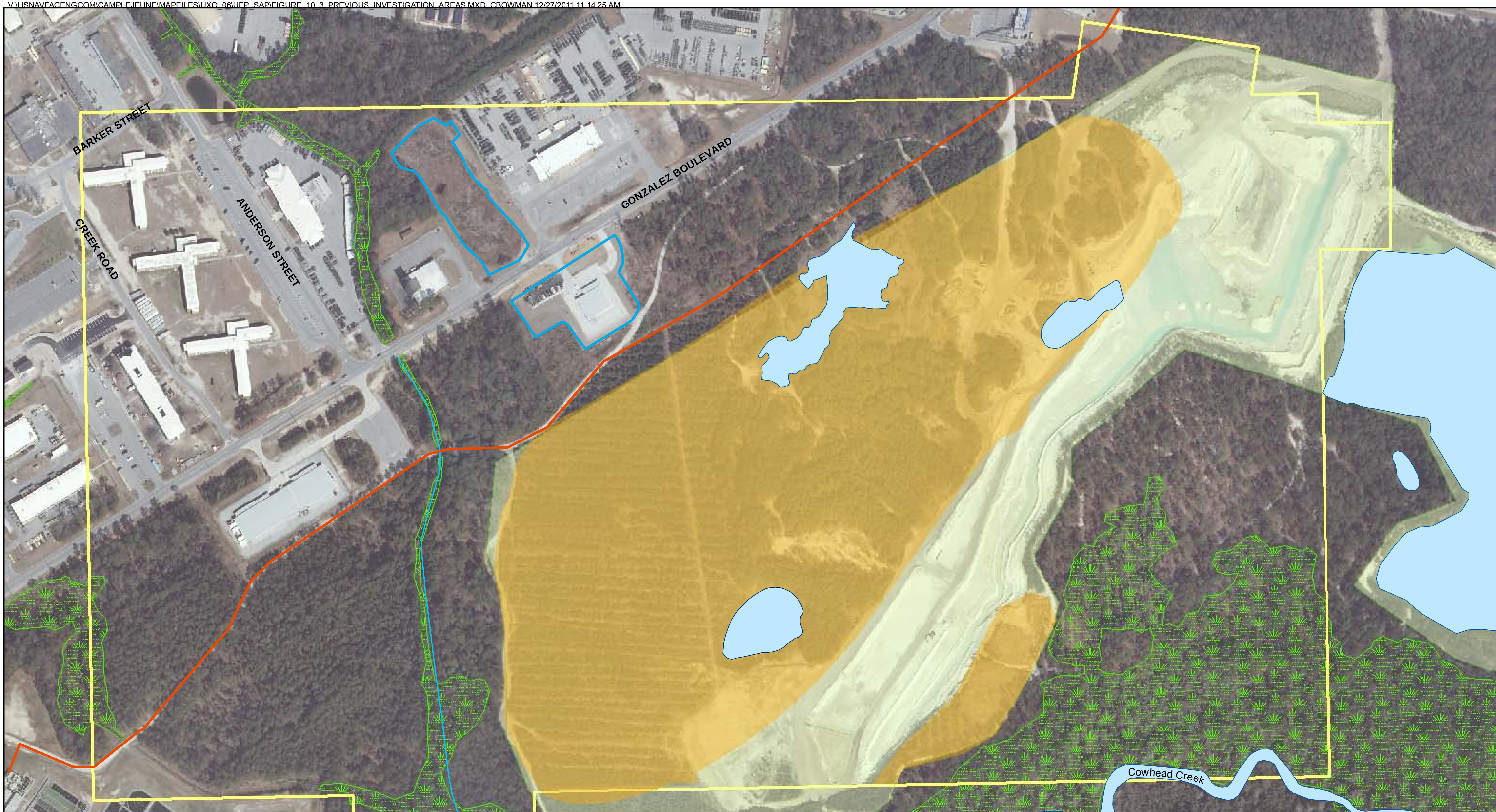

Legend
- Sewer Line Easement
- MILCON Area
- Stream
- Surface Water Body
- Jurisdictional Wetlands
- UXO-06 Site Boundary
- Active Borrow Pit
- Borrow Pit Expansion Area

N

0 150 300 600 Feet

1 inch = 300 feet

Figure 10-3
Previous Investigation Areas: MILCON Area, Sewer Line Easement, and Borrow Pit Expansion Area
Site UXO-06 Former Beach Assault Area
UFP-SAP
MCB CamLej
North Carolina

CH2MHILL

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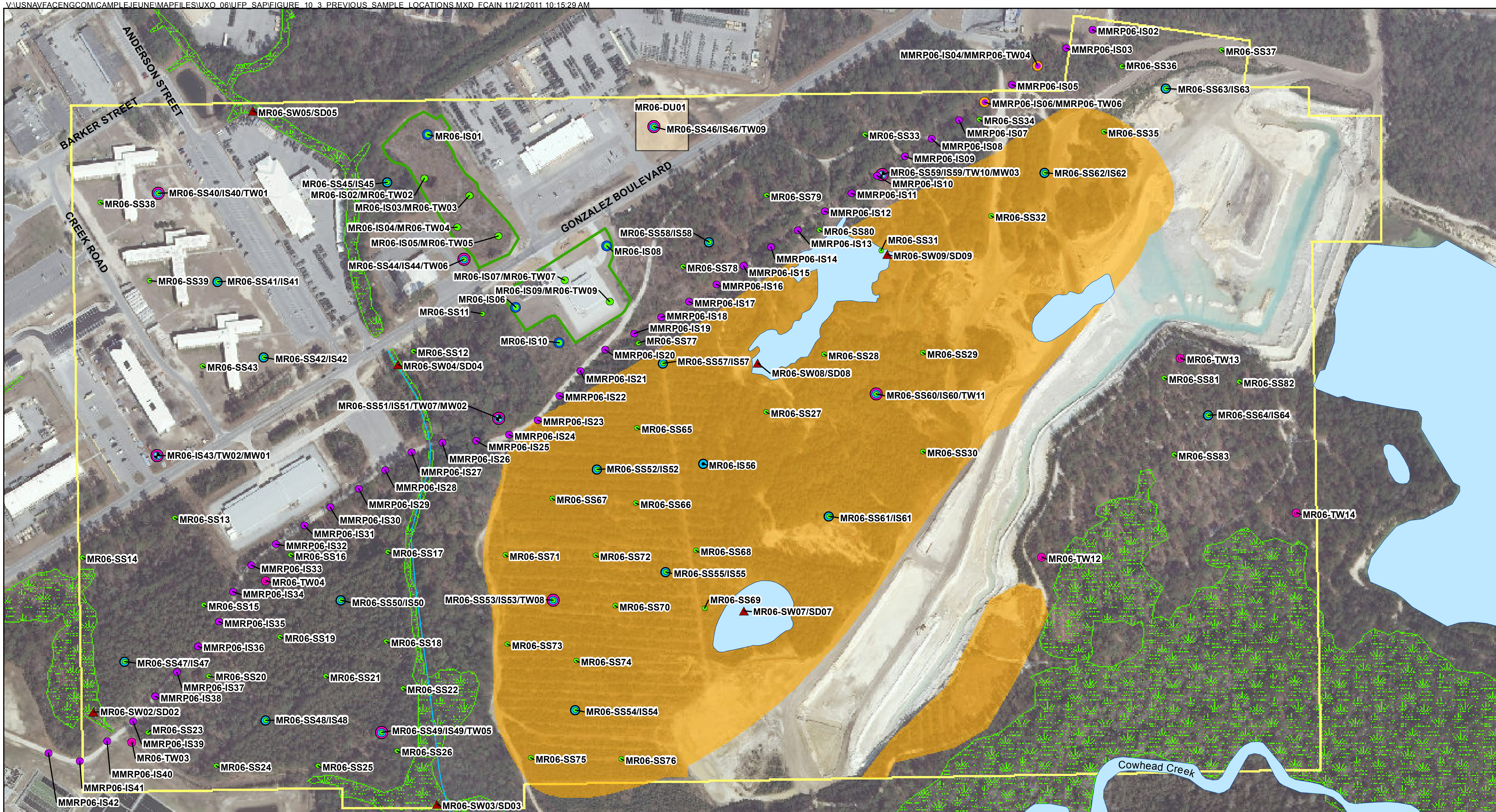

Legend

- Focused PA/SI Soil Sample Location
- Focused PA/SI Soil/Groundwater Sample Location
- Focused SI Soil Sample Location
- Focused SI Soil/Groundwater Sample Location
- PA/SI Permanent Monitoring Well
- PA/SI Surface Soil Sample Location
- PA/SI Surface/Subsurface Soil Sample Location and Temporary Well
- PA/SI Surface and Subsurface Soil Sample Location
- PA/SI Subsurface Soil Sample Location
- PA/SI Temporary Well
- PA/SI Subsurface Soil Sample Locations/Temporary Well
- PA/SI Surface Water and Sediment Sample Location
- MILCON Area
- Stream
- Surface Water Body
- Borrow Pit Expansion Area
- Decision Unit
- UXO-06 Site Boundary
- Jurisdictional Wetlands

N

0 150 300 600 Feet

1 inch = 300 feet

Figure 10-4
Previous Sampling Locations
Site UXO-06 Former Fortified Beach Assault Area
UFP-SAP
MCB CamLej
North Carolina

CH2MHILL

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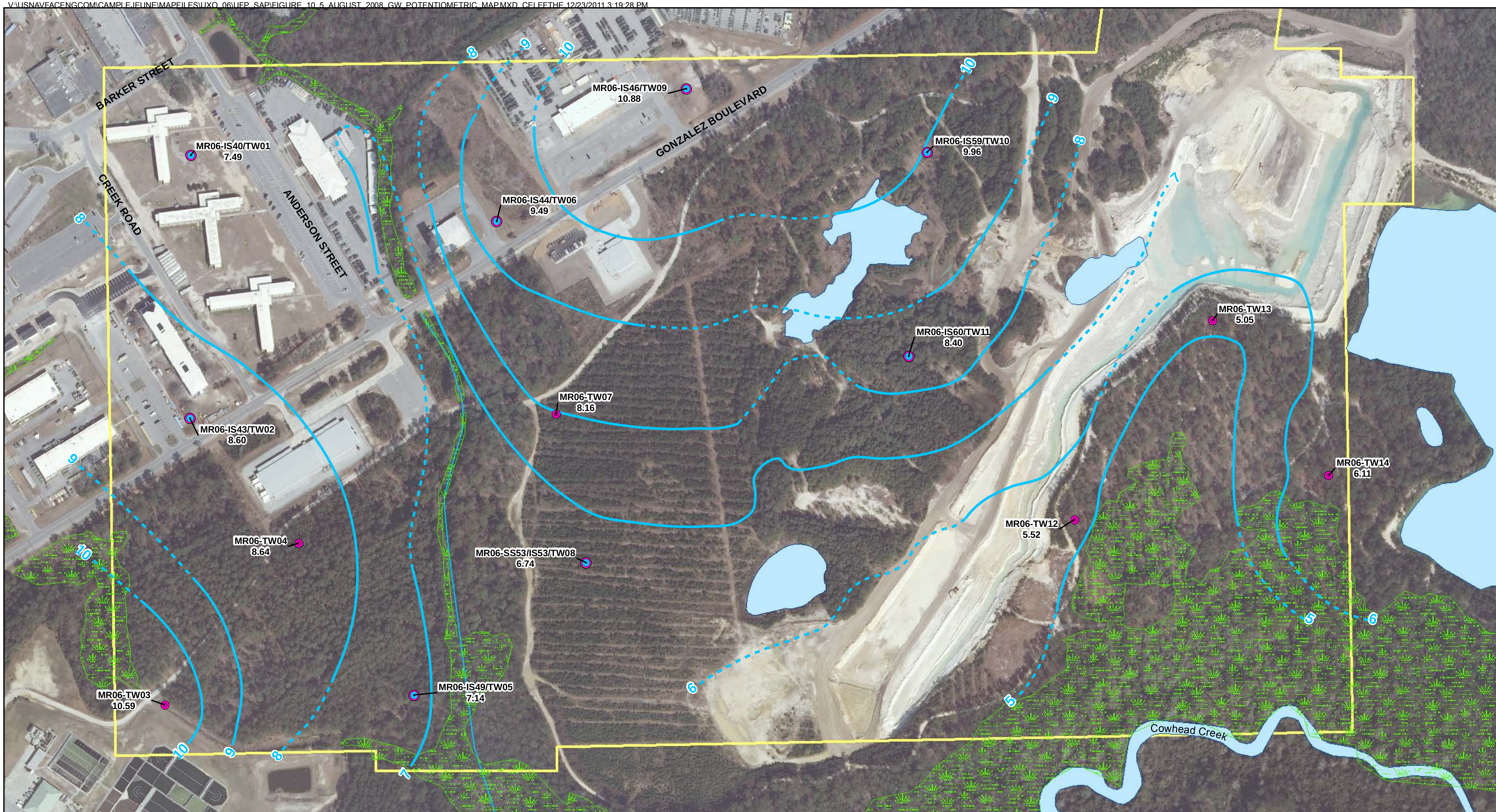

Legend
- Subsurface Soil Sample Locations/Temporary Wells
- Temporary Wells
- Potentiometric Surface Contours (Dashed where inferred)
- Jurisdictional Wetlands
- Stream
- Surface Water Body
- UXO-06 Site Boundary

Note: Potentiometric surface contours have been interpolated between temporary monitoring well locations. Actual conditions may differ from those shown here.
All measurements shown are in feet above mean sea level

1 inch = 300 feet

Figure 10-5
August 2008 Potentiometric Surface Map
Site UXO-06 Former Fortified Beach Assault Area
UFP-SAP
MCB CamLej
North Carolina

CH2MHILL

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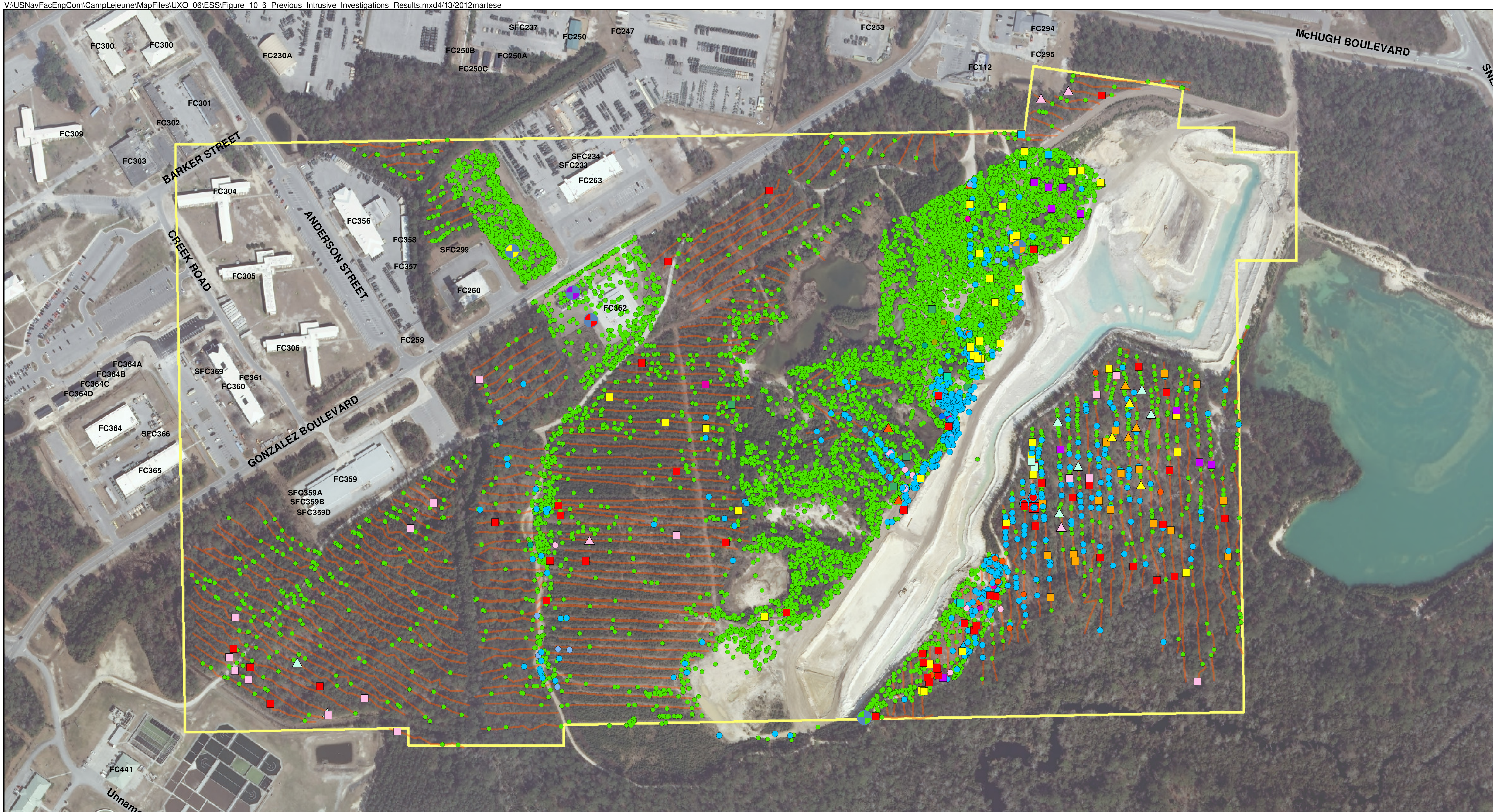

Legend

UXO-06 Site Boundary
DGM Transects
Investigated Anomaly- Non-MPPEH

MEC Items

3.5" M29 Rocket Practice, HE M28
MK13 Hand Signal Flare
M18 Smoke Grenade
Grenade, Rifle, Star, Cluster, Green M20A1
MKI Illuminating Hand Grenade

MPPEH/Munitions Debris

Grenade, Rifle, Star, Cluster, Green, M20A1
Other Munitions Debris
Signal, Illum (M17/M22/M23/M125A1/M127A1)
Ignitor M60
Grenade Fuze (M15/M18/M201A1/T-78/other)
Grenade fragments/spoon
Cannister 90mm M27 blank
Cartridge, 40mm illumination
81mm Training Mortar, M68
75mm Projectile Cartridge
60mm Mortar
105mm Projectile, Cartridge
2.36 inch Practice Rocket M6/M7
3.5 inch Rocket M28/M29
35mm Subcaliber Rocket M73
40mm Grenade
Grenade Fuze (M15/M18/M201A1/T-78/other)
Grenade Practice M1
Hand Grenade, Frag, M67
Ignitor M60
Other Munitions Debris (ammo links/M1 clips/rocket fins/bore riding pin cover)
Rifle Grenade (M9/M15/M20)
Signal, Illum (M17/M22/M23/M125A1/M127A1)
Fuze, 3.5 inch Rocket, M405
Cannister 90mm M27 blank
Cartridge, 40mm illumination
Grenade fragments/spoon
Landmine, Practice (M16/M16A1/other)
Rocket Fin/Motor
Burial Pit

N

0 175 350 700 Feet

1 inch = 350 feet

Figure 10-6
Previous Intrusive Investigation Results
Site UXO-06 Former Fortified Beach Assault Area
Explosives Safety Submission
MCB CamLej
North Carolina

CH2MHILL

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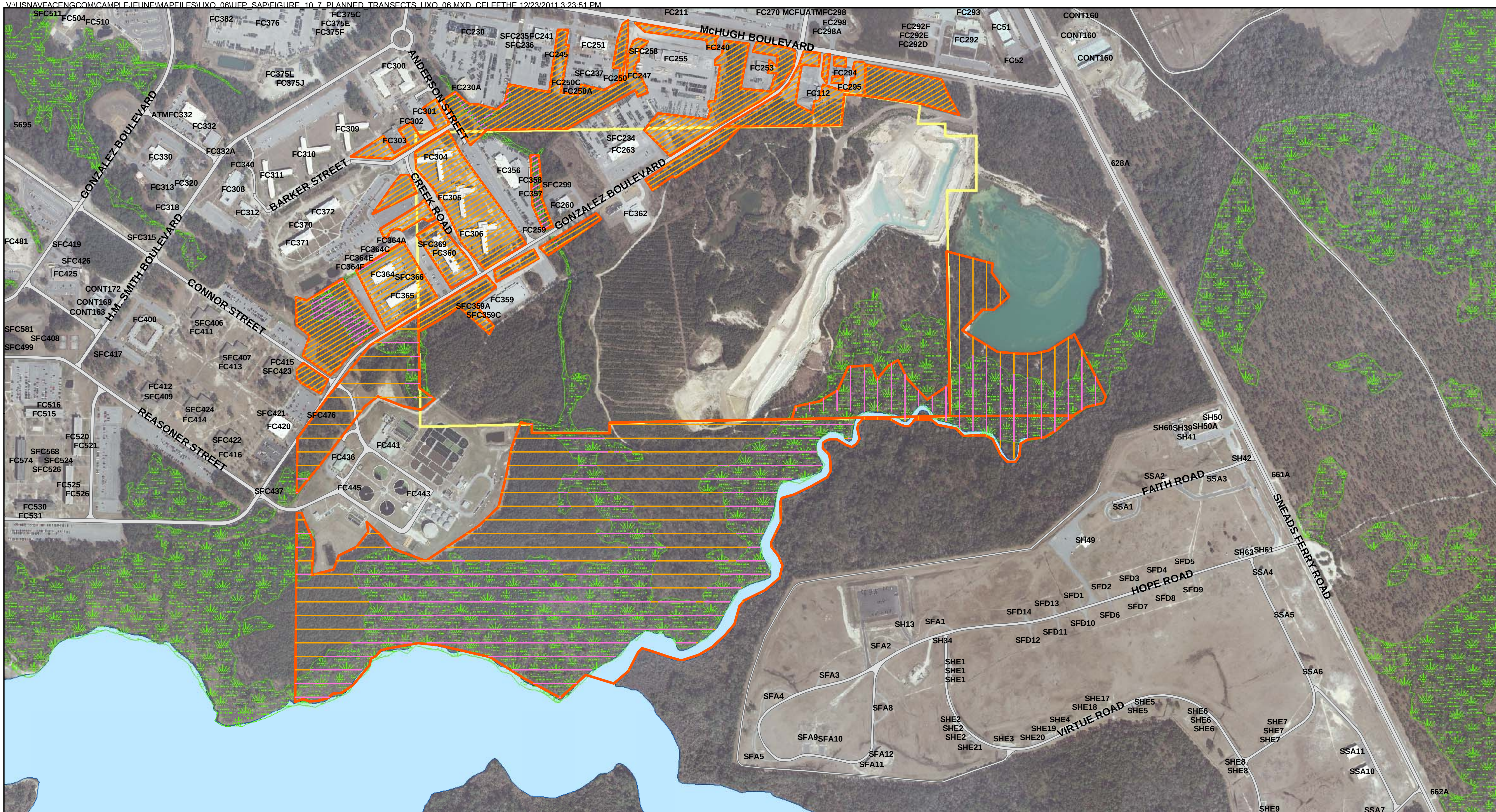

Legend

- Planned Transect Inside Wetland
- Planned Transect Outside Wetland
- Investigation Area
- Road
- Jurisdictional Wetland Area
- Surface Water Course Area
- UXO-06 Site Boundary (ASR #2.65)

N

0 350 700 1,400 Feet

1 inch = 700 feet

Figure 10-7
Planned Transects
MRP Site UXO-06 Former Fortified Beach Assault Area
UFP-SAP
MCB CamLej
North Carolina

CH2MHILL

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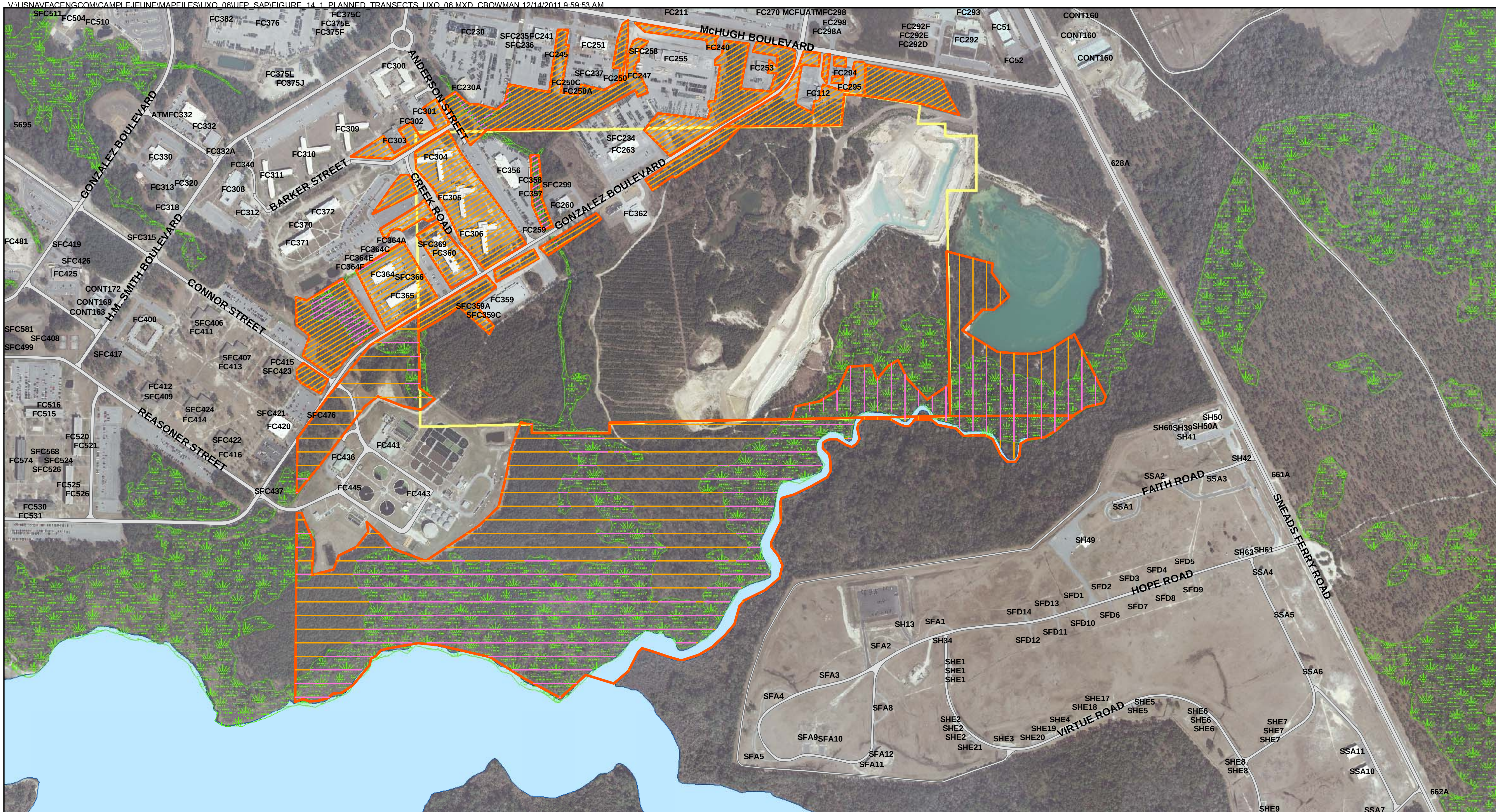

Legend

- Planned Transect Inside Wetland
- Planned Transect Outside Wetland
- Investigation Area
- Road
- Jurisdictional Wetland Area
- Surface Water Course Area
- UXO-06 Site Boundary (ASR #2.65)

N

0 350 700 1,400 Feet

1 inch = 700 feet

Figure 14-1
Planned Transects
MRP Site UXO-06 Former Fortified Beach Assault Area
UFP SAP
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.

<u>CH2M HILL In-house Utility Location Experts</u>

Tamir Klaff/WDC

Home Office Phone – 703-669-9611

<u>Electromagnetic Induction (EMI) Methods</u>

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.

______________________________ ____________

Subcontractor's Signature	Date

STANDARD OPERATING PROCEDURE

Shallow Soil Sampling

I. Purpose

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

II. Scope

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

III. Equipment and Materials

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

IV. Procedures and Guidelines

A. Wear protective gear, as specified in the Health and Safety Plan.

B. To locate samples, identify the correct location using the pin flags or stakes. Proceed to collect a sample from the undisturbed soil adjacent to the marker following steps C and D. If markers are not present, the following procedures will be used.

   1. For samples on a grid:

      a. Use measuring tape to locate each sampling point on the first grid line as prescribed in the sampling plan. As each point is located, drive a numbered stake in the ground and record its location on the site map and in the logbook.

b. Proceed to sample the points on the grid line.

c. Measure to location where next grid line is to start and stake first sample. For subsequent samples on the line take two orthogonal measurements: one to the previous grid line, and one to the previous sample on the same grid line.

d. Proceed to sample the points on the grid line as described in Section C below.

e. Repeat 1c and 1d above until all samples are collected from the area.

f. Or, a GPS unit can be used to identify each location based on map coordinated, if available.

2. For non-grid samples:

a. Use steel measuring tape to position sampling point at location described in the sampling plan by taking two measurements from fixed landmarks (e.g., corner of house and fence post).

b. Note measurements, landmarks, and sampling point on a sketch in the field notebook, and on a site location map.

c. Proceed to sample as described in Section C below.

d. Repeat 2a through 2c above until all samples are collected from the area.

e. Or, a GPS unit can be used to identify each location based on map coordinated, if available.

C. To the extent possible, differentiate between fill and natural soil. If both are encountered at a boring location, sample both as prescribed in the field sampling plan. Do not locate samples in debris, tree roots, or standing water. In residential areas, do not sample in areas where residents' activities may impact the sample (e.g., barbecue areas, beneath eaves of roofs, driveways, garbage areas). If an obstacle prevents sampling at a measured grid point, move as close as possible, but up to a distance of one half the grid spacing in any direction to locate an appropriate sample. If an appropriate location cannot be found, consult with the Field Team Leader (FTL). If the FTL concurs, the sampling point will be deleted from the program. The FTL will contact the CH2M HILL project manager (PM) immediately. The PM and Navy Technical Representative (NTR) will discuss whether the point should be deleted from the program. If it is deleted, the PM will follow-up with the NTR in writing.

D. To collect samples:

1. Use a decontaminated stainless steel scoop/trowel or disposable plastic scoopto scrape away surficial organic material (grass, leaves, etc.) adjacent to

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

2. If sampling:

   a. Surface soil: Obtain soil sample by scooping soil using the augering scoop/trowel, starting from the surface and digging down to a depth of about 6 inches, or the depth specified in the workplan.

   b. Subsurface soil: Obtain the subsurface soil sample using an auger down to the depths prescribed in the field sampling plan.

3. Take a photoionizaton detector (PID) reading of the sampled soil if organics are anticipated to be present and record the response in the field notebook. Also record lithologic description and any pertinent observations (such as discoloration) in the logbook.

4. Empty the contents of the scoop/trowel into a decontaminated stainless steel pan or dedicated sealable bag.

5. Repeat this procedure until sufficient soil is collected to meet volume requirements.

6. For TCL VOC and field GC aliquots, fill sample jars directly with the trowel/scoop or specialized sampling equipment (i.e. Encore® or Terra Core® sampler) and cap immediately upon filling. DO NOT HOMOGENIZE.

7. For TCL pesticides/PCBs and SVOCs, TAL metals, and field XRF aliquots, homogenize cuttings in the pan using a decontaminated stainless steel utensil in accordance with SOP *Decontamination of Drilling Rigs and Equipment*.

8. Transfer sample for analysis into appropriate containers with a decontaminated utensil.

9. Backfill the hole with soil removed from the borehole. To the extent possible, replace topsoil and grass and attempt to return appearance of sampling area to its pre-sampled condition. For samples in non-residential, unmowed areas, mark the sample number on the stake and leave stake in place. In mowed areas, remove stake.

V. Attachments

None.

VI. Key Checks and Items

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

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.

STANDARD OPERATING PROCEDURE

Homogenization of Soil and Sediment Samples

I. Purpose

The homogenization of soil and sediment samples is performed to minimize any bias of sample representativeness introduced by the natural stratification of constituents within the sample.

II. Scope

Standard techniques for soil and sediment homogenization and equipment are provided in this SOP. These procedures do not apply to aliquots collected for VOCs or field GC screening; samples for these analyses should NOT be homogenized.

III. Equipment and Materials

Sample containers, stainless steel spoons or spatulas, and stainless steel pans.

IV. Procedures and Guidelines

Soil and sediment samples to be analyzed for semivolatiles, pesticides, PCBs, metals, cyanide, or field XRF screening should be homogenized in the field. After a sample is taken, a stainless steel spatula should be used to remove the sample from the split spoon or other sampling device. The sampler should not use fingers to do this, as gloves may introduce organic interferences into the sample.

Samples for VOCs should be taken immediately upon collection and should not be homogenized.

Prior to homogenizing the soil or sediment sample, any rocks, twigs, leaves, or other debris should be removed from the sample. The sample should be placed in a decontaminated stainless steel pan and thoroughly mixed using a stainless steel spoon. The soil or sediment material in the pan should be scraped from the sides, corners, and bottom, rolled into the middle of the pan, and initially mixed. The sample should then be quartered and moved to the four corners of the pan. Each quarter of the sample should be mixed individually, and then rolled to the center of the pan and mixed with the entire sample again.

All stainless steel spoons, spatulas, and pans must be decontaminated following procedures specified in SOP *Decontamination of Personnel and Equipment* prior to homogenizing the sample. A composite equipment rinse blank of homogenization equipment should be taken each day it is used.

V. Attachments

None.

VI. Key Checks and Items

- Take VOC samples immediately and do not homogenize the soil.
- Homogenize soil for analyses other than VOCs in a clean, stainless steel bowl.

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

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.

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.

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)

STANDARD OPERATING PROCEDURE

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 ºC	+/ - 1.0 ºC
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.

STANDARD OPERATING PROCEDURE

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.

CH2MHILL

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:

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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 <u>active, operational ranges</u>. 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—<u>not</u> 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.

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
Brint Bixler	MR Northeastern Region MR Market Segment Manager	WDC
Kyra Donell/KNV	MR Southeastern Region MR Market Segment Manager	KNV
Steve Romanow	MR Project Delivery Manager	WDC
Kevin Lombardo	MR Operations Manager	WDC
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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

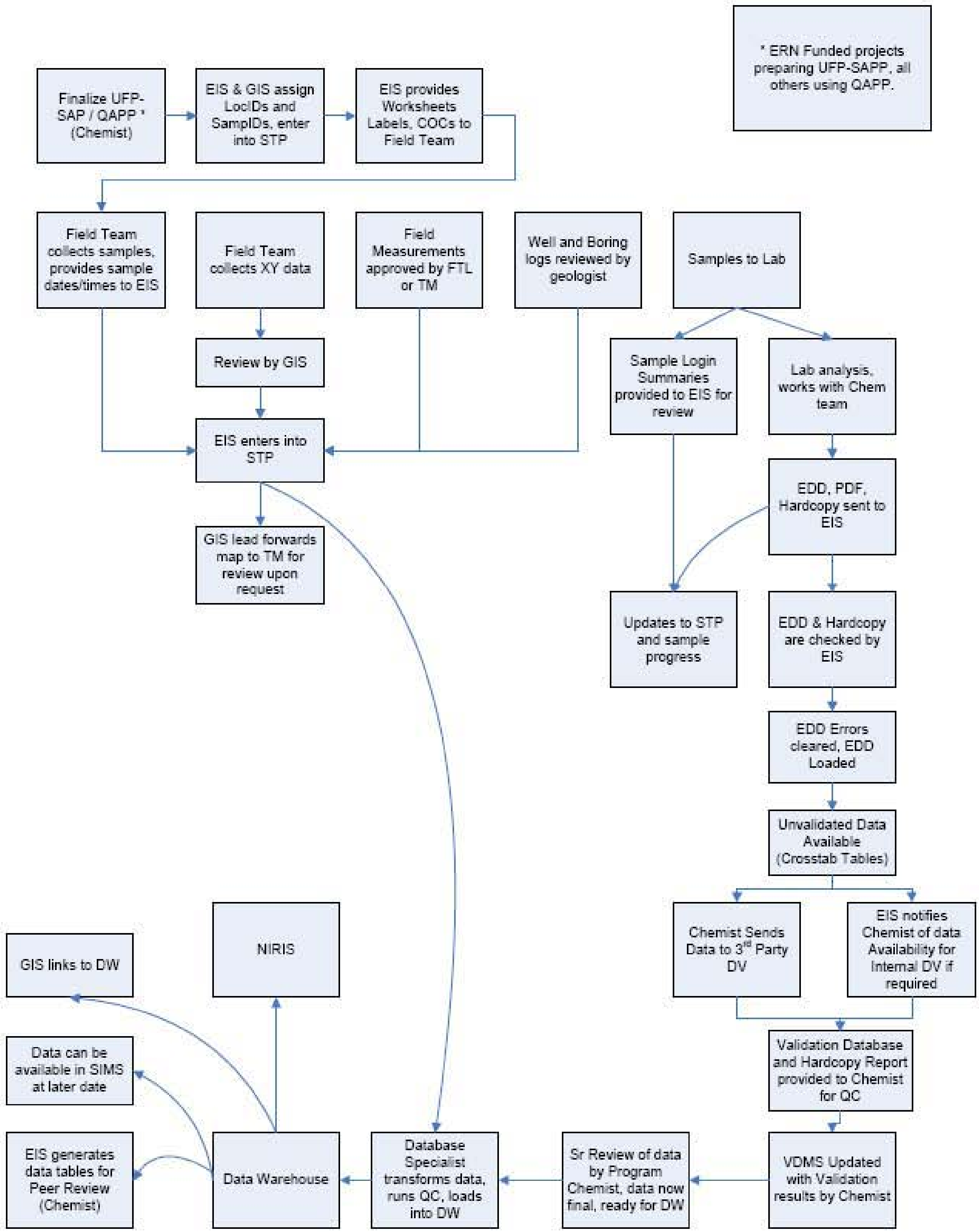

FIGURE P-1
ENVIRONMENTAL DATA MANAGEMENT WORKFLOW PROCESS

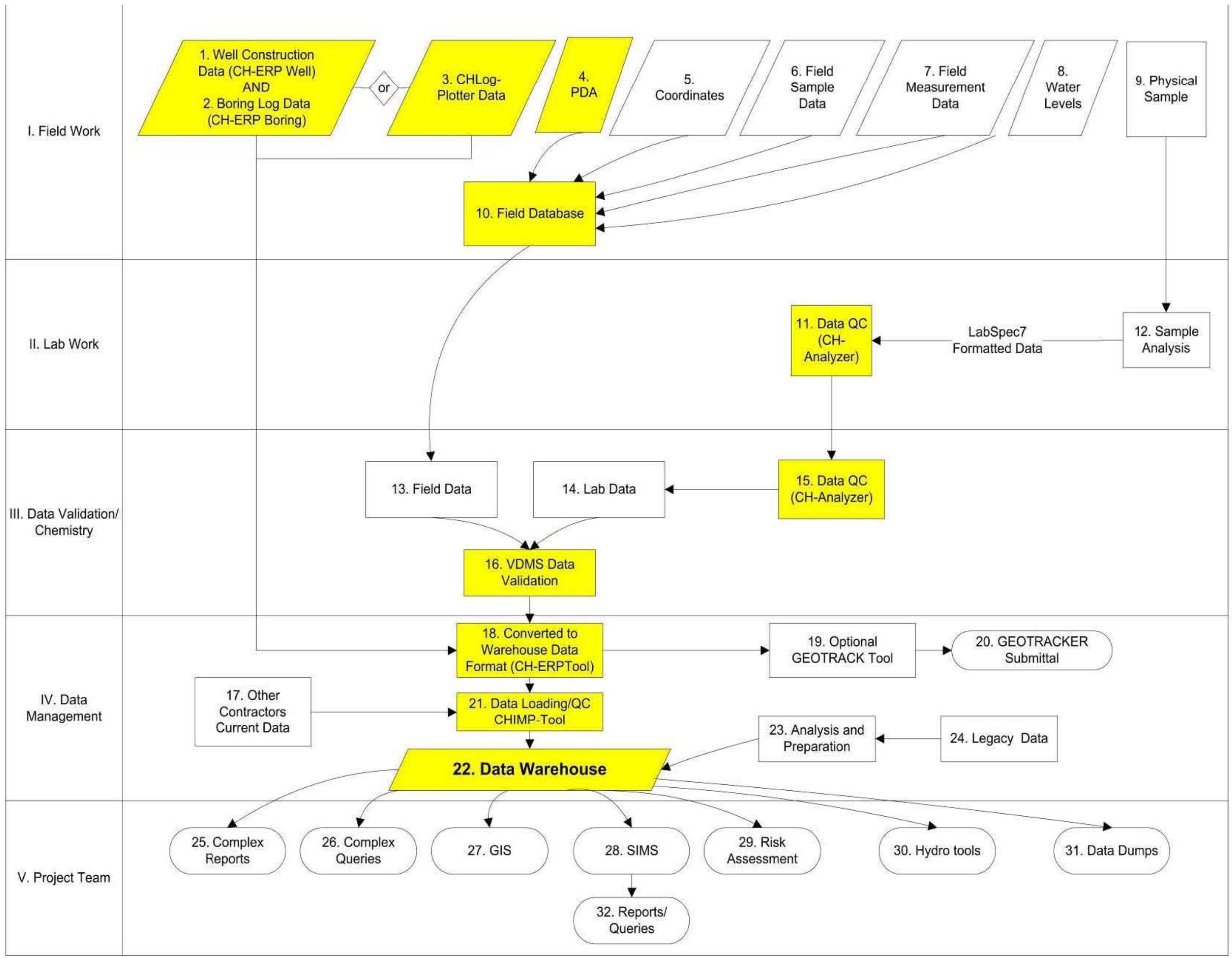

FIGURE P-2
DBMS PROCESS

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Appendices

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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
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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
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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
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GIS Analyst (GA)	Matt Rissing 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6243	757-497-6885	mrissing@ch2m.com
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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.

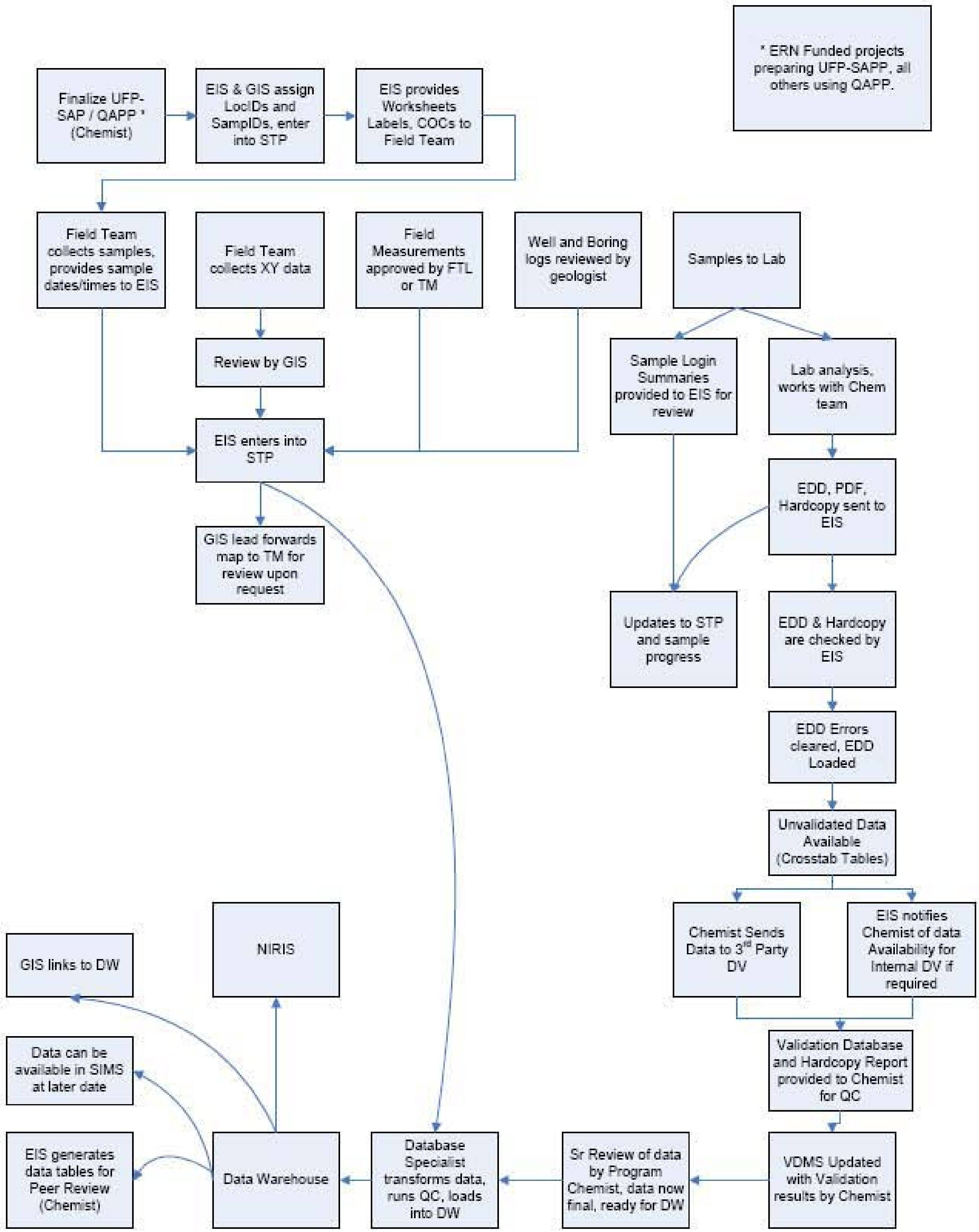


FIGURE 1
ENVIRONMENTAL DATA MANAGEMENT WORKFLOW PROCESS

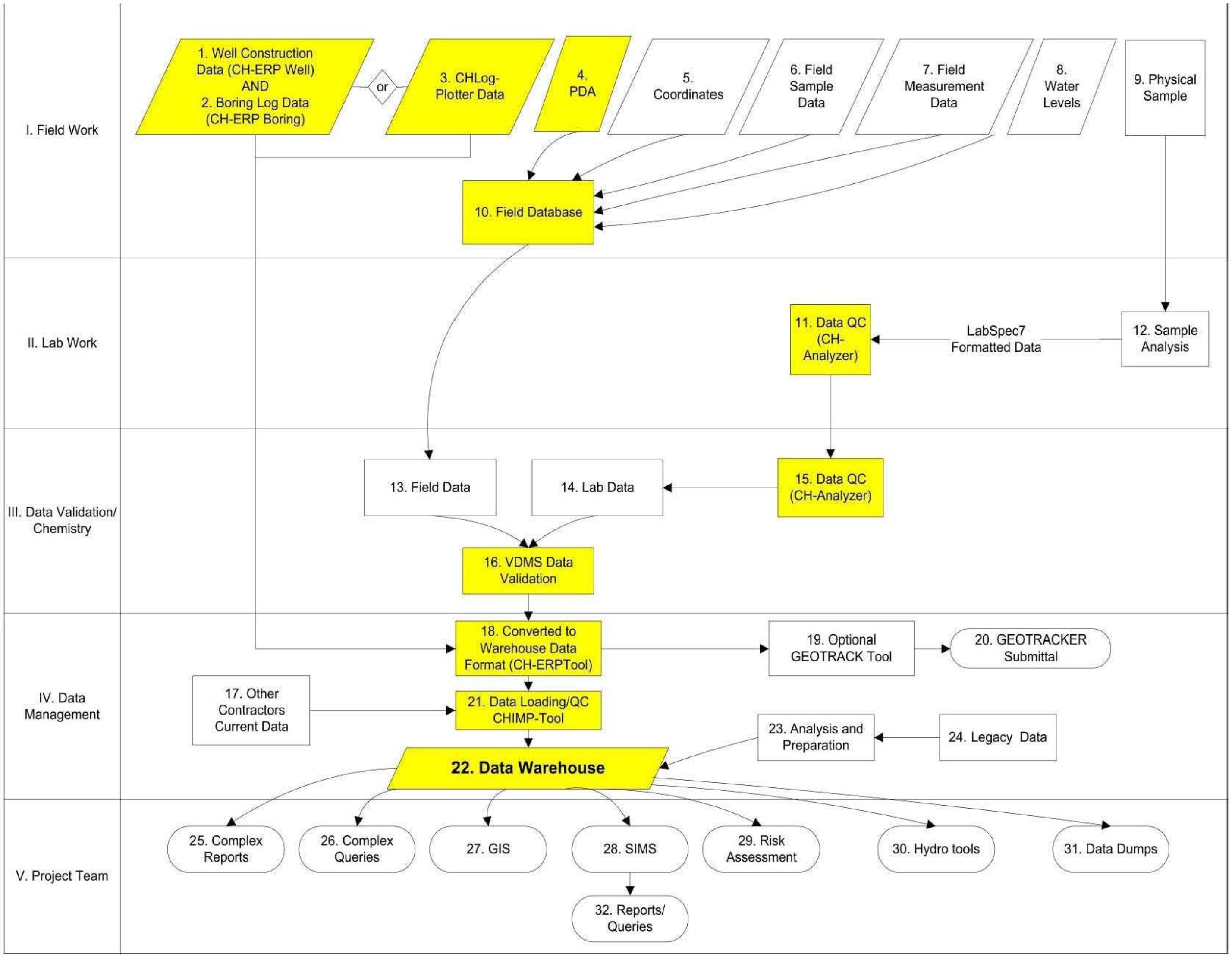


FIGURE 2
DBMS PROCESS

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.

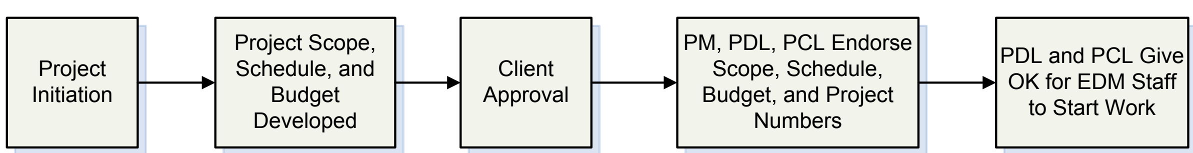


FIGURE 3
PROJECT PLANNING

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.

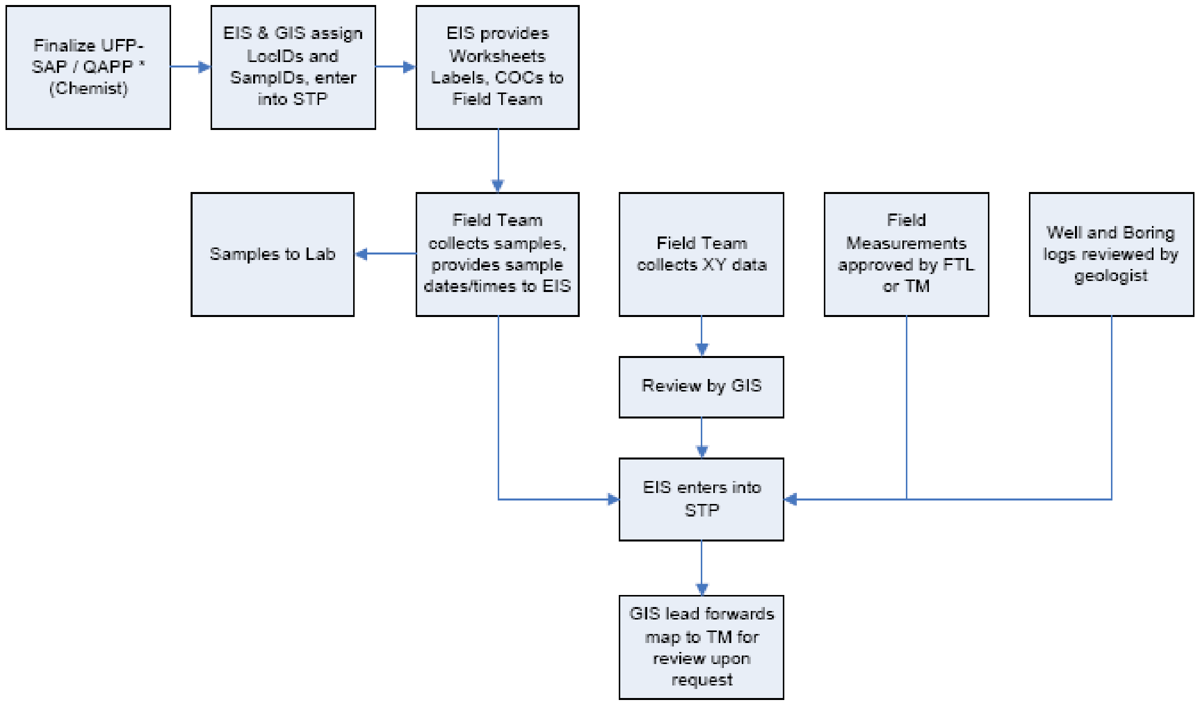


FIGURE 4
FIELD SAMPLING

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

<table>
<tr><th colspan="4">Navy Clean</th></tr>
<tr><th>First Segment</th><th>Second Segment</th><th>3rd Segment</th><th>Fourth Segment</th></tr>
<tr><td>Site ID
Facility, AOC Number</td><td>Station/Sample Type, Station Number, Modifier</td><td>Depth
(As Needed)</td><td>Date
(MMYY) A</td></tr>
<tr><td>AA,ANN</td><td>AANNNA</td><td>A</td><td>NNNNA</td></tr>
<tr><td colspan="4">Notes: "A"= alphabetic "N"= numeric</td></tr>
<tr><td>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 – 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)</td>
<td><u>Sample Type:</u>
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

<u>Station Number:</u>
Sequential Number (e.g., 001, 002, 003)

<u>Modifier (used selectively):</u>
D = Deep monitoring well
S = Shallow monitoring well
P = Duplicate</td>
<td colspan="2"><u>Depth</u>:
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…

<u>Sample Number:</u>
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
<u>Qualifier Codes</u>:
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…</td></tr>
<tr><td colspan="4"><u>Example Sample IDs:</u>
<u>WNA01-MW102S-0105A</u> = The first shallow groundwater sample collected at monitoring well location 102 in January 2005 in AOC01 at the Washington Navy Yard facility.
<u>PIW01-SW023P-0306</u> = Pineros Island duplicate surface water sample collected at location 23, at SMWU-1 in March 2006.
<u>SSW06-FB01-061106</u> = The first field blank collected on June 11, 2006 at SMWU-6 in Sabana Seca.</td></tr>
</table>

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.

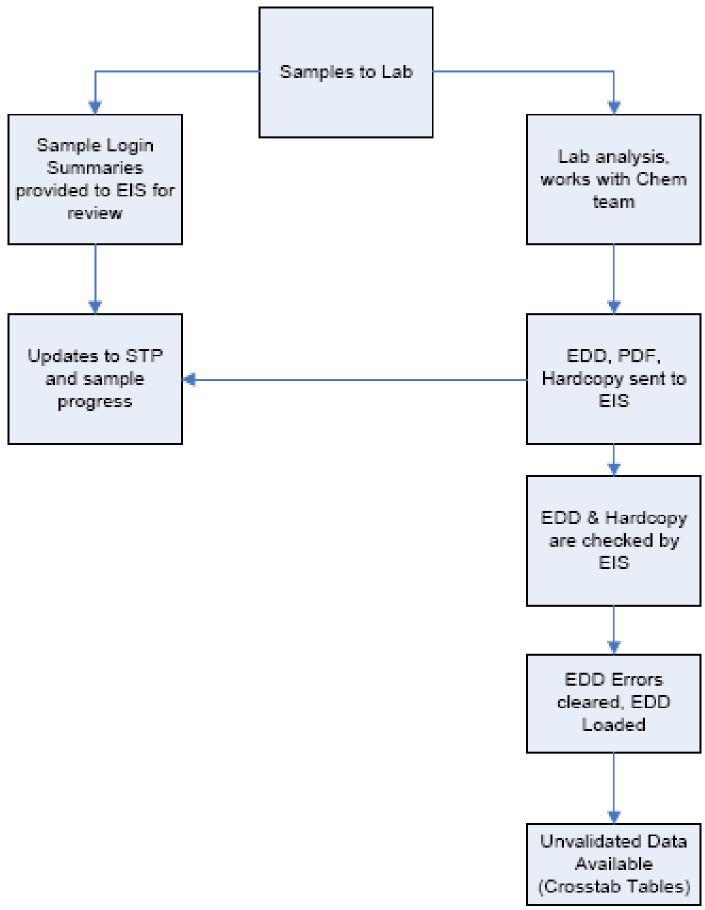


FIGURE 5
LABORATORY ANALYSIS

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)

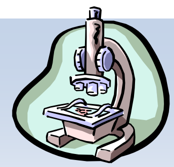
Step 2B

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.

SCOPE OF ACCREDITATION TO ISO/IEC 17025-2005

ENVIRONMENTAL CONSERVATION LABORATORIES – JACKSONVILLE
4810 Executive Park Court, Suite 211
Jacksonville, FL 32216
Dr. Mark Inman   Phone: 904 296 3007
Email address: minman@encolabs.com

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	---------------------------	---------------------------

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

The American Association for Laboratory Accreditation

World Class Accreditation

Accredited DoD ELAP Laboratory

A2LA has accredited

GEL LABORATORIES, LLC

Charleston, SC

for technical competence in the field of

Environmental Testing

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

Presented this 22nd day of August 2011.

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

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.

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

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

IAF Chair	**ILAC Chair**	**ISO Secretary General**

SCOPE OF ACCREDITATION TO ISO/IEC 17025:2005

GEL LABORATORIES, LLC
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rlp@gel.com

ENVIRONMENTAL

Valid To: June 30, 2013 Certificate Number: 2567.01

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

	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-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
Kinetic Phosphorescence Analyzer Total Uranium	GL-RAD-A-023	GL-RAD-B-018

	Preparation SOP	Analytical SOP
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-A-044, GL-RAD-A-054	GL-RAD-I-006, GL-RAD-I-015, GL-RAD-I-016
Gross Alpha/Gross Beta:	GL-RAD-A-001, GL-RAD-A-001B, GL-RAD-A-001C, GL-RAD-A-056	GL-RAD-I-006, GL-RAD-I-015, GL-RAD-I-016
48 hour Gross Alpha	GL-RAD-A-047	GL-RAD-I-006, GL-RAD-I-015, GL-RAD-I-016
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-RAD-A-055	 GL-MA-E-014 GL-RAD-B-034

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

Testing Technologies

Atomic Absorption/ICP-AES Spectrometry, ICP/MS, Gas Chromatography, Gas Chromatography/Mass Spectrometry, Gravimetry, High Performance Liquid Chromatography, Ion Chromatography, Methylene Blue Active Substances, Misc.- Electronic Probes (pH, 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 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Antimony	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C
Arsenic	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Barium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Beryllium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Boron	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Cadmium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Calcium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Chromium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Cobalt	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Copper	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Iron	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Lead	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Lithium	EPA 200.8/6020/6020A	EPA 6020/6020A
Magnesium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Manganese	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Mercury	EPA 1631E/7470/7470A/245.1/245.2	EPA 7470/7470A/7471A/7471B
Molybdenum	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Nickel	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Phosphorous	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Potassium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
Selenium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Silicon[1]	EPA 200.7/6010B/6010C modified	EPA 6010B/6010C modified
Silica as SiO2	EPA 200.7/6010B/6010C	EPA 6010B/6010C
Silver	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C
Sodium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Strontium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Thallium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Tin	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C
Titanium	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
Tungsten	----------	EPA 6020/6020A
Vanadium	EPA 200.7/6010B/6010C	EPA 6010B/6010C
Zinc	EPA 200.7/200.8/6010B/6010C/6020/6020A	EPA 6010B/6010C/6020/6020A
General Chemistry		
Acidity	SM 2310 B/EPA 305.1	----------
Adsorbable Organic Halogens (AOX)	EPA 1650	----------
Alkalinity	SM 2320B/EPA 310.1	----------
Ammenable Cyanide	EPA 9012A/9012B/EPA 335.1	EPA 9012A/9012B
Ammonia Nitrogen	EPA 350.1	----------
Biochemical oxygen demand	SM 5210 B/EPA 405.1	----------
Bromide	EPA 9056A/EPA 300.0	EPA 9056A[3]
Carbonaceous BOD	SM 5210 B	----------
Chemical Oxygen Demand (COD)	EPA 410.4	----------
Chloride	EPA 9056A/EPA 300.0	EPA 9056A[3]
Chlorine (residual)	SM 4500Cl-G/EPA 330.5	----------
Chromium VI	EPA 7196A/SM 3500Cr-B	EPA 7196A
Color	SM 2120B/EPA 110.2	----------
Corrosivity toward Steel	----------	EPA 1110/1110A
Cyanide	EPA 9012A/9012B/335.3/335.4	EPA 9012A/9012B
Density	----------	ASTM D 5057
Extractable Organic Halides (EOX)	----------	EPA 9023
Filterable residue	SM 2540C	----------
Fluoride	EPA 9056A/EPA 300.0	EPA 9056A[3]
Ignitability	EPA 1010/1020A/1020B	EPA 1010/1020A/1020B
Hardness	SM 2340B/SM 2340C/EPA 130.2	----------
Kjeldahl Nitrogen	EPA 351.2	----------
MBAS/Surfactants	SM 5540C/EPA 425.1	----------
Nitrate (as N)	EPA 9056A/EPA 300.0	EPA 9056A[3]
Nitrate-nitrite (as N)	EPA 9056A/EPA 300.0	EPA 9056A[3]

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
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
Total, fixed, and volatile residue	SM 2540G	----------
Total Nitrate-Nitrite	EPA 353.2	----------
Total Organic Carbon (TOC)	EPA 9060/9060A/ SM 5310D/415.1	EPA 9060/9060A[2]
Total Organic Halides (TOX)	EPA 9020B	EPA 9020B[2]
Total Petroleum Hydrocarbons	EPA 1664A	EPA 1664A
Total Phenolics	EPA 9066/EPA 420.4	----------
Total Phosphorous	EPA 365.4	----------
Total residue	SM 2540B	----------
Turbidity	EPA 180.1/SM 2130	EPA 180.1/SM 2130
Organic Analytes		
1,2-Dibromo-3-chloropropane (DBCP)	EPA 504.1/8011/8260B	EPA 8260B
1,2 Dibromoethane (EDB)	EPA 504.1/8011/8260B	EPA 8260B
Purgeable Organics (Volatiles)		
Acetone	EPA 624/8260B	EPA 8260B
Acetonitrile	EPA 624/8260B	EPA 8260B
Acrolein (Propenal)	EPA 624/8260B	EPA 8260B
Acrylonitrile	EPA 624/8260B	EPA 8260B
Allyl Chloride	EPA 624/8260B	EPA 8260B
Benzene	EPA 624/8260B	EPA 8260B
Benzyl chloride	EPA 624/8260B	EPA 8260B
Bromobenzene	EPA 624/8260B	EPA 8260B
Bromochloromethane	EPA 624/8260B	EPA 8260B
Bromodichloromethane	EPA 624/8260B	EPA 8260B
Bromoform	EPA 624/8260B	EPA 8260B
Bromomethane	EPA 624/8260B	EPA 8260B
2-Butanone (Methyl Ethyl Ketone)	EPA 8015B/8015C/624/8260B	EPA 8260B

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

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

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

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

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

Parameter/Analyte	Nonpotable Water	Solid Hazardous Waste (Liquids and Solids)
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 625/8270C/8270D/8330A/8330B	EPA 8270C/8270D/8330A/8330B
2,4-Dinitrotoluene	EPA 625/8270C/8270D/8330A/8330B	EPA 8270C/8270D/8330A/8330B
2,6-Dinitrotoluene	EPA 625/8270C/8270D/8330A/8330B	EPA 8270C/8270D/8330A/8330B
2,4,6-Trinitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B
2-Amino-4,6-Dinitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B
2-Nitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B
3-Nitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B
3,5-Dinitroaniline		EPA 8330B (Solids Only)
4-Amino-2,6-Dinitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B
4-Nitrotoluene	EPA 8330A/8330B	EPA 8330A/8330B
Nitrobenzene	EPA 625/8270C/8270D/8330A/8330B	EPA 8270C/8270D/8330A/8330B
Nitroglycerine	EPA 8330A/8330B	EPA 8330A/8330B
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)	EPA 8330A/8330B	EPA 8330A/8330B
Pentaerythritoltetranitrate (PETN)	EPA 8330A/8330B	EPA 8330A/8330B
hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)	EPA 8330A/8330B	EPA 8330A/8330B
Tetryl (methyl-2,4,6-trinitrophenylnitramine)	EPA 8330A/8330B	EPA 8330/8330B
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

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

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

	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
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.