M67001.AR.004773
MCB CAMP LEJEUNE
5090.3a

FINAL SAMPLING AND ANALYSIS PLAN PRELIMINARY ASSESSMENT/SITE INSPECTION MILITARY MUNITIONS RESPONSE PROGRAM (MMRP) SITE UXO-22 FORMER MUNITIONS DISPOSAL AREA MCB CAMP LEJEUNE NC

3/1/2012

CH2M HILL

Final

Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan) Preliminary Assessment/Site Inspection; Military Munitions Response Program Site UXO-22 – Former Munitions Disposal Area

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Prepared for

Department of the Navy

Naval Facilities Engineering Command Mid-Atlantic

Contract No.
N62470-08-D-1000
CTO-0014

March 2012

Prepared by

CH2MHILL

SAP Worksheet #1—Title and Approval Page

Final

Sampling and Analysis Plan (Field Sampling Plan and Quality Assurance Project Plan) Preliminary Assessment/Site Inspection; Military Munitions Response Program Site UXO-22 – Former Munitions Disposal Area

Marine Corps Base Camp Lejeune Jacksonville, North Carolina

Contract Task Order 0014

March 2012

Prepared for

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

Under the

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

Prepared by

CH2MHILL

Raleigh, North Carolina

This page intentionally left blank.

Review Signatures:

Bill Schmithorst, P.G.
CH2M HILL – Project Manager

Thomas M. Roth, P.E.
CH2M HILL – Activity Quality Manager

Approval Signatures:

Jan Nielsen
NAVFAC Atlantic – Chemist/QA Officer

Other Approval Signatures:

07 March 2012
Dave Cleland
NAVFAC Mid-Atlantic – Remedial Project Manager

3-7-2012
Gena Townsend
USEPA Region 4 – Remedial Project Manager

3/08/2012
Randy McElveen
NCDENR – Remedial Project Manager

This page intentionally left blank.

Executive Summary

This document presents the plan for the Preliminary Assessment and Site Inspection (PA/SI), including research of archival records, use of data from previous and ongoing investigations, and environmental sampling, at United States Marine Corps (USMC) Military Munitions Response Program (MMRP) Site Unexploded Ordnance (UXO) 22, Former Munitions Disposal Area, herein referred to as Site UXO-22, located at MCB Camp Lejeune (MCB CamLej) in Jacksonville, North Carolina. Historically, the site was used for disposal and storage of wastes and supplies. During subsequent remedial investigations and land clearing activities, material presenting a potential explosive hazard (MPPEH) and munitions and explosives of concern (MEC) were discovered at the site.

CH2M HILL prepared this document under the U.S. Navy, Naval Facilities Engineering Command (NAVFAC) Atlantic Division, Comprehensive Long-Term Environmental Action - Navy (CLEAN) 1000 Contract N62470-08-D-1000, Contract Task Order 0014, Modification 5. This document was prepared in accordance with the Navy's Uniform Federal Policy for Sampling and Analysis Plans (UFP-SAP) to ensure that environmental data collected are scientifically sound, of known and documented quality, and suitable for intended uses. The *Site Management Plan, Fiscal Year 2010, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina* (CH2M HILL, 2010a) provides additional information and background on MCB CamLej.

Empirical Laboratories in Nashville, Tennessee will be responsible for analyzing environmental samples collected from Site UXO-22. If additional laboratory services are requested that require modification to the existing SAP, revised SAP worksheets will be submitted to the Navy and regulatory agencies for approval.

The primary objective of this UFP-SAP is to evaluate whether releases of munitions constituents (MC) occurred within the 75-acre investigation area of Site UXO-22. Field activities to be conducted during the PA/SI include surveying, vegetation clearance, and environmental sampling of subsurface soil, sediment, surface water, and groundwater at Site UXO-22. Archival research and previous investigation results will be used to identify the most appropriate sampling locations. The environmental samples will be analyzed to evaluate whether a release of MC occurred that warrants further investigation or action.

UFP-SAP Outline

This UFP-SAP consists of 37 worksheets specific to the UFP-SAP. All tables are embedded within the worksheets. All figures are included at the end of the document. The project-specific Accident Prevention Plan/Health and Safety Plan (APP/HSP) is included as Attachment 1. Field standard operation procedures (SOPs) are included in Attachment 2. Data management guidelines are included in Attachment 3 and the laboratory's DoD ELAP accreditation letter is included in Attachment 4. Attachment 5 presents the Environmental Protection Plan. Upon approval of this Draft UFP-SAP, the sampling activities will be scheduled and executed.

This page intentionally left blank.

SAP Worksheets

SAP Worksheet #1—Title and Approval Page....1
SAP Worksheet #2—SAP Identifying Information....13
SAP Worksheet #3—Distribution List....15
SAP Worksheet #4—Project Personnel Sign-Off Sheet....17
SAP Worksheet #5—Project Organizational Chart....19
SAP Worksheet #6—Communication Pathways....21
SAP Worksheet #7—Personnel Responsibilities and Qualifications Table....23
SAP Worksheet #8—Special Personnel Training Requirements Table....25
SAP Worksheet #9—Project Scoping Session Participants Sheet....27
SAP Worksheet #10—Problem Definition....29
SAP Worksheet #11—Project Quality Objectives/Systematic Planning Process Statements....37
SAP Worksheet #12-1—Measurement Performance Criteria Table – Field QC Samples – Site UXO-22....43
SAP Worksheet #12-2—Measurement Performance Criteria Table – Field QC Samples – Site UXO-22....44
SAP Worksheet #12-3—Measurement Performance Criteria Table - Field QC Samples- Site UXO-22....45
SAP Worksheet #12-4—Measurement Performance Criteria Table – Field QC Samples – Site UXO-22....46
SAP Worksheet #12-5—Measurement Performance Criteria Table - Field QC Samples - Site UXO-22....47
SAP Worksheet #12-6—Measurement Performance Criteria Table - Field QC Samples - Site UXO-22....48
SAP Worksheet #12-7—Measurement Performance Criteria Table - Field QC Samples - Site UXO-22....49
SAP Worksheet #12-8—Measurement Performance Criteria Table - Field QC Samples - Site UXO-22....50
SAP Worksheet #12-9—Measurement Performance Criteria Table - Field QC Samples - Site UXO-22....51
SAP Worksheet #12-10—Measurement Performance Criteria Table - Field QC Samples - Site UXO-22....52
SAP Worksheet #13—Secondary Data Criteria and Limitations Table....53
SAP Worksheet #14—Summary of Project Tasks....55
SAP Worksheet #15-1—Reference Limits and Evaluation Table....61
SAP Worksheet #15-1A—QC Limits for Metals in Solid Samples....63
SAP Worksheet #15-2—Reference Limits and Evaluation Table....64
SAP Worksheet #15-2A—QC Limits for Explosives Residues in Solid Samples....65
SAP Worksheet #15-3—Reference Limits and Evaluation Table for Metals....66
SAP Worksheet #15-4—Reference Limits and Evaluation Table for Explosives Residues....67
SAP Worksheet #15-5—Reference Limits and Evaluation Table for TOC in Sediment....68
SAP Worksheet #15-5A—QC Limits for TOC in Solid Samples....69
SAP Worksheet #15-6—Reference Limits and Evaluation Table for Grain Size, Subsurface Soil....70
SAP Worksheet #15-7—Reference Limits and Evaluation Table....71
SAP Worksheet #15-7A—QC Limits for Metals in Aqueous Samples....72
SAP Worksheet #15-8—Reference Limits and Evaluation Table for Explosives Residues in Groundwater....73
SAP Worksheet #15-8A—QC Limits for Explosives Residues in Aqueous Samples....74
SAP Worksheet #15-9—Reference Limits and Evaluation Table for Metals in Surface Water....75
SAP Worksheet #15-10—Reference Limits and Evaluation Table for Explosives Residues in Surface Water....76
SAP Worksheet #15-11—Reference Limits and Evaluation Table for TOC in Surface Water....77
SAP Worksheet #15-11A—QC Limits for TOC in Aqueous Samples....77
SAP Worksheet #15-12—Reference Limits and Evaluation Table for Hardness in Surface Water....79
SAP Worksheet #15-12A—QC Limits for Hardness in Aqueous Samples....80
SAP Worksheet #16—Project Schedule/Timeline Table....81
SAP Worksheet #17—Sampling Design and Rationale....83
SAP Worksheet #18—Sampling Locations and Methods/SOP Requirements Table....87
SAP Worksheet #19—Analytical SOP Requirements Table....89
SAP Worksheet #20—Field Quality Control Sample Summary Table....91
SAP Worksheet #21—Project Sampling SOP References Table....93

SAP Worksheet #22—Field Equipment Calibration, Maintenance, Testing, and Inspection Table 95
SAP Worksheet #23—Analytical SOP References Table 97
SAP Worksheet #24—Analytical Instrument Calibration Table 99
SAP Worksheet #25—Analytical Instrument and Equipment Maintenance, Testing, and Inspection Table 103
SAP Worksheet #26—Sample Handling System 105
SAP Worksheet #27—Sample Custody Requirements Table 107
SAP Worksheet #28-1—Laboratory QC Samples Table – Site UXO-22 109
SAP Worksheet #28-2—Laboratory QC Samples Table - Site UXO-22 110
SAP Worksheet #28-3—Laboratory QC Samples Table - Site UXO-22 111
SAP Worksheet #28-4—Laboratory QC Samples Table - Site UXO-22 112
SAP Worksheet #28-5—Laboratory QC Samples Table - Site UXO-22 113
SAP Worksheet #28-6—Laboratory QC Samples Table - Site UXO-22 114
SAP Worksheet #28-7—Laboratory QC Samples Table - Site UXO-22 115
SAP Worksheet #28-8—Laboratory QC Samples Table - Site UXO-22 116
SAP Worksheet #28-9—Laboratory QC Samples Table - Site UXO-22 117
SAP Worksheet #29—Project Documents and Records Table 119
SAP Worksheet #30—Analytical Services Table 121
SAP Worksheet #31—Planned Project Assessments Table 123
SAP Worksheet #32—Assessment Findings and Corrective Action Responses 125
SAP Worksheet #32-1—Corrective Action Form 127
SAP Worksheet #32-2—Field Performance Audit Checklist 129
SAP Worksheet #33—QA Management Reports Table 131
SAP Worksheet #34—Verification (Step I) Process Table 133
SAP Worksheet #35—Validation (Steps IIa and IIb) Process Table 135
SAP Worksheet #36—Analytical Data Validation (Steps IIa and IIb) Summary Table 137
SAP Worksheet #37—Usability Assessment 139
References 143

Attachments

1 Health and Safety Plan
2 Standard Operating Procedures—CH2M HILL
3 Data Management Guidelines
4 DoD ELAP Accreditation Letter – Analytical Laboratory
5 Environmental Protection Plan

Figures

10-1 Site Location Map
10-2 Summary of Site Actions
10-3 Conceptual Site Model
10-4 Historical Intrusive Investigations
10-5 Proposed Sampling Locations
10-6 Proposed 2011 Intrusive Investigations

11-1 Soil Sample Strategy Decision Flow Chart
11-2 Project Quality Objectives Decision Flow Chart

Acronyms and Abbreviations

AA	Atomic Absorption
AHA	Activity Hazard Analysis
APP	Accident Prevention Plan
AST	aboveground storage tank
bgs	below ground surface
CA	Corrective Action
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLEAN	Comprehensive Long-Term Environmental Action - Navy
CLP	Contract Laboratory Program
COC	Contaminant of Concern
CSM	Conceptual Site Model
CTO	Contract Task Order
DGM	Digital Geophysical Mapping
DO	dissolved oxygen
DoD	Department of Defense
DPT	Direct Push Technology
DRMO	Defense Reutilization and Marketing Office
DQI	Data Quality Indicator
DU	Decision Unit
ECP	Environmental Condition of Property
EDS	Environmental Data Services
ESS	Explosives Safety Submission
FTL	Field Team Leader
GC	Gas Chromatograph
GC/MS	Gas Chromatograph/Mass Spectrometer
GIS	Geographic Information System
GIP	Geophysical Investigation Plan
GPS	Global Positioning System
GSV	Geophysical System Verification
GW	Groundwater
HSP	Health and Safety Plan
ICP	Inductively Coupled Plasma
IDW	Investigation-derived Waste
IR	Installation Restoration
IS	Incremental Sampling
lb	pound
LCS	Laboratory Control Sample
LIMS	Laboratory Information Management System
LUC	Land Use Controls
ug/L	micrograms per liter
MC	Munitions Constituents

MCL	Maximum Contaminant Level
MCB CamLej	Marine Corps Base Camp Lejeune
MDL	Method Detection Limit
MEC	Munitions and Explosives of Concern
MILCON	Military Construction
MMRP	Military Munitions Response Program
MPC	Measurement Performance Criteria
MPPEH	material potentially presenting an explosive hazard
MQO	Measurement Quality Objectives
MR	Munitions Response
MS/MSD	Matrix Spike/Matrix Spike Duplicate
MSL	maximum contaminant level
mV	millivolt
NAVFAC	Naval Facilities Engineering Command
NCAC	North Carolina Administrative Code
NCDENR	North Carolina Department of Environment and Natural Resources
NCEA	National Center for Environmental Assessment
NCAC 2B Standards	North Carolina Surface Water and Wetland Standards
NC 2L Standards	North Carolina Groundwater Quality Standards
NC SSL	North Carolina Soil Screening Level
NIRIS	Naval Installation Restoration Information Solution
NRWQC	National Recommended Water Quality Criteria
ORP	oxidation reduction potential
ORR	Operational Readiness Review
OU	Operable Unit
PA/SI	Preliminary Assessment/Site Inspection
PAL	Project Action Level
PCBs	polychlorinated biphenyls
PDF	Portable Document Format
PDM	Project Data Manager
PETN	pentaerythritol tetranitrate
PG	Professional Geologist
PM	Project Manager
PQO	Project Quality Objective
PRG	Preliminary Remediation Goal
PVC	polyvinyl chloride
QA	Quality Assurance
QAO	Quality Assurance Officer
QAPP	Quality Assurance Project Plan
QC	Quality Control
QL	Quantitation Limit
RCRA	Resource Conservation and Recovery Act
RDX	Hexahydro-1,3,5-trinitro-1,3,5-triazine
ROD	Record of Decision
RPD	Relative Percent Difference
RPM	Remedial Project Manager
RSD	Relative Standard Deviation
RLS	regional screening level
RT	Retention Time

SAP	Sampling and Analysis Plan
SD	Standard Deviation
SDG	Sample Delivery Group
SDWA	Safe Drinking Water Act
SOP	Standard Operating Procedure
SQL	Sample Quantitation Limit
SRM	Standard Reference Material
SVE	Soil-Vapor Extraction
SW	Surface Water
TBD	To Be Determined
TCRA	Time-Critical Removal Action
TSA	Technical Systems Audit
UFP	Uniform Federal Policy
USACE	United States Army Corps of Engineers
USEPA	United State Environmental Protection Agency
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound
WP	Work Plan
WQPs	Water quality parameters

This page intentionally left blank.

SAP Worksheet #2—SAP Identifying Information

Site Name/Number: Site UXO-22 – Former Munitions Disposal Area

Operable Unit: N/A

Contractor Name: CH2M HILL

Contract Number: N62470-08-D-1000

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

Work Assignment Number (optional): Contract Task Order (CTO) 0014, Modification 5

1. **This SAP was prepared in accordance with the requirements of:**

   Uniform Federal Policy – Quality Assurance Project Plan (UFP - QAPP) (USEPA, 2005)

   United States Environmental Protection Agency (USEPA) *Guidance for Quality Assurance Project Plans (QAPPs)* (USEPA, 2002)

   USEPA Quality Assurance (QA)/G-5, Quality Assurance Management Staff (QAMS) (USEPA, 2002)

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

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

3. **This SAP is a <u>Project Specific</u> SAP**

4. **List dates of scoping sessions that were held:**

Scoping Session	Date
Partnering Session	February 17, 2011

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

Title	Date

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

   North Carolina Department of Environment and Natural Resources (NC DENR) – regulatory stakeholder
   USEPA Region 4 – regulatory stakeholder
   NAVFAC Mid-Atlantic – lead organization
   MCB Camp Lejeune – site owner

7. **Lead organization:**

   U.S. Department of Navy – Lead Agency

8. **If any required SAP elements or required information are not applicable to the project or are provided elsewhere, then note the omitted SAP elements and provide an explanation for their exclusion below:**

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

This page intentionally left blank.

SAP Worksheet #3—Distribution List

Name of SAP Recipients	Title/Role	Organization	Telephone Number	E-mail Address or Mailing Address
Dave Cleland	Navy Technical Representative (NTR)	NAVFAC Mid-Atlantic	(757) 322-4851	david.t.cleland@navy.mil
Charity Rychak	Environmental Engineer	MCB Camp Lejeune- Environmental Management Division (EMD)	(910) 451-9386	charity.rychak@usmc.mil
Gena Townsend	Remedial Project Manager (RPM)	EPA Region 4	(404) 562-8538	townsend.gena@epa.gov
Randy McElveen	RPM	NCDENR	(919) 707-8341	randy.mcelveen@ncmail.net
Matt Louth	Activity Manager (AM)	CH2M HILL	(757) 671-6240	matt.louth@ch2m.com
Tom Roth	Activity Quality Manager/Senior Consultant		(404) 474-7640	tom.roth@ch2m.com
Teg Williams	Senior Technical Consultant		(704) 543-3297	tegwyn.williams@ch2m.com
Bill Schmithorst	Project Manager (PM)		(919) 760-1769	bill.schmithorst@ch2m.com
Brett Doerr	Navy CLEAN Program UFP-SAP Reviewer/QAO		(757) 671-6219	brett.doerr@ch2m.com
Carl Woods	Health & Safety (H&S) Manager		(513) 889-5771	carl.woods@ch2m.com
Roni Warren	Human Health Risk Assessors (HHRA)		(814) 364-2454	roni.warren@ch2m.com
Jonathon Weier	Ecological Risk Assessors (ERA)		(770) 485-7503	jonathon.weier@ch2m.com
Simon Kline	Assistant PM		(910) 622-4344	simon.kline@ch2m.com
Anita Dodson	Navy CLEAN Program Chemist	CH2M HILL	(757) 671-6218	anita.dodson@ch2m.com
Bianca Kleist	Project Chemist (PC)		(704) 543-3274	bianca.kleist@ch2m.com
Troy Horn	Project Data Manager (PDM)		(757) 671-6288	troy.horn @ch2m.com
Sonya Gordon	PM/Laboratory	Empirical Laboratories	(615) 345-1115	sgordon@empirlabs.com
Marcia McGinnity	QAO	Empirical Laboratories	(615) 345-1115	mmcginnity@empirlabs.com
Doug Weaver	PM/Data Validation	Environmental Data Services (EDS)	(757) 564-0090	dweaver@env-data.com

This page intentionally left blank.

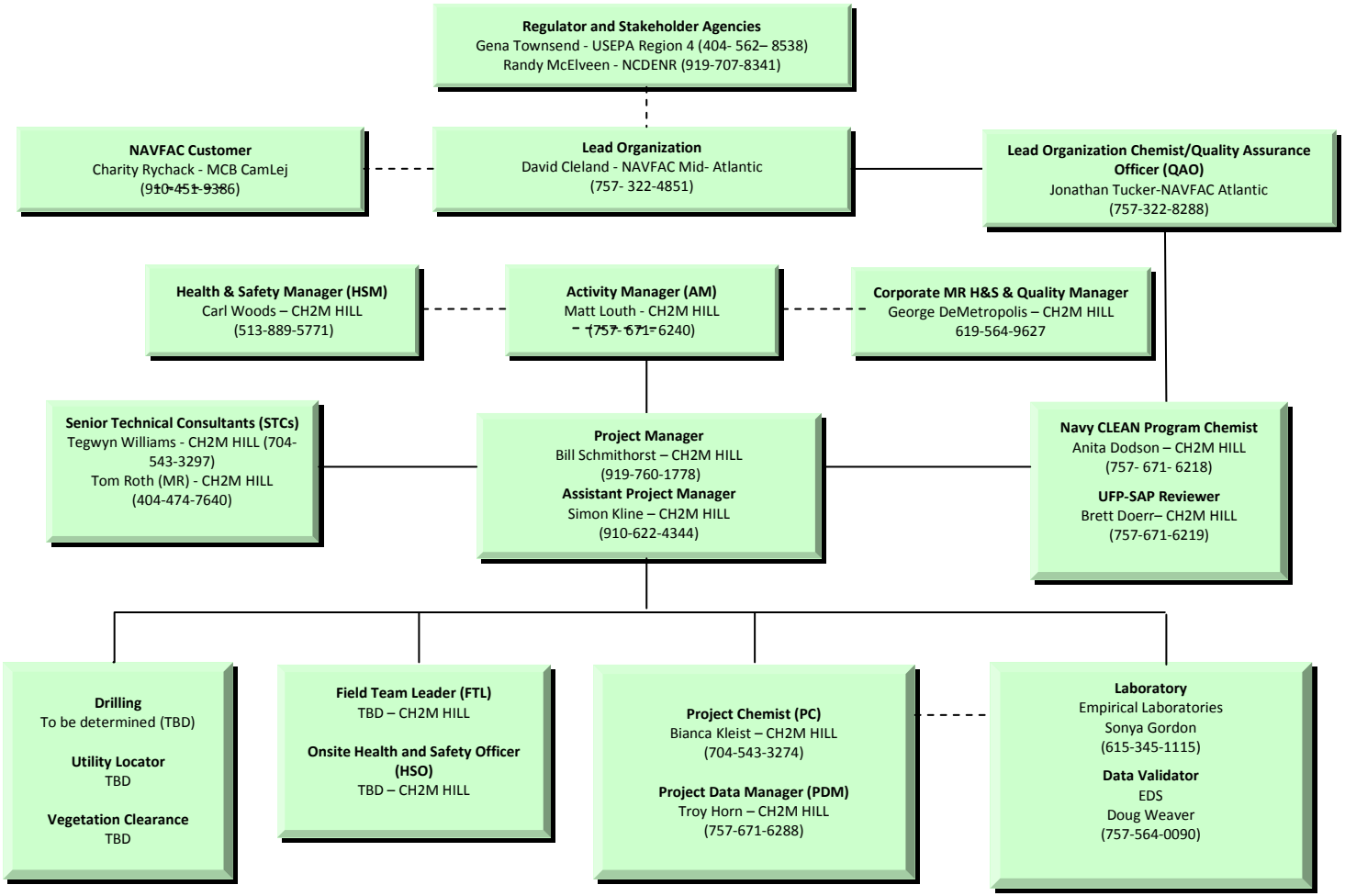
SAP Worksheet #4—Project Personnel Sign-Off Sheet

Name	Organization/Title/Role	Telephone Number	Signature/ email receipt	Section Reviewed	Date SAP Read
Charity Rychak	MCB Camp Lejeune/EMD	(910) 451-9386			
Matt Louth	CH2M HILL/AM	(757) 671-6240			
Brett Doerr	CH2M HILL/Navy CLEAN Program UFP-SAP Reviewer	(757) 671-6219			
Teg Williams	CH2M HILL/Senior Technical Support	(704) 543-3297			
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/PC	(704) 543-3274			
Troy Horn	CH2M HILL/PDM	(757) 671-6288			
Sonya Gordon	Empirical/PM	(615) 345-1115			
Marcia McGinnity	Empirical/QAO	(615) 345-1115			
Doug Weaver	EDS/PM	(757) 564-0090			

Note: The personnel sign-off sheet will be retained in the project file.

This page intentionally left blank.

SAP Worksheet #5—Project Organizationa Chart



This page intentionally left blank.

SAP Worksheet #6—Communication Pathways

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure, Pathway, etc.
Communication with Navy (lead agency)	Navy NTR/RPM	David Cleland	david.t.cleland@navy.mil	Primary point of contact (POC) for Navy; can delegate communication to other internal or external points of contact. RPM will notify EPA and NCDENR via email or telephone call within 24hrs if 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 EPA Region 4	EPA Region 4 RPM	Gena Townsend	townsend.gena@epa.gov	Primary POC for EPA; can delegate communication to other internal or external points of contact. Upon notification of field changes, EPA will have 24hrs 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@ncmail.net	Primary POC for NCDENR; can delegate communication to other internal or external points of contact. Upon notification of field changes, NCDENR will have 24hrs to approve or comment on the field changes.
Communication regarding overall project status and implementation and primary POC with Navy RPM, EPA, and NCDENR	CH2M HILL AM	Matt Louth	matt.louth@ch2m.com	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 field changes to the team via email within 24hrs. All data results will be communicated to the project team during the first partnering meeting following data receipt.
Technical communications for project implementation, and data interpretation	CH2M HILL Senior Consultants	Tom Roth Teg Williams	tom.roth@ch2m.com tegwyn.williams@ch2m.com	Contact senior consultant regarding questions/issues encountered in the field, input on data interpretation, as needed. Sr. Consultants will have 24 hrs to respond to technical field questions as necessary. Additionally, Sr. consultants will review of the data as necessary prior to partnering team discussion and reporting review.
Communications regarding project management and implementation	PM	Bill Schmithorst	bill.schmithorst@ch2m.com	All information and materials about the project will be forwarded to the Navy, Activity Mangers and Senior Consultants as necessary. POC for field sampling team.
Coordinate activities between PM and Field Team/Sub-contractors	Asst. PM	Simon Kline	simon.kline@ch2m.com	All field team and reporting activities will be forwarded to PM for further dissemination if necessary. Responsible for field team members' and subcontractors adherence to work plan.
Work Plan changes in field. QAPP Field Changes/Field Progress Reports	FTL	Simon Kline	simon.kline@ch2m.com	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.

SAP Worksheet #6—Communication Pathways (continued)

Communication Drivers	Responsible Affiliation	Name	Phone Number and/or e-mail	Procedure, Pathway, etc.
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.
Health & Safety (H&S)	Onsite H&S Officer	David Seed	david.seed@ch2m.com	Responsible for field team members' adherence to the site safety requirements described in the APP/SHP. Will report H&S incidents and near losses to PM.
Data tracking from field collection to database upload	PDM	Troy Horn	troy.horn@ch2m.com	Tracking data from sample collection through database upload.
Reporting Lab Data Quality Issues	Laboratory PM	Sonya Gordon	sgordon@empirlabs.com	All QA/Quality Control (QC) issues with project field samples will be reported within 2 days to the project chemist by the laboratory. The Navy RPM will be contacted if there are major laboratory issues, whom at his discretion will contact the Navy chemist.
Reporting Data Validation Issues	DV PM	Doug Weaver	dweaver@env-data.com	All data validation issues regarding resubmissions from the laboratory will copy the CH2M HILL PDM on communications. The data validation report will be due to CH2M HILL within 14 calendar days of data receipt.
Field and analytical corrective actions (CAs); Release of Analytical Data	Project Chemist	Bianca Kleist	bianca.kleist @ch2m.com	Any CAs for field and analytical issues will be determined by the FTL and/or the Project Chemist and reported to the PM within 4hrs. No analytical data can be released until validation of the data is completed and has been approved by the Project Chemist. The project chemist will review analytical results within 7 days of receipt for release to the project team.
Field corrective actions	Asst. PM and PM	Simon Kline Bill Schmithorst	simon.kline@ch2m.com bill.schmithorst@ch2m.com	Field and analytical issues requiring corrective action will be determined by the TM and/or PM; the PM will ensure SAP requirements are met by field staff

SAP Worksheet #7—Personnel Responsibilities and Qualifications Table

Name	Title/Role	Organizational Affiliation	Responsibilities	Education and Experience Qualifications (Optional)
Dave Cleland	Navy Technical Representative	NAVFAC Mid-Atlantic	Oversees project	
Charity Rychak	Base Environmental Management Division	MCB Camp Lejeune	Oversees project	
Matt Louth, PG	Activity Manager	CH2M HILL	Oversees project activities	B.S. Geology 16 years experience
Bill Schmithorst, PG	Project Manager	CH2M HILL	Manages Project and coordinates project tasks and project staff	M.S. Hydrogeology B.A. Geology 17 years experience
Brett Doerr	Navy CLEAN Program UFP-SAP Reviewer	CH2M HILL	Navy CLEAN Program UFP-SAP Reviewer	M.S. Environmental Science/Hydrogeology B.S. Chemistry 18 years experience
Tom Roth, PE	Activity Quality Manager	CH2M HILL	Provides senior MR technical support for remedial action design and implementation	B.S. Geological Engineering 25 years experience
Tim Garretson	Senior Technical Support	CH2M HILL	Provides senior MR technical support for MEC	Naval School, Explosive Ordnance Disposal 30 years experience
Tegwyn Williams, PG	Senior Technical Support	CH2M HILL	Provides senior technical support for field investigations and implementation	B.S. Earth Science 20 years experience
Carl Woods	H&S Manager	CH2M HILL	Prepares H&S Plan; manages H&S for all field activities	M.S. Occupational Safety and Health 15 years experience
Anita Dodson	Navy CLEAN Program Chemist	CH2M HILL	Program-level review of UFP-SAP	B.S. Chemistry 16 years experience
Troy Horn	PDM	CH2M HILL	Data Management: manages sample tracking, communicates with laboratory and data validator	B.A. Environmental Studies 2 years experience
Simon Kline, PG	Asst. Project Manager	CH2M HILL	Coordinates all field activities and sampling	M.S. Earth Sciences B.S. Geosciences 7 years experience
David Seed	Site H&S Officer	CH2M HILL	Oversees H&S for all field activities	B.S. Environmental Engineering 4 years experience

This page intentionally left blank.

SAP Worksheet #8—Special Personnel Training Requirements Table

Project Function	Specialized Training By Title or Description of Course	Training Provider	Training Date	Personnel/Groups Receiving Training	Personnel Titles/Organizational Affiliation	Location of Training Records/Certificates
Field Sampling	HAZWOPER 40-hour Training, 8 hour refreshers as applicable	Registered training organization	Annually[a]	All field staff	FTL, field team members/ CH2M HILL	CH2M HILL HSE
	CPR/First Aid Training		Every 3 years (CPR Annually)a			
	Behavior Based Loss Prevention System (BBLPS)					
	Site Safety Coordinator, Hazardous Waste (SSC-HW)			Onsite H&S Officer/FTL	FTL, Site safety coordinator (SSC)/CH2M HILL	
Investigation Derived Waste (IDW) Management	Waste Management	Registered training CH2M HILL online (UXO Safety-USAF)	Every 3 Years	PM and all field staff	FTL, field team members/ CH2M HILL	
Dangerous Goods Shipping	Dangerous Goods Training		Every 3 Years			
Blood Borne Pathogens	Blood Borne Pathogen Training		Annually			
UXO Safety	UXO Safety (unexploded ordnance) Training Package					

Notes:
[a] - Training records for field personnel are available on the CH2M HILL Virtual Office

This page intentionally left blank.

SAP Worksheet #9—Project Scoping Session Participants Sheet

Project Name: CTO-014 PA/SI of Site UXO 22	
Projected Date(s) of Sampling: April - June 2011	**Site Name:** Camp Lejeune
PM: Bill Schmithorst	**Site Location:** Camp Lejeune, Jacksonville, North Carolina

Dates of Session: February 17, 2011

Scoping Session Purpose: The purpose of the scoping session was to discuss the Site UXO-22 PA/SI objectives with the Camp Lejeune 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 Camp Lejeune	910-451-9386	charity.rychak@usmc.mil	Camp Lejeune 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@ncmail.net	NCDENR MMRP oversight lead
Matt Louth	Camp Lejeune Activity Manager	CH2M HILL	757 671-8311 x417	matt.louth@ch2m.com	Activity Manager for Camp Lejeune projects. Coordinates CH2M HILL projects at Camp Lejeune with Navy contacts.
Kim Henderson	Deputy Camp Lejeune Activity Manager	CH2M HILL	757-671-8311	kim.henderson@ch2m.com	Deputy Activity Manager for Camp Lejeune projects

Comments/Decisions:

The proposed sampling and analytical approach was discussed among the Project Team. Figures (10-4 and 10-5 of this SAP) showing the proposed sampling locations were discussed among the team. The analytical approach included the analysis of samples for metals, explosives residues, and perchlorate. The sampling approach is consistent with other PA/SIs conducted at Camp Lejeune. Relevant media that could potentially be affected, including soil, groundwater, surface water, and sediment, are included in the approach. In addition, the potential munitions constituents being assessed are consistent with previous site use. Members of the Project Team approved the approach and it was noted that a Sampling and Analysis Plan would be forwarded for review by the team.

Action Items: Prepare a sampling and analysis plan for review by the Project Team

Consensus Decisions: The Team agreed that the general approach for investigating Site UXO-22 (including the sampling locations presented in Figures 10-4 and 10-5) is acceptable.

This page intentionally left blank.

SAP Worksheet #10—Problem Definition

The objective of this SAP is to guide the assessment of potential environmental impacts related to munitions constituents (MC) resulting from historical waste management practices within Site UXO-22, and to evaluate whether potential impacts warrant further assessment. This objective will be addressed by sampling and analysis of environmental media for MC, and human health and ecological risk screenings.

Site UXO-22 – Former Munitions Disposal Area ASR# 2.212

Site UXO-22 covers an area of approximately 75 acres that includes Storage Lots 201 and 203 on 'Mainside' MCB CamLej. The site is accessed from an unnamed dirt road that bisects the site from east to west and links Piney Green Road and Holcomb Boulevard (**Figure 10-1**). Access is restricted to military personnel and contractors.

Site UXO-22 encompasses portions of Installation Restoration (IR) Sites 6 and 82. Historically, the site was used for disposal and storage of wastes and supplies, including pesticides, transformers containing polychlorinated biphenyls (PCBs), solvents, electrolytes, and waste oils. Disposal trenches at Site 6 were discovered during a 1992 Remedial Investigation and a 1994 Time-Critical Removal Action (TCRA), which lead to a Record of Decision (ROD) placed on Site 6 in 1997. Materials reported to be found in the trenches included MPPEH, communication wire, graphite battery packs, containers of petroleum, oil, lubricants, and metal 55-gallon drums. The ROD placed aquifer restrictions, Land Use Controls (LUCs), and required groundwater remediation at Site 82 to address volatile organic compound (VOC) contamination using a groundwater pump-and-treat system. MEC was also discovered in the southwest portion of Site 6 in November 2008 during vegetation clearing. MCB CamLej explosive ordnance disposal (EOD) responded and subsequently removed various types of MPPEH, including M-2 antipersonnel mines, 57mm brass cartridges, M-29 rockets, and 3.5-inch rocket motors. A Phase II Environmental Condition of Property (ECP) in 2010 found spent ammunition in two test pits within Lot 203.

The primary objective of this PA/SI is to evaluate whether releases of munitions constituents (MC) occurred within the 75-acre investigation area of Site UXO-22. Investigation and remediation of potential environmental contamination resulting from sources other than munitions are being managed separately under the IR program.

SAP Worksheet #10—Problem Definition (continued)

Previous Site Investigations

The table below summarizes the historical and ongoing investigations at Site UX0-22, including investigations from Site 6 and Site 82. Figures 10-2 presents the timeline for historical investigations at Site UXO-022. MEC was discovered during the following historical investigations: Remedial Investigation (1993), Time-Critical Removal Action (1993-97), Site 6 Chlorobenzene investigation (2009) and the Phase II Environmental Condition of Property (2010), which are highlighted below in gray.

TABLE 10-1
Previous and ongoing investigations at Site UXO-22

Investigation and Location within UXO-22	Year	Media Investigated	Purpose of Investigation	Target Analytes	Activities	MEC	Results and Conclusions
Initial Assessment Study (IAS) (Water and Air Research)- **Site 6**	1983	NA	Review previous land practices to determine environmental risk	NA	Document review, site inspection, and base personnel interviews	NA	Recommendation to conduct confirmation study on environmental media
Confirmation and Characterization Studies (Environmental Science and Engineering) - **Site 6**	1984-91	GW	Confirm potential source area identified in IAS	Full TCL VOCs, SVOCs, pesticides, metals	Installation of four monitoring wells to 25 ft below ground surface (bgs) and sampling of 2 water supply wells	None	Elevated metals in all wells, benzene detected in IR06-GW06. TCE, DCE, and VC detected in 2 water supply wells to the east of Site 6; wells were shut down
		SW		VOCs, Pesticides	Sampled in Wallace Creek		TCE detected in 1991. TCE, VC, and 1,2-DCE detected in 1986
		SD		Full TCL VOCs, SVOCs, pesticides, metals	Sampled in Wallace Creek		SVOCs detected
		SB		Pesticides	Soil borings from 0-3 ft bgs at unknown locations		Pesticides detected in shallow sub-surface.
Site Investigation (Halliburton) - **Site 82**	1991	GW	Identify potential source of VOCs in Wallace Creek (creating Site 82)	Full TCL VOCs, SVOCs, PCBs, pesticides, metals	Installation of 3 monitoring wells	None	Pesticides, PCBs detected
		SW			Sampled in Wallace Creek		Pesticides, PCBs, TCE, 1,2-DCE, and VC detected
		SD			Sampled in Wallace Creek		Pesticides, PCBs detected
		SB			6 soil borings (unknown depth)		Pesticides, PCBs detected

SAP Worksheet #10—Problem Definition (continued)

Investigation and Location within UXO-22	Year	Media Investigated	Purpose of Investigation	Target Analytes	Activities	MEC	Results and Conclusions
Remedial Investigation (Baker Environmental)-**Site 6 and Site 82** (Entire UXO-22)	1993	GW/SW/SS/SB/SD/Fish Tissue	Assess the nature and extent of impacts in all site media resulting from historical site use.	Full TCL VOCs, SVOCs, PCBs, pesticides, metals, grain size. **No MC**	Sampling all environmental media, stream gauging, fish population/tissue studies, test pits, Geophysical and UXO surveys	Spent casings, grenades and practice rockets in test pits located in Lot 203 (northern Site 6)	Soil: high pesticide concentrations in northern Site 6 (disposal area), high PCB concentrations in northern Site 6 (disposal area), VOCs and SVOCs widespread
							Groundwater: TCE detected at low concentrations. Site 82 had high levels of VOCs in shallow and deep aquifers to 230 ft bgs
							Surface Water: Pesticide and VOCs detected in Wallace Creek
							Sediments: Pesticides, PAHs, PCBs and metals detected in Wallace Creek and Ravine
							Fish; Pesticide, TCE and PCBs in tissue in population in Wallace Creek
							Test Pits: Debris, unknown blue liquid, batteries and some MEC
Time Critical Removal Action (Baker Environmental and OHM)-**Site 6 and Site 82**	1993-97	SS/SB	Conduct source removal from areas within Site 6 and Site 82	Full TCL VOCs, SVOCs, pesticides, metals	Aboveground storage tank (AST) purging and removal along railroad line in Lot 203, drum removal, trenching and soil removal from one trench in Site 82 and four trenches in Site 6 south of Lot 203, confirmatory sampling, stockpiling, waste and soil transport and disposal for impacted soil. Unimpacted soil used for backfill	Shell casings in 2 trenches at Site 6	1,350 cubic yards (cu yd) soil removed from 4 trenches in Site 6 containing drums, shell casings, wire and >100 tons of batteries
							1,300 cu yd of VOC contaminated soils removed from 1 trench in Site 82 containing wire, debris and 2-gallon petroleum product containers
							5 ASTs containing 750 gallons diesel/water mix removed from Site 6

SAP Worksheet #10—Problem Definition (continued)

Investigation and Location within UXO-22	Year	Media Investigated	Purpose of Investigation	Target Analytes	Activities	MEC	Results and Conclusions
Supplemental Investigation (Baker Environmental)- **Site 82**	1995	SB/SD/GW	Collect soil samples and conduct magnetometer survey to assist in the design of a groundwater/vapor extraction system	VOCs	Magnetometer survey, sampling of soils and sediments, installation of 2 shallow and 2 deep monitoring wells with subsequent GW sampling. Collected between proposed extraction system footprint and Wallace Creek	None	Soil borings: VOCs (PCE, TCE) in all samples. Highest concentrations in shallow levels
							Sediments: collected from wetlands in Site 82 impacted by VOCs (PCE, TCE, 1,2-DCE,
							Groundwater: VOCs present (PCE, TCE, 1,2-DCE and VC)
							Magnetometer Survey: no subsurface anomalies discovered in extraction system footprint
Groundwater Extraction System (OHM, Baker Environmental, Shaw Environmental, Rhea)-**Site 82**	1995-Present	VA/GW/SW/SD	Install remediation system to reduce PCE, TCE, and benzene levels at Site 82	VOCs and metals	Installation of 4 deep (80-110 ft) and 6 shallow extraction wells with associated system and monitoring well network at Site 82. Construction of a water treatment plant. Sediment and surface water sampling at Wallace Creek from 2000-2004	NA	Continuing Pump and Treat at Site 82. VOC concentrations remain high (>10,000 ppb) at 80-120 ft bgs
							Sediment and surface water sampling indicates elevated 1,2-DCE detections and TCE detections
Long Term Monitoring(Baker and CH2M HILL)-**Site 6**	1997-Present	GW	Perform long-term monitoring for VOCs to document chlorobenzene plume over time	VOCs	GW Sampling at Site 6	NA	Chlorobenzene detected in samples from IR06-GW16 range from ~5-57,000 micrograms per liter (ug/L) from 1992-2010

SAP Worksheet #10—Problem Definition (continued)

Investigation and Location within UXO-22	Year	Media Investigated	Purpose of Investigation	Target Analytes	Activities	MEC	Results and Conclusions
Limited Groundwater Investigation (CH2M HILL)-**Site 6**	2002-Present	GW	Assess extent of chlorobenzene contamination around IR06-GW16	VOCs	Direct-push technology (DPT) groundwater grab samples collected at 5 locations proximal to IR06-GW16	None	
Membrane Interface Probe Investigation (CH2M HILL)-**Site 6**			Refine chlorobenzene-impacted groundwater plume		DPT and MIP analysis. Confirmatory sampling taken in selected boreholes		Approx. 400-foot chlorobenzene plume trending in a NW/SE direction in the SW portion of Site 6
Supplemental Groundwater Assessment (CH2M HILL)-**Site 6**			Assess horizontal and vertical extent of chlorobenzene plume		4 shallow and 1 intermediate monitoring well installed at chlorobenzene plume, GW sample collection		Aerial photographs indicate IR06-GW16 was installed in former disposal trench location. Vertical and horizontal boundaries at the plume head not delineated
Chlorobenzene Investigation (CH2M HILL)-**Site 6**			Conduct plume delineation and geophysical survey to detect source	VOCs and Pesticides	6 shallow and 4 intermediate monitoring wells installed. Geophysical survey (DGM) in SW portion of Site 6. Interrupted by the discovery of MEC	340 pounds (lb) of MEC discovered in shallow soils NE of IR06-GW16	Geophysical surveys indicate 3 large ferrous metal anomalies E and NE of IR06-GW16
							Chlorobenzene plume migrating vertically, with larger areal extent in the intermediate aquifer than the surficial
Pilot Study Report (CH2M HILL)- **Site 82**	2008	GW	Evaluate performance of injection of emulsified soybean oil and ethyl lactate to stimulate enhanced reductive dechlorination (ERD) of VOCs at Site 82.	VOCs	Installation of 6 intermediate depth monitoring wells to 100 ft around existing system injection well with subsequent injection of 28,000 gallons of solution and GW monitoring	None	Dechlorination occurred in monitoring wells. Site needs better plume delineation to maximize effectiveness; present technology onsite (pump and treat) is reaching mass reduction goals

SAP Worksheet #10—Problem Definition (continued)

Investigation and Location within UXO-22	Year	Media Investigated	Purpose of Investigation	Target Analytes	Activities	MEC	Results and Conclusions
Phase II, Lot 203 Environmental Condition of Property (Rhea)-**Sites 6 and 82**	2010	SB/GW	Assessment to evaluate if potential environmental problems exist prior to lease renewal	Full TCL VOCs, SVOCs, PCBs, pesticides, metals	Records review, 10 test pits, sampling from 4 monitoring wells, geophysical survey of Site 6 and Site 82	MPPEH and spent casings in 2 test pits in Site 6	Test Pits: Debris, PCBs, heavy metals, arsenic, and pesticides in soil above screening levels, impacted groundwater, batteries, MPPEH, an unknown red wax-like substance (exceedances in antimony and cobalt), and a blue crumbly material (exceedances in copper, manganese and dieldrin).
							Groundwater: exceedances in metals (iron and cadmium)
							Geophysical Survey: Numerous anomalies throughout site but focused in Lot 203 and north of water treatment plant
Site 6 Supplemental Investigation (CH2M HILL)-**Site 6**	Ongoing	SB/GW	Assessment of nature and extent of chlorobenzene plume in groundwater, and intrusive investigation of geophysical anomalies indicative of trench burial	VOCs, Pesticides, MC, metals (if necessary)	6 test pits and monitoring well installation into the intermediate aquifer. Soil and groundwater sampling	TBD	Collect samples for MC analysis if MEC is discovered in test pits
MPPEH Burial Pit Intrusive Investigation (CH2M HILL) - **Site 6**		SB	Remove all MPPEH from excavation initiated during chlorobenzene investigation	MC, metals	Identification and disposal of debris and any MPPEH		Collect samples for MC analysis if MEC is discovered in excavation

Legend:

AST- aboveground storage tank
SS- surface soil
SB-subsurface soil
GW- groundwater
SW- surface water
SD- sediment
VA- vapor
NA- not applicable
VOCs- volatile organic compounds
MEK-methyl ethyl ketone
MIBK-methyl isobutyl ketone
PCB-polychlorinated biphenyls
SVOC- semi-volatile organic compound
TCE-Trichloroethene
1,2 DCE-1,2-Dichloroethene
MC - munitions constituents
MEC- munitions and explosives of concern
MPPEH- material potentially presenting an explosive hazard
UXO- unexploded ordnance
VC-vinyl chloride

SAP Worksheet #10—Problem Definition (continued)

Conceptual Site Model

A conceptual site model (CSM) is critical to the development of an investigation strategy. The following sections describe the site features, potential source areas and release mechanisms, and their relationship with surrounding environmental media and receptors. **Figure 10-3** -is a graphical representation of the CSM for Site UXO-22.

Physical Characteristics

The surface topography within Site UXO-22 consists of relatively level terrain with some decrease in elevation in the extreme northeastern area of the site and a narrow ravine northeast of Lot 203 that trends northwest to Wallace Creek.

Vegetative cover consists of coniferous woodland along the northern and eastern site boundaries and grassy areas within the Defense Reutilization and Marketing Office (DRMO). The remainder of the site generally consists of compacted gravel or bare ground. Cultural features for Site UXO-22 include all or portions of several fenced lots used for materials storage (i.e. the DRMO), the MCB CamLej truck scales, the Site 82 Water Treatment Plant and subcontractor field trailers.

Stormwater runoff from the northern portion of Site UXO-22 (north of the east-west unnamed road) is expected to flow in a northerly direction toward the ravine then discharge into Wallace Creek. Runoff from the area south of the unnamed road is in a southerly direction toward Bearhead Creek (a tributary of Wallace Creek) or a stormwater retention pond directly southwest of Site UXO-22 next to the Base truck scales.

Site UXO-22 is underlain by light colored, fine grained sands extending to depths of at least 50 feet bgs, with discontinuous silty or clayey sand lenses occurring at depths of 20 to 50-feet bgs. Beneath the finer grained lenses lie massive fine grained sands and occasional cemented limestone beds of the River Bend and Castle Hayne Formations, extending to over 200 ft bgs.

The water table (surficial aquifer) is encountered at a depth of approximately 5 to 10 ft bgs, within the shallow fine grained sands. The surficial aquifer is separated from the underlying Castle Hayne aquifer by lenses of fine-grained silty and clayey sands. The absence of a continuous confining unit between these aquifers allows downward movement of groundwater within recharge areas and upward movement of groundwater in lower lying discharge areas (near creeks). The direction of groundwater flow within the surficial and underlying upper Castle Hayne aquifers is toward Wallace Creek.

Potential Sources of Release

Potential sources of MC are munitions discarded on the ground surface and within burial trenches and pits that could potentially leach into underlying soils and groundwater. Munitions constituents that could potentially be released from discarded munitions are metals, explosives residues and perchlorate.

Fate and Transport

Munitions constituents may be present on the surface and in the shallow subsurface and could potentially release MC 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 likely be from storage and disposal of MEC historically conducted within Site UXO-22 and release from subsequent degradation of materials. Degradation of MEC on the ground surface could result in the release of MC, which 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)

Potential Receptors

The potential receptors at Site UXO-22 include:

- DRMO personnel, Site visitors and trespassers who may have dermal contact with and accidental ingestion/absorption of surface soils.
- Future construction workers who may have contact with soils, surface water, and groundwater through dermal contact and accidental ingestion/absorption during potential future building activities that may include basement construction and excavations.
- Ecological receptors such as plants and animals being exposed to surface water in wetlands and surface water north and south of Site UXO-22 with direct contact and root intake from soils and discharging groundwater

Problem Definition

Historical disposal activities and investigations indicate that MEC is present at Site UXO-22, but no previous investigation has been conducted for the entire 75-acre site. If one or more releases of MC have occurred, it is unknown whether such release(s) pose a potentially unacceptable risk to human health and/or ecological receptors; therefore, further assessment is warranted.

The environmental questions and problems to be addressed by the PA/SI are:

1. **Have there been releases of munitions constituents to soil?** This question will be addressed by collecting soil samples from areas of suspected or confirmed MEC disposal and submitting them for laboratory analysis. Surface soil samples were not proposed as the focus of this investigation are former burial pits and trenches. Ten discrete subsurface soil samples will be collected at a depth above the water table from locations adjacent to select geophysical anomalies identified in the 2009 geophysical investigation (**Figures 10-4 and 10-5**). In addition, up to 30 soil samples will be collected during ongoing site activities (Site 6 Supplemental Chlorobenzene Investigation and Site 6 MPPEH Pit in **Table 10-1**) from the sidewalls and base of proposed excavations if MEC is discovered (**Figure 10-6**). Soil samples will be analyzed for explosives residues, pentaerythritol tetranitrate (PETN), nitroglycerine, perchlorate, and TAL metals.
2. **Have there been releases of munitions constituents to groundwater?** This question will be addressed by collecting and analyzing groundwater samples from three new and four existing monitoring wells screened within the surficial aquifer. The three new monitoring wells will be constructed in areas that are hydraulically downgradient from former disposal trenches or geophysical anomalies (**Figure 10-5**). The actual monitoring well locations may be adjusted slightly to accommodate site conditions (e.g. to avoid potential MEC items). The groundwater samples will be analyzed for explosives residues, PETN, nitroglycerine, perchlorate, and TAL metals.
3. **Have there been releases of munitions constituents to surface water and sediment?** To address this question, up to four sediment and four surface water samples will be collected from the shallow ravine located in the north-central portion of the site that drains into Wallace Creek. The samples will be collected from likely depositional areas and standing water within the ravine (**Figure 10-5**). Sample locations may be modified during preliminary field activities because of variations in the occurrence of surface water bodies based on seasonal climatic conditions. The surface water and sediment samples will be analyzed for explosives residues, PETN, nitroglycerine, perchlorate, TAL and dissolved metals, total organic carbon (TOC), hardness (surface water only), and grain size (sediment only).
4. **If releases are identified through environmental sampling and analysis, what is the appropriate next step?**

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

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

This section presents the project quality objectives for the PA/SI.

Who will use the data?

The data will be used by the MCB CamLej project team to evaluate MC impacts to environmental media from onsite disposal activities and to assess whether the potential releases warrant further assessment or action.

What are the project action limits?

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

Groundwater

1. Previous investigations conducted within Site UXO-22 indicate that several of the target metals have been detected in groundwater at concentrations consistent with background concentrations. In accordance with policy developed by the Project Team, groundwater analytical results for metals will be compared to two times the mean Base background concentrations (Baker, 2002).
2. Groundwater analytical results will be compared to North Carolina Administrative Code (NCAC) 2L Groundwater Quality Standards (NCGWQS) (NCDENR, 2010b).
   - If a standard for a substance is less than the laboratory practical quantitation limit, the laboratory practical quantitation limit will substitute for the standard and the detection of that substance at or above the practical quantitation limit shall constitute a violation of the NCGWQS.
3. Groundwater analytical results also will be compared to the adjusted U.S. Environmental Protection Agency (USEPA) regional screening levels (RSLs) for tap water (USEPA, June 2011) and drinking water maximum contaminant levels (MCLs). The RSLs based on noncarcinogenic effects will be adjusted by dividing by 10 to account for exposure to multiple constituents; the RSLs based on carcinogenic effects will be used as presented in the USEPA RSL table.

Surface Water

1. Surface water analytical results will be compared to the NCAC Surface Water and Wetlands Standards (NCSWS) surface water quality standards for human health and water supply, if available.
2. Concentrations of surface water constituents also will be compared to the National Recommended Water Quality Criteria (NRWQC) for human health, if available. Results from dissolved metals analysis will be used for ecological risk screening purposes.
3. If a NCSWS or an NRWQC are not available for a detected constituent, the adjusted (as defined above) USEPA tap water RSL will be used for comparison, as agreed by the Project Team.

Subsurface Soil

1. Subsurface soil analytical results will be compared to two times the mean base background concentrations (Baker, 2001). Many of the metals being analyzed are found at background concentrations at MCB CamLej and metals analytical results will be compared to two times the mean base background concentrations. The Project Team established two times the mean base background as a suitable screening level to determine if additional sampling may be required.
2. Subsurface soil analytical results also will be compared to the adjusted (as defined above) USEPA RSLs for industrial and residential soil (USEPA, June 2011).

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

3. Subsurface soil analytical results also will be compared to the NCDENR Soil Screening Levels (SSLs) (NCDENR, 2010a).

Sediment

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

What will the data be used for?

The data will be used to evaluate:

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

What types of data are needed?

- Worksheet #10 defines the sample media and target analyte list to be used during this investigation. Since a purpose of this PA/SI is to identify the presence of MC, the target analytes list will include all potential constituents known to be used in the manufacture of MEC items. The target analytes are consistent with PA/SI investigations conducted across the Base under the MMRP.
- Water quality parameters, including field testing for pH, conductivity, oxidation-reduction potential, dissolved oxygen, temperature, and turbidity, will be measured during the purging of the monitoring wells and sampling of surface water at Site UXO-22.
- Lithologic logging of soil cuttings will be conducted during drilling operations. The logging activities will facilitate selection of well screen intervals and will supplement the CSM.
- Subsurface soil sample locations will be recorded by hand-held global positioning system (GPS) devices during environmental sampling activities (both drilling and pit excavation). Following sample collection, the 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 collected at Site UXO-22 with a level of confidence that the project objectives can be achieved.
- Visual observations (soil saturation, staining etc.) will be used at Site UXO-22 to help select subsurface soil sampling intervals and determine appropriate well screen placement for groundwater sampling. For drilled subsurface soil samples, collection will be from the 2-foot interval above the water table (estimated to range from 5 to 10 ft bgs). Subsurface soil samples collected from excavated pits will be from vadose zone soil and in areas of visible staining and contaminant impact (if observed). Sampling activities involving excavations will be conducted in accordance with "Excavation and Trenching SOP" (**Attachment 2**).
- 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**).

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

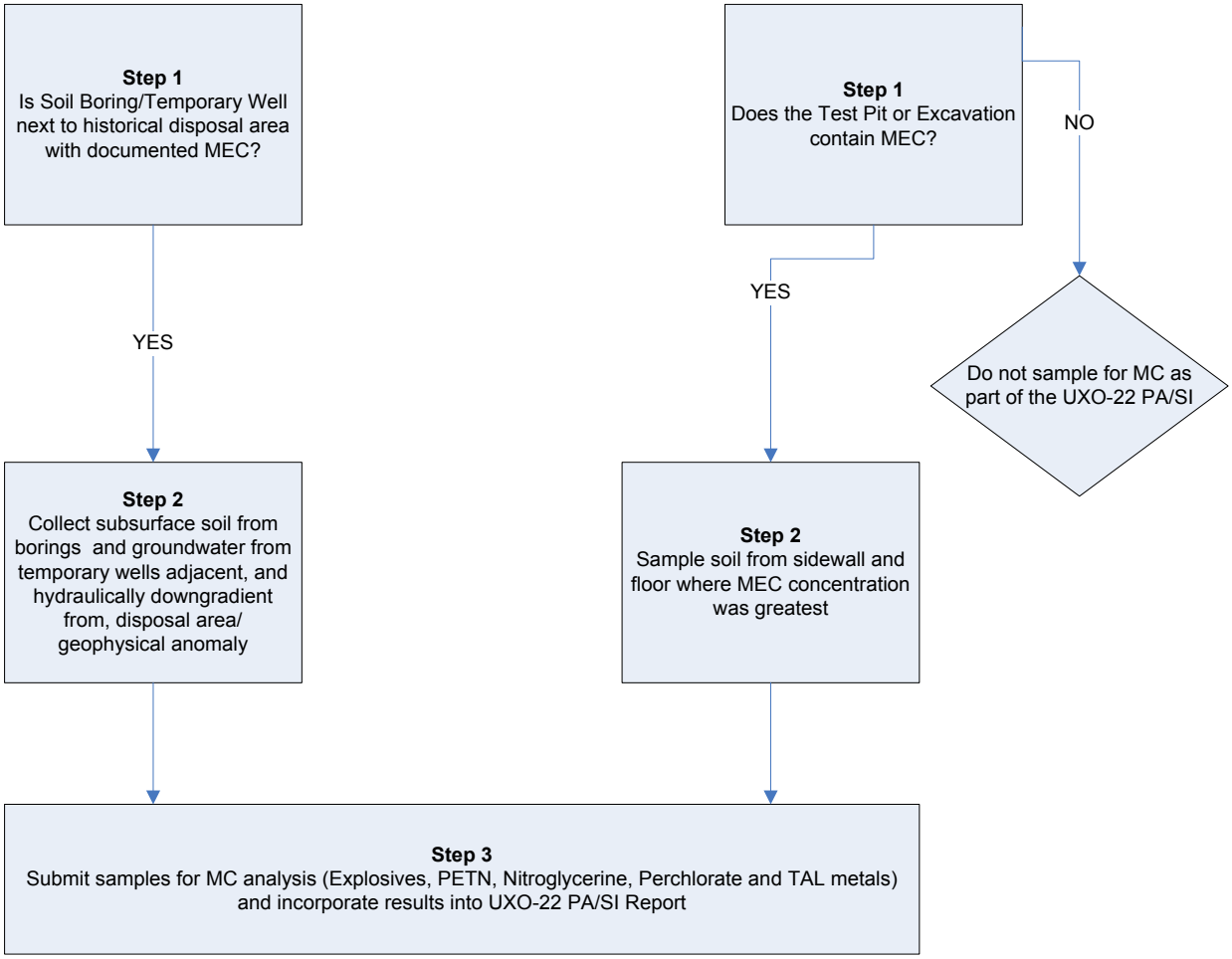
- In addition to correct installation procedures, monitoring wells must be purged to allow for a representative sample to be collected. Purging will be considered complete when the water quality parameters (temperature, pH, specific conductance, DO, turbidity and ORP) have stabilized for three consecutive 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: within 1 degree Celsius
  - pH: within 0.1 pH units
  - Specific conductance: within 3 percent
  - Dissolved oxygen: within 10 percent
  - Turbidity: within 10 percent or as low as practicable given sampling conditions
  - ORP: within 10 mV
- Groundwater sampling procedures are detailed in Worksheet #14.
- During the SI, 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?

1. For environmental sampling this question will be answered by the following. The number of samples and rationale are provided in Worksheet #17:
   - A total of up to 40 subsurface soil samples are proposed for Site UXO-22. Investigation activities are focused primarily on historical disposal activities involving the burial of suspected MPPEH in pits and trenches. MC contamination may have leached into surrounding subsurface soils and groundwater of the surficial aquifer. Ten of the proposed samples will be collected adjacent to geophysical anomalies using a DPT drill rig. Up to 30 additional subsurface soil samples will be collected from test pit side-walls during ongoing investigations.
   - The test pit samples will be collected during the MPPEH pit, Site 6 supplemental chlorobenzene investigation, Operable Unit [OU] 2 source area investigation and ECP test pitting investigation. **Figure 11-1** presents the sampling rationale to be followed during test pit excavation and soil borings.
   - A total of 7 groundwater samples will be collected from permanent groundwater monitoring wells; three of the samples will be collected from newly installed wells and four samples will be collected from existing wells. The number of samples and rationale are provided in Worksheet #17.
   - Four surface water and four sediment samples will be co-located at the shallow ravine immediately northeast of the DRMO fence line. Surface water samples will be collected prior to sediment samples to minimize disturbance and suspension of sediment. Surface water samples from the ravine will be collected from downstream to upstream. The number of samples and rationale are provided in Worksheet #17.

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

FIGURE 11-1
Soil Sample Strategy Decision Flow Chart: Contract Task Order 0014 Site UXO-22, MCB CamLej



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

- The environmental samples will be collected within and immediately north of Site UXO-22 as shown on **Figures 10-5** and **10-6**
- The proposed investigation will be conducted in the summer of 2011.
- The environmental samples will be collected in accordance with the SOPs presented in Worksheet #21.

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

- CH2M HILL staff will collect environmental samples, including groundwater, subsurface soil, sediment, and surface water, as outlined in Worksheets #10 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.

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

- Laboratory analytical services for Site UXO-22 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 PA/SI 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?

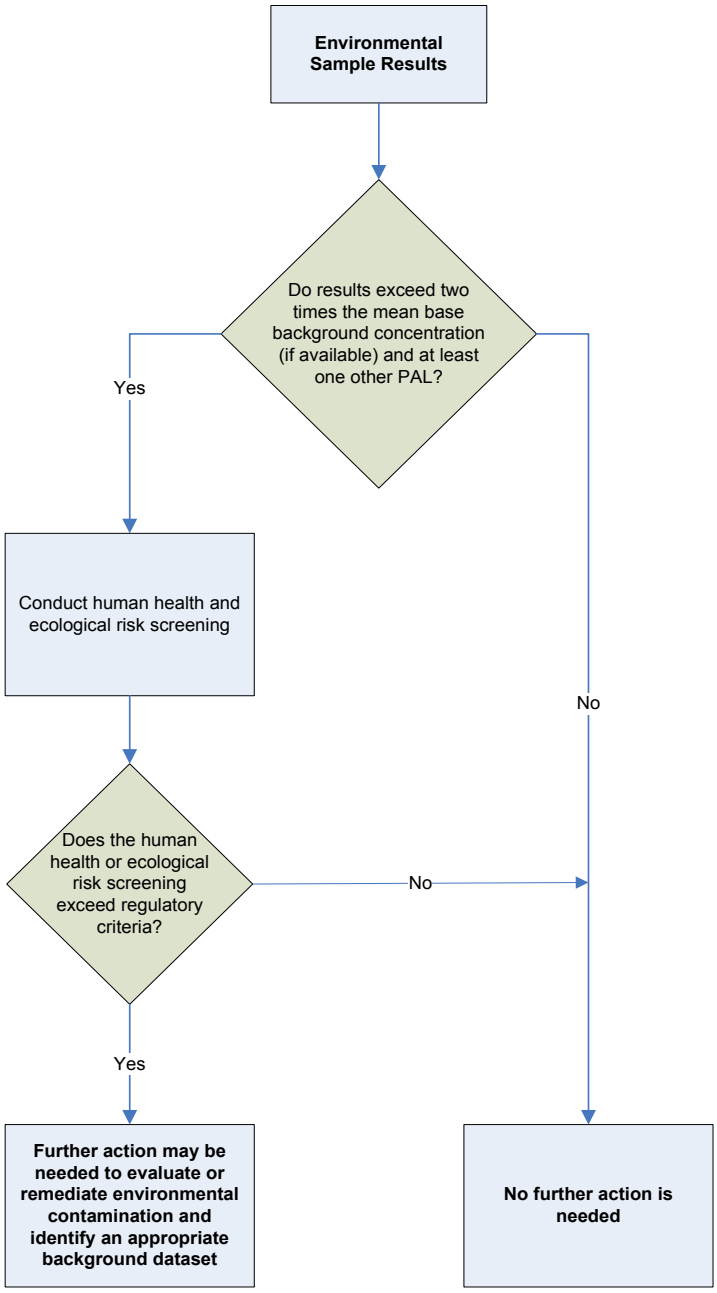
Data will be archived according to the Navy CLEAN program/contract requirements. Data will be uploaded into a centralized database Naval Installation Restoration Information Solution (NIRIS) maintained by CH2M HILL and used for Navy projects. At the end of the project, paper copies of archived laboratory 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 11-2** represents the project quality objectives (PQOs) for the environmental media sample data collected at the sites. The general objective of the decision analysis process is to evaluate whether a CERCLA-related release occurred and, if so, whether the release warrants further investigation or action.

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

FIGURE 11-2
Project Quality Objectives Decision Flow Chart: Contract Task Order 0014 Site UXO-22, MCB CamLej



SAP Worksheet #12-1—Measurement Performance Criteria Table – Field QC Samples – Site UXO-22

The analytical methods selected in this UFP-SAP and their respective Measurement Performance Criteria are acceptable for this investigation.

Matrix: Sediment, Subsurface Soil

Analytical Group: TAL Metals

Concentration Level: Medium

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)
Equipment Rinsate Blank	TAL Metals	One per day of sampling	Bias/Contamination	No analyte detected > 1/2 LOQ	S + A
Ambient Field Blank		One per week of sampling	Bias/Contamination		S + A
Cooler Temperature Blank		One per cooler to the laboratory	Accuracy/Representativeness	4°C (± 2° C)	S
Field Duplicate		One per 10 samples per matrix	Precision	RPD < 35%	S + A

SAP Worksheet #12-2—Measurement Performance Criteria Table – Field QC Samples – Site UXO-22

Matrix: Sediment, Subsurface Soil

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)
Equipment Rinsate Blank	Explosives Residues including PETN and Nitroglycerin	One per day of sampling	Bias/Contamination	No analyte detected > 1/2 LOQ	S + A
Ambient Field Blank		One per week of sampling	Bias/Contamination		S + A
Cooler Temperature Blank		One per cooler to the laboratory	Accuracy/Representativeness	4°C (± 2° C)	S
Field Duplicate		One per 10 samples per matrix	Precision	RPD < 35%	S + A

SAP Worksheet #12-3—Measurement Performance Criteria Table - Field QC Samples- Site UXO-22

Matrix: Sediment, Subsurface Soil
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)
Equipment Rinsate Blank	Perchlorate	One per day of sampling	Bias/Contamination	No analyte detected > 1/2 LOQ	S + A
Ambient Field Blank		One per week of sampling	Bias/Contamination		S + A
Cooler Temperature Blank		One per cooler to the laboratory	Accuracy/Representativeness	4°C (± 2° C)	S
Field Duplicate		One per 10 samples per matrix	Precision	RPD < 35%	S + A

SAP Worksheet #12-4—Measurement Performance Criteria Table – Field QC Samples – Site UXO-22

Matrix: Sediment

Analytical Group: TOC (Total Organic Carbon)

Concentration Level: Medium

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)
Cooler Temperature Indicator	TOC	One per cooler	Accuracy/Representativeness	4 ± 2 ° C	S&A
Equipment Rinseate Blank		One each per week for disposable equipment	Bias/Contamination	Target compounds ≤ ½ QL	S&A
Field Duplicate		One per 10 field samples	Precision	RPD ≤ 25%	S&A

SAP Worksheet #12-5—Measurement Performance Criteria Table - Field QC Samples - Site UXO-22

Matrix: Sediment

Analytical Group: Grain Size

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)
Cooler Temperature Blank	Grain Size	One per cooler to the laboratory	Accuracy/Representativeness	4 ± 2 ° C	S

SAP Worksheet #12-6—Measurement Performance Criteria Table - Field QC Samples - Site UXO-22

Matrix: Groundwater, Surface Water

Analytical Group: TAL Metals

Concentration Level: Medium

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)
Cooler Temperature Indicator	TAL Metals, Dissolved Metals (Surface water)	One per cooler	Accuracy/Representativeness	4 ± 2 ° C	S&A
Equipment Rinseate Blank, Field Blank		One each per week for disposable equipment	Bias/Contamination	Target compounds ≤ ½ QL	S&A
Field Duplicate		One per 10 field samples	Precision	RPD ≤ 25%	S&A

SAP Worksheet #12-7—Measurement Performance Criteria Table - Field QC Samples - Site UXO-22

Matrix: Groundwater, Surface Water

Analytical Group: Explosives Residues including Nitroglycerin and PETN

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)
Cooler Temperature Indicator	Explosives Residues including Nitroglycerin and PETN	One per cooler	Accuracy/Representativeness	4 ± 2 ° C	S&A
Equipment Rinseate Blank, Field Blank		One each per week for disposable equipment	Bias/Contamination	Target compounds ≤ ½ QL	S&A
Field Duplicate		One per 10 field samples	Precision	RPD ≤ 25%	S&A

SAP Worksheet #12-8—Measurement Performance Criteria Table - Field QC Samples - Site UXO-22

Matrix: Groundwater, Surface Water

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)
Cooler Temperature Indicator	Perchlorate	One per cooler	Accuracy/Representativeness	4 ± 2 ° C	S&A
Equipment Rinseate Blank, Field Blank		One each per week for disposable equipment	Bias/Contamination	Target compounds ≤ ½ QL	S&A
Field Duplicate		One per 10 field samples	Precision	RPD ≤ 25%	S&A

SAP Worksheet #12-9—Measurement Performance Criteria Table - Field QC Samples - Site UXO-22

Matrix: Surface Water

Analytical Group: TOC

Concentration Level: Medium

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)
Cooler Temperature Indicator	TOC	One per cooler	Accuracy/Representativeness	4 ± 2 ° C	S&A
Equipment Rinseate Blank		One each per week for disposable equipment	Bias/Contamination	Target compounds ≤ ½ QL	S&A
Field Duplicate		One per 10 field samples	Precision	RPD ≤ 25%	S&A

SAP Worksheet #12-10—Measurement Performance Criteria Table - Field QC Samples - Site UXO-22

Matrix: Surface Water

Analytical Group: Hardness

Concentration Level: Medium

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)
Cooler Temperature Indicator	Hardness	One per cooler	Accuracy/Representativeness	4 ± 2 ° C	S&A
Equipment Rinseate Blank		One each per week for disposable equipment	Bias/Contamination	Target compounds ≤ ½ QL	S&A
Field Duplicate		One per 10 field samples	Precision	RPD ≤ 25%	S&A

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
2008 Archival Report	CH2M HILL, *Archival Records Search Report for the Focused Preliminary Assessment/Site Investigation Former Firing Position 2 (Site UXO-22)*	Marine Corp Library at Quantico National Archives and Records Administration Camp Lejeune Base Files Base Personnel Interviews	Planning and Sample Location Selection	Data and Archival Records range in age from 5-50 years old and may not be representative of current conditions
2008 Focused PA/SI Report	CH2M HILL, Focused Preliminary Assessment/Site *Investigation Report, Former Firing Position 2 (Site UXO-22)*	CH2M HILL. Groundwater and soil data 2008	Planning and Sample Location Selection at Site UXO-22	Data is limited to four acres of the 12 acre investigation area

This page intentionally left blank.

SAP Worksheet #14—Summary of Project Tasks

Pre-Field Tasks

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

Field Tasks

The field investigation will accomplish the project objectives through the following activities, which will be conducted in accordance with CH2M HILL SOPs and the MMRP Master Project Plans. MEC anomaly avoidance will be conducted by a UXO technician as described in the APP/HSP (**Attachment 1**) during all field tasks.

Mobilization

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

General Activities

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

Kickoff/Safety Meeting

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

Utility Clearance

Prior to initiation of intrusive sampling activities, all buried utilities within 20 feet of each sampling location will be identified by a subcontracted utility locator.

Land Surveying

Land surveying services will be conducted in accordance with Section 7.4 of the MMRP Master Project Plans. MEC anomaly avoidance will be practiced as described in the APP/HSP (**Attachment 1**). The surveying at Site UXO-22 will occur after environmental sampling activities have concluded and will include surveying the coordinates and elevations of the newly installed monitoring well locations.

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

Vegetation Clearance

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

UXO technicians will conduct MEC avoidance activities in the vegetation removal areas according to the MEC avoidance procedures included in the APP/HSP (**Attachment 1**). The brush and trees will be mulched and left in place. Trees greater than 6 inches in diameter will not be removed.

Vegetation clearance will be in accordance with the Environmental Protection Plan (**Attachment 5**).

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.

Environmental Site Sampling

- Subsurface Soil Sampling using DPT
  - A DPT rig will be used to collect subsurface soil samples in a 3-foot section above the saturated zone, following the "Direct-Push Soil Sample Collection SOP" located in Worksheet #21 of the UFP-SAP. The proposed locations for each DPT borehole will be uploaded to a hand-held GPS unit, and used in the field to accurately locate the correct sampling site. The field team will make reasonable efforts to collect samples from the proposed sampling locations; however, the sampling locations may be slightly adjusted to a field-suitable location (area free of poison ivy, debris, etc.). The actual coordinates of the sampling locations will then be recorded by the GPS unit. The coordinates will also be recorded in the field logbook. Soil borings not used for monitoring well installation will be abandoned with hydrated bentonite chips.
  - MEC avoidance will be practiced during all intrusive sampling activities as described in the APP/HSP (**Attachment 1**). At the start of each borehole, a UXO technician will hand auger to a depth of 5 feet, checking the borehole with a down-hole magnetometer at 1-foot increments. A separate borehole will be advanced adjacent to the borehole cleared by the UXO technician in order to collect the subsurface sample.
  - The DPT rig will recover continuous soil cores from each location to allow examination and description of the lithological characteristics and soil sample collection. The continuous cores will be retrieved using an open core barrel and piston DPT sampling device along with a 4- or 5-foot disposable acetate liner to a depth just above the water table. The soil sample will be collected from a depth just above the saturated zone. Soil samples intended for laboratory analysis should not be collected from the saturated zone, but should be logged throughout the anticipated screen interval for boreholes selected for monitoring well installation. A new liner will be used to collect each continuous sample from the ground surface down to the bottom of the borehole. Down-hole sampling equipment will be decontaminated between each sample location.

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

- Test Pits and Excavation Samples
  - Up to 30 test pits/excavation samples will be collected at Site UXO-22 during ongoing investigation activities to assess potential MC contamination at the site. The proposed test pits are shown on **Figure 10-5**. The locations have been selected to address potential data gaps associated with previous investigations and will be implemented under separate task orders. Sampling of the test pits will be conducted in accordance with Section 3.15, Test Pits/Trenching, of the Master Project Plans (CH2M HILL, 2008b).
  - The depth of the test pits will be based upon the depth of suspected debris and other disposed materials and the groundwater table. The excavator bucket used for excavation will be decontaminated prior to and following the completion of each test pit in accordance with Section 3.16.1, Decontamination: Drilling Equipment and Well Construction Material, of the Master Project Plans (CH2M HILL, 2008b).
  - The excavation will proceed by removing lifts of no more than 12 inches at a time, until an assessment of the material can be made by the CH2MHILL scientist and UXO Tech. The material will be temporarily staged on 10-mil gauge plastic sheeting. The CH2M HILL representative will inspect and describe the excavated materials and document the characteristics of the excavation using digital photography and field sketches. Each test pit will be 5 foot by 5 foot in dimension for uniformity. The final length, width, and depth of each test pit will be measured. The test pits will be backfilled with the material removed from the excavation immediately after completion to reduce site hazards and minimize the potential for rainwater accumulation. If MEC or MPPEH is encountered, high-visibility fencing will be placed at a distance of at least 5 feet around the circumference of the back-filled test pit. Any metal debris encountered during test pit excavation will be disposed of in accordance with the Waste Management Plan (CH2M HILL, 2008c).
  - Test pits containing MEC will be assessed by collecting soil samples from the sidewalls and base of the excavation in the area of greatest MEC concentration. If MEC is uniform in distribution, the north sidewall will be sampled at the depth of greatest MEC concentration. The samples will be analyzed for explosives residues, PETN, nitroglycerine, perchlorate, and TAL metals.
- Monitoring Well Installation
  - Shallow groundwater monitoring wells will be constructed at Site UXO-22 to allow collection of groundwater samples. Each well will be constructed of 2-inch Schedule 40 polyvinyl chloride (PVC). Wells will be constructed using 10 feet of 2-inch inside diameter, 0.010-inch machine slotted Schedule 40 PVC screen with a bottom cap. The wells will be installed in accordance with the "Monitoring Well Installation SOP" located in Worksheet #21. The well screen will be installed to bracket the water table. Each well will be completed with a #2 filter pack from the bottom of the well to 2 feet above the top of the screen interval. A 2-foot hydrated bentonite will be installed above the filter pack and allowed to hydrate for 30 minutes prior to grouting with a bentonite/Portland cement slurry to ground surface. Each well will be completed with a flush-mounted, traffic-rated well monument and locking well cap
  - The monitoring wells will be developed by the drilling contractor. The primary purpose of well development is to reduce turbidity.
  - Static groundwater elevations will be measured in all monitoring wells using a water level indicator or oil/water interface probe, as appropriate. The depth from the top of casing to fluid level will be recorded to the nearest 0.01 foot. The indicator will be decontaminated after use in each well.

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

- Groundwater Sampling
  - Groundwater samples will be collected using a peristaltic or bladder pump following low-flow sampling protocols, and analyzed for parameters as detailed on Worksheet #20 and the "Groundwater Sampling SOP" located in Worksheet #21. All groundwater samples will be collected by placing the sample tubing or pump intake in the middle of the water column.
  - Water quality parameters (WQPs), including specific conductance, pH, turbidity, temperature, dissolved oxygen (DO), and oxidation reduction potential (ORP), will be measured and recorded prior to sampling using a multi-parameter water quality meter. The meter will be calibrated on a daily basis and thereafter as warranted. Sampling will begin when the WQPs have stabilized: pH within 0.1 pH units, specific conductance within 3 percent, dissolved oxygen within 10 percent, ORP within 10 mV and turbidity within 10 percent or as low as practicable for three consecutive readings. Depth to water, purge volume, WQPs, and total well depth measurements will be recorded in the field logbook.
- Surface Water and Sediment Sampling
  - WQPs (e.g., DO, temperature, specific conductance, and pH) will be measured prior to sample collection. Surface water samples will then be collected by submersing the sampling container directly into the surface water body or by using a "thief" type sampler and then transferring the sample to the sample container. If the volume of surface water encountered is insufficient to allow the direct submersion of the sampling containers, a glass interim vessel will be used to transfer the surface water sample to the sample containers. The glass interim vessel will be laboratory cleaned to the same specifications as the sample containers.
  - Sediment samples will be collected in the same location as surface water samples. Sediment and surface water sampling will follow the SOPs listed in Worksheet #21. Surface water samples will always be collected first at each location to minimize turbidity and agitation caused by sediment collection. Sediment will be collected using a decontaminated trowel and bowl, drained of excess water, and placed into the appropriate sample containers.

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.

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™ or equivalent solution spray and rinsed with deionized water between each measurement.
- Wastes generated during the investigation of potentially contaminated sites are classified as investigation-derived waste (IDW) and will be managed to protect human health and the environment, as well as to meet legal requirements. IDW will be managed in accordance with the Waste Management Plan. The FTL will be responsible for the documentation, containerization, and transportation to the appropriate on-base storage facility. The containers will be labeled in accordance with the Waste Management Plan either with a indelible marker or preprinted label. Trash will be placed in opaque, black garbage bags and placed into on-base trash receptacles.

Demobilization

Full demobilization will occur when the project is completed and appropriate QA/QC checks have been performed. Personnel no longer needed during field operations may be demobilized prior to the final project completion date. The following will occur prior to demobilization:

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

- Chain-of-custody records will be reviewed to ensure that all samples were collected as planned and submitted for appropriate analyses.
- Restoration of the site to an appropriate level (e.g., repair of deep ruts) will be verified by the CH2M HILL Field Team Leader (FTL).
- All equipment will be inspected, packaged, and returned to the appropriate location.

Analyses and Testing Tasks

- The analytical laboratory 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 3** of this UFP-SAP.
- Computerized and manual procedures for data from generation to final use and storage and QC checks for error detection to ensure data integrity:
  - See the Navy CLEAN **Data Management Plan** in the **Data Management Guidelines** presented in **Attachment 3** 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 3** 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 3** 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 PA/SI Report.

Assessment/Audit Tasks

See Worksheets #31 and #32.

This page intentionally left blank.

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

Analytical Group: TAL Metals
Matrix: Subsurface Soil

Analyte	CAS Number	Project Action Limit	Project Action Limit Reference[1]	Project Quantitation Limit Goal[2] (mg/kg)	Laboratory-specific		
					LOQs (mg/kg)	LODs (mg/kg)	DLs (mg/kg)
Aluminum	7429-90-5	7700	RSLs Residential for soil	3850	40.0	20.0	10.0
Antimony	7440-36-0	0.36	2x Base Background	0.18	2.00	1.60	1.00
Arsenic	7440-38-2	0.39	RSLs Residential for soil	0.195	2.00	1.20	0.600
Barium	7440-39-3	16.6	2x Base Background	8.3	8.00	4.00	1.00
Beryllium	7440-41-7	0.165	2x Base Background	0.0825	1.00	0.400	0.200
Cadmium	7440-43-9	0.023	2x Base Background	0.0115	1.00	0.400	0.200
Calcium	7440-70-2	441	2x Base Background	220.5	1000	400	200
Chromium	7440-47-3	0.29	RSLs Residential for soil	0.145	2.00	0.800	0.400
Cobalt	7440-48-4	0.822	2x Base Background	0.411	2.50	2.00	1.00
Copper	7440-50-8	2.56	2x Base Background	1.28	2.00	1.60	0.800
Iron	7439-89-6	150	NCSSL	75	20.0	12.0	6.00
Lead	7439-92-1	8.49	2x Base Background	4.245	1.00	0.600	0.300
Magnesium	7439-95-4	363	2x Base Background	181.5	1000	600	200
Manganese	7439-96-5	9.25	2x Base Background	4.625	3.00	1.20	0.600
Mercury	7439-97-6	0.071	2x Base Background	0.0355	0.033	0.033	0.0130
Nickel	7440-02-0	2.27	2x Base Background	1.135	2.00	1.20	0.600
Potassium	7440-09-7	361	2x Base Background	180.5	1000	600	200
Selenium	7782-49-2	0.505	2x Base Background	0.2525	2.00	1.00	0.600
Silver	7440-22-4	0.129	2x Base Background	0.0645	2.00	0.400	0.200
Sodium	7440-23-5	68.3	2x Base Background	34.15	1000	600	200

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

Analyte	CAS Number	Project Action Limit	Project Action Limit Reference[1]	Project Quantitation Limit Goal[2] (mg/kg)	Laboratory-specific		
					LOQs (mg/kg)	LODs (mg/kg)	DLs (mg/kg)
Thallium	7440-28-0	0.078	RSL Residential for soil	0.078	1.60	0.800	0.600
Vanadium	7440-62-2	17.2	2x Base Background	8.6	2.50	2.00	1.00
Zinc	7440-66-6	6.59	2x Base Background	3.295	4.00	2.00	1.00

Notes:
[1] PALs were developed to be protective of human health and the environment.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Worksheets #10 and #11 for a detailed discussion on development of PALs.
Base Background values are two times the mean background concentrations at MCB CamLej.
The Residential Soil RSLs were adjusted from the USEPA Regional Screening Levels Table (June 2011).
NC SSLs are from NCDENR (January 2010).
Shading represents cases where the PAL or Project QL goal is lower than the laboratory LOD. In these instances the laboratory LOD will be used as the default PAL.

SAP Worksheet #15-1A—QC Limits for Metals in Solid Samples

Analyte	CAS #	MS/MSD and LCS Recoveries		
		LCL (%)	UCL (%)	RPD (%)
Aluminum	7429-90-5	80	120	20
Antimony	7440-36-0	80	120	20
Arsenic	7440-38-2	80	120	20
Barium	7440-39-3	80	120	20
Beryllium	7440-41-7	80	120	20
Cadmium	7440-43-9	80	120	20
Calcium	7440-70-2	80	120	20
Chromium	7440-47-3	80	120	20
Cobalt	7440-48-4	80	120	20
Copper	7440-50-8	80	120	20
Iron	7439-89-6	80	120	20
Lead	7439-92-1	80	120	20
Magnesium	7439-95-4	80	120	20
Manganese	7439-96-5	80	120	20
Mercury	7439-97-6	80	120	20
Nickel	7440-02-0	80	120	20
Potassium	7440-09-7	80	120	20
Selenium	7782-49-2	80	120	20
Silver	7440-22-4	80	120	20
Sodium	7440-23-5	80	120	20
Thallium	7440-28-0	80	120	20
Vanadium	7440-62-2	80	120	20
Zinc	7440-66-6	80	120	20

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

Analytical Group: Explosive Residues

Matrix: Subsurface Soil

Analyte	CAS Number	Project Action Limit (ug/kg)	Project Action Limit Reference[1]	Project Quantitation Limit Goal[2] (ug/kg)	Laboratory-specific		
					LOQs (ug/kg)	LODs (ug/kg)	DLs (ug/kg)
1,3,5-Trinitrobenzene	99-35-4	220000	RSL Residential	110000	400	200	100
1,3-Dinitrobenzene	99-65-0	610	RSL Residential	305	400	200	100
2,4,6-Trinitrotoluene	118-96-7	3600	RSL Residential	1800	400	200	100
2,4-Dinitrotoluene	121-14-2	1600	RSL Residential	800	400	200	100
2,6-Dinitrotoluene	606-20-2	6100	RSL Residential	3050	400	200	100
2-Amino-4,6-dinitrotoluene	35572-78-2	15000	RSL Residential	7500	400	200	100
2-Nitrotoluene	88-72-2	2900	RSL Residential	1450	400	200	100
3-Nitrotoluene	99-08-1	610	RSL Residential	305	400	200	100
4-Amino-2,6-dinitrotoluene	19406-51-0	15000	RSL Residential	7500	400	200	100
4-Nitrotoluene	99-99-0	24000	RSL Residential	12000	400	200	100
HMX	2691-41-0	380000	RSL Residential	190000	400	200	100
Nitrobenzene	98-95-3	4800	RSL Residential	2400	400	200	100
Nitroglycerin	55-63-0	610	RSL Residential	305	1000	500	250
Pentaerythritol tetranitrate (PETN)	78-11-5	12000	RSL Residential	6000	1000	500	250
RDX	121-82-4	5600	RSL Residential	2800	400	200	100
Tetryl	479-45-8	24000	RSL Residential	12000	400	200	100
Perchlorate	14797-73-0	5500	RSL Residential	2750	5	2	0.600

Notes:
PAL and Project QL assumes dry weight basis.
[1] PALs were developed to be protective of human health and the environment.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Worksheets #10 and #11 for a detailed discussion on development of PALs.
The Residential Soil RSLs were adjusted from the USEPA Regional Screening Levels Table (June 2011).
NC = No Criteria

SAP Worksheet #15-2A—QC Limits for Explosives Residues in Solid Samples

Analyte	CAS #	MS/MSD and LCS Recoveries		
		LCL (%)	UCL (%)	RPD (%)
1,3,5-Trinitrobenzene	99-35-4	75	125	30
1,3-Dinitrobenzene	99-65-0	80	125	30
2,4,6-Trinitrotoluene	118-96-7	55	140	30
2,4-Dinitrotoluene	121-14-2	80	125	30
2,6-Dinitrotoluene	606-20-2	80	120	30
2-Amino-4,6-dinitrotoluene	35572-78-2	80	125	30
2-Nitrotoluene	88-72-2	80	125	30
3-Nitrotoluene	99-08-1	75	120	30
4-Amino-2,6-dinitrotoluene	19406-51-0	80	125	30
4-Nitrotoluene	99-99-0	75	125	30
HMX	2691-41-0	75	125	30
Nitrobenzene	98-95-3	75	125	30
Nitroglycerin	55-63-0	60	120	30
Pentaerythritol tetranitrate (PETN)	78-11-5	60	120	30
RDX	121-82-4	70	135	30
Tetryl	479-45-8	10	150	30
Perchlorate	14797-73-0	80	120	15

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

Analytical Group: TAL Metals

Matrix: Sediment

Analyte	CAS Number	Project Action Limit	Project Action Limit Reference[1]	Project Quantitation Limit Goal[2] (mg/kg)	Laboratory-specific		
					LOQs (mg/kg)	LODs (mg/kg)	DLs (mg/kg)
Aluminum	7429-90-5	7700	RSLs Residential for soil	3850	40.0	20.0	10.0
Antimony	7440-36-0	3.1	RSLs Residential for soil	1.55	2.00	1.60	1.00
Arsenic	7440-38-2	0.39	RSLs Residential for soil	0.195	2.00	1.20	0.600
Barium	7440-39-3	1500	RSLs Residential for soil	750	8.00	4	1.00
Beryllium	7440-41-7	16	RSLs Residential for soil	8	1.00	0.400	0.200
Cadmium	7440-43-9	7	RSLs Residential for soil	3.5	1	0.400	0.200
Calcium	7440-70-2	NC	NA	400	1000	400	200
Chromium	7440-47-3	0.29	RSLs Residential for soil	0.145	2.00	0.800	0.400
Cobalt	7440-48-4	2.3	RSLs Residential for soil	1.15	2.50	2.00	1.00
Copper	7440-50-8	310	RSLs Residential for soil	155	2.00	1.60	0.800
Iron	7439-89-6	5500	RSLs Residential for soil	2750	20.0	12.0	6.00
Lead	7439-92-1	400	RSLs Residential for soil	200	1	0.600	0.300
Magnesium	7439-95-4	NC	NC	600	1000	600	200
Manganese	7439-96-5	180	RSLs Residential for soil	90	3.00	1.20	0.600
Mercury	7439-97-6	2.3	RSLs Residential for soil	1.15	0.033	0.033	0.0130
Nickel	7440-02-0	150	RSLs Residential for soil	75	2.00	1.20	0.600
Potassium	7440-09-7	NC	NC	600	1000	600	200
Selenium	7782-49-2	39	RSLs Residential for soil	19.5	2	1.00	0.600
Silver	7440-22-4	39	RSLs Residential for soil	19.5	2.00	0.400	0.200
Sodium	7440-23-5	NC	NC	600	1000	600	200
Thallium	7440-28-0	0.078	RSLs Residential for soil	0.078	1.60	0.800	0.600
Vanadium	7440-62-2	39	RSLs Residential for soil	19.5	2.50	2.00	1.00
Zinc	7440-66-6	2300	RSLs Residential for soil	1150	4.00	2.00	1.00

Notes:
[1] PALs were developed to be protective of human health and the environment.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
The Residential Soil RSLs were adjusted from the USEPA Regional Screening Levels Table (June 2011).
Shading represents cases where the PAL or Project QL goal is lower than the laboratory LOD. In these instances the laboratory LOD will be used as the default PAL.

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

Analytical Group: Explosive Residues

Matrix: Sediment

Analyte	CAS Number	Project Action Limit (ug/kg)	Project Action Limit Reference[1]	Project Quantitation Limit Goal[2] (ug/kg)	Laboratory-specific		
					LOQs (ug/kg)	LODs (ug/kg)	DLs (ug/kg)
1,3,5-Trinitrobenzene	99-35-4	220000	RSL Residential	110000	400	200	100
1,3-Dinitrobenzene	99-65-0	610	RSL Residential	305	400	200	100
2,4,6-Trinitrotoluene	118-96-7	3600	RSL Residential	1800	400	200	100
2,4-Dinitrotoluene	121-14-2	1600	RSL Residential	800	400	200	100
2,6-Dinitrotoluene	606-20-2	6100	RSL Residential	3050	400	200	100
2-Amino-4,6-dinitrotoluene	35572-78-2	15000	RSL Residential	7500	400	200	100
2-Nitrotoluene	88-72-2	2900	RSL Residential	1450	400	200	100
3-Nitrotoluene	99-08-1	610	RSL Residential	305	400	200	100
4-Amino-2,6-dinitrotoluene	19406-51-0	15000	RSL Residential	7500	400	200	100
4-Nitrotoluene	99-99-0	24000	RSL Residential	12000	400	200	100
HMX	2691-41-0	380000	RSL Residential	190000	400	200	100
Nitrobenzene	98-95-3	4800	RSL Residential	2400	400	200	100
Nitroglycerin	55-63-0	610	RSL Residential	305	1000	500	250
Pentaerythritol tetranitrate (PETN)	78-11-5	12000	RSL Residential	6000	1000	500	250
RDX	121-82-4	5600	RSL Residential	2800	400	200	100
Tetryl	479-45-8	24000	RSL Residential	12000	400	200	100
Perchlorate	14797-73-0	5500	RSL Residential	2750	5	2	0.600

Notes:
PAL and Project QL assumes dry weight basis.
[1] PALs were developed to be protective of human health and the environment.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Worksheets #10 and #11 for a detailed discussion on development of PALs.
The Residential Soil RSLs were adjusted from the USEPA Regional Screening Levels Table (June 2011).
NC = No Criteria

SAP Worksheet #15-5—Reference Limits and Evaluation Table for TOC in Sediment

Analyte	CAS Number	Project Action Limit (mg/kg)	Project Action Limit Reference[1]	Project Quantitation Limit Goal[2] (mg/kg)	Laboratory-specific		
					LOQs (mg/kg)	LODs (mg/kg)	DLs (mg/kg)
Total Organic Carbon	TOC[3]	NC	NA	500	1000	500	250

Notes:
PAL and Project QL assumes dry weight basis.
[1] PALs were developed to be protective of human health and the environment.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Worksheets #10 and #11 for a detailed discussion on development of PALs.
[3] Contractor-generated CAS number
NC – No Criteria
See **Worksheet #10 or #11**

SAP Worksheet #15-5A—QC Limits for TOC in Solid Samples

Analyte	CAS Number	MS/MSD and LCS Recoveries		
		LCL (%)	UCL (%)	RPD (%)
Total Organic Carbon	TOC[1]	80	120	20

Notes:
[1]Contractor-generated CAS number

SAP Worksheet #15-6—Reference Limits and Evaluation Table for Grain Size, Subsurface Soil

Analyte	CAS Number[1]	Laboratory-specific		
		LOQ (mm)	LOD (mm)	DL (mm)
GS03 Sieve 3" (75 mm)	SIEVE75.0	NA	NA	NA
GS05 Sieve 2" (50 mm)	SIEVE50.0	NA	NA	NA
GS06 Sieve 1.5" (37.5 mm)	SIEVE37.5	NA	NA	NA
GS07 Sieve 1" (25.0 mm)	SIEVE25.0	NA	NA	NA
GS08 Sieve 0.75" (19.0 mm)	SIEVE19.0	NA	NA	NA
GS10 Sieve 0.375" (9.5 mm)	SIEVE9.5	NA	NA	NA
Sieve No. 004 (4.75 mm)	SIEVE4.75	NA	NA	NA
Sieve No. 010 (2.00 mm)	SIEVE2.0	NA	NA	NA
Sieve No. 020 (850 um)	SIEVE850	NA	NA	NA
Sieve No. 040 (425 um)	SIEVE425	NA	NA	NA
Sieve No. 060 (250 um)	SIEVE250	NA	NA	NA
Sieve No. 080 (180 um)	SIEVE180	NA	NA	NA
Sieve No. 100 (150 um)	SIEVE150	NA	NA	NA
Sieve No. 200 (75um)	SIEVE75	NA	NA	NA

Notes:
[1] Contractor-generated CAS number
Grain size results will be used for site characterization and fate and transport properties.

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

Analytical Group: TAL Metals

Matrix: Groundwater

Analyte	CAS Number	Project Action Limit	Project Action Limit Reference[1]	Project Quantitation Limit Goal[2] (ug/L)	Laboratory-specific		
					LOQs (ug/L)	LODs (ug/L)	DLs (ug/L)
Aluminum	7429-90-5	1886	2x Base Background	943	200	100	50.0
Antimony	7440-36-0	1.5	RSL	0.75	10	8.00	5.00
Arsenic	7440-38-2	0.045	RSL	0.0225	10.0	6.00	3.00
Barium	7440-39-3	86.2	2x Base Background	43.1	40.0	10.0	5.00
Beryllium	7440-41-7	0.308	2x Base Background	0.154	5.00	2.00	1.00
Cadmium	7440-43-9	0.358	2x Base Background	0.179	5.00	2.00	1.00
Calcium	7440-70-2	69078	2x Base Background	34539	5000	2000	1000
Chromium	7440-47-3	0.043	RSL	0.0215	10.0	4.00	2.00
Cobalt	7440-48-4	1.1	RSL	0.55	12.5	10.0	5.00
Copper	7440-50-8	2.76	2x Base Background	1.38	10.0	8.00	4.00
Lead	7439-92-1	2.8	2x Base Background	1.4	3.00	3.00	1.50
Magnesium	7439-95-4	6363	2x Base Background	3181.5	5000	3000	1000
Manganese	7439-96-5	50	NC2L	25	15.0	6.00	3.00
Mercury	7439-97-6	0.1	2x Base Background	0.05	0.20	0.20	0.0800
Nickel	7440-02-0	7.97	2x Base Background	3.985	10.0	6.00	3.00
Potassium	7440-09-7	3277	2x Base Background	1638.5	5000	3000	1000
Selenium	7782-49-2	3.14	2x Base Background	1.57	10	5.00	3.00
Silver	7440-22-4	0.77	2x Base Background	0.385	10.0	2.00	1.00
Sodium	7440-23-5	22508	2x Base Background	11254	5000	3000	1000
Thallium	7440-28-0	0.037	RSL	0.037	8.00	4.00	3.00
Vanadium	7440-62-2	4.72	2x Base Background	2.36	12.5	10.0	5.00
Zinc	7440-66-6	42.1	2x Base Background	21.05	20.0	10.0	5.00

Notes:
[1] PALs were developed to be protective of human health and the environment.[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Worksheets #10 and #11 for a detailed discussion on development of PALs.
Base Background values are two times the mean background concentrations at MCB CamLej.
Tap Water RSLs were adjusted from the USEPA Regional Screening Levels Table (June 2011).
NC2L values are from the North Carolina Administrative Code (NCAC) 2L Groundwater Quality Standards (January 2010).
Shading represents cases where the PAL or Project QL goal is lower than the laboratory LOD. In these instances the laboratory LOD will be used as the default PAL.

SAP Worksheet #15-7A—QC Limits for Metals in Aqueous Samples

Analyte	CAS #	MS/MSD and LCS Recoveries		
		LCL (%)	UCL (%)	RPD (%)
Aluminum	7429-90-5	80	120	20
Antimony	7440-36-0	80	120	20
Arsenic	7440-38-2	80	120	20
Barium	7440-39-3	80	120	20
Beryllium	7440-41-7	80	120	20
Cadmium	7440-43-9	80	120	20
Calcium	7440-70-2	80	120	20
Chromium	7440-47-3	80	120	20
Cobalt	7440-48-4	80	120	20
Copper	7440-50-8	80	120	20
Iron	7439-89-6	80	120	20
Lead	7439-92-1	80	120	20
Magnesium	7439-95-4	80	120	20
Manganese	7439-96-5	80	120	20
Mercury	7439-97-6	80	120	20
Nickel	7440-02-0	80	120	20
Potassium	7440-09-7	80	120	20
Selenium	7782-49-2	80	120	20
Silver	7440-22-4	80	120	20
Sodium	7440-23-5	80	120	20
Thallium	7440-28-0	80	120	20
Vanadium	7440-62-2	80	120	20
Zinc	7440-66-6	80	120	20

SAP Worksheet #15-8—Reference Limits and Evaluation Table for Explosives Residues in Groundwater

Analytical Group: Explosive Residues
Matrix: Groundwater

Analyte	CAS Number	Project Action Limit (ug/L)	Project Action Limit Reference[1]	Project Quantitation Limit Goal[2] (ug/L)	Laboratory-specific		
					LOQs (ug/L)	LODs (ug/L)	DLs (ug/L)
1,3,5-Trinitrobenzene	99-35-4	110	RSL	55	0.320	0.160	0.0800
1,3-Dinitrobenzene	99-65-0	0.37	RSL	0.185	0.320	0.160	0.0800
2,4,6-Trinitrotoluene	118-96-7	1.8	RSL	0.9	0.320	0.160	0.0800
2,4-Dinitrotoluene	121-14-2	0.22	RSL	0.11	0.320	0.160	0.0800
2,6-Dinitrotoluene	606-20-2	3.7	RSL	1.85	0.320	0.160	0.0800
2-Amino-4,6-dinitrotoluene	35572-78-2	7.3	RSL	3.65	0.320	0.160	0.0800
2-Nitrotoluene	88-72-2	0.31	RSL	0.155	0.320	0.160	0.0800
3-Nitrotoluene	99-08-1	0.37	RSL	0.185	0.320	0.160	0.0800
4-Amino-2,6-dinitrotoluene	19406-51-0	7.3	RSL	3.65	0.320	0.160	0.0800
4-Nitrotoluene	99-99-0	4.2	RSL	2.1	0.320	0.160	0.0800
HMX	2691-41-0	180	RSL	90	0.320	0.160	0.0800
Nitrobenzene	98-95-3	0.12	RSL	0.06	0.320	0.160	0.0800
Nitroglycerin	55-63-0	0.37	RSL	0.185	0.800	0.400	0.200
Pentaerythritol tetranitrate (PETN)	78-11-5	7.3	RSL	3.7	0.800	0.400	0.200
RDX	121-82-4	0.61	RSL	0.305	0.320	0.160	0.0800
Tetryl	479-45-8	15	RSL	7.5	0.320	0.160	0.0800
Perchlorate	14797-73-0	2.6	RSL	1.3	0.5	0.2	0.0660

Notes:
PAL and Project QL assumes dry weight basis.
[1] PALs were developed to be protective of human health and the environment.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Worksheets #10 and #11 for a detailed discussion on development of PALs.
Tap Water RSLs were adjusted from the USEPA Regional Screening Levels Table (June 2011).
NC = No Criteria
Shading represents cases where the PAL or Project QL goal is lower than the laboratory LOD. In these instances the laboratory LOD will be used as the default PAL.

SAP Worksheet #15-8A—QC Limits for Explosives Residues in Aqueous Samples

Analyte	CAS #	MS/MSD and LCS Recoveries		
		LCL (%)	UCL (%)	RPD (%)
1,3,5-Trinitrobenzene	99-35-4	65	140	30
1,3-Dinitrobenzene	99-65-0	45	160	30
2,4,6-Trinitrotoluene	118-96-7	50	145	30
2,4-Dinitrotoluene	121-14-2	60	135	30
2,6-Dinitrotoluene	606-20-2	60	135	30
2-Amino-4,6-dinitrotoluene	35572-78-2	50	155	30
2-Nitrotoluene	88-72-2	45	135	30
3-Nitrotoluene	99-08-1	50	130	30
4-Amino-2,6-dinitrotoluene	19406-51-0	55	155	30
4-Nitrotoluene	99-99-0	50	130	30
HMX	2691-41-0	80	115	30
Nitrobenzene	98-95-3	50	140	30
Nitroglycerin	55-63-0	60	120	30
Pentaerythritol tetranitrate (PETN)	78-11-5	60	120	30
RDX	121-82-4	50	160	30
Tetryl	479-45-8	20	175	30
Perchlorate	14797-73-0	80	120	15

SAP Worksheet #15-9—Reference Limits and Evaluation Table for Metals in Surface Water

Analytical Group: TAL Metals, Dissolved Metals

Matrix: Surface Water

Analyte	CAS Number	Project Action Limit	Project Action Limit Reference[1]	Project Quantitation Limit Goal[2] (ug/L)	Laboratory-specific		
					LOQs (ug/L)	LODs (ug/L)	DLs (ug/L)
Aluminum	7429-90-5	3700	RSL	1850	200	100	50.0
Antimony	7440-36-0	1.5	RSL	0.75	10	8.00	5.00
Arsenic	7440-38-2	0.018	NRWQC	0.009	10.0	6.00	3.00
Barium	7440-39-3	730	RSL	365	40.0	10.0	5.00
Beryllium	7440-41-7	4	NRWQC	2	5.00	2.00	1.00
Cadmium	7440-43-9	1.8	RSL	0.9	5.00	2.00	1.00
Calcium	7440-70-2	NC	NA	2000	5000	2000	1000
Chromium	7440-47-3	0.043	RSL	0.0215	10.0	4.00	2.00
Cobalt	7440-48-4	1.1	RSL	0.55	12.5	10.0	5.00
Copper	7440-50-8	150	RSL	75	10.0	8.00	4.00
Lead	7439-92-1	300	NRWQC	150	3.00	3.00	1.50
Magnesium	7439-95-4	15	RSL	7.5	5000	3000	1000
Manganese	7439-96-5	NC	NA	6.00	15.0	6.00	3.00
Mercury	7439-97-6	50	NRWQC	25	0.20	0.20	0.0800
Nickel	7440-02-0	25	NC2B	12.5	10.0	6.00	3.00
Potassium	7440-09-7	NC	NA	3000	5000	3000	1000
Selenium	7782-49-2	18	RSL	9	10	5.00	3.00
Silver	7440-22-4	18	RSL	9	10.0	2.00	1.00
Sodium	7440-23-5	NC	NA	3000	5000	3000	1000
Thallium	7440-28-0	0.037	RSL	0.037	8.00	4.00	3.00
Vanadium	7440-62-2	18	RSL	9	12.5	10.0	5.00
Zinc	7440-66-6	1100	RSL	550	20.0	10.0	5.00

Notes:
[1] PALs were developed to be protective of human health and the environment.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Worksheets #10 and #11 for a detailed discussion on development of PALs.
Tap Water RSLs were adjusted from the USEPA Regional Screening Levels Table (June 2011).
NRWQC values are from EPA's National Recommended Water Quality Criteria.
NC2B – North Carolina 2B Water Supply value
Shading represents cases where the PAL or Project QL goal is lower than the laboratory LOD. In these instances the laboratory LOD will be used as the default PAL.

SAP Worksheet #15-10—Reference Limits and Evaluation Table for Explosives Residues in Surface Water

Analyte	CAS Number	Project Action Limit (ug/L)	Project Action Limit Reference[1]	Project Quantitation Limit Goal[2] (ug/L)	Laboratory-specific		
					LOQs (ug/L)	LODs (ug/L)	DLs (ug/L)
1,3,5-Trinitrobenzene	99-35-4	110	RSL	55	0.320	0.160	0.0800
1,3-Dinitrobenzene	99-65-0	0.37	NA	0.185	0.320	0.160	0.0800
2,4,6-Trinitrotoluene	118-96-7	1.8	RSL	0.9	0.320	0.160	0.0800
2,4-Dinitrotoluene	121-14-2	0.11	NRWQC	0.055	0.320	0.160	0.0800
2,6-Dinitrotoluene	606-20-2	3.7	RSL	1.85	0.320	0.160	0.0800
2-Amino-4,6-dinitrotoluene	35572-78-2	7.3	RSL	3.65	0.320	0.160	0.0800
2-Nitrotoluene	88-72-2	0.31	RSL	0.155	0.320	0.160	0.0800
3-Nitrotoluene	99-08-1	0.37	RSL	0.185	0.320	0.160	0.0800
4-Amino-2,6-dinitrotoluene	19406-51-0	7.3	RSL	3.65	0.320	0.160	0.0800
4-Nitrotoluene	99-99-0	4.2	RSL	2.1	0.320	0.160	0.0800
HMX	2691-41-0	180	RSL	90	0.320	0.160	0.0800
Nitrobenzene	98-95-3	0.12	RSL	0.06	0.320	0.160	0.0800
Nitroglycerin	55-63-0	0.37	RSL	0.185	0.800	0.400	0.200
Pentaerythritol tetranitrate (PETN)	78-11-5	7.3	RSL	3.7	0.800	0.400	0.200
RDX	121-82-4	0.61	RSL	0.305	0.320	0.160	0.0800
Tetryl	479-45-8	15	RSL	7.5	0.320	0.160	0.0800
Perchlorate	14797-73-0	2.6	RSL	1.3	0.5	0.2	0.0660

Notes:
PAL and Project QL assumes dry weight basis.
[1] PALs were developed to be protective of human health and the environment.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Worksheets #10 and #11 for a detailed discussion on development of PALs.
Tap Water RSLs were adjusted from the USEPA Regional Screening Levels Table (June 2011).
NRWQC values are from EPA's National Recommended Water Quality Criteria.
NC = No Criteria

SAP Worksheet #15-11—Reference Limits and Evaluation Table for TOC in Surface Water

Analyte	CAS Number	Project Action Limit (ug/L)	Project Action Limit Reference[1]	Project Quantitation Limit Goal[2] (ug/L)	Laboratory-specific		
					LOQs (ug/L)	LODs (ug/L)	DLs (ug/L)
Total Organic Carbon	TOC[3]	NC	NA	500	1000	500	250

Notes:
PAL and Project QL assumes dry weight basis
[1] PALs were developed to be protective of human health and the environment.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Worksheets #10 and #11 for a detailed discussion on development of PALs.
[3] Contractor-generated CAS number
NC = No Criteria

SAP Worksheet #15-11A—QC Limits for TOC in Aqueous Samples

Analyte	CAS Number	MS/MSD and LCS Recoveries		
		LCL (%)	UCL (%)	RPD (%)
Total Organic Carbon	TOC[1]	80	120	20

Notes:
[1] Contractor-generated CAS number

SAP Worksheet #15-12—Reference Limits and Evaluation Table for Hardness in Surface Water

Analyte	CAS Number	Laboratory-specific		
		LOQs (ug/L)	LODs (ug/L)	DLs (ug/L)
Hardness*	Hardness	12500	5000	2500

Notes:
PAL and Project QL assumes dry weight basis.
[1] PALs were developed to be protective of human health and the environment.
[2] PQL Goals were determined on a case by case basis and in most cases are at least 2 times less than the PAL.
Refer to Worksheets #10 and #11 for a detailed discussion on development of PALs.
*as CaCO3

SAP Worksheet #15-12A—QC Limits for Hardness in Aqueous Samples

Analyte	CAS Number	MS/MSD and LCS Recoveries		
		LCL (%)	UCL (%)	RPD (%)
Hardness*	Hardness	80	120	20

Notes:
*as CaCO3

SAP Worksheet #16—Project Schedule/Timeline Table

Activities	Organization	Dates (MM/DD/YY)		Deliverable	Deliverable Due Date
		Anticipated Date(s) of Initiation	Anticipated Date of Completion		
Work Plan preparation	CH2M HILL	9/1/10	6/23/11	Draft UFP SAP	6/23/11
Work Plan reviewed by Navy	Navy	6/24/11	7/24/11	Comments	
Work Plan – address Navy comments	CH2M HILL	8/23/11	8/29/11	Draft UFP SAP	8/29/11
Work Plan Review and Approval by Regulatory Agencies	NC DENR, EPA Region IV	8/31/11	12/1/11	Comments	
Comment resolution	Navy, CH2M HILL	12/1/11	12/9/2011	Draft UFP SAP	12/9/11
Final acceptance	Navy, NC DENR, EPA Region IV	12/12/11	3/15/11	Final UFP SAP	3/15/12
Subcontracting	CH2M HILL	11/15/10	11/30/11	Subcontractor Contracts	
Surveying and Veg. Clearance	Subcontractor w/ CH2M HILL	12/10/11	12/10/11	Clearance and surveying	
Field sampling activities	CH2M HILL	12/10/11	3/21/12	Environ. Samples	
Laboratory analyses and data validation	CH2M HILL	12/24/11	3/31/12	Analytical and DV Reports	4/1/12
Data management and report preparation	CH2M HILL	1/2/12	5/31/12	PA/SI Draft Report	5/31/12

This page intentionally left blank.

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 preliminary investigation of environmental media that may have been impacted by munitions constituents. The objectives of this PA/SI are to evaluate whether CERCLA-related releases of MC have occurred and if so, whether the releases warrant further investigation or action.

The site investigation will draw upon historical information and the results of the previous and ongoing investigations to guide the selection of areas for sample collection. The subsurface soil and groundwater sampling locations are based upon known burial sites and geophysical anomalies where MEC items have been discovered during previous investigations.

Sample Matrices: Sample matrices will include subsurface soil, groundwater, surface water, and sediment.

Analytical Groups: The target analytical groups will be Explosives Residues, PETN, nitroglycerine, TAL Metals (aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, cyanide, iron, lead, magnesium, manganese, mercury, nickel, potassium, selenium, silver, sodium, thallium, vanadium, and zinc), perchlorate, total organic carbon and hardness (for surface water) and grain size (for sediment).

The rationale for the selection of the target analytical groups is that the scope of work for examining Site UXO-22 is based upon its former use as a munitions disposal area.

Site Sample Numbers and Locations: For Site UXO-22, the sampling approach, the rationale for the matrices to be sampled, the number of samples per matrix, the analytical groups, and the relevant concentration action levels are discussed in Worksheets #10, #11, #14 and #15 and in the below table. Sample location figures are provided in Worksheet #10. Exact sampling locations will be determined in the field during the site reconnaissance conducted by CH2M HILL staff, and may be re-located to avoid site obstructions, if present. Site sampling locations were agreed upon by the project team.

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

This page intentionally left blank.

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

Site UXO-22

Matrix	Depth of Samples	Analysis	Method	Number of Samples	Rationale	Sampling Strategy
Monitoring Well Locations - Groundwater Data	Middle of well screen	Explosives Residues (including PETN and Nitroglycerin)	SW-846 USEPA Method 8330/8332	7	Evaluate if groundwater quality has been impacted by potential releases into surficial aquifer. The well locations will be hydraulically downgradient of trenches and test pits containing MEC. Sample locations were agreed upon by the project team.	See **Figure 10-4** for proposed sampling locations.
		Perchlorate	SW-846 USEPA Method 6850	7		
		TAL Metals	SW-846 USEPA Method 6010B	7		
Subsurface Soil Samples- Soil Data	Immediately above the water table at each sampling location; or test pit floor and sidewall samples	Explosives Residues(including PETN and Nitroglycerin)	SW-846 USEPA Method 8330/8332	10 from Soil Borings Up to 30 from Test Pits	Evaluate if subsurface soils have been impacted by potential buried materials. MC contamination may have leached into surrounding subsurface soils. The number of proposed subsurface soil samples provides a suitable quality control check of subsurface soil conditions, and was agreed upon by the project team.	See **Figure 10-4** for proposed Soil Boring sampling locations and **Figure 10-5** for Test Pit/Excavation Locations if MEC is encountered.
		Perchlorate	SW-846 USEPA Method 6850	10 from Soil Borings Up to 30 from Test Pits		
		TAL Metals	SW-846 USEPA Method 6010B	10 from Soil Borings Up to 30 from Test Pits		
Sediment Data	0 – 2 inches into the surface water/soil interface if free standing water is present	Explosives Residues (including PETN and Nitroglycerin)	SW-846 USEPA Method 8330/8332	4	Evaluate if sediment has been impacted by contaminated runoff or shallow groundwater discharging in the ravine.	See **Figure 10-4** for proposed sampling locations.
		Perchlorate	SW-846 USEPA Method 6850	4		
		TAL Metals	SW-846 USEPA Method 6010B	4		
		Grain Size	ASTM D422-63	4		

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

Site UXO-22

Matrix	Depth of Samples	Analysis	Method	Number of Samples	Rationale	Sampling Strategy
Surface Water Data	Samples will be collected directly from the surface water at each sampling location	Explosives Residues (including PETN and Nitroglycerin)	SW-846 USEPA Method 8330/8332	4	Evaluate if surface water has been impacted by contaminated runoff or shallow groundwater discharging in the ravine. Dissolved metals results will be used for ecological risk screening purposes.	See **Figure 10-4** for proposed sampling locations.
		Perchlorate	SW-846 USEPA Method 6850	4		
		TAL Metals	SW-846 USEPA Method 6010B	4		
		Dissolved Metals	SW-846 USEPA Method 6010B	4		
		Total Organic Carbon	USEPA Method 415.3	4		
		Hardness	USEPA 200.7	4		

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

Sample ID & Location[1]	Matrix	Analytical Group	Number of Samples	Sampling SOP Reference
Site UXO-22				See Worksheet #21
MR22-IS01-11A through MR22-IS50-11A	Subsurface Soil	Explosives Residues, Perchlorate and Metals	40	
MR22-MW01-10B through MR22-MW10-11A	Groundwater	Explosives Residues, Perchlorate and Metals	7	
MR22-SD01-01-11A through MR22-SD04-11A	Sediment	Explosives Residues, Perchlorate, Metals, Grain Size	4	
MR22-SW01-01-11A through MR22-SW04-11A	Surface Water	Explosives Residues, Perchlorate, TAL Metals, Dissolved Metals, TOC, Hardness	4	

Notes:
[1] Refer to **Worksheet #10** for sample locations.

This page intentionally left blank.

SAP Worksheet #19—Analytical SOP Requirements Table

Matrix	Analytical Group	Analytical and Preparation Method/SOP Reference	Containers	Sample Volume	Preservation Requirements	Maximum Holding Time
Sediment, Subsurface Soil	TAL Metals	SW-846 6010B/SOP100, 105	(1) 4-oz glass	2 g (grams)	Cool to 4°C	180 days to analysis
	Mercury	SW-846 7471A/SOP104	(1) 4-oz glass (above)	0.3 g	Cool to 4°C	28 days to analysis
	Explosives Residues (including PETN and Nitroglycerin)	SW8330/SOP-327	4-ounce glass jar	2 g	Cool to 4oC	14 days until extraction/40 days to analysis
	Perchlorate	SW-846 6850/SOP-239	4 ounce glass	1 g	Cool to 4o Centigrade	28 days
Sediment	TOC	Lloyd Kahn/SOP221	(1) 4-oz glass (above)	0.25 g	Cool to 4°C	14 days to analysis
	Grain Size	ASTM D422	(2) 16-oz plastic	1000 g minimum	None	NA
Groundwater, Surface Water	TAL Metals	SW6010B/SOP-100,105	500 mL plastic	50 mL	HNO3 to a pH<2; Cool to 4°C	180 days to analysis
	Mercury	SW-846 7470A/SOP104	500 mL plastic	30 mL	HNO3 to a pH<2; Cool to 4°C	28 days to analysis
	Explosives Residues (including PETN and Nitroglycerin)	SW8330A/SOP-327	Two 1-liter glass amber bottles	1000 mL	Cool to 4°C	7 days until extraction/40 days to analysis
	Perchlorate	SW-846 6850/SOP-239	250 ml plastic	10 mL	Cool to 4°C	28 days
Surface Water	TOC	SW-846 9060/SOP-221	250mL poly	5 mL	H2SO4 or HCl to pH 2	28 days
	Hardness	EPA 200.7/SOP-105	500 mL plastic	50 mL	HNO3 to a pH<2; Cool to 4°C	180 days to analysis
	Dissolved Metals	SW6010B/SOP-100,105	500 mL plastic	50 mL	HNO3 to a pH<2; Cool to 4°C	180 days to analysis

Notes:
Sample container, and volume requirements are specified by the analytical laboratory performing the tests.
Three times the required volume should be collected for samples designated as MS/MSD samples.
Maximum holding time is calculated from the time the sample is collected to the time the sample is prepared/extracted (not VTSR).

This page intentionally left blank.

SAP Worksheet #20—Field Quality Control Sample Summary Table

Matrix	Analytical Group	No. of Sampling Locations	No. of Field Duplicates	No. of MS/MSDs[1]	No. of Field Blanks	No. of Equip. Blanks	No. of VOA Trip Blanks	Total No. of Samples to Lab
Site UXO-22								
Groundwater	Perchlorate	7	1	1/1	1	2	0	13
	Explosives Residues (including PETN and Nitroglycerin)	7	1	1/1	1	2	0	13
	Total Metals	7	1	1/1	1	2	0	13
Subsurface Soil	Perchlorate	40	4	3/3	1	5	0	56
	Explosives Residues (including PETN and Nitroglycerin)	40	4	3/3	1	5	0	56
	Total Metals	40	4	3/3	1	5	0	56
Surface Water	Perchlorate	4	1	1/1	1	1	0	9
	Explosives Residues (including PETN and Nitroglycerin)	4	1	1/1	1	1	0	9
	Total Metals	4	1	1/1	1	1	0	9
	Dissolved Metals	4	1	1/1	1	1	0	9
Surface Water	TOC	4	0	0	0	0	0	4
Surface Water	Hardness	4	0	0	0	0	0	4
Sediment	Perchlorate	4	1	1/1	1	1	0	9
	Explosives Residues (including PETN and Nitroglycerin)	4	1	1/1	1	1	0	9
	Total Metals	4	1	1/1	1	1	0	9
Sediment	Grain Size	4	0	0	0	0	0	4

This page intentionally left blank.

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

This page intentionally left blank.

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	

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

This page intentionally left blank.

SAP Worksheet #23—Analytical SOP References Table

All SOPs from the laboratories are reviewed yearly. If no revisions are needed to the SOP, the revision date is not updated.

Lab SOP Number	Title, Revision Date, and/or Number	Definitive or Screening Data	Matrix and Analytical Group	Instrument	Variance to QSM	Organization Performing Analysis	Modified for Project Work?1 (y/n)
100	Metals Digestion/Preparation Methods 3005A, 3010A, 3020A, 3030, 3040A, 3050B USEPA CLPILMO 04.1 AQUEOUS & Soil/Sediment USEPA CLPILMO 05.2 Aqueous & Soil/Sediment, USEPA Method 200.7 (Standard Methods) 3030C, Rev22, 20101117	Definitive	Metals - Digestion	None	None	Empirical	N
103	Mercury Analysis in Water by Manual Cold Vapor Technique Methods USEPA SW846 7470A & 245.1 CLP-M 4.1, Rev19, 20101117	Definitive	Mercury	CVAA	None	Empirical	N
104	Mercury Analysis in Soil/Sediment by Manual Cold Vapor Technique Methods SW846 7471A, 7471B , 245.5 & CLPILM 04.1, Rev20, 20110516	Definitive	Mercury	CVAA	None	Empirical	N
105	Metals Analysis by ICP Technique Methods 200.7, (SW846) 6010B, (SW-846) 6010C, (SM 19th Edition 2340B) USEPA CLP ILMO 4, Rev17, 20110516	Definitive	Metals; hardness	ICP-AES	None	Empirical	N
221	Total Organic Carbon SM5310C, USEPA Method 415.1 and SW846 Method 9060/9060A and Lloyd Kahn Method, Rev9, 20100712	Screening	TOC	TOC Analyzer	None	Empirical	N
239	Perchlorate in Water, Soil, and Solid Waste Using High Performance Liquid Chromatography/Electrospray Ionization/Mass Spectrometry by SW846 Method 6850, Rev6, 20101117	Definitive	Organic/LC/MS	Agilent/LC/MS	None	Empirical	N
327	Nitroaromatics and Nitramines by High Performance Liquid Chromatography (HPLC) Method 8330, 8330A and 8332, Rev20, 20110514	Definitive	Explosives Residues, PETN, and Nitroglycerin	HPLC/Ultraviolet (UV)	None	Empirical	N
QS10	Laboratory Sample Receiving, Log In and Storage Rev17, 20110516	NA	Login and Storage	NA	None	Empirical	N
QS14	Waste Disposal, Rev 6 20100831	NA	Waste Disposal	n/a	None	Empirical	N
ASTM D 422	Particle-Size Analysis of Soils	NA	Grain Size	NA	None	TestAmerica Burlington	N

This page intentionally left blank.

SAP Worksheet #24—Analytical Instrument Calibration Table

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
CVAA (Mercury)	Initial Calibration (ICAL)	Beginning of each day or if QC exceeds criteria	Min 5 pt initial Calibration and a calibration blank Linear regression correlation coefficient >0.995	Correct problem, repeat ICAL	Lab Section Supervisor	SOP-103, 104
	Initial Calibration Verification (ICV)	Second source, once after each ICAL, prior to beginning a sample run	Analytes must agree within 10% of the expected value	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		
	Continuing Calibration Verification (CCV)	Every 10 samples and at the end of the analytical sequence	Analyte must agree within 20% of the expected value	Correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last acceptable CCV.		
	Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOD	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.		
ICP-AES (TAL Metals, hardness)	ICAL	Beginning of each day or if QC exceeds criteria	Minimum one high standard and a calibration blank. If 3 standards plus calibration blank, linear regression correlation coefficient >0.995.	Correct problem, repeat ICAL	Lab Section Supervisor	SOP-100, 105
	ICV	Second source, once after each ICAL, prior to beginning a sample run	Analytes must agree within 10% of the expected value	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		
	CCV	Every 10 samples and at the end of the analytical sequence	Analytes must agree within 10% of the expected value	Correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last acceptable CCV.		

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

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
ICP-AES (TAL Metals, hardness) (Con't)	High-level check standard	Every 6 months	Within 10% of true value	Correct problem, reanalyze		
	Low-level calibration check standard	Daily after ICAL	Analytes must agree within 20% of the true value	Correct problem, reanalyze		
	Calibration Blank	Before beginning a sample run, after every 10 samples, and at the end of the analysis sequence.	No analytes detected > LOD	Correct problem. Re-prep and reanalyze calibration blank. All samples following the last acceptable calibration blank must be reanalyzed.		
	Interference check solutions (ICS)	After beginning of the analytical run	ICS-A: Absolute value of concentration for all non-spiked analytes < LOD ICS-AB: Within 20% of true value	Terminate analysis; locate and correct problem; reanalyze ICS, reanalyze all samples.		
TOC analyzer (TOC)	ICAL	Quarterly	R ≥ 0.995	Correct problem and repeat ICAL.	Analyst/Laboratory Manager	SOP-221
	ICV/CCV	Beginning and end of analysis and every 10 samples	All target analytes within ± 15% of the true value.	Reprepare and reanalyze. If it fails again, repeat ICAL.		
HPLC (Explosives Residues including PETN and Nitroglycerin)	ICAL	Prior to sample analysis (5 point minimum)	Min 5 pt initial Calibration for all target analytes % relative standard deviation (%RSD) ≤20%; or Linear regression correlation coefficient ≥0.995; or Non-linear regression R-Squared (COD) ≥ 0.990 (6 pts for non-linear)	Correct problem, repeat ICAL	Lab Section Supervisor	SOP-327
	ICV	Immediately following ICAL	Analytes must be within 15% of the expected value	Correct problem, rerun ICV. If that fails, repeat ICAL.		
	CCV	Prior to sample analysis, after every 10 field samples, and at the end of the analysis sequence	The %D between the CFs in the initial and continuing calibrations must be ≤ 15%	Correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last acceptable CCV.		
	Retention time window position establishment for each analyte and surrogate	Once per ICAL and at the beginning of the analytical shift	Position shall be set using the midpoint standard of the ICAL curve when ICAL is performed. On days when ICAL is not performed, the initial CCV is used.	N/A		

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

Instrument	Calibration Procedure	Frequency of Calibration	Acceptance Criteria	Corrective Action (CA)	Person Responsible for CA	SOP Reference
LC/MS (Perchlorate)	Mass Calibration	Upon instrument set-up and as needed	±0.3 m/z of mass 83, 85, and 89	Correct the problem and recalibrate	Analyst/Lab Section Supervisor	SOP-239
	ICAL	Prior to sample analysis	RSD for each analyte ≤ 20% or r > 0.995. The concentration corresponding with the y-intercept must be ≤LOD.	Correct problem then repeat ICAL		
	ICV	After each ICAL; analysis of second source standard at midpoint of calibration	85-115% Recovery	Correct problem and verify second source standard. Rerun ICV. If that fails, correct problem and repeat ICAL.		
	CCV	At the beginning of the analytical sequence; after each 10 field samples; at the end of the analytical sequence	85-115% Recovery	If %D is high and sample result is ND, qualify/narrate with project approval. If %D is low or project approval not received, correct problem, rerun CCV. If that fails, then repeat ICAL. Reanalyze all samples since the last acceptable CCV.		
	Interference Check Sample (ICS)	One per batch of 20 samples; at least one 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 re-extract all samples in the batch. If column degradation is suspected, a new column must be calibrated before the samples can be reanalyzed.		
	Tuning	Prior to ICAL and after any mass calibration or maintenance is performed	Tuning standards must contain the analytes of interest and meet acceptance criteria in SOP	Retune instrument and perform instrument mass calibration if retune doesn't meet criteria.		
	LODV	Before and after each analytical batch	Within 30% of the true value.	Correct problem and rerun LODV and all samples with concentrations less than RL analyzed since the last successful LODV.		
Grain Size Scale	Standard Weight	Daily or before use	+/- 0.1%	Correct Problem and recalibrate	Lab supervisor	ASTM D 422

This page intentionally left blank.

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

Instrument/ Equipment	Maintenance Activity	Testing Activity	Inspection Activity	Frequency	Acceptance Criteria	Corrective Action	Responsible Person	SOP Reference
ICP-AES (TAL Metals, hardness)	Clean plasma torch; clean filters; clean spray and nebulizer chambers; replace pump tubing	Metals	Torch, filters, nebulizer chamber, pump, pump tubing	Maintenance is performed prior to initial calibration or as necessary.	See **Worksheet #24**	Repeat maintenance activity or remove from service.	Analyst/Supervisor	SOP-105
CVAA (Mercury)	Change the tubing, filter, clean windows, and check gas flow. Check the reagents and standards.	Mercury	Inspect the tubing, filter, and the optical cell	Maintenance is performed prior to initial calibration or as necessary.		Repeat maintenance activity or remove from service.	Analyst/Supervisor	SOP-103, 104
TOC analyzer (TOC)	Replace sample tubing, clean sample boat, replace syringe	TOC	Tubing, sample boat, syringe	As needed		Repeat maintenance activity or remove from service.	Analyst/Supervisor	SOP-221
LC/MS (Perchlorate)	Change analytical column as needed, change mobile phase when insufficient for run or contamination, change inlet filters as needed for contamination	Perchlorate	Check pump pressure, check for leaks, check for adequate mobile phase	Instrument receipt, instrument change (new column, etc.), when CCV does not meet criteria		Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data	Analyst/Supervisor	SOP-239

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
HPLC (Explosives Residues including PETN and Nitroglycerin)	Change analytical column as needed, change mobile phase when insufficient for run or contamination, change inlet filters as needed for contamination	Explosives Residues	Check pump pressure, check for leaks, check for adequate mobile phase	Prior to initial calibration or as necessary		Recalibrate and/or perform necessary equipment maintenance. Check calibration standards. Reanalyze affected data.	Analyst/Supervisor	SOP-327
Sieves, Balance, Hydrometer (Grain Size)	Balance scale daily, clean sieves daily, check hydrometer daily	Grain Size Analysis	Check balance, calibrate daily, check sieves for uniformity, check hydrometer daily			Recalibrate and/or perform necessary equip. maintenance. Check calibration standards.Reanalyze affected data.	Lab Supervisor	ASTM D 422

SAP Worksheet #26—Sample Handling System

Sample Handling System

SAMPLE COLLECTION, PACKAGING, AND SHIPMENT
Sample Collection (Personnel/Organization): FTL/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): Empirical Laboratories
Sample Custody and Storage (Personnel/Organization): Empirical Laboratories:
Sample Preparation (Personnel/Organization): Empirical Laboratories
Sample Determinative Analysis (Personnel/Organization): Empirical Laboratories
SAMPLE ARCHIVING
Field Sample Storage (No. of days from sample collection): 90 days
Sample Extract/Digestate Storage (No. of days from extraction/digestion): 1 year
Biological Sample Storage (No. of days from sample collection): n/a
SAMPLE DISPOSAL
Personnel/Organization: Empirical Laboratories
Number of Days from Analysis: 90 days from sample receipt

This page intentionally left blank.

SAP Worksheet #27—Sample Custody Requirements Table

Sample Labeling Procedures

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

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

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

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

Chain-of-custody Procedures

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

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

The laboratory receiving samples will comply with all sample custody requirements outlined in the laboratory SOPs referenced in Worksheet #23. The SOPs for documenting sample custody will be provided upon request.

All samples from Site UXO-22 will be shipped to Empirical Laboratories. Samples to be analyzed for Grain Size will be shipped by Empirical Laboratories to TestAmerica Burlington.

Sample Integrity

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

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

This page intentionally left blank.

SAP Worksheet #28-1—Laboratory QC Samples Table – Site UXO-22

Matrix	Sediment, Subsurface Soil
Analytical Group	TAL Metals
Analytical Method/SOP Reference	SW846 6010B, 7471A/100,104,105

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One is performed for each batch of up to 20 samples.	Target analytes must be ≤½ LOQ	Correct the problem; if required, reprep and reanalyze the method blank and all samples processed with the contaminated blank	Analyst/Laboratory Area Supervisor	Contamination/ Bias	Target analytes must be ≤½ LOQ
LCS		Percent recoveries must meet the control limits listed in Worksheet #15-1A	Re-prepare and analyze all associated samples.		Accuracy/Bias	Percent recoveries must meet the control limits listed in Worksheet #15-1A
MS/MSD		Percent recoveries must meet the control limits and RPD listed in Worksheet #15-1A	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	Percent recoveries must meet the control limits and RPD listed in Worksheet #15-1A
Serial Dilution(does not apply to Cold Vapor)	One is performed for each preparation batch with sample concentration(s) > 50x LOQ	The five-fold dilution result must agree within ± 10% of the original sample result.	Perform Post Digestion Spike		Precision/Accuracy	The five-fold dilution result must agree within ± 10% of the original sample result.
Post Digestion Spike (does not apply to Cold Vapor)	One is performed when serial dilution fails or analyte concentration(s) in all samples < 50x LOD.	The result must agree within ± 25% of expected result.	Run all associate sample in the preparatory batch by method of standard additions or qualify results.		Precision/Accuracy	The result must agree within ± 25% of expected result.

SAP Worksheet #28-2—Laboratory QC Samples Table - Site UXO-22

Matrix	Sediment, Subsurface Soil
Analytical Group	Explosives Residues including PETN and Nitroglycerin
Analytical Method/SOP Reference	SW846 8330A/327

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One is performed for each batch of up to 20 samples.	Target analytes must be ≤½ LOQ	Correct the problem; if required, reprep and reanalyze the method blank and all samples processed with the contaminated blank	Analyst/Laboratory Area Supervisor	Contamination/ Bias	Target analytes must be ≤½ LOQ
LCS		Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-2A	Re-prepare and analyze all associated samples if holding time remains. Discuss qualification with client.		Accuracy/Bias	Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-2A
MS/MSD		Percent recoveries must meet the control limits and RPD listed in Worksheet #15-2A	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	Percent recoveries must meet the control limits and RPD listed in Worksheet #15-2A
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%
Surrogates	All field and QC samples.	1-chloro-3-nitrobenzene Water 40%-145%, Soil 55%-140%	Re-prepare and reanalyze all failed samples in the associated preparatory batch for confirmation of matrix interference.		Accuracy/Bias	1-chloro-3-nitrobenzene Water 40%-145%, Soil 55%-140%

SAP Worksheet #28-3—Laboratory QC Samples Table - Site UXO-22

Matrix	Sediment, Subsurface Soil
Analytical Group	Perchlorate
Analytical Method/SOP Reference	SW-846 6850/239

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	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	Reextract 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	1 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 ICAL.	Reanalyze samples at increasing dilutions until the ± 50% criteria can be met		Precision/ Accuracy/Bias	Relative retention times for internal standard must be 0.98-1.02 and the responses within ± 50% of the average response of the ICAL.
Lab reagent blank	One per batch of 20 or less	No target compounds should be > ½ the LOQ	Re-clean, retest, re-extract, reanalyze, and/or qualify data		Bias/ Contamination	No target compounds should be > ½ the LOQ
Method blank		No target compounds should be > ½ the LOQ	Re-clean, retest, re-extract, reanalyze, and/or qualify data		Bias/ Contamination	No target compounds should be > ½ the LOQ
LCS		See Worksheet #15-2A	Evaluate and re-prepare/reanalyze the LCS and associated samples.		Precision/ Accuracy/Bias	See Worksheet #15-3A
MS/MSD		See Worksheet #15-2A	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	See Worksheet #15-3A

SAP Worksheet #28-4—Laboratory QC Samples Table - Site UXO-22

Matrix	Sediment, Subsurface Soil
Analytical Group	TOC
Analytical Method/SOP Reference	Lloyd Kahn/SOP-221

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One is performed for each batch of up to 20 samples.	Target analytes must be < ½ LOQ or <1/10 the concentration found in the sample or <1/10th the regulatory limit.	Re-prepare and analyze all associated samples. Discuss with client/qualify if re-extraction/re-analysis not feasible.	Analyst, Laboratory Supervisor	Contamination/ Bias	Target analytes must be < ½ LOQ or <1/10 the concentration found in the sample or <1/10th the regulatory limit.
Lab duplicate		RPD < 20%			Precision/ Accuracy	RPD < 20%
LCS		See Worksheet #15-5A			Accuracy/Bias	See Worksheet #15-5A

SAP Worksheet #28-5—Laboratory QC Samples Table - Site UXO-22

Matrix	Soil
Analytical Group	Grain Size
Analytical Method/SOP Reference	ASTM D422/SOP S3

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One per preparatory batch of up to 20 samples.	No analytes detected > 1/2 RL and greater than 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.	Correct the problem. If required, reprep and reanalyze the method blank and all samples processed with the contaminated blank.	Analyst/Laboratory Area Supervisor	Contamination/ Bias	No analytes detected > 1/2 RL and greater than 1/10 the regulatory limit (whichever is greater). Blank result must not otherwise affect sample results.
Sample Duplicate (DUP)	One per preparatory batch of up to 20 samples.	Use in-house recovery limits for LCS. RPD $\leq$ 20% (between sample and sample duplicate).	Examine results of LCS. If both the LCS and Sample/DUP are unacceptable, re-prepare and analyze the associated samples and QC, otherwise report and narrate.	Analyst/Laboratory Area Supervisor	Precision/ Accuracy/Bias	Use in-house recovery limits for LCS. RPD < 20% (between sample and sample duplicate).

SAP Worksheet #28-6—Laboratory QC Samples Table - Site UXO-22

Matrix	Soil
Analytical Group	Grain Size
Analytical Method/SOP Reference	ASTM D422/SOP S3

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One is performed for each batch of up to 20 samples.	Target analytes must be ≤½ LOQ	Correct the problem; if required, reprep and reanalyze the method blank and all samples processed with the contaminated blank	Analyst/Laboratory Area Supervisor	Contamination/ Bias	Target analytes must be ≤½ LOQ
LCS		Percent recoveries must meet the control limits listed in Worksheet #15-7A	Re-prepare and analyze all associated samples.		Accuracy/Bias	Percent recoveries must meet the control limits listed in Worksheet #15-7A
MS/MSD		Percent recoveries must meet the control limits and RPD listed in Worksheet #15-7A	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	Percent recoveries must meet the control limits and RPD listed in Worksheet #15-7A
Serial Dilution(does not apply to Cold Vapor)	One is performed for each preparation batch with sample concentration(s) > 50x LOQ	The five-fold dilution result must agree within ± 10% of the original sample result.	Perform Post Digestion Spike		Precision/ Accuracy	The five-fold dilution result must agree within ± 10% of the original sample result.
Post Digestion Spike (does not apply to Cold Vapor)	One is performed when serial dilution fails or analyte concentration(s) in all samples < 50x LOD.	The result must agree within ± 25% of expected result.	Run all associate sample in the preparatory batch by method of standard additions or qualify results.		Precision/ Accuracy	The result must agree within ± 25% of expected result.

SAP Worksheet #28-7—Laboratory QC Samples Table - Site UXO-22

Matrix	Groundwater, Surface Water,
Analytical Group	Explosives Residues including PETN and Nitroglycerin
Analytical Method/SOP Reference	SW846 8330A/327

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One is performed for each batch of up to 20 samples.	Target analytes must be ≤½ LOQ	Correct the problem; if required, reprep and reanalyze the method blank and all samples processed with the contaminated blank	Analyst/Laboratory Area Supervisor	Contamination/ Bias	Target analytes must be ≤½ LOQ
LCS		Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-8A	Re-prepare and analyze all associated samples if holding time remains. Discuss qualification with client.		Accuracy/Bias	Contains all target analytes. Percent recoveries must meet the control limits listed in Worksheet #15-8A
MS/MSD		Percent recoveries must meet the control limits and RPD listed in Worksheet #15-8A	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	Percent recoveries must meet the control limits and RPD listed in Worksheet #15-8A
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%
Surrogates	All field and QC samples.	1-chloro-3-nitrobenzene Water 40%-145%, Soil 55%-140%	Re-prepare and reanalyze all failed samples in the associated preparatory batch for confirmation of matrix interference.		Accuracy/Bias	1-chloro-3-nitrobenzene Water 40%-145%, Soil 55%-140%

SAP Worksheet #28-8—Laboratory QC Samples Table - Site UXO-22

Matrix	Groundwater, Surface Water
Analytical Group	Perchlorate
Analytical Method/SOP Reference	SW-846 6850/239

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	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	Reextract 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	1 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 ICAL.	Reanalyze samples at increasing dilutions until the ± 50% criteria can be met		Precision/ Accuracy/Bias	Relative retention times for internal standard must be 0.98-1.02 and the responses within ± 50% of the average response of the ICAL.
Lab reagent blank	One per batch of 20 or less	No target compounds should be > ½ the LOQ	Re-clean, retest, re-extract, reanalyze, and/or qualify data		Bias Contamination	No target compounds should be > ½ the LOQ
Method blank		No target compounds should be > ½ the LOQ	Re-clean, retest, re-extract, reanalyze, and/or qualify data		Bias/ Contamination	No target compounds should be > ½ the LOQ
LCS		See Worksheet #15-8A	Evaluate and re-prepare/ reanalyze the LCS and associated samples.		Precision/ Accuracy/Bias	See Worksheet #15-8A
MS/MSD		See Worksheet #15-8A	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	See Worksheet #15-8A

SAP Worksheet #28-9—Laboratory QC Samples Table - Site UXO-22

Matrix	Groundwater, Surface Water
Analytical Group	TOC
Analytical Method/SOP Reference	SW846 9060/SOP-221

QC Sample:	Frequency/ Number	Method/SOP QC Acceptance Limits	Corrective Action	Person(s) Responsible for Corrective Action	Data Quality Indicator (DQI)	Measurement Performance Criteria
Method Blank	One is performed for each batch of up to 20 samples.	Target analytes must be < ½ LOQ or <1/10 the concentration found in the sample or <1/10th the regulatory limit.	Re-prepare and analyze all associated samples. Discuss with client/qualify if re-extraction/re-analysis not feasible.	Analyst/Laboratory Manager	Contamination/ Bias	Target analytes must be < ½ LOQ or <1/10 the concentration found in the sample or <1/10th the regulatory limit.
Lab duplicate		RPD < 20%			Precision/ Accuracy	RPD < 20%
LCS		See Worksheet #15-11A			Accuracy/Bias	See Worksheet #15-11A

This page intentionally left blank.

SAP Worksheet #29—Project Documents and Records Table

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

Notes:
Sample collection documents and records will be scanned and saved on the network server. Field parameters will be loaded into the database using the FDE Tool.
Off-site analysis documents and records will be archived after a period of 6 months. Hardcopy deliverables from the data validator will be archived. Data assessment documents and records will be archived as described above. All archived documents will be archived with Iron Mountain Inc., headquartered at 745 Atlantic Avenue, Boston, MA 02111.

This page intentionally left blank.

SAP Worksheet #30—Analytical Services Table

Matrix	Analytical Group	Sample Locations/ID Number	Analytical Method	Data Package Turnaround Time	Laboratory/Organization[1]	Backup Laboratory/ Organization[1]
Groundwater, Surface Water for Site UXO-22	Explosives Residues (including PETN and Nitroglycerin)	See Worksheet #18	SW846 8330	28 calendar days	Empirical Laboratories Sonya Gordon 621 Mainstream Drive, Suite 270 Nashville, TN 37228 (615) 345-1115	TBD
	Perchlorate		SW846 6850			
Surface Water for Site UXO-22	TOC		SW846 9060			
	Hardness		EPA 200.7			
	Total/Dissolved Metals		SW846 6010B/7470A			
Subsurface Soil, Sediment for Site UXO-22	Explosives Residues (including PETN and Nitroglycerin)		SW846 8330			
	Perchlorate		SW846 6850			
	Total Metals		SW846 6010B/7471A			
Sediment for Site UXO-22	TOC		Lloyd Kahn			
	Grain Size		ASTM D422		Test America – Burlington 30 Community Drive, Suite 11 South Burlington, VT 05403 (802) 923-1028	

Notes:
[1]If circumstances arise that render a lab unable to provide analytical services, a backup laboratory will be chosen at that time.

This page intentionally left blank.

SAP Worksheet #31—Planned Project Assessments Table

Assessment Type	Frequency	Internal or External	Organization Performing Assessment	Person(s) Responsible for Performing Assessment	Person(s) Responsible for Responding to Assessment Findings	Person(s) Responsible for Identifying and Implementing CA	Person(s) Responsible for Monitoring Effectiveness of CA
Field Performance Audit	One during sampling activities	Internal	CH2M HILL	Bill Schmithorst Project Manager CH2M HILL	Field Team Leader CH2M HILL	Bill Schmithorst Project Manager CH2M HILL	Bill Schmithorst Project Manager CH2M HILL
Offsite Laboratory Technical Systems Audit	Laboratories will be operating under a current DoD ELAP accreditation letter. The laboratory must be re-evaluated prior to expiration of period of performance	External	Third Party Accrediting Body	TBD, Third Party Accrediting Body	Empirical Laboratories	Empirical Laboratories QA Officer	Anita Dodson, Program Chemist, CH2M HILL
Safe Behavior Observation	One/week during field activities	Internal	CH2M HILL	Site Safety Coordinator CH2M HILL	Field Team Member observed CH2M HILL	Carl Woods H&S Manager CH2M HILL	Site Safety Coordinator CH2M HILL

This page intentionally left blank.

SAP Worksheet #32—Assessment Findings and Corrective Action Responses

Assessment Type	Nature of Deficiencies Documentation	Individual(s) Notified of Findings	Timeframe of Notification	Nature of 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	Empirical Laboratories QA Officer	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

This page intentionally left blank.

SAP Worksheet #32-1—Corrective Action 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)**

_____

_____

_____

_____

_____

CA implemented by: _____ Date: _____

CA initially approved by: _____ Date: _____

Follow-up date: _____

Final CA approved by: _____ Date: _____

Information copies to:

Anita Dodson, CH2M HILL Navy CLEAN Program Chemist

_____

_____

This page intentionally left blank.

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 _____

_____

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

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

Comments _____

_____

Yes _ No _ 7) Are photographs taken and documented?

Comments _____

_____

Document Control

Yes _ No _ 1) Have any accountable documents been lost?

Comments _____

_____

Yes _ No _ 2) Have any accountable documents been voided?

Comments _____

_____

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

Comments _____

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

Comments _____

_____

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

Comments _____

_____

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

Comments _____

_____

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

Comments _____

_____

SAP Worksheet #33—QA Management Reports Table

Project-Specific SAP
Site 35 Comprehensive Groundwater Sampling
Marine Corps Base Camp Lejeune

Draft SAP
Revision Number:
Revision Date:

Type of Report	Frequency	Projected Delivery Date(s)	Person(s) Responsible for Report Preparation	Report Recipient(s)
Field Audit Report	One during sampling activities	Submitted with Final Report	Bill Schmithorst Project Manager CH2M HILL	Included in project files.

This page intentionally left blank.

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

Verification (Step I) Process Table

Verification Input	Description	Internal/ External	Responsible for Verification
Chain of Custody and shipping forms	CoC 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 CoC will be initialed by the reviewer, a copy of the CoC retained in the site file, and the original and remaining copies taped inside the cooler for shipment. See CoC SOP (on CD) for further details.	Internal	FTL CH2M HILL
Planning Documents	Evidence of approval and completeness of UFP-SAP.	Internal	Bill Schmithorst CH2M HILL
Field Log Notebooks	Field notes will be reviewed to ensure completeness of field data parameters, shipping information, sample collection times, etc. The logbook will also be used to document, explain, and justify all deviations from the approved UFP-SAP.	Internal	Bill Schmithorst CH2M HILL
QC Summary Report	A summary of all QC sample results will be verified for completeness once the data is received from the laboratory.	External	Troy Horn CH2M HILL
Chain of Custody Documentation	Upon their arrival at the laboratory, the samples will be cross-referenced against the COC records. All sample labels will be checked against the COC, and any mislabeling will be identified, investigated, and corrected. The samples will be logged in at every storage area and work station required by the designated analyses. Individual analysts will verify the completeness and accuracy of the data recorded on the forms.	Internal	Empirical Laboratory
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 unadjusted residential risk-based concentration (RBC) and Biological Technical Assistance Group (BTAG) flora and fauna screening values.	Internal	Bill Schmithorst CH2M HILL

This page intentionally left blank.

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

Step IIa/IIb	Validation Input	Description	Responsible for Validation
IIa	SOPs	Review field logbooks, laboratory case narratives, data deliverables for compliance to methods.	Bianca Kleist/CH2M HILL EDS
IIa	QC Results	Establish that all QC samples were run and compliant with method-required limits.	EDS
IIb	QC Results	Verify that QC samples were run and compliant with limits established in the UFP-SAP.	Bianca Kleist/CH2M HILL EDS
IIb	Project Quantification Limits	Ensure all sample results met the project quantification and action limits specified in the SAP.	Bill Schmithorst, Bianca Kleist/CH2M HILL
IIb	Raw data	10% review of raw data to confirm laboratory calculations.	EDS

This page intentionally left blank.

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

Step IIa/IIb	Matrix	Analytical Group	Validation Criteria	Data Validator
IIa	GW, SW, SB, SD	TAL Metals; Explosives Residues including PETN and Nitroglycerin, Perchlorate	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, Multi-Media, Multi-Concentration* (October 1999) and *National Functional Guidelines for Inorganic Data Review* (October 2004). National Functional Guidelines will not be used for data 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.	EDS
IIb	GW, SW, SB, SD	TAL Metals; Explosives Residues including PETN and Nitroglycerin, Perchlorate; TOC, hardness, and grains-size.	Action levels in Worksheet #15. See Method calibration and QC criteria in **Worksheets #24** and **#28**.	Anita Dodson Bill Schmithorst CH2M HILL

This page intentionally left blank.

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

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

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

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

- Data tables will be produced to reflect detected and non-detected site COC's and geochemical parameters. Data qualifiers will be reflected in the tables and discussed in the data quality evaluation.
- Figures will be produced to reflect areas of investigation including environmental sampling locations and results.
- A data quality evaluation will be provided as part of the technical memorandum prepared to assess remedy effectiveness.
- If needed a technical memorandum will be produced that will identify any data usability limitations and make recommendations for corrective action.

Identify the personnel responsible for performing the usability assessment.

The CH2M HILL team, including the Project Manager and Project Chemist, will review the data and compile a presentation for the Tier I Project Team. The Tier I Project Team as a whole will assess the usability of the data.

This page intentionally left blank.

References

Baker. 2001. *Final Base Background Soil Study Report*. Marine Corps Base Camp Lejeune, North Carolina. April.

Baker. 2002. *Draft Base Background Groundwater Study, Marine Corps Base Camp Lejeune, North Carolin*a. August.

CH2M HILL. 2008. *Site Specific Work Plan Addendum for Focused Preliminary Assessment/Site Inspection, Former Firing Position 2*, *Marine Corps Base Camp Lejeune, Jacksonville, North Carolina*. August.

CH2M HILL. 2009a. *Draft Focused Preliminary Assessment/Site Inspection, Former Firing Position 2*, *Marine Corps Base Camp Lejeune, Jacksonville, North Carolina*. June.

CH2M HILL. 2009b. *Site Management Plan Fiscal Year 2010, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina.* August.

North Carolina Department of Environment and Natural Resources (NCDENR). 2007. *'Redbook' Surface Waters and Wetlands Standards.* Division of Water Quality. October.

NCDENR. 2009. *Inactive Hazardous Sites Program Guidelines for Assessment and Cleanup*. October.

NCDENR. 2010a*. Inactive Hazardous Site Branch Soil Remediation Goals.* January.

NCDENR. 2010b. *Subchapter 2L, Classifications and Water Quality Standards Applicable to the Groundwaters of North Carolina.* Title 15A, Department of Environment and Natural Resources, Division of Water Quality. January.

United States Army Corps of Engineers (USACE). 2001. *Final Range Identification and Preliminary Range Assessment, Marine Corps Base Camp Lejeune, Onslow, North Carolina.* St. Louis District. December.

United States Environmental Protection Agency (USEPA). 1994. *Explosives Residues SOP, Rev. 1.3.* Region II. September.

USEPA. 1999 [a, b, c?] . *CLP National Functional Guidelines for Organic Data Review.* October.

USEPA. 1999a. *Improving Site Assessment: Abbreviated Preliminary Assessments.* Office of Solid Waste and Emergency Response, EPA-540-F-98-037. OSWER DIRECTIVE 9375.2-09FS. October.

USEPA. 1999b. *Improving Site Assessment: Pre-CERCLIS Screening Assessments.* Office of Solid Waste and Emergency Response, EPA-540-F-98-037. OSWER 9375.2-11FS. October

USEPA. 2002. *Guidance for QAPPs, USEPA QA/G-5, Quality Assurance Management Section (QAMS).* EPA QA/G-5. October.

USEPA. 2004. *CLP National Functional Guidelines for Inorganic Data Review.* October.

USEPA. 2004a [b?] . *2004 Edition of the Drinking Water Standards and Health Advisories* U.S. Environmental Protection Agency. Office of Water. EPA 822/R/04/005.

USEPA. 2005. *Intergovernmental Data Quality Task Force Uniform Federal Policy for Quality Assurance Plans (UFP-QAPP).* March.

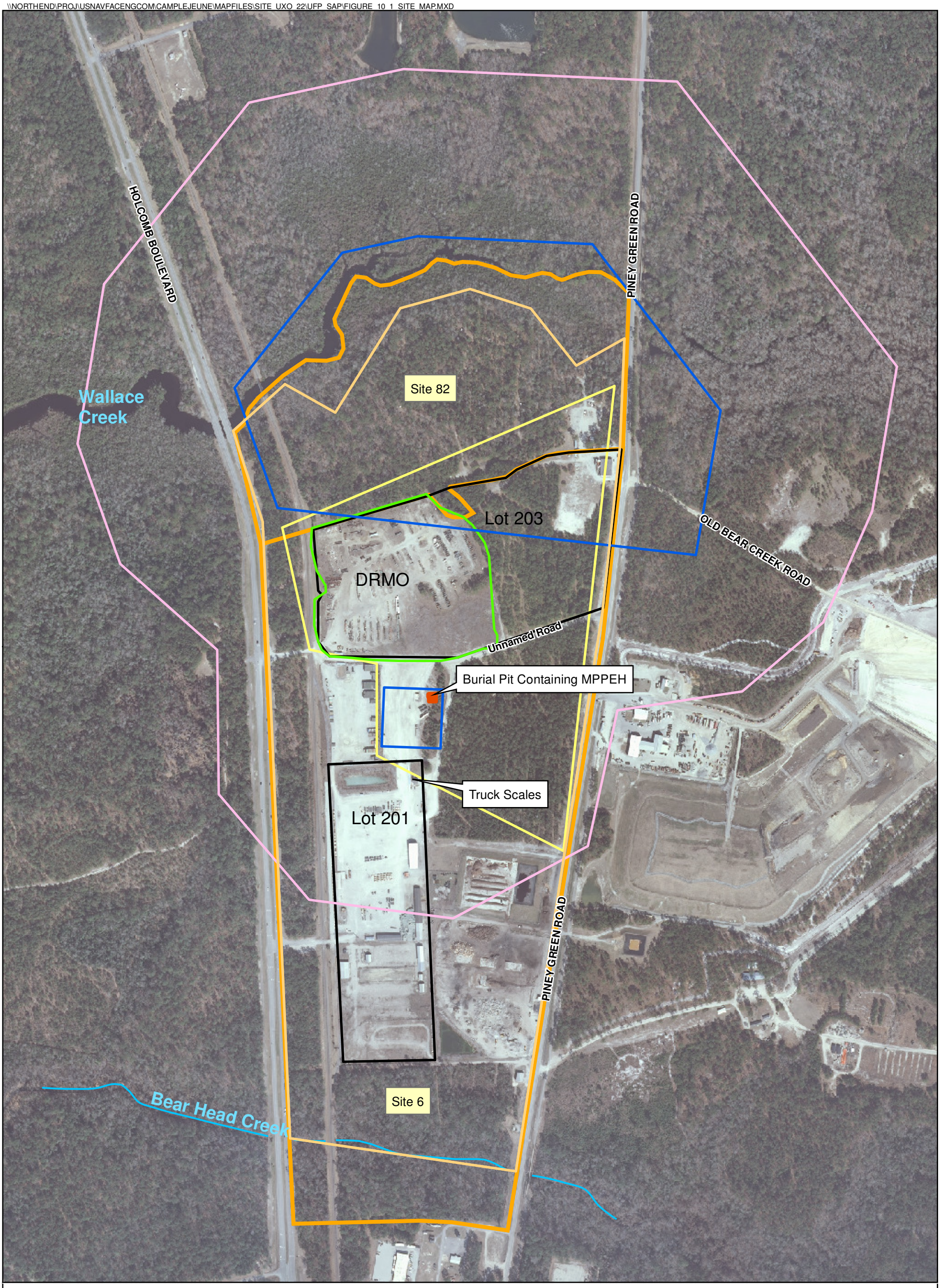
USEPA. 2006. *National Recommended Water Quality Criteria.* http://epa.gov/waterscience/criteria/wqctable/

USEPA. 2009. *Regional Screening Levels for Chemicals at Superfund Sites*. December.

This page intentionally left blank.

Figures

\\NORTHEND\PROJ\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\SITE_UXO_22\UFP_SAP\FIGURE_10_1_SITE_MAP.MXD



Legend

- Aquifer Use Control Boundary
- Non-Industrial Use and Intrusive Activites (Soil) Control Boundary
- Intrusive Activities Control Boundary (Groundwater)
- Burial Pit Containing MPPEH
- DRMO-Defense Reutilization and Marketing Office
- Lots 201 and 203
- UXO-22 Boundary
- Site 6 and 82 Boundary (OU2)
- Surface Water Course Centerline

N

0 275 550 1,100 Feet

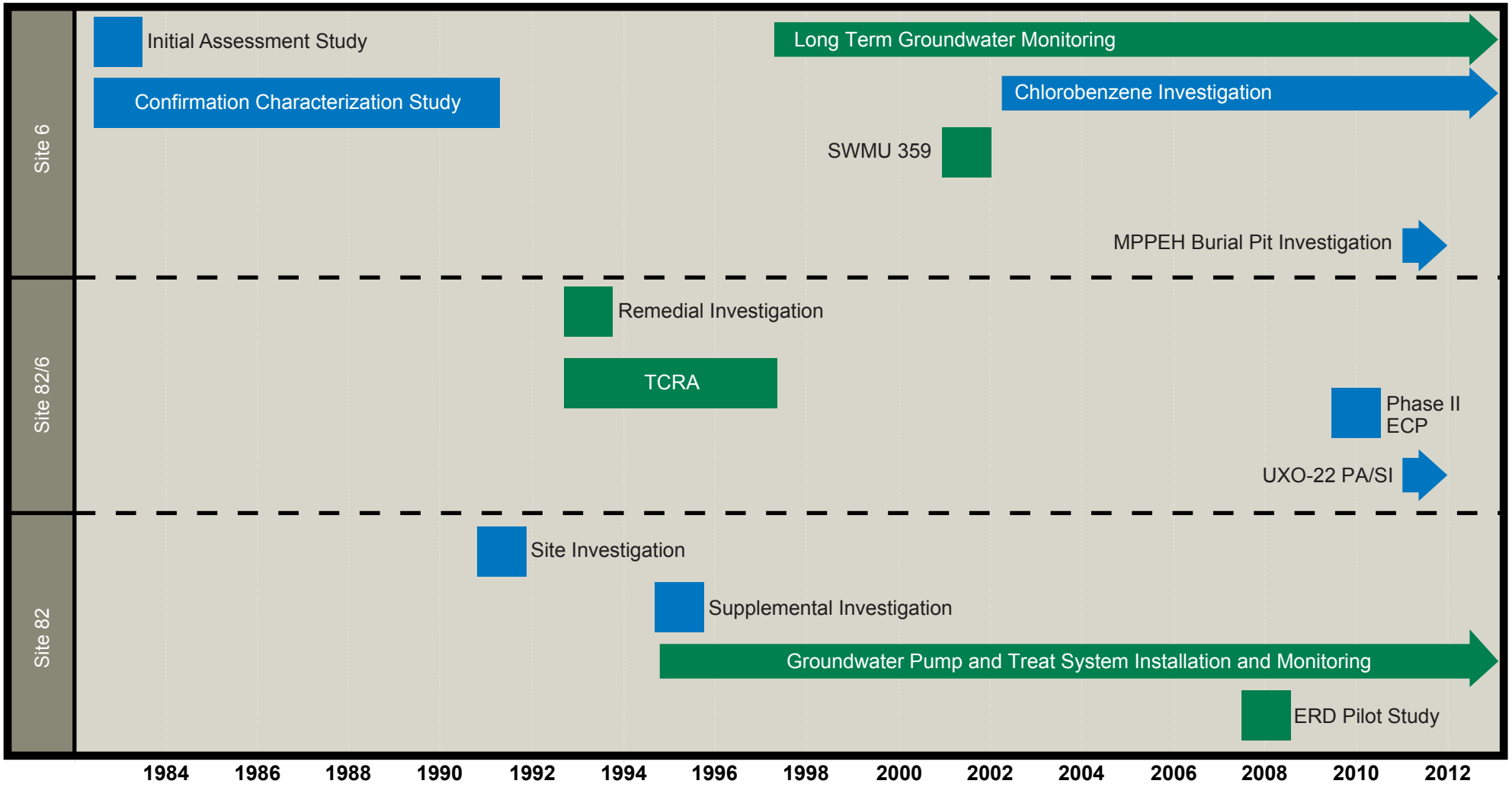
1 inch = 550 feet

2009 Aerial Photograph

Figure 10-1
Site Map
Site UXO-22 UFP-SAP
MCB CamLej
North Carolina

CH2MHILL

Generated by: *K. Rogers/RDU* Checked by:



LEGEND

Characterization Study		TCRA	Time Critical Removal Action
Remedial Action		ECP	Environmental Condition of Property
		ERD	Enhanced Reductive Chlorinization
		DRMO	Defense Reutilization and Marketing Office
		MPPEH	Materials Potentially Presenting Explosive Hazard
		PA/SI	Preliminary Assessment / Site Inspection

Figure 10-2
Summary of Site Actions
Site UXO-22 PA/SI
MCB Camp Lejeune, North Carolina

CH2MHILL

ES041910153122RDD_02

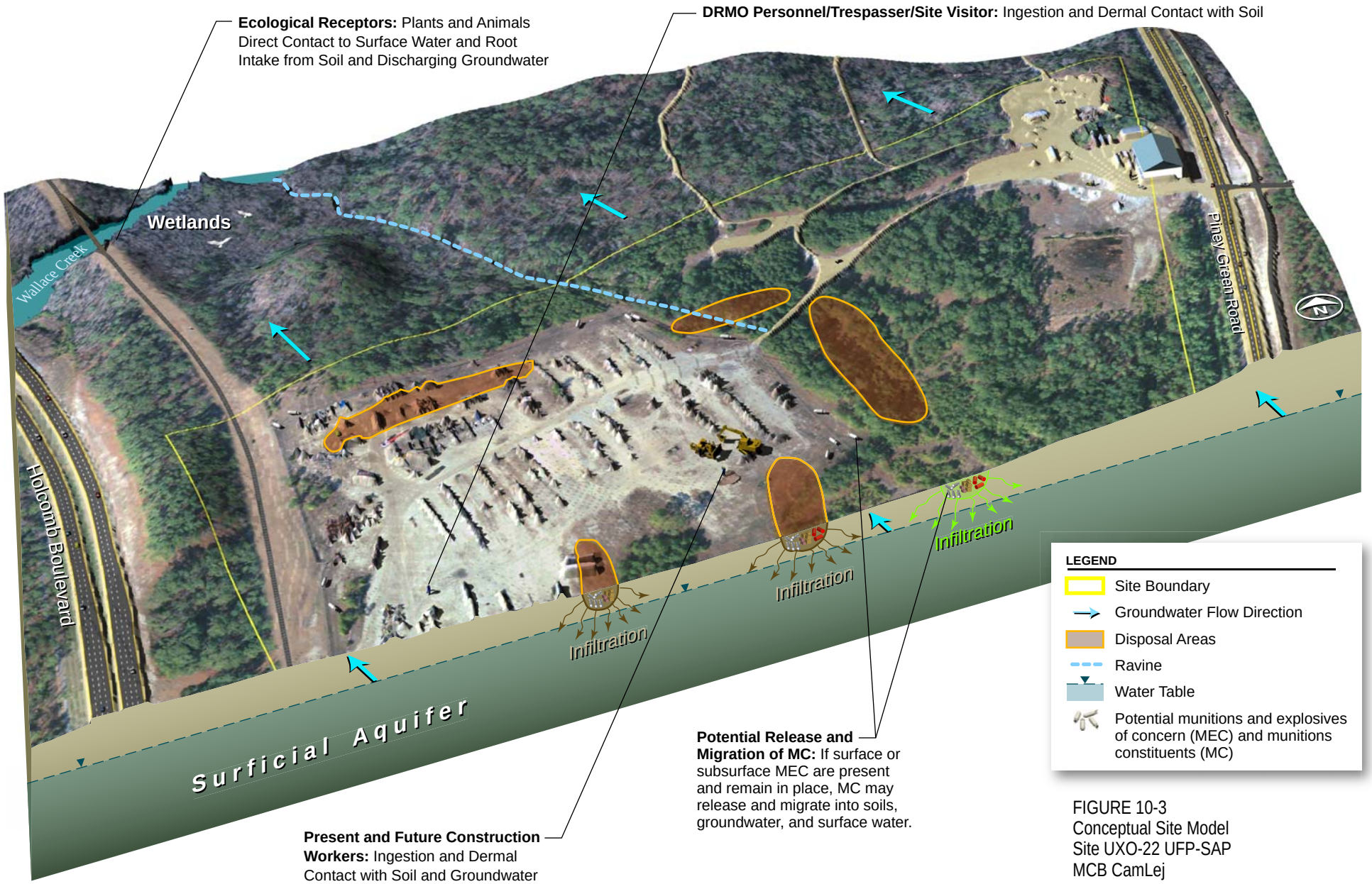
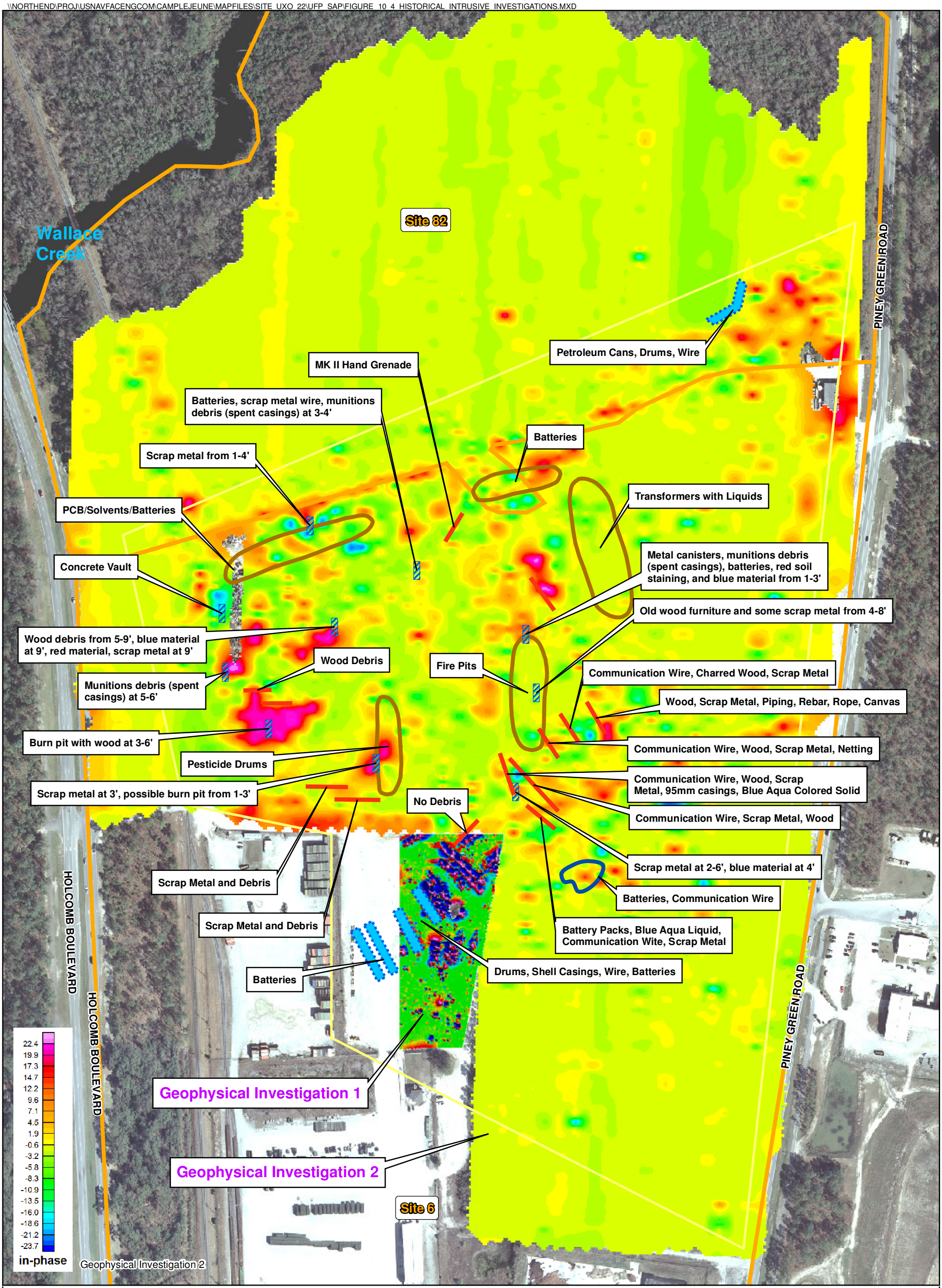


FIGURE 10-3
Conceptual Site Model
Site UXO-22 UFP-SAP
MCB CamLej
North Carolina

CH2MHILL

ES100810194054GNV lejeuneLAFASAPUXO-22Ltr_rev3.ai 05/26/11 LED

\\NORTHEND\PROJ\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\SITE_UXO_22\UFP_SAP\FIGURE_10_4_HISTORICAL_INTRUSIVE_INVESTIGATIONS.MXD



Legend

- Geophysical Transect Locations (Baker, 1993)
- Phase II ECP DRMO Test Pits (2010)
- Estimated Disposal Areas (Water and Air Research, 1983)
- SWMU 359 (Baker, 2002)
- Source Removal Trenches (OHM, 1997)
- UXO-22 Boundary
- Site 6 and 82 Boundary (OU2)

N

0 125 250 500 Feet

1 inch = 250 feet

Vertical Gradient

nT/m

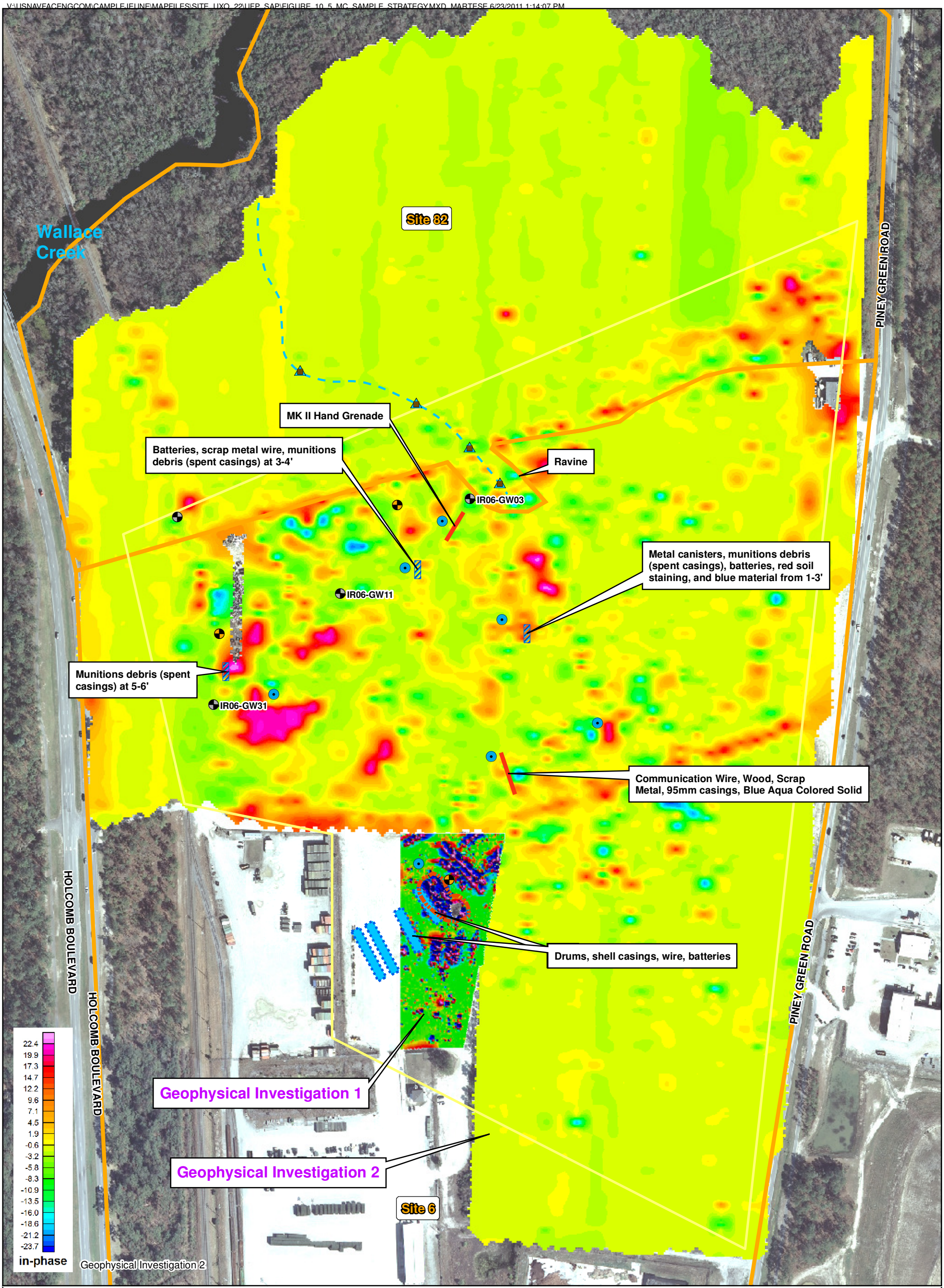
-13147 -276 -112 -51 -24 -10 -0 7 14 34 76 190 878

Geophysical Investigation 1

Figure 10-4
Historical Intrusive Investigations
Site UXO-22 UFP SAP
MCB CamLej
North Carolina

CH2MHILL

V:\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\SITE_UXO_22\UFP_SAP\FIGURE_10_5_MC_SAMPLE_STRATEGY.MXD MARTESE 6/23/2011 1:14:07 PM



Legend

- Sediment/Surface Water Sample Location
- Monitoring Well
- Proposed Soil Boring
- Proposed Monitoring Well/Soil Boring
- Intermittent Drainage Feature
- Geophysical Transect Location (Baker, 1993)
- MPPEH Pit
- Phase II ECP DRMO Test Pit Location (2010)
- Source Removal Trenches (OHM, 1997)
- UXO-22 Boundary
- Site 6 and 82 Boundary (OU2)

N

0 125 250 500 Feet

1 inch = 250 feet

Vertical Gradient

nT/m

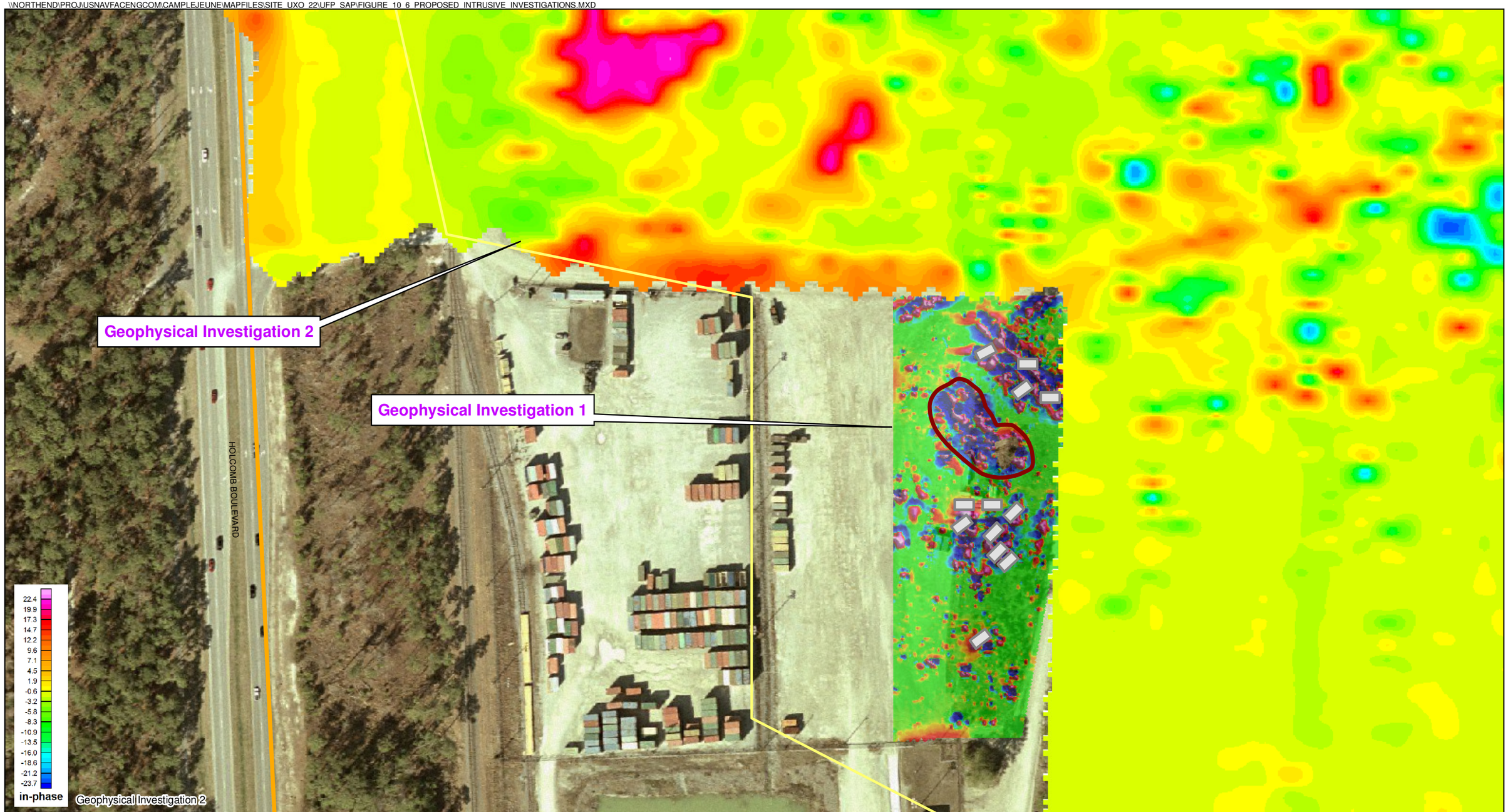
-13147 -276 -112 -51 -24 -10 -0 7 14 34 76 190 878

Geophysical Investigation 1

Figure 10-5
MC Sample Strategy
Site UXO-22 UFP SAP
MCB CamLej
North Carolina

CH2MHILL

\\NORTHEND\PROJ\USNAVFACENGCOM\CAMPLEJEUNE\MAPFILES\SITE_UXO_22\UFP_SAP\FIGURE_10_6_PROPOSED_INTRUSIVE_INVESTIGATIONS.MXD



Legend

- Proposed MPPEH Pit
- UXO-22 Boundary (74.55 acres)
- Site 6 and 82 Boundary (OU2)
- Proposed Test Pit Locations

Vertical Gradient

nT/m

-13147 -276 -112 -51 -24 -10 -0 7 14 34 76 190 878

Geophysical Investigation 1

N

0 62.5 125 250 Feet

1 inch = 125 feet

Figure 10-6
Proposed Intrusive Investigations
Site UXO-22 UFP SAP
MCB CamLej
North Carolina

CH2MHILL

Generated by: *K. Rogers/RDU* Checked by: *T. Grim/CLT*

Attachment 1
Health and Safety Plan

Health and Safety Plan
Preliminary Assessment/Site Inspection for Site UXO-22- Former Munitions Disposal Area

Marine Corps Base Camp Lejeune
Jacksonville, North Carolina

Contract Task Order 0014, Mod 5

December 2011

Prepared for

Department of the Navy
Naval Facilities Engineering Command
Mid-Atlantic

Under the

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

Prepared by

CH2MHILL

Raleigh, North Carolina

Contents

1.0 INTRODUCTION 1-1

1.1 CH2M HILL POLICY AND COMMITMENT 1-2
1.1.1 Safe Work Policy 1-2
1.1.2 Health and Safety Commitment 1-2
1.1.3 Project-Specific Health, Safety, and the Environment Goals 1-2

2.0 APPLICABILITY 2-1

3.0 GENERAL PROJECT INFORMATION 3-1

3.1 PROJECT INFORMATION AND BACKGROUND 3-1
3.2 SITE BACKGROUND AND SETTING 3-1
3.3 DESCRIPTION OF TASKS 3-2
3.3.1 Hazwoper-Regulated Tasks 3-2
3.3.2 Non-Hazwoper-Regulated Tasks 3-2

4.0 PROJECT ORGANIZATION AND RESPONSIBILITIES 4-1

4.1 CLIENT 4-1
4.2 CH2M HILL 4-1
4.2.1 Project Manager 4-1
4.2.2 CH2M HILL Responsible Health and Safety Manager 4-2
4.2.3 CH2M HILL Project Environmental Manager 4-2
4.2.4 CH2M HILL Safety Coordinator 4-2
4.3 CH2M HILL SUBCONTRACTORS 4-4
4.4 EMPLOYEE RESPONSIBILITIES 4-5
4.4.1 Employee Authority 4-5
4.5 CLIENT CONTRACTORS 4-6

5.0 STANDARDS OF CONDUCT 5-1

5.1 STANDARDS OF CONDUCT VIOLATIONS 5-1
5.2 DISCIPLINARY ACTIONS 5-1
5.3 SUBCONTRACTOR SAFETY PERFORMANCE 5-1
5.3.1 Observed Hazard Form 5-2
5.3.2 Stop Work Order 5-2
5.4 INCENTIVE PROGRAM 5-2
5.5 REPORTING UNSAFE CONDITIONS/PRACTICES 5-2

6.0 SAFETY PLANNING AND CHANGE MANAGEMENT 6-1

6.1 DAILY SAFETY MEETINGS AND PRE-TASK SAFETY PLANS 6-1
6.2 CHANGE MANAGEMENT 6-1
6.3 AGENCY INSPECTION GUIDANCE 6-1

7.0 PROJECT HAZARD ANALYSIS 7-1

7.1 ACTIVITY HAZARD ANALYSIS 7-1
7.2 SUBCONTRACTOR ACTIVITY HAZARD ANALYSIS 7-2

8.0 GENERAL HAZARDS AND CONTROLS 8-1

8.1 BLOODBORNE PATHOGENS 8-1
8.2 CHEMICAL STORAGE 8-1

8.2.1 Storage of Flammable/Combustible Liquids *8-2*
8.2.2 Indoor Storage of Flammable/Combustible Liquids *8-2*
8.2.3 Outside Storage of Flammable/Combustible Liquids *8-2*
8.2.4 Storage of Hazardous Waste *8-2*
8.2.5 Storage of Chemical Injection Chemicals/Materials *8-3*
8.3 DRIVING SAFETY 8-3
8.4 ELECTRICAL SAFETY 8-3
8.5 FIELD VEHICLES 8-4
8.6 FIRE PREVENTION 8-5
8.6.1 Fire Extinguishers and General Fire Prevention Practices *8-5*
8.6.2 Dispensing of Flammable/Combustible Liquids *8-6*
8.7 GENERAL PRACTICES AND HOUSEKEEPING 8-6
8.8 HAZARD COMMUNICATION 8-8
8.9 KNIFE USE 8-8
8.10 LIGHTING 8-8
8.11 MANUAL LIFTING 8-9
8.12 PERSONAL HYGIENE 8-9
8.13 SHIPPING AND TRANSPORTATION OF HAZARDOUS MATERIALS 8-10
8.14 SUBSTANCE ABUSE 8-11

9.0 PROJECT-SPECIFIC HAZARD CONTROLS 9-1

9.1 ARSENIC 9-1
9.2 BLASTING/EXPLOSIVES 9-1
9.3 BLASTING/EXPLOSIVES 9-2
9.4 DRILLING SAFETY 9-3
9.5 DRUM AND PORTABLE TANK HANDLING 9-4
9.6 DRUM SAMPLING SAFETY 9-5
9.7 GROUNDWATER SAMPLING/WATER LEVEL MEASUREMENTS 9-6
9.8 HAND AND POWER TOOLS 9-6
9.9 LEAD 9-7
9.10 AVOIDANCE OF MUNITIONS AND EXPLOSIVES OF CONCERN (MEC) AND/OR MATERIAL POTENTIALLY PRESENTING AN EXPLOSIVE HAZARD (MPPEH) 9-8
9.10.1 Hazard Identification *9-8*
9.11 PRESSURE WASHING OPERATIONS 9-10
9.12 TRAFFIC CONTROL 9-10
9.13 UTILITIES (UNDERGROUND) 9-11
9.14 UTILITIES (OVERHEAD) 9-14
9.15 VISIBLE LIGHTING 9-15
9.16 WORKING ALONE 9-15

10.0 PHYSICAL HAZARDS AND CONTROLS 10-1

10.1 NOISE 10-1
10.2 ULTRAVIOLET RADIATION (SUN EXPOSURE) 10-2
10.3 TEMPERATURE EXTREMES 10-3
10.3.1 Heat *10-3*
10.3.2 Cold *10-5*

11.0 BIOLOGICAL HAZARDS AND CONTROLS 11-1

11.1 BLACK BEARS 11-1
11.2 BEES AND OTHER STINGING INSECTS 11-1
11.3 BIRD DROPPINGS 11-2
11.4 COYOTES 11-2
11.5 MOSQUITO BITES 11-2
11.6 POISON IVY, POISON OAK, AND POISON SUMAC 11-3
11.7 SNAKES 11-4

11.8 SPIDERS - BROWN RECLUSE AND WIDOW 11-6
11.9 TICKS 11-7

12.0 CONTAMINANTS OF CONCERN 12-1

13.0 SITE MONITORING 13-1

13.1 DIRECT READING MONITORING SPECIFICATIONS 13-1
13.2 CALIBRATION SPECIFICATIONS 13-2
13.3 INTEGRATED PERSONAL AIR SAMPLING 13-2

14.0 PERSONAL PROTECTIVE EQUIPMENT 14-1

14.1 REQUIRED PERSONAL PROTECTIVE EQUIPMENT 14-1
14.2 RESPIRATORY PROTECTION 14-3

15.0 WORKER TRAINING AND QUALIFICATION 15-1

15.1 CH2M HILL WORKER TRAINING 15-1
15.1.1 Hazardous Waste Operations Training 15-1
15.1.2 First Aid/Cardiopulmonary Resuscitation 15-2
15.1.3 Safety Coordinator Training 15-2
15.1.4 Site-Specific Training 15-2
15.1.5 Project-Specific Training Requirements 15-2

16.0 MEDICAL SURVEILLANCE AND QUALIFICATION 16-1

16.1 HAZARDOUS WASTE OPERATIONS AND EMERGENCY RESPONSE 16-1
16.2 JOB OR SITE-SPECIFIC MEDICAL SURVEILLANCE 16-1
16.3 RESPIRATOR USER QUALIFICATION 16-1
16.4 HEARING CONSERVATION 16-1

17.0 SITE-CONTROL PLAN 17-1

17.1 SITE-CONTROL PROCEDURES 17-1
17.2 REMEDIATION WORK AREA ZONES 17-1
17.2.1 Support Zone 17-1
17.2.2 Contamination Reduction Zone 17-1
17.2.3 Exclusion Zone 17-2
17.2.4 Other Controlled Areas 17-2

18.0 DECONTAMINATION 18-1

18.1 CONTAMINATION PREVENTION 18-1
18.2 PERSONNEL AND EQUIPMENT DECONTAMINATION 18-1
18.3 DECONTAMINATION DURING MEDICAL EMERGENCIES 18-2
18.4 WASTE COLLECTION AND DISPOSAL 18-2
18.5 DIAGRAM OF PERSONNEL-DECONTAMINATION LINE 18-2

19.0 EMERGENCY RESPONSE PLAN 19-2

19.1 PRE-EMERGENCY PLANNING 19-2
19.2 EMERGENCY EQUIPMENT AND SUPPLIES 19-3
19.3 INCIDENT RESPONSE 19-3
19.4 EMERGENCY MEDICAL TREATMENT 19-3
19.5 EVACUATION 19-4
19.6 EVACUATION SIGNALS 19-4
19.7 INCLEMENT WEATHER 19-4

20.0 SPILL CONTAINMENT PROCEDURES 20-1

21.0 INSPECTIONS 21-1

21.1 PROJECT ACTIVITY SELF-ASSESSMENT CHECKLISTS 21-1
21.2 SAFE BEHAVIOR OBSERVATIONS 21-1

22.0 INCIDENT NOTIFICATION, REPORTING, AND INVESTIGATION 22-1

22.1 GENERAL INFORMATION 22-1
22.2 SECTION DEFINITIONS 22-1
22.3 REPORTING REQUIREMENTS 22-1
22.4 HITS SYSTEM AND INCIDENT REPORT FORM (IRF) 22-2
22.5 INJURY MANAGEMENT/RETURN-TO-WORK (FOR CH2M HILL STAFF ONLY) 22-2
22.5.1 Background 22-2
22.5.2 The Injury Management/Return-to-Work Notification Process: 22-2
22.6 SERIOUS INCIDENT REPORTING REQUIREMENTS 22-3
22.6.1 Serious Incident Determination 22-3
22.6.2 Serious Incident Reporting 22-3
22.7 INCIDENT ROOT CAUSE ANALYSIS 22-5
22.7.1 Personal Factors 22-5
22.7.2 Job Factors 22-5
22.7.3 Corrective Actions 22-6

23.0 RECORDS AND REPORTS 23-1

ATTACHMENTS

Attachment 1 Employee Signoff Form – Health and Safety Plan
Attachment 2 Chemical Inventory/Register Form
Attachment 3 Chemical-Specific Training Form
Attachment 4 Project Activity Self-Assessment Checklists/Forms/Permits
Attachment 5 Key Target Zero Program Elements
Attachment 6 Material Safety Data Sheets
Attachment 7 Working Alone Standard
Attachment 8 Tick Fact Sheet
Attachment 9 Observed Hazard Form
Attachment 10 Stop Work Order Form
Attachment 11 Agency Inspection Target Zero Bulletin
Attachment 12 Completed CH2M HILL AHAs

Approval

This site-specific Health and Safety Plan (HSP) has been written for use by CH2M HILL only. CH2M HILL claims no responsibility for its use by others unless that use has been specified and defined in project or contract documents. The plan is written for the specific site conditions and identified scope(s) of work and must be amended if those conditions or scope(s) of work change.

By approving this HSP, the Responsible Health and Safety Manager (RHSM) certifies that the personal protective equipment has been selected based on the project-specific hazard assessment.

Original Plan

RHSM Approval: Carl Woods **Date**: 12/7/11

Field Operations Manager Approval: **Date:**

Revisions

Revisions Made By: **Date:**

Description of Revisions to Plan:

Revisions Approved By: **Date:**

1.0 Introduction

CH2MHILL

HSSE Target Zero World-Class Performance

Health, Safety, Security, and Environment Policy

Protection of people and the environment is a CH2M HILL core value. It is our vision to create a culture within CH2M HILL that empowers employees to drive this value into all global operations and achieve excellence in health, safety, security, and environment (HSSE) performance. CH2M HILL deploys an integrated, enterprise-wide behavior-based HSSE management system to fulfill our mission and the expectations of our clients, staff, and communities based on the following principles:

- We require all management and supervisory personnel to provide the leadership and resources to inspire and empower our employees to take responsibility for their actions and for the actions of their fellow employees to create a safe, healthy, secure, and environmentally-responsible workplace.
- We provide value to clients by tailoring HSSE processes to customer needs and requiring all CH2M HILL employees and subcontractors to deliver projects with agility, personal service, and responsiveness and in compliance with HSSE requirements and company standards to achieve health, safety, security, and pollution prevention excellence. Our performance will aspire to influence others and continually redefine world-class HSSE excellence.
- We systematically evaluate our design engineering and physical work environment to verify safe and secure work conditions and practices are established, consistently followed, and timely corrected.
- We continually assess and improve our HSSE program to achieve and maintain world-class performance by setting and reviewing objectives and targets, reporting performance metrics, and routinely reviewing our progress.
- We care about the safety and security of every CH2M HILL employee and expect all employees to embrace our culture, share our core value for the protection of people and the environment, understand their obligations, actively participate, take responsibility, and "walk the talk" on and off the job.

The undersigned pledge our leadership, commitment, and accountability for making this policy a reality at CH2M HILL.

Dated the 1st day of October 2009.

Lee A. McIntire
Chief Executive Officer

Garry Higdem
President, Energy Division

Jacqueline Rast
President, Major Programs Group

Robert C. Allen
Chief Human Resources Officer

Mark Lasswell
President, Transportation Business Group

Catherine Santee
Chief Financial Officer

Bob Zard
President, Facilities & Infrastructure Division

Margaret McLean
Chief Legal Officer

Thomas G. Searle
President, International Division

Bill Dehn
Senior Vice President, Special Projects

Michael E. McKelvy
President, Government, Environment, and Nuclear Division

Nancy R. Tuor
Vice-Chair, International

Keith Christopher
Senior Vice President, Health, Safety, Security, and Environment

1.1 CH2M HILL Policy and Commitment

1.1.1 Safe Work Policy

It is the policy of CH2M HILL to perform work in the safest manner possible. Safety must never be compromised. To fulfill the requirements of this policy, an organized and effective safety program must be carried out at each location where work is performed.

CH2M HILL believes that all injuries are preventable, and we are dedicated to the goal of a safe work environment. To achieve this goal, every employee on the project must assume responsibility for safety.

Every employee is empowered to:

- Conduct their work in a safe manner;
- Stop work immediately to correct any unsafe condition that is encountered; and
- Take corrective actions so that work may proceed in a safe manner.

Safety, occupational health, and environmental protection will not be sacrificed for production. These elements are integrated into quality control, cost reduction, and job performance, and are crucial to our success.

1.1.2 Health and Safety Commitment

CH2M HILL has embraced a philosophy for health and safety excellence. The primary driving force behind this commitment to health and safety is simple: employees are CH2M HILL's most significant asset and CH2M HILL management values their safety, health, and welfare. Also, top management believes that all injuries are preventable. CH2M HILL's safety culture empowers employees at all levels to accept ownership for safety and take whatever actions are necessary to eliminate injury. Our company is committed to world-class performance in health and safety and also understands that world-class performance in health and safety is a critical element in overall business success.

CH2M HILL is committed to the prevention of personal injuries, occupational illnesses, and damage to equipment and property in all of its operations; to the protection of the general public whenever it comes in contact with the Company's work; and to the prevention of pollution and environmental degradation.

Company management, field supervisors, and employees plan safety into each work task in order to prevent occupational injuries and illnesses. The ultimate success of CH2M HILL's safety program depends on the full cooperation and participation of each employee.

CH2M HILL management extends its full commitment to health and safety excellence.

1.1.3 Project-Specific Health, Safety, and the Environment Goals

All management and employees are to strive to meet the project-specific Health, Safety, and the Environment (HSE) goals outlined below. The team will be successful only if everyone makes a concerted effort to accomplish these goals. The goals allow the project to stay focused on optimizing the health and safety of all project personnel and, therefore, making the project a great success.

The Project has established eleven specific goals and objectives:

- Create an injury-free environment;
- Have zero injuries or incidents;
- Provide management leadership for HSE by communicating performance expectations, reviewing and tracking performance, and leading by example;
- Ensure effective implementation of the HSP through education, delegation, and team work;
- Ensure 100 percent participation in HSE compliance;
- Continuously improve our safety performance;
- Maintain free and open lines of communication;
- Make a personal commitment to safety as a value;
- Focus safety improvements on high-risk groups;
- Continue strong employee involvement initiatives; and
- Achieve health and safety excellence.

2.0 Applicability

This HSP applies to:

- All CH2M HILL staff, including subcontractors and tiered subcontractors of CH2M HILL working on the site; and
- All visitors to the construction site in the custody of CH2M HILL (including visitors from the Client, the Government, the public, and other staff of any CH2M HILL company).

This HSP does not apply to the third-party contractors, their workers, their subcontractors, their visitors, or any other persons not under the direct control or custody of CH2M HILL.

This HSP defines the procedures and requirements for the health and safety of CH2M HILL staff and visitors when they are physically on the work site. The work site includes the project area (as defined by the contract documents) and the project offices, trailers, and facilities thereon.

This HSP will be kept onsite during field activities and will be reviewed as necessary. The HSP will be amended or revised as project activities or conditions change or when supplemental information becomes available. The HSP adopts, by reference, the Enterprise-wide Core Standards and Standard Operating Procedures (SOPs), as appropriate. In addition, the HSP may adopt procedures from the project Work Plan and any governing regulations. If there is a contradiction between this HSP and any governing regulation, the more stringent and protective requirement shall apply.

All CH2M HILL staff and subcontractors must sign the employee sign-off form included in this document as Attachment 1 to acknowledge review of this document. Copies of the signature page will be maintained onsite by the Safety Coordinator (SC).

3.0 General Project Information

3.1 Project Information and Background

Project Number: 378849

Client: NAVFAC Mid-Atlantic

Project/Site Name: Site UXO-22, Former Munitions Disposal Area

Site Address: Marine Corps Base Camp Lejeune

CH2M HILL Project Manager: Bill Schmithorst/RDU

CH2M HILL Office: Raleigh, NC

DATE HSP Prepared: July 07, 2011

Date(s) of Site Work: December 6, 2011 through January 14, 2012

3.2 Site Background and Setting

Marine Corps Base Camp Lejeune (MCB CamLej) is investigating former munitions disposal area, Unexploded Ordnance Site 22 (UXO-22). UXO-22 located within Operable Unit 2 between Holcombe Boulevard and Piney Green Road and includes portions of Installation Restoration (IR) Site 6 and IR Site 82.

Historically, the site was used for disposal and storage of wastes and supplies, including pesticides, transformers containing polychlorinated biphenyls (PCBs), solvents, electrolytes, and waste oils. Disposal trenches containing material potentially presenting an explosive hazard (MPPEH), communication wire, graphite battery packs, containers of petroleum, oil, and lubricants, and metal 55-gallon drums were discovered during Remedial Investigation activities at Site 06 in 1992. A Time-critical Removal Action (TCRA) was completed in accordance with CERCLA in 1994. In November 2008, MPPEH was discovered in the central area of Site 06 during vegetation clearing. Base explosive ordnance disposal (EOD) responded and subsequently removed various types of munitions debris (MD) such as M-2 antipersonnel mines, 57mm brass cartridges, M-29 rockets, and 3.5-inch rocket motors. Due to the quantity of MPPEH in the area, EOD determined that further action was beyond the scope of EOD emergency response. Therefore, the excavation started by EOD was secured by placing a 4-foot by 8-foot steel plate over the excavation and enclosing the area with chain-link fencing posted with warning signs.

No former range activities are known to have occurred at UXO-22. Removal action excavations conducted at Site 6 within UXO-22 revealed the presence of munitions debris (including expended 105 mm cartridges), communication wire, graphite battery packs, containers of petroleum, oil, and lubricants, and metal 55-gallon drums.

Due to the previous site usage, a munitions response program (MRP) Preliminary Assessment/Site Inspection (PA/SI) is being conducted to accomplish the following objectives:

- Identify historical activities that may have resulted in environmental contamination with munitions of explosives concern (MEC) or munitions constituents (MC).
- Evaluate the presence and nature of MC contamination that may exist at Site UXO22
- Conduct ecological and human health risk screenings using analytical data collected at the Site.

This PA/SI is being conducted by CH2M HILL under the NAVFAC Mid-Atlantic, Comprehensive Long-Term Environmental Action—Navy (CLEAN) Program, Contract N62470-08-D-1000, Contract Task Order (CTO) 0014, Modification 5.

3.3 Description of Tasks

Refer to project documents (i.e., Work Plan) for detailed task information. Tasks other than those listed below require an approved amendment or revision to this plan before tasks begin. Refer to the "Site Control" section of this HSP for procedures related to "clean" tasks that do not involve hazardous waste operations and emergency response (HAZWOPER).

3.3.1 Hazwoper-Regulated Tasks

- Well Installation/Drilling
- Subsurface Soil Sampling
- Groundwater Sampling
- Sediment Sampling
- Surface Water Sampling
- Well Abandonment

3.3.2 Non-Hazwoper-Regulated Tasks

Under specific circumstances, the training and medical monitoring requirements of federal or state Hazwoper regulations are not applicable. It must be demonstrated that the tasks can be performed without the possibility of exposure in order to use non-Hazwoper-trained personnel. **Contact the Responsible Health and Safety Manager prior to using non-Hazwoper-trained personnel for the following tasks when working on a regulated hazardous waste site.**

TASKS

- Underground Utility Clearance
- Surveying

CONTROLS

- Brief on hazards, limits of access, and emergency procedures.
- Post areas of contamination as appropriate.
- Perform air sampling/monitoring as specified in this HSP.

Site Map

4.0 Project Organization and Responsibilities

4.1 Client

Contact Name: Dave Cleland
Phone: (757) 322-4851
Facility Contact Name: Charity Rychak
Phone: (910) 451-9386

4.2 CH2M HILL

4.2.1 Project Manager

Project Manager Name: Bill Schmithorst
Job Title: Project Manager
CH2M HILL Office Raleigh, North Carolina
Telephone Number: (919) 760-1769
Cellular Number: (919) 272-7001

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

- Incorporate standard terms and conditions, and contract-specific HSE roles and responsibilities in contract and subcontract agreements (including flow-down requirements to lower-tier subcontractors).
- Select safe and competent subcontractors by:
  - Choosing potential subcontractors based on technical ability and HSE performance;
  - Implementing the subcontractor prequalification process;
  - Ensuring that acceptable certificates of insurance, including CH2M HILL as named additional insured, are secured as a condition of subcontract award; and
  - Ensuring HSE submittals, subcontract agreements, and appropriate site-specific safety procedures are in place and accepted prior field mobilization.
- Ensure copies of training and medical monitoring records, and site-specific safety procedures are being maintained in the project file accessible to site personnel.
- Provide oversight of subcontractor HSE practices per the site-specific safety plans and/or procedures.
- Manage the site and interfacing with 3rd parties in a manner consistent with the contract and subcontract agreements and the applicable standard of reasonable care.
- Ensure that the overall, job-specific, HSE goals are fully and continuously implemented.
- Support and implement use of stop-work orders when subcontractor safety performance is not adequate.

4.2.2 CH2M HILL Responsible Health and Safety Manager

RHSM Name: Carl Woods CH2M HILL Office: Cincinnati, Ohio Telephone Number: (513) 889-5771 Mobile Number: (513) 319-5771

The RHSM is responsible for the following:

- Review and evaluate subcontractor HSE performance using the pre-qualification process;
- Approve HSP and its revisions as well as Activity Hazard Analyses (AHA);
- Review and evaluate subcontractor site-specific safety procedures for adequacy prior to start of subcontractor's field operations;
- Support the oversight (or SC's direct oversight) of subcontractor and tiered subcontractor HSE practices;
- Permit upgrades and downgrades in respiratory protection after reviewing analytical data;
- Conduct audits as determined by project schedule and coordination with PM; and
- Participate in incident investigations, lessons learned, loss and near loss reporting.

4.2.3 CH2M HILL Project Environmental Manager

EM Name: Hope Wilson CH2M HILL Office: ATL Telephone Number: 678-530-4426 Cellular Number: 678-656-5411

The Project EM is responsible for the following:

- Provide environmental program support in areas such as training, auditing, planning, permit tracking, and subcontractor oversight as needed or as specified in the project environmental plan;
- Review and evaluate qualifications for subcontractors with a history of environmental non-compliance and for waste transportation and disposal subcontractors;
- Evaluate any spills, releases, or environmental permit incidents for appropriate follow-up actions, notifications, and recordkeeping requirements; and
- Provide environmental compliance and environmental management expertise and advice to the project team as needed during the course of the project.

4.2.4 CH2M HILL Safety Coordinator

SC Name: Simon Kline Job Title: Safety Coordinator CH2M HILL Office: Raleigh, NC Cellular Number: (910) 622-4344

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

- Verify this HSP is current and amended when project activities or conditions change;
- Verify CH2M HILL site personnel and subcontractor personnel read the HSP and sign the Employee Sign-Off Form, prior to commencing field activities;
- Verify CH2M HILL site personnel have completed any required specialty training (for example, fall protection, confined space entry, among others) and medical surveillance as identified in this HSP;
- Verify that project files available to site personnel include copies of executed subcontracts and subcontractor certificates of insurance (including CH2M HILL as named additional insured), bond, contractor's license, training and medical monitoring records, and accepted site-specific safety procedures prior to start of subcontractor's field operations;
- Act as the project "Hazard Communication Coordinator" and perform the responsibilities outlined in the HSP;
- Act as the project "Emergency Response Coordinator" and perform the responsibilities outlined in the HSP;
- Post the Occupational Safety and Health Administration (OSHA) job-site poster; the poster is required at sites where project field offices, trailers, or equipment-storage boxes are established;
- Hold and/or verify that safety meetings are conducted and documented in the project file initially and as needed throughout the course of the project (as tasks or hazards change);
- Verify that project health and safety forms and permits are being used as outlined this HSP;
- Perform oversight and assessments of subcontractor HSE practices per the site-specific safety plan and verify that project activity self-assessment checklists are being used as outlined this HSP;
- Coordinate with the RHSM regarding CH2M HILL and subcontractor operational performance, and 3rd party interfaces;
- Verify appropriate personal protective equipment (PPE) use, availability, and training;
- Ensure that the overall, job-specific, HSE goals are fully and continuously implemented;
- Conduct accident investigations including root cause analysis;
- Calibrate and conduct air monitoring in accordance with the HSP; maintain all air monitoring records in project file;
- Maintain HSE records and documentation;
- Facilitate OSHA or other government agency inspections including accompanying inspector and providing all necessary documentation and follow-up;
- Deliver field HSE training as needed based on project-specific hazards and activities;
- Contact the RHSM and PM in the event of an incident;

- When an apparent imminent danger exists, immediately remove all affected CH2M HILL employees and subcontractors, notify subcontractor safety representative, stop affected work until adequate corrective measures are implemented, and notify the PM and RHSM as appropriate; and
- Document all oral health and safety-related communications in project field logbook, daily reports, or other records.

4.3 CH2M HILL Subcontractors

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

Subcontractor: LDSI Subcontractor Contact Name: David Boyles Telephone: 704-337-8329
Subcontractor: Parratt Wolff Subcontractor Contact Name: Butch Stevens Telephone: 800-760-1787
Subcontractor: Accumark Subcontractor Contact Name: TBD Telephone: TBD

Subcontractors must comply with the following activities, and are responsible to:

- Comply with all local, state, and federal safety standards;
- Comply with project and owner safety requirements;
- Actively participate in the project safety program and either hold or attend and participate in all required safety meetings;
- Provide a qualified safety representative to interface with CH2M HILL;
- Maintain safety equipment and PPE for their employees;
- Maintain and replace safety protection systems damaged or removed by the subcontractor's operations;
- Notify the SC of any accident, injury, or incident immediately and submit reports to CH2M HILL within 24 hours;
- Install contractually required general conditions for safety (for example, handrail, fencing, fall protection systems, floor opening covers);
- Conduct and document weekly safety inspections of project-specific tasks and associated work areas;
- Conduct site-specific and job-specific training for all subcontractor employees, including review of the CH2M HILL HSP, subcontractor HSPs, and subcontractor AHAs and sign appropriate sign-off forms; and

- Determine and implement necessary controls and corrective actions to correct unsafe conditions.

The subcontractors listed above may be required to submit their own site-specific HSP and other plans such as lead or asbestos abatement compliance plans. Subcontractors are responsible for the health and safety procedures specific to their work, and are required to submit their plans to CH2M HILL for review and acceptance before the start of field work.

Subcontractors are also required to prepare AHAs before beginning each activity posing hazards to their personnel. The AHA shall identify the principle steps of the activity, potential health and safety hazards for each step and recommended control measures for each identified hazard. In addition, a listing of the equipment to be used to perform the activity, inspection requirements, and training requirements for the safe operation of the equipment listed must be identified.

4.4 Employee Responsibilities

All personnel are assigned responsibility for safe and healthy operations. This concept is the foundation for involving all employees in identifying hazards and providing solutions. For any operation, individuals have full authority to stop work and initiate immediate corrective action or control. In addition, each worker has a right and responsibility to report unsafe conditions or practices. This right represents a significant facet of worker empowerment and program ownership. Through shared values and a belief that all accidents are preventable, our employees accept personal responsibility for working safely.

Each employee is responsible for the following performance objectives:

- Perform work in a safe manner and produce quality results;
- Perform work in accordance with company policies, and report injuries, illnesses, and unsafe conditions;
- Complete work without injury, illness, or property damage;
- Report all incidents immediately to supervisor, and file proper forms with a human resources representative;
- Report all hazardous conditions and/or hazardous activities immediately to supervisor for corrective action; and
- Complete an HSE orientation prior to being authorized to enter the project work areas.

4.4.1 Employee Authority

Each employee on the project has the obligation and authority to shut down any perceived unsafe work and during employee orientation, each employee will be informed of their authority to do so.

4.5 Client Contractors

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

Contractor: N/A Contact Name: Telephone: Contractor Task(s): Contractor: Contact Name: Telephone: Contractor Task(s):

This HSP does not cover contractors that are contracted directly to the client or the owner. CH2M HILL is not responsible for the health and safety or means and methods of the contractor's work, and we must never assume such responsibility through our actions (such as advising on health and safety issues). In addition to these instructions, CH2M HILL team members should review contractor safety plans so that we remain aware of appropriate precautions that apply to us. Self-assessment checklists are to be used by the SC and CH2M HILL team members to review the contractor's performance only as it pertains to evaluating CH2M HILL exposure and safety. The RHSM is the only person who is authorized to comment on or approve contractor safety procedures.

Health and safety-related communications with contractors should be conducted as follows:

- Request the contractor to brief CH2M HILL team members on the precautions related to the contractor's work;
- When an apparent contractor non-compliance or unsafe condition or practice poses a risk to CH2M HILL team members:
  - Notify the contractor safety representative;
  - Request that the contractor determine and implement corrective actions;
  - If necessary, stop affected CH2M HILL work until contractor corrects the condition or practice; and
  - Notify the client, PM, and RHSM as appropriate.

If apparent contractor non-compliance or unsafe conditions or practices are observed, inform the contractor safety representative (CH2M HILL's obligation is limited strictly to informing the contractor of the observation; the contractor is solely responsible for determining and implementing necessary controls and corrective actions).

If an apparent imminent danger is observed, immediately warn the contractor employee(s) in danger and notify the contractor safety representative (CH2M HILL's obligation is limited strictly to immediately warning the affected individual(s) and informing the contractor of the observation; the contractor is solely responsible for determining and implementing necessary controls and corrective actions).

All verbal health and safety-related communications will be documented in project field logbook, daily reports, or other records.

5.0 Standards of Conduct

All individuals associated with this project must work injury-free and drug-free and must comply with the following standards of conduct, the HSP, and the safety requirements of CH2M HILL. Commonly accepted standards of conduct help maintain good relationships between people. They promote responsibility and self-development. Misunderstandings, frictions, and disciplinary action can be avoided by refraining from thoughtless or wrongful acts.

5.1 Standards of Conduct Violations

All individuals associated with this project are expected to behave in a professional manner. Violations of the standards of conduct would include, but not be limited to:

- Failure to perform work;
- Inefficient performance, incompetence, or neglect of work;
- Willful refusal to perform work as directed (insubordination);
- Negligence in observing safety regulations, poor housekeeping, or failure to report on-the-job injuries or unsafe conditions;
- Unexcused or excessive absence or tardiness;
- Unwillingness or inability to work in harmony with others;
- Discourtesy, irritation, friction, or other conduct that creates disharmony;
- Harassment or discrimination against another individual;
- Failure to be prepared for work by wearing the appropriate construction clothing or bringing the necessary tools; or
- Violation of any other commonly accepted reasonable rule of responsible personal conduct.

5.2 Disciplinary Actions

The Environmental Services (ES) business group employees, employees working on ES business group projects, and subcontractor employees are subject to disciplinary action for not following HSE rules and requirements. Potential disciplinary action is equally applicable to all employees including management and supervision. Disciplinary action may include denial of access to the worksite, warnings, reprimands, and other actions up to and including termination depending on the specific circumstances.

5.3 Subcontractor Safety Performance

CH2M HILL should continuously endeavor to observe subcontractors' safety performance and adherence to their plans and AHAs. This endeavor should be reasonable, and include observing for hazards or unsafe practices that are both readily observable and occur in common work areas. CH2M HILL is not responsible for exhaustive observation for hazards and unsafe practices. CH2M HILL oversight does not relieve subcontractors of their responsibility for effective implementation and compliance with the established plan(s).

5.3.1 Observed Hazard Form

When apparent non-compliance or unsafe conditions or practices are observed, notify the subcontractor's supervisor or safety representative verbally, and document using the Observed Hazard Form, included as an attachment to this HSP, and require corrective action.

If necessary, stop subcontractor's work using the Stop Work Order Form until corrective actions is implemented for observed serious hazards or conditions. Update the Observed Hazard Form to document corrective actions have been taken. The subcontractor is responsible for determining and implementing necessary controls and corrective actions.

5.3.2 Stop Work Order

CH2M HILL has the authority, as specified in the contract, and the responsibility to stop work in the event any CH2M HILL employee observes unsafe conditions or failure of the subcontractor to adhere to its safe-work practices. This authority and action does not in any way relieve the subcontractor of its responsibilities for the means and methods of the work or, therefore, of any corrective actions. Failure to comply with safe work practices can be the basis for restriction or removal of the subcontractor staff from the job site, termination of the subcontract, restriction from future work, or all three.

When an apparent imminent danger is observed, immediately stop work and alert all affected individuals. Remove all affected CH2M HILL employees and subcontractor staff from the danger, notify the subcontractor's supervisor or safety representative, and do not allow work to resume until adequate corrective measures are implemented. Notify the PM, Contract Administrator (KA) and RHSM.

When repeated non-compliance or unsafe conditions are observed, notify the subcontractor's supervisor or safety representative and stop affected work by completing and delivering the Stop Work Order Form (attached to this HSP) until adequate corrective measures are implemented. Consult the KA to determine what the contract dictates for actions to pursue in event of subcontractor non-compliance including work stoppage, back charges, progress payments, removal of subcontractor manager, monetary penalties, or termination of subcontractor for cause.

5.4 Incentive Program

Each project is encouraged to implement a safety incentive program that rewards workers for exhibiting exemplary safety behaviors. Actions that qualify are those that go above and beyond what is expected. Actions that will be rewarded include spotting and correcting a hazard, bringing a hazard to the attention of your foreman, telling your foreman about an incident, coming up with a safer way to get the work done, or stopping a crew member from doing something unsafe. The program will operate throughout the project, covering all workers. The incentive program will be communicated to all employees during the project employee orientation and project safety meetings.

5.5 Reporting Unsafe Conditions/Practices

Responsibility for effective health and safety management extends to all levels of the project and requires good communication between employees, supervisors, and management. Accident prevention requires a pro-active policy on near misses, close calls, unsafe conditions,

and unsafe practices. All personnel must report any situation, practice, or condition which might jeopardize the safety of our projects. All unsafe conditions or unsafe practices will be corrected immediately. CH2M HILL has zero tolerance of unsafe conditions or unsafe practices.

No employee or supervisor will be disciplined for reporting unsafe conditions or practices. Individuals involved in reporting the unsafe conditions or practices will remain anonymous.

The following reporting procedures will be followed by all project employees:

- Upon detection of any unsafe condition or practice, the responsible employee will attempt to safely correct the condition;
- The unsafe condition or practice will be brought to the attention of the worker's direct supervisor, unless the unsafe condition or practice involves the employee's direct supervisor. If so, the SC needs to be notified at once by the responsible employee;
- Either the responsible employee or responsible employee's direct supervisor is responsible for immediately reporting the unsafe condition or practice to the SC;
- The SC will act promptly to correct the unsafe condition or practice; and
- Details of the incident or situation will be recorded by the SC in the field logbook or use the Observed Hazard Form if subcontractor was involved.

6.0 Safety Planning and Change Management

6.1 Daily Safety Meetings and Pre-Task Safety Plans

Daily safety meetings are to be held with all project personnel in attendance to review the hazards posed and required HSE procedures and AHAs that apply for each day's project activities. The Pre-Task Safety Plans (PTSPs) serve the same purpose as these general assembly safety meetings, but the PTSPs are held between the crew supervisor and their work crews to focus on those hazards posed to individual work crews.

At the start of each day's activities, the crew supervisor completes the PTSP, provided as an attachment to this HSP, with input from the work crew, during their daily safety meeting. The day's tasks, personnel, tools and equipment that will be used to perform these tasks are listed, along with the hazards posed and required HSE procedures, as identified in the HSP and AHA. The use of PTSPs promotes worker participation in the hazard recognition and control process while reinforcing the task-specific hazard and required HSE procedures with the crew each day.

6.2 Change Management

The evaluation form below should be reviewed on a continuous basis to determine if the current site health and safety plan adequately addresses ongoing project work, and should be completed whenever new tasks are contemplated or changed conditions are encountered.

6.3 Agency Inspection Guidance

(Reference CH2M HILL SOP HSE-201, *Agency Inspections and Communications*)

Agency inspections (e.g., OSHA, EPA, other regulatory agencies) are on the rise. CH2M HILL implements safety and environmental programs in order to ensure safety to workers, the public, and the environment. This plan addresses things like labeling containers, completing the hazard communication training using the attachments to this HSP, listing training requirements and PPE requirements, and addressing project-specific hazards. Field personnel need to contact the RHSM to update this plan if hazards are encountered that are not addressed.

Following is some pertinent information regarding OSHA inspections in 2011:

- The number of OSHA inspectors increased by 130;
- A goal has been set to conduct 44,000 workplace inspections which is up from 36,000;
- The definition for "Repeat Violations" will encompass the past 5 years versus 3 years;
- OSHA directors can only reduce fines by a maximum of 30%;
- Some fines will be increased between $3,000 and $4,000 per violation;
- Proposed legislature - Serious fines raised from $7,000 to $12,000; and
- Proposed legislature - Willful fines from $70,000 to $250,000.

SOP HSE-201 addresses agency inspections in detail, and the attached **Target Zero Bulletin on Agency Inspections** provides a good summary of the inspection process and what to do if an agency such as OSHA or EPA shows up at the site. It is critical immediate notification or the

RHSM if an inspector arrives (and EM if it is environmental-related); they can help facilitate and make additional notifications.

Please either post the Target Zero Bulletin at your field trailer or keep it with your Health and Safety Plan/Environmental Plan; make it a topic at a safety meeting and keep it readily available in the event of an inspection.

PROJECT HSE Change Management Form			
Project Task:	**PA/SI Field Investigation**	Project/Task Manager: Simon Kline	
Project Number:	**378849**	Project Name: Site UXO-22	

	Evaluation Checklist	Yes	No
1.	Has the CH2M HILL staff listed in the original HSP changed?		
2.	Has a new subcontractor been added to the project?		
3.	Is any chemical or product to be used that is not listed in Attachment 2 of the plan?		
4.	Have additional tasks been added which were not originally addressed in the "Project Information" section of this HSP?		
5.	Have new contaminants or higher than anticipated levels of original contaminants been encountered?		
6.	Has other safety, equipment, activity or environmental hazards been encountered that are not addressed in this HSP?		

If the answer is "YES" to the questions above, HSP revision may be needed. For questions 2-6, contact RHSM prior to continuing work. In addition to contacting the RHSM, the following actions can be taken for questions 1-3:

- Confirm that staff's medical and training status is current – check training records at: http://www.int.ch2m.com/hands (or contact your regional safety program assistant [SPA]), and confirm subcontractor qualifications.
- Confirm with the project RHSM that subcontractor safety performance has been reviewed and is acceptable.
- Confirm with the RHSM that subcontractor safety procedures, plans, and/or AHAs have been reviewed and are acceptable.
- Add the new chemical or product information to the Chemical Inventory Form, inform the RHSM, and ensure that personnel handling the chemical or product have been trained, and that training is documented using the Chemical-Specific Training Form included as an attachment to this HSP. Add the Material Safety Data Sheet(s) (MSDS) for chemicals handled or used at the project to this HSP. AHAs may need to be developed or amended to account for new chemicals. The RHSM shall review the AHAs prior to the chemical use.

7.0 Project Hazard Analysis

A health and safety risk analysis (Table 1) has been performed for each task. In the order listed below, the RHSM considers the various methods for mitigating the hazards. Employees are trained on this hierarchy of controls during their hazardous waste training and reminded of them throughout the execution of projects:

- Elimination of the hazards (use remote sampling methodology to avoid going into a confined space);
- Substitution (reduce exposure to vapors by using a Geoprobe instead of test pitting);
- Engineering controls (ventilate a confined space to improve air quality);
- Warnings (establish exclusion zones to keep untrained people away from hazardous waste work);
- Administrative controls (implement a work-rest schedule to reduce chance of heat stress); or
- Use of PPE (use of respirators when action levels are exceeded).

The hazard controls and safe work practices are summarized in the following sections of this HSP:

- General hazards and controls;
- Project-specific hazards and controls;
- Physical hazards and controls;
- Biological hazards and controls; and
- Contaminants of concern

7.1 Activity Hazard Analysis

An AHA defines the activity being performed, the hazards posed and control measures required to perform the work safely. Workers are briefed on the AHA before doing the work and their input is solicited prior, during, and after the performance of work to further identify the hazards posed and control measures required. The AHA shall identify the work tasks required to perform each activity, along with potential HSE hazards and recommended control measures for each hazard. In addition, a listing of the equipment to be used to perform the activity, inspection requirements and training requirements for the safe operation of the equipment listed must be identified. The following hazard controls and applicable CH2M HILL core standards and SOPs should be used as a basis for preparing AHAs.

AHAs must be prepared for CH2M HILL activities and included as an attachment to this HSP.

7.2 Subcontractor Activity Hazard Analysis

CH2M HILL subcontractors are required to provide AHAs specific to their scope of work on the project for acceptance by CH2M HILL. Each subcontractor shall submit AHAs for their field activities, as defined in their scope of work, along with their project-specific safety plan and/or procedures. Additions or changes in field activities, equipment, tools, or material used to perform work or hazards not addressed in existing AHAs requires either a new AHA to be prepared or an existing AHA to be revised.

Table 1 – General Activity Hazard Analysis

Potential Hazard / Project Activity	Well Installation/ Drilling	Soil Sampling	Surveying	Utility Locating	Surface water and sediment sampling	Groundwater Sampling
Arsenic	X	X			X	X
Biological Hazards	X	X	X	X	X	X
Chemical Hazard	X	X			X	X
Drilling	X					
Drum Handling	X					
Drum Sampling		X			X	X
Electrical Safety	X					
Field Vehicles	X	X	X	X	X	X
Fire Prevention	X	X	X	X	X	X
Hand & Power Tools	X	X	X			
Knife Use	X	X	X	X	X	X
Lead	X	X			X	X
Manual Lifting	X	X	X	X	X	X
Noise	X					
Pressurized Lines/ Equipment	X					
Pressure Washing Equipment/ Decontamination	X					
Temperature Extremes	X	X	X	X	X	X
Traffic Control	X	X	X	X	X	X
Ultraviolet Light exposure (sunburn)	X	X	X	X	X	X
Utilities (underground/overhead)	X			X		
Visible Lighting	X	X	X	X	X	X
Work Alone	X	X	X	X	X	X

8.0 General Hazards and Controls

This section provides safe work practices and control measures used to reduce or eliminate potential hazards. It is a summarized list of requirements. Always consult the appropriate CH2M HILL SOP to ensure all requirements are implemented.

8.1 Bloodborne Pathogens

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

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

Employees trained in first-aid/CPR or those exposed to PIM must complete CH2M HILL's 1-hour bloodborne pathogens computer-based training module annually. When performing first-aid/CPR the following shall apply:

- Observe universal precautions to prevent contact with blood or other PIMs. Where differentiation between body fluid types is difficult or impossible, consider all body fluids to be potentially infectious materials;
- Always wash your hands and face with soap and running water after contacting PIMs. If washing facilities are unavailable, use an antiseptic cleanser with clean paper towels or moist towelettes; and
- If necessary, decontaminate all potentially contaminated equipment and surfaces with chlorine bleach as soon as possible. Use one part chlorine bleach (5.25 percent sodium hypochlorite solution) diluted with 10 parts water for decontaminating equipment or surfaces after initially removing blood or other PIMs. Remove contaminated PPE as soon as possible before leaving a work area.

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

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

8.2 Chemical Storage

The following are general guidelines for storing chemicals and other hazardous materials:

- Keep acids away from bases;
- Keep oxidizers (nitric acid, nitrates, peroxides, chlorates) and organics away from inorganic reducing agents (metals);
- Keep flammables and corrosives in appropriate storage cabinets;
- Do not store paper or other combustibles near flammables;
- Use secondary containment and lipped shelving that is secured; and

- Have a fire suppression system available.

8.2.1 Storage of Flammable/Combustible Liquids

- Only approved containers and portable tanks shall be used for storage and handling of flammable and combustible liquids.
- Approved safety cans shall be used for the handling and use of flammable liquids in quantities of 5 gallons (22.7 liters) or less. Do not use plastic gas cans.
- For quantities of 1 gallon (4.5 liters) or less, the original container may be used for storage and use of flammable liquids.
- Flammable or combustible liquids shall not be stored in areas used for stairways or normally used for the passage of people.

8.2.2 Indoor Storage of Flammable/Combustible Liquids

- No more than 25 gallons (113.7 liters) of flammable or combustible liquids shall be stored in a room outside of an approved storage cabinet.
- Quantities of flammable and combustible liquids in excess of 25 gallons (113.7 liters) shall be stored in an acceptable or approved cabinet.
- Cabinets shall be conspicuously lettered: "FLAMMABLE: KEEP FIRE AWAY."
- Not more than 60 gallons (272.8 liters) of flammable or 120 gallons (545.5 liters) of combustible liquids shall be stored in any one storage cabinet. Not more than three such cabinets may be located in a single storage area.

8.2.3 Outside Storage of Flammable/Combustible Liquids

- Storage of containers (not more than 60 gallons [272.8 liters] each) shall not exceed 1,100 gallons (5000 liters) in any one area. No area shall be within 20 feet (6.1 meters) of any building.
- Storage areas shall be graded to divert spills away from buildings and surrounded by an earthen dike.
- Storage areas may not be located near a storm drain. Overflow and spills must be diverted away from storm drains or surface waters.
- Storage areas shall be free from weeds, debris, and other combustible materials.
- Outdoor portable tanks shall be provided with emergency vent devices and shall not be closer than 20 feet (6.1 meters) to any building.
- Signs indicating no smoking shall be posted around the storage area.

8.2.4 Storage of Hazardous Waste

- All facilities storing ignitable and combustible liquids and hazardous wastes must be designed, constructed, maintained, and operated to minimize the possibility of a fire, explosion, or any release of hazardous constituents.
- Flammable wastes should be stored more than 50 feet from the property line.

8.2.5 Storage of Chemical Injection Chemicals/Materials

When chemical injection remediation technologies are being used at a site, the following storage guidelines must be followed:

- Some injection chemicals, such as strong oxidizers, may have stringent storage requirements per local or National Fire Codes. Verify that appropriate storage provisions are in place prior to starting work.

  NOTE: Counties and cities may have requirements specific to storing these chemicals. Also, storage and use of certain chemicals such as potassium permanganate and hydrogen peroxide may be subject to the new Chemical Facility Anti-Terrorism Standards of the Department of Homeland Security – the applicability depends on the chemical, quantity/concentration, and type of facility. Please contact the project Environmental Manager to determine whether chemicals are subject to these standards.

- Injection chemicals must be stored in a designated, secured area with spill prevention capabilities. Review MSDS or other information to determine potential incompatible materials. Incompatible materials shall not be stored together. Ensure all containers are labeled.

8.3 Driving Safety

Follow the guidelines below when operating a vehicle:

- Refrain from using a cellular phone while driving. Pull off the road, put the vehicle in park and turn on flashers before talking on a cellular phone;
- Never operate a personal digital assistant (PDA), or other device with e-mail, internet, or text messaging function while driving a vehicle;
- Obey speed limits; be aware of blind spots or other hazards associated with low visibility. Practice defensive driving techniques, such as leaving plenty of room between your vehicle and the one ahead of you;
- Do no drive while drowsy. Drowsiness can occur at any time, but is most likely after 18 hours or more without sleep;
- Maintain focus on driving. Eating, drinking, smoking, adjusting controls can divert attention from the road. Take the time to park and perform these tasks when parked rather than while driving; and
- Ensure vehicle drivers are familiar with the safe operation of vehicles of the type and size to be operated. Large vehicles such as full size vans and pick-ups have different vision challenges and handling characteristics than smaller vehicles.

8.4 Electrical Safety

(Reference CH2M HILL SOP HSE-206, *Electrical Safety*)

Below are the hazard controls and safe work practices to follow when using electrical tools, extension cords, and/or other electrical-powered equipment or when exposed to electrical hazards. Ensure the requirements of the referenced SOP are followed:

- Only qualified personnel are permitted to work on unprotected energized electrical systems;

- Only authorized personnel are permitted to enter high-voltage areas;
- CH2M HILL employees who might from time to time work in an environment influenced by the presence of electrical energy must complete Awareness Level Electrical Safety Training located on the CH2M HILL Virtual Office;
- Do not tamper with electrical wiring and equipment unless qualified to do so. All electrical wiring and equipment must be considered energized until lockout/tagout procedures are implemented;
- Inspect electrical equipment, power tools, and extension cords for damage prior to use. Do not use defective electrical equipment, remove from service;
- CH2M HILL has selected Ground Fault Circuit Interrupters (GFCIs) as the standard method for protecting employees from the hazards associated with electric shock;
  - GFCIs shall be used on all 120-volt, single phase 15 and 20-amphere receptacle outlets which are not part of the permanent wiring of the building or structure.
- An assured equipment grounding conductor program may be required under the following scenarios:
  - GFCIs can not be utilized;
  - Client requires such a program to be implemented; or
  - Business group decides to implement program in addition to GFCI protection.
- Extension cords must be equipped with third-wire grounding. Cords passing through work areas must be covered, elevated or protected from damage. Cords should not be routed through doorways unless protected from pinching. Cords should not be fastened with staples, hung from nails, or suspended with wire;
- Electrical power tools and equipment must be effectively grounded or double-insulated and Underwriters Laboratory (UL) approved;
- Operate and maintain electric power tools and equipment according to manufacturers' instructions;
- Maintain safe clearance distances between overhead power lines and any electrical conducting material unless the power lines have been de-energized and grounded, or where insulating barriers have been installed to prevent physical contact. Maintain at least 10 feet (3 meters) from overhead power lines for voltages of 50 kV or less, and 10 feet (3 meters) plus 0.4 inches (1.0 cm) for every 1 kV over 50 kV;
- Temporary lights shall not be suspended by their electric cord unless designed for suspension. Lights shall be protected from accidental contact or breakage; and
- Protect all electrical equipment, tools, switches, and outlets from environmental elements.

8.5 Field Vehicles

- Field vehicles may be personal vehicles, rental vehicles, fleet vehicles, or project vehicles.
- Maintain a first aid kit, bloodborne pathogen kit, and fire extinguisher in the field vehicle at all times.
- Utilize a rotary beacon on vehicle if working adjacent to active roadway.

- Familiarize yourself with rental vehicle features prior to operating the vehicle:
  - Vision Fields and Blind Spots
  - Vehicle Size
  - Mirror adjustments
  - Seat adjustments
  - Cruise control features, if offered
  - Pre-program radio stations and Global Positioning System (GPS), if equipped
- Always wear seatbelt while operating vehicle.
- Adjust headrest to proper position.
- Tie down loose items if utilizing a van or pick-up truck.
- Close car doors slowly and carefully. Fingers can get pinched in doors.
- Park vehicle in a location where it can be accessed easily in the event of an emergency. If not possible, carry a phone.
- Have a designated place for storing the field vehicle keys when not in use.
- Ensure back-up alarms are functioning, if equipped. Before backing a vehicle, take a walk around the vehicle to identify obstructions or hazards. Use a spotter when necessary to back into or out of an area.
- See the Vehicle Accident Guidance attached to this HSP, if a vehicle incident is experienced in a rental or fleet vehicle.

8.6 Fire Prevention

(Reference CH2M HILL SOP HSE-403, *Hazardous Material Handling*)

Follow the fire prevention and control procedures listed below.

8.6.1 Fire Extinguishers and General Fire Prevention Practices

- Fire extinguishers shall be provided so that the travel distance from any work area to the nearest extinguisher is less than 100 feet (30.5 meters). When 5 gallons (19 liters) or more of a flammable or combustible liquid is being used, an extinguisher must be within 50 feet (15.2 meters). Extinguishers must:
  - be maintained in a fully charged and operable condition;
  - be visually inspected each month; and
  - undergo a maintenance check each year.
- The area in front of extinguishers must be kept clear.
- Post “Exit” signs over exiting doors, and post “Fire Extinguisher” signs over extinguisher locations.
- Combustible materials stored outside should be at least 10 feet (3 meters) from any building.

- Solvent waste and oily rags must be kept in a fire resistant, covered container until removed from the site.
- Keep areas neat. Housekeeping is important.

8.6.2 Dispensing of Flammable/Combustible Liquids

- Areas in which flammable or combustible liquids are dispensed in quantities greater than 5 gallons (22.7 liters) (shall be separated from other operations by at least 25 feet (7.6 meters).
- Drainage away from storm drains or surface waters or other means of containment shall be provided to control spills.
- Adequate natural or mechanical ventilation shall be provided to maintain the concentration of flammable vapor at or below 10 percent of the lower flammable limit.
- Dispensing of flammable liquids from one container to another shall be done only when containers are electrically interconnected (bonded).
- Dispensing flammable or combustible liquids by means of air pressure on the container or portable tanks is prohibited.
- Dispensing devices and nozzles for flammable liquids shall be of an approved type.

8.7 General Practices and Housekeeping

The following are general requirements applicable to all portions of the work:

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

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

8.8 Hazard Communication

(Reference CH2M HILL SOPs HSE-107, *Hazard Communication* and HSE-403, *Hazardous Material Handling*)

The hazard communication coordinator is to perform the following:

- Complete an inventory of chemicals brought on site by CH2M HILL using the chemical inventory form included as an attachment to this HSP;
- Confirm that an inventory of chemicals brought on site by CH2M HILL subcontractors is available;
- Request or confirm locations of material safety data sheets (MSDSs) from the client, contractors, and subcontractors for chemicals to which CH2M HILL employees potentially are exposed;
- Before or as the chemicals arrive on site, obtain an MSDS for each hazardous chemical and include on the chemical inventory sheet (attached to this HSP) and add the MSDS to the MSDS attachment section of this HSP;
- Label chemical containers with the identity of the chemical and with hazard warnings, and store properly;
- Give employees required chemical-specific HAZCOM training using the chemical-specific training form included as an attachment to this HSP; and
- Store all materials properly, giving consideration to compatibility, quantity limits, secondary containment, fire prevention, and environmental conditions.

8.9 Knife Use

Open-bladed knives (for example, box cutters, utility knives, pocket knives, machetes, and multi-purpose tools with fixed blades such as a Leatherman™) are prohibited at worksites except where the following three conditions are met:

- The open-bladed knife is determined to be the best tool for the job;
- An approved Activity Hazard Analysis (AHA) or written procedure is in place that covers the necessary safety precautions (work practices, PPE, and training); and
- Knife users have been trained and follow the AHA.

8.10 Lighting

Lighting shall be evaluated when conducting work inside buildings, confined spaces, or other areas/instances where supplemental light may be needed (e.g., work before sunrise or after sunset). A light meter can be used to evaluate the adequacy of lighting. The following are common requirements for lighting and the conditions/type of work being performed:

- While work is in progress outside construction areas shall have at least 33 lux (lx);
- Construction work conducted inside buildings should be provided with at least 55 lux light;

- The means of egress shall be illuminated with emergency and non-emergency lighting to provide a minimum 11 lx measured at the floor. Egress illumination shall be arranged so that the failure of any single lighting unit, including the burning out of an electric bulb will not leave any area in total darkness.

8.11 Manual Lifting

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

Back injuries are the leading cause of disabling work and most back injuries are the result of improper lifting techniques or overexertion. Use the following to mitigate the hazards associated with lifting:

- When possible, the task should be modified to minimize manual lifting hazards;
- Lifting of loads weighing more than 40 pounds (18 kilograms) shall be evaluated by the SC using the Lifting Evaluation Form contained in SOP HSE-112;
- Using mechanical lifting devices is the preferred means of lifting heavy objects such as forklifts; cranes, hoists, and rigging; hand trucks; and trolleys;
- Personnel shall seek assistance when performing manual lifting tasks that appear beyond their physical capabilities;
- In general, the following steps must be practiced when planning and performing manual lifts: Assess the situation before you lift; ensure good lifting and body positioning practices; ensure good carrying and setting down practices; and
- All CH2M HILL workers must have training in proper manual lifting training either through the New Employee Orientation or through Manual Lifting module located on the VO.

8.12 Personal Hygiene

Good hygiene is essential for personal health and to reduce the potential of cross-contamination when working on a hazardous waste site. Implement the following:

- Keep hands away from nose, mouth, and eyes during work;
- Keep areas of broken skin (chapped, burned, etc.) covered; and
- Wash hands with soap and water prior to eating, smoking, or applying cosmetics.

8.13 Shipping and Transportation of Hazardous Materials

(Reference CH2M HILL SOP HSE-417, *Hazardous Materials Transportation*)

The U.S. Department of Transportation (DOT) has specific regulations governing shipping of hazardous materials (also called dangerous goods). Chemicals brought to the site might be defined as hazardous materials by the U.S DOT. Hazardous wastes that may be shipped offsite are also defined as hazardous materials by U.S. DOT. Other wastes may also be U.S. DOT hazardous materials. To confirm whether a material or a waste is a U.S. DOT hazardous material, check with the ESBG Waste Coordinator (Lisa Schwan/ATL), the project EM, or the CH2M HILL Dangerous Goods Shipping Coordinators (John Blasco/BAO or Rob Strehlow/MKW).

All staff who affect shipment of hazardous materials, including receiving hazardous materials, preparing profiles or manifests, packaging hazardous wastes, labeling, or transporting hazardous materials by road, are called HazMat employees (note CH2M HILL cannot transport hazardous wastes by public road). HazMat employees must receive CH2M HILL online training in shipping dangerous goods. CH2M HILL's online Dangerous Goods Shipping course can be found on the CH2M HILL HSSE website.

All hazardous materials that are shipped (e.g., via Federal Express) or are transported by road must be properly identified, labeled, packed, and documented by trained staff. If the material is a product that is being shipped (e.g., calibration gas), use the HazMat ShipRight tool on the CH2M HILL virtual office (under Company Resources – Online Shipping). Contact the Dangerous Goods Shipping coordinators, the ESBG Waste Coordinator or the project EM for additional information.

49 CFR 172 requires that all hazmat employees be aware of potential transportation security concerns. Hazardous materials security is addressed in CH2M HILL's Hazardous Materials SOP (HSE-403). The following points are provided as an overview of security measures to increase awareness of this important matter:

- It is essential that each employee understand the security risks involved with transporting hazardous materials;
- All transporters of hazardous materials must be prequalified by a Contracts Administrator who evaluate the carrier's safety rating, security measures, and employee screening procedures;
- When shipping hazardous materials, check driver credentials and ask about shipping details;
- When receiving a hazardous materials shipment, inspect packages for signs of tampering or damage to the contents. Verify the drivers and company information on the form with the driver; and
- If there is suspicious or unusual behavior (e.g., driver without credentials, evasive answers) or any discrepancies identified, do not offer or accept the shipment, and immediately notify the project manager or the RHSM.

Employees responsible for shipping hazard materials must also review the CH2M HILL Transportation Security Plan (HSE-417 Appendix A).

8.14 Substance Abuse

(Reference CH2M HILL SOP HSE-105, *Drug-Free Workplace*)

Employees who work under the influence of controlled substances, drugs, or alcohol may prove to be dangerous or otherwise harmful to themselves, other employees, clients, the company, the company's assets and interests, or the public. CH2M HILL does not tolerate illegal drug use, or any use of drugs, controlled substances, or alcohol that impairs an employee's work performance or behavior.

Prohibitions onsite include:

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

Drug and/or alcohol testing is applicable under CH2M HILL Constructors, Inc. and munitions response projects performed in the United States. In addition, employees may be required to submit to drug and/or alcohol testing as required by clients. When required, this testing is performed in accordance with SOP HSE-105, Drug-Free Workplace. Employees who are enrolled in drug or alcohol testing are required to complete annual training located on the CH2M HILL Virtual Office (VO).

9.0 Project-Specific Hazard Controls

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

9.1 Arsenic

(Reference CH2M HILL, SOP HSE-501, *Arsenic*)

CH2M HILL employees is required to control employee exposure to arsenic when exposures are at or above 5.0 mg/m3 (micrograms per cubic meter), or if there is the possibility of skin or eye irritation from arsenic, by implementing a program that meets the requirements of the U.S. OSHA Inorganic Arsenic standard, 29 CFR 1910.1018. The elements of the CH2M HILL arsenic program include the following:

- Exposure monitoring
- Methods of control, including PPE and respirators
- Medical surveillance
- Training on hazards of arsenic and control measures
- Recordkeeping requirements

If air monitoring indicates there is potential exposure at the action level concentrations above, notify the RHSM to ensure the above have been adequately addressed. Other exposure control measures include:

- Do not enter regulated work areas unless training, medical monitoring, and PPE requirements established by the competent person have been met;
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas;
- Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained from the competent person; and
- Review the fact sheet included as an attachment to this HSP.

9.2 Blasting/Explosives

(Reference CH2M HILL SOP HSE-610, Explosives Usage and Munitions Response)

- A (safety) Technical Risk Evaluation (TRE) must be conducted with the Munitions Response (MR) Safety/Quality Manager prior to the Go/No Go decision making opportunity for all projects involving the use of explosives or work to be performed on a MR site.
- Only authorized, trained and qualified personnel shall handle, use and transfer explosives.

- Blasting subcontractors are responsible for providing a competent person to oversee blasting operations.
- 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.
- 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 must be reviewed and approved by the MR Safety/Quality Officer and the MR Operations Manager.
- Details of explosives management and safety requirements are developed and included in a site-specific Explosives Management Plan (EMP).
- Security of explosives shall conform to the requirements set forth by federal, state, and local jurisdictions. Project site and overnight explosives security will conform to 49 CFR 171-173, transportation security requirements.
- **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.
- 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.

9.3 Blasting/Explosives

(Reference CH2M HILL SOP HSE-610, Explosives Usage and Munitions Response)

- A (safety) Technical Risk Evaluation (TRE) must be conducted with the Munitions Response (MR) Safety/Quality Manager prior to the Go/No Go decision making opportunity for all projects involving the use of explosives or work to be performed on a MR site.
- Only authorized, trained and qualified personnel shall handle, use and transfer explosives.
- Blasting subcontractors are responsible for providing a competent person to oversee blasting operations.
- 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.

- 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 must be reviewed and approved by the MR Safety/Quality Officer and the MR Operations Manager.
- Details of explosives management and safety requirements are developed and included in a site-specific Explosives Management Plan (EMP).
- Security of explosives shall conform to the requirements set forth by federal, state, and local jurisdictions. Project site and overnight explosives security will conform to 49 CFR 171-173, transportation security requirements.
- **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.
- 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.

9.4 Drilling Safety

(Reference CH2M HILL SOP HSE-204, *Drilling*)

Below are the hazard controls and safe work practices to follow when working around or performing drilling. Ensure the requirements in the referenced SOP are followed.

- The drill rig is not to be operated in inclement weather.
- The driller is to verify that the rig is properly leveled and stabilized before raising the mast.
- Personnel should be cleared from the sides and rear of the rig before the mast is raised.
- The driller is not to drive the rig with the mast in the raised position.
- The driller must check for overhead power lines before raising the mast. A minimum distance of 10 feet (3 meters) between mast and overhead lines (<50 kV) is recommended. Increased separation may be required for lines greater than 50 kV.
- Personnel should stand clear before rig startup.
- The driller is to verify that the rig is in neutral when the operator is not at the controls.
- Become familiar with the hazards associated with the drilling method used (cable tool, air rotary, hollow-stem auger, etc.).
- Do not wear loose-fitting clothing, watches, etc., that could get caught in moving parts.
- Do not smoke or permit other spark-producing equipment around the drill rig.
- The drill rig must be equipped with a kill wire or switch, and personnel are to be informed of its location.
- Be aware and stand clear of heavy objects that are hoisted overhead.

- The driller is to verify that the rig is properly maintained in accordance with the drilling company's maintenance program.
- The driller is to verify that all machine guards are in place while the rig is in operation.
- The driller is responsible for housekeeping (maintaining a clean work area).
- The drill rig should be equipped with at least one fire extinguisher.
- If the drill rig comes into contact with electrical wires and becomes electrically energized, do not touch any part of the rig or any person in contact with the rig, and stay as far away as possible. Notify emergency personnel immediately.
- Use the drilling self-assessment checklist attached to this HSP to evaluate drilling operations.

9.5 Drum and Portable Tank Handling

Below are the hazard controls and safe work practices to follow when overseeing the movement of drums or when handling drums:

- Ensure that personnel are trained in proper lifting and moving techniques to prevent back injuries;
- Ensure drum or tank bungs and lids are secured and are labeled prior to moving;
- Ensure that drums and tanks remain covered except when removing or adding material or waste. Covers and/or lids will be properly secured at the end of each workday;
- Provide equipment to keep the operator removed from the drums to lessen the likelihood of injury. Such equipment might include: a drum grappler attached to a hydraulic excavator; a small front-end loader, which can be either loaded manually or equipped with a bucket sling; a rough terrain forklift; Roller conveyor equipped with solid rollers; drum carts designed specifically for drum handling;
- Make sure the vehicle selected has sufficient rated load capacity to handle the anticipated loads, and make sure the vehicle can operate smoothly on the available road surface;
- Ensure there are appropriately designed Plexiglas cab shields on loaders, backhoes, etc., when handling drums containing potentially explosive materials;
- Equipment cabs should be supplied with fire extinguishers, and should be air-conditioned to increase operator efficiency;
- Supply operators with appropriate respiratory protective equipment when needed;
- Ensure that drums are secure and are not in the operator's view of the roadway;
- Prior to handling, all personnel should be warned about hazards of handling;
- Before moving anything, determine the most appropriate sequence in which the various drums, portable tanks, and other containers should be moved (e.g. small containers may have to be removed first to permit heavy equipment to enter and move the drums;
- Overpack drums and an adequate volume of absorbent should be kept near areas where minor spills may occur;

- Use containers or overpacks that are compatible with the waste or materials;
- Drums containing liquids or hazardous waste will be provided with secondary containment and may not be located near a storm water inlet or conveyance;
- Allow enough aisle space between drum pallets and between drums and other equipment that the drums can be easily accessed (at least 2 to 3 feet) by fire control equipment and similar equipment.; and
- Make sure that a spill kit is available in drum or tank storage areas (or where liquids are transferred from one vessel to another).

9.6 Drum Sampling Safety

Personnel are permitted to handle and/or sample drums containing certain types of waste (drilling waste, investigation-derived waste, waste from known sources) only. Handling or sampling drums with unknown contents requires a plan revision or amendment approved by the RHSM. The following control measures will be taken when sampling drums:

- Minimize transportation of drums.
- Sample only labeled drums or drums from a known waste stream.
- Do not sample bulging or swollen drums. Contact the RHSM.
- If drums contain, or potentially contain, flammable materials, use non-sparking tools to open.
- Use the proper tools to open and seal drums.
- Reseal bung holes or plugs whenever possible.
- Avoid mixing incompatible drum contents.
- Sample drums without leaning over the drum opening.
- Transfer/sample the content of drums using a method that minimizes contact with material.
- Use the PPE and perform air monitoring as specified in the PPE and Site Monitoring sections of this HSP.
- Have a spill kit accessible during sampling activities.
- If transferring/sampling drums containing flammable or combustible liquids, drums and liquid transfer equipment should be grounded and bonded to reduce the potential of a static discharge.

9.7 Groundwater Sampling/Water Level Measurements

Below are the hazard controls and safe work practices to follow when personnel or subcontractors are performing groundwater sampling and/or water level measurements.

- Full coolers are heavy. Plan in advance to have two people available at the end of the sampling effort to load full coolers into vehicles. If two people won't be available use several smaller coolers instead of fewer large ones.
- Wear the appropriate PPE when sampling, including safety glasses, nitrile gloves, and steel toe boots (see PPE section of this HSP).
- Monitor headspace of wells prior to sampling to minimize any vapor inhalation (refer to the "Site Monitoring" section of this HSP).
- Use caution when opening well lids. Wells may contain poisonous spiders and hornet or wasp nests.
- Use the appropriate lifting procedures (see CH2M HILL SOP HSE-112) when unloading equipment and sampling at each well.
- Avoid sharp edges on well casings.
- If dermal contact occurs with groundwater or the acid used in sample preservation, immediately wash all affected skin thoroughly with soap and water.
- Avoid eating and drinking on site and during sampling.
- Use ear plugs during sampling if sampling involves a generator.
- Containerize all purge water and transport to the appropriate storage area.
- Use two people to transport full coolers/containers whenever possible. If two people are not available use a dolly to move coolers. If the coolers weigh more than 40 pounds Attachment 1 of the HSE-112, *Manual Lifting,* shall be completed by the SC. If the coolers weigh more than 50 pounds they should never be lifted by one person.

9.8 Hand and Power Tools

(Reference CH2M HILL, SOP HSE-210, *Hand and Power Tools*)

Below are the hazard controls and safe work practices to follow when personnel or subcontractors are using hand and power tools. Ensure the requirements in the referenced SOP are followed.

- Tools shall be inspected prior to use and damaged tools will be tagged and removed from service.
- Hand tools will be used for their intended use and operated in accordance with manufacturer's instructions and design limitations;
- Maintain all hand and power tools in a safe condition.
- Use PPE (such as gloves, safety glasses, earplugs, and face shields) when exposed to a hazard from a tool.

- Do not carry or lower a power tool by its cord or hose.
- Portable power tools will be plugged into GFCI protected outlets; and
- Portable power tools will be Underwriters Laboratories (UL) listed and have a three-wire grounded plug or be double insulated.
- Disconnect tools from energy sources when they are not in use, before servicing and cleaning them, and when changing accessories (such as blades, bits, and cutters).
- Safety guards on tools must remain installed while the tool is in use and must be promptly replaced after repair or maintenance has been performed.
- Store tools properly in a place where they will not be damaged or come in contact with hazardous materials.
- If a cordless tool is connected to its recharge unit, both pieces of equipment must conform strictly with electrical standards and manufacturer's specifications.
- Tools used in an explosive environment must be rated for work in that environment (that is, intrinsically safe, spark-proof, etc.).
- Working with manual and pistol-grip hand tools may involve highly repetitive movement, extended elevation, constrained postures, and/or awkward positioning of body members (for example, hand, wrist, arm, shoulder, neck, etc.). Consider alternative tool designs, improved posture, the selection of appropriate materials, changing work organization, and sequencing to prevent muscular, skeletal, repetitive motion, and cumulative trauma stressors.

Machine Guarding

- Ensure that all machine guards are in place to prevent contact with drive lines, belts, chains, pinch points or any other sources of mechanical injury.
- Unplugging jammed equipment will only be performed when equipment has been shut down, all sources of energy have been isolated and equipment has been locked/tagged and tested.
- Maintenance and repair of equipment that results in the removal of guards or would otherwise put anyone at risk requires lockout of that equipment prior to work.

9.9 Lead

(Reference CH2M HILL SOP HSE-508, *Lead*)

CH2M HILL is required to control employee exposure to lead when exposures are at or above 30 $\mu g/m^3$ by implementing a program that meets the requirements of the OSHA Lead standard, 29 CFR 1910.1025 and 29 CFR 1926.62. The elements of the CH2M HILL lead program include the following:

- Exposure monitoring;
- Methods of control, including personal protective equipment (PPE) and respirators;
- Medical surveillance;

- Training on hazards of lead and control measures (includes project-specific training and the computer-based training on CH2M HILL's Virtual Office, *Lead Exposure Training);* and
- Record keeping requirements.

If air monitoring indicates there is potential exposure at the action level concentrations above, notify the RHSM to ensure the above have been adequately addressed. Other exposure control measures include:

- Do not enter regulated work areas unless training, medical monitoring, and PPE requirements established by the competent person have been met;
- Do not eat, drink, smoke, chew tobacco or gum, or apply cosmetics in regulated areas;
- Respiratory protection and other exposure controls selection shall be based on the most recent exposure monitoring results obtained from the competent person; and
- Review the fact sheet included as an attachment to this HSP.

9.10 Avoidance of Munitions and Explosives of Concern (MEC) and/or Material Potentially Presenting an Explosive Hazard (MPPEH)

(Reference CH2M HILL, SOP HSE-610, Explosives Usage and Munitions Response)

9.10.1 Hazard Identification

The nature of activities on this project may result in the potential of encountering MEC/MPPEH items that have been disposed of, but may still represent a hazard. Non-Unexploded Ordnance (UXO) trained personnel will avoid all contact with MEC/MPPEH. .

9.10.1.1 Hazard Mitigation/Prevention

All field personnel will be given munitions recognition training prior to working on the site. The training will be verified by signature on the site training form. Personnel will be instructed to be alert for MEC/MPPEH. The following general precautions concerning suspect MEC will be observed at all times:

- Suspect MEC item(s) WILL NOT be touched or moved regardless of the markings or apparent condition. Only UXO trained personnel are allowed to handle MEC/MPPEH.
- Radios or cellular phones WILL NOT be used in the vicinity of suspect MEC items.
- Areas where the ground cannot be seen WILL NOT be traveled across without escort.
- Vehicles WILL NOT be driven into suspected MEC areas; clearly marked lanes will be used.
- Matches, cigarettes, lighters, or other flame-producing devices WILL NOT be carried on to a munitions response site (MRS).
- Color codes WILL NOT be relied upon for positive identification of MEC items or their contents.
- Suspect MEC items will be approached from the side whenever possible; approaching the front or rear areas will be avoided.
- Personnel will always assume that a MEC item contains a live charge until it can be determined otherwise.

- EME Operations within an EZ will be performed under the supervision of a UXO technician III
- EME will not be used to excavate soils within 12 inches of an anomaly.
- Anomaly investigation personnel are not permitted to enter an excavation greater than four feet in depth. If an investigation needs to be performed in an excavation deeper than four feet, operations at that work area will be halted and the Site Safety & Health Officer (SSHO) will be notified. If further investigation is warranted, the SSHO will notify the Health & Safety Manager (HSM) to determine the appropriate safety measures (e.g. sloping, shoring, etc.) to be implemented. The implementation of excavation safety provisions will require an amendment to this APP/SSHP.
- When anomaly investigation personnel must be in the area of Earth Moving Equipment (EME):
  - Sufficient separation between ground support personnel and operating EME must be maintained.
  - Wear reflective vests or high visibility clothing to promote visibility of ground personnel by equipment operators.
  - Isolate equipment swing areas from workers, fixed objects or other equipment. Ground personnel shall avoid positioning themselves between fixed object and operating equipment.
  - Make/maintain eye contact with operators before approaching equipment. Do not approach equipment from rear or from blind spot of operator. Stay out of the swing radius of operating heavy equipment.
  - Suspended loads shall not be passed over ground personnel and ground personnel shall not walk under or in front of suspended loads.

The following actions will be taken if munitions are found:

- Personnel who are not UXO-qualified will note the area of concern, and leave the immediate vicinity. They WILL NOT touch, move, or otherwise disturb the item.
- Personnel should not be misled by markings on the munitions item stating or indicating that the item is a practice bomb or inert. Even practice bombs may have explosive charges that are used to mark/spot the point of impact, or the item could be incorrectly marked.
- Immediately upon locating any suspect MEC, the Senior UXO Supervisor (SUXOS) and UXO Safety Officer (UXOSO) will be notified. In turn, the SUXOS will notify the Project Manager who will then provide required notifications to the client.
- Operations in the immediate area of the suspect MEC will be halted and the appropriate procedures will be implemented.

Removal and disposal of MEC is part of this scope of work and will be undertaken by a MEC support contractor under the oversight of CH2M HILL UXO qualified personnel. MEC will be consolidated, demilitarized, and disposed of in accordance with procedures outline in the approved Work Plan and Explosive Site Submission (ESS).

9.11 Pressure Washing Operations

Below are the hazard controls and safe work practices to follow when working around or performing pressure washing.

- Only trained, authorized personnel may operate the high-pressure washer.
- Follow manufacturer's safety and operating instructions.
- Inspect pressure washer before use and confirm deadman trigger is fully operational
- The wand must always be pointed at the work area.
- The trigger should never be tied down
- Never point the wand at yourself or another worker.
- The wand must be at least 42 inches (1.1 meter) from the trigger to the tip and utilize greater than 10 degree tips.
- The operator must maintain good footing.
- Non-operators must remain a safe distance from the operator.
- No unauthorized attachment may be made to the unit.
- Do not modify the wand.
- All leaks or malfunctioning equipment must be repaired immediately or the unit taken out-of-service.
- Polycoated Tyvek or equivalent, 16-inch-high steel-toed rubber boots, safety glasses, hard hat with face shield, and inner and outer nitrile gloves will be worn, at a minimum.

9.12 Traffic Control

(Reference CH2M HILL SOP HSE-216, *Traffic Control*)

The following precautions must be taken when working around traffic, and in or near an area where traffic controls have been established by a sub contractor. Ensure the requirements in the referenced SOP are followed.

- Exercise caution when exiting traveled way or parking along street – avoid sudden stops, use flashers, etc.
- Park in a manner that will allow for safe exit from vehicle, and where practicable, park vehicle so that it can serve as a barrier.
- All staff working adjacent to traveled way or within work area must wear reflective/high-visibility safety vests.
- Eye protection should be worn to protect from flying debris.
- Remain aware of factors that influence traffic related hazards and required controls – sun glare, rain, wind, flash flooding, limited sight-distance, hills, curves, guardrails, width of shoulder (i.e., breakdown lane), etc.

- Always remain aware of an escape route (e.g., behind an established barrier, parked vehicle, guardrail, etc).
- Always pay attention to moving traffic – never assume drivers are looking out for you.
- Work as far from traveled way as possible to avoid creating confusion for drivers.
- When workers must face away from traffic, a "buddy system" should be used, where one worker is looking towards traffic.
- When working on highway projects, obtain a copy of the contractor's traffic control plan.
- Work area should be protected by a physical barrier – such as a K-rail or Jersey barrier.
- Review traffic control devices to ensure that they are adequate to protect your work area. Traffic control devices should: 1) convey a clear meaning, 2) command respect of road users, and 3) give adequate time for proper traffic response. The adequacy of these devices are dependent on limited sight distance, proximity to ramps or intersections, restrictive width, duration of job, and traffic volume, speed, and proximity.
- Either a barrier or shadow vehicle should be positioned a considerable distance ahead of the work area. The vehicle should be equipped with a flashing arrow sign and truck-mounted crash cushion (TMCC). All vehicles within 40 feet (12.2 meters) of traffic should have an orange flashing hazard light atop the vehicle.
- Except on highways, flaggers should be used when 1) two-way traffic is reduced to using one common lane, 2) driver visibility is impaired or limited, 3) project vehicles enter or exit traffic in an unexpected manner, or 4) the use of a flagger enhances established traffic warning systems.
- Lookouts should be used when physical barriers are not available or practical. The lookout continually watches approaching traffic for signs of erratic driver behavior and warns workers.
- Vehicles should be parked at least 40 feet (12.2 meters) away from the work zone and traffic. Minimize the amount of time that you will have your back to oncoming traffic.
- Traffic control training module on the VO shall be completed when CH2M HILL workers who work in and around roadways and who exposed to public vehicular traffic.

9.13 Utilities (underground)

An assessment for underground utilities must be conducted where there is a potential to contact underground utilities or similar subsurface obstructions during intrusive activities. Intrusive activities include excavation, trenching, drilling, hand augering, soil sampling, or similar activities.

The assessment must be conducted <u>before any intrusive subsurface activity</u> and must include at least the following elements:

1. A background and records assessment of known utilities or other subsurface obstructions.
2. Contacting and using the designated local utility locating service.

3. Conducting an independent field survey to identify, locate, and mark potential underground utilities or subsurface obstructions. *Note: This is independent of, and in addition to, any utility survey conducted by the designated local utility locating service above.*

4. A visual survey of the area to validate the chosen location.

When any of these steps identifies an underground utility within 5 feet (1.5 meters) of intrusive work, then non-aggressive means must be used to physically locate the utility before a drill rig, backhoe, excavator or other aggressive method is used.

Aggressive methods are never allowed within 2 feet of an identified high risk utility (see paragraph below).

Any deviation from these requirements must be approved by the Responsible HS Manager and the Project Manager.

Background and Records Assessment of Known Utilities

Identify any client- or location-specific permit and/or procedural requirements (e.g., dig permit or intrusive work permit) for subsurface activities. For military installations, contact the Base Civil Engineer and obtain the appropriate form to begin the clearance process.

Obtain available utility diagrams and/or as-built drawings for the facility.

Review locations of possible subsurface utilities including sanitary and storm sewers, electrical lines, water supply lines, natural gas lines, fuel tanks and lines, communication lines, lighting protection systems, etc. Note: Use caution in relying on as-built drawings as they are rarely 100 percent accurate.

Request that a facility contact with knowledge of utility locations review and approve proposed locations of intrusive work.

Designated Local Utility Locating Service

Contact your designated local utility locating service (e.g., Dig-Safe, Blue Stake, One Call) to identify and mark the location of utilities. Call 811 in the US or go to www.call811.com to identify the appropriate local service group. Contacting the local utility locating service is a legal requirement in most jurisdictions.

Independent Field Survey (Utility Locate)

CH2M HILL will contract a private utility locating company to perform an independent field survey to identify, locate, and mark any potential subsurface utilities in the work area. This survey is in addition to any utility survey conducted by the designated local utility locating service.

The independent field survey provider shall determine the most appropriate instrumentation/ technique or combinations of instrumentation/techniques to identify subsurface utilities based on their experience and expertise, types of utilities anticipated to be present, and specific site conditions.

A CH2M HILL or subcontractor representative must be present during the independent field survey to observe the utility locate and verify that the work area and utilities have been

properly identified and marked. If there is any question that the survey was not performed adequately or the individual was not qualified, then arrangements must be made to obtain a qualified utility locate service to re-survey the area. Obtain documentation of the survey and clearances in writing and signed by the party conducting the clearance. Maintain all documentation in the project file.

If the site owner (military installation or client) can provide the independent field survey, CH2M HILL or the subcontractor shall ensure that the survey includes:

- Physically walking the area to verify the work location and identify, locate, and mark underground utility locations:
- Having qualified staff available and instrumentation to conduct the locate;
- Agreeing to document the survey and clearances in writing.

Should any of the above criteria not be met, CH2M HILL or subcontractor must arrange for an alternate independent utility locate service to perform the survey.

The markings from utility surveys must be protected and preserved until the markings are no longer required. If the utility location markings are destroyed or removed before intrusive work commences or is completed, the PM, SC, or designee must notify the independent utility locate service or the designated local utility locating service to resurvey and remark the area.

Visual Assessment before and during Intrusive Activities

Perform a "360 degree" assessment. Walk the area and inspect for utility-related items such as valve caps, previous linear cuts, patchwork in pavement, hydrants, manholes, utility vaults, drains, and vent risers in and around the dig area.

The visual survey shall include all surface landmarks, including manholes, previous liner cuts, patchwork in pavement, pad-mounted transformers, utility poles with risers, storm sewer drains, utility vaults, and fire hydrants.

If any unanticipated items are found, conduct further research before initiating intrusive activities and implement any actions needed to avoid striking the utility or obstruction.

Subsurface Activities within 5 feet of an Underground Utility or if there is Uncertainty

When aggressive intrusive activities will be conducted within 5 feet (1.5 meters) of an underground utility or when there is uncertainty about utility locations, locations must be physically verified by non-aggressive means such as air or water knifing, hand digging, or human powered hand augering. Non-conductive tools must be used if electrical hazards may be present. If intrusive activities are within 5 feet (1.5 meters) and parallel to a marked existing utility, the utility location must be exposed and verified by non-aggressive methods every 100 feet (30.5 meters). Check to see if the utility can be isolated during intrusive work.

Intrusive Activities within 2 feet of an Underground Utility

Use non-aggressive methods (hand digging, vacuum excavation, etc.) to perform intrusive activities within 2 feet of a high risk utility (i.e., a utility that cannot be de-energized or would cause significant impacts to repair/replace). Hazardous utilities shall be de-energized whenever possible.

Spotter

A spotter shall be used to monitor for signs of utilities during advancement of intrusive work (e.g., sudden change in advancement of auger or split spoon, presence of pea gravel or sand in soils, presence of concrete or other debris in soils, refusal of auger or excavating equipment). If any suspicious conditions are encountered stop work immediately and contact the PM or RHSM to evaluate the situation. The spotter must have a method to alert an operator to stop the intrusive activity (e.g., air horn, hand signals).

9.14 Utilities (overhead)

Proximity to Power Lines

No work is to be conducted within 50 feet (15.2 meters) of overhead power lines without first contacting the utility company to determine the voltage of the system. No aspect of any piece of equipment is to be operated within 50 feet (15.2 meters) of overhead power lines without first making this determination.

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

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

MINIMUM DISTANCES FROM POWERLINES

Powerlines Nominal System Kv	Minimum Required Distance, Feet (Meters)
0-50	10 (3.0)
51-100	12 (3.7)
101-200	15 (4.6)
201-300	20 (6.1)
301-500	25 (7.6)
501-750	35 (10.7)
751-1000	45 (13.7)

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

- The power line(s) has been isolated through the use of insulating blankets which have been properly placed by the utility. If insulating blankets are used, the utility will determine the minimum safe operating distance; get this determination in writing with the utility representative's signature.
- All inquiries regarding electric utilities must be made in writing and a written confirmation of the outage/isolation must be received by the PM prior to the start of work.

9.15 Visible Lighting

Lighting shall be evaluated when conducting work inside buildings, confined spaces, or other areas/instances where supplemental light may be needed (e.g., work before sunrise or after sunset). A light meter can be used to evaluate the adequacy of lighting. The following are common requirements for lighting and the conditions/type of work being performed.

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

9.16 Working Alone

(Reference CH2M HILL Core Standard, *Working Alone*)

Personnel can only be tasked to work alone by the Project Manager who shall assess potential hazards and appropriate control measures, with assistance from the Responsible Health and Safety Manager (RHSM).

"Lone workers" with an accountability system in place is permitted, depending on the hazards presented during the execution of the task. Reference the "Lone Worker Protocol" included as an attachment to this HSP.

The employee shall at all times be equipped with a working voice communication device such as a cellular phone or two-way radio to check-in to their project contact (s) at pre-determined times.

Call in contact name:	• BLACKBURN (Range Control)
Phone numbers (office and cell):	• 910-451-3064

Check-in or contact times must be based on the risk associated with the task, or the timeframe expected to complete the task, but at a minimum of at least two times during an 8 hour work shift.

Call in contact Form shall be completed by lone worker and given to call in contact prior to going into the field. Refer to the "Lone Worker Protocol" attached to this HSP.

Work tasks will cease if communication is lost during work day. Work may resume when communication is re-established.

10.0 Physical Hazards and Controls

10.1 Noise

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

CH2M HILL is required to control employee exposure to occupational noise levels of 85 decibels, A-weighted, (dBA) and above by implementing a hearing conservation program that meets the requirements of the OSHA Occupational Noise Exposure standard, 29 CFR 1910.95. A noise assessment may be conducted by the RHSM or designee based on potential to emit noise above 85 dBA and also considering the frequency and duration of the task.

- Areas or equipment emitting noise at or above 90dBA shall be evaluated to determine feasible engineering controls. When engineering controls are not feasible, administrative controls can be developed and appropriate hearing protection will be provided.
- Areas or equipment emitting noise levels at or above 85 dBA, hearing protection must be worn.
- Employees exposed to 84 dBA or a noise dose of 50% must participate in the Hearing Conservation program including initial and annual (as required) audiograms.
- The RHSM will evaluate appropriate controls measures and work practices for employees who have experienced a standard threshold shift (STS) in their hearing.
- Employees who are exposed at or above the action level of 85 dBA are required to complete the online Noise Training Module located on CH2M HILL's virtual office.
- Hearing protection will be maintained in a clean and reliable condition, inspected prior to use and after any occurrence to identify any deterioration or damage, and damaged or deteriorated hearing protection repaired or discarded.
- In work areas where actual or potential high noise levels are present at any time, hearing protection must be worn by employees working or walking through the area.
- Areas where tasks requiring hearing protection are taking place may become hearing protection required areas as long as that specific task is taking place.
- High noise areas requiring hearing protection should be posted or employees must be informed of the requirements in an equivalent manner.

10.2 Ultraviolet Radiation (sun exposure)

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

Limit Exposure Time

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

Provide Shade

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

Clothing

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

Sunscreen

- Apply sunscreen generously to all exposed skin surfaces at least 20 minutes before exposure, allowing time for it to adhere to the skin.
- Re-apply sunscreen at least every 2 hours, and more frequently when sweating or performing activities where sunscreen may be wiped off.
- Choose a sunscreen with a high sun protection factor (SPF). Most dermatologists advocate SPF 30 or higher for significant sun exposure.
- Waterproof sunscreens should be selected for use in or near water, and by those who perspire sufficiently to wash off non-waterproof products.

- Check for expiration dates, because most sunscreens are only good for about 3 years. Store in a cool place out of the sun.
- No sunscreen provides 100 percent protection against UV radiation. Other precautions must be taken to avoid overexposure.

10.3 Temperature Extremes

Each employee is responsible for the following:

- Recognizing the symptoms of heat or cold stress;
- Taking appropriate precautionary measures to minimize their risk of exposure to temperature extremes (see following sections); and
- Communicating any concerns regarding heat and cold stress to their supervisor or SC.

10.3.1 Heat

Heat-related illnesses are caused by more than just temperature and humidity factors.

Physical fitness influences a person's ability to perform work under heat loads. At a given level of work, the more fit a person is, the less the physiological strain, the lower the heart rate, the lower the body temperature (indicates less retrained body heat—a rise in internal temperature precipitates heat injury), and the more efficient the sweating mechanism.

Acclimatization is the degree to which a worker's body has physiologically adjusted or acclimatized to working under hot conditions. Acclimatization affects their ability to do work. Acclimatized individuals sweat sooner and more profusely than un-acclimatized individuals. Acclimatization occurs gradually over 1 to 2 weeks of continuous exposure, but it can be lost in as little as 3 days in a cooler environment.

Dehydration reduces body water volume. This reduces the body's sweating capacity and directly affects its ability to dissipate excess heat.

The ability of a body to dissipate heat depends on the ratio of its surface area to its mass (surface area/weight). **Heat dissipation** is a function of surface area, while heat production depends on body mass. Therefore, overweight individuals (those with a low ratio) are more susceptible to heat-related illnesses because they produce more heat per unit of surface area than if they were thinner. Monitor these persons carefully if heat stress is likely.

When wearing **impermeable clothing**, the weight of an individual is not as important in determining the ability to dissipate excess heat because the primary heat dissipation mechanism, evaporation of sweat, is ineffective.

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

Precautions

- Drink 16 ounces of water before beginning work. Disposable cups and water maintained at 50°Fahrenheit (10 degrees Celsius [C]) to 60°Fahrenheit (F) (15.6 degrees C) should be available. Under severe conditions, drink 1 to 2 cups every 20 minutes, for a total of 1 to 2 gallons (7.5 liters) per day. Do not use alcohol in place of water or other nonalcoholic fluids. Decrease your intake of coffee and caffeinated soft drinks during working hours.
- Acclimate yourself by slowly increasing workloads (do not begin with extremely demanding activities).
- Use cooling devices, such as cooling vests, to aid natural body ventilation. These devices add weight, so their use should be balanced against efficiency.
- Use mobile showers or hose-down facilities to reduce body temperature and cool protective clothing.
- Conduct field activities in the early morning or evening and rotate shifts of workers, if possible.
- Avoid direct sun whenever possible, which can decrease physical efficiency and increase the probability of heat stress. Take regular breaks in a cool, shaded area. Use a wide-brim hat or an umbrella when working under direct sun for extended periods.
- Provide adequate shade to protect personnel against radiant heat (sun, flames, hot metal).
- Maintain good hygiene standards by frequently changing clothing and showering.
- Observe one another for signs of heat stress. PREVENTION and communication is key.

Thermal Stress Monitoring

The following procedures should be implemented when the ambient air temperature exceeds 70° F (21 degrees C), the relative humidity is high (greater than 50 percent), or when the workers exhibit symptoms of heat stress.

- The heart rate should be measured by the radial pulse for 30 seconds, as early as possible in the resting period.
- The heart rate at the beginning of the rest period should not exceed 110 beats per minute, or 20 beats per minute above resting pulse.
- If the heart rate is higher, the next work period should be shortened by 33 percent, while the length of the rest period stays the same.
- If the pulse rate still exceeds 110 beats per minute at the beginning of the next rest period, the following work cycle should be further shortened by 33 percent.
- Continue this procedure until the rate is maintained below 110 beats per minute, or 20 beats per minute above resting pulse.
- Alternately, the oral temperature can be measured before the workers have something to drink.
- If the oral temperature exceeds 99.6 degrees F (37.6 degrees C) at the beginning of the rest period, the following work cycle should be shortened by 33 percent.
- Continue this procedure until the oral temperature is maintained below 99.6 degrees F (37.6 degrees C). While an accurate indication of heat stress, oral temperature is difficult to measure in the field.

10.3.2 Cold

General

Low ambient temperatures increase the heat lost from the body to the environment by radiation and convection. In cases where the worker is standing on frozen ground, the heat loss is also due to conduction.

Wet skin and clothing, whether because of water or perspiration, may conduct heat away from the body through evaporative heat loss and conduction. Thus, the body cools suddenly when chemical protective clothing is removed if the clothing underneath is perspiration soaked.

Movement of air across the skin reduces the insulating layer of still air just at the skin's surface. Reducing this insulating layer of air increases heat loss by convection.

Non-insulating materials in contact or near-contact with the skin, such as boots constructed with a metal toe or shank, conduct heat rapidly away from the body.

Certain common drugs, such as alcohol, caffeine, or nicotine, may exacerbate the effects of cold, especially on the extremities. These chemicals reduce the blood flow to peripheral parts of the body, which are already high-risk areas because of their large surface area to volume ratios. These substances may also aggravate an already hypothermic condition.

Precautions

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

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

Wind Chill Chart

Wind (mph)	Temperature (°F)																	
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

11.0 Biological Hazards and Controls

Biological hazards are everywhere and change with the region and season. If you encounter a biological hazard that has not been identified in this plan, contact the RHSM so that a revision to this plan can be made. Whether it is contact with a poisonous plant, a poisonous snake, or a bug bite, do not take bites or stings lightly. If there is a chance of an allergic reaction or infection, or to seek medical advice on how to properly care for the injury, contact the occupational nurse at 1-866-893-2514.

11.1 Black Bears

Bears may inhabit wooded areas where there is scarce continuous human presence. Make your presence known-especially when vegetation and terrain make it hard to see. Make noise, sing, or talk loudly. Avoid thick brush. Try to walk with the wind at your back so your scent will warn bears of your presence.

Give bears plenty of room. Every bear has a "personal space" - the distance within which a bear feels threatened – that can be from a few feet to a few hundred feet. If you stray within that zone, a bear may act aggressively. Never approach bears, even if only out of curiosity, and never attempt to feed bears.

If a bear cannot recognize you, he may come closer or stand on his hind legs for a better view. You may try to back away slowly diagonally, but if the bear follows, stop and stand your ground. If the bear moves closer or acts aggressively, stay close together and wave your arms and shout.

Do not climb a tree – black bears are good climbers.

Do not run. Bears have been clocked at speeds of up to 35 mph, and like dogs, will chase fleeing animals. Bears often make bluff charges, sometimes up to 10 feet away without making contact. Continue waving your arms and shouting. Never imitate bears sounds or use high-pitched squeals.

If attacked, do not run. Clasp your hands tightly over the back of your neck or if you are carrying a backpack use it to protect your head and neck and remain still.

For Black bears, if the attack lasts for more than a few seconds, respond aggressively - use sticks, rocks, your fists or noise. Black bears will sometimes back off if they are challenged.

11.2 Bees and Other Stinging Insects

Bees and other stinging insects may be encountered almost anywhere and may present a serious hazard, particularly to people who are allergic. Watch for and avoid nests. Keep exposed skin to a minimum. Carry a kit if you have had allergic reactions in the past, and inform your supervisor and/or a buddy. If you are stung, contact the occupational nurse at 1-866-893-2514. If a stinger is present, remove it carefully with tweezers. Wash and disinfect the wound, cover it, and apply ice. Watch for an allergic reaction if you have never been stung before. Call 911 if the reaction is severe.

11.3 Bird Droppings

Large amounts of bird droppings may present a disease risk. The best way to prevent exposure to fungus spores in bird droppings is to avoid disturbing it. A brief inhalation exposure to highly contaminated dust may be all that is needed to cause infection and subsequent development of fungal disease.

If disturbing the droppings or if removal is necessary to perform work, follow these controls:

- Use dust control measures (wetting with water or HEPA vacuuming) for all activities that may generate dust from the accumulated droppings.
- Wear Tyvek with hoods, disposable gloves and booties, and air-purifying respirators with a minimum N95 rating.
- Put droppings into plastic/poly bags and preferably into a 55-gallon drum to prevent bag from ripping.

11.4 Coyotes

While far from domesticated, coyotes show little fear of humans and have become comfortable living in close proximity to our communities. Although they tend to do most of their hunting after dusk, coyotes can be active at any time. Under normal circumstances, a coyote is not a danger to humans. They are, however, territorial and will respond aggressively if they or their family are threatened.

If you encounter a coyote that behaves aggressively, you have probably gotten too close to its prey or its family. Try to scare the coyote by yelling and waving your arms. Throw rocks, sticks or other objects. Do not turn away and run.

11.5 Mosquito Bites

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

- Stay indoors at dawn, dusk, and in the early evening;
- Wear long-sleeved shirts and long pants whenever you are outdoors;
- Spray clothing with repellents containing permethrin or N,N-diethyl-meta-toluamide (DEET) since mosquitoes may bite through thin clothing;
- Apply insect repellent sparingly to exposed skin. An effective repellent will contain 35% DEET. Repellents may irritate the eyes and mouth, so avoid applying repellent to the hands; and
- Whenever you use an insecticide or insect repellent, be sure to read and follow the manufacturer's DIRECTIONS FOR USE, as printed on the product.

Vitamin B and "ultrasonic" devices are NOT effective in preventing mosquito bites.

Symptoms of Exposure to the West Nile Virus

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

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

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

11.6 Poison Ivy, Poison Oak, and Poison Sumac

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

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

Poison Ivy

Poison Sumac

Poison Oak

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

- Direct skin contact with any part of the plant (even roots once above ground foliage has been removed).
- Contact with clothing that has been contaminated with the oil.

- Contact from removing shoes that have been contaminated (shoes are coated with urishol oil).
- Sitting in a vehicle that has become contaminated.
- Contact with any objects or tools that have become contaminated.
- Inhalation of particles generated by weed whacking, chipping, vegetation clearing.

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

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

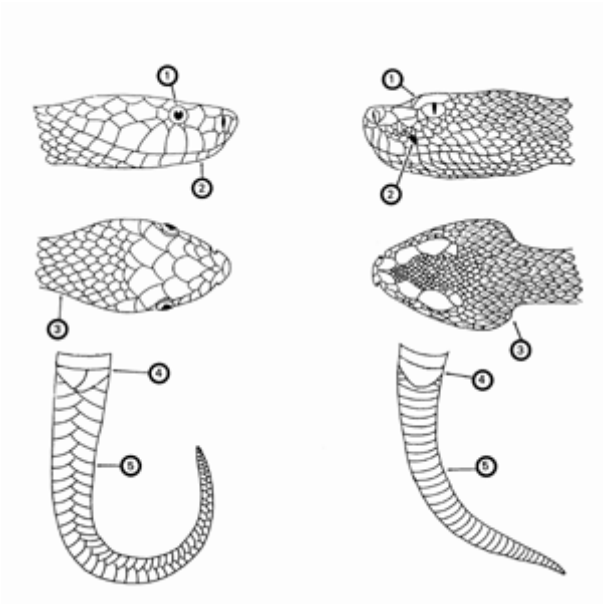
If you do come into contact with one of these poisonous plants and a reaction develops, contact your supervisor and the occupational nurse 1-866-893-2514.

11.7 Snakes

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

Identification of Poisonous Snakes

Major Identification Features Non-venomous Snake	Major Identification Features Venomous Snake
1. Round pupils	1. Elliptical pupils
2. No sensing pit	2. Sensing pit between eye and nostril
3. Head slightly wider than neck	3. Head much wider than neck
4. Divided anal plate	4. Single anal plate
5. Double row of scales on the underside of the tail	5. Single scales on the underside of the tail



11.8 Spiders - Brown Recluse and Widow

The Brown Recluse spider can be found most anywhere in the United States. It varies in size in shape, but the distinguishing mark is the violin shape on its body. They are typically non-aggressive. Keep an eye out for irregular, pattern-less webs that sometimes appear almost tubular built in a protected area such as in a crevice or between two rocks. The spider will retreat to this area of the web when threatened.

The Black Widow, Red Widow and the Brown Widow are all poisonous. Most have globose, shiny abdomens that are predominantly black with red markings (although some may be pale or have lateral stripes), with moderately long, slender legs. These spiders are nocturnal and build a three-dimensional tangled web, often with a conical tent of dense silk in a corner where the spider hides during the day.

Hazard Controls

- Inspect or shake out any clothing, shoes, towels, or equipment before use.
- Wear protective clothing such as a long-sleeved shirt and long pants, hat, gloves, and boots when handling stacked or undisturbed piles of materials.
- Minimize the empty spaces between stacked materials.
- Remove and reduce debris and rubble from around the outdoor work areas.
- Trim or eliminate tall grasses from around outdoor work areas.
- Store apparel and outdoor equipment in tightly closed plastic bags.
- Keep your tetanus boosters up-to-date (every 10 years). Spider bites can become infected with tetanus spores.

If you think you have been bit by a poisonous spider, immediately call the occupational nurse at 1-866-893-2514 and follow the guidance below:

- Remain calm. Too much excitement or movement will increase the flow of venom into the blood;
- Apply a cool, wet cloth to the bite or cover the bite with a cloth and apply an ice bag to the bite;
- Elevate the bitten area, if possible;
- Do not apply a tourniquet. Do not try to remove venom; and
- Try to positively identify the spider to confirm its type. If the spider has been killed, collect it in a plastic bag or jar for identification purposes. Do not try to capture a live spider—especially if you think it is a poisonous spider.

Black Widow

Red Widow

Brown Widow

Brown Recluse

11.9 Ticks

Every year employees are exposed to tick bites at work and at home putting them at risk of illness. Ticks typically are in wooded areas, bushes, tall grass, and brush. Ticks are black, black and red, or brown and can be up to one-quarter inch (6.4 mm) in size.

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

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

Take precautions to avoid exposure by including pre-planning measures for biological hazards prior to starting field work. Avoid habitats where possible, reduce the abundance through habitat disruption or application of acracide. If these controls aren't feasible, contact your local or regional warehouse for preventative equipment such as repellants, protective clothing and tick removal kits. Use the buddy system and perform tick inspections prior to entering the field vehicle. If ticks were not planned to be encountered and are observed, do not continue field work until these controls can be implemented.

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

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

Be sure to complete an Incident Report (either use the Hours and Incident Tracking System [HITS] system on the VO) if you do come in contact with a tick.

12.0 Contaminants of Concern

The table below summarizes the potential contaminants of concern (COC) and their occupational exposure limit and signs and symptoms of exposure. The table also includes the maximum concentration of each COC and the associated location and media that was sampled (groundwater, soil boring, surface soil). These concentrations were used to determine engineering and administrative controls described in the "Project-Specific Hazard Controls" section of this HSP, as well as PPE and site monitoring requirements.

Contaminant	**Location and Maximum[a] Concentration (ppm)**	**Exposure Limit[b]**	**IDLH[c]**	**Symptoms and Effects of Exposure**	**PIP[d] (eV)**
Arsenic	GW: SB: SS:	0.01 mg/m^3	5 Ca	Ulceration of nasal septum, respiratory irritation, dermatitis, gastrointestinal disturbances, peripheral neuropathy, hyperpigmentation	NA
Benzene	GW: SB: SS:	0.5 ppm	500 Ca	Eye, nose, skin, and respiratory irritation; headache; nausea; dermatitis; fatigue; giddiness; staggered gait; bone marrow depression	9.24
2-Butanone (Methyl Ethyl Ketone, MEK)	GW: SB: SS:	200 ppm	3,000	Eye, skin, and nose irritation; headache; dizziness; vomiting; dermatitis	9.54
Cadmium	GW: SB: SS:	0.005 mg/m^3	9 Ca	Pulmonary edema, coughing, chest tightness/pain, headache, chills, muscle aches, nausea, vomiting, diarrhea, difficulty breathing, loss of sense of smell, emphysema, mild anemia	NA
Carbon Tetrachloride	GW: SB: SS:	2 ppm	200 Ca	Central nervous system (CNS) depression, nausea, vomiting, eye and skin irritation, liver and kidney injury, drowsiness, dizziness	11.47
Chlordane	GW: SB: SS:	0.5 mg/m^3	100 Ca	Blurred vision, confusion, ataxia, delirium, coughing, abdominal pain, nausea, vomiting, diarrhea, irritability, tremors anuria	UK
Chlorobenzene	GW: SB: SS:	10 ppm	1,000	Skin, eye, and nose irritation; drowsiness; uncoordination; CNS depression	9.07
Chloroform	GW: SB: SS:	2 ppm	500 Ca	Dizziness, mental dullness, nausea, confusion, disorientation, headache, fatigue, eye and skin irritation, anesthesia, enlarged liver	11.42

Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Chromium (as Cr(II) & Cr(III))	GW: SB: SS:	0.5 mg/m^3	25	Irritated eyes, sensitization dermatitis, histologic fibrosis of lungs	NA
Chromium (hexavalent)	GW: SB: SS:	0.005 mg/m^3	15 Ca	Irritated respiratory system, nasal septum perforation, liver and kidney damage, leucytosis, leupen, monocytosis, eosinophilla, eye injury, conjunctivitis, skin ulcer, sensitization dermatitis	NA
Cobalt (Metal, Dusts, and Fumes)	GW: SB: SS:	0.05 mg/m^3	20	Coughing, difficulty breathing, wheezing, decreased pulmonary function, diffuse nodule fibrosous, dermatitis, respiratory hypersensitivity, asthma	NA
Cresol (all isomers of 2-, 3-, & 4-methylphenol)	GW: SB: SS:	5 ppm	250	Eye, skin, and mucous membrane irritant; CNS effects including confusion, depression, and respiratory failure; difficulty breathing; irregular rapid respiration; weak pulse; eye and skin burns; dermatitis; lung, liver, kidney, and pancreas damage	8.98
DDT	GW: SB: SS:	0.5 mg/m^3	500 Ca	Paresthesia of tongue, lips, hand, and face; tremors; dizziness; confusion; headache; fatigue; convulsion; eye and skin irritation; vomiting	UK
Dibutylphthalate (DBP)	GW: SB: SS:	5 mg/m^3	4,000	Eye, upper respiratory system, and stomach irritant	UK
o-Dichlorobenzene (1,2-Dichlorobenzene)	GW: SB: SS:	25 ppm	200	Nose and eye irritation, liver and kidney damage, skin blisters	9.06
p-Dichlorobenzene (1,4-Dichlorobenzene)	GW: SB: SS:	10 ppm	150 Ca	Headache, eye irritation, nausea, vomiting, swelling periorbital, profus rhinitis, jaundice, cirrhosis	8.98
1,1-Dichloroethane	GW: SB: SS:	100 ppm	3,000	CNS depression, skin irritation; liver, kidney, and lung damage	11.06
1,2-Dichloroethane (Ethylene Dichloride)	GW: SB: SS:	1 ppm	50 Ca	CNS depression, nausea, vomiting, dermatitis, eye irritation, liver, kidney, and CNS damage; corneal opacity	11.05

Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Bis-(2-ethylhexyl)phthalate (DEHP, DOP)	GW: SB: SS:	5 mg/m^3	5,000 Ca	Eye and mucous membrane irritant	UK
Endosulfan	GW: SB: SS:	0.1 mg/m^3	NL	Irritated skin, nausea, confusion, agitation, flushing, dry mouth, tremor, convulsion, headache	UK
Ethyl Benzene	GW: SB: SS:	100 ppm	800	Eye, skin, and mucous membrane irritation; headache; dermatitis; narcotic; coma	8.76
Diesel Range Organics	GW: SB: SS:	100 mg/m^3 (REL)	NL	Primary system effect is CHS depression. Inhalation of vapors may cause nausea, confusion, drowsiness, convulsions, and coma. Liquid may cause skin and eye irritation.	UK
Gasoline Range Organics	GW: SB: SS:	300 ppm	ND Ca	Eye, skin and mucous membrane irritation; dermatitis, headache, fatigue, blurred vision, dizziness, slurred speech, confusion, convulsions, chemical pneumonia on aspiration, possible liver and kidney damage	UK
Hexavalent Chromium	GW: SB: SS:	5 ug/m^3 (insoluble) 1 ug/m^3 (soluble)	ND	Acute: Coughing, sneezing, chest pain, breathing difficulty, itching and burning sensation to skin and lungs. Long term (Chronic): Allergic (asthma like symptoms) respiratory reaction, skin and eye irritation, nosebleeds, contact dermatitis, allergic like skin reaction, ulceration and perforation of the nasal septum.	NA
Lead	GW: SB: SS:	0.05 mg/m^3	100	Weakness lassitude, facial pallor, pal eye, weight loss, malnutrition, abdominal pain, constipation, anemia, gingival lead line, tremors, paralysis of wrist and ankles, encephalopathy, kidney disease, irritated eyes, hypertension	NA
Mercury	GW: SB: SS:	0.025 mg/m^3	10	Skin and eye irritation, cough, chest pain, difficult breathing, bronchitis, pneumontitis, tremors, insomnia, irritability, indecision, headache, fatigue, weakness, GI disturbance	

Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
MTBE		40 ppm (ACGIH)		Breathing small amounts of MTBE for short periods may cause nose and throat irritation. Is a flammable liquid with a distinctive, disagreeable odor	
Naphthalene	GW: SB: SS:	10 ppm	250	Eye irritation, headache, confusion, excitement, nausea, vomiting, abdominal pain, bladder irritation, profuse sweating, dermatitis, corneal damage, optical neuritis	8.12
PCBs (Limits as Aroclor 1254)	GW: SB: SS:	0.5 mg/m^3	5 Ca	Eye and skin irritation, acne-form dermatitis, liver damage, reproductive effects	UK
PNAs (Limits as Coal Tar Pitch)	GW: SB: SS:	02 mg/m^3	80 Ca	Dermatitis and bronchitis	UK
1,1,2,2-Tetrachloroethane (Tetrachlorethane)	GW: SB: SS:	1 ppm	100 Ca	Nausea, vomiting, abdominal pain, finger tremors, jaundice, hepatitis, liver tenderness, monocytosis, kidney damage, dermatitis	11.10
Tetrachloroethylene (PCE)	GW: SB: SS:	25 ppm	150 Ca	Eye, nose, and throat irritation; nausea; flushed face and neck; vertigo; dizziness; sleepiness; skin redness; headache; liver damage	9.32
1,1,2-Trichloroethane	GW: SB: SS:	10 ppm	100 Ca	Eye and nose irritation, CNS depression, liver damage, dermatitis	11.00
Trichloroethylene (TCE)	GW: SB: SS:	10 ppm	1,000 Ca	Headache, vertigo, visual disturbance, eye and skin irritation, fatigue, giddiness, tremors, sleepiness, nausea, vomiting, dermatitis, cardiac arrhythmia, paresthesia, liver injury	9.45
Toluene	GW: SB: SS:	50 ppm	500	Eye and nose irritation, fatigue, weakness, confusion, dizziness, headache, dilated pupils, excessive tearing, nervousness, muscle fatigue, paresthesia, dermatitis, liver and kidney damage	8.82

Contaminant	Location and Maximum[a] Concentration (ppm)	Exposure Limit[b]	IDLH[c]	Symptoms and Effects of Exposure	PIP[d] (eV)
Xylenes	GW: SB: SS:	100 ppm	900	Irritated eyes, skin, nose, and throat; dizziness; excitement; drowsiness; incoherence; staggering gait; corneal vacuolization; anorexia; nausea; vomiting; abdominal pain; dermatitis	8.56
Vinyl Chloride	GW: SB: SS:	1 ppm	NL Ca	Weakness, abdominal pain, gastrointestinal bleeding, enlarged liver, pallor or cyanosis of extremities	9.99
Vinylidene Chloride (1,1-dichloroethylene)	GW: SB: SS:	1 ppm	NL Ca	Eye, skin, and throat irritation; dizziness; headache; nausea; difficult breathing; liver and kidney dysfunction; pneumonitis	10.0

Footnotes:

[a] Specify sample-designation and media: SB (Soil Boring), A (Air), D (Drums), GW (Groundwater), L (Lagoon), TK (Tank), S (Surface Soil), SL (Sludge), SW (Surface Water).
[b] Appropriate value of PEL, REL, or TLV listed.
[c] IDLH = immediately dangerous to life and health (units are the same as specified "Exposure Limit" units for that contaminant); NL = No limit found in reference materials; CA = Potential occupational carcinogen.
[d] PIP = photoionization potential; NA = Not applicable; UK = Unknown.

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

13.0 Site Monitoring

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

When performing site monitoring, record all the information, such as in a field logbook. Note date and time, describe monitoring location (for example, in breathing zone, at source and site location), and what the reading is. If any action levels are reached, note it in the field logbook and note the action taken.

Exposure records (air sampling) must be preserved for the duration of employment plus thirty years. Ensure that copies of the field log book are maintained in the project file.

Copies of all project exposure records (e.g., copies of field logbook pages where air monitoring readings are recorded and associated calibration) shall be sent to the regional SPA for retention and maintained in the project files.

13.1 Direct Reading Monitoring Specifications

Instrument	Tasks	Action Levels[a]	Action to be Taken when Action Level reached	Frequency [b]	Calibration
Toxic Gas Monitor: MultiRAE Plus with 11.7 eV lamp (VOCs, O_2, LEL, CO,, H_2S)	Groundwater and soil sampling Drilling/Well Installation	<1 ppm 1 to 5 ppm >5 ppm	Level D Level C Level B, not authorized, stop work and contact HSM	Initially and periodically during task	Daily
Dust Monitor: DataRAM or equivalent	Well Installation and Drilling Groundwater Sampling and soil sampling	<5mg/m3 or visible dust >5mg/m3 or visible dust	Level D Evacuate work area and contact HSM	Continuous during advancement of boring	Daily
Colormetric Tube: Drager benzene or vinyl chloride specific (0.5 to 30 ppm range) with pre-tube, or equivalent	Whenever PID ≥1 PPM	< 1 ppm 1-10 ppm >10 ppm	→ Level D → Level C → Level B	Initially and periodically when PID >1 ppm	Not Applicable

[a] Action levels apply to sustained breathing-zone measurements above background.
[b] The exact frequency of monitoring depends on field conditions and is to be determined by the SC; generally, every 5 to 15 minutes if acceptable; more frequently may be appropriate.
[c] If the measured percent of O_2 is less than 10, an accurate LEL reading will not be obtained. Percent LEL and percent O_2 action levels apply only to ambient working atmospheres, and not to confined-space entry. More-stringent percent LEL and O_2 action levels are required for confined-space entry.
[d] Noise monitoring and audiometric testing also required.

13.2 Calibration Specifications

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

Instrument	Gas	Span	Reading	Method
PID: OVM, 10.6 or 11.8 eV bulb	100 ppm isobutylene	RF = 1.0	100 ppm	1.5 lpm reg T-tubing
Dust Monitor: DataRAM	Dust-free air	Not applicable	0.00 mg/m^3 in "Measure" mode	Dust-free area OR Z-bag with HEPA filter

Calibrate air monitoring equipment daily (or prior to use) in accordance with the instrument's instructions. Document the calibration in the field logbook (or equivalent) and include the following information:

- Instrument name
- Serial Number
- Owner of instrument (for example, CH2M HILL, HAZCO)
- Calibration gas (including type and lot number)
- Type of regulator (for example, 1.5 lpm)
- Type of tubing (for example, direct or T-tubing)
- Ambient weather condition (for example, temperature and wind direction)
- Calibration/instrument readings
- Operator's name and signature
- Date and time

13.3 Integrated Personal Air Sampling

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

Method Description

Not Anticipated

Personal Breathing Zone and Area Samples

Personal breathing zone and area sampling results must be sent immediately to the RHSM.

Employees potentially exposed to the substances for which air sampling is being performed shall be given the opportunity to observe the exposure measurements, and records shall be made available to all affected employees upon request or when they are required to be provided by a specific regulation. Employees may also receive a copy of their exposure records from the Medical Surveillance Program Administrator (MSPA).

14.0 Personal Protective Equipment

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

14.1 Required Personal Protective Equipment

PPE must be worn by employees when actual or potential hazards exist and engineering controls or administrative practices cannot adequately control those hazards.

A PPE assessment has been conducted by the RHSM based on project tasks (see PPE specifications below). Verification and certification of assigned PPE by task is completed by the RHSM that approved this plan. Below are items that need to be followed when using any form of PPE:

- Employees must be trained to properly wear and maintain the PPE;
- In work areas where actual or potential hazards are present at any time, PPE must be worn by employees working or walking through the area;
- Areas requiring PPE should be posted or employees must be informed of the requirements in an equivalent manner;
- PPE must be inspected prior to use and after any occurrence to identify any deterioration or damage;
- PPE must be maintained in a clean and reliable condition;
- Damaged PPE shall not be used and must either be repaired or discarded; and
- PPE shall not be modified, tampered with, or repaired beyond routine maintenance.

The table below outlines PPE to be used according to task based on project-specific hazard assessment. If a task other than the tasks described in this table needs to be performed, contact the RHSM so this table can be updated.

Project-Specific Personal Protective Equipment Requirements[a]

Task	Level	Body	Head	Respirator [b]
General Site Entry Surveying Utility Clearance,	D	Work clothes; safety toed leather work boots and gloves	Hardhat [c] Safety glasses with side shields Ear protection [d]	None required
-Subsurface Soil Sampling -Sediment Sampling -Surface Soil Sampling -Ground Water, Surface Water Sampling -Drilling/Well Installation -Investigation-derived waste (drum) sampling and disposal **if contact with contaminated sediment, soil or water is anticipated	Modified D	Work clothes or cotton coveralls **Boots:** Safety-toe, chemical-resistant boots OR Safety -toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves. OR Work Clothes or Coveralls. SC to determine body protection based on potential contact with site contaminants. If outer layer of personal clothing cannot be kept clean, then outer cotton coveralls or uncoated Tyvek coveralls shall be worn. (Polycoated Tyvek when there is potential to contact contaminated groundwater or free liquids from drums.)	Hardhat [c] Safety glasses with side shields Ear protection [d]	None required

Project-Specific Personal Protective Equipment Requirements[a]

Task	Level	Body	Head	Respirator [b]
Work near vehicular traffic ways or earth moving equipment.	All	Appropriate level of ANSI/ISEA 107-2004 high-visibility safety vests.	Work near vehicular traffic ways or earth moving equipment.	
Equipment decontamination if using pressure washer	Modified D with splash protection	Work clothes or cotton coveralls **Boots:** Safety -toe, leather work boots **Gloves:** Surgical-style nitrile gloves..	Hardhat [c] Splash shield [c] over safety glasses with side shields or splash goggles Ear protection [d]	None required.
Tasks requiring upgrade	C	**Coveralls:** Polycoated Tyvek® **Boots:** Safety -toe, chemical-resistant boots OR Safety -toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] Ear protection [d] Spectacle inserts	APR, full face, MSA Ultratwin or equivalent; [Lead] [e].
Tasks requiring upgrade NOT AUTHORIZED CONTACT HSM	B	**Coveralls:** Polycoated Tyvek® **Boots:** Safety -toe, chemical-resistant boots OR Safety -toe, leather work boots with outer rubber boot covers **Gloves:** Inner surgical-style nitrile & outer chemical-resistant nitrile gloves.	Hardhat [c] Splash shield [c] Ear protection [d] Spectacle inserts	Positive-pressure demand self-contained breathing apparatus (SCBA); MSA Ultralite, or equivalent.

Reasons for Upgrading or Downgrading Level of Protection (with approval of the RHSM)

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

[a] Modifications are as indicated. CH2M HILL will provide PPE only to CH2M HILL employees.
[b] No facial hair that would interfere with respirator fit is permitted.
[c] Hardhat and splash-shield areas are to be determined by the SC.
[d] Ear protection should be worn when conversations cannot be held at distances of 3 feet (1 meter) or less without shouting.
[e] See cartridge change-out schedule.
[f] Performing a task that requires an upgrade to a higher level of protection (e.g., Level D to Level C) is permitted only when the PPE requirements have been approved by the RHSM, and an SC qualified at that level is present.

14.2 Respiratory Protection

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

Implement the following if respiratory protection is warranted based on field conditions:

- Respirator users must have completed appropriate respirator training within the past 12 months. Level C training is required for air-purifying respirators (APR) use and Level B training is required for supplied-air respirators (SAR) and self-contained breathing apparatus (SCBA) use. Specific training is required for the use of powered air-purifying respirators (PAPR).
- Respirator users must complete the respirator medical monitoring protocol and been approved for the specific type of respirator to be used.
- Tight-fitting facepiece respirator (negative or positive pressure) users must have passed an appropriate fit test within past 12 months.
- Respirator use shall be limited to those activities identified in this plan. If site conditions change that alters the effectiveness of the specified respiratory protection, the RHSM shall be notified to amend the written plan.
- Tight-fitting facepiece respirator users shall be clean-shaven and shall perform a user seal check before each use.
- Canisters/cartridges shall be replaced according to the change-out schedule specified in this plan. Respirator users shall notify the SC or RHSM of any detection of vapor or gas breakthrough. The SC shall report any breakthrough events to the RHSM for schedule upgrade.
- Respirators in regular use shall be inspected before each use and during cleaning
- Respirators in regular use shall be cleaned and disinfected as often as necessary to ensure they are maintained in a clean and sanitary condition.
- Respirators shall be properly stored to protect against contamination and deformation.
- Field repair of respirators shall be limited to routine maintenance. Defective respirators shall be removed from service.
- When breathing air is supplied by cylinder or compressor, the SC or RHSM shall verify the air meets Grade D air specifications.
- The SC or designee shall complete the H&S Self-Assessment Checklist – Respiratory Protection included in as attachment to this plan to verify compliance with CH2M HILL's respiratory protection program.

15.0 Worker Training and Qualification

15.1 CH2M HILL Worker Training

(Reference CH2M HILL SOP HSE-110, *Training*)

15.1.1 Hazardous Waste Operations Training

All employees engaging in hazardous waste operations or emergency response shall receive appropriate training as required by 29 CFR 1910.120 and 29 CFR 1926.65. At a minimum, the training shall have consisted of instruction in the topics outlined in 29 CFR 1910.120 and 29 CFR 1926.65. Personnel who have not met these training requirements shall not be allowed to engage in hazardous waste operations or emergency response activities.

15.1.1.1 Initial Training

General site workers engaged in hazardous waste operations shall, at the time of job assignment, have received a minimum of 40 hours of initial health and safety training for hazardous waste site operations, unless otherwise noted in the above-referenced standards.

Employees who may be exposed to health hazards or hazardous substances at treatment, storage, and disposal (TSD) operations shall receive a minimum of 24 hours of initial training to enable the employee to perform their assigned duties and functions in a safe and healthful manner.

Employees engaged in emergency response operations shall be trained to the level of required competence in accordance with 29 CFR 1910.120.

15.1.1.2 Three-Day Actual Field Experience

General site workers for hazardous waste operations shall have received three days of actual experience (on-the-job training) under the direct supervision of a trained, qualified supervisor and shall be documented. If the field experience has not already been received and documented at a similar site, this supervised experience shall be accomplished and documented at the beginning of the assignment of the project.

15.1.1.3 Refresher Training

General site workers and TSD workers shall receive 8-hours of refresher training annually (within the previous 12-month period) to maintain qualifications for fieldwork. Employees engaged in emergency response operations shall receive annual refresher training of sufficient content and duration to maintain their competencies or shall demonstrate competency in those areas at least annually.

15.1.1.4 Eight-Hour Supervisory Training

On site management or supervisors who will be directly responsible for, or supervise employees engaged in hazardous waste site operations, will have received at least 8 hours of additional specialized training on managing such operations. Employees designated as Safety Coordinator – Hazardous Waste are considered 8-hour HAZWOPER Site Safety Supervisor trained.

15.1.2 First Aid/Cardiopulmonary Resuscitation

First aid and CPR training consistent with the requirements of a nationally recognized organization such as the American Red Cross Association or National Safety Council shall be administered by a certified trainer. A minimum of two personnel per active field operation will have first aid and CPR training. Bloodborne pathogen training located on CH2M HILL's Virtual Office is also required for those designated as first aid/CPR trained.

15.1.3 Safety Coordinator Training

SCs are trained to implement the HSE program on CH2M HILL field projects. A qualified SC is required to be identified in the site-specific HSP for CH2M HILL field projects. SCs must also meet the requirements of the worker category appropriate to the type of field project (construction or hazardous waste). In addition, the SCs shall have completed additional safety training required by the specific work activity on the project that qualifies them to implement the HSE program (for example, fall protection, excavation).

15.1.4 Site-Specific Training

Prior to commencement of field activities, all field personnel assigned to the project will have completed site-specific training that will address the contents of applicable HSPs, including the activities, procedures, monitoring, and equipment used in the site operations. Site-specific training will also include site and facility layout, potential hazards, risks associated with identified emergency response actions, and available emergency services. This training allows field workers to clarify anything they do not understand and to reinforce their responsibilities regarding safety and work operations for their particular activity.

15.1.5 Project-Specific Training Requirements

Project-specific training for this project includes:

- Training on CH2M HILL HSP and AHAs;
- Training on subcontractor or client AHAs;
- Drilling (subcontractor)

The training listed below is required computer-based training located on CH2M HILL's Virtual Office (VO) at

https://www.int.ch2m.com/safety%5Fcounts/Training/Computer_Based_Courses.asp

- Lifting training (part of new employee orientation training or available on the Virtual Office);
- Arsenic training (on the Virtual Office)
- Lead Exposure training (on the Virtual Office)
- Bloodborne Pathogen Training (on the Virtual Office)
- Dangerous Goods training (on the Virtual Office)
- Environmental Awareness (on the Virtual Office)
- Noise Exposure training (on the Virtual Office)

- Hand Safety (on the Virtual Office)
- Munitions 3R Training

Project Manager/Site Supervisor Training

Project managers or persons having site supervision responsibilities must complete

- Project Manager/Site Supervisor Training(on the Virtual Office)
- Initial Safety Coordinator Training.(on the Virtual Office)

16.0 Medical Surveillance and Qualification

All site workers participating in hazardous waste operations or emergency response will maintain an adequate medical surveillance program in accordance with 29 CFR 1910.120 or 29 CFR 1926.65 and other applicable OSHA standards. Documentation of employee medical qualification (e.g., physician's written opinion) will be maintained in the project files and made available for inspection.

16.1 Hazardous Waste Operations and Emergency Response

CH2M HILL personnel expected to participate in on site hazardous waste operations or emergency response are required to have a current medical qualification for performing this work. Medical qualification shall consist of a qualified physician's written opinion regarding fitness for duty at a hazardous waste site, including any recommended limitations on the employee's assigned work. The physician's written opinion shall state whether the employee has any detected medical conditions that would place the employee at increased risk of material impairment of the employee's health from work in hazardous waste operations or emergency response, or from respirator use.

16.2 Job or Site-Specific Medical Surveillance

Due to the nature of hazards for a particular job or work site, specialized medical surveillance may be necessary. This surveillance could include biological monitoring for specific compounds, or specialized medical examinations.

Site-specific medical surveillance includes:

- N/A

16.3 Respirator User Qualification

Personnel required to wear respirators must have a current medical qualification to wear respirators. Medical qualification shall consist of a qualified physician's written opinion regarding the employee's ability to safely wear a respirator in accordance with 29 CFR 1910.134.

16.4 Hearing Conservation

Personnel working in hazardous waste operations or operations that fall under 29 CFR 1910.95 and exposed to noise levels in excess of the 85dBA time-weighted average shall be included in a hearing conservation program that includes annual audiometric testing.

17.0 Site-Control Plan

17.1 Site-Control Procedures

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

Site control is established to prevent the spread of contamination throughout the site and to ensure that only authorized individuals are permitted into potentially hazardous areas.

The SC will implement site control procedures including the following bulleted items.

- Establish support, contamination reduction, and exclusion zones. Delineate with flags or cones as appropriate. Support zone should be upwind of the site. Use access control at entry and exit from each work zone.
- Establish onsite communication consisting of the following:
  - Line-of-sight and hand signals;
  - Air horn; and
  - Two-way radio or cellular telephone if available.
- Establish offsite communication.
- Establish and maintain the "buddy system."

17.2 Remediation Work Area Zones

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

A three-zone approach will be used to control areas where site contaminants exist. Access will be allowed only after verification of appropriate training and medical qualification. The three-zone approach shall include an EZ, Contamination Reduction Zone (CRZ) and a Support Zone (SZ). The three-zone approach is not required for construction work performed outside contaminated areas where control of site contamination is not a concern.

Specific work control zones shall be established as necessary during task planning. Site work zones should be modified in the field as necessary, based on such factors as equipment used, air monitoring results, environmental conditions, or alteration of work plans. The following guidelines shall be used for establishing and revising these preliminary zone designations.

17.2.1 Support Zone

The SZ is an uncontaminated area (trailers, offices, field vehicles, etc.) that will serve as the field support area for most operations. The SZ provides field team communications and staging for emergency response. Appropriate sanitary facilities and safety and emergency response equipment will be located in this zone. Potentially contaminated personnel/materials are not allowed in this zone. The only exception will be appropriately packaged and decontaminated materials, or personnel with medical emergencies that cannot be decontaminated.

17.2.2 Contamination Reduction Zone

The CRZ is established between the EZ and the SZ, upwind of the contaminated area where possible. The CRZ provides an area for decontamination of personnel, portable handheld equipment and tools, and heavy equipment. In addition, the CRZ serves as access for heavy equipment and emergency support services.

17.2.3 Exclusion Zone

The EZ is where activities take place that may involve exposure to site contaminants and/or hazardous materials or conditions. This zone shall be demarcated to prevent unauthorized entry. More than one EZ may be established if there are different levels of protection to be employed or different hazards that exist in the same work area. The EZ shall be large enough to allow adequate space for the activity to be completed, including field personnel and equipment, as well as necessary emergency equipment.

The EZ shall be demarcated with some form of physical barrier or signage. The physical barrier or signage shall be placed so that they are visible to personnel approaching or working in the area. Barriers and boundary markers shall be removed when no longer needed.

17.2.4 Other Controlled Areas

Other work areas may need to be controlled due to the presence of an uncontrolled hazard, to warn workers of requirements, or to prevent unauthorized entry. Examples include general construction work areas, open excavations, high noise areas, vehicle access areas, and similar activities or limited access locations. These areas shall be clearly demarcated with physical barriers (fencing, cones, reinforced caution tape or rope) as necessary and posted with appropriate signage.

18.0 Decontamination

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

Decontamination areas will be established for work in potentially contaminated areas to prevent the spread of contamination. Decontamination areas should be located upwind of the exclusion zone where possible and should consider any adjacent or nearby projects and personnel. The SC must establish and monitor the decontamination procedures and their effectiveness. Decontamination procedures found to be ineffective will be modified by the SC. The SC must ensure that procedures are established for disposing of materials generated on the site.

No eating, drinking, or smoking is permitted in contaminated areas and in exclusion or decontamination zones. The SC should establish areas for eating, drinking, and smoking.

18.1 Contamination Prevention

Preventing or avoiding contamination of personnel, tools, and equipment will be considered in planning work activities at all field locations. Good contamination prevention and avoidance practices will assist in preventing worker exposure and result in a more efficient decontamination process. Procedures for contamination prevention and avoidance include the following:

- Do not walk through areas of obvious or known contamination;
- Do not directly handle or touch contaminated materials;
- Make sure there are no cuts or tears in PPE;
- Fasten all closures in suits and cover them with duct tape, if appropriate;
- Take particular care to protect any skin injuries;
- Stay upwind of airborne contamination, where possible;
- Do not eat or drink in contaminated work areas;
- Do not carry food, beverages, tobacco, or flame-producing equipment into contaminated work areas;
- Minimize the number of personnel and amount of equipment in contaminated areas to that necessary for accomplishing the work;
- Choose tools and equipment with nonporous exterior surfaces that can be easily cleaned and decontaminated;
- Cover monitoring and sampling equipment with clear plastic, leaving openings for the sampling ports, as necessary; and
- Minimize the amount of tools and equipment necessary in contaminated areas.

18.2 Personnel and Equipment Decontamination

Personnel exiting an EZ must ensure that they are not spreading potential contamination into clean areas or increasing their potential for ingesting or inhaling potential contaminants. Personal decontamination may range from removing outer gloves as exiting the EZ, to proceeding through an outer layer doffing station including a boot and glove wash and rinse, washing equipment, etc. Equipment that has come into contact with contaminated media must also be cleaned/decontaminated when it is brought out of the EZ.

18.3 Decontamination During Medical Emergencies

Standard personnel decontamination practices will be followed whenever possible. For emergency life saving first aid and/or medical treatment, normal decontamination procedures may need to be abbreviated or omitted. In this situation, site personnel shall accompany contaminated victims to advise emergency response personnel on potential contamination present and proper decontamination procedures.

Outer garments may be removed if they do not cause delays, interfere with treatment, or aggravate the problem. Protective clothing can be cut away. If the outer garments cannot be safely removed, a plastic barrier between the individual and clean surfaces should be used to help prevent contaminating the inside of ambulances or medical personnel. Outer garments can then be removed at the medical facility.

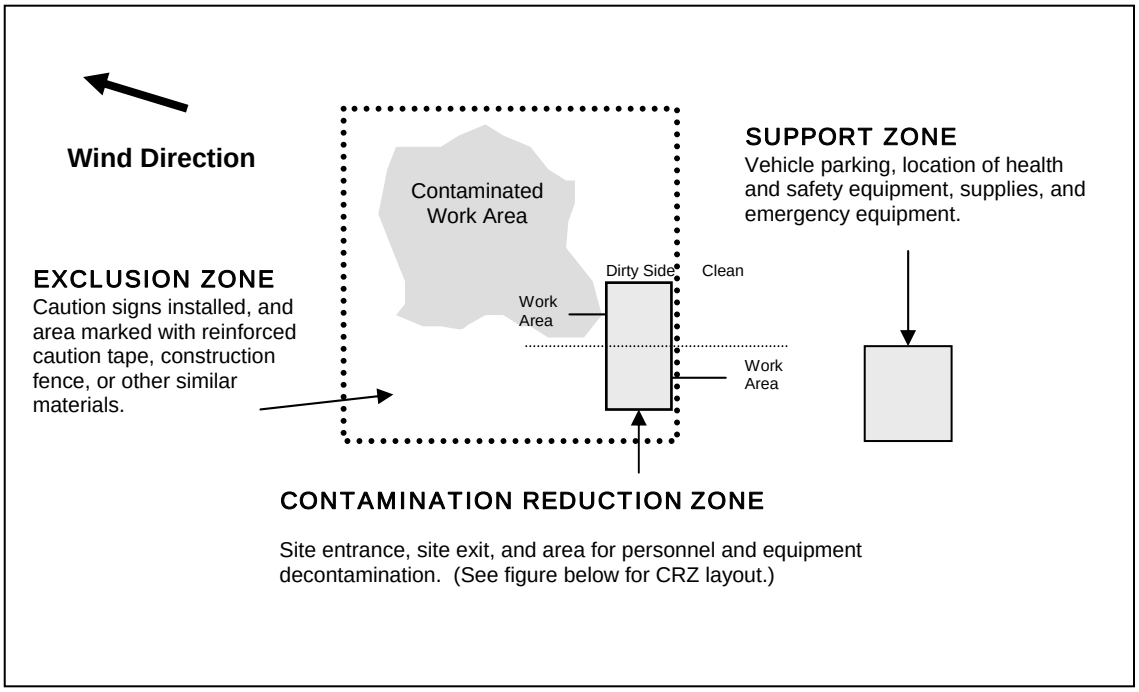
18.4 Waste Collection and Disposal

All contaminated material generated through the personnel and equipment decontamination processes (e.g., contaminated disposable items, gross debris, liquids, sludges) will be properly containerized and labeled, stored at a secure location, and disposed in accordance with the project plans.

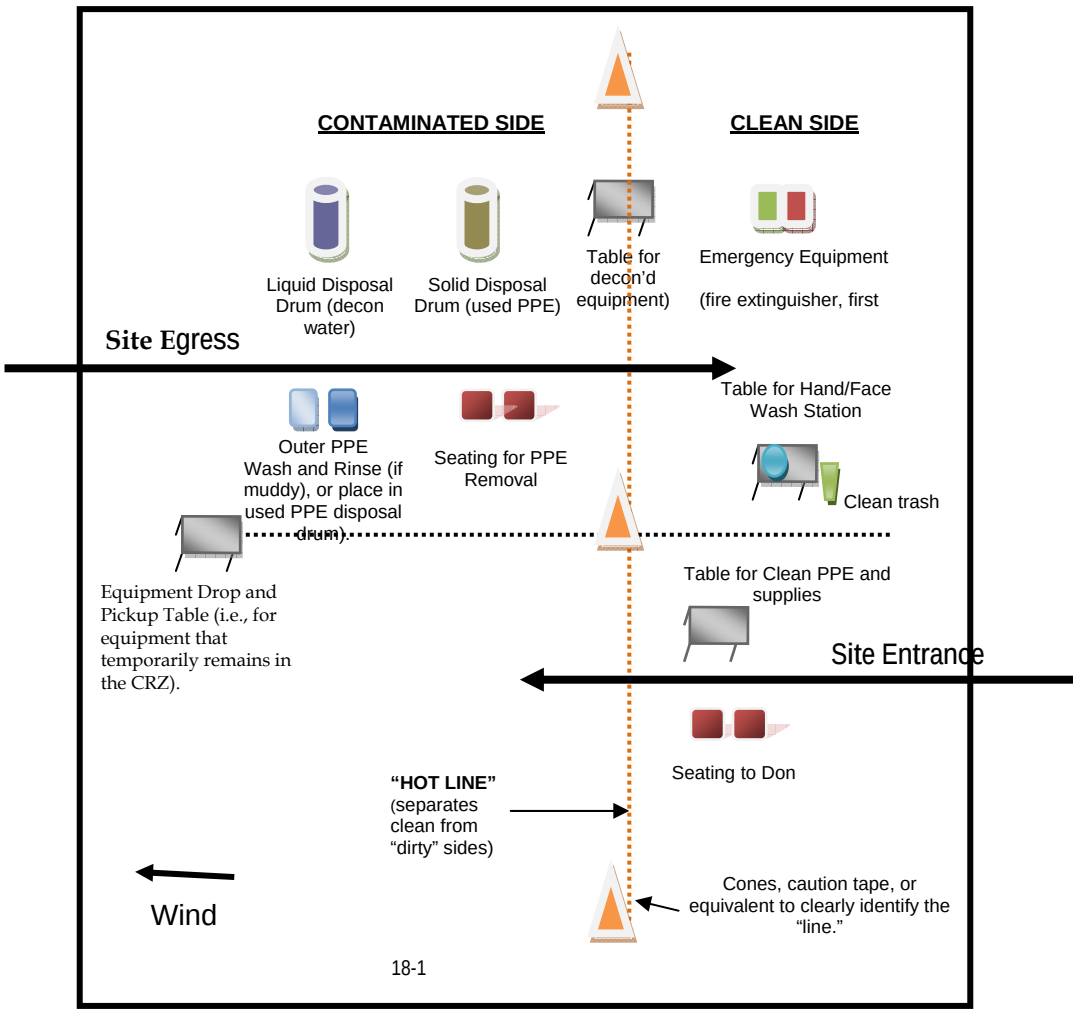
18.5 Diagram of Personnel-Decontamination Line

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

Work Area - Set up appropriately based on wind direction



Typical Contamination Reduction Zone



19.0 Emergency Response Plan

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

19.1 Pre-Emergency Planning

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

19.2 Emergency Equipment and Supplies

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

Emergency Equipment and Supplies	Location
20 (or two 10) class A,B,C fire extinguisher	Support zone, field vehicle
First aid kit	Support zone, field vehicle
Eye Wash	Support zone, field vehicle
Potable water	Support zone, field vehicle
Bloodborne-pathogen kit	Support zone, field vehicle
Additional equipment (specify): Cell Phone, Spill kit	Support zone, field vehicle

19.3 Incident Response

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

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

Small fires or spills posing minimal safety or health hazards may be controlled with onsite spill kits or fire extinguishers without evacuating the site. When in doubt evacuate. Follow the incident reporting procedures in the "Incident Notification, Reporting, and Investigation" section of this HSP.

19.4 Emergency Medical Treatment

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

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

- Follow the Serious Incident Reporting process in HSE SOP-111, Incident Notification, Reporting and Investigation, and complete incident report using the HITS system on the Virtual Office or if not feasible, use the hard copy forms provided as an attachment to this HSP.
- Notify and submit reports to client as required in contract.

19.5 Evacuation

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

19.6 Evacuation Signals

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

19.7 Inclement Weather

Sudden inclement weather can rapidly encroach upon field personnel. Preparedness and caution are the best defenses. Field crew members performing work outdoors should carry clothing appropriate for inclement weather. Personnel are to take heed of the weather forecast for the day and pay attention for signs of changing weather that indicate an impending storm. Signs include towering thunderheads, darkening skies, or a sudden increase in wind. If stormy weather ensues, field personnel should discontinue work and seek shelter until the storm has passed.

Protective measures during a lightning storm include seeking shelter; avoiding projecting above the surrounding landscape (don't stand on a hilltop--seek low areas); staying away from open water, metal equipment, railroad tracks, wire fences, and metal pipes; and positioning people several yards apart. Some other general precautions include:

- Know where to go and how long it will take to get there. If possible, take refuge in a large building or vehicle. Do not go into a shed in an open area.
- The inclination to see trees as enormous umbrellas is the most frequent and most deadly mistake. Do not go under a large tree that is standing alone. Likewise, avoid poles, antennae and towers.
- If the area is wide open, go to a valley or ravine, but be aware of flash flooding.
- If you are caught in a level open area during an electrical storm and you feel your hair stand on end, drop to your knees, bend forward and put your hands on your knees or crouch. The idea is to make yourself less vulnerable by being as low to the ground as possible and taking up as little ground space as possible. Lying down is dangerous, since the wet earth can conduct electricity. Do not touch the ground with your hands.
- Do not use telephones during electrical storms, except in the case of emergency

Remember that lightning may strike several miles from the parent cloud, so work should be stopped/restarted accordingly. The lightning safety recommendation is 30-30: Seek refuge when thunder sounds within 30 seconds after a lightning flash; and do not resume activity until 30 minutes after the last thunder clap.

High winds can cause unsafe conditions, and activities should be halted until wind dies down. High winds can also knock over trees, so walking through forested areas during high-wind situations should be avoided. If winds increase, seek shelter or evacuate the area. Proper body protection should be worn in case the winds hit suddenly, because body temperature can decrease rapidly.

Emergency Contacts

24-hour CH2M HILL Injury Reporting– 1-866-893-2514
24-hour CH2M HILL Serious Incident Reporting Contact – 720-286-4911

Medical Emergency – 911 **Facility Medical Response #:**(910) 451-4841 (910) 451-4842 Onslow County ER (Off-Base) #: (910) 577-2240 Ambulance (On-Base) #: (910) 451-3004 (910) 451-3005 Ambulance (Public) #: (910) 451-9111 LEPC (Poison Control)#: (800) 222-1222	**CH2M HILL- Medical Consultant** WorkCare Dr. Peter Greaney M.D. 300 S. Harbor Blvd, Suite 600 Anaheim , CA 92805 800-455-6155/866-893-2514 714-978-7488
Fire/Spill Emergency – 911 **Facility Fire Response #:** (910) 451-9111	**CH2M HILL Director – Health, Safety, Security & Environment** Andy Strickland/DEN (720) 480-0685 (cell) or (720) 286-2393 (office)
Security & Police – 911 **Facility Security #:** (910) 451-2555	**CH2M HILL Responsible Health and Safety Manager (RHSM)** Name: Carl Woods Phone: (513) 319-5771
Utilities Emergency Phone Numbers Water: Gas: Contact Base EMD Electric:	**CH2M HILL Human Resources Department** Name: Mary Jo Jordan/GNV Phone: (352) 355-2867
CH2M HILL Project Manager Name: Bill Schmithorst Phone: (919) 875-4311	**CH2M HILL Worker's Compensation:** Contact Business Group HR dept. to have form completed or contact Jennifer Rindahl after hours: (720)891-5382
CH2M HILL Safety Coordinator (SC) Name: Simon Kline Phone: (910) 622-4344	**Media Inquiries Corporate Strategic Communications** Name: John Corsi Phone: (720) 286-2087
CH2M HILL Project Environmental Manager Name: Hope Oaks Phone: 678-530-4226	**Automobile Accidents** Rental: Jennifer Rindahl/DEN: 720-286-2449 CH2M HILL owned vehicle: Linda George/DEN: 720-286-2057
Federal Express Dangerous Goods Shipping Phone: 800/238-5355	**CHEMTEL (hazardous material spills)** **Phone: 800/255-3924**

Facility Alarms: TBD

Evacuation Assembly Area(s): TBD by SC-HW

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

Directions to Local Hospital

Local Hospital **Nearest On-Base hospital:**

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

Local hospital:

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

Local ambulance service:

Base Ambulance: (910) 451-3004, (910) 451-3005

Public Ambulance: (910) 451-9111

From MCB Camp Lejeune

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

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

Directions to Onslow County Memorial Hospital :

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

20.0 Spill Containment Procedures

CH2M HILL and subcontractor personnel working at the project site shall be knowledgeable of the potential health, safety and environmental concerns associated with petroleum and other hazardous substances that could potentially be released at the project site.

The following is a list of criteria that must be addressed in CH2M HILL's or the subcontractor's plans in the event of a spill or release. In the event of a large quantity spill notify emergency services. Personnel discovering a spill shall (only if safe to do so):

- Stop the spill immediately (if possible) or note source. If unsafe conditions exist, then leave the area, call emergency services, inform nearby personnel, notify the site supervisors, and initiate incident reporting process. The SC shall be notified immediately.
- Extinguish sources of ignition (e.g., flames, sparks, hot surfaces, cigarettes, etc.)
- Clear personnel from the spill location and barricade the area.
- Utilize available spill control equipment in an effort to ensure that fires, explosions, and releases do not occur, recur, or spread.
- Use sorbent materials to control the spill at the source.
- Construct a temporary containment dike of sorbent materials, cinder blocks, bricks or other suitable materials to help contain the spill.
- Attempt to identify the character, exact source, amount, and extent of the released materials. Identification of the spilled material should be made as soon as possible so that the appropriate cleanup procedure can be identified.
- Assess possible hazards to human health or the environment as a result of the release, fire or explosion.
- A Spill Report shall be completed, including a description of the event, root causes, and corrective actions.

21.0 Inspections

21.1 Project Activity Self-Assessment Checklists

In addition to the hazard controls specified in this document, Project Activity Self-Assessment Checklists are contained as an attachment to this HSP. The Project-Activity Self–Assessment Checklists are based upon minimum regulatory compliance and some site-specific requirements may be more stringent. The objective of the self-assessment process is to identify gaps in project safety performance, and prompt for corrective actions in addressing these gaps. The self-assessment checklists, including documented corrective actions, shall be made part of the permanent project records and maintained by the SC.

The self-assessment checklists will also be used by the SC in evaluating the subcontractors and any client contractors' compliance on site.

The self-assessment checklists for the following tasks and exposures are required when the task or exposure is initiated and weekly thereafter while the task or exposure is taking place. The checklists shall be completed by the SC or other CH2M HILL representative and maintained in project files.

- Biological Prevention Measures
- Drilling
- Electrical
- Hand and Power Tools
- Manual Lifting
- Hazardous Materials Handling/Waste Characterization & Sampling
- PPE

21.2 Safe Behavior Observations

Safe Behavior Observations (SBOs) are a tool to be used by supervisors to provide positive reinforcement for work practices performed correctly, while also identifying and eliminating deviations from safe work procedures that could result in a loss.

The SC or designee shall perform at least one SBO each week for any field work performed by subcontractors or when there are at least two CH2M HILL personnel performing field work.

The SC or designee shall complete the SBO form (attached to this HSP) for the task/operation being observed and submit them weekly.

For Federal projects, SBOs may be submitted electronically by e-mailing them to the address, "CH2M HILL ES FED Safe Behavior Observations" when connected to the network or at CH2MHILLESFEDSafeBehaviorObservation@ch2m.com.

22.0 Incident Notification, Reporting, and Investigation

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

22.1 General Information

This section applies to the following:

- All injuries involving employees, third parties, or members of the public
- Damage to property or equipment
- Interruptions to work or public service (e.g., hitting a utility)
- Incidents which attract negative media coverage
- Near misses
- Spills, leaks, or regulatory violations
- Motor vehicle accidents

Documentation, including incident reports, investigation, analysis and corrective measure taken, shall be kept by the SC and maintained onsite for the duration of the project.

22.2 Section Definitions

Incident: an undesired event which results or could have resulted in loss through injury, damage to assets or environmental harm. This includes all of the definitions below.

Accident: an incident involving actual loss through injury, damage to assets, or environmental harm.

Near Miss: an unsafe act or incident which, in other circumstances, could have resulted in loss through injury, damage to assets, or environmental harm.

Serious Incident:

- All fatalities including contractors, subcontractors, third parties, or members of the public
- Kidnap/Missing Person
- Event that involves a fire, explosion, or property damage that requires a site evacuation or is estimated to result in greater than $ 500,000 in damage.
- Acts or threats of terrorism
- Spill or release of hazardous materials or substances that involves a significant threat of imminent harm to site workers, neighboring facilities, the community or the environment.

22.3 Reporting Requirements

All employees and subcontractors' employees shall immediately report any incident (including "near misses," as defined in the section above) in which they are involved or witness to their supervisor.

The CH2M HILL or Subcontractor supervisor, upon receiving an incident report, shall inform his immediate superior and the CH2M HILL SC.

The SC shall immediately report the following information to the RHSM and PM by phone and e-mail:

- Project Name/Site Manager
- Date and time of incident
- Description of incident
- Extent of know injuries/damage
- Level of medical attention
- Preliminary root cause/corrective actions

The SC shall complete an entry into the Hours and Incident Tracking System (HITS) database system located on CH2M HILL's Virtual Office (or if VO not available, use the hard copy Incident Report Form and Root Cause Analysis Form and forward it to the RHSM) within 24 hours and finalize those forms within 3 calendar days.

The CH2M HILL team shall comply with all applicable statutory incident reporting requirements such as those to OSHA and the police.

22.4 HITS System and Incident Report Form (IRF)

It is the policy of CH2M HILL to maintain a HITS entry and/or Incident Report Form (IRF) for all work-related injuries and illnesses sustained by its employees in accordance with recordkeeping and insurance requirements. A HITS entry and/or IRF will also be maintained for other incidents (property damage, fire or explosion, spill, release, potential violation, and near misses) as part of our loss prevention and risk reduction initiative.

22.5 Injury Management/Return-to-Work (for CH2M HILL Staff Only)

(Reference CH2M HILL, SOP HSSE-124, Injury Management/Return-to-Work)

22.5.1 Background

The Injury Management Program has been established to provide orderly, effective and timely medical treatment and return-to-work transition for an employee who sustains a work-related injury or illness. It also provides guidance and assistance with obtaining appropriate treatment to aid recovery, keep supervisors informed of employee status, and to quickly report and investigate work-related injury/illnesses to prevent recurrence.

To implement the Injury Management/Return-to-Work Program successfully, supervisors and/or SC should:

- Ensure employees are informed of the Injury Management/Return-to-Work Program.
- Become familiar with the Notification Process (detailed below).
- Post the Injury Management/Return-to-Work Notification Poster.

22.5.2 The Injury Management/Return-to-Work Notification Process:

- Employee informs their Supervisor.
- Employee calls the Injury Management Program toll free number 1-866-893-2514 immediately and speaks with the Occupational Injury Nurse. This number is operable 24 hours per day, 7 days a week.
- Supervisor ensures employee immediately calls the Injury Management Program number. Supervisor makes the call with the injured worker or for the injured worker if needed.

- Nurse assists employee with obtaining appropriate medical treatment, as necessary schedules clinic visit for employee (calls ahead, and assists with any necessary follow up treatment) with the supervisor or SC accompany the employee if a clinic visit is necessary to ensure that employees receive appropriate and timely care.
- Supervisor/SC completes the HITS entry or Incident Report Form immediately (within 24 hours) and forwards it to the Project Manager and RHSM.
- Nurse notifies appropriate CH2M HILL staff by e-mail (supervisor, Health & Safety, Human Resources, Workers' Compensation).
- Nurse communicates and coordinates with and for employee on treatment through recovery.
- Supervisor ensures suitable duties are identified and available for injured/ill workers who are determined to be medically fit to return to work on transitional duty (temporary and progressive).
- Supervisor ensures medical limitations prescribed (if any) by physician are followed until the worker is released to full duty.

22.6 Serious Incident Reporting Requirements

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

The Serious Incident Reporting Requirements ensures timely notification and allows for positive control over flow of information so that the incident is handled effectively, efficiently, and in conjunction with appropriate corporate entities. This standard notification process integrates Health, Safety, Security and Environment (HSSE) and Firm Wide Security Operations (FWSO) requirements for the consistent reporting of and managing of serious events throughout our operations.

22.6.1 Serious Incident Determination

The following are general criteria for determining whether an incident on CH2M HILL owned or managed facilities or program sites is considered serious and must be immediately reported up to Group President level through the reporting/notification process:

- Work related death, or life threatening injury or illness of a CH2M HILL employee, subcontractor, or member of the public
- Kidnap/missing person
- Acts or threats of terrorism
- Event that involves a fire, explosion, or property damage that requires a site evacuation or is estimated to result in greater than $ 500,000 in damage.
- Spill or release of hazardous materials or substances that involves a significant threat of imminent harm to site workers, neighboring facilities, the community or the environment.

22.6.2 Serious Incident Reporting

If an incident meets the "Serious Incident" criteria, the Project Manager is to immediately contact the Crisis Manager at 720-286-4911, then follow the standard incident reporting procedure.

For all serious incidents this standard reporting process is implemented immediately so as to ultimately achieve notification to the Business Group President within 2 hours of incident onset or discovery, and notification to appropriate corporate Crisis Management Support Team.

ESBG US Operations
Incident Reporting Flow Diagram

Direct Reporting Responsibility

Informational Reporting

Incident:

- Injury or illness
- Hazardous substance exposure
- Damage to property
- Fire or explosion
- Spill, release, potential violation, or permit exceedance
- A "near-miss"

If incident is an **injury** to US or Puerto Rico based CH2M HILL personnel contact the Occupational Health Nurse at 866/893-2514. Outside the US, the supervisor must notify the HR

The Ops Leader is responsible for completing the Incident Report Form (IRF) in **HITS** when there is an injury to a CH2M HILL employee. The PM, CM or SC is responsible for completing the IRF for all other incidents. ***The IRF/HITS must be completed within 24 hours of the incident and does not replace the required immediate PM and RHSM notifications.***

Incident

Ensure that Emergency Responders have been notified as necessary

Employee or Subcontractor

Provide immediate notification.

Supervisor – Construction Manager - Safety Coordinator

Provide immediate notification by phone and email to PM <u>and</u> RHSM. In addition, for spills, NOVs, and permit issues you may also call the EM.

CRISIS MANAGER:

<u>If</u> the incident meets the "**Serious Incident**" criteria, contact the Crisis Manager

(720.286.4911)

Third Party – Incidents outside of our contractual obligations do not need to be communicated, unless they are serious and/or may affect CH2M HILL. The RHSM will determine the level of communication necessary for third party incidents.

Serious Incident:

- Work related death, or life threatening injury or illness of a CH2M HILL employee, subcontractor, or member of the public
- Kidnap/missing person
- Acts or threats of terrorism
- Event that involves a fire, explosion, or property damage that requires a site evacuation or is estimated to result in greater than $ 500,000 US in damage.
- Spill or release of hazardous materials or substances that involves a significant threat of imminent harm to site workers, neighboring facilities, the community or the environment.

Responsible HSM (RHSM)

Immediately notify the Sector <u>OR</u> Client Program HSE Manager, immediately notify the Responsible Environmental Manager (EM) for <u>spills, NOVs, and permit issues</u>, and direct the incident investigation.

Client Program HSE Manager

Notify Sector HSM, and coordinate communication and incident investigations.

Immediate notification to the Sector HSM is not required for some minor incidents. Follow the program or sector protocol.

Sector HSE Manager

Coordinate communication, direct significant incident investigations, notify Sector EM for spills, NOVs, & permit issues.

HSSE Director

Provide decision-making assistance or direction for incident resolution.

Project Manager

Provide notification to the Sector <u>OR</u> Program Project Delivery (PD) or Operations (Ops) Manager or designee. Notification is based on program or sector specific criteria.

Immediate notification to the PD/Ops Manager is not required for some minor incidents. Follow the program or sector protocol.

Sector or Program PD/Ops Manager

Notify Client Program Manager <u>OR</u> Sector Director, provide guidance and follow the incident through to resolution.

Client Program Manager

Notify Sector Director; provide decision-making assistance or direction for incident resolution.

Keep unnecessary communication of serious incidents to a minimum.

Sector Director

Provide decision-making assistance or direction for incident resolution.

ES US Operations Director/ Executive Leadership Team

Provide decision-making assistance, direction for incident resolution, and make higher level notifications as necessary

Post-emergency incident communications regarding serious incidents at a CH2M HILL office or project (regardless of the party involved) shall be considered sensitive in nature and must be controlled in a confidential manner.

22.7 Incident Root Cause Analysis

The accident analysis is essential if all causes of the incident are to be identified for the correct remedial actions to be taken to prevent the same and similar type of incident from recurring. The investigation team will consist of the SC (with support from RHSM), appropriate subcontractor personnel as necessary, the PM, and the responsible supervisor. More participants may be involved as needed to complete the investigation.

The Root Cause Analysis Form must be completed for all Loss Incidents and Near Loss Incidents. This form must be submitted to the investigation team for review.

For minor losses or near losses, the information may be gathered by the supervisor or other personnel immediately following the loss. Based on the complexity of the situation, this information may be all that is necessary to enable the investigation team to analyze the loss, determine the root cause, and develop recommendations. More complex situations may require the investigation team to revisit the loss site or re-interview key witnesses to obtain answers to questions that may arise during the investigation process.

Photographs or videotapes of the scene and damaged equipment should be taken from all sides and from various distances. This point is especially important when the investigation team will not be able to review the loss scene.

The investigation team must use the Root Cause Analysis Flow Chart to assist in identifying the root cause(s) of a loss. Any loss may have one or more root causes and contributing factors. The root cause is the primary or immediate cause of the incident, while a contributing factor is a condition or event that contributes to the incident happening, but is not the primary cause of the incident. Root causes and contributing factors that relate to the person involved in the loss, his or her peers, or the supervisor should be referred to as "personal factors." Causes that pertain to the system within which the loss or injury occurred should be referred to as "job factors."

22.7.1 Personal Factors

- Lack of skill or knowledge
- Correct way takes more time and/or requires more effort
- Short-cutting standard procedures is positively reinforced or tolerated
- Person thinks there is no personal benefit to always doing the job according to standards

22.7.2 Job Factors

- Lack of or inadequate operational procedures or work standards
- Inadequate communication of expectations regarding procedures or standards
- Inadequate tools or equipment

The root cause(s) could be any one or a combination of these seven possibilities or some other uncontrollable factor. In the vast majority of losses, the root cause is very much related to one or more of these seven factors. Uncontrollable factors should be used rarely and only after a thorough review eliminates all seven other factors.

22.7.3 Corrective Actions

Include all corrective actions taken or those that should be taken to prevent recurrence of the incident. Include the specific actions to be taken, the employer and personnel responsible for implementing the actions, and a timeframe for completion. Be sure the corrective actions address the causes.

Once the investigation report has been completed, the PM shall hold a review meeting to discuss the incident and provide recommendations. The responsible supervisors shall be assigned to carry out the recommendations, and shall inform the SC upon successful implementation of all recommended actions.

- The RHSM will inform the Responsible Environmental Manager (REM) of any environmental incidents.
- Evaluation and follow-up of the IRF will be completed by the type of incident by the RHSM, REM, or FWSO. The Business Group (BG) HSE Lead will review all BG incidents and modify as required.
- Incident Investigations must be initiated and completed as soon as possible but no later than 72 hours after the incident.

23.0 Records and Reports

An organized project filing system is essential for good documentation and recordkeeping. There are many benefits to an organized filing system:

- Other CH2M HILL employees can easily and quickly find documents
- Records are readily available for review
- Records may be needed during OSHA investigations, audits, or other legal matters
- Records may be needed on short notice in case of an accident, illness or other emergency
- Systematic recordkeeping aids in overall project organization

The project filing system shall be established at the beginning of the project and maintained throughout all phases of construction and archived in accordance with CH2M HILL's Records Retention Policy. The information contained in the filing system shall be updated regularly and/or as specified in this document. The PM and SC are responsible for collecting documentation, including subcontractor documentation, and maintaining a complete and organized filing system.

Below are examples of records that must be maintained as the project progresses:

- Exposure records includes air monitoring data (including calibration records), MSDSs, exposure modeling results.
- Physical hazard exposure records include noise, ionizing radiation, non-ionizing radiation, vibration, and lasers exposure assessments and measurements.
- Respiratory Fit Test Records
- Training Records
- Injury/illness reports and investigations
- Federal or State Agency Inspection Records
- Other Records
  - Ergonomic evaluations
  - HSE audits and assessments
  - Project-Specific HSE Plans
  - Confined Space Entry Permits
  - Equipment inspections
  - Equipment maintenance
  - SBOs
  - Self-Assessment Checklists

- The RHSM shall coordinate with the PM or designee to ensure that final project-specific HSE records described in this section, including negative exposure determinations, are maintained with the project files in accordance with the CH2M HILL records retention schedule, or forwarded to the Medical Surveillance Program Administrator, as appropriate. Records retention requirements are detailed in the Recordkeeping and Access to Records SOP, HSE-119.

CH2M HILL Health and Safety Plan

Attachment 1

Health and Safety Plan Employee Sign-off Form

EMPLOYEE SIGNOFF FORM

Health and Safety Plan

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

Project Name: Site UXO-22 PA/SI **Project Number:** 378849

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

CH2M HILL Health and Safety Plan

Attachment 2

Chemical Inventory/Register Form

CH2MHILL

CHEMICAL INVENTORY/REGISTER FORM

Refer to SOP HSE-107, Attachment 1, for instructions on completing this form.

Location:

HCC:

☐ Office ☐ Warehouse ☐ Laboratory ☐ Project:

Project No.:

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

MSDS for the listed products will be maintained at:

CH2M HILL Health and Safety Plan

Attachment 3

Chemical-Specific Training Form

CH2MHILL

CHEMICAL-SPECIFIC TRAINING FORM

Refer to SOP HSE-107 Attachment 1 for instructions on completing this form.

Location:	Project # :
HCC:	Trainer:

TRAINING PARTICIPANTS:

NAME	SIGNATURE	NAME	SIGNATURE

REGULATED PRODUCTS/TASKS COVERED BY THIS TRAINING:

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

☐ Physical and health hazards

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

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

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

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

CH2M HILL Health and Safety Plan

Attachment 4

Project Activity Self-Assessment Checklists/Permits/Forms

Biological Prevention Measures
Drilling
Electrical
Hand and Power Tools
Hazardous Materials Handling/Waste Characterization & Sampling
Manual Lifting
Personal Protective Equipment

CH2MHILL

HS&E Self-Assessment Checklist - DRILLING

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

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

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

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

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

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

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

SECTION 1 - SAFE WORK PRACTICES (4.1)

	Yes	No	N/A	N/O
1. Personnel cleared during rig startup	☐	☐	☐	☐
2. Personnel clear of rotating parts	☐	☐	☐	☐
3. Personnel not positioned under hoisted loads	☐	☐	☐	☐
4. Loose clothing and jewelry removed	☐	☐	☐	☐
5. Smoking is prohibited around drilling operation	☐	☐	☐	☐
6. Personnel wearing appropriate personal protective equipment (PPE), per written plan	☐	☐	☐	☐
7. Personnel instructed not to approach equipment that has become electrically energized	☐	☐	☐	☐

SECTION 2 - SUPPORT FUNCTIONS (4.2)

FORMS/PERMITS (4.2.1)

8. Driller license/certification obtained	☐	☐	☐	☐
9. Well development/abandonment notifications and logs submitted and in project files	☐	☐	☐	☐
10. Water withdrawal permit obtained, where required	☐	☐	☐	☐
11. Dig permit obtained, where required	☐	☐	☐	☐

UTILITY LOCATING (4.2.2)

12. Location of underground utilities and structures identified	☐	☐	☐	☐

SECTION 2 (Continued)

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

SECTION 3 - DRILLING SAFETY REQUIREMENTS (4.3)

GENERAL (4.3.1)				
20. Only authorized personnel operating drill rigs	☐	☐	☐	☐
21. Daily safety briefing/meeting conducted with crew	☐	☐	☐	☐
22. Daily inspection of drill rig and equipment conducted before use	☐	☐	☐	☐
DRILL RIG PLACEMENT (4.3.2)				
23. Location of underground utilities and structures identified	☐	☐	☐	☐
24. Safe clearance distance maintained from overhead power lines	☐	☐	☐	☐
25. Drilling pad established, when necessary	☐	☐	☐	☐
26. Drill rig leveled and stabilized	☐	☐	☐	☐
27. Additional precautions taken when drilling in confined areas	☐	☐	☐	☐
DRILL RIG TRAVEL (4.3.3)				
28. Rig shut down and mast lowered and secured prior to rig movement	☐	☐	☐	☐
29. Tools and equipment secured prior to rig movement	☐	☐	☐	☐
30. Only personnel seated in cab are riding on rig during movement	☐	☐	☐	☐
31. Safe clearance distance maintained while traveling under overhead power lines	☐	☐	☐	☐
32. Backup alarm or spotter used when backing rig	☐	☐	☐	☐
DRILL RIG OPERATION (4.3.4)				
33. Kill switch clearly identified and operational	☐	☐	☐	☐
34. All machine guards are in place	☐	☐	☐	☐
35. Rig ropes not wrapped around body parts	☐	☐	☐	☐
36. Pressurized lines and hoses secured from whipping hazards	☐	☐	☐	☐
37. Drill operation stopped during inclement weather	☐	☐	☐	☐
38. Air monitoring conducted per written safety plan for hazardous atmospheres	☐	☐	☐	☐
39. Rig placed in neutral when operator not at controls	☐	☐	☐	☐
DRILL RIG SITE CLOSURE (4.3.5)				
40. Ground openings/holes filled or barricaded	☐	☐	☐	☐
41. Equipment and tools properly stored	☐	☐	☐	☐
42. All vehicles locked and keys removed	☐	☐	☐	☐
DRILL RIG MAINTENANCE (4.3.6)				
28. Defective components repaired immediately	☐	☐	☐	☐
29. Lockout/tagout procedures used prior to maintenance	☐	☐	☐	☐
30. Cathead in clean, sound condition	☐	☐	☐	☐
31. Drill rig ropes in clean, sound condition	☐	☐	☐	☐
32. Fall protection used for fall exposures of 6 feet (U.S.) 1.5 meters (Australia) or greater	☐	☐	☐	☐
33. Rig in neutral and augers stopped rotating before cleaning	☐	☐	☐	☐
34. Good housekeeping maintained on and around rig	☐	☐	☐	☐

SECTION 4

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

Item #	Corrective Action Planned/Taken	Date Corrected

CH2MHILL

HS&E Self-Assessment Checklist—Waste Characterization, Sampling and Analysis

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where: 1) CH2M HILL employees will be managing wastes generated on project sites and/or 2) CH2M HILL provides oversight of subcontractor personnel who are managing wastes generated at project sites.

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

Completed checklists shall be sent to the HS&E Staff for review.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Person filling out checklist: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL compliance with its waste characterization, sampling and analysis standard (SOP-79).

☐ Evaluate a CH2M HILL subcontractor's compliance with the waste characterization, sampling and analysis standard and its requirements

Subcontractors Name: _____

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

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HS-42.

	Yes	No	N/A	N/O
GENERAL WASTE CHARACTERIZATION INFORMATION (6.0)				
1. Personnel told not to sign waste documentation (e.g., manifests) unless specifically authorized by the client in writing.	☐	☐	☐	☐
2. Waste Management Plan developed and available to all project personnel (see HSE-78).	☐	☐	☐	☐
3. Waste characterized before it is generated.	☐	☐	☐	☐
4. Waste characterized by Client using generator information.	☐	☐	☐	☐
5. Waste volumes estimated.	☐	☐	☐	☐
6. Disposal facility sampling and analytical requirements identified.	☐	☐	☐	☐
7. Disposal facility evaluated (see HSE-78).	☐	☐	☐	☐
8. Waste stream characterization documented in project file.	☐	☐	☐	☐
IDENTIFY ANALYTICAL TEST METHODS (7.1)				
9. Nature and quantity of the waste determined.	☐	☐	☐	☐
10. Analyses required for transport, treatment, and disposal determined.	☐	☐	☐	☐
11. Detection limits identified.	☐	☐	☐	☐
12. Provide disposal facility with analytical results.	☐	☐	☐	☐
13. Analytical test methods identified.	☐	☐	☐	☐

SAMPLING (7.2)				
14. Developed a sampling plan.	☐	☐	☐	☐
15. Field activities recorded in a logbook.	☐	☐	☐	☐
16. Exceptions to sampling plan documented in field logbook.				
17. Each container labeled with the project name, number, sample ID number, date and time,	☐	☐	☐	☐
18. The label on the container is covered with clear tape to prevent loss. collected sampler's name, sample preserves, analysis to be performed.	☐	☐	☐	☐
CHAIN OF CUSTODY (COC)				
19. Sample shipping containers sealed with two custody seals.	☐	☐	☐	☐
20. Custody seals placed over the left and rights sides of the container's cover (cooler).	☐	☐	☐	☐
21. Each seal signed and dated (with time).	☐	☐	☐	☐
22. Seals are covered with clear tape to prevent loss.	☐	☐	☐	☐
23. Custody seals placed on sample container immediately after collection.	☐	☐	☐	☐
24. Custody seals must be placed in a manner that they must be broken to open sample container.	☐	☐	☐	☐
25. The sample is in custody (in view or physical possession, it has not been tampered with, it is retained in a secured area with restricted access, it is placed in a container and secured with an official seal such that it cannot be reached without breaking the seal).	☐	☐	☐	☐
CHAIN OF CUSTODY FORM INSTRUCTIONS (7.2.5)				
26. Chain of Custody form completed per instructions	☐	☐	☐	☐
RECORDS (7.2.6)				
27. Original COC submitted to the lab along with final data packages.	☐	☐	☐	☐
28. Official copy of COC form sent to the project chemist and lab with sample shipment.	☐	☐	☐	☐
29. Changes to analytical requests on COC form or the PO made in writing to the lab.	☐	☐	☐	☐
30. A copy of written change sent to PM, lab, and placed in project files.	☐	☐	☐	☐
31. Reasons for change are included in sample log and project file.	☐	☐	☐	☐
32. Sample logbooks, sample logs, and COC forms sent to PM at completion of project activities.	☐	☐	☐	☐

CH2MHILL

H&S Self-Assessment Checklist—Waste Characterization, Sampling and Analysis

Complete this section for all items checked "No" in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

CH2MHILL

HS&E Self-Assessment Checklist – Electrical Safety

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

This checklist is to be used at locations when: (1) CH2M HILL employees are required to use electrical appliances, are exposed to electrical hazards, or are working on or near exposed energized electrical equipment; and/or (2) CH2M HILL provides oversight of an electrical subcontractor.

The Safety Coordinator (SC) may consult with electrical subcontractors when completing this checklist, but shall not direct the means and methods of electrical operations nor direct the details of corrective actions. Subcontractors shall determine how to correct deficiencies, and CH2M HILL must carefully rely on their expertise. Items or conditions considered to be imminently dangerous (possibility of serious injury or death) shall be corrected immediately, or all exposed personnel shall be removed from the hazard until corrected.

Project Name: _____ Project No.: _____

Location: _____ Project Manager: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposure to electrical hazards (Complete Section 1)

☐ Evaluate a CH2M HILL subcontractor's compliance with electrical safety requirements (Complete entire checklist)
Subcontractor's Name: _____

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

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HSE-206.

SECTION 1 – SAFE WORK PRACTICES

General Requirements (5.1)	Yes	No	N/A	N/O
1. Personnel have completed electrical safety training.	☐	☐	☐	☐
2. Attempts are made to locate all energized electrical circuits before work begins.	☐	☐	☐	☐
3. Installation/repair areas sufficiently guarded with barriers and signs to prevent unauthorized entry.	☐	☐	☐	☐
4. Only qualified employees installing or working with electrical equipment.	☐	☐	☐	☐
5. Electrical circuits that may be contacted are de-energizing and grounded or guarded.	☐	☐	☐	☐
6. Lockout/Tagout procedures when required verified using the checklist provided in HSE-307.	☐	☐	☐	☐
7. Only qualified electrical workers defeating electrical safety interlocks.	☐	☐	☐	☐
8. Where the location of underground power lines is unknown, insulated gloves are used.	☐	☐	☐	☐
Electrical Power Tools and Extension Cords (5.3)				
9. Electric power tools and extension cords inspected prior to use. Damaged equipment not used.	☐	☐	☐	☐
10. Extension cords supplying power tools provided with Ground Fault Circuit Interrupters (GFCI).	☐	☐	☐	☐
11. Electric power tools operated and maintained according to manufacturer's instructions.	☐	☐	☐	☐
12. Electric power tools effectively grounded or double-insulated.	☐	☐	☐	☐
13. Extension cords grounded and designed for heavy duty or industrial grade.	☐	☐	☐	☐
14. Extension cords not substituted for fixed wiring.	☐	☐	☐	☐
15. Extension cords covered, elevated, or protected when passing through work areas.	☐	☐	☐	☐
16. Extension cords passing through doorways or other pinch points protected from damage.	☐	☐	☐	☐
17. Extension cords not concealed or run through walls, ceilings, or floors.	☐	☐	☐	☐
18. Extension cords not fastened with staples, hung from nails, or suspended with wire.	☐	☐	☐	☐
19. Working space, walkways, and similar areas are kept clear of cords to prevent tripping hazards.	☐	☐	☐	☐

We will only maintain controlled copies online. Printed versions of this document are uncontrolled copies. To ensure you have the current version, use the copy located at HSE&Q website.

SECTION 1 – SAFE WORK PRACTICES (Continued)

Portable Lighting (5.4)	**Yes**	**No**	**N/A**	**N/O**
20. Portable lamps wired with flexible cord with grounded plugs.	☐	☐	☐	☐
21. Portable lights not suspended by their electric cords unless designed for suspension.	☐	☐	☐	☐
22. Portable lights protected from contact or breakage.	☐	☐	☐	☐
23. Portable lights used in wet locations operated at 12 volts or less or used with GFCI.	☐	☐	☐	☐

23.1.1.1 Overhead Power Lines (5.5)

24. Lines de-energized and grounded, insulated, or safe clearance distance maintained.	☐	☐	☐	☐
25. Personnel stay clear of grounding point of equipment intentionally grounded.	☐	☐	☐	☐
26. Personnel do not touch or approach equipment that has become energized.	☐	☐	☐	☐

SECTION 2 – ELECTRICAL SAFETY REQUIREMENTS

General Installation Requirements (5.7)				
35. Competent person overseeing electrical activities, including inspections.	☐	☐	☐	☐
36. Subcontractor personnel using appropriate safety and protective equipment.	☐	☐	☐	☐
37. Electrical equipment free from recognized hazards.	☐	☐	☐	☐
38. Equipment approved for intended use and installed according to approvals.	☐	☐	☐	☐
39. Manufacturer's name, trademark, or other descriptive marking placed on equipment.	☐	☐	☐	☐
40. Energized parts > 50 volts guarded against accidental contact.	☐	☐	☐	☐
41. Electrical equipment > 600 volts placed in a vault, room, closet, or protected area.	☐	☐	☐	☐
42. Sufficient access and working clearances provided and maintained for all electric equipment.	☐	☐	☐	☐
43. Means provided to disconnect conductors from the service-entrance conductors.	☐	☐	☐	☐
44. Circuit breakers sufficient for system current load.	☐	☐	☐	☐
45. Over-current protection devices readily accessible and legibly marked to indicate purpose.	☐	☐	☐	☐
46. Equipment firmly secured to surface on which it is mounted.	☐	☐	☐	☐
47. Electrical equipment ventilated for cooling as required.	☐	☐	☐	☐
48. Electrical equipment protected from damage by environmental conditions.	☐	☐	☐	☐
49. Equipment in hazardous locations maintained in a dust-tight, ignition-proof condition.	☐	☐	☐	☐
50. Equipment producing arcs, sparks, flames, enclosed or separated from combustible material.	☐	☐	☐	☐
51. Conductors spliced or joined properly and free ends covered with insulation.	☐	☐	☐	☐
52. Equipment grounding provided on all equipment requiring such grounding.	☐	☐	☐	☐
Ground-fault Protection (5.6)				
53. GFCIs used or an assured equipment-grounding conductor (AEGC) program implemented.	☐	☐	☐	☐
54. When GFCIs used, installed on all 120-volt, 15- and 20-ampere temporary receptacle outlets.	☐	☐	☐	☐
55. When AEGC program used, covers all extension cords and temporary receptacles.	☐	☐	☐	☐
56. AEGC program also covers all equipment connected by cord and plug.	☐	☐	☐	☐
57. Under AEGC program, equipment visually inspected for external defects before each day's use.	☐	☐	☐	☐
58. Under AEGC program, continuity and grounding testing performed at least every 3 months.	☐	☐	☐	☐
59. Records maintained for all AEGC program testing.	☐	☐	☐	☐

SECTION 3

Complete this section for all items checked "No" in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: _____ Project Manager: _____

CH2MHILL

HSE Self-Assessment Checklist—HAND AND POWER TOOLS

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where: (1) CH2M HILL employees are exposed to hand and power tool hazards and/or (2) CH2M HILL provides oversight of subcontractor personnel who are exposed to hand and power tool hazards.

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

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposure to hand and power tool hazards.
☐ Evaluate a CH2M HILL subcontractor's compliance with hand and power tool requirements.
Subcontractors Name: _____

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

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HSE-210.

SECTION 1

SAFE WORK PRACTICES (5.1)

	Yes	No	N/A	N/O
1. All tools operated according to manufacturer's instructions and design limitations.	☐	☐	☐	☐
2. All hand and power tools maintained in a safe condition and inspected and tested before use.	☐	☐	☐	☐
3. Defective tools are tagged and removed from service until repaired.	☐	☐	☐	☐
4. PPE is selected and used according to tool-specific hazards anticipated.	☐	☐	☐	☐
5. Power tools are not carried or lowered by their cord or hose.	☐	☐	☐	☐
6. Tools are disconnected from energy sources when not in use, servicing, cleaning, etc.	☐	☐	☐	☐
7. Safety guards remain installed or are promptly replaced after repair.	☐	☐	☐	☐
8. Tools are stored properly.	☐	☐	☐	☐
9. Cordless tools and recharging units both conform to electrical standards and specifications.	☐	☐	☐	☐
10. Tools used in explosive environments are rated for such use.	☐	☐	☐	☐
11. Knife or blade hand tools are used with the proper precautions.	☐	☐	☐	☐
12. Consider controls to avoid muscular skeletal, repetitive motion, and cumulative trauma stressors.	☐	☐	☐	☐

CH2MHILL

HSE Self-Assessment Checklist—HAND AND POWER TOOLS

SECTION 2	Yes	No	N/A	N/O
GENERAL (5.2.2)				
13. PPE is selected and used according to tool-specific hazards anticipated.	☐	☐	☐	☐
14. Tools are tested daily to assure safety devices are operating properly.	☐	☐	☐	☐
15. Damaged tools are removed from service until repaired.	☐	☐	☐	☐
16. Power operated tools designed to accommodate guards have guards installed.	☐	☐	☐	☐
17. Rotating or moving parts on tools are properly guarded.	☐	☐	☐	☐
18. Machines designed for fixed locations are secured or anchored.	☐	☐	☐	☐
19. Floor and bench-mounted grinders are provided with properly positioned work rests.	☐	☐	☐	☐
20. Guards are provided at point of operation, nip points, rotating parts, etc.	☐	☐	☐	☐
21. Fluid used in hydraulic-powered tools is approved fire-resistant fluid.	☐	☐	☐	☐
ELECTRIC-POWERED TOOLS (5.2.3)				
22. Electric tools are approved double insulated or grounded and used according to SOP HSE-206.	☐	☐	☐	☐
23. Electric cords are not used for hoisting or lowering tools.	☐	☐	☐	☐
24. Electric tools are used in damp/ wet locations are approved for such locations or GFCI installed.	☐	☐	☐	☐
25. Hand-held tools are equipped with appropriate on/off controls appropriate for the tool.	☐	☐	☐	☐
26. Portable, power-driven circular saws are equipped with proper guards.	☐	☐	☐	☐
ABRASIVE WHEEL TOOLS (5.2.4)				
27. All employees using abrasive wheel tools are wearing eye protection.	☐	☐	☐	☐
28. All grinding machines are supplied with sufficient power to maintain spindle speed.	☐	☐	☐	☐
29. Abrasive wheels are closely inspected and ring-tested before use.	☐	☐	☐	☐
30. Grinding wheels are properly installed.	☐	☐	☐	☐
31. Cup-type wheels for external grinding are protected by the proper guard or flanges.	☐	☐	☐	☐
32. Portable abrasive wheels used for internal grinding are protected by safety flanges.	☐	☐	☐	☐
33. Safety flanges are used only with wheels designed to fit the flanges.	☐	☐	☐	☐
34. Safety guards on abrasive wheel tools are mounted properly and of sufficient strength.	☐	☐	☐	☐
PNEUMATIC-POWERED TOOLS (5.2.5)				
35. Tools are secured to hoses or whip by positive means to prevent disconnection.	☐	☐	☐	☐
36. Safety clips or retainers are installed to prevent attachments being expelled.	☐	☐	☐	☐
37. Safety devices are installed on automatic fastener feed tools as required.	☐	☐	☐	☐
38. Compressed air is not used for cleaning unless reduced to < 30 psi, with PPE, and guarded.	☐	☐	☐	☐
39. Manufacturer's safe operating pressure for hoses, pipes, valves, etc. are not exceeded.	☐	☐	☐	☐
40. Hoses are not used for hoisting or lowering tools.	☐	☐	☐	☐
41. All hoses >1/2-inch diameter have safety device at source to reduce pressure upon hose failure.	☐	☐	☐	☐
42. Airless spray guns have required safety devices installed.	☐	☐	☐	☐
43. Blast cleaning nozzles are equipped with operating valves, which are held open manually.	☐	☐	☐	☐
44. Supports are provided for mounting nozzles when not in use.	☐	☐	☐	☐
45. Air receiver drains, handholes, and manholes are easily accessible.	☐	☐	☐	☐
46. Air receivers are equipped with drainpipes and valves for removal of accumulated oil and water.	☐	☐	☐	☐
47. Air receivers are completely drained at required intervals.	☐	☐	☐	☐
48. Air receivers are equipped with indicating pressure gauges.	☐	☐	☐	☐
49. Safety, indicating, and controlling devices are installed as required.	☐	☐	☐	☐
50. Safety valves are tested frequently and at regular intervals to assure good operating condition.	☐	☐	☐	☐

SECTION 2 (continued)

	Yes	No	N/A	N/O
LIQUID FUEL-POWERED TOOLS (5.2.6)				
51. Liquid fuel-powered tools are stopped when refueling, servicing, or maintaining.	☐	☐	☐	☐
52. Liquid fuels are stored, handled, and transported in accordance with SOP HSE-403	☐	☐	☐	☐
53. Liquid fuel-powered tools are used in confined spaces in accordance with SOP HSE-203.	☐	☐	☐	☐
54. Safe operating pressures of hoses, valves, pipes, filters, and other fittings are not exceeded.	☐	☐	☐	☐
POWDER-ACTUATED TOOLS (5.2.7)				
55. Only trained employee operates powder-actuated tools.	☐	☐	☐	☐
56. Powder-actuated tools are not loaded until just prior to intended firing time.	☐	☐	☐	☐
57. Tools are not pointed at any employee at any time.	☐	☐	☐	☐
58. Hands are kept clear of open barrel end.	☐	☐	☐	☐
59. Loaded tools are not left unattended.	☐	☐	☐	☐
60. Fasteners are not driven into very hard or brittle materials.	☐	☐	☐	☐
61. Fasteners are not driven into easily penetrated materials unless suitable backing is provided.	☐	☐	☐	☐
62. Fasteners are not driven into spalled areas.	☐	☐	☐	☐
63. Powder-actuated tools are not used in an explosive or flammable atmosphere.	☐	☐	☐	☐
64. All tools are used with correct shields, guards, or attachments recommended by manufacturer.	☐	☐	☐	☐
JACKING TOOLS (5.2.8)				
65. Rated capacities are legibly marked on jacks and not exceeded.	☐	☐	☐	☐
66. Jacks have a positive stop to prevent over-travel.	☐	☐	☐	☐
67. The base of jacks are blocked or cribbed to provide a firm foundation, when required.	☐	☐	☐	☐
68. Wood blocks are place between the cap and load to prevent slippage, when required.	☐	☐	☐	☐
69. After load is raised, it is cribbed, blocked, or otherwise secured immediately.	☐	☐	☐	☐
70. Antifreeze is used when hydraulic jacks are exposed to freezing temperatures.	☐	☐	☐	☐
71. All jacks are properly lubricated.	☐	☐	☐	☐
72. Jacks are inspected as required.	☐	☐	☐	☐
73. Repair or replacement parts are examined for possible defects.	☐	☐	☐	☐
74. Jacks not working properly are removed from service and repaired or replaced.	☐	☐	☐	☐
HAND TOOLS (5.2.9)				
75. Wrenches are not used when jaws are sprung to the point of slippage.	☐	☐	☐	☐
76. Impact tools are kept free of mushroomed heads.	☐	☐	☐	☐
77. Wooden handles of tools are kept free of splinters or cracks and are tightly fitted in tool.	☐	☐	☐	☐

CHAIN SAWS (5.2.10)	Yes	No	N/A	N/O
78. Chainsaw equipped with spark arrestor and fully functioning chain brake	☐	☐	☐	☐
79. Chainsaw operator's manual readily available	☐	☐	☐	☐
80. Fully stocked first aid kit and multipurpose fire extinguisher available	☐	☐	☐	☐
81. Appropriate personal protective equipment available and worn	☐	☐	☐	☐
82. Clothing free of loose edges that could become entangled in the saw	☐	☐	☐	☐
83. Chainsaw handles kept dry, clean, and free of oil or fuel mixture	☐	☐	☐	☐
84. Chainsaws held firmly with both hands and used right-handed	☐	☐	☐	☐
85. Operator standing to the left of the saw out of the plane of the chain	☐	☐	☐	☐
86. Saw used between the waist and mid-chest level	☐	☐	☐	☐
87. Full throttle maintained while cutting	☐	☐	☐	☐
88. Operator aware of position of guide bar tip, does not contact tip with anything being cut	☐	☐	☐	☐
89. Bumper spikes maintained as close to the object as possible	☐	☐	☐	☐
90. Operator aware of what is in the saw's downward path after the cut	☐	☐	☐	☐
91. No attempt to made to cut material that is larger than the guide bar of the saw	☐	☐	☐	☐
92. Cuts avoided that will cause chain to jam	☐	☐	☐	☐
93. Non-metallic wedges used to prevent compression cuts from jamming the blade	☐	☐	☐	☐
94. Bystanders and helpers kept at a safe distance from operation	☐	☐	☐	☐
95. Chainsaw not operated when fatigued	☐	☐	☐	☐
96. Fire extinguisher present when operating the chainsaw in forest or brushy areas	☐	☐	☐	☐

CH2MHILL

23.2 HSE Self-Assessment Checklist—Lifting

This checklist shall be used **only** by CH2M HILL personnel and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where: (1) CH2M HILL employees perform manual lifting activities (office or projects), and/or (2) CH2M HILL provides oversight of a subcontractor performing manual lifting activities.
SC or Office Safety Coordinators/Committee members may consult with subcontractors (if applicable) when completing this checklist but shall not direct the means and methods of activities nor direct the details of corrective actions. Subcontractors shall determine how to correct deficiencies, and we must carefully rely on their expertise. Conditions considered imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazardous area until corrected.
Complete the appropriate project or office information:

Project Information
Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

Office Information
Office Location: _____
Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:
☐ Evaluate CH2M HILL employee manual lifting activities.
☐ Evaluate a CH2M HILL subcontractor's manual lifting activities.
Subcontractor Name: _____

- Check "Yes" if an assessment item is complete/correct.
- Check "No" if an item is incomplete/deficient. Deficiencies shall be brought to the immediate attention of the subcontractor.
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HSE-112.

Planning Activities	**Yes**	**No**	**N/A**	**N/O**
1. Efforts have been made to inquire about receiving equipment or supplies in containers weighting less than 50 pounds (23 kilograms).	☐	☐	☐	☐
2. Equipment or supplies are being delivered as close as possible to their use point.	☐	☐	☐	☐
3. Heavy equipment or supplies are being stored off the ground and no lower than knee height.	☐	☐	☐	☐
4. Adequate space has been provided to access and lift equipment or supplies without reaching or twisting.	☐	☐	☐	☐
Safe Work Practices (5.1)	**Yes**	**No**	**N/A**	**N/O**
5. Tasks or activities have been modified to reduce or minimize manual lifting.	☐	☐	☐	☐
6. All employees performing manual lifting have received training on how to lift safely.	☐	☐	☐	☐
7. Manual lifting control measures are evaluated during assessments.	☐	☐	☐	☐
8. Manual lifting incidents are reviewed as part of the HSE Program reviews.	☐	☐	☐	☐
9. Manual lifting incidents are reviewed as part of the HSE Program reviews.	☐	☐	☐	☐
Office Environments (5.1.1)	**Yes**	**No**	**N/A**	**N/O**
10. Employees have received lifting training.	☐	☐	☐	☐

11. Mechanical devices are readily available to employees handling equipment or supplies weighing more than 40 pounds (18 kilograms).	☐	☐	☐	☐
Field Projects (5.1.2)	**Yes**	**No**	**N/A**	**N/O**
12. All manual lifting tasks or activities have been addressed in the written site safety plan.	☐	☐	☐	☐
13. Employees have received safe lifting training as required by the written site safety plan.	☐	☐	☐	☐
Mechanical Lifting (5.2)	**Yes**	**No**	**N/A**	**N/O**
14. Hand trucks and trolleys are visually inspected before use.	☐	☐	☐	☐
15. Hand trucks and trolleys do not have any broken or damaged parts.	☐	☐	☐	☐
16. Hand truck and trolley paths are free of uneven surfaces, water, oil, or cracks and holes.	☐	☐	☐	☐
17. Loads carried by hand trucks are balanced and sturdy.	☐	☐	☐	☐
18. Hand trucks or dollies are being pushed when on level ground.	☐	☐	☐	☐
19. When going up or down a slope using a hand truck or trolley, the load is downslope of the person.	☐	☐	☐	☐
20. Employees using hand trucks or dollies are moving slowly and cautiously.	☐	☐	☐	☐
21. Employees using hand trucks or trolleys are able to see over the load.	☐	☐	☐	☐
Assisted Lifting (5.3)	**Yes**	**No**	**N/A**	**N/O**
22. Personnel are not performing manual lifting beyond their physical capabilities.	☐	☐	☐	☐
23. Loads are evenly distributed when being handled by multiple people.	☐	☐	☐	☐
Manual Lifting (5.4)	**Yes**	**No**	**N/A**	**N/O**
24. Before the lift, the load and path was assessed.	☐	☐	☐	☐
25. Loads being lifted are free of sharp edges, slivers, or wet or greasy spots.	☐	☐	☐	☐
26. Gloves are used for manual lifts of loads with sharp or splintered edges.	☐	☐	☐	☐
27. Employees performing manual lifts use the proper lifting techniques.	☐	☐	☐	☐
28. Special tools fabricated for lifting grates or manhole covers are used.	☐	☐	☐	☐

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: _____ Project Manager: _____

CH2MHILL

HS&E Self-Assessment Checklist: PPERSONAL PROTECTIVE EQUIPMENT

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where CH2M HILL employees are required to wear PPE or are required to perform oversight of a subcontractor using PPE or both.

CH2M HILL staff shall not direct the means and methods of subcontractor use of PPE nor direct the details of corrective actions. The subcontractor must determine how to correct deficiencies and CH2M HILL staff must carefully rely on their expertise. Conditions considered to be imminently dangerous (possibility of serious injury or death) must be corrected immediately or all exposed personnel must be removed from the hazard until corrected.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to (check only one of the boxes below):

☐ Evaluate CH2M HILL compliance with its PPE program (SOP HSE-117)
☐ Evaluate a CH2M HILL subcontractor's compliance with its PPE program
Subcontractor's Name: _____

Check the appropriate box, as follows:

- Check "Yes" if an assessment item is complete or correct.
- Check "No" if an item is incomplete or deficient. Section 2 must be completed for all items checked "No."
- Check "N/A" if an item is not applicable.
- Check "N/O" if an item is applicable but was not observed during the assessment.

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HSE-121.

SECTION 1	**Yes**	**No**	**N/A**	**N/O**
GENERAL				
1. Required PPE listed in HSP FSI or AHA.	☐	☐	☐	☐
2. PPE available for use by employees.	☐	☐	☐	☐
3. PPE cleaning supplies available for use.	☐	☐	☐	☐
4. PPE stored appropriately to prevent deformation or distortion.	☐	☐	☐	☐
5. PPE written certification has been completed.	☐	☐	☐	☐
EYEWEAR (Glasses/Goggles/Face Shields)				
6 Eyewear cleaning supplies available.	☐	☐	☐	☐
7 Safety glasses in good condition and lenses free of scratches.	☐	☐	☐	☐
8 Goggles adjustment strap not cracked or frayed, not deformed, or lenses not scratched.	☐	☐	☐	☐
9. Face shields in good condition, including adjustment band, and free of scratches or chips.	☐	☐	☐	☐

SECTION 1 (**Continued**)	**Yes**	**No**	**N/A**	**N/O**
HEAD PROTECTION				
10. Hard hat bill and suspension attached as allowed by manufacturer.	☐	☐	☐	☐
11. Shell is pliable, free of dents, cracks, nicks, or any damage due to impact.	☐	☐	☐	☐
12. Suspension maintained at 1.25 inches from inside of shell.	☐	☐	☐	☐
13. Suspension free of cuts or fraying, torn headband, adjustment strap workable.	☐	☐	☐	☐
14. Electrical hard hat matched to hazard classification.	☐	☐	☐	☐
15. Dated to determine whether within manufacturer's allowable 5-year use time period.	☐	☐	☐	☐
HAND PROTECTION				
16. Available in sizes matched to employee.	☐	☐	☐	☐
17. Gloves free of rips tears, abrasions, or holes.	☐	☐	☐	☐
18. Matched to manufacturer's specification for chemicals used onsite.	☐	☐	☐	☐
19. Electrical gloves matched to hazard and periodically inspected for insulating rating. ☐	☐		☐	☐
20. Maintained in a clean and sanitary condition, decontaminated or disposed properly.	☐	☐	☐	☐
BODY PROTECTION				
21. Available in sizes matched to employee.	☐	☐	☐	☐
22. Maintained in a clean and sanitary condition, decontaminated or disposed properly.	☐	☐	☐	☐
23. Vapor-tight fully encapsulated suits tested at required periodic intervals.	☐	☐	☐	☐
24. Flame-resistant clothing matched to electrical hazard and arc flash rating.	☐	☐	☐	☐
25 Welding gear matched to degree of hazard and free of cuts, tears or burn holes.	☐	☐	☐	☐
26 Flotation gear available for work near or on water and in good condition.	☐	☐	☐	☐
HOT AND COLD BODY PROTECTION				
27 Cooling gear available based on degree of heat stress hazard.	☐	☐	☐	☐
28 Cooling gear in operable, clean, and sanitary condition.	☐	☐	☐	☐
29 Cold-weather gear provided based on needs assessment.	☐	☐	☐	☐
30. Cold-weather gear available in sizes to match employees.	☐	☐	☐	☐
31 Cold-weather gear is in free of tears, rips, or holes and in maintained in a clean condition.	☐	☐	☐	☐
TRAINING				
32 Initial PPE training completed by employees.	☐	☐	☐	☐
33 Training conducted when new types or styles of PPE are issued.	☐	☐	☐	☐
34 PPE selection, use, and maintenance reviewed at daily safety briefings.	☐	☐	☐	☐

We will only maintain controlled copies online. Printed versions of this document are uncontrolled copies. To ensure you have the current version, use the copy located at HSE&Q website.

SECTION 2

Complete this section for all items checked "No" in Section 1. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned or Taken	Date Corrected

CH2MHILL

HS&E Self-Assessment Checklist—TRAFFIC CONTROL

This checklist shall be used by CH2M HILL personnel **only** and shall be completed at the frequency specified in the project's HSP/FSI.

This checklist is to be used at locations where: (1) CH2M HILL employees are exposed to traffic hazards and/or (2) CH2M HILL provides oversight of subcontractor personnel who are exposed to traffic hazards.

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

Completed checklists shall be sent to the HS&E Staff for review.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposure to traffic hazards.
☐ Evaluate a CH2M HILL subcontractor's compliance with traffic control requirements.
Subcontractors Name: _____

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

Numbers in parentheses indicate where a description of this assessment item can be found in Standard of Practice HSE-216.

SECTION 1

SAFE WORK PRACTICES (3.1)	Yes	No	N/A	N/O
1. Personnel working on/adjacent to active roadways or in control zones are wearing safety vests.	☐	☐	☐	☐
2. Traffic control plan (TCP) is consistent with roadway, traffic, and working conditions.	☐	☐	☐	☐
3. TCP has been approved by regulatory or contractual authority prior to work.	☐	☐	☐	☐
4. TCP considers all factors that may influence traffic related hazards and controls.	☐	☐	☐	☐
5. Work areas are protected by rigid barriers.	☐	☐	☐	☐
6. Lookouts are used when applicable.	☐	☐	☐	☐

7. Vehicles are parked 40 feet away from work zone or are equipped with hazard beacon/strobe.	☐	☐	☐	☐
8. TMCC or TMA vehicle is used where appropriate.	☐	☐	☐	☐
9. All CH2M HILL traffic control devices conform to MUTCD standards.	☐	☐	☐	☐
10. Traffic control devices are inspected continuously.	☐	☐	☐	☐
11. Flagging is only used when other means of traffic control are inadequate.	☐	☐	☐	☐
12. Additional traffic control zone controls have been implemented.	☐	☐	☐	☐
13. Cranes do not swing loads/booms over nor do workers enter/cross live roadways (as defined).	☐	☐	☐	☐

CH2MHILL

HS&E Self-Assessment Checklist—TRAFFIC CONTROL

SECTION 2	Yes	No	N/A	N/O
GENERAL (3.2.1)				
14. Lane closings are performed when required by this SOP.	☐	☐	☐	☐
15. Traffic control configurations are based on an engineering study of the location.	☐	☐	☐	☐
16. If no study, traffic control is performed with approval of the authority having jurisdiction.	☐	☐	☐	☐
17. TCP has been prepared and understood by all responsible parties prior to work.	☐	☐	☐	☐
18. Special preparation/coordination with external parties has been conducted where applicable.	☐	☐	☐	☐
19. All contractor traffic control devices conform to MUTCD standards.	☐	☐	☐	☐
20. Traffic movement and flow are inhibited or disrupted as little as possible.	☐	☐	☐	☐
21. Supplemental equipment and activities do not interfere with traffic.	☐	☐	☐	☐
22. Drivers and pedestrians are considered when entering and traversing traffic control zone.	☐	☐	☐	☐
TRAFFIC CONTROL ZONES (3.2.2)				
23. Traffic control zones are divided into the necessary five areas.	☐	☐	☐	☐
24. Advances warning area is designed based on conditions of speed, roadways, and driver needs.	☐	☐	☐	☐
25. Advanced warning signage is spaced according to roadway type and conditions.	☐	☐	☐	☐
26. Transition areas are used to channelize traffic around the work area.	☐	☐	☐	☐
27. Buffer areas are used to provide a margin of safety for traffic and workers.	☐	☐	☐	☐
28. The buffer area is free of equipment, workers, materials, and worker vehicles.	☐	☐	☐	☐
29. The length of the buffer area is two times the posted speed limit in feet.	☐	☐	☐	☐
30. All work is contained in the work area and is closed to all traffic.	☐	☐	☐	☐
31. A termination area is used to provide traffic to return to normal lanes.	☐	☐	☐	☐
32. A downstream taper is installed in the termination area.	☐	☐	☐	☐
DEVICE INSTALLATION AND REMOVAL (3.2.3)				
33. All vehicles involved with device installation/removal have hazard beacons/strobes.	☐	☐	☐	☐
34. Devices are installed according to the order established by this SOP.	☐	☐	☐	☐
35. Devices are removed in the opposite order of installation.	☐	☐	☐	☐ 36.
37. Tapers are created using channelizing devices.	☐	☐	☐	☐
38. The length of taper is determined by posted speed and width of lane to be closed (see formula).	☐	☐	☐	☐
39. Local police or highway patrol assist during taper installation and removal.	☐	☐	☐	☐
40. TMCC/ TMA vehicles are used to protect personnel during installation and removal of devices.	☐	☐	☐	☐
41. Cone trucks are equipped with platforms and railings.	☐	☐	☐	☐
42. Cones are the appropriate height for the specific roadway and are reflectorized.	☐	☐	☐	☐
43. Temporary sign supports are secured using sandbags to prevent movement.	☐	☐	☐	☐
44. Arrow panels are used on lane closures where required.	☐	☐	☐	☐
45. Concrete barriers are used where required.	☐	☐	☐	☐
46. Barrels, crash cushions, or energy absorbing terminals are used to protect traffic as required.	☐	☐	☐	☐
47. Changeable message signs (CMS) are used as required.	☐	☐	☐	☐
48. CMS are not used to replace required signage.	☐	☐	☐	☐
49. No more than two message panels are used in any message cycle on CMS.	☐	☐	☐	☐
FLAGGING (3.2.4)				
50. Flagging is used only when other traffic control methods are inadequate.	☐	☐	☐	☐
51. Only approved personnel with current certification are allowed to be used as flaggers.	☐	☐	☐	☐
52. Flaggers are located off the traveled portion of the roadway.	☐	☐	☐	☐
53. A communication system is established when more than one flagger is used.	☐	☐	☐	☐
54. Hand signaling by flaggers is by means of red flags, sign paddles, or red lights.	☐	☐	☐	☐
55. Flaggers are alert, positioned close enough to warn work crews, and easily identified from crew.	☐	☐	☐	☐
56. An escape plan is established by crew and flaggers prior to traffic control set up.	☐	☐	☐	☐
57. Signs indicating a flagger is present are used and removed as required.	☐	☐	☐	☐

SECTION 2	Yes	No	N/A	N/O
INSPECTION AND MAINTENANCE (3.2.5)				
58. Traffic control zones are monitored to determine their effectiveness under varying conditions.	☐	☐	☐	☐
59. Traffic control devices are inspected at the beginning and continuously during work shift.	☐	☐	☐	☐
60. Traffic control devices are restored to their proper position immediately and continuously.	☐	☐	☐	☐
61. Damaged, old, or ineffective devices are removed and replace immediately and continuously.	☐	☐	☐	☐
62. Devices using reflected light for illumination are cleaned and monitored continuously.	☐	☐	☐	☐

CH2MHILL

HS&E Self-Assessment Checklist—TRAFFIC CONTROL

SECTION 3

Complete this section for all items checked "No" in Sections 1 or 2. Deficient items must be corrected in a timely manner.

Item #	Corrective Action Planned/Taken	Date Corrected

Auditor: _____ Project Manager: _____

CH2M HILL Health and Safety Plan

Attachment 5

Key Target Zero Program Elements

Activity Hazard Analysis

Pre-Task Safety Plans

Safe Behavior Observation

Incident Report and Investigation
(use electronic form when possible)
HITS

Lessons Learned Template

ACTIVITY HAZARD ANALYSIS

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

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

ACTIVITY HAZARD ANALYSIS

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

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

ACTIVITY HAZARD ANALYSIS

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

Pre-Task Safety Plan (PTSP) and Safety Meeting Sign-in Sheet

Project:_____ Location: _____ Date:_____

Supervisor: _____ Job Activity:_____

_____

Attendees: Print Name Sign Name

_____
_____
_____
_____
_____
_____
_____

List Tasks and verify that applicable AHAs have been reviewed:

_____
_____
_____

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

_____
_____
_____

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

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

Other Potential Hazards (Describe):

_____
_____
_____

Hazard Control Measures (Check All That Apply):			
PPE __ Thermal/lined __ Eye __ Dermal/hand __ Hearing __ Respiratory __ Reflective vests __ Flotation device __ Hard Hat	Protective Systems __ Sloping __ Shoring __ Trench box __ Barricades __ Competent person __ Locate buried utilities __ Daily inspections __ Entry Permits/notification	Fire Protection __ Fire extinguishers __ Fire watch __ Non-spark tools __ Grounding/bonding __ Intrinsically safe equipment	Electrical __ Lockout/tagout __ Grounded __ Panels covered __ GFCI/extension cords __ Power tools/cord inspected __ Overhead line clearance __ Underground utils ID'd
Fall Protection __ Harness/lanyards __ Adequate anchorage __ Guardrail system __ Covered opening __ Fixed barricades __ Warning system	Air Monitoring __ PID/FID __ Detector tubes __ Radiation __ Personnel sampling __ LEL/O2 __ No visible dust __ Other	Proper Equipment __ Aerial lift/ladders/scaffolds __ Forklift/heavy equipment __ Backup alarms __ Hand/power tools __ Crane with current inspection __ Proper rigging __ Operator qualified	Welding & Cutting __ Cylinders secured/capped __ Cylinders separated/upright __ Flash-back arrestors __ No cylinders in CSE __ Flame retardant clothing __ Appropriate goggles
Confined Space Entry __ Isolation __ Air monitoring __ Trained personnel __ Permit completed __ Rescue	Medical/ER __ First-aid kit __ Eye wash __ FA-CPR trained personnel __ Route to hospital	Heat/Cold Stress __ Work/rest regime __ Rest area __ Liquids available __ Monitoring __ Training	Vehicle/Traffic __ Traffic control __ Barricades __ Flags __ Signs
Permits __ Hot work __ Confined space __ Lockout/tagout __ Excavation __ Demolition __ Energized work	Demolition __ Pre-demolition survey __ Structure condition __ Isolate area/utilities __ Competent person __ Hazmat present	Inspections: __ Ladders/aerial lifts __ Lanyards/harness __ Scaffolds __ Heavy equipment __ Drill rigs/geoprobe rigs __ Cranes and rigging __ Utilities marked	Training: __ Hazwaste (current) __ Construction __ Competent person __ Task-specific __ FA/CPR __ Confined Space __ Hazcom
Underground Utilities __Dig alert called __3rd Party locater __As-builts reviewed __Interview site staff __Client review __soft locate necessary?	Incident Communications __Work stops until cleared by TM/CM __Immediate calls to TM/CM __Client notification __24 hour notification setup __Clear communications	AHA' s __reviewed and approved by HSM __on site and current __applicable for this day's work __Communication and incident processes included?	

Field Notes (including observations from prior day, etc.):
_____
_____
_____

Name (Print): _____
Signature:_____ Date:_____

CH2MHILL

Safe Behavior Observation Form		
☐Federal or ☐Commercial Sector (check one)	☐Construction or ☐Consulting (check one)	
Project Number:	Client/Program:	
Project Name:	Observer:	Date:
Position/Title of worker observed:	Background Information/ comments:	
Task/Observation Observed:		

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

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

For ES Federal Sector projects please email completed forms to: CH2M HILL ES FED Safe Behavior Observation
For ES Commercial Sector projects please email completed forms to: CH2M HILL ES COM Safe Behavior Observation
For CNR ES staff please email completed forms to: cnressafe@ch2m.com

HITS Incident Report Hardcopy (Phase 1 – Initial Entry)

Phase 1 – Initial Entry

Type of Incident (May select more than one)

☐ Injury/Illness ☐ Spill/Release ☐ Near Miss
☐ Property Damage ☐ Environment/Permit ☐ Other

General Information Section

Preparer's Name: _____ **Preparer's Phone Number:** _____

Date of Incident: _____ **Time of Incident**: _____ AM / PM

What Business Group is accountable for this incident: _____

What Business Group SubGroup is accountable for this incident: _____

What CH2M HILL Company is accountable for this incident: _____

Where did the Incident occur?

- ☐ United States, Geographic Region: _____
- ☐ Canada, Province/Territory: _____
- ☐ International, County: _____

Location of Incident?

- ☐ Company Premises, CH2M HILL Office (use 3 letter office code if available): _____
- ☐ Project, Project name: _____
- ☐ In Transit
  Traveling from: _____
  Traveling to: _____
- ☐ At Home
- ☐ Other, Specify: _____

Describe the incident: _____

_____

_____

Describe how this event could have been prevented: _____

_____

Provide Witness Information:

Name: _____ Phone: _____
Name: _____ Phone: _____
Name: _____ Phone: _____

Personnel Notified of Incident (Provide name, date and time):

CH2M HILL Personnel:

_____

Client Personnel:

_____

Additional Comments:

_____

_____

Injury/Illness Section **[Complete only if Injury/Illness Incident type selected]**

Who was injured?

- ☐ CH2M HILL Employee or CH2M HILL Temp Employee
- ☐ Subcontractor to CH2M HILL (Non-LLC Joint Venture Project)
- ☐ LLC Joint Venture Partner Employee
- ☐ LLC Joint Venture Project Subcontractor/Contractor
- ☐ Other

Name of Injured: _____ **Job Title:** _____

Employer Name: _____ **Supervisor of Employee:** _____

Complete for CH2M HILL Employee Injuries

Business Group of Injured Employee: _____

Has the employee called the Injury Management Administrator (1-800-756-1130)?

☐ Yes ☐ No ☐ Not Sure

Has the injured employee's supervisor been notified of this incident?

☐ Yes ☐ No ☐ Not Sure

Complete for Non-CH2M HILL Employee Injuries

Has the project safety coordinator been notified of this incident?

☐ Yes ☐ No ☐ Not Sure

Project Safety Coordinator: _____

Body Part Affected: _____

Injury/Illness (Result): _____

Describe treatment provided (if medication provided, identify whether over-the-counter or prescription): _____

_____

Describe any work restriction prescribed (include dates and number of days): _____

_____

Physician/Health Care Provider Information

Name: _____ Phone: _____

Was treatment provided away from the worksite?

☐ No

☐ Yes

Facility Name:

_____

Address:

_____

City: _____ Phone Number:

_____

Was injured treated in an emergency room?

☐ No ☐ Yes

Was injured hospitalized overnight as an in-patient?

☐ No ☐ Yes

General Information Environmental Section **[Complete only if Environment/Permit or Spill/Release Incident type selected]**

Who had control of the area during the incident?

☐ CH2M HILL, Company: _____

☐ Subcontractor, Company: _____

☐ Joint Venture Partner/Contractor/Subcontractor, Company: _____

☐ Other, Company: _____

Relationship to CH2M HILL: _____

Property Damage Section **[Complete only if Property Damage Incident type selected]**

Property Damaged: _____

Property Owner: _____

Damage Description: _____

Estimated US Dollar Amount: _____

Spill or Release Section **[Complete only if Spill/Release Incident type selected]**

Substance: _____

Estimated Quantity: _____

Did the spill/release move off the property?: _____

Spill/Release From: _____

Spill/Release To: _____

Environment/Permit Section **[Complete only if Environment/Permit Incident type selected]**

Describe Environmental or Permit Issue: _____

Permit Type: _____

Permitted Level or Criteria (e.g., discharge limit): _____

Permit Name and Number (e.g., NPDES No. ST1234): _____

Substance and Estimated Quantity: _____

Duration of Permit Exceedence: _____

HSSE

Lessons Learned

[Date] ESBG LL-11-xx

Subject	**[Insert Descriptive Name of Lessons Learned]**
CH2M HILL Project?	[Yes or No]
Situation	[Describe incident or situation that occurred in general terms. Try to be brief and avoid unnecessary details such as names of people or projects, business groups, divisions, dates, location, etc.]
Lessons Learned (Recommendations and Comments)	• Bullet out any lessons learned, recommendations or other important "take away" information that would benefit others. Tie the recommendations to the incident or event, and avoid including information that is not directly tied to the event.
Submitted By	[Name/Office Location/Phone]
Additional Information Contact	[Name/Office Location/Phone]
Keywords/Categories	[Insert any keywords or incident categories that would aid in a search for this lessons learned]

Send completed Lessons Learned to the ESBG HSSE Director for posting and distribution. Please include a recommended distribution list.

CH2M HILL Health and Safety Plan

Attachment 6

Material Safety Data Sheets

&

Hazard Fact Sheets

CH2MHILL

Arsenic

Standard of Practice HSE-501

Arsenic Fact Sheet

Uses and Occurrences

The manufacture and transportation of arsenic compounds; used in the manufacture of herbicide, pesticide, fungicides, and defoliants; used in the manufacture and handling of calcium arsenate; used in the manufacture of electrical semiconductors, diodes, and solar batteries; used as an additive for food and drinking water for animals; used as a preharvest desiccant, sugarcane ripener, soil sterilant, or for timber thinning; used as a bronzing or decolorizing addition in glass manufacturing; used in the production of opal glass and enamels; used as an addition to alloys to increase hardening and heat resistance; used during smelting of ores; used during the cleanup of soil contaminated with arsenic; used military applications; and used in the general handling, storage, and use of arsenic.

Physical Characteristics

Appearance:	Gray metal or white powder
Odor:	Odorless solid, garlic-like when heated
Flammable:	None
Flash Point:	None
Flammable Range:	None
Specific Gravity:	5.73 for arsenic metal, 3.74 for arsenic trioxide
Stability:	Stable
Incompatibilities:	Heat, hydrogen gas, and oxidizing agents
Melting Point:	Sublimes at 613°C (1135°F); 315°C (599 °F) for arsenic trioxide
Boiling Point:	Sublimes at 613°C (1135°F); 465°C (869 °F) for arsenic trioxide

Signs and Symptoms of Exposure

Short-term (Acute):	Nausea, vomiting, diarrhea, weakness, loss of appetite, cough, chest pain, giddiness, headache, and breathing difficulty.
Long-term (Chronic):	Numbness and weakness in the legs and feet, skin and eye irritation, hyperpigmentation, thickening of palms and soles (hyperkeratosis), contact dermatitis, skin sensitization, warts, ulceration, perforation of the nasal septum, and lung and lymphatic cancer.

Modes of Exposure

Inhalation:	Dusts and Vapors
Absorption:	Liquid
Ingestion:	Dusts and Liquid

Exposure Limits

Action level (AL)	5 μg/m^3
PEL	10 μg/m^3
STEL	None
TLV	10 μg/m^3

Exposure Level vs. Regulatory Requirements

EXPOSURE LEVEL (EL)	REGULATORY REQUIREMENTS
EL < AL	Maintain exposure as low as reasonably achievable.
AL > EL, EL < PEL	Implement portions of the OSHA Arsenic Standard and training.
EL > PEL	Implement all portions of the OSHA Arsenic Standard, including training, medical surveillance, engineering controls, establishment of work areas, etc.

PPE

Eye:	Safety glasses; contact lenses should **not** be worn.
Skin:	Chemical protective gloves and body protection.
Respiratory:	Air purifying respirators and supplied air respirators, depending on the exposure.

First Aid

Inhalation:	Move to fresh air; seek medical attention promptly.
Skin:	Quick drenching with water; wash skin with soap and water; seek medical attention promptly.
Eyes:	Flush with water for 15 minutes, lifting the lower and upper lids occasionally; seek medical attention promptly.
Ingestion:	Seek medical attention promptly.

CH2MHILL

Lead

Standard of Practice HSE-508

Lead Fact Sheet

Uses and Occurrences

Lead can be found in the following: construction materials for tank linings and piping; component of lead-acid storage batteries; lead solder; plastics; steel; and pigments for paints. Lead can also be found in waste rock associated with mining activities, wood debris or stock used for electrical co-generation activities, and soil and waste associated with manufacturing activities. Elevated levels of naturally occurring lead may also be found in the soil in certain parts of this country.

Physical Characteristics

Appearance:	Bluish-white, slivery, gray metal. Very soft and easily malleable
Odor:	None
Flammable:	Noncombustible
Flash Point:	Not Applicable
Flammable Range:	Not Applicable
Specific gravity:	11.35
Stability:	very stable
Incompatibilities:	hot nitric acid, boiling concentrated hydrochloric and sulfuric acids
Melting Point:	327°C

Signs and Symptoms of Exposure

Skin and Eye: Irritation

Ingestion and Inhalation (Acute Overexposure): Lead is a potent, systemic poison that serves no known useful function once absorbed by your body. Taken in large enough doses, lead can kill you in a matter of days. A condition affecting the brain called acute encephalopathy may arise that develops quickly to seizures, coma, and death from cardio-respiratory arrest. A short term dose of lead can lead to acute encephalopathy. Short term occupational exposures of this magnitude are highly unusual, but not impossible. Similar forms of encephalopathy may, however, arise from extended, chronic exposure to lower doses of lead. There is no sharp dividing line between rapidly developing acute effects of lead, and chronic effects that take longer to acquire. Lead adversely affects numerous body systems, and causes forms of health impairment and disease that arise after periods of exposure as short as days or as long as several years.

Ingestion and Inhalation (Chronic Overexposure):Chronic overexposure to lead may result in severe damage to your blood-forming, nervous, urinary and reproductive systems. Some common symptoms of chronic overexposure include loss of appetite, metallic taste in the mouth, anxiety, constipation, nausea, pallor, excessive tiredness, weakness, insomnia, headache, nervous irritability, muscle and joint pain or soreness, fine tremors, numbness, dizziness, hyperactivity and colic. In lead colic, there may be severe abdominal pain.

Modes of Exposure

Inhalation:	Dusts and fumes
Skin Absorption:	None
Ingestion:	Dusts and solids

Exposure Limits

Action level	0.03 mg/m^3
PEL	0.05 mg/m^3
STEL	None
PEL-C	None
TLV	0.05 mg/m^3

Exposure Level vs. Regulatory Requirements

EXPOSURE LEVEL (EL)	REGULATORY REQUIREMENTS
EL less than Action Level (AL)	Maintain exposure as low as reasonably achievable
EL greater than AL and less than PEL	Implement portions of the OSHA Lead Standard (i.e., initial medical monitoring) and Training
EL greater than PEL	Implement all portions of the OSHA Lead Standard including training, medical surveillance, engineering controls, establishment of work areas, etc.

PPE

Eye:	Safety Glasses
Skin:	Coveralls or disposable coveralls to keep lead off clothing and to prevent the spread of lead contamination.
Respiratory:	Air purifying respirators and supplied air respirators, depending on the exposure.

First Aid

Inhalation:	Move to fresh air, contact a physician
Skin:	Wash with water
Eyes	Flush with water
Ingestion:	Contact a physician

CH2M HILL Health and Safety Plan

Attachment 7

Working Alone Standard

CALL – IN CONTACT FORM

Date of site work:_____ Expected start time:_____

Name of CH2M HILL employee in the field:_____

Name of CH2M HILL employee responsible to receive contact:

Client Emergency Contact (if any):

CH2M HILL employee's contact numbers:

Radio #_____

Cell Phone #_____

Address and Location of work:_____

Directions/Map:

Planned Activity:_____

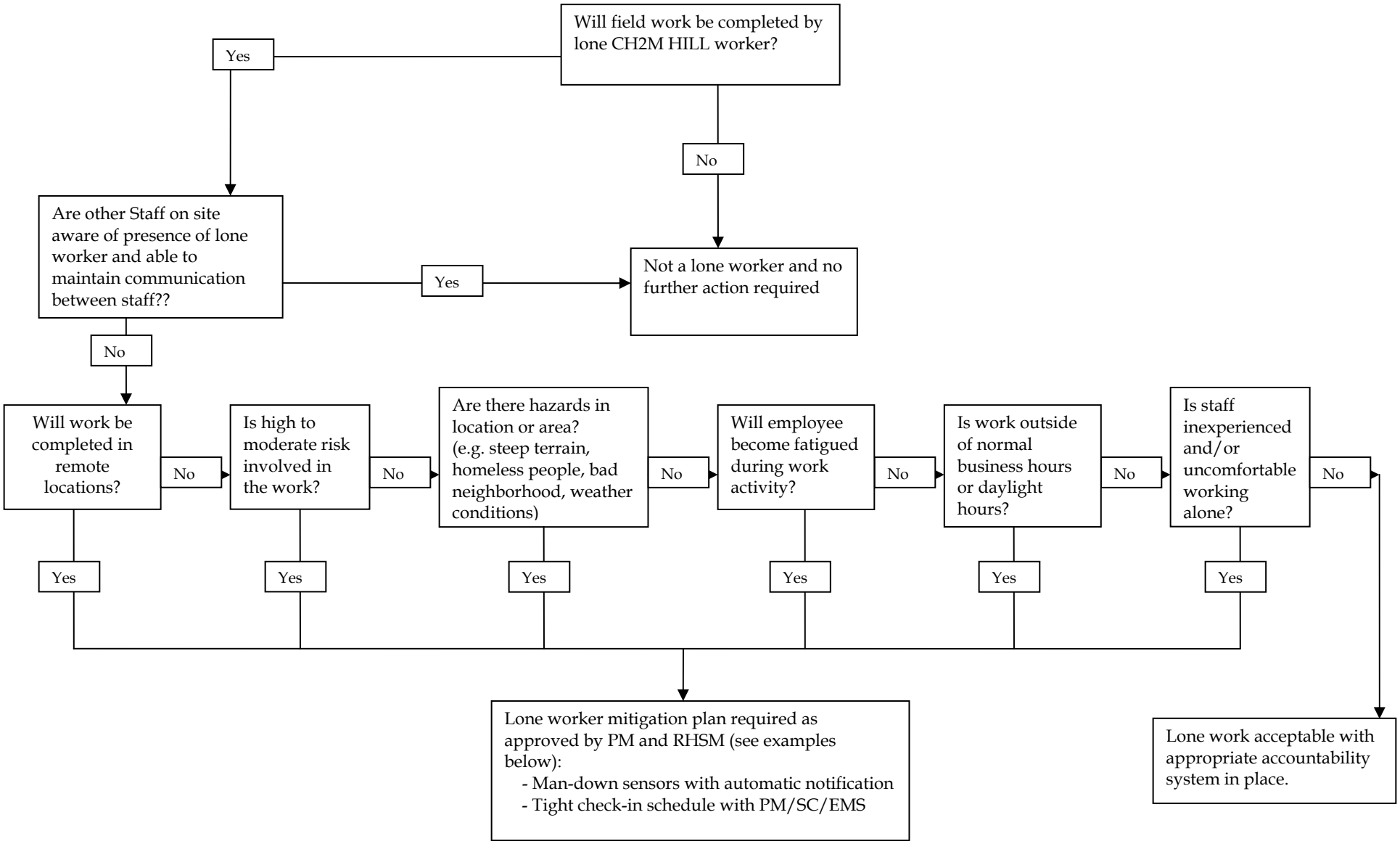
Specified Frequency and time for call in:_____

Time	Verified	Location

If lone worker fails to call in at specified frequency/time:

1) Call worker's radio and cell to determine if an emergency exists.
2) If no reply, immediately call Client security/emergency service if there is one at the site.
3) If there is no client security call Emergency Services (911). Inform the dispatcher there is a lone worker that cannot be contacted and there may be an emergency on site. Provide the lone worker's name, their last known location, and your contact information.
4) After Emergency Services have been contacted, call the other emergency contacts, Project Manager, and Responsible Health and Safety Manager.

Lone Worker Protocol



CH2M HILL HEALTH AND SAFETY PLAN

Attachment 8

Tick Fact Sheet

Vehicle Accident Guidance

Tick-Borne Pathogens — A Fact Sheet

Most of us have heard of Lyme disease or Rocky Mountain Spotted Fever (RMSF), but there are actually six notifiable tick-borne pathogens that present a significant field hazard. In some areas, these account for more than half of our serious field incidents. The following procedures should be applied during any field activity—even in places that are predominantly paved with bordering vegetation.

Hazard Recognition

An important step in controlling tick related hazards is understanding how to identify ticks, their habitats, their geographical locations, and signs and symptoms of tick-borne illnesses.

Tick Identification

There are five varieties of hard-bodied ticks that have been associated with tick-borne pathogens. These include:

- Deer (Black Legged) Tick (eastern and pacific varieties)
- Lone Star Tick
- Dog Tick
- Rocky Mountain Wood Tick

These varieties and their geographical locations are illustrated on the following page.

Tick Habitat

In eastern states, ticks are associated with deciduous forest and habitat containing leaf litter. Leaf litter provides a moist cover from wind, snow, and other elements. In the north-central states, is generally found in heavily wooded areas often surrounded by broad tracts of land cleared for agriculture.

On the Pacific Coast, the bacteria are transmitted to humans by the western black-legged (deer) tick and habitats are more diverse. For this region, ticks have been found in habitats with forest, north coastal scrub, high brush, and open grasslands. Coastal tick populations thrive in areas of high rainfall, but ticks are also found at inland locations.

Illnesses and Signs & Symptoms

There are six notifiable tick-borne pathogens that cause human illness in the United States. These pathogens may be transmitted during a tick bite—normally hours after attachment. The illnesses, presented in approximate order of most common to least, include:

- Lyme (bacteria)
- RMSF (bacteria)
- Ehrlichiosis (bacteria)
- STARI (Southern Tick-Associated Rash Illness) (bacteria)
- Tularemia (Rabbit Fever) (bacteria)
- Babesia (protozoan parasite)

Symptoms will vary based on the illness, and may develop in infected individuals typically between 3 and 30 days after transmission. Some infected individuals will not become ill or may develop only mild symptoms. These illnesses present with some or all of the following signs & symptoms: fever, headache, muscle aches, stiff neck, joint aches, nausea, vomiting, abdominal pain, diarrhea, malaise, weakness, small solid, ring-like, or spotted rashes. The bite site may be red, swollen, or develop ulceration or lesions. For Lyme disease, the bite area will sometimes resemble a target pattern. A variety of long-term symptoms may result if the illness is left untreated, including debilitating effects and death.

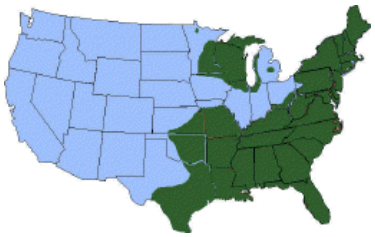
Deer Tick

From Left: adult female, adult male, nymph, and larvae Deer Tick (cm scale)

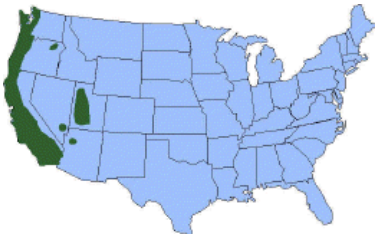
Lone Star Tick

Dog Tick

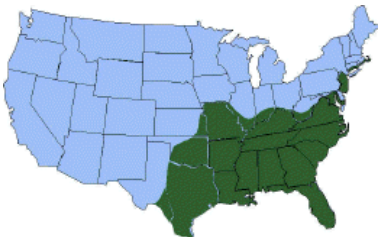
Rocky Mountain Wood Tick



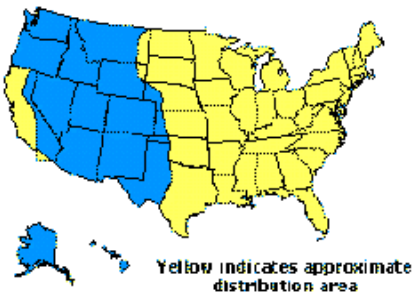
Distribution of Deer Tick (dark green)

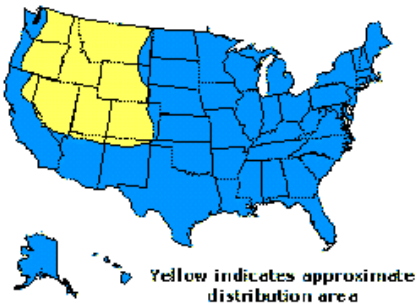


Distribution of Pacific Deer Tick (dark green)



Distribution of Lone Star Tick (Green)





Hazard Control

The methods for controlling exposure to ticks include, in order of most- to least-preferred:

- Avoiding tick habitats and ceasing operations in heavily infested areas
- Reducing tick abundance through habitat disruption or application of acracide
- Personal protection through use of repellants and protective clothing
- Frequent tick inspections and proper hygiene

Vaccinations are not available and preventative antibiotic treatment after a bite is generally not recommended.

Avoidance and Reduction of Ticks

To the extent practical, tick habitats should be avoided. In areas with significant tick infestation, consider stopping work and withdrawing from area until adequate tick population control can be achieved. Stopping and withdrawing should be considered as seriously as entering an area without proper energy control or with elevated airborne contaminants—tick-borne pathogens present risk of serious illness!

In areas where significant population density or infestation exists, tick reduction should be considered. Tick reduction can be achieved by disrupting tick habitats and/or direct population reduction through the use of tick-toxic pesticides (Damminix, Dursban, Sevin, etc.).

Habitat disruption may include only simple vegetative maintenance such as removing leaf litter and trimming grass and brush. Tick populations can be reduced by between 72 and 100 percent when leaf litter alone is removed. In more heavily infested areas, habitat disruption may include grubbing, tree trimming or removal, and pesticide application (Damminix, Dursban, Sevin, etc.). This approach is practical in smaller, localized areas or perimeter areas that require occasional access. Habitat controls are to be implemented with appropriate health and safety controls, in compliance with applicable environmental requirements, and may be best left to the property owner or tenant or to a licensed pesticide vendor. Caution should be exercised when using chemical repellents or pesticides in or around areas where environmental or industrial media samples will be collected for analysis.

Personal Protection

After other prevention and controls are implemented, personal protection is still necessary to control exposure to ticks. Personal protection must include all of the following steps:

- So that ticks may be easily seen, wear light-colored clothing. Full-body New Tyvek (paper-like disposable coveralls) may also be used
- To prevent ticks from getting underneath clothing tuck pant legs into socks or tape to boots
- Wear long-sleeved shirts, a hat, and high boots
- Apply DEET repellent to exposed skin or clothing per product label
- Apply permethrin repellent to the outside of boots and clothing before wearing, per product label
- Frequently check for ticks and remove from clothing
- At the end of the day, search your entire body for ticks (particularly groin, armpits, neck, and head) and shower
- To prevent pathogen transmission through mucous membranes or broken/cut skin, wash or disinfect hands and/or wear surgical-style nitrile gloves any time ticks are handled

Pregnant individuals and individuals using prescription medications should consult with their physician and/or pharmacists before using chemical repellents. Because human health effects may not be fully known, use of chemical repellents should be kept to a minimum frequency and quantity. Always follow manufacturers' use instructions and precautions. Wash hands after handling, applying, or removing protective gear and clothing. Avoid situations such as hand-to-face contact, eating, drinking, and smoking when applying or using repellents.

Remove and wash clothes per repellent product label. Chemical repellents should not be used on infants and children.

Vaccinations are generally not available for tick-borne pathogens. Although production of the LYMErix™ Lyme disease vaccination has been ceased, vaccination may still be considered under specific circumstances and with concurrence from the consulting physician.

Tick Check

A tick check should be performed after field survey before entering the field vehicle (you do not want to infest your field vehicle with ticks). Have your field partner check your back; the backs of your legs, arms, and neck; and your hairline. Shake off clothing as thorough as possible before entering the vehicle. Once the field day is complete, repeat this procedure and perform a thorough self check.

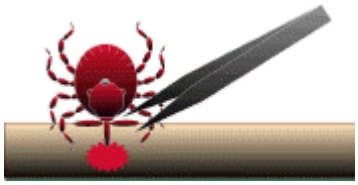
If a tick has embedded itself into the skin, remove the tick as described below.

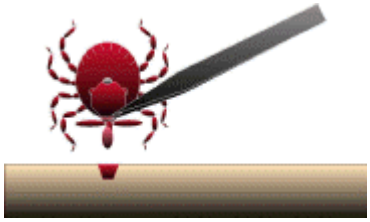
Tick Removal

1. Use the tick removal kit obtained through the CH2M HILL Milwaukee warehouse, or a fine-tipped tweezers or shield your fingers with a tissue, paper towel, or nitrile gloves.

Tick Bites\Tick Remover.pdf

2. Grasp the tick as close to the skin surface as possible and pull upward with steady, even pressure. Do not twist or jerk the tick; this may cause the mouthparts to break off and remain in the skin. If this happens, remove mouthparts with tweezers. Consult your healthcare provider if infection occurs.





3. Avoid squeezing, crushing or puncturing the body of the tick because its fluids (saliva, hemolymph, gut contents) may contain infectious organisms. Releasing these organisms to the outside of the tick's body or into the bite area may increase the chance of infectious organism transmission.

4. Do not handle the tick with bare hands because infectious agents may enter through mucous membranes or breaks in the skin. This precaution is particularly directed to individuals who remove ticks from domestic animals with unprotected fingers. Children, elderly persons, and immunocompromised persons may be at greater risk of infection and should avoid this procedure.

5. After removing the tick, thoroughly disinfect the bite site and wash your hands with soap and water.

6. Should you wish to save the tick for identification, place it in a plastic bag, with the date of the tick bite, and place in your freezer. It may be used at a later date to assist a physician with making an accurate diagnosis (if you become ill).

Note: Folklore remedies such as petroleum jelly or hot matches do little to encourage a tick to detach from skin. In fact, they may make matters worse by irritating the tick and stimulating it to release additional saliva, increasing the chances of transmitting the pathogen. These methods of tick removal should be avoided. In addition, a number of tick removal devices have been marketed, but none are better than a plain set of fine tipped tweezers.

First-Aid and Medical Treatment

Tick bites should always be treated with first-aid. Clean and wash hands and disinfect the bite site after removing embedded tick. Individuals previously infected with Lyme disease does not confer immunity—re-infection from future tick bites can occur even after a person has contracted a tick-borne disease.

The employee should contact the Injury Management/Return To Work provider (IMRTW), WorkCare using the toll-free number 866-893-2514 to report the tick bite. WorkCare will follow-up with each CH2M Hill employee who reports a tick bite and is at risk of developing Lyme disease by monitoring for symptoms up to 45 days, and will refer the employee to a medical provider for evaluation and treatment as necessary.

2011 Vehicle Accident Guidance—ESBG

Remember that if you a **renting** a non-CH2M HILL owned vehicle (short-term rental) in the U.S., you should carry the insurance card from the state where your driver's license is issued.

If you operate a **fleet vehicle**, carry the insurance card where the vehicle is registered.

For ALL Vehicles if you are in an accident:

1. If you are injured, call 911 for emergency medical treatment or 1-866-893-2514 to contact the CH2M HILL Occupational Nurse/Physician for minor injuries. If you feel you have not been injured, contact the RHSM for guidance on whether calling the CH2M HILL Occupation Nurse/Physician is applicable.

2. **Call the Police--**For any vehicle accident/damage, it is recommended that the local police (or site security/emergency services if working on a client site that provides such services) be called to determine if a report needs to be filed. In some instances, a report may not be required (during accident alerts, or in public parking lots). Document that the authorities were called and follow up with any guidance they give you. State requirements vary. If a report is filed, obtain a copy.

3. Notify Supervisor, (and PM/RHSM if working on a project site)

4. Complete a HITS report on the VO.

Additional Steps

To report an auto accident, and before a claim can be taken by telephonic reporting, have available your name (the company name alone is no longer accepted, a driver's name must be provided even for fender benders), location of accident and your office address if different than the accident location, business group and project number. A claim cannot be taken without your name, address, business group and your project number. By location the state where the accident occurred, and which office you are aligned to, i.e., accident occurs in Idaho, but you are out of the Denver office. Advise the claim recorder the accident occurred in ID, but that your office location is Denver. This will assist the claim intake person in identifying location coding for the claims.

Auto accidents involve two different sections of an Auto policy:

1) Liability to others due to Bodily Injury and Property Damage

2) Physical Damage - Comprehensive and Collision - damage to the vehicle CH employee is driving

CH2M Hill has Liability coverage for any auto - our policy will respond on either a primary or excess basis.

Refer to the table below for additional notifications to make based on the type of accident experienced and type of vehicle being used.

CH2MHILL

HSSE Target Zero World-Class Performance

Liability - Bodily Injury or Property Damage to Others

Scenario	Which Coverage Responds	What to do if in an accident
CH2M Hill fleet, pool or project vehicle - long term lease - lower 48	CH2M Hill - Primary	Contact Broadspire (1-800-753-6737); Jennifer Rindahl/DEN (720-286-2449); Linda George/DEN (720-286-2057)
CH2M Hill fleet, pool or project vehicle - long term lease - Alaska (North Slope)	CH2M Hill - Primary	Contact Jennifer Rindahl/DEN (720-286-2449)
Client vehicle driven by CH2M Hill employee	Client's auto policy unless client has made CH2M Hill responsible for vehicle	Contact Broadspire (1-800-753-6737); Contact Jennifer Rindahl/DEN (720-286-2449); contact client;
Short term lease (30 days or less)	Rental car company if rented through Enterprise, Budget or Hertz; CH2M Hill excess	Contact Broadspire (1-800-753-6737); Contact local branch of rental car company where vehicle leased (ERAC includes 24 hour roadside assistance) and Jennifer Rindahl/DEN (720-286-2449)
Short term lease (30 days or less)	CH2M Hill - Primary if rented through company other than our national agreements; $100,000 deductible	Contact Broadspire (1-800-753-6737); Contact rental car company and Jennifer Rindahl/DEN (720-286-2449)
Personal vehicle used on business	Employee's personal auto policy; CH2M Hill on an excess basis	Contact personal auto insurance company; contact Jennifer Rindahl/DEN (720-286-2449)

Physical Damage - damage to vehicle CH employee was driving

Scenario	Which Coverage Responds	What to do if in an accident
CH2M Hill fleet, pool or project vehicle - long term lease - lower 48	CH2M Hill ONLY if vehicle is scheduled on policy - $5,000 deductible	Contact Broadspire (1-800-753-6737); Jennifer Rindahl/DEN (720-286-2449); Linda George/DEN (720-286-2057)
CH2M Hill fleet, pool or project vehicle - long term lease - Alaska (North Slope)	CH2M Hill Equipment Schedule if scheduled on policy	Contact Jennifer Rindahl/DEN (720-286-2449)
CH2M Hill fleet, pool or project vehicle - long term lease	ARI if physical damage coverage purchased - $500 deductible	Contact Jennifer Rindahl/DEN 720.286.2449; call ARI at 1-800-221-1645 give them Client Code and ARI fleet vehicle number; and notify Linda George/DEN - Fleet Coordinator - 720-286-2057
Client vehicle CH2M Hill Employee is driving	Client's auto policy unless client has made CH2M Hill contractually responsible for vehicle	Contact Jennifer Rindahl/DEN (720-286-2449); contact client; contact Broadspire (1-800-753-6737)
Short term lease (30 days or less) using corporate VISA	VISA if corporate credit card used and vehicle is not a pickup, truck, cargo van or used off-road	Contact VISA - 1-800-847-2911 or http://www.visa.com/eclaim
Short term lease (30 days or less) through Enterprise (ERAC) and vehicle is used off-road and physical damage coverage included when vehicle leased	ERAC up to $3,000 in damage; CH2M Hill's coverage is excess	Notify Rental Car Company; contact Jennifer Rindahl/DEN (720-286-2449) if damage over $5,000
Short term lease (30 days or less) did **not** use corporate VISA	CH2M Hill - $5,000 deductible (project responsibility)	Contact Broadspire (1-800-753-6737); Contact Jennifer Rindhal/DEN 720-286-2449; contact VISA - 1-800-847-2911 or http://www.visa.com/eclaim
Personal vehicle used on business	CH will reimburse the amount of the deductible carried on the employee's policy up to $500 whichever is less	Contact Jennifer Rindahl/DEN (720-286-2449); contact client; contact Broadspire (1-800-753-6737)

Details for reporting a claim on the CH2M Hill VO are accessed by going to the VO home page and clicking:

GLOBAL ENTERPRISE SERVICES/INSURANCE & BONDING/CLAIMS REPORTING

HOW DO I REPORT A CLAIM TAB or access the following URL:

https://www.int.ch2m.com/intrnl/voffice/corp/insurance/claims/report.asp?Menu=menu3h

For Personally Owned Vehicles (POVs):

CH2M HILL does not provide auto insurance for POVs, it is responsibility of the owner. If you are in a vehicle accident conducting company business, contact the police as above, supervisor, and 911 or CH2M HILL's occupational nurse/physician as stated above. Complete a HITS report. Contact Jennifer Rindahl/DEN for assistance for meeting personal insurance deductibles (up to $500) with proof of insurance and deductible.

If using your POV for extended project use, notify the PM to make sure a rental car is not needed. Check your insurance policy for guidance on using the POV for business use.

Additional Resources:

Claims Resource Manual

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 9

Observed Hazard Form

CH2MHILL

OBSERVED HAZARD FORM

Name/Company of Observer (*optional*):

Date reported:_____

Time reported:_____

Contractor/s performing unsafe act or creating unsafe condition:

1. _____

2. _____

3. _____

Unsafe Act or Condition:

_____

_____

_____

_____

_____

_____

_____

_____

_____

Location of Unsafe Act or Condition:

Name of CH2M HILL Representative:

_____

Corrective Actions Taken: Date: _____

_____

_____

_____

_____

_____

Project Safety Committee Evaluation: Date: _____

_____

_____

_____

_____

_____

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 10

Stop Work Order Form

CH2MHILL

Stop Work Order

REPORT PREPARED BY:

Name:	**Title:**	**Signature:**	**Date:**

ISSUE OF NONPERFORMANCE:

Description:	Date of Nonperformance:
	_____

SUBCONTRACTOR SIGNATURE OF NOTIFICATION:

Name:	**Title:**	**Signature:**	**Date:**

**** Corrective action is to be taken immediately. Note below the action taken, sign and return to CCI.* Work may not resume until authorization is granted by CH2M HILL Constructors, Inc. Representative,***

SUBCONTRACTOR'S CORRECTIVE ACTION

Description:	Date of Nonperformance:
	_____

SUBCONTRACTOR SIGNATURE OF CORRECTION

Name:	**Title:**	**Signature:**	**Date:**

Attachment 11

Agency Inspection Target Zero Bulletin

Environmental Services Business Group

TARGET ZERO BULLETIN

Subject: HSSE Agency Inspections (OSHA, EPA, DOT, State Health Department)

Do you know what YOU would do if an agency inspector arrived at your site unannounced?

Recently, a State Occupational Safety and Health Administration (OSHA) inspector made an unannounced visit to one of our Federal project sites. OSHA, U.S. Environmental Protection Agency (EPA), and authorized state or local agencies have authority to inspect any facility that is subject to health, safety, and environmental legislation. Inspections may be announced or unannounced. This particular inspector indicated that the project was targeted for an inspection because the work was funded by the American Recovery and Reinvestment Act (ARRA).

Enterprise Standard Operating Procedure (SOP) HSE-201, *Agency Inspections and Communications,* describes the responsibilities, procedures, and requirements associated with inspections conducted by external regulatory agencies, as well as the methods for communicating information to key individuals. This Target Zero Bulletin is a brief summary of what to do in the event of an agency inspection at your site. Refer to the SOP for more specific guidance.

Notification of Inspections

- If the inspection is an announced regulatory agency inspection, the Project Manager (PM) should notify the Responsible Health and Safety Manager (RHSM) and Responsible Environmental Manager (REM) well in advance of the inspection.
- If an unannounced agency inspector visits one of our projects, Field personnel must immediately notify the project Emergency Response Coordinator (ERC). Typically the ERC is the Safety Coordinator (SC).
- The ERC must immediately notify the RHSM/REM, as appropriate, of unannounced inspections, or designate someone to call the RHSM/REM. The RHSM/REMs can provide guidance to the field staff and PM.

Inspector Credential Verification

- Upon arrival, the ERC must request the inspector to provide official credentials. Record the inspector's name and office phone number or obtain the inspector's business card.
- The inspector shall sign the visitors log and be given a site-specific health, safety, and environmental protection briefing.
- The inspector shall meet any site access requirements associated with security clearances, specialized training, and medical monitoring. The CH2M HILL representative shall verify that the inspector possesses these requirements; access will only be granted to those areas where appropriate access requirements are met. Some inspectors have the authority to gain access to any work area at any time, such as an inspector with a search warrant. In these cases, we can stop work operations as necessary to protect the safety of the inspector(s).

Opening Conference

- The CH2M HILL Project Manager, ERC, RHSM, or REM, and the inspector shall determine attendees for the opening conference. The RHSM (for OSHA and other worker health and safety inspections) or REM (for environmental inspections) shall join the opening conference via conference call.
- The inspector shall inform CH2M HILL of the purpose of the inspection and provide a copy of the complaint, if applicable.
- The inspector shall outline the scope of the inspection, including employee interviews conducted in private, physical inspection of the workplace and records, possible referrals, discrimination complaints, and the closing conference(s).

Requests for OSHA Logs

- An OSHA inspector may request to review the project OSHA Injury/Illness log, better known as the OSHA 300 Log. Contact your RHSM for assistance in obtaining the OSHA 300 Log.
- Field projects with a continuous duration of one year or longer are considered to be separate establishments and are required to maintain an OSHA 300 log specific to the project. The project OSHA 300 log should be maintained onsite and kept current.
- Recordable injuries and illnesses sustained on field projects less than one year in duration are maintained on the CH2M HILL office log where the injured employee is based.

The Inspection

- The scope of the inspection shall be limited to that indicated by the inspector in the opening conference. The inspector shall be escorted to relevant areas only. The ERC or other designated by the RHSM or REM must accompany the inspector during the inspection.
- Ensure that the inspection is limited to the scope that the inspector disclosed during the opening conference. The ERC should always take notes which identify: areas inspected, machinery or equipment and materials examined, employees or other persons interviewed, and photographs taken by the inspector.
- The inspector will observe safety, health, and environmental conditions and practices and document the inspection process. The inspector may also take photos and instrument readings, examine records, collect air samples, measure noise levels, survey existing engineering controls, and monitor employee exposure to toxic vapors, gases, and dusts.
- CH2M HILL should gather duplicate information (photographs, readings, samples) in the same manner and condition as the inspector. If the equipment needed to take duplicate samples is not onsite, ask the inspector if the sampling can wait until the equipment is available. If samples are taken, request a description of the tests that the agency intends to perform on the samples and request results as soon as they are available.
- Employees may be questioned during the inspection tour. The employee can refuse to speak to an inspector, can speak to the inspector with a company representative (including management) present, or can speak to the inspector privately. It is CH2M HILL policy that employees who wish to speak to the inspector are not discriminated against, intimidated, or otherwise mistreated for exercising their rights during compliance inspections.
- Copies of documents should not be provided to the inspector without the approval of the RHSM or REM or Legal Insurance Department (LID). **DO NOT** voluntarily release documents. Respond only to inspection team requests.
- During the course of the inspection, the inspector may point out violations. For each violation, the CH2M HILL representative should ask the inspector to discuss possible corrective action. Where possible, violations detected by the inspector should be corrected immediately and noted by the inspector as corrected.
- For those items which cannot be corrected immediately, an action plan shall be formulated for timely correction. In any instance, employees exposed to hazards shall be removed from the area.

Closing Conference

After the inspection, a closing conference is normally held as follows:

- The CH2M HILL PM, ERC, RHSM or REM shall be involved via conference call in the closing conference, at a minimum;
- The inspector shall describe the apparent violations found during the inspection and other pertinent issues as deemed necessary by the inspector. CH2M HILL shall be advised of their rights to participate in any subsequent conferences, meetings or discussions. Any unusual circumstances noted during the closing conference shall be documented by the ERC;
- The inspector shall discuss violations observed during the inspection and indicate for which violations a citation and a proposed penalty may be issued or recommended;
- The ERC shall request receipts for all samples and approved documents photocopied by the inspector, request a photocopy of the inspector's photograph log, and request a copy of the final inspection report; and
- Any documentation from an agency inspection must be transmitted immediately to the RHSM or REM, and LID.

Unannounced regulatory agency inspections may happen at any time on our projects -

Get your RHSM/REM and PM involved immediately if an Inspector arrives.

CH2M HILL HEALTH AND SAFETY PLAN

Attachment 12

Completed CH2M HILL AHAs

Attachment 2
Standard Operating Procedures—CH2M HILL

CLICK HERE FOR ATTACHMENTS

Excavation and Trenching Safety
Enterprise Standard Operating Procedure HSE-307

1.0 Purpose

This Enterprise Standard Operating Procedure (SOP) outlines the requirements that CH2M HILL legal entities and business groups (BGs) must comply with when performing excavation and trenching activities.

This SOP provides information about the spectrum of hazards and issues to be addressed during each phase of a project associated with excavation operations. Excavation hazards addressed in this SOP include exposure to cave-ins, falls, falling objects, hazardous atmospheres, unstable structures, and excavating into underground utilities.

2.0 Scope and Application

This SOP applies enterprise-wide to all CH2M HILL legal entities and BGs, their employees, subcontractors, and their lower-tier subcontractors that operate in the United States (U.S.) and internationally.

Some state's Occupational Safety and Health Administration (OSHA) plans may have more stringent requirements. Contact the appropriate Responsible BG health and safety manager (RHSM) to address these specific requirements. This SOP should be used as a starting point for international operations, but country-specific health and safety (H&S) regulations (such as Canada or Australia) shall prevail, and a country-specific addendum to this SOP should be developed to comply with those specific H&S regulations.

This Enterprise SOP applies when:

- CH2M HILL employees enter excavations, regardless of the company responsible for excavation safety (CH2M HILL, subcontractor, or third party contractor)
- CH2M HILL self-performs excavation activities; and/or,
- CH2M HILL provides oversight of subcontractor's excavation activities

This SOP does not apply to excavation activities in areas with known or potential ordnance explosives (OE)/unexploded ordnance (UXO) hazards. These requirements are addressed in HSE-610, *Explosives Usage and Munitions Response*.

2.1 Applicable Enterprise SOPs

Other Enterprise SOPs that may be applicable to excavation activities include the following:

We will only maintain controlled copies online. Printed versions of this document are uncontrolled copies. To ensure you have the current version, use the copy located at HSSE website.

- HSE-306, *Earthmoving Equipment* HSE-610, *Explosive Usage and* Munitions
- HSE-408, *Waste Management: Analysis and Characterization*
- HSE-416, *Waste Management: Wastewater and* Stormwater
- HSE-409, *Waste Management: Hazardous* Waste HSE-218, *Hazardous Waste* Operations

3.0 Definitions

The following definitions are used in this excavation and trenching SOP.

3.1 Benching

Benching is a method of protecting personnel from cave-ins by excavating the sides of an excavation to form one or a series of horizontal levels or steps, usually with vertical or near-vertical surfaces between levels.

3.2 Company Responsible for Excavation Safety

The party that has direct control over the excavation operations is responsible for excavation safety. This could be CH2M HILL, a subcontractor, or an independent third party. When CH2M HILL self-performs excavation operations, CH2M HILL assumes responsibility for excavation safety. When CH2M HILL hires a subcontractor to perform an excavation operation, the subcontractor assumes responsibility for excavation safety. When CH2M HILL employees must enter excavations on projects controlled by an independent third party contractor, the third party contractor assumes responsibility for excavation safety.

3.3 Competent Person

A competent person is one who is capable of identifying existing and predictable hazards in the surroundings, or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authorization to take prompt corrective measures to eliminate them. The company responsible for excavation safety designates the excavation-specific competent person.

3.4 Excavation

An excavation is any man-made cut, cavity, trench, or depression in an earth surface that is formed by earth removal.

3.5 Hazardous Atmosphere

A hazardous atmosphere is one that by reason of being explosive, flammable, poisonous, corrosive, oxidizing, irritating, oxygen-deficient, toxic, or otherwise harmful, may cause death, illness, or injury. Specific examples of hazardous atmospheres are provided below.

- Oxygen-deficient atmospheres contain less than 19.5 percent oxygen and can result in a range of symptoms, from dizziness to unconsciousness, and even death at extremely low levels.

We will only maintain controlled copies online. Printed versions of this document are uncontrolled copies. To ensure you have the current version, use the copy located at HSSE website.

- Oxygen-enriched atmospheres contain greater than 23.5 percent oxygen and can increase the flammability of combustible materials.

- Explosive atmospheres contain flammable gases that exceed 10 percent of the lower explosive limit (LEL).

- Carbon monoxide from the exhausts of earthmoving equipment can collect in excavations. Carbon monoxide causes oxygen starvation and can be fatal at a concentration of 1 percent [10,000 parts per million (ppm)] after a 1-minute exposure. Ventilation or respiratory protection is required when carbon monoxide levels exceed 35 ppm.

- Toxic atmospheres may develop depending on the level of contamination in the soil. Refer to the site-specific health, safety and environment (HS&E) plan or field safety instructions for more details.

3.6 Independent Third Party Contractor

An independent third party contractor has no contractual relationship with CH2M HILL and is contracted directly to the owner.

3.7 Protective Systems

Protective systems provide a method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into an excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems and other systems that provide the necessary protection.

3.8 Shielding

Shielding is a structure that is able to withstand the forces imposed on it by a cave-in, thereby protecting personnel within the structure. Shields can be permanent structures or they can be designed to be portable and moved as work progresses. Additionally, shields can be either pre-manufactured or job-built in accordance with local regulatory agency requirements. Shields used in trenches are usually referred to as ”trench boxes” or ”trench shields.”

3.9 Shoring

A structure such as a metal hydraulic, mechanical, or timber shoring system supports the sides of an excavation and is designed to prevent cave-ins.

3.10 Sloping

Sloping is a method of excavating in which the sides of an excavation are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies depending on such factors as the soil type, environmental conditions of exposure, and application of surcharge loads.

3.11 Stable Rock

We will only maintain controlled copies online. Printed versions of this document are uncontrolled copies. To ensure you have the current version, use the copy located at HSSE website.

Stable rock is natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed.

3.12 Trench

A trench is a narrow excavation (in relation to its length) made below the surface of the ground. In general, the depth is greater than the width, but the width of a trench (measured at the bottom) is not greater than 15 feet (4.6 meters). An excavation is also considered to be a trench if forms or other structures are installed or constructed in the excavation that reduce the dimension measured from the forms or structure to the side of the excavation to 15 feet (4.6 meters) or less (measured at the bottom of the excavation).

3.13 Type A Soil

Type A soils are cohesive soils with an unconfined compressive strength of 1.5 tons per square foot (14,629 kilograms per square meter) or greater. Type A soils include clay, silty clay, sandy clay, clay loam, caliche, hardpan, and sometimes silty clay loam and sandy clay loam. No soil should be classified as Type A if it is fissured; if it is subject to vibration from heavy traffic, pile driving, or similar activities; if it was previously disturbed; or if it is part of a sloped, layered system in which the layers dip into the excavation on a slope of four horizontal to one vertical (4H:1V) or steeper.

3.14 Type B Soil

Type B soils are cohesive soils with an unconfined compressive strength greater than 0.5-ton per square foot (4,876 kilograms per square meter) but less than 1.5 tons per square foot (14,629 kilograms per square meter). Type B soils include granular cohesionless soils such as angular gravel, silt, silt loam, sandy loam, and sometimes silty clay loam and sandy clay loam; previously disturbed soils that are not Type C; fissured soils and soils subject to vibration that would otherwise be classified as Type A; dry rock that is not stable; and material that is part of a sloped, layered system in which the layers dip on a slope less steep than four horizontal to one vertical (4H:1V).

3.15 Type C Soil

Type C soils are cohesive soils with an unconfined compressive strength of 0.5-ton per square foot (4,876 kilograms per square meter) or less. Type C soils include granular soils such as gravel, sand, and loamy sand; submerged soil; soil from which water is freely seeping; submerged rock that is not stable; or material in a sloped, layered system in which the layers dip into the excavation at a slope of four horizontal to one vertical (4H:1V) or steeper.

We will only maintain controlled copies online. Printed versions of this document are uncontrolled copies. To ensure you have the current version, use the copy located at HSSE website.

4.0 Roles and Responsibilities

The following sections outline the roles and responsibilities for individuals when using this procedure.

4.1 Business Group Health and Safety Leads

The BG H&S Leads are responsible for implementing this Enterprise H&S SOP for all projects in their BG. The BG HSE Lead also has the authority to approve deviation from this standard to accommodate local requirements.

4.2 Project Manager

The CH2M HILL Project Manager (PM) is responsible for providing adequate resources (budget and staff) for project-specific implementation of the H&S management process. The PM has overall H&S management responsibility, but may delegate specific tasks to other project staff. The PM retains ultimate H&S responsibility for the project.

4.3 Site Manager

The CH2M HILL Site Manager (SM) is responsible for all field operations onsite and is typically the Construction Manager (CM), Site Superintendent, Site Supervisor or Field Team Leader. The SM is directly responsible for implementing all aspects of the project H&S plan, as assigned by the PM.

4.4 Responsible Business Group Health and Safety Manager

The Responsible BG HSM (RHSM) is the HSM assigned by the BG H&S Lead to provide health and safety technical guidance and support to the project. The RHSM prepares and/or approves the CH2M HILL project H&S plan, reviews subcontractor H&S plans and submittals, conducts project H&S audits, and provides H&S support and guidance to the project.

4.5 Site Safety Coordinator

The Site Safety Coordinator (SSC) is either the SM, or is designated by the SM to implement the project H&S Plan. He or she has successfully completed all required SSC training. The SSC ensures that the party responsible for excavation safety provides an excavation-competent person to inspect and oversee all excavation activities.

4.6 Excavation-competent Person

The company responsible for excavation safety shall provide an excavation-competent person to inspect and oversee all excavation activities. The competent person shall have training in and knowledge of soil classification, the use of protective systems, and the requirements of local regulatory agency excavation standards. The competent person shall be capable of identifying excavation hazards and have the authority to take corrective actions to eliminate the hazards. The excavation-competent person shall be onsite during excavation activities and during entry into excavations.

We will only maintain controlled copies online. Printed versions of this document are uncontrolled copies. To ensure you have the current version, use the copy located at HSSE website.

4.7 CH2M HILL Employees

All employees are responsible for following safe work practices and complying with this SOP and project H&S requirements.

All employees are responsible for following the requirements established by the excavation-competent person, ensuring that the excavation-competent person has completed the daily inspection prior to entry and informing the competent person of any unsafe conditions associated with the excavation.

5.0 Requirements

The following excavation and trenching safety requirements outlined in this Enterprise SOP must be implemented.

5.1 General Requirements

CH2M HILL employees who enter excavations must take precautions to avoid excavation hazards by following the excavation entry requirements provided in Section 5.4 of this standard. CH2M HILL employees who provide oversight of subcontractor excavation activities must also follow the excavation safety requirements provided in Sections 5.5 and 5.6 of this standard. CH2M HILL employees who self-perform excavation activities must follow the excavation safety requirements provided in Sections 5.3, 5.4, 5.5 and 5.6 of this standard.

5.2 Subcontractor Management

Subcontractor H&S responsibilities are expressly defined through the subcontract terms and conditions. Subcontractors must determine how to conduct their operations, in compliance with applicable H&S regulations and industry standards, and how to correct deficiencies. CH2M HILL employees shall not direct the means and methods of subcontractor operations.

Subcontractors are responsible and accountable for implementing these requirements and any additional requirements established in their own safety procedures. 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 "Subcontractor Safety Procedure Criteria—Excavations" presented in Attachment 1 provides the minimum criteria for excavation safety procedures. These criteria may be used by the HS&E staff to review submitted subcontractor safety procedures when CH2M HILL is performing oversight of the subcontractor's operations.

The "HS&E Self-Assessment Checklist—Excavations" in Attachment 2 may be used to verify the subcontractor's compliance with established safe work practices, regulations, and industry standards.

5.3 CH2M HILL Self-performed Excavation Activities

We will only maintain controlled copies online. Printed versions of this document are uncontrolled copies. To ensure you have the current version, use the copy located at HSSE website.

The CH2M HILL Excavation Permit (Attachment 3) is required to be completed by the CH2M HILL excavation-competent person when CH2M HILL self-performs excavation activities. The Permit is completed and signed by the CH2M HILL excavation- competent person prior to each day's excavation activities for each excavation on the project.

The physical features of each excavation are documented in the Permit, including the length, depth, and location of the excavation. The Permit also confirms that adequate excavation protective systems have been instituted to protect workers from cave-ins, and that protective measures have been taken to control the hazards posed by surface encumbrances, underground installations, potential hazardous atmospheres, water accumulations, and stability of adjacent structures for each excavation.

An excavation permit may be extended for the same excavation for more than one day, provided there are no changes in the excavation physical features, protective systems to prevent cave-ins, or other protective measures to control the hazards posed by surface encumbrances, underground installations, potential hazardous atmospheres, water accumulations, or stability of adjacent structures.

Excavations and their adjacent areas and protective systems shall be inspected by an excavation-competent person prior to the start of each day's excavation activities, as needed throughout the work shift, and after every rainfall or other event that could increase the potential for excavation cave-in. Excavation inspections are conducted to identify evidence of a situation that could result in possible cave-ins, indications of failure of protective systems, hazardous atmospheres or other hazardous conditions.

The CH2M HILL Daily Excavation Inspection Checklist (Attachment 4) is required to be completed by the CH2M HILL excavation-competent person when CH2M HILL self-performs excavation activities. The Inspection Checklist is completed and signed by the CH2M HILL excavation-competent person each day prior to entering the excavation.

5.4 Excavation Entry Requirements

The requirements of this subsection are to be followed by CH2M HILL employees and subcontractor personnel who enter excavations, regardless of the company responsible for excavation safety (CH2M HILL, subcontractor, or third party contractor).

The party responsible for excavation safety shall provide an excavation-competent person to inspect and oversee all excavation activities. CH2M HILL personnel entering an excavation controlled by a third party contractor or subcontractor must comply with the written procedures or permits governing the third party contractor's or subcontractor's excavation activities, and must document the name of the third party or subcontractor excavation-competent person in their daily log.

All personnel entering the excavation shall verify that an excavation permit has been completed prior to entry.

- Personnel shall not enter excavations until the competent person has completed the daily inspection and has authorized entry.

We will only maintain controlled copies online. Printed versions of this document are uncontrolled copies. To ensure you have the current version, use the copy located at HSSE website.

- Personnel entering excavations shall be aware of and follow all requirements established by the excavation-competent person.

- Personnel shall not enter excavations where protective systems are damaged or unstable unless they are responsible for excavation safety and entry must be made to repair the systems. Entry shall be made only after additional precautions have been taken to ensure safe entry, as determined by the excavation-competent person.

- Personnel shall not enter excavations where objects (including machinery) or structures above the work location might become unstable and fall into the excavation.

- Personnel shall not enter excavations where there is the potential for a hazardous atmosphere until the air has been tested and found to be at safe levels, as determined by the excavation-competent person. It is important to remember that some chemical vapors are heavier than air and can accumulate at the bottom of excavations.

- Personnel shall not enter excavations that contain accumulated water unless precautions have been taken to prevent excavation cave-in, as determined by the excavation-competent person.

5.5 Excavation Safety Requirements

The requirements of the following subsections are to be followed by CH2M HILL personnel when self-performing excavation activities, and by subcontractors when performing excavation activities while CH2M HILL provides oversight of subcontractors activities.

5.5.1 General

- A daily safety briefing/meeting shall be conducted with all excavation personnel to discuss the work planned for the day and the HS&E requirements to be followed.

- Excavations that are to be entered shall be inspected each day, as needed throughout the work shift, and after every rainfall or other event that could increase the potential for excavation cave-in. This inspection shall be conducted by the excavation-competent person and shall include, at a minimum, indications of possible cave-in, water accumulation, failure of any component of protective systems, stability of spoil piles and adjacent structures, and indications of hazardous atmosphere. Subcontractors shall document their daily excavation inspections using their excavation inspection checklist.

- If the excavation-competent person observes any deficiency or unsafe condition, excavation entry will not be permitted and all exposed personnel shall be removed from the excavation until adequate precautions have been taken to ensure safe entry.

- Walkways shall be provided where personnel are required or permitted to cross over excavations. Walkways 6 feet (1.8 m) or more above lower levels shall be equipped with standard guardrails.

- Guardrails, fences, or barricades shall be installed at excavations 6 feet (1.8 m) or deeper when the excavations are not readily visible because of plant growth or other visual obstruction.

We will only maintain controlled copies online. Printed versions of this document are uncontrolled copies. To ensure you have the current version, use the copy located at HSSE website.

- Wells, pits, shafts and similar excavations 6 feet (1.8 m) or deeper shall be provided with guardrails, fences, barricades or covers.

- Earthmoving equipment shall be operated in compliance with local regulatory agency requirements.

5.5.2 Prior to Excavating

- A Dig Permit may be required at certain client facilities.

- Excavation activities that are performed on sites with known or potential unexploded ordinance (UXO) must implement additional excavation precautions as described in HSE-610, *Explosive Usage and Munitions Respons.*

- Soils suspected to be contaminated should be sampled and analyzed for characterization prior to excavation as described in HSE-408, *Waste Management: Analysis and Characterization.*

- Stockpiles *may require liners and covers an*d excavations may require silt fences, covering, or other best management practices (BMPs) to control erosion or runoff.

- The location of underground utilities such as electric, gas, fuel, water, cable, telephone, and sewer, either in service or abandoned, and underground installations such as foundations, underground storage tanks, and any other structures shall be identified before excavating is permitted. Utility companies and/or installation owners shall be contacted for exact locations of their equipment. When the exact location cannot be determined, detection equipment or other acceptable means of locating the underground installations shall be used before excavation.

5.5.3 Excavating Activities

- All rocks, trees, and other surface encumbrances that are undermined or could become unstable as a result of excavating activities shall be removed or supported to prevent them from falling into the excavation.

- Fugitive dust and noise must be monitored and suppressed where necessary.

- Support systems such as shoring, bracing, or underpinning shall be used to support exposed underground utilities that may become unstable as a result of excavating operations.

- Excavating below the base of a foundation, wall, sidewalk or other surface structure shall not be permitted unless: 1) a support system is provided to ensure the stability of the structure, 2) the excavation is in stable rock, or 3) a registered professional engineer has determined that the structure is far enough away that it will not be affected by the excavating activity.

- When mobile equipment is required to approach the edge of an excavation and the operator does not have a clear and direct view of the edge, warning systems such as

We will only maintain controlled copies online. Printed versions of this document are uncontrolled copies. To ensure you have the current version, use the copy located at HSSE website.

barricades, hand and/or mechanical signals, or stop logs shall be in place to remind the operator of the location of the edge.

5.5.4 Excavation Entry

- Trenches greater than 4 feet (1.2 meters) deep shall be provided with a ladder, stairway, or ramp positioned so that the maximum lateral travel distance is no more than 25 feet (7.6 meters).

- Structural ramps used solely by personnel shall be designed by a competent person. Structural ramps used by equipment shall be designed by a competent person qualified in structural design (generally a registered professional engineer).

- The atmosphere of excavations greater than 4 feet (1.2 meters) deep shall be tested prior to entry when a hazardous atmosphere exists or could reasonably be expected to exist, such as excavating landfills, hazardous waste dumps; or areas containing sewer or gas utility systems, petroleum distillates, or areas where hazardous substances are stored nearby.

- When atmospheric testing indicates a hazardous atmosphere exists or could reasonably be expected to exist, emergency rescue equipment such as safety harnesses and lifelines and emergency self-contained breathing apparatus (SCBA) shall be readily available.

- When atmospheric testing indicates that a hazardous atmosphere is present, ventilation or appropriate respiratory protection shall be used to eliminate or reduce exposure to safe levels. If ventilation is used, atmospheric testing shall be conducted as often as necessary to ensure safe levels are maintained.

- Excavations that contain accumulated water shall not be entered unless precautions have been taken to prevent excavation undermining and cave-ins. Precautions may include special support systems or shield systems, water removal equipment that is monitored by the excavation-competent person to ensure proper operation, or safety harnesses and lifelines.

- Adequate precautions such as diversion ditches or dikes shall be used to prevent surface water from entering the excavation, and to provide adequate drainage of the area adjacent to the excavation when the natural drainage of surface water is interrupted.

- Personnel shall be protected from materials falling or rolling from the face of the excavation by scaling to remove loose material, or by installing protective barricades.

- Spoil piles, material, and equipment must be kept at least 2 feet (61 centimeters) from the edge of the excavation, or a retaining device must be used to prevent the material from falling into the excavation.

5.5.5 Protective Systems

The excavation-competent person is responsible for determining the appropriate protective system to be used to prevent excavation cave-in. This determination may be based on the soil classification, space limitations, available materials, type of work to be performed in the

We will only maintain controlled copies online. Printed versions of this document are uncontrolled copies. To ensure you have the current version, use the copy located at HSSE website.

excavation, and availability of tabulated data or a registered professional engineer. CH2M HILL must rely on the expertise of the excavation-competent person with regard to excavation protective systems. The following information provides a general understanding of the common minimum protective system requirements. For the U.S., refer to "OSHA Protective System Requirements Summary" in Attachment 5. For other countries, refer to the country-specific SOP or local regulatory agency requirements.

- Sloping, benching, shoring, shielding, or other protective systems are required to protect personnel from cave-ins except when the excavation is made entirely in stable rock or is less than 5 feet (1.5 meters) deep and there is no indication of possible cave-in, as determined by the excavation-competent person.

- Excavations that are less than 5 feet in depth where examination of the ground by a competent person provides any indication of a potential cave-in shall be sloped to 34 degrees.

- Protective systems for excavations deeper than 20 feet (6.1 meters) must be designed or approved by a registered professional engineer.

- If the excavation soil is not classified by the excavation-competent person, the maximum allowable slope shall be 34 degrees measured from the horizontal. Refer to 5.7 for details about the actual slope and configurations allowed.

- Protective system materials shall be free from damage that might impair their proper function. Damaged components shall be inspected by the competent person to evaluate their suitability for continued use.

- Protective system materials shall be used in a manner consistent with manufacturers' recommendations and shall not be subjected to loads exceeding their design limits.

- Protective system materials shall be securely connected together to prevent sliding, falling, kickouts or other predictable failures.

- Personnel shall be protected from cave-ins while entering and exiting shielding systems.

- Personnel shall not work in shielding systems during installation, removal, or vertical movement. Personnel may remain inside the shield during horizontal movement as long as the shield is not lifted.

5.5.6 Protective Systems Removal and Backfilling

- Precautions shall be taken when removing protective system components. Removal shall start at, and progress from, the bottom of the excavation. Components shall be released slowly so that it is possible to detect indications of possible failure of the remaining components. Temporary structural members may be required to carry the loads imposed on the protective system.

- Backfilling shall take place immediately after removal of the protective system.

We will only maintain controlled copies online. Printed versions of this document are uncontrolled copies. To ensure you have the current version, use the copy located at HSSE website.

6.0 Training Requirements

CH2M HILL employees who enter excavations, regardless of the company responsible for excavation safety, are required to complete either the CH2M HILL 10-Hour Construction Safety Awareness training course or the Excavation computer-based training module found on the HS&E web page.

CH2M HILL may choose to supplement internal construction training courses with courses provided by local regulatory agencies.

When CH2M HILL self-performs excavation activities, the CH2M HILL excavation-competent person is required to complete a separate excavation-competent person course.

Excavation subcontractors are responsible for complying with all applicable HS&E training requirements and for providing the training necessary to complete their tasks safely.

7.0 Assessment Requirements

The "HS&E Self-Assessment Checklist—Excavations" in Attachment 2 is provided as a method for verifying compliance with this SOP. The RHSM may use this checklist when performing H&S audits at CH2M HILL projects, including subcontractor's activities.

9.0 Revision Log

Revision	Date	Description	Prepared by	Approved by
1	09/05/2005	Updated to Standard Operating Procedure	Angelo Liberatore and Mark Fagan	
2	03/30/2010	Updated Applicable SOPs and requirements in Sections 5.5.3 and Section 5.5.4	Angelo Liberatore/ Jeff Stumpf	

We will only maintain controlled copies online. Printed versions of this document are uncontrolled copies. To ensure you have the current version, use the copy located at HSSE website.

10.0 Attachments

Attachment 1 **Subcontractor Safety Procedure Criteria—Excavations**

Attachment 2 **HS&E Self-Assessment Checklist—Excavations**

Attachment 3 **CH2M HILL Excavation Permit**

Attachment 4 **CH2M HILL Daily Excavation Inspection Checklist**

Attachment 5: **OSHA Protective System Requirements Summary**

We will only maintain controlled copies online. Printed versions of this document are uncontrolled copies. To ensure you have the current version, use the copy located at HSSE website.

Attachment 1: Subcontractor Safety Procedure Criteria—Excavations

The following criteria are not intended to be all-inclusive, but are provided as a tool to facilitate development and review of subcontractor safety procedures. Subcontractors are expected to address the following items in their safety procedures:

Minimum Acceptable Criteria for Subcontractor Excavation Safety Procedures:

1. Provide name and qualifications of the "competent person" responsible for excavation activities (for example, years and type of experience, training background):
2. Describe excavation and protective system inspection criteria or procedures (for example, frequency of inspections—daily, as needed throughout day, after rain; visual versus written inspections, items that are inspected):
3. Describe methods of identifying underground utilities (for example, contacting utility companies, detection equipment):
4. Describe specific method(s) of cave-in protection to be used on project (for example, sloping, benching, shoring, shielding):
5. Describe option(s) that will be used for protective systems determination (for example, soil classification, tabulated data, other data, registered professional engineer design):
6. Describe methods used to identify hazardous atmospheres and controls (for example , detection equipment, ventilation, respiratory protection, rescue equipment):
7. Describe methods used to prevent water accumulation (for example , water removal equipment, special support systems, harnesses and lifelines):
8. Describe methods used to protect workers from material falling into the excavation (for example , remove or support objects, keep material 2 feet (61 cm) back from edge of excavation, or keep workers off slopes):
9. Describe methods used to support adjacent structures near excavations (for example , shoring, bracing, or underpinning):
10. Describe safe work practices for other activities to be performed during this project [for example , use of ladders, fall protection, personal protective equipment (PPE)]:
11. Provide summary of equipment that will be needed to perform excavation safely and verify that equipment is in good operational condition (for example , excavation digging equipment, shoring and shielding materials):

Attachment 2: HS&E Self-Assessment Checklist—Excavations

This checklist shall be used by CH2M HILL personnel only and shall be completed at the frequency specified in the project's Health and Safety Plan/Field Safety Instruction (HSP/FSI).

This checklist is to be used at locations where: 1) CH2M HILL employees enter excavations (complete Sections 1 and 3), and/or 2) CH2M HILL oversight of an excavation subcontractor is required (complete entire checklist).

The SSC may consult with excavation subcontractors when completing this checklist, but shall not direct the means and methods of excavation operations nor direct the details of corrective actions. Excavation subcontractors shall determine how to correct deficiencies and we must rely on their expertise. Conditions considered imminently dangerous (possibility of serious injury or death) shall be corrected immediately or all exposed personnel shall be removed from the hazardous area until the situation is corrected.

Project Name: _____ Project No.: _____

Location: _____ PM: _____

Auditor: _____ Title: _____ Date: _____

This specific checklist has been completed to:

☐ Evaluate CH2M HILL employee exposures to excavation hazards
☐ Evaluate a CH2M HILL subcontractor's compliance with excavation HS&E requirements
Subcontractor Name: _____

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

SECTION 1	Yes	No	N/A	N/O
EXCAVATION ENTRY REQUIREMENTS (4.1)				
1. Personnel have completed excavation safety training	☐	☐	☐	☐
2. Competent person has completed daily inspection and has authorized entry	☐	☐	☐	☐
3. Personnel are aware of entry requirements established by competent person	☐	☐	☐	☐
4. Protective systems are free from damage and in stable condition	☐	☐	☐	☐
5. Surface objects/structures secured from falling into excavation	☐	☐	☐	☐
6. Potential hazardous atmospheres have been tested and found to be at safe levels	☐	☐	☐	☐
7. Precautions have been taken to prevent cave-in from water accumulation in the excavation	☐	☐	☐	☐
8. Personnel wearing appropriate, PPE per HSP/SI	☐	☐	☐	☐

SECTION 2	Yes	No	N/A	N/O
GENERAL (4.2.1)				
9. Daily safety briefing/meeting conducted with personnel	☐	☐	☐	☐
10. Excavation and protective systems adequately inspected by competent person	☐	☐	☐	☐
11. Defective protective systems or other unsafe conditions corrected before entry	☐	☐	☐	☐
12. Guardrails provided on walkways over excavation 6 ft (1.8m) or deeper	☐	☐	☐	☐
13. Barriers provided at excavations 6 ft or deeper when excavation not readily visible	☐	☐	☐	☐
14. Barriers or covers provided for wells, pits, shafts, or similar excavation 6 ft (1.8 m) or deeper	☐	☐	☐	☐
15. Earthmoving equipment operated safely (use earthmoving equipment checklist in HSE-306)	☐	☐	☐	☐
PRIOR TO EXCAVATING (4.2.2)				
16. Dig Permit obtained where required by client/facility	☐	☐	☐	☐
17. Location of underground utilities and installations identified	☐	☐	☐	☐
EXCAVATING ACTIVITIES (4.2.3)				
26. Rocks, trees, and other unstable surface objects removed or supported	☐	☐	☐	☐
27. Exposed underground utility lines supported	☐	☐	☐	☐
28. Undermined surface structures supported or determined to be in safe condition	☐	☐	☐	☐
29. Warning system used to remind equipment operators of excavation edge	☐	☐	☐	☐
EXCAVATION ENTRY (4.2.4)				
32. Trenches > 4 ft (1.2 m) deep provided with safe means of egress within 25 ft (7.6 m)	☐	☐	☐	☐
33. Structure ramps designed and approved by competent person	☐	☐	☐	☐
34. Potential hazardous atmospheres tested prior to entry	☐	☐	☐	☐
35. Rescue equipment provided where potential for hazardous atmosphere exists	☐	☐	☐	☐
36. Ventilation used to control hazardous atmosphere and air tested frequently	☐	☐	☐	☐
37. Appropriate respiratory protection used when ventilation does not control hazards	☐	☐	☐	☐
38. Precautions taken to prevent cave-in resulting from water accumulation in excavation	☐	☐	☐	☐
39. Precautions taken to prevent surface water from entering excavation	☐	☐	☐	☐
40. Protection provided from falling/rolling material originating from excavation face	☐	☐	☐	☐
41. Spoil piles, equipment, materials restrained or kept at least 2 ft (61 cm) from excavation edge	☐	☐	☐	☐
EXCAVATION PROTECTIVE SYSTEMS (4.2.5)				
42. Protective systems used for excavations 5 ft (1.5 m) or deeper, unless in stable rock	☐	☐	☐	☐
43. Protective systems for excavation deeper than 20 ft (6.1 m) designed by registered PE	☐	☐	☐	☐
44. If soil unclassified, maximum allowable slope is 34 degrees	☐	☐	☐	☐
45. Protective systems free from damage	☐	☐	☐	☐
46. Protective system used according to manufacturer's recommendations and not subjected to loads exceeding design limits	☐	☐	☐	☐
47. Protective system components securely connected to prevent movement or failure	☐	☐	☐	☐
48. Cave-in protection provided while entering/exiting shielding systems	☐	☐	☐	☐
49. Personnel removed from shielding systems when installed, removed, or if vertical movement	☐	☐	☐	☐

	Yes	No	N/A	N/O
PROTECTIVE SYSTEM REMOVAL AND BACKFILLING (4.2.6)				
50. Protective system removal starts and progresses from excavation bottom	☐	☐	☐	☐
51. Protective systems removed slowly and cautiously	☐	☐	☐	☐
52. Temporary structure supports used if failure of remaining components observed	☐	☐	☐	☐
53. Backfilling takes place immediately after protective system removal	☐	☐	☐	☐

Attachment 3: CH2M HILL Excavation Permit

CH2MHILL

EXCAVATION PERMIT

This Permit is required to be completed by the CH2M HILL excavation-competent person when CH2M HILL self-performs excavation activities. The Permit is completed and signed by the CH2M HILL excavation-competent person prior to each day's planned excavation activities for each excavation on the project.

This Permit may be extended for the same excavation for more than one day, provided there are no changes in the excavation's physical features, protective systems to prevent cave-ins, or other protective measures to control the hazards posed by surface encumbrances, underground installations, potential hazardous atmospheres, water accumulations, or stability of adjacent structures.

GENERAL INFORMATION

Date:_____ Time:_____ Date Expires:_____

Project/Site Name: _____Project Number: _____
Location of Excavation: _____
Scope of Work Description: _____
Size of Excavation: Depth: _____Width: _____ Length:_____

PRIOR TO EXCAVATING

- ☐ Dig Permit obtained, where required by client/facility
- ☐ Client, installation owners, and utility companies contacted for location of underground utilities
- ☐ Detection equipment used when exact location of underground utilities is unknown
- ☐ Underground utilities located **within 5 feet** of excavations are hand-excavated to determine their exact location

The above data have been checked with drawing on file. When underground utilities are located within 5 feet of excavations, hand-excavation must be used to determine the exact location of buried utilities. Existing lines and interferences in the vicinity of work must be marked by stakes indicating the location and depth before excavating.

LINES IN THE VICINITY OF WORK

Electrical _____ Sewer_____ Drain_____ Other_____

Telephone_____ Steam_____ Process_____ (Specify)_____

Water_____ Alarm_____ Fiber Optic_____ Gas_____

PRECAUTIONS TAKEN

De-Energize Line_____ Insulate Operator_____

Ground Tools_____ Hand-excavate_____

ACCESS AND EGRESS

Ladder(s)_____ Ramp_____ Stairs_____

SOIL CLASSIFICATION

☐ Soils to be excavated have been classified: ☐ Stable Rock ☐ Type A ☐ Type B ☐ Type C
☐ Combination, describe: _____

NOTE: If soils unclassified, assume to be Type C

Soil Classification Basis (one visual and one manual test required):
☐ Visual Test ☐ Manual Test ☐ Pocket Penetrometer

EXCAVATING

☐ Rocks, trees, and other unstable surface encumbrances located that present a hazard to employees are removed or supported when required
☐ Underground utilities protected, supported, or removed to safeguard employees
☐ Undermined surface structures supported or determined to be in safe condition
☐ Warning system used to remind equipment operators of excavation edge

HAZARDOUS ATMOSPHERES

Is there a concern for developing a hazardous atmosphere? Yes_____ No_____

WATER ACCUMULATIONS

Is protection from the hazards associated with water accumulation required? Yes_____ No____
Excavation interrupts drainage from surface water? Yes_____ No____

PROTECTIVE SYSTEMS

☐ Protective systems used for excavations 5 ft (1.5 m) or deeper, unless stable rock
☐ Protective systems for excavation deeper than 20 ft (6.1 m) designed by registered PE
☐ Protective systems used: ☐ Sloping/Benching ☐ Shoring ☐ Trench Box ☐ Combination
Describe: _____

NOTE: No Benching allowed for Type C soil.

☐ Sloping cut to appropriate angle of incline for soil classification (if unclassified, assume Type C soil)

☐ Shoring/trench boxes used according to manufacturer recommendations and not subjected to loads exceeding design limits
☐ Protective system components securely connected to prevent movement or failure
☐ Protective systems inspected before installed
☐ Defective protective systems replaced or corrected

CH2M HILL Excavation-competent Person Name: _____

CH2M HILL Excavation-competent Person Signature: _____

Attachment 4: CH2M HILL Daily Excavation Inspection Checklist

CH2MHILL

DAILY EXCAVATION INSPECTION CHECKLIST

Excavations, their adjacent areas, and their protective systems shall be inspected by an excavation-competent person prior to the start of each day's excavation activities, as needed throughout the work shift, and after every rainfall or other event that could increase the potential for excavation cave-in. This Inspection Checklist is required to be completed by the CH2M HILL excavation-competent person when CH2M HILL self-performs excavation activities. The Inspection Checklist is completed and signed by the CH2M HILL excavation-competent person prior to each day's entry into the excavation.

GENERAL INFORMATION

Date:_____ Time:_____ Weather Conditions:_____

Project/Site Name: _____ Project Number: _____

Name/Location of Excavation: _____

Scope of Work Description: _____

INSPECTION CHECKLIST

☐ Excavation effectively barricaded to prevent unauthorized entry
☐ Barriers provided at excavations 6 ft or deeper when not readily visible
☐ Guardrails provided on walkways over excavations 6 ft or deeper
☐ Underground utilities protected, supported, or removed to safeguard employees
☐ Adjacent structures are adequately supported
☐ No tension cracks/fractures or evidence of caving, sloughing, or weak zones observed in soil
☐ Precautions taken to prevent surface water from entering excavation
☐ Water is not accumulating in excavation
☐ When water removal equipment used, it is monitored for proper operation
☐ Air monitoring conducted for excavations with hazardous atmosphere potential
☐ If hazardous atmosphere, ventilation used to bring conditions to safe level and tested frequently
☐ If ventilation unable to bring conditions to safe level, appropriate respiratory protection used
☐ Rescue equipment provided where potential for hazardous atmosphere exists
☐ Protective systems provided to prevent excavation cave-in
☐ Protective systems used: ☐ Benching ☐ Sloping ☐ Shoring ☐ Trench Box ☐ Combination
Describe: _____
☐ Protective systems inspected and are free from damage and in stable condition
☐ Protective system components securely connected to prevent movement or failure
☐ Sloping cut to appropriate angle of incline for soil classification
☐ Shoring installed according to design and secured from movement
☐ Hydraulic shores maintained at designed pressure
☐ Trench boxes not subjected to loads exceeding design limits
☐ Vehicular traffic diverted an adequate distance from excavation

- ☐ Spoil piles, equipment, and materials restrained or kept at least 2 ft (61 cm) from excavation edge
- ☐ Protection provided to prevent material from falling/rolling into excavation
- ☐ Safe means of egress provided every 25 ft (7.6 m) inside excavation
- ☐ Personnel entering excavation briefed and understand planned work and safety precautions
- ☐ Additional precautions taken when entering excavation to repair damaged or unstable protective systems

CH2M HILL Excavation-competent Person Name:

_____

CH2M HILL Excavation-competent Person Signature:

_____

Attachment 5: OSHA Protective System Requirements Summary

Sloping and Benching Systems

Sloping and benching systems must be designed by a registered professional engineer for excavations deeper than 20 feet (6.1 meters). System design for excavations 20 feet (6.1 meters) or less in depth must be selected and constructed by using one or more of the following options:

Option 1: Soil classification not required. Maximum allowable slope = 1-½ horizontal (H) to 1 vertical (V) or 34 degrees measured from the horizontal. Acceptable configurations are determined in accordance with Appendix B, Figure B-1.3 of OSHA 29 CFR 1926 Subpart P.

Option 2: Maximum allowable slope based on the soil classification type. A competent person must classify the soil as Stable Rock, Type A, Type B, or Type C soil based on at least one visual and at least one manual analysis. Acceptable test methods are outlined in Appendix A of CFR 1926 Subpart P. Acceptable configurations are determined in accordance with Appendix B, Figure B-1 of CFR 1926 Subpart P. The following table provides the maximum allowable slope based on soil classification.

Soil Type	**Maximum Allowable Slope (H:V)**
Stable Rock	Vertical (90 degrees)
Type A	¾ : 1 (53 degrees)
Type A—open less than 24 hours and 12' (3.7 m) or less deep	½ : 1 (63 degrees)
Type B	1: 1 (45 degrees)
Type C	1-½: 1 (34 degrees)

Option 3: Maximum allowable slope based on other tabulated data, such as tables and charts. The identity of the approving registered professional engineer must be stamped on the data. The tabulated data must be in written form, describing detailed information on its use and limitations, and must be at the job site during construction of the protective system.

Option 4: Sloping or benching designs prepared and approved by a registered professional engineer. The identity of the registered professional engineer who approved the data must be stamped on the design. The design must identify the project and the configurations must be determined safe for the project. The design documents must be at the job site during construction of the protective system.

Notes: Options 1 and 2:

- The actual slope shall not be steeper than the maximum allowable slope.
- When the excavation shows signs of distress, the actual slope shall be reduced from the maximum allowable slope by ½ horizontal and 1 vertical (½H:1V).
- When surcharge loads from operating equipment, traffic, stored material, and equipment are present, the competent person shall determine the degree to which the actual slope must be reduced below the maximum allowable slope.

Shoring, Shielding, and Other Protective Systems

Shoring, shielding, and other protective systems must be selected and constructed by using one of the following options. Soil classification using Appendix A of OSHA 29 CFR 1926 Subpart P is required for each option.

Option 1: Timber shoring design determined in accordance with the conditions and requirements of Appendix C of OSHA 29 CFR 1926 Subpart P. Aluminum hydraulic shoring design determined in accordance with Option 2, unless the manufacturer's tabulated data cannot be used. In such cases, Appendix D of OSHA 29 CFR 1926 Subpart P shall be followed. This option may be used only for excavations 20 feet or less in depth.

Option 2: Designs for protective systems determined in accordance with the specifications, recommendations, and limitations of the manufacturer's tabulated data. The manufacturer must issue written approval to deviate from these requirements and the approval must be available at the job site.

Option 3: Protective system designs determined using other tabulated data, such as tables and charts. The identity of the approving registered professional engineer must be stamped on the data. The tabulated data must be in written form, describing detailed information on its use and limitations, and must be at the job site during construction of the protective system.

Option 4: Protective system designs prepared and approved by a registered professional engineer. The identity of the registered professional engineer who approved the data must be stamped on the design. The design must identify the project and the configurations must be determined safe for the project. The design must be in written form, describing detailed information on its use and limitations, and must be at the job site during construction of the protective system.

WHERE TO GO FOR MR PROJECT SUPPORT
March 2008

CH2MHILL

CH2M HILL OE Team- March 2008

- Ben Redmond/KNV – MR Market Segment Director
- George DeMetropolis/SDO – MR Western Region MR Market Segment Manager
- Brint Bixler/WDC – MR Northeastern Region MR Market Segment Manager
- Kyra Donnell/KNV - MR Southeastern Region MR Market Segment Manager
- Steve Romanow/WDC – MR Project Delivery Manager
- Kevin Lombardo/WDC- MR Operations Manager
- Dan Young/NVR – MR H&S&E Manager
- Tamir Klaff/WDC - MR Geophysicist
- Tim Garretson/VBO – MR EOD Lead for Navy CLEAN

STANDARD OPERATING PROCEDURE

Preparing Field Log Books

I. Purpose

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

II. Scope

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

III. Equipment and Materials

- Log book
- Indelible pen

IV. Procedures and Guidelines

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

A. PROCEDURES FOR COMPLETING FIELD LOG BOOKS

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

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

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

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

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

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

5. Daily entries will be made chronologically.

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

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

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

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

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

B. INFORMATION TO BE INCLUDED IN FIELD LOG BOOKS

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

C. SUGGESTED FORMAT FOR RECORDING FIELD DATA

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

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

3. Sketch sampling locations and other pertinent information.

4. Sketch well construction diagrams.

V. Attachments

Example field notes.

Standard Operating Procedure

Locating and Clearing Underground Utilities

I. Purpose

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

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

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

II. Scope

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

Scenario 1

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

Scenario 2

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

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

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

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

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

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

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

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

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

III. Services and Equipment

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

Services

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

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

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

Equipment

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

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

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

IV. Procedures and Guidelines

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

Activity Notification and Dig Permit Procedures

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

Activity Specific: To be provided by Activity or Project Manager

CH2M HILL Utility Clearance Procedures

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

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

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

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

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

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

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

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

IV. Attachments

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

Attachment A – Example SOW for Subcontracting Underground Utilities Locating Services

CTO-XXX

Scope of Work

Subsurface Utility Locating

Site XX

Navy Activity

City, State

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

Proposed Scope of Work

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

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

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

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

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

Field Marking and Documentation

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

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

Bid Sheet/Payment Units

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

Health and Safety Requirements

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

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

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

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

Security

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

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

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

Quality Assurance

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

Subcontractor Standby Time

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

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

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

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

Down Time

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

Schedule

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

Attachment B - Services Available for Identifying and Marking Underground Utilities

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

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

Each are discussed below.

Navy Public Works Department

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

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

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

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

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

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

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

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

Private Subcontractors

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

   The level of service required from the subcontractor will vary depending on the nature of the site. At sites where utility locations are well defined on the maps and

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

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

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

Notes:

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

[1]Equipment types are:

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

[2]Other services include:

A. Data interpretation and/or report preparation to provide a permanent record of the geophysical survey results and a professional interpretation of the findings, including expected accuracy and precision.
B. Non-destructive excavation to field-verify the depths, locations, and types of subsurface utilities.
C. Concrete/asphalt coring and pavement/surface restoration.

Attachment C – Equipment Used for Identifying Underground Utilities

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

CH2M HILL In-house Utility Location Experts

Tamir Klaff/WDC

Home Office Phone – 703-669-9611

Electromagnetic Induction (EMI) Methods

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

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

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

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

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

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

Ground Penetrating Radar (GPR)

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

Magnetic Field Methods

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

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

Optical Methods

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

Attachment D – Utility Clearance Documentation Form

Attachment E – Utility Marking Color Codes

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

White – Proposed excavations and borings

Pink – Temporary survey markings

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

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

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

Blue – Potable water

Purple – Reclaimed water, irrigation and slurry lines

Green – Sewer and storm drain lines

Buried Utility Location Tracking Form

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

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

CH2M HILL Purchase Order:

Utility Location Subcontractor:
Subcontractor POC:

Dates of location activities:

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

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

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

Subcontractor's Signature

Date

STANDARD OPERATING PROCEDURE

Surface Water Sampling

I. Purpose and Scope

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

II. Materials and Equipment

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

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

III. Procedures and Guidelines

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

A. Manual Sampling

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

assembly. Specific types of weighted bottle samplers include dissolved oxygen, Kemmerer, or Van Dorn, and are acceptable in most instances.

A sample is taken with the following specific steps:

1. The location and desired depth for water sampling are selected.
2. The sample site is approached from downstream in a manner that avoids disturbance of bottom sediments as much as possible. The sample bottle is gently submerged with the mouth pointed upstream and the bottle tilted slightly downstream. Bubbles and floating materials should be prevented from entering the bottle. If using a Peristaltic pump, lower the tubing into the water to the desired depth.
3. For weighted bottle samplers, the assembly is slowly lowered to the desired depth. The bottle stopper is unseated with a sharp tug and the bottle is allowed to fill until bubbles stop rising to the surface.
4. When the bottle is full, it is gently removed from the water. If sample transfer is required, it should be performed at this time.
5. Measure dissolved oxygen, specific conductance, temperature, and pH at the sampling location.

IV. Attachments

None.

V. Key Checks and Items

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

STANDARD OPERATING PROCEDURE

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

Soil Boring Drilling and Abandonment

I. Purpose and Scope

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

II. Equipment and Materials

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

III. Procedures and Guidelines

A. Drilling

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

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

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

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

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

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

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

B. Sampling

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

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

Undisturbed fine-grained samples may be collected for analysis for geotechnical parameters such as vertical hydraulic conductivity. These samples will be collected using thin-walled sampling tubes (sometimes called Shelby tubes). Tubes will be 24- to 36 inches long and 3- to 4-inches in diameter, depending upon the quantity of sample required. Undisturbed samples will be obtained by smoothly pressing the sampling tube through the interval to be sampled using the weight of the drilling rig. Jerking the sample should be avoided. Once the sample is brought to the surface, the ends will be sealed with bees wax and then sealed with end caps and heavy tape. The sample

designation, data and time of sampling, and the up direction will be noted on the sampling tube. The tube shall be kept upright as much as possible and will be protected from freezing, which could disrupt the undisturbed nature of the sample. Samples for geochemical analysis normally are not collected from thin-walled tube samples. More details are provided in the ASTM D 1587 standard (attached).

C. Abandonment

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

D. Decontamination and Waste Disposal

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

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

IV. Attachments

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

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

V. Key Checks and Preventative Maintenance

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

STANDARD OPERATING PROCEDURE

Installation of Shallow Monitoring Wells

I. Purpose and Scope

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

II. Equipment and Materials

Drilling

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

Well Riser/Screen and Associated Materials

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

Sand

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

Bentonite

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

Protective Casing

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

Well Development

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

III. Procedures and Guidelines

A. Drilling Method

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

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

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

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

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

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

B. Monitoring-Well Installation

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

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

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

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

and bentonite seal may be modified in the field to account for a shallow water table and a small saturated thickness of the surficial aquifer.

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

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

C. Well Completion

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

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

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

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

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

D. Well Development

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

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

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

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

IV. Attachments

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

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 ^{o}C	+/- 1.0 ^{o}C
ORP	-999 to +999 mV	+/- 15 mV
Salinity	0 to 4 %	+/- 0.3 %

B. Calibration:

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

Horiba 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.

STANDARD OPERATING PROCEDURE

Decontamination of Drilling Rigs and Equipment

I. Purpose and Scope

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

II. Equipment and Materials

- Portable steam cleaner and related equipment
- Potable water
- Phosphate-free detergent such as Liquinox®
- Buckets
- Brushes
- 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

STANDARD OPERATING PROCEDURE

Chain-of-Custody

I Purpose

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

II Scope

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

III Definitions

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

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

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

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

IV Responsibilities

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

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

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

V Procedures

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

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

V.1 Sample Identification

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

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

- Field Sampler(s),
- Contract Task Order (CTO) Number,
- Project Sample Number,
- Sample location or sampling station number,
- Date and time of sample collection and/or measurement,

- Field observations,
- Equipment used to collect samples and measurements, and
- Calibration data for equipment used

Measurements and observations shall be recorded using waterproof ink.

V.1.1 Sample Label

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

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

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

V.2 Chain-of-Custody Procedures

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

V.2.1 Field Custody Procedures

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

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

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

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

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

V.2.2 Transfer of Custody and Shipment

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

- Enter header information (CTO number, samplers, and project name).

- Enter sample specific information (sample number, media, sample analysis required and analytical method grab or composite, number and type of sample containers, and date/time sample was collected).

- Sign, date, and enter the time under "Relinquished by" entry.

- Have the person receiving the sample sign the "Received by" entry. If shipping samples by a common carrier, print the carrier to be used in this space (i.e., Federal Express).

- If a carrier is used, enter the airbill number under "Remarks," in the bottom right corner;

- Place the original (top, signed copy) of the Chain-of-Custody Record Form in a plastic zipper-type bag or other appropriate sample-shipping package. Retain the copy with field records.

- Sign and date the custody seal, a 1-inch by 3-inch white paper label with black lettering and an adhesive backing. Attachment C is an example of a custody seal. The custody seal is part of the chain-of-custody process and is used to prevent tampering with samples after they have been collected in the field. Custody seals shall be provided by the analytical laboratory.

- Place the seal across the shipping container opening (front and back) so that it would be broken if the container were to be opened.

- Complete other carrier-required shipping papers.

The custody record is completed using waterproof ink. Any corrections are made by drawing a line through and initialing and dating the change, then entering the correct information. Erasures are not permitted.

Common carriers will usually not accept responsibility for handling Chain-of-Custody Record Forms; this necessitates packing the record in the shipping container (enclosed with other documentation in a plastic zipper-type bag). As long as custody forms are sealed inside the shipping container and the custody seals are intact, commercial carriers are not required to sign the custody form.

The laboratory representative who accepts the incoming sample shipment signs and dates the Chain-of-Custody Record, completing the sample transfer process. It is then the laboratory's responsibility to maintain internal logbooks and custody records throughout sample preparation and analysis.

VI Quality Assurance Records

Once samples have been packaged and shipped, the Chain-of-Custody copy and airbill receipt become part of the quality assurance record.

VII Attachments

A. Sample Label
B. Chain of Custody Form
C. Custody Seal

VIII References

USEPA. *User's Guide to the Contract Laboratory Program*. Office of Emergency and Remedial Response, Washington, D.C. (EPA/540/P-91/002), January 1991.

SOP UXO Contacts

Name	Title	Office	Phone Number	Email
Ben Redmond	MR Market Segment Director	KNV	(865) 560-2906	ben.redmond@ch2m.com
George DeMetropolis	MR Western Region MR Market Segment Manager	SDO	(619) 687-0120 x37239	george.demetropolis@ch2m.com
Brint Bixler	MR Northeastern Region MR Market Segment Manager	WDC	(703) 376-5035 x45035	brint.bixler@ch2m.com
Kyra Donell/KNV	MR Southeastern Region MR Market Segment Manager	KNV	(865) 560-2883	kyra.donnell@ch2m.com
Steve Romanow	MR Project Delivery Manager	WDC	703) 376-5229	steve.romanow@ch2m.com
Kevin Lombardo	MR Operations Manager	WDC	(703) 376-5175	kevin.lombardo@ch2m.com
Dan Young	Coporate MR Safety QC Officier	NVR	(251) 962-2963	dan.young@ch2m.com
Tamir Klaff	MR Geophysicist	WDC	(703) 669-9611	tamir.klaff@ch2m.com
Tim Garretson	MR EOD Lead for Navy CLEAN	VBO	(757) 671-6224	timothy.garretson@ch2m.com

There is one SOP to address MR and that is HSE 610. The latest version can be found in the HSE section on our intranet.

Explosives Usage and Munitions Response (MR)

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 3
Data Management Guidelines

Version 1

Navy CLEAN
Data Management Plan

Prepared for

Navy CLEAN & Joint Venture Programs

June 2010

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

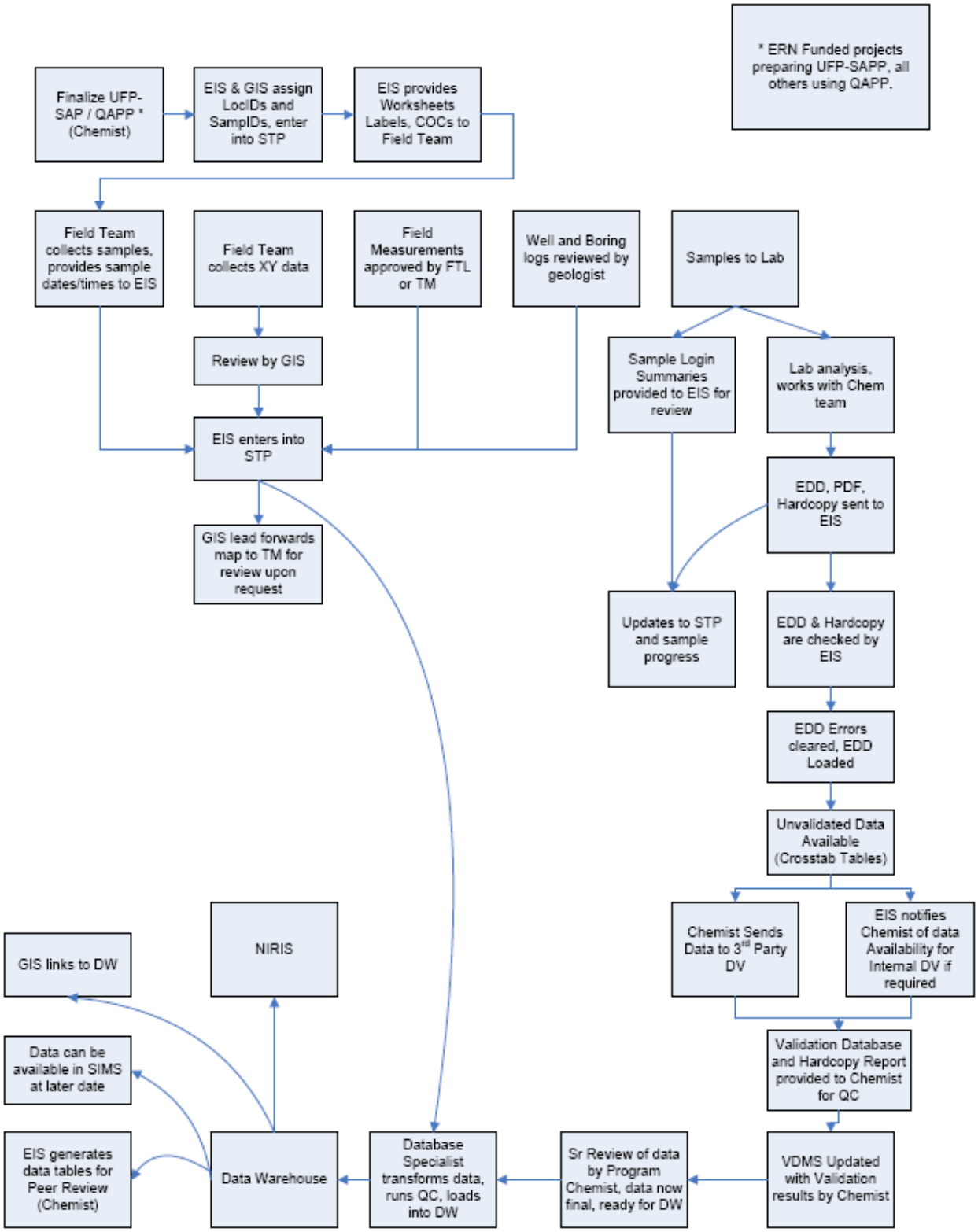


FIGURE P-1
ENVIRONMENTAL DATA MANAGEMENT WORKFLOW PROCESS

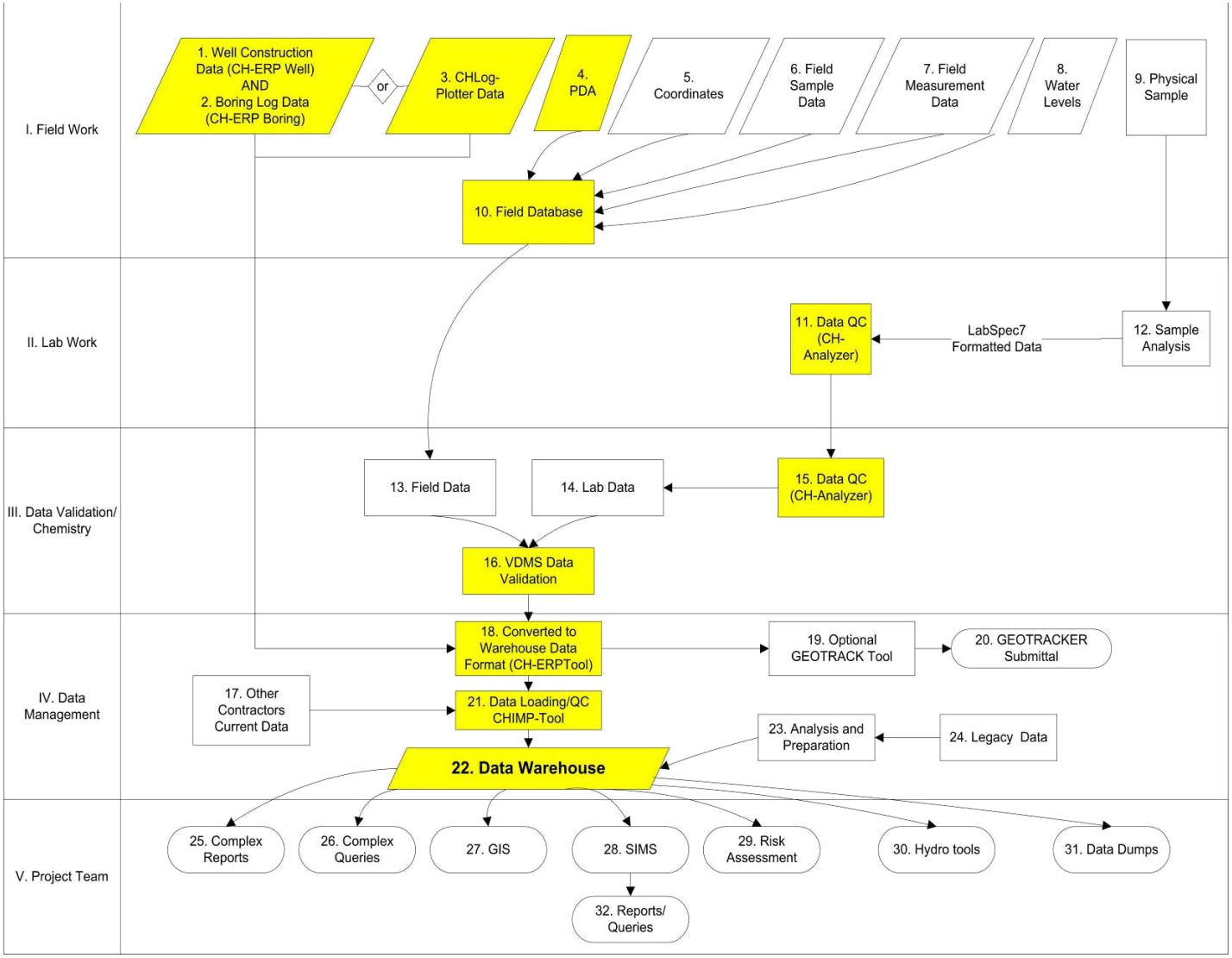


FIGURE P-2
DBMS PROCESS

Contents

Preface ..... **i**

Acronyms and Abbreviations ..... **vii**

1. Introduction **1-1**
- 1.1 Purpose and Objective 1-1
- 1.2 Scope of the Data Management Plan 1-2

2. Roles and Responsibilities **2-1**

3. Data Management System Description **3-1**

4. Phases of Data Management **4-1**
- 4.1 Project Planning and Setup 4-1
  - 4.1.1 Database Setup and Administration 4-1
  - 4.1.2 Data Security Procedures 4-3
  - 4.1.3 Data Backup and Recovery 4-3
- 4.2 Sample Collection and Management 4-3
  - 4.2.1 Sample Tracking Program 4-4
  - 4.2.2 Sample Nomenclature Guidelines 4-4
  - 4.2.3 Sample Collection 4-9
  - 4.2.4 Chain-of-Custody and eData 4-9
  - 4.2.5 Sample and Document Tracking 4-9
- 4.3 Laboratory Analysis 4-10
- 4.4 Data Validation 4-11
  - 4.4.1 External Data Validation 4-12
  - 4.4.2 Internal Data Validation 4-12
  - 4.4.3 Unvalidated Data Preload Check 4-12
  - 4.4.4 Senior Review 4-13
- 4.5 Data Preparation and Loading 4-13
  - 4.5.1 Data Preparation 4-13
  - 4.5.2 Data Loading 4-13
  - 4.5.3 Data Warehouse 4-14
- 4.6 Data Reporting 4-14
  - 4.6.1 Tables, Figures, and Diagrams 4-15
  - 4.6.2 GIS 4-15
  - 4.6.3 Site Information Management System 4-15
  - 4.6.4 Legacy Data 4-16

5. Project Closeout **5-1**
- 5.1 Archive Procedures 5-1
- 5.2 Invoice Review and Approval 5-1
- 5.3 Project Closeout 5-2

Appendices

A RASCI/Workflow Process
B Data Collection Flow Diagram
C List of Standard Operating Procedures

Tables

1 Navy CLEAN and Joint Venture Environmental Data Management Program Team 2-2
2 Station ID Scheme 4-6
3 Station ID SchEME 4-1

Figures

P-1 Environmental Data Management Workflow Process iii
P-2 DBMS Process iv
1 Environmental Data Management Workflow Process 3-2
2 DBMS Process 3-3
3 Project Planning 4-1
4 Field Sampling 4-4
5 Laboratory Analysis 4-10

Acronyms and Abbreviations

AFCEE	Air Force Center for Engineering and the Environment
AM	Activity Manager
CAD	computer-aided design
COC	chain-of-custody
DBMS	Database Management System
DBS	Database Specialist
DMP	Data Management Plan
EDD	electronic data deliverable
EDM	Environmental Data Management
EIS	Environmental Information Specialist
EMS	Enterprise Management Solutions
ERP	Environmental Restoration Program
ERPIMS	Environmental Restoration Program Information Management System
EVS	Environmental Visualization System
FD	field duplicate
FTL	Field Team Leader
GA	GIS Analyst
GIS	geographic information system
ID	identification
IDW	investigation-derived waste
IRP	Installation Restoration Program
MS	matrix spike
MSD	matrix spike duplicate
N/FD	normal/field duplicate
NAVFAC	Naval Facilities Engineering Command
NEDD	Naval Installation Restoration Information Solution Electronic Data Deliverable

NIRIS	Naval Installation Restoration Information Solution
ODBC	open database connectivity
PC	Project Chemist
PCL	Program Chemistry Lead
PDL	Program Data Management Lead
PGDB	personal geodatabase
PGL	Program GIS Lead
PM	Project Manager
QA	quality assurance
QC	quality control
RASCI	responsible, approve, support, consult, and inform
RDM	Regional Database Manager
SDG	Sample Delivery Group
SIMS	Site Information Management System
SOP	standard operating procedure
STSP	Sample Tracking Program
VDMS	Validated Data Management System

SECTION 1

Introduction

This Data Management Plan (DMP) describes the methods CH2M HILL will use to manage and present environmental data to support work it is conducting for the Navy CLEAN and Joint Venture Programs. These processes and procedures are part of an overall environmental data management system called the Validation Data Management System (VDMS) hosted by CH2M HILL.

Project members and any subcontractors supporting program data needs for site characterization and remediation activities can use this DMP. It is a living document that is flexible enough to meet the dynamic needs of the teams and stakeholders. Data management program details and procedures are included in the appendices.

1.1 Purpose and Objective

This document outlines how environmental data for the Navy CLEAN and Joint Venture Programs will be obtained and managed using an Enterprise Management Solutions (EMS) approach. The systematic approach will facilitate the retrieval of data from project files and the data warehouse when they are needed, help ensure that the required data are collected and are of the appropriate quality, and help ensure that data records are not lost during transfer to the central program database repository.

The EMS objectives critical to the success of the DMP are as follows:

- **Standardize and facilitate data collection.** Use standard field forms and database applications; provide guidance and standard operating procedures (SOPs) for formatting, reviewing, and transferring data collected in the field to the Database Management System (DBMS).
- **Provide the ability to capture electronic field data directly or indirectly.** Items that will be captured through standardized forms or applications include chains-of-custody (COCs), field parameter information, groundwater elevation data, and sample tracking records.
- **Minimize the uncertainties associated with the data.** Implement quality assurance (QA) and quality control (QC) measures to provide accurate representation of all data collected and stored in the DBMS. QA/QC procedures include restricting data import or entry to specific valid value lists that will not allow incorrect data to be included in the DBMS.
- **Provide a structured, yet flexible data set.** The DBMS will store all types of environmental data and provides a standard framework for all projects within the Navy CLEAN Program to use. The DBMS is organized and structured, yet flexible enough to allow additional data and data types to be added at any time over the life of the program.
- **Provide data that are well documented.** Retain enough descriptive and source information for technical defensibility and legal admissibility of the data.

- **Provide end-users with tools to gain access to the data.** Provide reporting and delivery support from a single DBMS source and allow relatively simple and rapid access to stored data for environmental characterization, report generation, modeling, geographic information system (GIS) mapping, statistical analyses, and risk assessments.
- **Provide data visualization capabilities.** Allow accurate representation of data used in models, GIS, boring log programs (Environmental Visualization System [EVS), computer-aided design (CAD), graphics, and other software used for mapping, graphing, charting, analyzing, and displaying environmental data.
- **Provide the ability to compare data electronically.** Allow electronic comparison of project data to specific reference or screening criteria.
- **Provide the ability to transfer data to different formats.** Provide the ability to reformat, convert, and transfer the data to any format as required by specific end-user applications.

1.2 Scope of the Data Management Plan

The scope of the data management activities addressed by this plan includes the following:

- Definition of staff roles and responsibilities (Appendix A).
- Flow diagrams illustrating how environmental data are collected, reviewed, and entered into the DBMS (Appendix B)
- SOPs (Appendix C).
- Description and use of data outputs (Appendix D).
- Electronic data deliverable (EDD) format specifications that analytical laboratories are required to use to transfer analytical data electronically to CH2M HILL. (Provided to laboratories via a scope of work.)
- Management and archive procedures for hard copy and electronic project documentation.

SECTION 2

Roles and Responsibilities

The Navy CLEAN and Joint Venture Programs Environmental Data Management (EDM) team will work together to properly execute the DMP and ensure that the project objectives and scope are realized. The EDM team is composed of environmental, data, GIS, and EMS resources. The EDM team is responsible for all aspects of planning, execution, and reporting environmental data. Data are derived from sampling events related to investigative and remedial activities for Navy CLEAN and Joint Venture projects.

Responsibilities related to data management and information solutions functions are grouped into roles, as listed in Table 1. Checklist_VDMS-DM-Process_20090615 in Appendix C documents the specific responsibilities associated with each of these roles.

TABLE 1
Navy CLEAN and Joint Venture Environmental Data Management Program Team
The Navy CLEAN Program Data Management Plan

Title	Name/Address	Phone	Fax	E-mail
Navy CLEAN Activity Manager (AM)	Various	Various	Various	Various
Navy CLEAN Project Manager (PM)	Various	Various	Various	Various
Field Team Leader (FTL)	Various	Various	Various	Various
Program EMS Team Lead	John Kochanowski 5700 Cleveland Street Suite 101 Virginia Beach, VA 23462	757-671-6227	757-497-6885	jkochanowski@ch2m.com
Program Chemistry Lead (PCL)	Anita Dodson 5700 Cleveland Street Suite 101 Virginia Beach, VA 23462	757-671-6218	757-497-6885	adodson@ch2m.com
Project Chemist (PC)	Mike Zamboni 15010 Conference Center Dr. Suite 200 Chantilly, VA 20151	703-376-5111	703-376-5801	mzamboni@ch2m.com
Project Chemist (PC)	Megan Hilton 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	401-619-2657	703-376-5801	mhilton@ch2m.com
Project Chemist (PC) / Environmental Information Specialist (EIS)	Bianca Kleist 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6281	757-497-6885	bkleist@ch2m.com
Database Specialist (DBS)	Bhavana Reddy 15010 Conference Center Dr. Suite 200 Chantilly, VA 20151	703- 462-3784	703- 376-5010	breddy@ch2m.com

TABLE 1
Navy CLEAN and Joint Venture Environmental Data Management Program Team
The Navy CLEAN Program Data Management Plan

Title	Name/Address	Phone	Fax	E-mail
Program Data Management Lead (PDL)	Chelsea Leigh 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6208	773-695-1378	cleigh@ch2m.com
Environmental Information Specialist (EIS)	Genevieve Moore 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6284	757-497-6885	gmoore@ch2m.com
Environmental Information Specialist (EIS)	Emma Brower 15010 Conference Center Dr. Suite 200 Chantilly, VA 20151	703-376-5305	703-376-5805	ebrower@ch2m.com
Environmental Information Specialist (EIS)	Rebekha Shaw 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6279	757-497-6885	rshaw22@ch2m.com
Environmental Information Specialist (EIS)	Gwendolyn Buckley 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-8311	757-497-6885	Gbuckle1@ch2m.com
Environmental Information Specialist (EIS)	Kyle Block 25 New Chardon Street. Suite 300 Boston, MA 02114	617-626-7013		kblock@ch2m.com
Environmental Information Specialist (EIS)	Victoria Brynildsen 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462		757-497-6885	vbrynildsen@ch2m.com
Program GIS Lead (PGL)	Mike Dierstein 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6216	757-497-6885	mdierstein@ch2m.com

TABLE 1
Navy CLEAN and Joint Venture Environmental Data Management Program Team
The Navy CLEAN Program Data Management Plan

Title	Name/Address	Phone	Fax	E-mail
GIS Analyst (GA)	Blake Hathaway 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6230	757-497-6885	bhathawa@ch2m.com
GIS Analyst (GA)	Mary Beth Artese 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6228	757-497-6885	martese@ch2m.com
GIS Analyst (GA)	Mark Unwin 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6261	757-497-6885	munwin@ch2m.com
GIS Analyst (GA)	Chris Bowman 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6276	757-497-6885	cbowman@ch2m.com
GIS Analyst (GA)	Matt Rissing 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6243	757-497-6885	mrissing@ch2m.com
GIS Analyst (GA)	Forrest Cain 5700 Cleveland Street. Suite 101 Virginia Beach, VA 23462	757-671-6271	757-497-6885	fcain@ch2m.com

SECTION 3

Data Management System Description

During field investigation, monitoring, and remedial activities, CH2M HILL will collect a variety of environmental information to support data analysis, reporting, and decision-making activities. To meet current regulatory QA requirements, a complete audit trail of the information flow must be implemented. The six steps in the workflow process are:

1. Project planning and database setup
2. Sample collection and management
3. Laboratory analysis
4. Data validation
5. Data management and loading
6. Data evaluation and reporting

Each step in the data management process must be adequately planned, executed, and documented. Figure 1 presents a simplified presentation of the workflow process specific to the Navy CLEAN and Joint Venture Programs. Figure 2 presents, in more detail, the tools used in each step of the process.

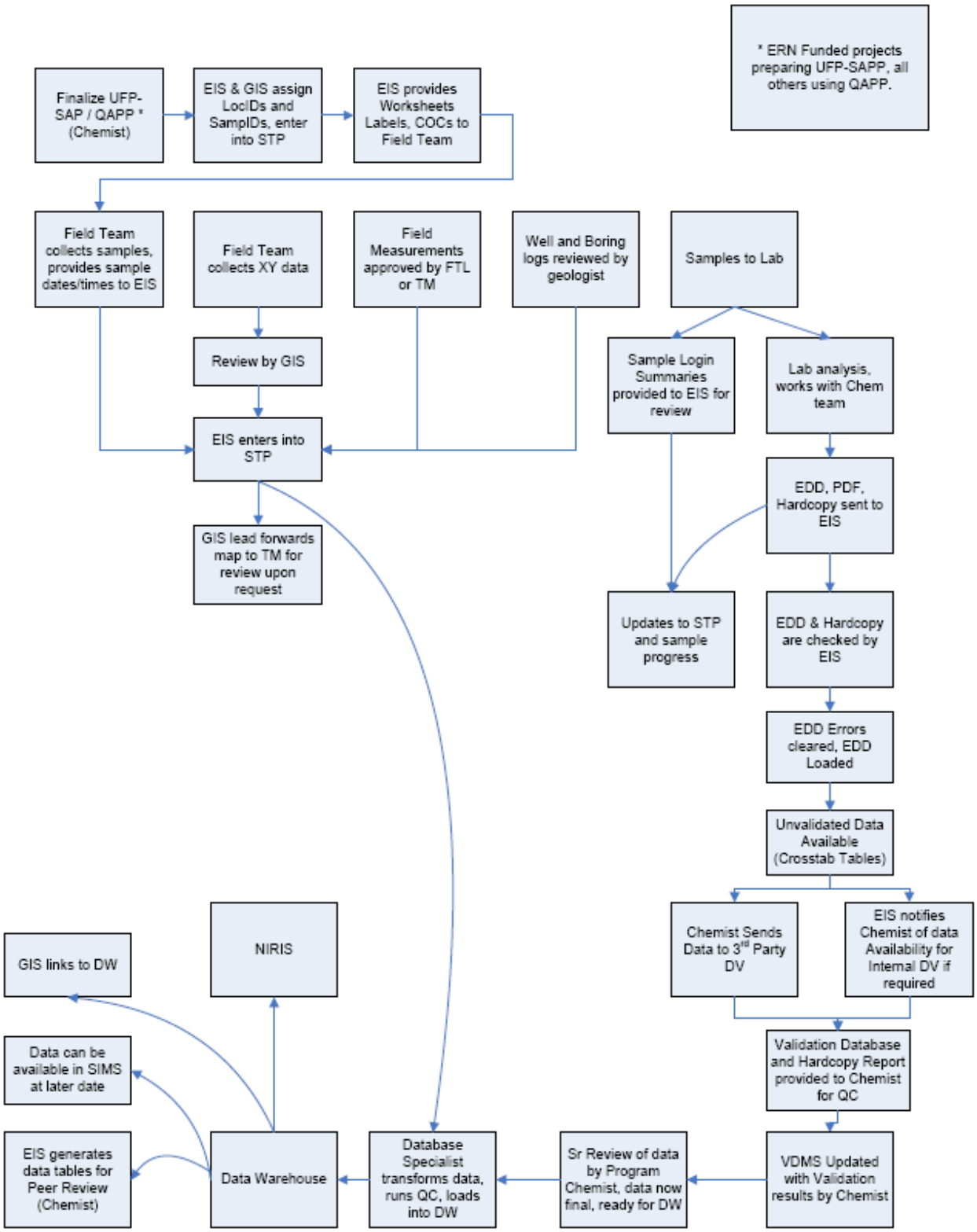


FIGURE 1
ENVIRONMENTAL DATA MANAGEMENT WORKFLOW PROCESS

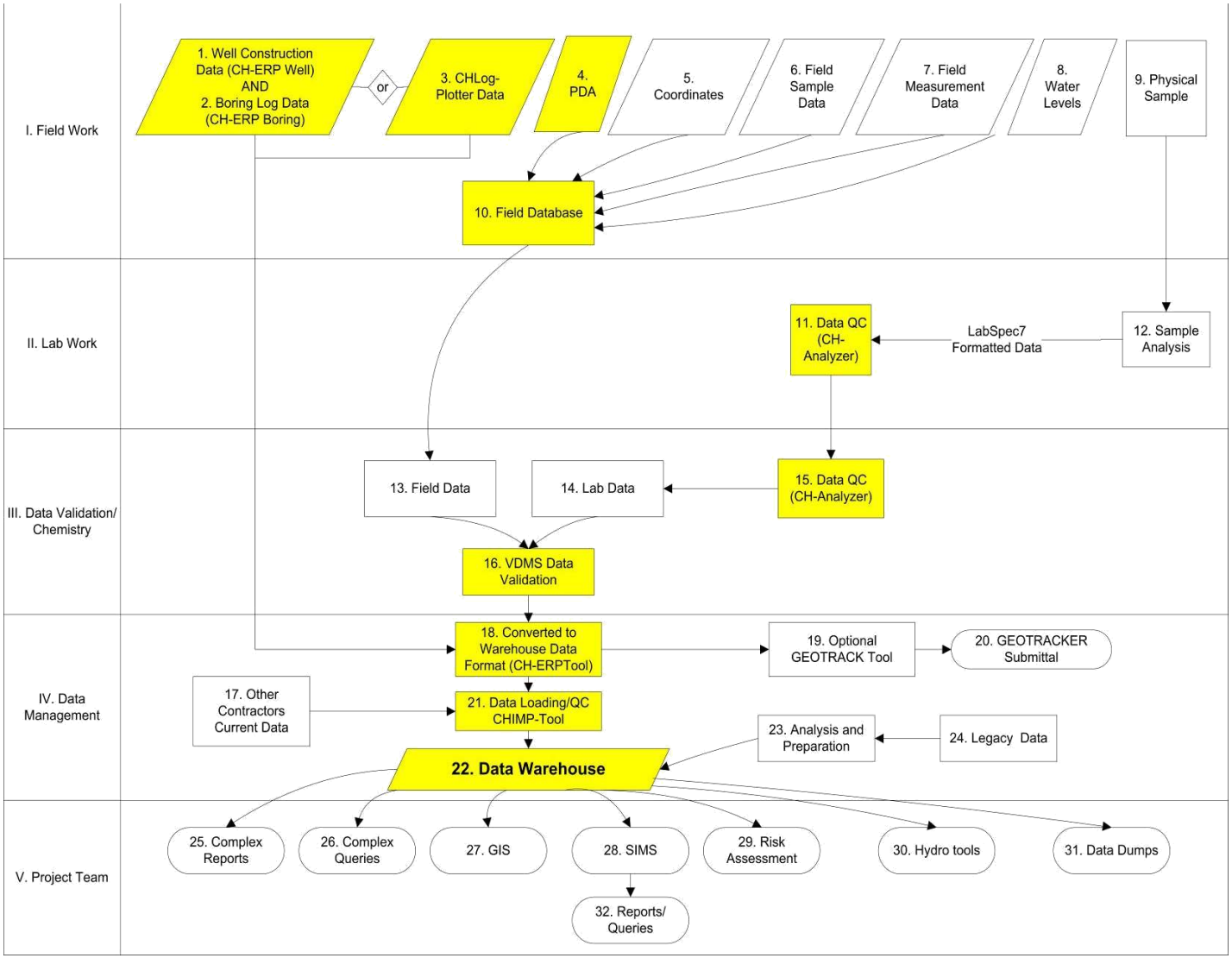


FIGURE 2
DBMS PROCESS

SECTION 4

Phases of Data Management

4.1 Project Planning and Setup

Project planning starts when a new project or task is identified in the program. Evaluation of what is required from the data management and visualization occurs to determine the data needs. The Program EMS Team Lead (EMS Lead) works with the project and/or program manager to determine what is expected and required from the data management and visualization team. Specific items that should be considered are as follows:

- Inputs – Determine what data will be collected and stored in the database. Determine frequency and quantity. Determine what tools will be used to handle data input.
- Historical Data – This is a unique data input and requires special consideration. The Program Data Management Lead (PDL) ***must*** work with the other technical leads to assess what effort will be required. This step is often missed, and the resulting data quality issues created from inadequate planning in this area can plague the project for its entire duration.
- Outputs – Determine what data will need to be presented in reports, figures, and electronic deliverables. Determine frequency and quality requirements. Determine preliminary data, validated data, and what tools will most effectively handle the output requirements. Discuss how the outputs needed by the team will be requested and documented.
- Visualization – Determine necessity for GIS and CAD.

After the information above is determined, the data management scope, schedule, and budget are developed and endorsed by the Project Manager (PM), PDL, and Program Chemistry Lead (PCL). The team can then proceed upon client authorization of the overall project budget. Figure 3 shows the process for project planning.

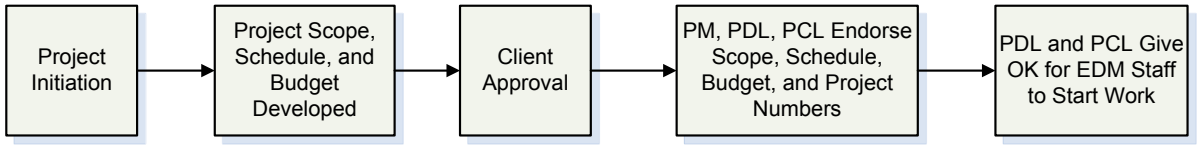


FIGURE 3
PROJECT PLANNING

4.1.1 Database Setup and Administration

CH2M HILL Database

The PDL will oversee the administration of the DBMS, including the design, development, and maintenance of the program database and data management processes. Database and data management process design and development will focus on providing rapid data entry and

data retrieval while promoting data integrity through various automated procedures. The PDL will perform the database maintenance, which consists of the following:

- Assisting with the allocation of sufficient system storage for the program database
- Adding, altering, and deleting users, roles, and privileges
- Periodically defragmenting and compacting the database for more efficient operation
- Upgrading database software and associated applications as necessary
- Maintaining an approved list of valid values for data consistency
- Maintaining redundancy control to ensure that each data record is unique and consistent with conventions
- Performing routine virus checks on incoming and outgoing data

The DBMS is comprised of VDMS and the Data Warehouse combined, and will support the storage, analysis, display, and reporting of the Navy's environmental, analytical, and geotechnical data. The DBMS will consist of primary data tables that store the environmental data, dependent tables that store more details related to the data in the primary tables, and look-up tables that store valid values to provide input to the primary tables. The EIS will maintain the table content and the PDL will manage it.

Valid values are critical to any large relational database. Tables 2 and 3 provide examples of valid values for the Navy CLEAN and Joint Venture Programs' sites, stations, and samples. Inconsistencies in naming conventions, subtle analyte or method spelling differences, and the use of non-standard abbreviations can result in lost data and incorrect conclusions. Most tables and forms in the program database will use look-up tables for acceptable valid values and will not allow the entry of data that do not conform.

The primary purpose of managing data in a relational database environment is to ensure that each data record is unique and that the information contained within each field is consistent with conventions defined in other areas of the database. To ensure uniqueness, a key field or fields will be identified for each data record. Key fields define the record as unique. The VDMS architecture supports this approach and eliminates the possibility of data redundancy.

NIRIS Database

All Navy CLEAN and Joint Venture data must be loaded into the Navy's own internal database system, the Naval Installation Restoration Information Solution (NIRIS). NIRIS is a web-based centralized database that has been implemented across all Naval Facilities Engineering Command (NAVFAC) offices and will be used by the Navy and contractors to manage, evaluate, and visualize data, documents and records for Navy and the Marine Corps sites. NIRIS manages all Environmental Restoration Program (ERP) analytical and spatial data, which includes the Munitions Response and Installation Restoration Program (IRP) data, ensuring institutional memory is preserved, land use controls are maintained, and remedial actions are effective.

CH2M HILL will use the VDMS system to track, collect, review, and prepare Navy-related sample and project data for loading into NIRIS. Project data stored in VDMS must be consistent

and comparable with data that is loaded and stored within NIRIS. As such, all associations between VDMS and NIRIS valid values, output reports, and data tables will be tracked and maintained.

4.1.2 Data Security Procedures

Some VDMS applications and data are stored in a secure location with login and password protection. Authorized users of the STSP tool and VDMS will have logins and passwords in advance. The PDL will provide security access to these tools. Access2003 must be installed on the computer that the user will be using to run these applications, and proper licenses distributed. Files received from any subcontractors will be scanned for common viruses using industry standard, current virus protection programs. The file servers storing the data must be running current virus software, with automatic virus signature updates.

NIRIS data are stored in a secure location with login and password protection. Users who require access to NIRIS and the data contained therein will need to follow procedures outlined in the SOP Access to NIRIS to procure security certificates, training, and access rights to installation-specific data. Authorized users of NIRIS will be assigned logins and passwords maintained by the Navy.

4.1.3 Data Backup and Recovery

All project data management files will reside on CH2M HILL's terminal server, "Gaia," and will have a tape backup or equivalent created in accordance with CH2M HILL's network server management policy.

4.2 Sample Collection and Management

Sample control during the sampling phase is required to ensure the integrity of the associated data. Sample control must be maintained and documented from the point of collection through the point of disposal. Sample control will be managed both in the field and in the laboratory, and will be documented through the use of field log books and a Chain of Custody (COC). When custody of a sample is transferred from one party to another, the recipient of the sample assumes responsibility for maintaining control of the sample and documenting that control on the COC. Figure 4 shows the process for planning and executing field sampling events.

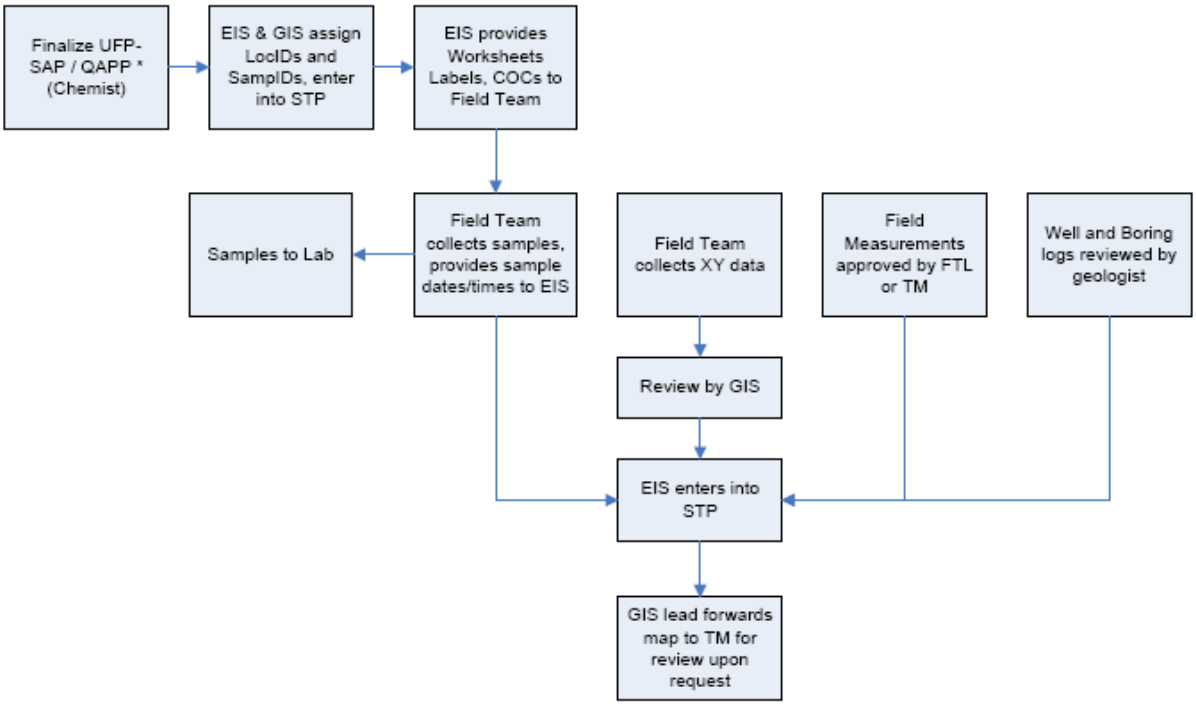


FIGURE 4
FIELD SAMPLING

4.2.1 Sample Tracking Program

During the planning stage, the PM specifies the data requirements for the sampling event. The work plan or similar document will provide project-specific data requirements for a given sampling event. The PC is responsible for reviewing the Sampling and Analysis Plan and ensuring that the FTL is aware of the number of field and laboratory QC samples required for the sampling event (trip blanks, equipment blanks, field blanks, field duplicates, matrix spikes, and matrix spike duplicates). All of this information is to be entered into the STSP.

The STSP tool will be used in advance to develop daily assignments for field crews, identify sampling container and preservation requirements, identify analytical laboratories for samples, print labels for sample bottles before the sampling event, and prepare and print COC forms after sampling is complete.

4.2.2 Sample Nomenclature Guidelines

The following guidelines are provided for sample nomenclature, COC clarification, and eData expectations.

Station ID (Location)

Field station data are information assigned to a physical location in the field at which some sort of sample is collected. For example, a monitoring well that has been installed will require a name that will uniquely identify it with respect to other monitoring wells or other types of sample locations. The station name provides a key in a database to which any samples collected from that location can be linked to form a relational database structure.

Before beginning fieldwork, the FTL will review the proposed level of effort and coordinate a list of unique station identification names, or station IDs, with the PDL or EIS. The FTL will be responsible for enforcing the use of the standardized ID system and agreed upon station IDs during all field activities.

Each station will be uniquely identified by an alphanumeric code that will describe the station's attributes. These attributes are facility, Area of Concern (AOC)/Site/Operable Unit (OU) number, station type, sequential station number, and possibly an additional qualifier as needed. The naming scheme to be used for the identification of a sampling station is documented in Table 2.

For example, if the first sample location at next month's event within Yorktown Site 30 is at a soil location, then the location ID could possibly YS30-SO391 because that was the next available sequence number for soil locations. This should also be reflected in the Sample ID. QC and IDW station IDs must be established for each site that they are associated with.

Please consult with the PDL or EIS should any questions arise. This will avoid complications that could occur if a station is mislabelled and ensure there are unique identifiers for every sampling location. Required deviations to this format in response to field conditions will be documented in the field logbook.

Sample ID

Field sample data are information assigned to a physical piece of material collected in the field for which some sort of analysis will be run. Before collecting samples, the FTL will review the proposed level of effort and coordinate a list of unique sample identification names, or sample IDs, with the PDL or EIS. The FTL will be responsible for enforcing the use of the standardized ID system and agreed upon sample IDs during all field activities.

Each sample will be uniquely identified by an alphanumeric code that will describe the sample's attributes. These attributes are facility, Area of Concern (AOC)/Site/Operable Unit (OU) number, sample/station type, sequential station number, modifier (as needed), depth (as needed), date, and date modifier (as needed). The naming scheme to be used for the identification of samples is documented in Table 3.

The standardized ID system will identify all samples collected during sampling activities. The system will provide a tracking procedure to ensure accurate data retrieval of all samples taken. For example, a surface soil sample collected from station YS30-SO391 reference above in June of 2009 will result in a sample ID of YS30-SS391-0609.

Please consult with the PDL or EIS should any questions arise. This will avoid complications that could occur if a sample is mislabelled and ensure there are unique identifiers for every sample. Required deviations to this format in response to field conditions will be documented in the field logbook.

Navy Clean		
First Segment	**Second Segment**	
Facility, Site Number	Station Type	Station Number, Modifier
AA,ANN	AA	NNN_A
Notes: "A"= alphabetic "N"= numeric		

Facility:

A = ABL
AN = Anacostia
BA = Bainbridge
BW = Bloodsworth Island
BR = Bremerton
CA = Cheatham Annex
CH = Cherry Point
CI = Craney Island
CL = Camp Lejeune
CP = Camp Peary
CR = Carderock
DA = Dahlgren
DN = Dam Neck
DR = Driver
IH = Indian Head
LS = Little Creek
NA = Naval Academy
NB = Naval Station Norfolk
NM = NNMC (Bethesda Naval Hospital)
NN = Norfolk Naval Shipyard
NR = Naval Research Laboratory
NWA = Northwest Annex
OC = Oceana
PA = Pax River
PI = Pineros Islands
QU = Quantico
RO = Rota
RR = Roosevelt Roads
SI = Sigonella
SJ = St. Juliens
SS = Sabana Seca
VE = Vieques East
VW = Vieques West
WN = Washington Navy Yard
WO = White Oak
Y = Yorktown

Site/AOC/SWMU Number – Sequential Number:

Site = S01, S02, S03…
Site Screening Area = SA01, SA02, SA03…
AOC = A01, A02, A03…
AOI = AI01, AI02, AI03…
SWMU = W01, W02…
Building = B01, B02, B03…
Range = R01, R02…
LIA – LI Area, East Vieques

BSxx = Background locations outside of site (BS25 = Background Site 25)
BKL = Background locations outside of the facility
BKG = Background locations (inside base)

QC and IDW Stations
Site ID (First Segment) followed by –QC or -IDW

Station Type:

AGT = Above Ground Tank
AS = Ash
BH = Borehole
CO = Concrete
DP = Direct Push
DR = Drill Rig
EW = Extraction Well
FG = Frog
FS = Fish
GB = Geotechnical Boring
GP = Geoprobe
GV = Gas Vent
HP = Holding Pond/Lagoon
IDW = Investigative Derived Waste
IW = Injection Well
LW = Leach Well
MA = Alluvial Monitoring Well
MB = Bedrock Monitoring Well
MU = UST Monitoring Well
MW = Monitoring Well (GW for Y)
PC = Paint Chip
PW = Production Well
QC = Quality Control
RK = Rock
RC = Recovery Well
RM = Remediation Well
RW = Residential Well
SD = Sediment Location
SG = Soil Gas
SL = Storm Sewer Line Sediment
SO = Soil Location
SP = Seep
ST = Storm Water
SU = Sump
SV = Soil Vapor
SW = Surface Water
SWS = Surface Water Body (for SW and SD)
UST = Underground Storage Tank
TA = Tap Water
TD = Tidal Station
TI = Tissue Sample (general)
TO = Tadpole
TP = Test Pit
TR = Trench Sediment
TS = Treatment System
TW = Temporary Well
WA = Alluvial Extraction Well
WB = Bedrock Extraction Well
WL = Water Supply Well
WN = Pore Water
WP = Wipe Sample
WT = Water Table Piezometer

Station Number:
Sequential Station Number (i.e., 01, 02, 03…)

Modifier (used selectively):
D = Deep monitoring well
S = Shallow monitoring well

Example Station IDs:

YS01-DP02 = Direct push soil location #2 at Yorktown Naval Weapons Station Site 1
CHR05-MW02S = Shallow monitoring well location 2, at the Cheatham Annex facility, Range 5.
NMBKL-SD02 = Background sediment location #2 located outside of NNMC
CHBS03-SO05 = Soil location #5, located in reference area outside of Site 3 in Cherry Point
VEW04-QC = QC Station at East Vieques SWMU-4
CAA08-IDW = IDW Station at Cheatham Annex AOC-8

TABLE 2
STATION ID SCHEME

Navy Clean			
First Segment	**Second Segment**	**3rd Segment**	**Fourth Segment**
Site ID Facility, AOC Number	Station/Sample Type, Station Number, Modifier	Depth (As Needed)	Date (MMYY) $_A$
AA,ANN	AANNN$_A$	A	NNNN$_A$
Notes: "A"= alphabetic "N"= numeric			

A = ABL
AN = Anacostia
BA = Bainbridge
BW = Bloodsworth Island
BR = Bremerton
CA = Cheatham Annex
CH = Cherry Point
CI = Craney Island
CL = Camp Lejeune
CP = Camp Peary
CR = Carderock
DA = Dahlgren
DN = Dam Neck
DR = Driver
IH = Indian Head
LS = Little Creek
NA = Naval Academy
NB = Naval Station Norfolk
NM = NNMC (Bethesda Naval Hospital)
NN = Norfolk Naval Shipyard
NR = Naval Research Laboratory
NWA = Northwest Annex
OC = Oceana
PA = Pax River
PI = Pineros Islands
QU = Quantico
RO = Rota
RR = Roosevelt Roads
SI = Sigonella
SJ = St. Juliens
SS = Sabana Seca
VE = Vieques East
VW = Vieques West
WN = Washington Navy Yard
WO = White Oak
Y = Yorktown

Site/AOC/SWMU – Sequential Number:

Site = S01, S02, S03…
Site Screening Area = SA01, SA02, SA03…
AOC = A01, A02, A03…
AOI = AI01, AI02, AI03…
SWMU = W01, W02…
Building = B01, B02, B03…
Range = R01, R02…
LIA – LI Area, East Vieques

BSxx = Background locations outside of site (BS25 = Background Site 25)
BKL = Background locations outside of the facility
BKG Background locations (inside base)

Sample Type:
AGT = Above Ground Tank
AH = Air - Headspace
AS = Ash
BH = Borehole
CO = Concrete
DR = Drill Rig
DS = Direct Push—Soil
DW = Direct Push—Groundwater
EW = Extraction Well
FG = Frog
FS = Fish
GB = Geotechnical Boring
GP = Geoprobe
GV = Gas Vent
HP = Holding Pond/Lagoon
IW = Injection Well
LF = Free Product
LW = Leach Well
MA = Alluvial Monitoring Well
MB = Bedrock Monitoring Well
MU = UST Monitoring Well
MW = Monitoring Well (GW for Y)
PC = Paint Chip
PW = Production Well
RK = Rock
SW = Surface Water
RC = Recovery Well
RM = Remediation Well
RW = Residential Well
SB = Subsurface Soil
SD = Sediment Location
SG = Soil Gas
SL = Storm Sewer Line Sediment
SO = Soil Location (Composite)
SP = Seep
SS = Surface Soil
SSD = Subsurface Sediment
ST = Storm Water
SU = Sump
SV = Soil Vapor
SW = Surface Water
UST = Underground Storage Tank
TA = Tap Water
TD = Tidal Station
TI = Tissue Sample (general)
TO = Tadpole
TP = Test Pit
TR = Trench Sediment
TS = Treatment System
TW = Temporary Well
WA = Alluvial Extraction Well
WB = Bedrock Extraction Well
WL = Water Supply Well
WN = Pore Water
WP = Wipe Sample
WT = Water Table Piezometer

Station Number:
Sequential Number (e.g., 001, 002, 003)

Modifier (used selectively):
D = Deep monitoring well
S = Shallow monitoring well
P = Duplicate

Depth:

Use only if applicable. A sequential letter is used to reflect varying depths, as actual depths can change in the field after sample planning has occurred. E.g. A, B, C…

Sample Number:

1. Duplicate Samples - Use a 'P' modifier in the second segment of the sample ID, directly after the location number to indicate a duplicate sample. E.g. AB01-MW11P-0506

2. MS/MSD Samples – Append a modifier of '-MS' for matrix spike or '-SD' for matrix spike duplicate to the end of the sample ID.

3. QC & IDW Samples (Blank Samples & Waste Char.) - Format consists of Facility, AOC Number, Qualifier Code, Sequential Qualifier Number-Date (AAANN-AANN-MMDDYY). E.g. LSA05-TB02-061106

Qualifier Codes:
TB = Trip Blank
FB = Field Blank
EB = Equipment Blank
WQ = Source Blank
WS = Waste Char. Soil
WW = Waste Char. Water

4. Drill Rig Samples – Format consists of Facility, AOC Number, Station Type, Station Number, Date. E.g. YS12-DR02-020507

5. Multiple samples - Should multiple samples be collected from the same location in a given day/month (affects only samples not differentiated by depth), a sequential letter will be added to the end of the fourth segment (date). E.g. A, B, C…

Example Sample IDs:

WNA01-MW102S-0105A = The first shallow groundwater sample collected at monitoring well location 102 in January 2005 in AOC01 at the Washington Navy Yard facility.
PIW01-SW023P-0306 = Pineros Island duplicate surface water sample collected at location 23, at SMWU-1 in March 2006.
SSW06-FB01-061106 = The first field blank collected on June 11, 2006 at SMWU-6 in Sabana Seca.

TABLE 3
STATION ID SCHEME

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.

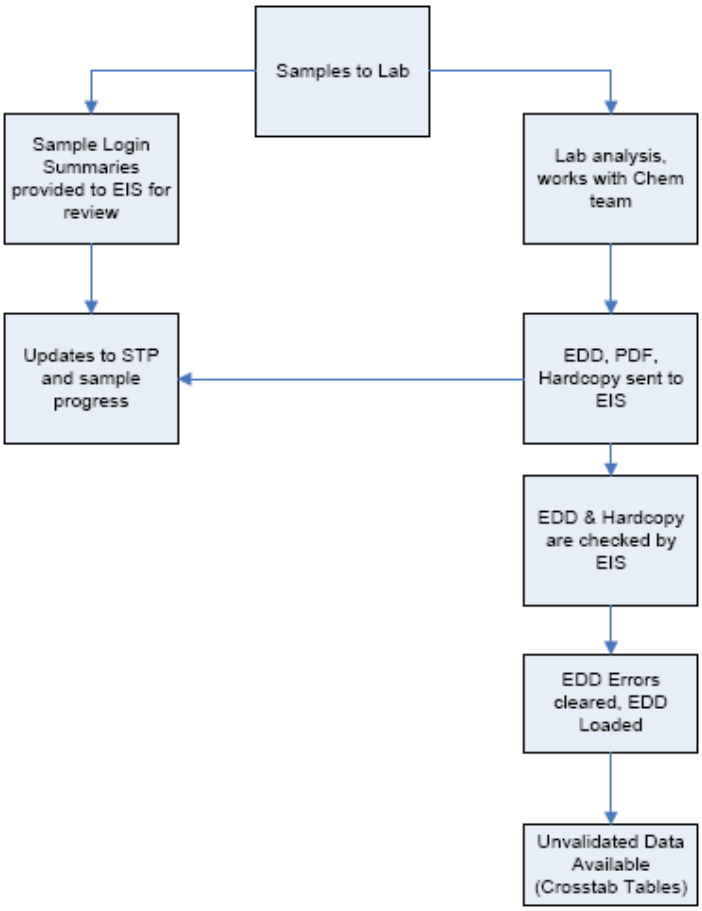


FIGURE 5
LABORATORY ANALYSIS

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)

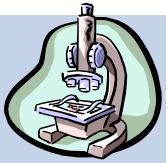
Step 2B

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

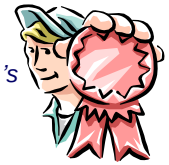
- EIS & PC are notified that data is loaded
- EIS verifies info loaded is correct (Sample, Station, Analyses, Result)
- EIS then helps decide whether info needs to be updated or not
- File and archive all Lab and DV deliverables

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 4
DoD ELAP Accreditation Letter—Analytical Laboratory

LABORATORY ACCREDITATION BUREAU

Certificate of Accreditation

ISO/IEC 17025:2005 ***Certificate Number L2226***

Empirical Laboratories, LLC

621 Mainstream Drive, Suite 270
Nashville, TN 37228

has met the requirements set forth in L-A-B's policies and procedures, all requirements of ISO/IEC 17025:2005 "General Requirements for the competence of Testing and Calibration Laboratories" and the U.S. Department of Defense Environmental Laboratory Accreditation Program (DoD ELAP).*

The accredited lab has demonstrated technical competence to a defined "Scope of Accreditation" and the operation of a laboratory quality management system (refer to joint ISO-ILAC-IAF Communiqué dated 8 January 2009).

Accreditation Granted through: November 30, 2012

R. Douglas Leonard, Jr., Managing Director
Laboratory Accreditation Bureau
Presented the 30th of November 2009

*See the laboratory's Scope of Accreditation for details of the DoD ELAP requirements
Laboratory Accreditation Bureau is found to be in compliance with ISO/IEC 17011:2004 and recognized by ILAC (International Laboratory Accreditation Cooperation) and NACLA (National Cooperation for Laboratory Accreditation).

LABORATORY ACCREDITATION BUREAU

Certificate # L2226

Scope of Accreditation For Empirical Laboratories, LLC

621 Mainstream Drive, Suite 270
Nashville, TN 37228
Marcia K. McGinnity
1-877-345-1113

In recognition of a successful assessment to ISO/IEC 17025:2005 and the requirements of the DoD Environmental Laboratory Accreditation Program (DoD ELAP) as detailed in the DoD Quality Systems Manual for Environmental Laboratories (DoD QSM v4.1) based on the National Environmental Laboratory Accreditation Conference Chapter 5 Quality Systems Standard (NELAC Voted Revision June 5, 2003), accreditation is granted to Empirical Laboratories, LLC to perform the following tests:

Accreditation granted through: **November 30, 2012**

Testing - Environmental

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	8260B	1,1,1-Trichloroethane (1,1,1-TCA)
GC/MS	8260B	1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)
GC/MS	8260B	1,1,2-Trichloroethane
GC/MS	8260B	1,1,2,2-Tetrachloroethane
GC/MS	8260B	1,1,1,2-Tetrachloroethane
GC/MS	8260B	1,1-Dichloroethane (1,1-DCA)
GC/MS	8260B	1,1-Dichloroethene (1,1-DCE)
GC/MS	8260B	1,2,3-Trichlorobenzene
GC/MS	8260B	1,2,4-Trichlorobenzene
GC/MS	8260B	1,2,3-Trichloropropane
GC/MS	8260B	1,2,4-Trimethylbenzene
GC/MS	8260B	1,3,5-Trimethylbenzene
GC/MS	8260B	1,2-Dibromoethane (EDB)
GC/MS	8260B	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	8260B	1,2-Dichlorobenzene
GC/MS	8260B	1,2-Dichloroethane (EDC)
GC/MS	8260B	1,2-Dichloropropane
GC/MS	8260B	1,3-Dichlorobenzene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	8260B	1,4-Dichlorobenzene
GC/MS	8260B	1,1-Dichloropropene
GC/MS	8260B	1,3-Dichloropropane
GC/MS	8260B	2,2-Dichloropropane
GC/MS	8260B	2-Butanone (Methyl ethyl ketone; MEK)
GC/MS	8260B	2-Hexanone (Methyl butyl ketone; MBK)
GC/MS	8260B	4-Methyl-2-pentanone (Methyl isobutyl ketone; MIBK)
GC/MS	8260B	Acetone
GC/MS	8260B	Benzene
GC/MS	8260B	Bromochloromethane
GC/MS	8260B	Bromodichloromethane
GC/MS	8260B	Bromobenzene
GC/MS	8260B	Bromoform
GC/MS	8260B	Bromomethane
GC/MS	8260B	n-Butylbenzene
GC/MS	8260B	sec-Butylbenzene
GC/MS	8260B	tert-Butylbenzene
GC/MS	8260B	Carbon Disulfide
GC/MS	8260B	Carbon Tetrachloride
GC/MS	8260B	Chlorobenzene
GC/MS	8260B	Chloroethane
GC/MS	8260B	Chloroform
GC/MS	8260B	Chloromethane
GC/MS	8260B	2-Chlorotoluene
GC/MS	8260B	4-Chlorotoluene
GC/MS	8260B	cis-1,2-Dichloroethene (cis-1,2-DCE)
GC/MS	8260B	cis-1,3-Dichloropropene
GC/MS	8260B	Cyclohexane
GC/MS	8260B	Dibromochloromethane
GC/MS	8260B	Dibromomethane
GC/MS	8260B	Dichlorodifluoromethane (CFC-12)
GC/MS	8260B	Ethylbenzene
GC/MS	8260B	Hexachlorobutadiene
GC/MS	8260B	Isopropylbenzene (Cumene)
GC/MS	8260B	p-Isopropyltoluene
GC/MS	8260B	Methyl Acetate
GC/MS	8260B	Methyl Tertiary Butyl Ether (MTBE)
GC/MS	8260B	Methylcyclohexane
GC/MS	8260B	Methylene Chloride, or Dichloromethane

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	8260B	Naphthalene
GC/MS	8260B	n-Propylbenzene
GC/MS	8260B	Styrene
GC/MS	8260B	Tetrachloroethene (PCE; PERC)
GC/MS	8260B	Toluene
GC/MS	8260B	trans-1,2-Dichloroethene (trans-1,2-DCE)
GC/MS	8260B	trans-1,3-Dichloropropene
GC/MS	8260B	Trichloroethene (TCE)
GC/MS	8260B	Trichlorofluoromethane (CFC-11)
GC/MS	8260B	Vinyl Chloride (VC)
GC/MS	8260B	Xylenes (Total)
GC/MS	8260B	Acrolein
GC/MS	8260B	Acrylonitrile
GC/MS	8260B	Di-isopropyl ether
GC/MS	8260B	ETBE
GC/MS	8260B	Ethyl methacrylate
GC/MS	8260B	Iodomethane
GC/MS	8260B	Methyl methacrylate
GC/MS	8260B	t-Butyl alcohol
GC/MS	8260B	tert-Amyl methyl ether
GC/MS	8260B	2-Chloroethyl vinyl ether
GC/MS	8260B	1-Chlorohexane
GC/MS	8260B	Tetrahydrofuran
GC/MS	8260B	Vinyl acetate
GC/MS	8270C/D	Bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)
GC/MS	8270C/D	1,2-Dichlorobenzene
GC/MS	8270C/D	1,3-Dichlorobenzene
GC/MS	8270C/D	1,4-Dichlorobenzene
GC/MS	8270C/D	2,4,5-Trichlorophenol
GC/MS	8270C/D	2,4,6-Trichlorophenol (TCP)
GC/MS	8270C/D	2,4-Dichlorophenol (DCP)
GC/MS	8270C/D	2,4-Dimethylphenol
GC/MS	8270C/D	2,4-Dinitrophenol
GC/MS	8270C/D	2,4-Dinitrotoluene (DNT)
GC/MS	8270C/D	2,6-Dichlorophenol
GC/MS	8270C/D	2,6-Dinitrotoluene
GC/MS	8270C/D	1,2-Diphenylhydrazine
GC/MS	8270C/D	2-Chloronaphthalene
GC/MS	8270C/D	2-Chlorophenol

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	8270C/D	2-Methylnaphthalene
GC/MS	8270C/D	2-Methylphenol (o-Cresol)
GC/MS	8270C/D	2-Nitroaniline
GC/MS	8270C/D	2-Nitrophenol (ONP)
GC/MS	8270C/D	3,3'-Dichlorobenzidine (DCB)
GC/MS	8270C/D	3-Methylphenol
GC/MS	8270C/D	3-Nitroaniline
GC/MS	8270C/D	4,6-Dinitro-2-methylphenol (DNOC)
GC/MS	8270C/D	4-Bromophenyl phenyl ether
GC/MS	8270C/D	4-Chloro-3-methylphenol
GC/MS	8270C/D	4-Chloroaniline
GC/MS	8270C/D	4-Chlorophenyl phenyl ether
GC/MS	8270C/D	4-Methylphenol (p-Cresol)
GC/MS	8270C/D	4-Nitroaniline (PNA)
GC/MS	8270C/D	4-Nitrophenol (PNP)
GC/MS	8270C/D	Acenaphthene
GC/MS	8270C/D	Acenaphthylene
GC/MS	8270C/D	Acetaphenone
GC/MS	8270C/D	Anthracene
GC/MS	8270C/D	Benzo(a)anthracene
GC/MS	8270C/D	Benzo(a)pyrene
GC/MS	8270C/D	Benzo(b)fluoranthene
GC/MS	8270C/D	Benzo(g,h,i)perylene
GC/MS	8270C/D	Benzo(k)fluoranthene
GC/MS	8270C/D	Benzyl alcohol
GC/MS	8270C/D	Benzoic Acid
GC/MS	8270C/D	bis(2-Chloroethoxy)methane
GC/MS	8270C/D	bis(2-Chloroethyl)ether (BCEE)
GC/MS	8270C/D	bis(2-Ethylhexyl)phthalate (BEHP)
GC/MS	8270C/D	Butyl benzyl phthalate (BBP)
GC/MS	8270C/D	Carbazole
GC/MS	8270C/D	Chrysene
GC/MS	8270C/D	Di-n-butyl phthalate (DBP)
GC/MS	8270C/D	Di-n-octyl phthalate (DNOP)
GC/MS	8270C/D	Dibenz(a,h)anthracene
GC/MS	8270C/D	Dibenzofuran (DBF)
GC/MS	8270C/D	Diethyl phthalate (DEP)
GC/MS	8270C/D	Dimethyl phthalate (DMP)
GC/MS	8270C/D	Fluoranthene

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/MS	8270C/D	Fluorene
GC/MS	8270C/D	Hexachlorobenzene (HCB)
GC/MS	8270C/D	Hexachlorobutadiene (HCBD)
GC/MS	8270C/D	Hexachlorocyclopentadiene (HCCPD)
GC/MS	8270C/D	Hexachloroethane (HCE)
GC/MS	8270C/D	Indeno(1,2,3-cd)pyrene
GC/MS	8270C/D	Isophorone
GC/MS	8270C/D	N-Nitrosodimethylamine
GC/MS	8270C/D	N-Nitroso-di-n-propylamine (NDPA)
GC/MS	8270C/D	N-nitrosodiphenylamine (NDPHA)
GC/MS	8270C/D	Naphthalene
GC/MS	8270C/D	Nitrobenzene
GC/MS	8270C/D	Pentachlorophenol
GC/MS	8270C/D	Phenanthrene
GC/MS	8270C/D	Phenol
GC/MS	8270C/D	Pyrene
GC/MS	8270C/D	Pyridine
GC/MS	8270C/D	1,2,4-Trichlorobenzene
GC/MS	8270C/D	1,1'-Biphenyl
GC/MS	8270C/D	1,2,4,5-Tetrachlorobenzene
GC/MS	8270C/D	1,4-Dioxane
GC/MS	8270C/D	1-Methylnaphthalene
GC/MS	8270C/D	2,3,4,6-Tetrachlorophenol
GC/MS	8270C/D	Aniline
GC/MS	8270C/D	Atrazine
GC/MS	8270C/D	Benzaldehyde
GC/MS	8270C/D	Benzidine
GC/MS	8270C/D	7,12-Dimethylbenz(a)anthracene
GC/MS	8270C/D	Caprolactam
GC/ECD	8081A/B	4,4'-DDD
GC/ECD	8081A/B	4,4'-DDE
GC/ECD	8081A/B	4,4'-DDT
GC/ECD	8081A/B	Aldrin
GC/ECD	8081A/B	alpha-BHC (alpha-HCH)
GC/ECD	8081A/B	alpha-Chlordane
GC/ECD	8081A/B	beta-BHC (beta-HCH)
GC/ECD	8081A/B	delta-BHC (delta-HCH)
GC/ECD	8081A/B	Dieldrin
GC/ECD	8081A/B	Endosulfan I

Non-Potable Water		
Technology	**Method**	**Analyte**
GC/ECD	8081A/B	Endosulfan II
GC/ECD	8081A/B	Endosulfan sulfate
GC/ECD	8081A/B	Endrin
GC/ECD	8081A/B	Endrin aldehyde
GC/ECD	8081A/B	Endrin ketone
GC/ECD	8081A/B	gamma-BHC (Lindane; gamma-HCH)
GC/ECD	8081A/B	gamma-Chlordane
GC/ECD	8081A/B	Heptachlor
GC/ECD	8081A/B	Heptachlor epoxide
GC/ECD	8081A/B	Methoxychlor
GC/ECD	8081A/B	Chlordane
GC/ECD	8081A/B	Toxaphene
GC/ECD	8082 /A	Aroclor-1016
GC/ECD	8082 /A	Aroclor-1221
GC/ECD	8082 /A	Aroclor-1232
GC/ECD	8082 /A	Aroclor-1242
GC/ECD	8082 /A	Aroclor-1248
GC/ECD	8082 /A	Aroclor-1254
GC/ECD	8082 /A	Aroclor-1260
GC/ECD	8151A	2,4,5-T
GC/ECD	8151A	2,4,5-TP (Silvex)
GC/ECD	8151A	2,4-D
GC/ECD	8151A	2,4-DB
GC/ECD	8151A	Dalapon
GC/ECD	8151A	Dicamba
GC/ECD	8151A	Dichlorprop
GC/ECD	8151A	Dinoseb
GC/ECD	8151A	MCPA
GC/ECD	8151A	MCPP (Mecoprop)
HPLC/UV	8330A	1,3,5-Trinitrobenzene
HPLC/UV	8330A	1,3-Dinitrobenzene
HPLC/UV	8330A	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	8330A	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	8330A	2,4-Dinitrotoluene (DNT)
HPLC/UV	8330A	2,6-Dinitrotoluene
HPLC/UV	8330A	2-Amino-4,6-dinitrotoluene
HPLC/UV	8330A	2-Nitrotoluene (ONT)
HPLC/UV	8330A	3-Nitrotoluene
HPLC/UV	8330A	4-Amino-2,6-dinitrotoluene

Non-Potable Water		
Technology	**Method**	**Analyte**
HPLC/UV	8330A	4-Nitrotoluene (PNT)
HPLC/UV	8330A	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	8330A	Nitroglycerin
HPLC/UV	8330A	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	8330A	3,5-Dinitroaniline
HPLC/UV	8330A	Nitrobenzene
HPLC/UV	8330A	PETN
HPLC/UV	8330A	Nitroguanidine
GC/FID	FLPRO	Petroleum Range Organics
GC/FID	8015B	TPH DRO
GC/FID	8015B	TPH GRO
GC/FID	RSK-175	Methane
GC/FID	RSK-175	Ethane
GC/FID	RSK-175	Ethene
GC/ECD	8011	1,2-Dibromoethane (EDB)
GC/ECD	8011	1,2-Dibromo-3-chloropropane (DBCP)
HPLC/MS	6850	Perchlorate
ICP	6010B/C	Aluminum
ICP	6010B/C	Antimony
ICP	6010B/C	Arsenic
ICP	6010B/C	Barium
ICP	6010B/C	Beryllium
ICP	6010B/C	Cadmium
ICP	6010B/C	Calcium
ICP	6010B/C	Chromium, total
ICP	6010B/C	Cobalt
ICP	6010B/C	Copper
ICP	6010B/C	Iron
ICP	6010B/C	Lead
ICP	6010B/C	Magnesium
ICP	6010B/C	Manganese
CVAA	7470A	Mercury
ICP	6010B/C	Nickel
ICP	6010B/C	Potassium
ICP	6010B/C	Selenium
ICP	6010B/C	Silver
ICP	6010B/C	Sodium
ICP	6010B/C	Thallium
ICP	6010B/C	Vanadium

Non-Potable Water		
Technology	**Method**	**Analyte**
ICP	6010B/C	Zinc
ICP	6010B/C	Molybdenum
ICP	6010B/C	Tin
ICP	6010B/C	Strontium
ICP	6010B/C	Titanium
IC	300.0	Chloride
IC	300.0	Fluoride
IC	300.0	Nitrate
IC	300.0	Nitrite
IC	300.0	Sulfate
IC	9056A	Chloride
IC	9056A	Fluoride
IC	9056A	Nitrate
IC	9056A	Nitrite
IC	9056A	Sulfate
Titration	SM 2320B 20th ed.	Alkalinity
ISE	SM 4500 B, D, 20th ed.	Ammonia
UV/Vis	7196A	Hexavalent Chromium
Colorimetric	353.2	Nitrocellulose
Colorimetric	353.2	Nitrate/Nitrite
Titration	Chap.7, Sect. 7.3 Mod.	Reactive Sulfide
Titration	SM 4500 S-2CF, 20th edition	Sulfide
UV/Vis	SM 4500 P B5, E, 20th edition	Total Phosphorus (as P)
UV/Vis	SM 4500 PE, 20th edition	Ortho-Phosphate (as P)
TOC	9060A/SM5310C, 20th edition	Total Organic Carbon
Gravimetric	SM 2540C, 20th edition	TDS
Colorimetric	9012A/B	Cyanide
Physical	1010A	Ignitability
Physical	9095B	Paint Filter
Probe	9040B/C	pH
Preparation	**Method**	**Type**
Preparation	1311	TCLP
Preparation	3005A	Metals digestion
Preparation	3010A	Metals digestion
Preparation	3510C	Organics Liquid Extraction
Preparation	5030A/B	Purge and Trap Water

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	8260B	1,1,1-Trichloroethane (1,1,1-TCA)
GC/MS	8260B	1,1,2-Trichloro-1,2,2-trifluoroethane (CFC-113; Freon 113)
GC/MS	8260B	1,1,2-Trichloroethane
GC/MS	8260B	1,1,2,2-Tetrachloroethane
GC/MS	8260B	1,1,1,2-Tetrachloroethane
GC/MS	8260B	1,1-Dichloroethane (1,1-DCA)
GC/MS	8260B	1,1-Dichloroethene (1,1-DCE)
GC/MS	8260B	1,2,3-Trichlorobenzene
GC/MS	8260B	1,2,4-Trichlorobenzene
GC/MS	8260B	1,2,3-Trichloropropane
GC/MS	8260B	1,2,4-Trimethylbenzene
GC/MS	8260B	1,3,5-Trimethylbenzene
GC/MS	8260B	1,2-Dibromoethane (EDB)
GC/MS	8260B	1,2-Dibromo-3-chloropropane (DBCP)
GC/MS	8260B	1,2-Dichlorobenzene
GC/MS	8260B	1,2-Dichloroethane (EDC)
GC/MS	8260B	1,2-Dichloropropane
GC/MS	8260B	1,3-Dichlorobenzene
GC/MS	8260B	1,4-Dichlorobenzene
GC/MS	8260B	1,1-Dichloropropene
GC/MS	8260B	1,3-Dichloropropane
GC/MS	8260B	2,2-Dichloropropane
GC/MS	8260B	2-Butanone (Methyl ethyl ketone; MEK)
GC/MS	8260B	2-Hexanone (Methyl butyl ketone; MBK)
GC/MS	8260B	4-Methyl-2-pentanone (Methyl isobutyl ketone; MIBK)
GC/MS	8260B	Acetone
GC/MS	8260B	Benzene
GC/MS	8260B	Bromochloromethane
GC/MS	8260B	Bromodichloromethane
GC/MS	8260B	Bromobenzene
GC/MS	8260B	Bromoform
GC/MS	8260B	Bromomethane
GC/MS	8260B	n-Butylbenzene
GC/MS	8260B	sec-Butylbenzene
GC/MS	8260B	tert-Butylbenzene
GC/MS	8260B	Carbon Disulfide
GC/MS	8260B	Carbon Tetrachloride
GC/MS	8260B	Chlorobenzene
GC/MS	8260B	Chloroethane

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	8260B	Chloroform
GC/MS	8260B	Chloromethane
GC/MS	8260B	2-Chlorotoluene
GC/MS	8260B	4-Chlorotoluene
GC/MS	8260B	cis-1,2-Dichloroethene (cis-1,2-DCE)
GC/MS	8260B	cis-1,3-Dichloropropene
GC/MS	8260B	Cyclohexane
GC/MS	8260B	Dibromochloromethane
GC/MS	8260B	Dibromomethane
GC/MS	8260B	Dichlorodifluoromethane (CFC-12)
GC/MS	8260B	Ethylbenzene
GC/MS	8260B	Hexachlorobutadiene
GC/MS	8260B	Isopropylbenzene (Cumene)
GC/MS	8260B	p-Isopropyltoluene
GC/MS	8260B	Methyl Acetate
GC/MS	8260B	Methyl Tertiary Butyl Ether (MTBE)
GC/MS	8260B	Methylcyclohexane
GC/MS	8260B	Methylene Chloride, or Dichloromethane
GC/MS	8260B	Naphthalene
GC/MS	8260B	n-Propylbenzene
GC/MS	8260B	Styrene
GC/MS	8260B	Tetrachloroethene (PCE; PERC)
GC/MS	8260B	Toluene
GC/MS	8260B	trans-1,2-Dichloroethene (trans-1,2-DCE)
GC/MS	8260B	trans-1,3-Dichloropropene
GC/MS	8260B	Trichloroethene (TCE)
GC/MS	8260B	Trichlorofluoromethane (CFC-11)
GC/MS	8260B	Vinyl Chloride (VC)
GC/MS	8260B	Xylenes (Total)
GC/MS	8260B	Acrolein
GC/MS	8260B	Acrylonitrile
GC/MS	8260B	Ethyl methacrylate
GC/MS	8260B	Iodomethane
GC/MS	8260B	Methyl methacrylate
GC/MS	8260B	Vinyl acetate
GC/MS	8270C/D	Bis(2-chloroisopropyl)ether, or 2,2'-oxybis (1-Chloropropane)
GC/MS	8270C/D	1,2-Dichlorobenzene
GC/MS	8270C/D	1,3-Dichlorobenzene
GC/MS	8270C/D	1,4-Dichlorobenzene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	8270C/D	2,4,5-Trichlorophenol
GC/MS	8270C/D	2,4,6-Trichlorophenol (TCP)
GC/MS	8270C/D	2,4-Dichlorophenol (DCP)
GC/MS	8270C/D	2,4-Dimethylphenol
GC/MS	8270C/D	2,4-Dinitrophenol
GC/MS	8270C/D	2,4-Dinitrotoluene (DNT)
GC/MS	8270C/D	2,6-Dichlorophenol
GC/MS	8270C/D	2,6-Dinitrotoluene
GC/MS	8270C/D	1,2-Diphenylhydrazine
GC/MS	8270C/D	2-Chloronaphthalene
GC/MS	8270C/D	2-Chlorophenol
GC/MS	8270C/D	2-Methylnaphthalene
GC/MS	8270C/D	2-Methylphenol (o-Cresol)
GC/MS	8270C/D	2-Nitroaniline
GC/MS	8270C/D	2-Nitrophenol (ONP)
GC/MS	8270C/D	3,3'-Dichlorobenzidine (DCB)
GC/MS	8270C/D	3-Methylphenol
GC/MS	8270C/D	3-Nitroaniline
GC/MS	8270C/D	4,6-Dinitro-2-methylphenol (DNOC)
GC/MS	8270C/D	4-Bromophenyl phenyl ether
GC/MS	8270C/D	4-Chloro-3-methylphenol
GC/MS	8270C/D	4-Chloroaniline
GC/MS	8270C/D	4-Chlorophenyl phenyl ether
GC/MS	8270C/D	4-Methylphenol (p-Cresol)
GC/MS	8270C/D	4-Nitroaniline (PNA)
GC/MS	8270C/D	4-Nitrophenol (PNP)
GC/MS	8270C/D	Acenaphthene
GC/MS	8270C/D	Acenaphthylene
GC/MS	8270C/D	Acetaphenone
GC/MS	8270C/D	Anthracene
GC/MS	8270C/D	Benzo(a)anthracene
GC/MS	8270C/D	Benzo(a)pyrene
GC/MS	8270C/D	Benzo(b)fluoranthene
GC/MS	8270C/D	Benzo(g,h,i)perylene
GC/MS	8270C/D	Benzo(k)fluoranthene
GC/MS	8270C/D	Benzyl alcohol
GC/MS	8270C/D	Benzoic Acid
GC/MS	8270C/D	bis(2-Chloroethoxy)methane
GC/MS	8270C/D	bis(2-Chloroethyl)ether (BCEE)

Solid and Chemical Materials

Technology	Method	Analyte
GC/MS	8270C/D	bis(2-Ethylhexyl)phthalate (BEHP)
GC/MS	8270C/D	Butyl benzyl phthalate (BBP)
GC/MS	8270C/D	Carbazole
GC/MS	8270C/D	Chrysene
GC/MS	8270C/D	Di-n-butyl phthalate (DBP)
GC/MS	8270C/D	Di-n-octyl phthalate (DNOP)
GC/MS	8270C/D	Dibenz(a,h)anthracene
GC/MS	8270C/D	Dibenzofuran (DBF)
GC/MS	8270C/D	Diethyl phthalate (DEP)
GC/MS	8270C/D	Dimethyl phthalate (DMP)
GC/MS	8270C/D	Fluoranthene
GC/MS	8270C/D	Fluorene
GC/MS	8270C/D	Hexachlorobenzene (HCB)
GC/MS	8270C/D	Hexachlorobutadiene (HCBD)
GC/MS	8270C/D	Hexachlorocyclopentadiene (HCCPD)
GC/MS	8270C/D	Hexachloroethane (HCE)
GC/MS	8270C/D	Indeno(1,2,3-cd)pyrene
GC/MS	8270C/D	Isophorone
GC/MS	8270C/D	N-Nitrosodimethylamine
GC/MS	8270C/D	N-Nitroso-di-n-propylamine (NDPA)
GC/MS	8270C/D	N-nitrosodiphenylamine (NDPHA)
GC/MS	8270C/D	Naphthalene
GC/MS	8270C/D	Nitrobenzene
GC/MS	8270C/D	Pentachlorophenol
GC/MS	8270C/D	Phenanthrene
GC/MS	8270C/D	Phenol
GC/MS	8270C/D	Pyrene
GC/MS	8270C/D	Pyridine
GC/MS	8270C/D	1,2,4-Trichlorobenzene
GC/MS	8270C/D	1,1'-Biphenyl
GC/MS	8270C/D	1,2,4,5-Tetrachlorobenzene
GC/MS	8270C/D	1,4-Dioxane
GC/MS	8270C/D	1-Methylnaphthalene
GC/MS	8270C/D	2,3,4,6-Tetrachlorophenol
GC/MS	8270C/D	Aniline
GC/MS	8270C/D	Atrazine
GC/MS	8270C/D	Benzaldehyde
GC/MS	8270C/D	Benzidine
GC/MS	8270C/D	Benzo(a)anthracene

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
GC/MS	8270C/D	Caprolactam
GC/ECD	8081A/B	4,4'-DDD
GC/ECD	8081A/B	4,4'-DDE
GC/ECD	8081A/B	4,4'-DDT
GC/ECD	8081A/B	Aldrin
GC/ECD	8081A/B	alpha-BHC (alpha-HCH)
GC/ECD	8081A/B	alpha-Chlordane
GC/ECD	8081A/B	beta-BHC (beta-HCH)
GC/ECD	8081A/B	delta-BHC (delta-HCH)
GC/ECD	8081A/B	Dieldrin
GC/ECD	8081A/B	Endosulfan I
GC/ECD	8081A/B	Endosulfan II
GC/ECD	8081A/B	Endosulfan sulfate
GC/ECD	8081A/B	Endrin
GC/ECD	8081A/B	Endrin aldehyde
GC/ECD	8081A/B	Endrin ketone
GC/ECD	8081A/B	gamma-BHC (Lindane; gamma-HCH)
GC/ECD	8081A/B	gamma-Chlordane
GC/ECD	8081A/B	Heptachlor
GC/ECD	8081A/B	Heptachlor epoxide
GC/ECD	8081A/B	Methoxychlor
GC/ECD	8081A/B	Chlordane
GC/ECD	8081A/B	Toxaphene
GC/ECD	8082 /A	Aroclor-1016
GC/ECD	8082 /A	Aroclor-1221
GC/ECD	8082 /A	Aroclor-1232
GC/ECD	8082 /A	Aroclor-1242
GC/ECD	8082 /A	Aroclor-1248
GC/ECD	8082 /A	Aroclor-1254
GC/ECD	8082 /A	Aroclor-1260
GC/ECD	8151A	2,4,5-T
GC/ECD	8151A	2,4,5-TP (Silvex)
GC/ECD	8151A	2,4-D
GC/ECD	8151A	2,4-DB
GC/ECD	8151A	Dalapon
GC/ECD	8151A	Dicamba
GC/ECD	8151A	Dichlorprop
GC/ECD	8151A	Dinoseb
GC/ECD	8151A	MCPA

Solid and Chemical Materials

Technology	Method	Analyte
GC/ECD	8151A	MCPP (Mecoprop)
HPLC/UV	8330A	1,3,5-Trinitrobenzene
HPLC/UV	8330A	1,3-Dinitrobenzene
HPLC/UV	8330A	2,4,6-Trinitrophenylmethylnitramine (Tetryl)
HPLC/UV	8330A	2,4,6-Trinitrotoluene (TNT)
HPLC/UV	8330A	2,4-Dinitrotoluene (DNT)
HPLC/UV	8330A	2,6-Dinitrotoluene
HPLC/UV	8330A	2-Amino-4,6-dinitrotoluene
HPLC/UV	8330A	2-Nitrotoluene (ONT)
HPLC/UV	8330A	3-Nitrotoluene
HPLC/UV	8330A	4-Amino-2,6-dinitrotoluene
HPLC/UV	8330A	4-Nitrotoluene (PNT)
HPLC/UV	8330A	Hexahydro-1,3,5-trinitro-1,3,5-triazine (RDX)
HPLC/UV	8330A	Nitroglycerin
HPLC/UV	8330A	Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine (HMX)
HPLC/UV	8330A	Nitrobenzene
HPLC/UV	8330A	PETN
HPLC/UV	8330A	Nitroguanidine
GC/FID	FLPRO	Petroleum Range Organics
GC/FID	8015B	TPH DRO
GC/FID	8015B	TPH GRO
HPLC/MS	6850	Perchlorate
ICP	6010B/C	Aluminum
ICP	6010B/C	Antimony
ICP	6010B/C	Arsenic
ICP	6010B/C	Barium
ICP	6010B/C	Beryllium
ICP	6010B/C	Cadmium
ICP	6010B/C	Calcium
ICP	6010B/C	Chromium, total
ICP	6010B/C	Cobalt
ICP	6010B/C	Copper
ICP	6010B/C	Iron
ICP	6010B/C	Lead
ICP	6010B/C	Magnesium
ICP	6010B/C	Manganese
CVAA	7471A/B	Mercury
ICP	6010B/C	Nickel
ICP	6010B/C	Potassium

LABORATORY ACCREDITATION BUREAU

Certificate # L2226

Solid and Chemical Materials		
Technology	**Method**	**Analyte**
ICP	6010B/C	Selenium
ICP	6010B/C	Silver
ICP	6010B/C	Sodium
ICP	6010B/C	Thallium
ICP	6010B/C	Vanadium
ICP	6010B/C	Zinc
ICP	6010B/C	Molybdenum
ICP	6010B/C	Tin
ICP	6010B/C	Strontium
ICP	6010B/C	Titanium
UV/Vis	7196A	Hexavalent Chromium
TOC	Lloyd Kahn	Total Organic Carbon
Colorimetric	353.2	Nitrocellulose
Colorimetric	9012A/B	Cyanide
Titration	Chap.7, Sect. 7.3 Mod.	Reactive Sulfide
Titration	9034	Sulfide
Probe	9045D	pH
Preparation	**Method**	**Type**
Preparation	1311	TCLP
Preparation	1312	SPLP
Preparation	NJ Modified 3060A	Hexavalent Chromium
Preparation	3050B	Metals Digestion
Preparation	3546	Organics Microwave Extraction
Preparation	3541	Organics Soxhlet Extraction
Preparation	3550B	Organics Sonication
Preparation	SM 2540B 20th edition	Percent Solids (Percent Moisture)
Preparation	5035 /A	Purge and Trap Solid

Notes:

1) This laboratory offers commercial testing service.

Approved By: _____ Date: March 31, 2010

R. Douglas Leonard
Chief Technical Officer

Issued: 11/30/09 Revised: 2/9/10 Revised: 3/31/10

Attachment 5
Environmental Protection Plan

FINAL

Environmental Protection Plan Preliminary Assessment/Site Inspection; Unexploded Ordnance (UXO) Site UXO-22 Former Munitions Disposal Areas

Marine Corps Base Camp Lejeune Jacksonville, North Carolina

Contract Task Order 014, Modification 5

October 2010

Prepared for

Department of the Navy
Naval Facilities Engineering Command

Under the

CLEAN 1000 Program
Contract No. N62470-08-D-1000

Prepared by

CH2MHILL

Raleigh, North Carolina

Contents

Section 1 - Environmental Protection Plan 1-1
1.1 Regional Ecological Summary 1-1
1.2 Endangered/Threatened Species within the Project Site 1-1
1.3 Wetlands Within the Project Site 1-2
1.4 Cultural and Archaeological Resources within the Project Site 1-2
1.5 Water Resources within the Project Site 1-3
1.6 Coastal Zones within the Project Site ..... **Error! Bookmark not defined.**
1.7 Vegetation to be removed within the Project Site 1-3
1.8 Existing Waste Disposal Sites within the Project Site 1-3
1.9 Compliance with Applicable or Relevant and Appropriate Requirements ... 1-3
1.10 Detailed Procedures and Methods to Protect and/or Mitigate the ..... Resources/Sites Identified 1-3
1.11 References 1-4

Tables

1-1 Species Potentially Occurring on or Adjacent to MCB CamLej, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the USFWs

SECTION 1

Environmental Protection Plan

This Environmental Protection Plan (EPP) is a supplement to the Marine Corps Base (MCB) Camp Lejeune (CamLej) Master EPP (Section 9 of the MCB CamLej Munitions Response Program [MRP] Master Project Plans [MPP] [CH2M HILL, 2008]) from the MCB CamLej MRP Project Plan (CH2M HILL, 2008) and provides additional site specific details related to the environmental protection procedures to be implemented at the Site UXO-22 Former Munitions Disposal Area, MCB CamLej, North Carolina. Only additional detail, modifications or additions to the information provided in the Master EPP from the MRP MPP are discussed herein.

1.1 Regional Ecological Summary

A summary of the regional ecology is provided in Section 9.1 of the MRP Master Project Plans (CH2M HILL, 2008).

1.2 Endangered/Threatened Species within the Project Site

Many protected species have been sighted in the vicinity of and aboard MCB CamLej, such as American alligator, green sea turtle, loggerhead sea turtle, piping plover, red-cockaded woodpecker (RCW), seabeach amaranth, and rough-leaf loosestrife (USMC, 2006). **Table 1** lists those species that could occur in or adjacent to MCB CamLej that are listed as threatened, endangered, or of special concern by the United States Fish and Wildlife Service (USFWS) under the Endangered Species Act of 1973, as amended.

MCB CamLej has active programs in place to protect the two federally protected avian species (piping plover and RCW) that are known to occur on the Base. UXO-22 is not within the vicinity of any of these management areas. Suitable habitat for the piping plover does not exist at UXO-22. No impacts to this species would result.

MCB CamLej worked with the USFWS to establish guidelines for military training in RCW cluster sites. Additionally, through Section 7 Consultation, the Base implemented measures to properly manage the RCW habitats located on base (loblolly pine [*Pinus taeda*], longleaf [*Pinus palustris*], and pond pine [*Pinus serotina*] areas). These guidelines and measures are presented in the *2007-2011 Integrated Natural Resource Management Plan (INRMP)* (USMC, 2006). MCB CamLej's RCW population has been monitored since 1985. Reproductive success, population demographics, and habitat use are recorded annually to help successfully manage the population while facilitating the military use of the land. UXO-22 is not within the vicinity of any current RCW management areas and the closest active RCW habitat is located approximately 0.7 miles east of the site. No impacts to this species would result.

UXO-22 contains no open water habitat and does not connect to the ocean. Therefore, the federally protected marine species (e.g., green sea turtle, leatherback sea turtle, loggerhead

sea turtle, West Indian manatee) listed in **Table 1** would not occur the area. No impacts to these species would result.

The American alligator is listed on the Federal Threatened and Endangered species list due to its similarity of appearance to the American crocodile. There is no potentially suitable habitat for the American alligator in UXO-22 investigation area and the species would not occur in the project area. No impact to this species is expected.

Two of the five federally listed plant species identified in Table 1 have been identified on the Base: rough-leaved loosestrife and seabeach amaranth. Approximately 22 rough-leaved loosestrife sites are found on MCB CamLej with 76 acres buffered and marked to protect this species. Rough-leaved loosestrife sites are visited annually to visually inspect for changes in extent and apparent health. Approximately half of the rough-leaved loosestrife sites occur within protected RCW sites, obviating the need for marking each of these sites individually. The other sites, mostly falling within the Greater Sandy Run Area are marked with white paint around a perimeter that extends 100 ft from the outermost individuals. None of these sites are located on or adjacent to UXO-22. No impacts to rough-leaved loosestrife are expected.

Seabeach amaranth is an annual that has been described as a dune-builder because it frequently occupies areas seaward of primary dunes often growing closer to the high tide line than any other coastal plant. As such, this plant is generally found along Onslow Beach. Seabeach amaranth does not occur on or adjacent to UXO-22 because there is no beach or dune habitat. No impacts to this species would occur.

The eastern cougar is the only federally listed mammal species that could occur in Onslow County. The only extant population of eastern cougar is located in south Florida and the species has not been observed in North Carolina in over 50 years. Suitable habitat for the eastern cougar does not exist at UXO-22 and the level of human activity would tend to make the species avoid the area. Because the eastern cougar has not been verified in the area in more than 50 years and there is human activity at UXO-22, it is very unlikely that the eastern cougar would occur on the site and no impacts are expected.

Environmental reviews completed in preparation for the INRMP determined that the remaining species listed in **Table 1** are not expected to exist at the site. No adverse impacts to listed species are expected to result from the proposed work at UXO-22. Project design features have been developed to prevent impacts to listed species.

1.3 Wetlands Within the Project Site

There are no jurisdictional wetland areas within UXO-22.

1.4 Cultural and Archaeological Resources within the Project Site

The probability that any significant cultural or archeological resources will be impacted by the field investigation is low. Consultation with the Base archaeologist confirmed that no cultural or archaeological resource is known to lie within the UXO-22 boundary. If any unmapped cultural or archaeological materials or resources are discovered within the

project investigation area, the Base archaeologist will be notified to provide guidance on performing further work in the area.

1.5 Water Resources within the Project Site

As shown in **Figure 10-2** of the Work Plan, a Wallace Creek occurs near the northern end of UXO-22 and Bear Head Creek crosses the southern portion of the site. No water resources are expected to be impacted by the project.

1.6 Vegetation to be removed within the Project Site

Vegetation removal is not anticipated in association with the current field activities described in this WP.

1.7 Existing Waste Disposal Sites within the Project Site

Historically, UXO-22 was used for disposal and storage of wastes and supplies, including pesticides transformers containing PCBs, solvents, electrolytes, and waste oils. Currently, Lot 201 is used to store military equipment, vehicles, hydraulic oils, and other "non-hazardous" supplies. Lot 203 is used by the Defense Reutilization Marketing Office as a scrap and surplus storage lot. As part of the CERCLA process at this site, soil intrusive land use controls (LUC) are currently in place in order to reduce worker exposure to potential soil contamination. As required by the LUC, standard level D personal protective gear will be used by workers disturbing the ground surface.

1.8 Compliance with Applicable or Relevant and Appropriate Requirements

CH2M HILL will follow all applicable regulations concerning environmental protection, pollution control, and abatement for the proposed project work as described in Section 9.3 of the MRP Master Project Plans (CH2M HILL, 2008). No permits have been determined to be required for the proposed work.

1.9 Detailed Procedures and Methods to Protect and/or Mitigate the Resources/Sites Identified

During the proposed work, a general survey of the project area will be conducted by the field personnel to identify obvious environmental concerns. The PM, in conjunction with a qualified ecologist, will provide instructions to field personnel regarding the protection of onsite environmental resources. Such protective measures will include, but are not limited to, the following:

- Should a federally protected plant species be identified within the project area, specimens will be flagged for easy relocation and verification
- Should cultural or archaeological material or resources be discovered within the project area, the Base archaeologist will be notified to provide guidance on performing further work in the area

- The PM will seek the guidance of a qualified ecologist to determine appropriate mitigation measures in the event that the performed work activities impact an environmental resource

1.10 References

Baker Environmental, Incorporated (Baker). 1993. *Remedial Investigation Report for Operable Unit No. 2 Marine Corps Base Camp Lejeune, North Carolina*. Final.

Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF). 1990. *ATF Explosives Laws and Regulations.* P 5400.7.

CH2M HILL. 2008. *MCB Camp Lejeune Munitions Response Program Master Project Plans, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina.* May.

CH2M HILL. 2009a. *Explosives Safety Submission for Munitions Response Activities, Site 6 (Operable Unit 2), Marine Corps Base Camp Lejeune, Jacksonville, North Carolina.* March.

CH2M HILL. 2009b. *Amendment No. 1, Explosives Safety Submission for Munitions Response Activities, Site 6 (Operable Unit 2), Marine Corps Base Camp Lejeune, Jacksonville, North Carolina.* March.

Department of Defense (DoD). 1997. *Defense Materiel Disposition Manual.* DoD 4160.21-M. August.

DoD. 2004. *DoD Ammunition and Explosives Safety Standards.* October.

Naval Ordnance Safety and Security Activity (NOSSA). 2009. Instruction 8020.15B, *Explosives Safety Review, Oversight, and Verification of Munitions Responses*.

OHM Remediation Services Corp. 1997. *Final Contractor's Close Out Report for Sites 6 and 82 Source Removal Operable Unit No. 2, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina*

United States Army Corps of Engineers (USACE). 2004. *Basic Safety Concepts and Considerations for Munitions and Explosives of Concern (MEC) Response Action Operations.* Engineer Pamphlet (EP) 385-1-95a. Washington, DC. 27 August.

United States Marine Corps (USMC). 2006. *2007-2011 Integrated Natural Resource Management Plan.*

Draft

Environmental Protection Plan Preliminary Assessment/Site Inspection; Unexploded Ordnance (UXO) Site UXO-22 Former Munitions Disposal Areas

Marine Corps Base Camp Lejeune Jacksonville, North Carolina

Contract Task Order 014, Modification 5

July 2011

Prepared for

Department of the Navy
Naval Facilities Engineering Command

Under the

CLEAN 1000 Program
Contract No. N62470-08-D-1000

Prepared by

CH2MHILL

Raleigh, North Carolina

Contents

1 Regional Ecological Summary 1

2 Endangered/Threatened Species within the Project Site 1

3 Wetlands Within the Project Site 2

4 Cultural and Archaeological Resources within the Project Site 2

5 Water Resources within the Project Site 3

6 Vegetation to be removed within the Project Site 3

7 Existing Waste Disposal Sites within the Project Site 3

8 Compliance with Applicable or Relevant and Appropriate Requirements 3

9 Detailed Procedures and Methods to Protect and/or Mitigate the Resources/Sites Identified 3

10 References 4

Table

1 Species Potentially Occurring on or Adjacent to MCB CamLej, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the USFWs

Environmental Protection Plan

This Environmental Protection Plan (EPP) is a supplement to the Marine Corps Base (MCB) Camp Lejeune (CamLej) Master EPP (Section 9 of the MCB CamLej Munitions Response Program [MRP] Master Project Plans [MPP] [CH2M HILL, 2008]) from the MCB CamLej MRP Project Plan (CH2M HILL, 2008) and provides additional site specific details related to the environmental protection procedures to be implemented at the Site UXO-22 Former Munitions Disposal Area, MCB CamLej, North Carolina. Only additional detail, modifications or additions to the information provided in the Master EPP from the MRP MPP are discussed herein.

1 Regional Ecological Summary

A summary of the regional ecology is provided in Section 9.1 of the MRP Master Project Plans (CH2M HILL, 2008).

2 Endangered/Threatened Species within the Project Site

Many protected species have been sighted in the vicinity of and aboard MCB CamLej, such as American alligator, green sea turtle, loggerhead sea turtle, piping plover, red-cockaded woodpecker (RCW), seabeach amaranth, and rough-leaf loosestrife (USMC, 2006). **Table 1** lists those species that could occur in or adjacent to MCB CamLej that are listed as threatened, endangered, or of special concern by the United States Fish and Wildlife Service (USFWS) under the Endangered Species Act of 1973, as amended.

MCB CamLej has active programs in place to protect the two federally protected avian species (piping plover and RCW) that are known to occur on the Base. UXO-22 is not within the vicinity of any of these management areas. Suitable habitat for the piping plover does not exist at UXO-22. No impacts to this species would result.

MCB CamLej worked with the USFWS to establish guidelines for military training in RCW cluster sites. Additionally, through Section 7 Consultation, the Base implemented measures to properly manage the RCW habitats located on base (loblolly pine [*Pinus taeda*], longleaf [*Pinus palustris*], and pond pine [*Pinus serotina*] areas). These guidelines and measures are presented in the *2007-2011 Integrated Natural Resource Management Plan (INRMP)* (USMC, 2006). MCB CamLej's RCW population has been monitored since 1985. Reproductive success, population demographics, and habitat use are recorded annually to help successfully manage the population while facilitating the military use of the land. UXO-22 is not within the vicinity of any current RCW management areas and the closest active RCW habitat is located approximately 0.7 miles east of the site. No impacts to this species would result.

UXO-22 contains no open water habitat and does not connect to the ocean. Therefore, the federally protected marine species (e.g., green sea turtle, leatherback sea turtle, loggerhead sea turtle, West Indian manatee) listed in **Table 1** would not occur the area. No impacts to these species would result.

The American alligator is listed on the Federal Threatened and Endangered species list due to its similarity of appearance to the American crocodile. There is no potentially suitable habitat for the American alligator in UXO-22 investigation area and the species would not occur in the project area. No impact to this species is expected.

Two of the five federally listed plant species identified in **Table 1** have been identified on the Base: rough-leaved loosestrife and seabeach amaranth. Approximately 22 rough-leaved loosestrife sites are found on MCB CamLej with 76 acres buffered and marked to protect this species. Rough-leaved loosestrife sites are visited annually to visually inspect for changes in extent and apparent health. Approximately half of the rough-leaved loosestrife sites occur within protected RCW sites, obviating the need for marking each of these sites individually. The other sites, mostly falling within the Greater Sandy Run Area are marked with white paint around a perimeter that extends 100 ft from the outermost individuals. None of these sites are located on or adjacent to UXO-22. No impacts to rough-leaved loosestrife are expected.

Seabeach amaranth is an annual that has been described as a dune-builder because it frequently occupies areas seaward of primary dunes often growing closer to the high tide line than any other coastal plant. As such, this plant is generally found along Onslow Beach. Seabeach amaranth does not occur on or adjacent to UXO-22 because there is no beach or dune habitat. No impacts to this species would occur.

The eastern cougar is the only federally listed mammal species that could occur in Onslow County. The only extant population of eastern cougar is located in south Florida and the species has not been observed in North Carolina in over 50 years. Suitable habitat for the eastern cougar does not exist at UXO-22 and the level of human activity would tend to make the species avoid the area. Because the eastern cougar has not been verified in the area in more than 50 years and there is human activity at UXO-22, it is very unlikely that the eastern cougar would occur on the site and no impacts are expected.

Environmental reviews completed in preparation for the INRMP determined that the remaining species listed in **Table 1** are not expected to exist at the site. No adverse impacts to listed species are expected to result from the proposed work at UXO-22. Project design features have been developed to prevent impacts to listed species.

3 Wetlands Within the Project Site

There are no jurisdictional wetland areas within UXO-22.

4 Cultural and Archaeological Resources within the Project Site

The probability that any significant cultural or archeological resources will be impacted by the field investigation is low. Consultation with the Base archaeologist confirmed that no cultural or archaeological resource is known to lie within the UXO-22 boundary. If any unmapped cultural or archaeological materials or resources are discovered within the project investigation area, the Base archaeologist will be notified to provide guidance on performing further work in the area.

5 Water Resources within the Project Site

As shown in **Figure 10-2** of the Work Plan, a Wallace Creek occurs near the northern end of UXO-22 and Bear Head Creek crosses the southern portion of the site. No water resources are expected to be impacted by the project.

6 Vegetation to be removed within the Project Site

Vegetation removal is not anticipated in association with the current field activities described in this WP.

7 Existing Waste Disposal Sites within the Project Site

Historically, UXO-22 was used for disposal and storage of wastes and supplies, including pesticides transformers containing PCBs, solvents, electrolytes, and waste oils. Currently, Lot 201 is used to store military equipment, vehicles, hydraulic oils, and other "non-hazardous" supplies. Lot 203 is used by the Defense Reutilization Marketing Office as a scrap and surplus storage lot. As part of the CERCLA process at this site, soil intrusive land use controls (LUC) are currently in place in order to reduce worker exposure to potential soil contamination. As required by the LUC, standard level D personal protective gear will be used by workers disturbing the ground surface.

8 Compliance with Applicable or Relevant and Appropriate Requirements

CH2M HILL will follow all applicable regulations concerning environmental protection, pollution control, and abatement for the proposed project work as described in Section 9.3 of the MRP Master Project Plans (CH2M HILL, 2008). No permits have been determined to be required for the proposed work.

9 Detailed Procedures and Methods to Protect and/or Mitigate the Resources/Sites Identified

During the proposed work, a general survey of the project area will be conducted by the field personnel to identify obvious environmental concerns. The PM, in conjunction with a qualified ecologist, will provide instructions to field personnel regarding the protection of onsite environmental resources. Such protective measures will include, but are not limited to, the following:

- Should a federally protected plant species be identified within the project area, specimens will be flagged for easy relocation and verification
- Should cultural or archaeological material or resources be discovered within the project area, the Base archaeologist will be notified to provide guidance on performing further work in the area

- The PM will seek the guidance of a qualified ecologist to determine appropriate mitigation measures in the event that the performed work activities impact an environmental resource

10 References

Baker Environmental, Incorporated (Baker). 1993. *Remedial Investigation Report for Operable Unit No. 2 Marine Corps Base Camp Lejeune, North Carolina*. Final.

Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF). 1990. *ATF Explosives Laws and Regulations*. P 5400.7.

CH2M HILL. 2008. *MCB Camp Lejeune Munitions Response Program Master Project Plans, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina.* May.

CH2M HILL. 2009a. *Explosives Safety Submission for Munitions Response Activities, Site 6 (Operable Unit 2), Marine Corps Base Camp Lejeune, Jacksonville, North Carolina.* March.

CH2M HILL. 2009b. *Amendment No. 1, Explosives Safety Submission for Munitions Response Activities, Site 6 (Operable Unit 2), Marine Corps Base Camp Lejeune, Jacksonville, North Carolina.* March.

Department of Defense (DoD). 1997. *Defense Materiel Disposition Manual*. DoD 4160.21-M. August.

DoD. 2004. *DoD Ammunition and Explosives Safety Standards*. October.

Naval Ordnance Safety and Security Activity (NOSSA). 2009. Instruction 8020.15B, *Explosives Safety Review, Oversight, and Verification of Munitions Responses*.

OHM Remediation Services Corp. 1997. *Final Contractor's Close Out Report for Sites 6 and 82 Source Removal Operable Unit No. 2, Marine Corps Base Camp Lejeune, Jacksonville, North Carolina*

United States Army Corps of Engineers (USACE). 2004. *Basic Safety Concepts and Considerations for Munitions and Explosives of Concern (MEC) Response Action Operations.* Engineer Pamphlet (EP) 385-1-95a. Washington, DC. 27 August.

United States Marine Corps (USMC). 2006. *2007-2011 Integrated Natural Resource Management Plan.*

TABLE 1
Species Potentially Occurring on or Adjacent to Camp Lejeune, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the USFWS
Site UXO-22, Former Munitions Disposal Area
MCB CamLej
Jacksonville, North Carolina

Scientific Name	Common Name	Federal Status	Habitat
Anguilla rostrata	American eel	FSC	The American eel is catadromous; it spawns in oceanic waters but uses freshwater, brackish and estuarine systems for most of its developmental life. Migrates in autumn to the Sargasso Sea to spawn. Occurs usually in permanent streams with continuous flow. Hides during the day in undercut banks and in deep pools near logs and boulders.
Chelonia mydas	Green sea turtle	T	Green turtles are generally found in fairly shallow waters (except when migrating) inside reefs, bays, and inlets. The turtles are attracted to lagoons and shoals with an abundance of marine grass and algae. Open beaches with a sloping platform and minimal disturbance are required for nesting.
Caretta caretta	Loggerhead sea turtle	T	The loggerhead is widely distributed within its range. It may be found hundreds of miles out to sea, as well as in inshore areas such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers.
Dermochelys coriacea	Leatherback sea turtle	E	An open ocean species, it sometimes moves into shallow bays, estuaries and even river mouths.
Trichechus manatus	West Indian Manatee	E	Manatees inhabit both salt and fresh water of sufficient depth (1.5 meters to usually less than 6 meters) throughout their range.
Alligator mississippiensis	American alligator	T(S/A)	Rivers, swamps, estuaries, lakes, and marshes
Charadrius melodus	Piping plover	T	Open, sandy beaches close to the primary dune of the barrier islands and coastlines of the Atlantic for breeding. They prefer sparsely vegetated open sand, gravel, or cobble for a nest site. They forage along the rack line where the tide washes up onto the beach.
Aimophila aestivalis	Bachman's sparrow	FSC	Occurs only in pine forests of the southeastern U.S.
Haliaeetus leucocephalus	American bald eagle	T	A single bald eagle's nest is found on Camp Lejeune- at the junction of Sneads Creek and the New River near the back gate. Three protective buffers have been established at approximately 750', 1000', and 1500' from the nest site.
Laterallus jamaicensis	Black rail	FSC	Marsh/wetlands; The "Eastern" Black Rail can be found in appropriate saltmarsh habitat along the eastern seaboard from Connecticut to Florida and along the Gulf Coast.

TABLE 1
Species Potentially Occurring on or Adjacent to Camp Lejeune, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the USFWS
Site UXO-22, Former Munitions Disposal Area
MCB CamLej
Jacksonville, North Carolina

Scientific Name	Common Name	Federal Status	Habitat
Acipenser brevirostrum	Shortnose sturgeon	E	Sturgeon inhabits the lower sections of larger rivers and coastal waters along the Atlantic coast. It may spend most of the year in brackish or salt water and move into fresh water only to spawn. The fish feeds on invertebrates (shrimp, worms, etc.) and stems and leaves of macrophytes.
Rana capito capito	Carolina crawfish frog	FSC	Carolina crawfish frogs live primarily in the sandhills and pine barrens of the North Carolina Coastal Plain. Crawfish frogs are more terrestrial than most frogs, generally only coming to the water to breed. They are also nocturnal, spending daylight hours underground in burrows.
Puma concolor couguar	Eastern cougar	E	No preference for specific habitat types has been noted. The primary need is apparently for a large wilderness area with an adequate food supply. Male cougars of other subspecies have been observed to occupy a range of 25 or more square miles, and females from 5 to 20 square miles.
Passerina ciris ciris	Eastern painted bunting	FSC*	Found mainly in southern states and Mexico, where the brushy, weedy shrub-scrub habitat that this bird prefers abound
Ammodramus henslowii	Eastern Henslow's sparrow	FSC	A species of tallgrass prairies, agricultural grasslands, and pine savannas of the eastern U.S.; the species migrates south to spend the non-breeding season in the native pine savanna habitats of the southeastern U.S.
Ophisaurus mimicus	Mimic glass lizard	FSC	This species is found in the southeastern Coastal Plain. They are most common in pine flatwoods and open woodlands.
Picoides borealis	Red-cockaded Woodpecker	E	For nesting/roosting habitat, open stands of pine containing trees 60 years old and older. Red-cockaded woodpeckers need live, older pines in which to excavate their cavities. Longleaf pines (Pinus palustris) are most commonly used, but other species of southern pine are also acceptable. Dense stands (stands that are primarily hardwoods, or that have a dense hardwood understory) are avoided. Foraging habitat is provided in pine and pine hardwood stands 30 years old or older with foraging preference for pine trees 10 inches or larger in diameter. In good, moderately-stocked, pine habitat, sufficient foraging substrate can be provided on 80 to 125 acres.

TABLE 1
Species Potentially Occurring on or Adjacent to Camp Lejeune, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the USFWS
Site UXO-22, Former Munitions Disposal Area
MCB CamLej
Jacksonville, North Carolina

Scientific Name	Common Name	Federal Status	Habitat
Heterodon simus	Southern hognose snake	FSC	These snakes are found in sandy fields and woods of the Coastal Plain, particularly in the Sandhills region.
Agrotis buchholzi	Buchholz's dart moth	FSC	Found in Forested wetlands, scrub-shrub wetlands, shrubland/chaparral and coniferous woodlands This moth is found mostly in recently burned habitats. Populations can persist up to about a decade or rarely two without fire, until litter accumulates sufficiently to cover foodplants. In most cases habitat is probably suboptimal beginning about 5 years after a fire.
Atrytonopsis sp.	a skipper	FSC	One species, the dusteds are fairly rare at the coast but found throughout North Carolina (*A. hianna*). An assumption is made that the genius is generally defined.
Isoetes microvela	A quillwort	FSC	Quillworts are usually restricted to areas of clean water where other plants are absent. Occasionally, quilwort may grow partly or entirely out of the water.
Rhexia aristosa	Awned meadowbeauty	FSC	Found in a variety of wet habitats in the Coastal Plain from New Jersey to Alabama.
Lobelia boykinii	Boykin's lobelia	FSC	Grows in swamps and cypress ponds from the coastal plain of Delaware to Florida. The lower portion is often immersed in water, at least seasonally.
Solidago pulchra	Coastal goldenrod	FSC	Bogs, freshwater habitats, grasslands.
Parnassia caroliniana	Carolina grass-of-parnassus	FSC	Bogs, freshwater habitats, grasslands.
Trillium pusillum var. pusillum	Carolina trillium	FSC	Grows in alluvial woods, pocosin borders and savannahs.
Asplenium heteroresiliens	Carolina (wagner) spleenwort	FSC	Rock outcrops.
Rhynchospora pleiantha	Coastal beaksedge	FSC	Extremely rare, found at fewer than 25 sites throughout its North Carolina-to-Alabama range.
Solidago villosicarpa	Coastal Goldenrod	FSC	Known to occur in only 5 populations in three counties in eastern North Carolina. Three of these populations occur on Camp Lejeune. The other sites occur in Pender and Brunswick Counties. Currently the North Carolina Natural Heritage Program is conducting a survey of likely habitat to look for coastal goldenrod.

TABLE 1
Species Potentially Occurring on or Adjacent to Camp Lejeune, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the USFWS
Site UXO-22, Former Munitions Disposal Area
MCB CamLej
Jacksonville, North Carolina

Scientific Name	Common Name	Federal Status	Habitat
Thalictrum cooleyi	Cooley's meadowrue	E	Cooley's meadowrue occurs in moist to wet bogs and savannahs. It grows along fireplow lines, roadside ditches, woodland clearings, and powerline rights-of-way, and needs some type of disturbance to maintain its open habitat.
Carex lutea	Golden sedge	E	Biologists have located golden sedge in only eight locations, all in coastal savannas in Onslow and Pender Counties that are underlain by calcareous, or chalk, deposits.
Sagittaria weatherbiana	Grassleaf arrowhead	FSC	Found in shallow water of brackish swamps
Dichanthelium sp.	Hirst's panic grass	FSC	Worldwide, Hirst's panic grass occurs in four extant populations. Historically, it was found in coastal plain habitats in the states of New Jersey, Delaware, North Carolina and Georgia. Currently Hirst's panic grass is known to exist in one site in Delaware and two known sites in North Carolina, both of which are on Camp Lejeune.
Myriophyllum laxum	Loose watermilfoil	FSC	Riparian habitats.
Calopogon multiflorus	Many-flower grass-pink	FSC	Grasslands, pinelands; typically in wet areas.
Plantago sparsiflora	Pineland plantain	FSC	Savannahs, roadsides and ditches.
Lindera melissifolia	Pondberry	E	Associated with wetland habitats such as bottomland and hardwoods in the interior areas, and the margins of sinks, ponds and other depressions in the more coastal sites. The plants generally grow in shaded areas but may also be found in full sun.
Litsea aestivalis	Pondspice	FSC	Freshwater habitats.
Lysimachia asperulaefolia	Rough-leaved loosestrife	E	Species generally occurs in the ecotones or edges between longleaf pine uplands and pond pine pocosins (areas of dense shrub and vine growth usually on a wet, peaty, poorly drained soil), on moist to seasonally saturated sands and on shallow organic soils overlaying sand. Rough-leaved loosestrife has also been found on deep peat in the low shrub community of large Carolina bays
Amaranthus pumilus	Seabeach amaranth	T	Occurs on barrier island beaches.
Allium sp.	Savanna onion	FSC	Wet savannahs.
Scleria sp.	Smooth-seeded hairy nutrush	FSC	Dry woods, pineland and savannahs (*S. triglomerata*)

TABLE 1
Species Potentially Occurring on or Adjacent to Camp Lejeune, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the USFWS
Site UXO-22, Former Munitions Disposal Area
MCB CamLej
Jacksonville, North Carolina

Scientific Name	Common Name	Federal Status	Habitat
Rhynchospora decurrens	Swamp forest beakrush	FSC	Swamp forests, very rare.
Solidago verna	Spring-flowering goldenrod	FSC	The only spring-flowering goldenrod that occurs in the Sandhills and Coastal Plain of the Carolinas. It can be found in a wide array of habitats, including pine savannas, pocosins, and pine barrens.
Rhynchospora thornei	Thorne's beaksedge	FSC	Bogs, freshwater habitats, pinelands.
Dionea muscipula	Venus flytrap	FSC	Bogs, pinelands.

E = Endangered—A taxon in danger of extinction throughout all or a significant portion of its range.

T = Threatened—A taxon likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

FSC = Federal species of special concern—species may or may not be listed in the future.

T(S/A)—Threatened due to similarity of appearance (e.g., American alligator)--a species that is threatened due to similarity of appearance with other rare species and is listed for its protection. These species are not biologically endangered or threatened and are not subject to Section 7 consultation.

*Historic record—the species was last observed in the county more than 50 years ago.

TABLE 1-1
Species Potentially Occurring on or Adjacent to Camp Lejeune, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the USFWS
Site UXO-22, Former Munitions Disposal Area
MCB CamLej
Jacksonville, North Carolina

Scientific Name	Common Name	Federal Status	Habitat
Anguilla rostrata	American eel	FSC	The American eel is catadromous; it spawns in oceanic waters but uses freshwater, brackish and estuarine systems for most of its developmental life. Migrates in autumn to the Sargasso Sea to spawn. Occurs usually in permanent streams with continuous flow. Hides during the day in undercut banks and in deep pools near logs and boulders.
Chelonia mydas	Green sea turtle	T	Green turtles are generally found in fairly shallow waters (except when migrating) inside reefs, bays, and inlets. The turtles are attracted to lagoons and shoals with an abundance of marine grass and algae. Open beaches with a sloping platform and minimal disturbance are required for nesting.
Caretta caretta	Loggerhead sea turtle	T	The loggerhead is widely distributed within its range. It may be found hundreds of miles out to sea, as well as in inshore areas such as bays, lagoons, salt marshes, creeks, ship channels, and the mouths of large rivers.
Dermochelys coriacea	Leatherback sea turtle	E	An open ocean species, it sometimes moves into shallow bays, estuaries and even river mouths.
Trichechus manatus	West Indian Manatee	E	Manatees inhabit both salt and fresh water of sufficient depth (1.5 meters to usually less than 6 meters) throughout their range.
Alligator mississippiensis	American alligator	T(S/A)	Rivers, swamps, estuaries, lakes, and marshes
Charadrius melodus	Piping plover	T	Open, sandy beaches close to the primary dune of the barrier islands and coastlines of the Atlantic for breeding. They prefer sparsely vegetated open sand, gravel, or cobble for a nest site. They forage along the rack line where the tide washes up onto the beach.
Aimophila aestivalis	Bachman's sparrow	FSC	Occurs only in pine forests of the southeastern U.S.
Haliaeetus leucocephalus	American bald eagle	T	A single bald eagle's nest is found on Camp Lejeune- at the junction of Sneads Creek and the New River near the back gate. Three protective buffers have been established at approximately 750', 1000', and 1500' from the nest site.
Laterallus jamaicensis	Black rail	FSC	Marsh/wetlands; The "Eastern" Black Rail can be found in appropriate saltmarsh habitat along the eastern seaboard from Connecticut to Florida and along the Gulf Coast.

TABLE 1-1
Species Potentially Occurring on or Adjacent to Camp Lejeune, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the USFWS
Site UXO-22, Former Munitions Disposal Area
MCB CamLej
Jacksonville, North Carolina

Scientific Name	Common Name	Federal Status	Habitat
Acipenser brevirostrum	Shortnose sturgeon	E	Sturgeon inhabits the lower sections of larger rivers and coastal waters along the Atlantic coast. It may spend most of the year in brackish or salt water and move into fresh water only to spawn. The fish feeds on invertebrates (shrimp, worms, etc.) and stems and leaves of macrophytes.
Rana capito capito	Carolina crawfish frog	FSC	Carolina crawfish frogs live primarily in the sandhills and pine barrens of the North Carolina Coastal Plain. Crawfish frogs are more terrestrial than most frogs, generally only coming to the water to breed. They are also nocturnal, spending daylight hours underground in burrows.
Puma concolor couguar	Eastern cougar	E	No preference for specific habitat types has been noted. The primary need is apparently for a large wilderness area with an adequate food supply. Male cougars of other subspecies have been observed to occupy a range of 25 or more square miles, and females from 5 to 20 square miles.
Passerina ciris ciris	Eastern painted bunting	FSC*	Found mainly in southern states and Mexico, where the brushy, weedy shrub-scrub habitat that this bird prefers abound
Ammodramus henslowii	Eastern Henslow's sparrow	FSC	A species of tallgrass prairies, agricultural grasslands, and pine savannas of the eastern U.S.; the species migrates south to spend the non-breeding season in the native pine savanna habitats of the southeastern U.S.
Ophisaurus mimicus	Mimic glass lizard	FSC	This species is found in the southeastern Coastal Plain. They are most common in pine flatwoods and open woodlands.
Picoides borealis	Red-cockaded Woodpecker	E	For nesting/roosting habitat, open stands of pine containing trees 60 years old and older. Red-cockaded woodpeckers need live, older pines in which to excavate their cavities. Longleaf pines (Pinus palustris) are most commonly used, but other species of southern pine are also acceptable. Dense stands (stands that are primarily hardwoods, or that have a dense hardwood understory) are avoided. Foraging habitat is provided in pine and pine hardwood stands 30 years old or older with foraging preference for pine trees 10 inches or larger in diameter. In good, moderately-stocked, pine habitat, sufficient foraging substrate can be provided on 80 to 125 acres.

TABLE 1-1
Species Potentially Occurring on or Adjacent to Camp Lejeune, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the USFWS
Site UXO-22, Former Munitions Disposal Area
MCB CamLej
Jacksonville, North Carolina

Scientific Name	Common Name	Federal Status	Habitat
Heterodon simus	Southern hognose snake	FSC	These snakes are found in sandy fields and woods of the Coastal Plain, particularly in the Sandhills region.
Agrotis buchholzi	Buchholz's dart moth	FSC	Found in Forested wetlands, scrub-shrub wetlands, shrubland/chaparral and coniferous woodlands This moth is found mostly in recently burned habitats. Populations can persist up to about a decade or rarely two without fire, until litter accumulates sufficiently to cover foodplants. In most cases habitat is probably suboptimal beginning about 5 years after a fire.
Atrytonopsis sp.	a skipper	FSC	One species, the dusteds are fairly rare at the coast but found throughout North Carolina (*A. hianna*). An assumption is made that the genius is generally defined.
Isoetes microvela	A quillwort	FSC	Quillworts are usually restricted to areas of clean water where other plants are absent. Occasionally, quilwort may grow partly or entirely out of the water.
Rhexia aristosa	Awned meadowbeauty	FSC	Found in a variety of wet habitats in the Coastal Plain from New Jersey to Alabama.
Lobelia boykinii	Boykin's lobelia	FSC	Grows in swamps and cypress ponds from the coastal plain of Delaware to Florida. The lower portion is often immersed in water, at least seasonally.
Solidago pulchra	Coastal goldenrod	FSC	Bogs, freshwater habitats, grasslands.
Parnassia caroliniana	Carolina grass-of-parnassus	FSC	Bogs, freshwater habitats, grasslands.
Trillium pusillum var. pusillum	Carolina trillium	FSC	Grows in alluvial woods, pocosin borders and savannahs.
Asplenium heteroresiliens	Carolina (wagner) spleenwort	FSC	Rock outcrops.
Rhynchospora pleiantha	Coastal beaksedge	FSC	Extremely rare, found at fewer than 25 sites throughout its North Carolina-to-Alabama range.
Solidago villosicarpa	Coastal Goldenrod	FSC	Known to occur in only 5 populations in three counties in eastern North Carolina. Three of these populations occur on Camp Lejeune. The other sites occur in Pender and Brunswick Counties. Currently the North Carolina Natural Heritage Program is conducting a survey of likely habitat to look for coastal goldenrod.

TABLE 1-1
Species Potentially Occurring on or Adjacent to Camp Lejeune, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the USFWS
Site UXO-22, Former Munitions Disposal Area
MCB CamLej
Jacksonville, North Carolina

Scientific Name	Common Name	Federal Status	Habitat
Thalictrum cooleyi	Cooley's meadowrue	E	Cooley's meadowrue occurs in moist to wet bogs and savannahs. It grows along fireplow lines, roadside ditches, woodland clearings, and powerline rights-of-way, and needs some type of disturbance to maintain its open habitat.
Carex lutea	Golden sedge	E	Biologists have located golden sedge in only eight locations, all in coastal savannas in Onslow and Pender Counties that are underlain by calcareous, or chalk, deposits.
Sagittaria weatherbiana	Grassleaf arrowhead	FSC	Found in shallow water of brackish swamps
Dichanthelium sp.	Hirst's panic grass	FSC	Worldwide, Hirst's panic grass occurs in four extant populations. Historically, it was found in coastal plain habitats in the states of New Jersey, Delaware, North Carolina and Georgia. Currently Hirst's panic grass is known to exist in one site in Delaware and two known sites in North Carolina, both of which are on Camp Lejeune.
Myriophyllum laxum	Loose watermilfoil	FSC	Riparian habitats.
Calopogon multiflorus	Many-flower grass-pink	FSC	Grasslands, pinelands; typically in wet areas.
Plantago sparsiflora	Pineland plantain	FSC	Savannahs, roadsides and ditches.
Lindera melissifolia	Pondberry	E	Associated with wetland habitats such as bottomland and hardwoods in the interior areas, and the margins of sinks, ponds and other depressions in the more coastal sites. The plants generally grow in shaded areas but may also be found in full sun.
Litsea aestivalis	Pondspice	FSC	Freshwater habitats.
Lysimachia asperulaefolia	Rough-leaved loosestrife	E	Species generally occurs in the ecotones or edges between longleaf pine uplands and pond pine pocosins (areas of dense shrub and vine growth usually on a wet, peaty, poorly drained soil), on moist to seasonally saturated sands and on shallow organic soils overlaying sand. Rough-leaved loosestrife has also been found on deep peat in the low shrub community of large Carolina bays
Amaranthus pumilus	Seabeach amaranth	T	Occurs on barrier island beaches.
Allium sp.	Savanna onion	FSC	Wet savannahs.
Scleria sp.	Smooth-seeded hairy nutrush	FSC	Dry woods, pineland and savannahs (*S. triglomerata*)

TABLE 1-1
Species Potentially Occurring on or Adjacent to Camp Lejeune, in Onslow County, Listed as Threatened, Endangered, or of Special Concern by the USFWS
Site UXO-22, Former Munitions Disposal Area
MCB CamLej
Jacksonville, North Carolina

Scientific Name	Common Name	Federal Status	Habitat
Rhynchospora decurrens	Swamp forest beakrush	FSC	Swamp forests, very rare.
Solidago verna	Spring-flowering goldenrod	FSC	The only spring-flowering goldenrod that occurs in the Sandhills and Coastal Plain of the Carolinas. It can be found in a wide array of habitats, including pine savannas, pocosins, and pine barrens.
Rhynchospora thornei	Thorne's beaksedge	FSC	Bogs, freshwater habitats, pinelands.
Dionea muscipula	Venus flytrap	FSC	Bogs, pinelands.

E = Endangered—A taxon in danger of extinction throughout all or a significant portion of its range.

T = Threatened—A taxon likely to become endangered within the foreseeable future throughout all or a significant portion of its range.

FSC = Federal species of special concern—species may or may not be listed in the future.

T(S/A)—Threatened due to similarity of appearance (e.g., American alligator)--a species that is threatened due to similarity of appearance with other rare species and is listed for its protection. These species are not biologically endangered or threatened and are not subject to Section 7 consultation.

*Historic record—the species was last observed in the county more than 50 years ago.